

## Indo-German Science & Technology Centre



**Annual Report**

2014-15 | 2015-16



# Indo-German Science & Technology Centre

**Annual Report**

2014-15 | 2015-16



The Indo-German Science & Technology Centre (IGSTC) has been established to facilitate Indo-German R&D networking through substantive interactions among government, academia/research systems and industry to foster innovation and application for the overall economic and societal developments of both the countries. Both Governments currently contribute up to Euro 2 million (₹ 13 crore) every year for realizing the goals.

#### IGSTC aims to:

- Play a proactive role in facilitating participation of industry in joint R&D projects.
- Provide/assist in mobilizing resources to carry out industrial R&D projects.
- Promote electronic exchange and dissemination of information on opportunities in bilateral S&T cooperation. The Centre will also prepare/compile state-of-the-art reports on topics of interest with the help of highly qualified scientists and technologists, one from each country.
- Provide individual advice to institutes and industries from either country, the possibilities of Indo-German cooperation and help in the identification of suitable partners.
- Facilitate and promote Indo-German bilateral collaboration in basic and applied science, research and technology through substantive interaction among government, academia and industry.
- Encourage public-private partnerships (PPP) to foster elements of innovation and application and cultivate a culture of cooperation between science and industry.
- Nurture contacts between young and mid career scientists and technologists to develop a sense of mutual trust, leadership and entrepreneurship.
- Develop cooperation through the identification of scientists and scientific institutions of the two countries.
- Organize workshops, seminars, training programmes and other types of events on topics of mutual interest.

## Governance

### GOVERNING BODY



**Arabinda Mitra**  
DST  
Indian Co-chair



**Christian Joergens**  
BMBF  
German Co-chair



**Anuradha Mitra\***  
DST  
(Served till December 2014)



**Gerold Heinrich**  
DLR-PT



**Krishnan Balasubramaniam\*\***  
IIT Madras  
(Served till September 2014)



**Eberhard Abele**  
TU Darmstadt



**Anjan Das**  
Confederation of Indian Industry



**Clas Neumann**  
SAP India



**Shailja Gupta**  
DBT



**Philip Petit\*\*\***  
German Embassy in India  
(Served till May 2014)



**\*J.B. Mohapatra**  
DST, Joined GB in place of  
Anuradha Mitra



**\*\*\*Stephan Lanzinger**  
German Embassy in India  
Joined GB in place of Philip Petit



**\*\*Sandeep Verma**  
IIT Kanpur  
Joined GB in place of Krishnan  
Balasubramaniam



# From the Director's Desk

Seeking new horizons, IGSTC strives to bring together the immense scientific talent in both countries, to work together and resolve immediate and future S&T challenges.

In terms of numbers there are 19 ongoing projects in 2+2 mode involving 76 partners across academia and industry from India and Germany with investment of about 14 million euros.



Seeing the trajectory of growth of Indo-German relationship, evolved over last 5 years, the years 2014 and 2015 are certainly significant especially when we talk about Indo-German strategic partnership which includes evolution of IGSTC.

Research partnership across the boundaries connecting academia and industry with a motto “invention to Innovation” is the model with which Indo-German Science & Technology centre (IGSTC) began its journey in 2011. The influence of WTO, globalisation of R&D and emergence of global challenges made us think of a partnership which invokes the power of collaboration and ethos of mutuality of interest and respect.

The Year of Germany in India in 2012 gave the slogan “Germany and India: Infinite Opportunities”. Yes, the opportunities are unlimited and more so in the innovation space. Establishment of German House for Research and Innovation (DWHI) in New Delhi in the same year also signalled the era of strategic partnership between these two great nations.

The years 2014/2015 have been significant. These years not only have seen significant growth of

Indian researchers/students in Germany, they also witnessed IGSTC spreading its wings connecting more than 80 best research institutions and industry partners from both countries taking up real life challenges to find out the solutions which are relevant for socio-economic development. IGSTC call for proposals during this period in the areas of Medical Technology including Diagnostic tool, New Materials for energy efficiency and water & Wastewater Technology received overwhelming response – 10 projects in 2+2 mode engaging best brains from academia and industry made a beginning in a true partnership mode to find industry ready technological solutions. Investment of about 2 million euro committed to these projects (mostly TRL 5 and above) with flexible project funding model which they all need to succeed.

2014/2015 also took a review of IGSTC as an unique model of research partnership. It opened our eyes. To create level playing field, Indian side started offering grant to the Indian industry instead of loan. The recommendation emerged out of the IGSTC review committee, excellent outcomes of some of the ongoing projects and the growing expectations & aspirations of the

stakeholders made us to believe that (a) IGSTC is in right tract but can improve (b) IGSTC needs to expand and consolidate its gains and (c) make more investment in right instruments to attract more players and to drive innovation.

Hannover Fair (April 2015) provided an excellent platform, when IGSTC could showcase one of its projects on flexible electronics (FLEXIPRIDE) in the form of a solar tree with TU Chemnitz taking the lead. Indian Prime Minister (who was on a visit to Germany for the inauguration of Hannover Fair) and German Chancellor made a joint statement which also included in-principle decision for extension and expansion of IGSTC. This was formalised (October 2015) with signing of the Joint Declaration by both the Governments with enhanced annual commitment of 4 million euro by each side.

The report presented here is a testimony of IGSTC and its journey through its initial period.

Shall appreciate if you could find time to turn these pages and offer your considered views for us to improve. For IGSTC to fly high.

A. Chakraborty  
Director

# Contents

|           |   |
|-----------|---|
| <b>11</b> | <b>PROGRAMME ACTIVITIES (2+2 PROJECTS)</b>                        |
| 12        | MIDARDI   |
| 15        | SIBAC   |
| 18        | Sound4ALL   |
| 21        | NANOTRANS   |
| 24        | NPORE   |
| 27        | IHBT  |
| 30        | ICRISAT   |
| 33        | ICGEB   |
| 36        | CLFR  |
| 38        | REMSOLAR  |
| 40        | FLEXIPRIDE  |
| 43        | RESERVES  |
| 46        | DP-FORGE  |
| 49        | NDT-DATAFUSION  |
| 52        | IN-DEUS   |
| 55        | AMPLAST   |
| 58        | DNDHCSA   |
| 61        | SeNaMeB   |
| 64        | AUTOSAFE  |
| 68-69     | Upcoming Projects   |
| <b>71</b> | <b>JOINT WORKSHOPS</b>  |
| 72        | Electrochemical Storage Systems                                   |
| 73        | Advancement in Online/Remote Water Quality Monitoring             |
| 74        | Decentralized Approach for Wastewater Management                  |
| 75        | New Generation Sensors for Unsaturated Soils and Water Technology |
| <b>77</b> | <b>DST-MAX PLANCK PROGRAMME</b>                                   |
| 80        | Max Planck Partner Groups   |
| 83        | Max Planck - India Fellowships/Mobility Grants                    |
| <b>85</b> | <b>FINANCIAL STATEMENTS</b>                                       |
| 85        | Audit Report 2014-15  |
| 105       | Audit Report 2015-16  |



# A glance through the years.....

During the years 2014-15 and 2015-16, IGSTC continued its support to 19 joint projects in 2+2 mode in emerging areas of (a) sustainable energy (b) advanced manufacturing (c) biomedical devices and biotechnology (d) water and wastewater technologies (e) nanotechnology and (f) embedded system and ICT. There are 6 projects in the pipeline from the Call 2015 in the areas of energy materials, energy

76 (seventy six) project partners from academia and industry from India/Germany.

In conjunction with the 6th GB Meeting of IGSTC, Partners Meet was held in Bernried, Germany on 2-4 February 2015. Subsequently the 7th GB Meeting of IGSTC was held in New Delhi on 16th March 2016.



storage and water biosensors/wastewater technologies. The total project investment (both Indian and German) can be estimated as Rs. 100 Cr. or 14 million Euros and is involving



On 13 April 2015, Hannover Fair (Germany) with India as a partner country was inaugurated by the Indian Prime Minister. IGSTC was represented at the pavilion of the BMBF with one of its projects FLEXIPRIDE as a successful model of Indo-German partnership. It was showcased as a "Solar Tree" with each leaf acting as a solar panel in a flexible form using flexible/printable electronics technology, jointly being developed by IIT Kanpur and Technical University, Chemnitz.

During the period, 4 Indo-German Joint workshops were supported by IGSTC and 2 each were organized in India and Germany connecting more than 150 researchers from both the countries.

By the time, IGSTC has completed its First Phase, the Centre was recognized as a successful model and flagship initiative of Indo-German R&D partnership. Adding a feather to its cap, the tenure of IGSTC was extended to 2022 and beyond (Second Phase) with increase in annual investment from 2 to 4 million Euros by each side for expansion of its scope and horizon through a joint declaration signed between Govt. of India (DST) and Govt. of Germany (BMBF) at the ministerial level on 5 October 2015 in the presence of Hon'ble Prime



Minister of India and the visiting German Chancellor Dr. Angela Merkel.

In conjunction with the 7th Governing Board Meeting, IGSTC organised Project Partners Meeting on 15 March 2016 in New Delhi. Principal Investigators representing all IGSTC supported projects participated in the programme. There were presentations from selected projects and all the projects were exhibited as posters in the evening session. Hon'ble Minister of State for Science & Technology, Dr Harsh Vardhan inaugurated the poster session.

In a yet another endeavor to promote Indo-German Research partnership, IGSTC is organizing a Symposium on "Smart Cities: Challenges and Opportunities" during 27-29 April 2016 in Berlin, Germany in association with FICCI (India), Nexus Institute (Germany) and PTV AG (Germany). The symposium will be focusing on governance and integrative planning approaches. There will be presentations from eminent experts in various topics and also interactive part - working sessions at five "thematic roundtables": energy and buildings, mobility and management, waste management and



sanitation, water and communication - safety - security. It is expected that approximately 80 participants will attend the workshop from India and Germany from both academia and industry.

IGSTC continued shouldering the responsibility of implementation of the DST-Max Planck Programme on behalf of DST. This Programme has provided an excellent opportunity to the Indian young scientists to partner with the global leaders at the Max Planck Institutes in Germany through a networked model of cooperation. IGSTC has been administering 15 Partner Groups at newly established IISERs, IITs and Central Universities. As some of them already completed their project term, currently IGSTC is handling only 10 Partner groups. There are 19 ongoing Max Planck-India Visiting Fellowships (Mobility Grants) granted to young researchers from various universities / research institutes.

The detailed report on various activities are presented in the following pages.



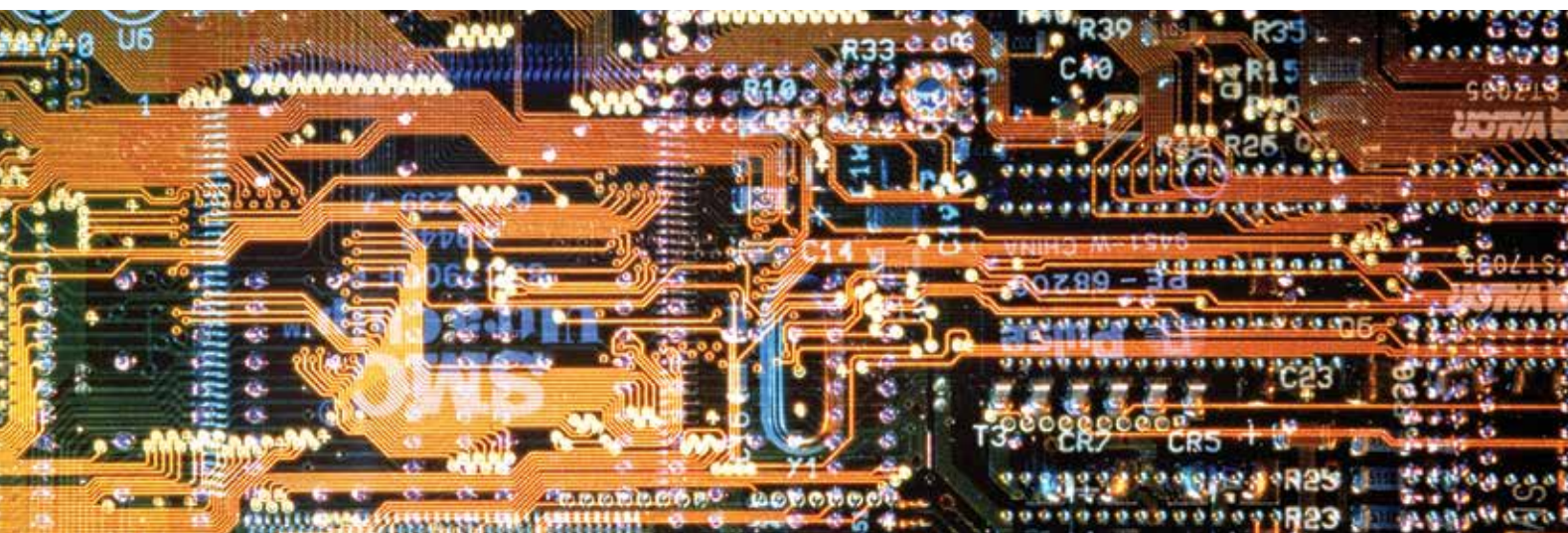


# Programme Activities

**(2+2 Projects)**



## Microfluidic based detection of microbial communities and antibiotic responses in the management of diabetic foot ulcers

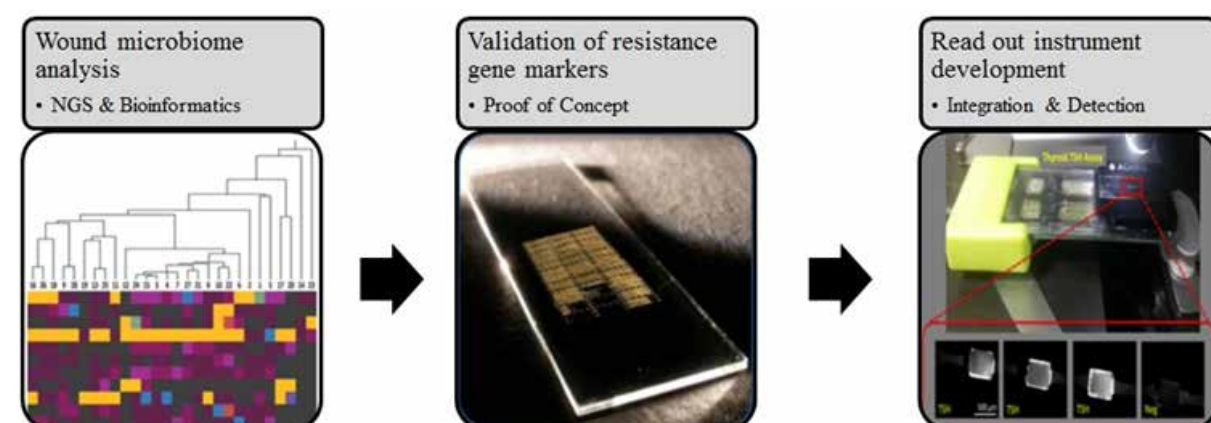


### The Project

Europe and India face an epidemic of obesity and Type 2 diabetes (T2D). Development of T2D strongly correlate and very often predisposes to increased risk of many disabling chronic diseases including Lower Extremity Amputations (LEA) such as foot infections. Bacterial communities in such foot infections show diverse morphological and physiological characteristics and their bioburden in diabetic foot ulcers (DFU) show a distinct pattern of antibiotic resistance which significantly delays wound healing. Though infected ulcers require proper antibiotic therapy, rapid and accurate detection of polymicrobial communities in wound environment is critical in proper wound management. In this polymicrobial setting, the project aims at developing a microfluidics-based lab-on-a-chip for rapid and accurate detection of different types of bacteria, their virulence/fitness factors and antibiotic resistant genes that may contribute to dominance of certain

types in DFU settings. The detection module would aid clinicians in decision-making process to improve specific outcomes that would concomitantly improve wound healing per se in DFU scenario.

- ❖ Assay development for species identification and antibiotic resistance testing based on gene and mutation detection
- ❖ Fully-integrated, disposable Lab-on-a-Chip System to perform DNA sequence detection assays
- ❖ Readout unit dedicated to local environment to demonstrate species and drug resistance testing of pathogenic bacteria
- ❖ Proof-of-concept of mutation detection for translation



### Project Investigators Partnering Institutions



K Satyamoorthy  
Manipal University  
Manipal



Frank Bier  
Fraunhofer-IZI  
leipzig

Thomas Geßner  
Fraunhofer-ENAS  
Chemnitz



Dhananjaya Dendukuri  
Achira Labs Pvt. Ltd  
Bangalore

Joerg Nestler  
BiFlow Systems GmbH  
Chemnitz



### Progress Achieved

Different use case scenarios were evaluated and technical requirements and specifications were derived both from a user and a market perspective. Foot ulcer wound samples were collected from more than 100 patients both diabetic and non diabetic individuals. Based on the wound and severity, each sample was assigned a Wagner grade. A total of 201 strains have been isolated and the dominant microbes were identified. Of these, 121 isolates were processed for antibiotic sensitivity. Culture independent analysis was carried out for wound microbiomes by sequencing the 16S rDNA gene using the ION PGM platform. After quality filtering, we obtained 9 million reads with an average of 237,000 reads per library. A total of 237 genera were classified and of these, 11 species had a relative abundance of >0.01% in more than half of the samples. The dominant phyla across all grades were Proteobacteria and Firmicutes, consistent with the culture results.

Relevant genes for species identification and resistance detection were defined. An identification of Methicillin Resistant Staphylococcus aureus (MRSA) was established as most relevant. In order to identify bacterial species and further differentiate between Staphylococcus species a DNA microarray was developed. The microarray consists of specific probes for species identification as well as probes for relevant antibiotic resistance detection. To distinguish S. aureus from other Staphylococcus species, such as S. haemolyticus and S. epidermidis, the identification of single-nucleotide-polymorphisms (SNPs) was necessary, and successfully achieved, resulting in an array containing 10 non-SNP and 6 SNP probes.

On the instrumentation and hardware aspect of the Lab-on-a-Chip, user and technical requirements for the proposed product have been identified. A successful proof-of-concept for a technological merge between BiFlow's cartridge technology and Achira's sensing technology has been demonstrated. A Thyroid Stimulating Hormone (TSH) assay from Achira'sAcix platform was run seamlessly on a BiFlowflex.flow cartridge. Control electronics has been developed being able to both control all the integrated heating and pumping steps required for both the species and drug resistance assay. A two-wavelength band detection system with a high dynamic range, low noise has been conceptualized. A monochromatic working prototype has already been setup.

#### Publications:

Apoorva J, Ramya V, Varghese VK, Chakrabarty S, Paul B, Nestler J, Harald P, Morschhauser A, Bier F, Dendukuri D Murali TS and Satyamoorthy K. 2016. Modelling the wound microbiome: Microbiological insights based on next generation sequencing. 2016 NextGen Genomics, Biology, Bioinformatics and Technologies Conference, Cochin, India (3-5 October 2016).

Any other relevant points:

Kavitha S, Spoorthi J, Deepika VB, Raviraj A, Ramachandra L, Satyamoorthy K, Murali TS. 2017. Virulence determinants in clinical Staphylococcus aureus from monomicrobial and polymicrobial infections of diabetic foot ulcers. Journal of Medical Microbiology (in press). DOI:10.1099/jmm.0.000370 ●



## Microfluidic based detection of microbial communities and antibiotic responses in the management of Diabetic Foot Ulcers (MIDARDI)

### INTRODUCTION

- Chronic and non healing foot ulcers - common complication of diabetes
- A major healthcare burden and decrease the quality of life
- Microbes that colonize wounds play a major role in wound healing
- Current cultural techniques are time-consuming and not thorough
- Leads to indiscriminate antibiotic use increasing antibiotic resistance
- Imminent need for rapid, accurate profiling of microbial virulence

### OBJECTIVES

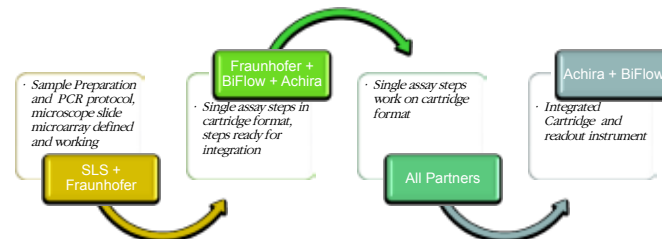
- Assay development for species identification and antibiotic resistance testing based on gene and mutation detection
- Fully-integrated, disposable Lab-on-a-Chip System to perform DNA sequence detection assays
- Proof-of-concept of mutation detection for translation
- Readout unit dedicated to local environment to demonstrate species and drug resistance testing of pathogenic bacteria

### IMPROVED DIAGNOSTICS - SCENARIO

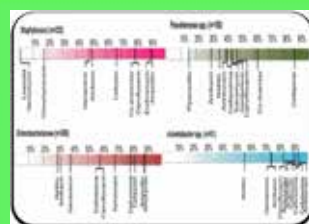
**MIDARDI**

High prevalence and debilitating  
Current methods - Time consuming  
Point-of-care needed in Primary Health Care  
Accurate and Rapid - PCR based testing  
Synergy of partners - DNA Diagnostic  
Can be carried forward to other bacterial infections

### MAJOR MILESTONES



### CORE COMPETENCEIES AND SPECIFIC ROLE OF PARTNERS



#### SLS MANIPAL UNIVERSITY

Clinical and molecular diagnostics

#### CONTRIBUTION:

Clinical, molecular and biochemistry of foot ulcers.  
Molecular diagnostics and sample preparation based on magnetic particles.

#### ACHIRA LABS Pvt. Ltd

Microfabrication, assay development and instrument development.

#### CONTRIBUTION:

Instrumentation and informatics.  
Large scale production of polymer parts.  
Testing and validation.

#### FRAUNHOFER ENAS ZUR ANGEWANDTEN FORSCHUNG

ivD platform cartridge and drug resistance testing.

#### CONTRIBUTION:

Instrumentation.  
Assay and biosensor development.  
Assay miniaturization and integration.  
Sample preparation based on silica membrane.

#### BIFLOW SYSTEMS GmbH

Assembly line for microfluidic cartridge and quality control.

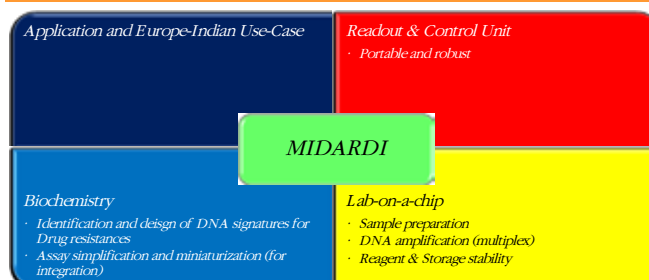
#### CONTRIBUTION:

- Cartridges and evaluation kits for quick assay integration in a real lab on chip environment.
- Assembly technologies for microfluidic cartridges.
- Microfluidic cartridge development.

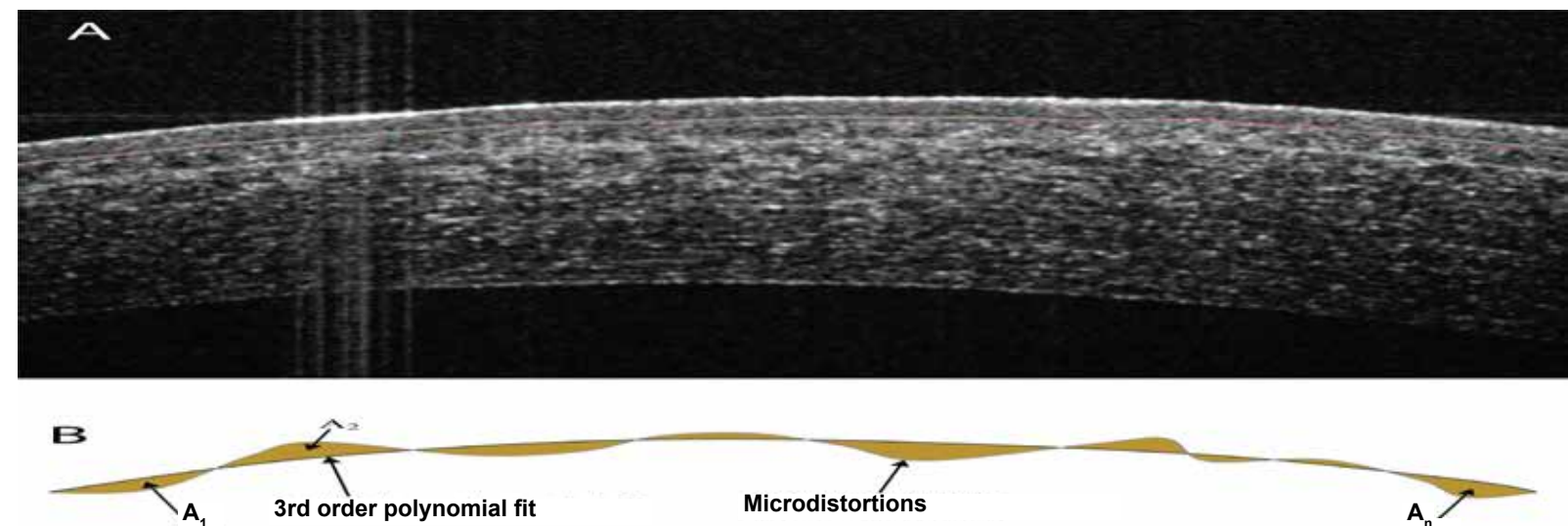
### WORK DISTRIBUTION

|                        | MANIPAL UNIVERSITY | ACHIRA | Fraunhofer | bi.FLOW |
|------------------------|--------------------|--------|------------|---------|
| Readout & Control Unit |                    |        |            | (I)     |
| Lab-on-Chip Hardware   |                    |        |            |         |
| Lab-on-Chip Software   |                    |        |            |         |
| Biochemistry           |                    |        |            |         |
| Fabrication            |                    |        |            |         |
| Testing                |                    |        |            |         |
| Dissemination          |                    |        |            |         |
| Exploitation           |                    |        |            |         |

### EXPECTED OUTCOMES



## Next-generation dynamic scheimpflug imaging and biomechanical analytics for in vivo quantification of corneal viscoelasticity



### The Project

- Development of faster imaging sensor and location-specific measurement of corneal biomechanics using a non-contact air-puff technique
- Development of software package for real time parallel simulation using inverse finite element technique to estimate non-linear fiber dependent viscoelastic properties of the corneal tissue from deformation measurements of the cornea
- Combine the tools [aims (1) and (2)] into a clinical prototype that will be assessed in groups of patients with normal eyes (pre/post refractive surgery and ocular hypertension) and degenerative eye disease, namely keratoconus, and assess its sensitivity to treatments (collagen crosslinking).

#### Expected Outcome :

- First device with high definition imaging and location

specific quantification of corneal biomechanical response

- First clinical ocular device to use inverse finite element and continuum soft tissue mechanics
- First ocular device to quantify non-linear biomechanical properties of ocular tissues
- First ocular device to enable customization of treatments based on corneal biomechanics

### Progress Achieved

The following are significant achievements made so far:

- First prototype of location specific biomechanical measurement of instrument built and undergoing design improvement. Preliminary testing on living human eyes performed to evaluate safety.
- Inverse finite element model (FEM) for LASIK and SMILE constructed. A prospective study on contra-





## Project Investigators Partnering Institutions



Abhijit Sinha Roy  
Narayana Nethralaya  
Bangalore

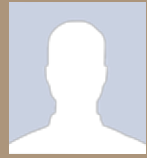


Sven Reisdorf  
OCULUS Optikgeräte GmbH  
Wetzlar

Everette J Remington Nelson  
VIT University  
Vellore



Eberhard Spoerl  
University Carl Gustav Carus  
Dresden



Shyam Vasudevrao  
Forus Health  
Bangalore



lateral treatment was completed and data analyses are ongoing. The objective of this study was to develop the inverse finite element structure for future studies with new version of the biomechanical testing of the device. Biomechanical measurements were performed with the 1st generation of the instrument. A publication on some of the study results has also come out in Translational vision science and technology (doi:10.1167/tvst.5.5.12).

- ❖ State of the art image algorithms have been developed for 3-D reconstruction of topography of corneal layers from high resolution Optical coherence tomography (DRI Triton, Topcon Inc., Japan) device funded by SIBAC. This will be used for future FEM simulations.

## Publications:

- i. Shroff R, Francis M, Pahuja N, Veeboy L, Shetty R, Sinha Roy A. Quantitative Evaluation of Microdistortions in

Bowman's Layer and Corneal Deformation after Small Incision Lenticule Extraction. Transl Vis Sci Technol. 2016; 5(5): 12.

- ii. Matalia H, Francis M, Gangil T, Chandapura RS, Kurian M, Shetty R, Nelson EJR, Sinha Roy A. Non-contact quantification of topography of anterior corneal surface and Bowman's layer with high speed OCT. Under final review in Journal of Refractive Surgery, November 2016.
- iii. Francis M, Pahuja N, Shroff R, Gowda R, Matalia H, Shetty R, Nelson EJR, Sinha Roy. Waveform analyses of deformation amplitude and corneal deformation in normal, suspect and keratoconus eyes. Under final review in Journal of Cataract and Refractive Surgery, November 2016. ●



# Next-generation dynamic Scheimpflug imaging and biomechanical analytics for in vivo quantification of corneal viscoelasticity

Forus

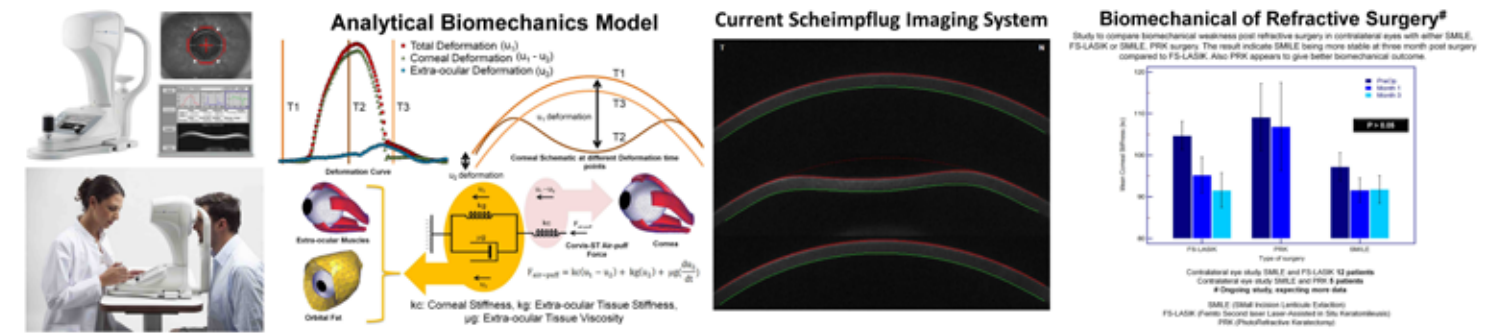
OCULUS®

Dr. Abhijit Sinha Roy<sup>1</sup>, Dr. Everette Jacob Remington Nelson<sup>2</sup>,  
Mathew Francis<sup>3</sup>

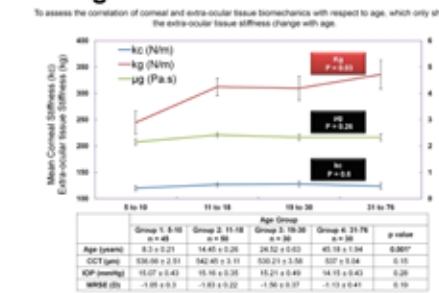
Universitätsklinikum  
Carl Gustav Carus

<sup>1</sup>Chief Scientist, Imaging, Biomechanics and Mathematical Modeling Solutions Lab, Narayana Nethralaya Foundation; <sup>2</sup>Associate Professor, School of Bio Sciences and Technology, VIT University; <sup>3</sup>Research Engineer, Imaging Biomechanics and Mathematical Modeling Solutions Lab

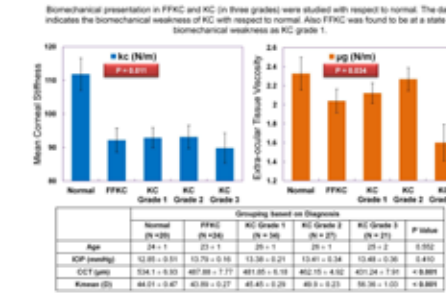
## Analytical Model



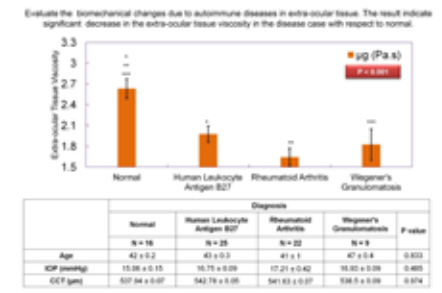
## Age Related Biomechanics



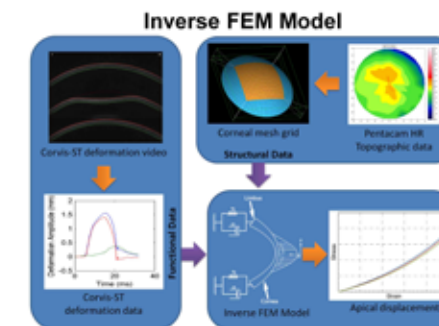
## Biomechanics of Keratoconus



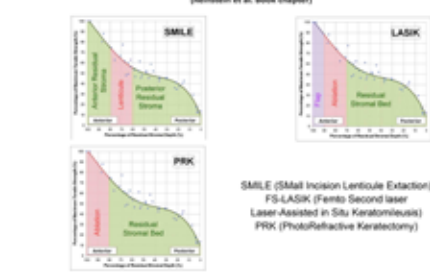
## Biomechanics in Autoimmune Diseases



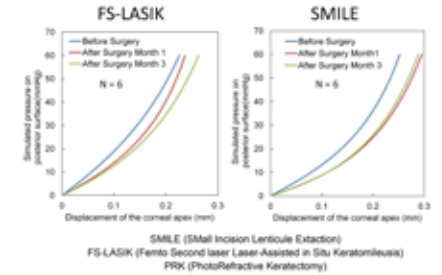
## Inverse Finite Element Model



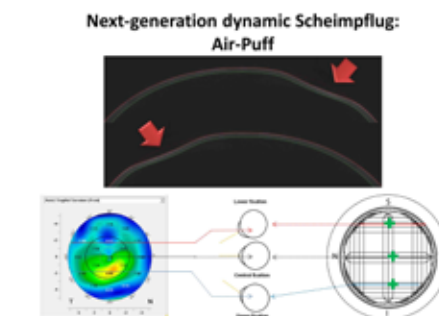
## SMILE vs. LASIK vs. PRK Theoretical Implication



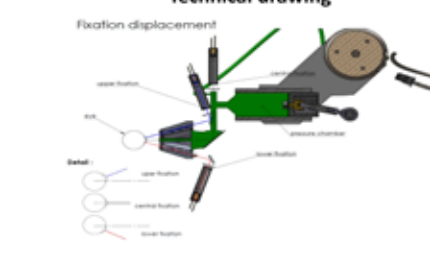
## Inverse FEM Result



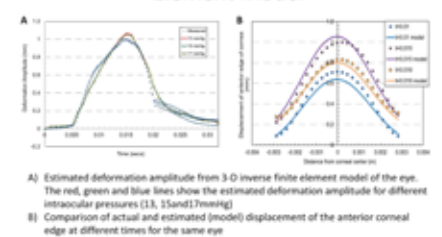
## Next-generation dynamic Scheimpflug imaging and biomechanics



## Next-generation dynamic Scheimpflug: Technical drawing



## Estimation Based on Inverse Finite Element Model



Forus



OCULUS®



## Re-engineering high-end audiometric devices for robust and affordable audiological testing



### The Project

- ❖ Hearing impairment is one of the most common forms of disability and is widespread in countries like India. With regular screening, hearing impairment may be detected early and treated. Whilescreening of newborns for hearing loss is slowly gaining momentum in India, it needs to be more widespread. However, monitoring children and adults regularly is almost non-prevalent. Currently available audiometric screening equipment are too expensive and require trained specialists for administering tests. The problem of deafness is rampant and difficult to detect, but is mostly curable if detected early. This project aims to completely re-engineer such a screening device in order to (i) significantly bring down its cost, and (ii) enable it to be used by laypersons in the same manner that we use blood pressure monitors or thermometers.
- ❖ To reduce the cost of screening devices, a completely different hardware and software architecture need to be used, without sacrificing the quality. Developing such architectures and evaluating them are the main scientific goals of this project. In particular, two main techniques proposed: (i) offload the involved signal processing algorithms onto a mobile phone, and (ii)

instead of using expensive and specialized probes, use commercially available off-the-shelf components. This will introduce significant measurement distortions, which will be corrected using suitable signal processing algorithms. Since the usage and penetration of mobile phones even in rural areas in India is relatively high, designs based on such solutions will bring down the manufacturing cost. This project aims

- ❖ to design new low-cost versions of such equipment, which at the same time be easily usable by laymen; three different classes of devices expected to design are
  1. with a cost of < ₹100 (Rs. 8,000), schools and factories use;
  2. with a cost of < ₹10 (Rs. 800), personal use;
  3. with a cost of ≈ ₹1-2 (Rs. 80-160) to be donated or sponsored by aid/governmental organizations for individual use, particularly in rural areas.
- ❖ to develop an oto-acoustic emission device that will be robust, reliable and most importantly affordable for community based and individual hearing screening.

### Project Investigators Partnering Institutions



Dinesh Kalyanasundaram  
IIT Delhi



Suyash Ojha  
Elkon India Pvt. Ltd.



Samarjit Chakraborty  
TU Munich



Kapil Sikka  
AIIMS, Delhi



Amit Chirom  
AIIMS, Delhi



Thomas Rosner  
PATH Medical GmbH  
Germering



### Progress Achieved

- ❖ AIIMS Team has worked in evaluating the external canal volumes in 600 subjects of all ages, sex and ethnicity and data shared with other investigators.
- ❖ The work on probe design and printing is being carried out by IIT Delhi.

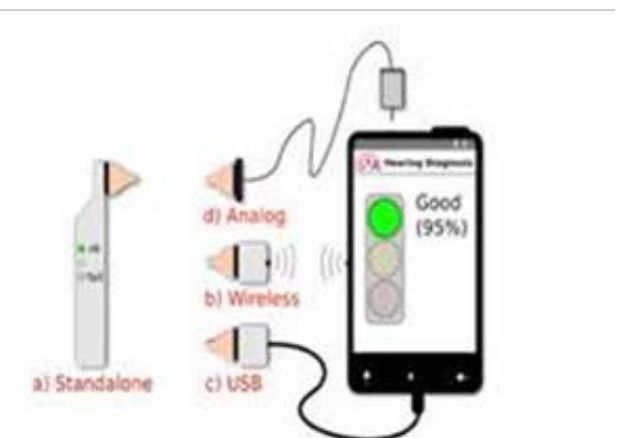
- ❖ Sound processing algorithms are being worked out by German partners.

#### Any other relevant points:

It is planned to host a Sound4All workshop in Delhi during December 2016 by AIIMS and IIT Delhi with an aim to disseminate the knowledge on subject of deafness and inspire young clinicians. ●



Currently available hearing screening device



Target hearing screening device with 4 different modes

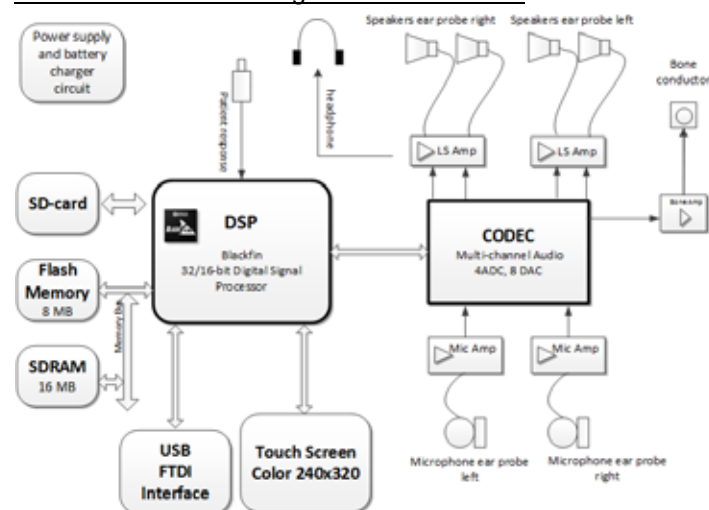




## Motivation

- Hearing impairment is one of the most common forms of disability and is widespread in countries like India.
- Currently available audiometric screening equipments are too expensive for widespread use in India and require trained specialists for administering tests using them.
- Goal of this project is to design new low-cost versions of such equipment, which at the same time can be used by laypersons.

## Architecture of an existing audiometric device



## Proposed solution/ methodology

Re-engineer an audiometric screening device to:

- Significantly bring down its cost.
- Enable it to be used by laypersons.

➤ This in turn will help with the detection of the onset of hearing impairment and the affected patients may be referred for treatment early on, thereby significantly improving their chances of recovery or to prevent further deterioration.

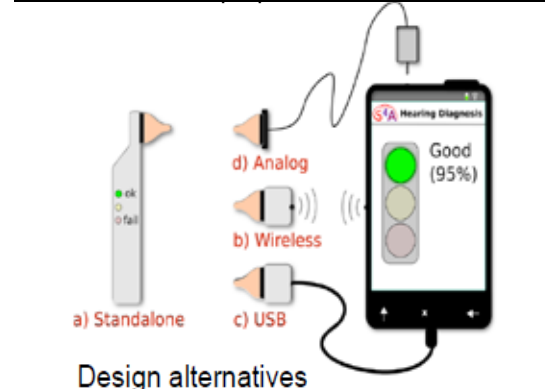
➤ Newly designed devices will need to use a completely different hardware and software architecture, without sacrificing the quality of the screening.

➤ Developing such architectures and evaluating them are the main scientific goals of this project.

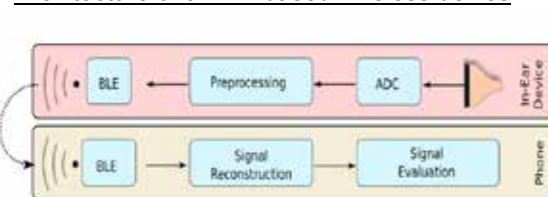
## Objective assessment of hearing using otoacoustic emissions (OAE):

- Transiently evoked OAEs (TEOAE) elicited by clicks or tone bursts
- Distortion product OAEs (DPOAE) to obtain frequency specific information

## Architecture of an proposed audiometric device



## Architecture of a BLE-based wireless device

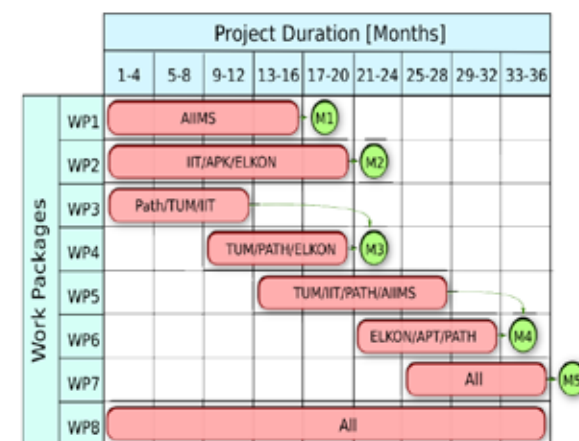


## Investigate the design of 3 different classes of devices:

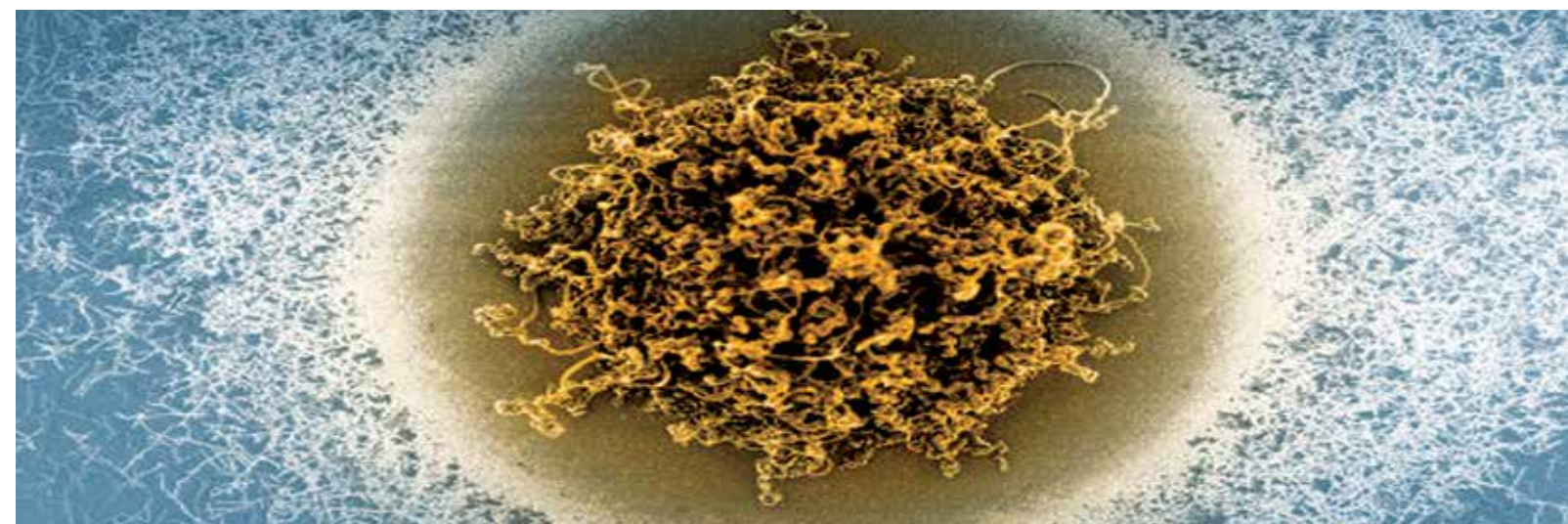
- with a cost of < €100 (Rs. 8,000), schools and factories.
- with a cost of < €10 (Rs. 800), personal.
- with a cost of ≈ €1-2 (Rs. 80-160) to be donated or sponsored by aid/governmental organizations for individual use, particularly in rural areas.

## Design Principle/ methodology

- Reduce the number of parts that are needed by incorporating multiple functions into single parts.
- Eliminate moving parts.
- Modularize multiple parts into single sub-assemblies.
- Use of standard off-the shelf components.
- Use of snap fits and elimination of fasteners
- Offload signal processing and GUI onto a mobile phone



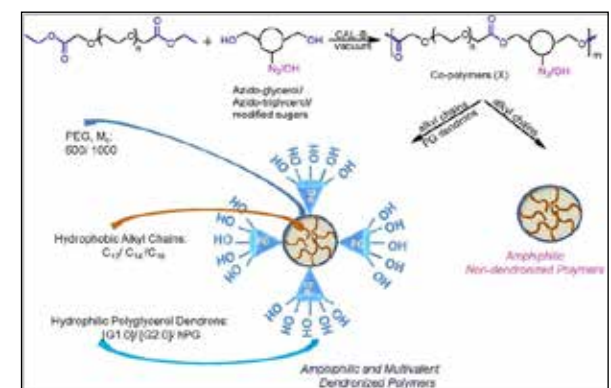
# On chemoenzymatic synthesis and development of biodegradable structurally persistent core-shell nano-architectures for drug delivery application



## The Project

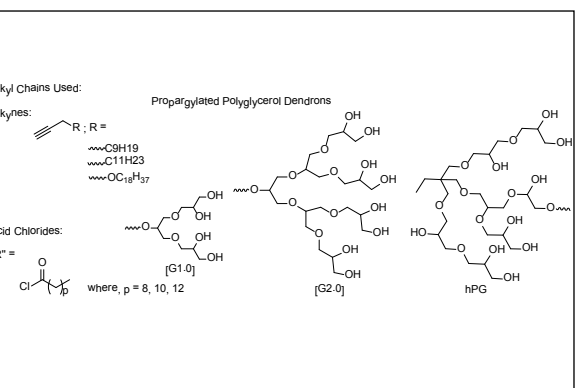
Despite incredible improvements in health in recent decades, there are still a number of challenges and unmet needs for curing or treating a myriad of diseases. This is attributed to insufficient drug doses, actually reaching the target site due to their partial degradation, and adverse side effects. To reduce doses required and the incidence of systemic complications, and to ensure appropriate drug dosing directly at the target site, drugs can be directly and continuously delivered to the tissue of interest by using delivery systems. Polymeric micelles have been used as a potential carrier for a wide variety of drugs, due to their solubilization, low toxicity, long circulation, targeting and nano-size. The team is working to design and develop novel nanomaterials based upon a combination of linear and dendritic architectures and to study the entrapment of the drug molecules in the nanoparticles and their biological response. Expected deliverables are

- To design and develop novel environmentally benign



biocatalytic routes to synthesize nanomaterials based upon amphiphilic copolymers

- To study the entrapment mechanisms of the drug molecules in the nanoparticles and their release inside the cell
- To study the structural properties of nanomaterials using state of art electron microscopy facilities to eventually standardize the method and allow control of the size and distribution of the particles entrapping biomolecules
- To analyze bio-distribution and pharmacokinetics in a mice model system
- To realize efficient delivery of drug and phenotypic expression in a mice model system
- To enhance the aqueous solubility and to study the pharmacokinetics (PK) and the pharmacodynamics (PD) of our 'new chemical entities (NCEs)' and other molecules of interest



Scheme 1: Synthesis of AmphiphilicDendronized and Non-dendronized Polymers.



## Project Investigators Partnering Institutions



Sunil K Sharma  
University of Delhi  
Delhi



Ashok K Prasad  
University of Delhi,  
Delhi



Rainer Haag  
Freie Universität Berlin,  
Berlin



Piramal Life Sciences  
Bombay



Paul Servin  
Nanopartica GmbH  
Berlin



Christoph Böttcher  
Freie Universität  
Berlin

## Progress Achieved

- ❖ Explored PEG (Mn: 600/ 1000 diethyl ester) and azido glycerol/ triglycerol/ modified sugar based dendronized/ non-dendronized polymers grafted with hydrophobic chains of varying lengths (C12/ C14/ C18) and hydrophilic polyglycerol based regular '[G1.0]/ [G2.0]' and hyperbranched dendrons for their transport potential using Pyrene, Nile red, ICG, Dexamethasone, Curcumin and also studied for their cyto-toxicity profile.
- ❖ The dendronized polymers grafted with longer hydrophobic chains (C18) and [G2.0] generation regular and hyperbranched polyglycerol dendrons have shown superior encapsulation for Nile red and also found to be have better biocompatibility even up to the concentration of 500  $\mu\text{g/mL}$  till 72 hr.
- ❖ The polyglycerol based dendrons were found to increase the biocompatibility of the polymers as it was found in the following order: Non-dendronized < [G1.0] dendronized < [G2.0] dendronized.

- ❖ The dendronized polymeric systems were observed to exhibit superior transport systems as compared to the respective low molecular weight amphiphile as shown by the cellular fluorescence microscopy and FACS measurements.
- ❖ The degree of polymerization (DOP) was increased from 9 to 20 (approx) for base co-polymer for the modified PEG diesters and azido glycerol as compared to the unmodified ones.

## Publications:

- ❖ S. Gupta, R. Tyagi, V. S. Parmar, S. K. Sharma and R. Haag. Polymer 2012, 53, 3053-3078.
- ❖ S. Gupta, B. Schade, S. Kumar, C. Böttcher, S. K. Sharma, and R. Haag. Small 2013, 9(6), 894-904.
- ❖ M. Kumari, A. K. Singh, S. Kumar, K. Achazi, S. Gupta, R. Haag, S. K. Sharma. Polymer Adv. Tech. 2014, 25, 1208-1215.
- ❖ M. Kumari, S. Gupta, K. Achazi, R. Haag, S. K. Sharma. Macromol. Rapid Commun. 2015, 36, 254-261.





## Development, characterization and validation of nanoparticles for the adsorption of uremic toxins in renal failure patients



Source : Shutterstock

### The Project

- ❖ The goal of the NPore project was the development and modification, characterization and validation of absorbing material to remove the uremic toxins (UTs) from serum of renal failure patients.
- ❖ The project was divided into five work packages (WPs) out of which the WP2 was prepared by Charite/IMCAR-Institute (University Hospital RWTH Aachen (Germany)). The objective of the WP2 was to assess and quantify the protein adsorption onto PEI-based microparticles, determination of the adsorption capacity of PEI-based microparticles by application of modern techniques such as reverse-phase chromatography (RP-HPLC) and matrix-assisted-laser-desorption-ionization-mass-spectrometry (MALDI-MS).
- ❖ Non cytotoxic and hemocompatible nanoporous spherical microparticles based on purified poly(ether imide) (PEI) and/or hydrophylically functionalized PEI surface were successfully engineered by the HZG partner of the NPore project. The porous microparticles exhibited the requested characteristics to remove the UTs.
- ❖ Initially, the adsorption capacity of non- and modified PEI microparticles for adsorption of UTs such as phenylacetic acid (PAA), indoxyl sulfate (IDS) and p-cresyl sulfate (p-CS) was assessed in human blood and plasma, respectively. The RP-HPLC results evidenced a significant binding affinity of pCRS and IDS to the PEI microparticles than that of PAA. The adsorption capacity of PEI microparticles was further investigated in the recirculation experiments.
- ❖ The experimental setup and analytical conditions for adsorption capacity assessment of PEI microparticles against UTs were established. Sampling was performed at two assembling points such as prior (sampling spot 1) and after solution passed through the PEI-filled cartridge

(sampling spot 2). RP-HPLC data showed significant adsorbed amounts of IDS and pCRS in the sampling spot 2 compared to PAA sampling spots 1 and 2, respectively. Although previously designed PEI microparticles exhibited significant adsorption characteristics for the UTs, it has been demonstrated that they did not show significant bio- and hemocompatibility.

- ❖ Alternatively, new modified PEI-based particles with hemocompatibility properties were fabricated and their bulk morphology was assessed by means of cryo-SEM. The morphometric parameters such as full width at the height maximum (FWHM) of PEI-based microparticle size histograms revealed a higher distribution width for ET-modified PEI and a lower one for non-modified PEI microparticles.
- ❖ The quantification studies of adsorption capacity of newly designed PEI-based microparticles to IDS revealed that the smaller the FWHM the larger the binding affinity. Hence, larger amounts of IDS of  $4.6 \text{ mg/g} \pm 0.08$ ,  $4.8 \text{ mg/g} \pm 0.02$ , and  $2.5 \text{ mg/g} \pm 0.01$ , respectively were partially adsorbed to PEI-PVP-I, PEI-PVP-II, and PEI type microparticles, whereas PEI-ET, PEI-DET, and PEI-PEG showed a lower adsorption capacity to IDS:  $0.50 \text{ mg/g} \pm 0.02$ ,  $2.55 \text{ mg/g} \pm 0.04$ , and  $2.5 \text{ mg/g} \pm 0.01$ , respectively.
- ❖ Within the experimental design of the NPore project, it has been evidenced that PEI-PVP-II microparticles have high dewetting contact angle ( $47^\circ \pm 8$ ), thus ensures a predominant antifouling character. Next to it, PEI-PVP-II microparticles present suitable hemocompatibility and cytotoxicity as well as physico-chemical characteristics requested for "in-situ" adsorption experiments of UTs. Based on the experimental feedback, PEI-PVP-II microparticles can confidently be considered as a good candidate for further recirculation adsorption experiments.

### Project Investigators Partnering Institutions



Sarada D Tetali  
University of Hyderabad  
Hyderabad



H D Lemke  
Excorlab GmbH  
Obernburg



J Jankowski  
RWTH Aachen University  
Aachen



Karl Kratz  
Helmholtz Zentrum Geesthacht  
Berlin

### Progress Achieved

- ❖ First PEI particles are characterized regarding their ability to adsorb hydrophobic uremic-toxins.
- ❖ Adsorption of uremic toxins by the PEI particles developed within the NPore project are characterized.
- ❖ Techniques of quantification of adsorbed plasma proteins by the PEI particles are established. Amount of adsorbed plasma proteins are quantified.
- ❖ First quantification of adsorption capacity of the PEI-particles is done.
- ❖ Amount of adsorbed plasma proteins is quantified.
- ❖ MALDI-mass spectrometry is adapted to the necessities of the NPore project.
- ❖ PEI-particles are characterized based on MALDI-mass-spectrometric images.

#### Publications:

- Basu, S.; Heuchel, M.; Weigel, T.; Kratz, K.; Lendlein, A., Integrated process for preparing porous, surface functionalized polyetherimide microparticles. *Polymers for Advanced Technologies* 2015, 26 (12) 1447-1455.
- Kumar, R. K.; Basu, S.; Lemke, H.-D.; Jankowski, J.; Kratz, K.; Lendlein, A.; Tetali, S. D., Effect of extracts of poly(ether imide) microparticles on cytotoxicity, ROS generation and proinflammatory effects on human monocytic (THP-1) cells. *Clinical Hemorheology and Microcirculation* 2015, 61 (4) 657-65.
- Tetali, S. D.; Jankowski, V.; Luetzow, K.; Kratz, K.; Lendlein, A.; Jankowski, J. Adsorption capacity of poly(ether imide) microparticles to uremic toxins; *Clinical Hemorheology and Microcirculation* 2015, 61 (4) 667-80.
- Reddi K. Kumar, Sayantani Basu, Horst-Dieter Lemke, Joachim Jankowski, Karl Kratz, Andreas Lendlein., Sarada D. Tetali. Influence of nanoporous poly (ether imide) particle extracts on

human aortic endothelial cells (HAECs); *ClinHemorheolMicrocirc.* 2016 Nov 4.

- Reddi K. Kumar, Sayantani Basu, Horst-Dieter Lemke, Joachim Jankowski, Karl Kratz, Andreas Lendlein, Sarada D. Tetali Effect of extracts of poly(ether imide) microparticles on cytotoxicity, ROS generation and proinflammatory effects on human monocytic (THP-1) cells; *Clinical Hemorheology and Microcirculation* 61 (2015) 667-680
- Sarada D. Tetali, Vera Jankowski, Karola Luetzow, Karl Kratz, Andreas Lendlein, Joachim Jankowski; Adsorption capacity of poly(ether imide) microparticles to uremic toxins; *Clinical Hemorheology and Microcirculation* 61 (2015) 657-665
- "Surface modification of porous polyetherimide microparticles prepared via a spraying/coagulation process", Basu, S.; Kratz, K.; Lendlein, A.; Annual Conference Advanced Functional Polymers in Medicine (AFPM) 2015, March 23.-25., Galway, Ireland.
- "Strategy for the hemocompatibility testing of polymer-based Microparticles", Braune, S.; Kratz, K.; Lendlein, A.; Jung, F. (oral presentation 7.2); 34. Jahrestagung der Deutsche Gesellschaft für Klinische Mikrozirkulation und Hämorheologie. V., November 27/28, 2015, Regensburg, Germany.
- "Adsorption capacity of poly(etherimide) microparticles to uremic toxins", Tetali, S.D.; Jankowski, V.; F. Brettschneider, F.; Luetzow, K.; Kratz, K.; Lendlein, A.; Jankowski, J. (poster presentation P12); 34. Jahrestagung der Deutsche Gesellschaft für Klinische Mikrozirkulation und Hämorheologie. V., November 27/28, 2015, Regensburg, Germany.
- "Examining the influence of poly(etherimide) microparticles on cytotoxicity and proinflammatory effects on human monocytic cells as well as apoptosis of human aortic endothelial cells", Kumar, R. K.; Basu, S.; Kratz, K.; Lendlein, A.; Tetali, S.D. (poster presentation P12); 34. Jahrestagung der Deutsche Gesellschaft für Klinische Mikrozirkulation und Hämorheologie. V., November 27/28, 2015, Regensburg, Germany. ●





Development, characterisation and validation of nanoparticles for the adsorption of hydrophobic uremic toxins in renal failure patients (NPORE).



Reddi K. Kumar<sup>1</sup>, Vamsy K. Damiseti<sup>1</sup>, Sayantani Basu<sup>2,3</sup>, Marieke R  th<sup>4</sup>, Christoph Sauvant<sup>4</sup>, Horst-Dieter Lemke<sup>4</sup>, Vera Jankowski<sup>5</sup>, Joachim Jankowski<sup>5,6</sup>, Karl Kratz<sup>2</sup>, Andreas Lendlein<sup>2,3</sup>, Sarada D. Tetali<sup>\*1</sup>

<sup>1</sup> Dept. of Plant Sciences, School of Life Sciences, University of Hyderabad, Hyderabad - 500046, India,  
<sup>2</sup> Institute of Biomaterial Science and Berlin-Brandenburg Center for Regenerative Therapies, Helmholtz-Zentrum Geesthacht, 14513 Teltow, Germany;  
<sup>3</sup> Institute of Chemistry, University Potsdam, 14476 Potsdam, Germany;  
<sup>4</sup> eXcorLab GmbH, Industrie Center Osnabr  ck, 63784 Osnabr  ck, Germany  
<sup>5</sup> Institute for Molecular Cardiovascular Research (IMCAR), RTWTH Aachen University, University Hospital, Pauwelsstra  e 30, 52074 Aachen, Germany;  
<sup>6</sup> School of Cardiovascular Diseases (CARIM), University of Maastricht, Universiteitssingel 50, 6229 ER, Maastricht, The Netherlands.





### Background

Chronic kidney disease (CKD), loss of kidney function over time, is a public health problem and its prevalence is estimated to be 8-16% worldwide<sup>1</sup>. The burden of CKD is very high in India although the data on patient population is limited<sup>2</sup>. Introduction of **The National Dialysis Program** into 2016 union budget of India is a huge relief to CKD patient families.

As current haemodialysis techniques, which are operated under aqueous conditions, are not capable to remove low molecular weight hydrophobic uremic toxins from the blood of chronic renal failure patients<sup>3</sup>. With respect to the hydrophobic nature and the high level of protein binding of such uremic toxins, hydrophobic adsorbent materials are required i.e. apheresis particles. One candidate material are highly porous microparticles prepared from poly(ether imide) (PEI)<sup>4</sup>. In this work we explored the viability, the monocytic differentiation, the proinflammatory behaviour and the intracellular ROS levels of human monocytic cells as well as the proinflammatory and apoptotic behaviour of human aortic endothelial cells which were treated using PEI microparticles extracts.



Clinical motivation and issues in elimination of hydrophobic uremic toxins in hemodialysis is insufficient

Increasing prevalence of chronic kidney disease (CKD) patients

### Specific aims

#### Partnership



#### Synthesis

#### Poly(ether imide) microparticles



#### Capacity

#### Uremic toxin adsorption by PEI particles



#### Biocompatibility (in vitro) of PEI particles on blood and vascular cells



### Methodology

#### Preparation of PEI particles



#### Preparation of PEI microparticle (unmodified) extracts for cellular treatments



#### Modification of PEI particles

PEI-B: 0.5g, steam sterile, non treated  
PEI-D: 0.5g, steam sterile, polyethyleneimine treatment 10min  
PEI-F: 0.5g, steam sterile, polyethyleneimine treatment 30min  
PEI-H: 0.5g, steam sterile, KOH post-treatment 10min  
PEI-J: 0.5g, steam sterile, KOH post-treatment 30min  
PEI-L: 0.5g, steam sterile, KOH post-treatment 60min

#### Rewetting the dry modified-I PEI particles for Cellular treatments

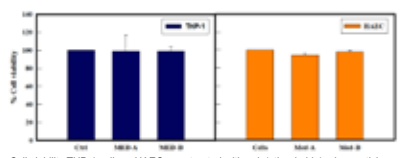


### Results-

All data represent mean ± SD of at least 3 independent experiments

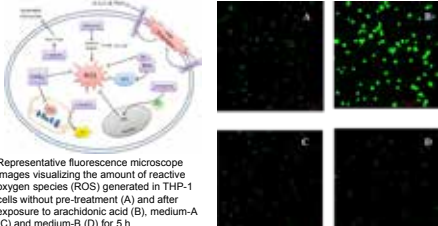
#### Effect of unmodified PEI particles on cultured monocytic and endothelial cells<sup>5</sup>

##### Toxicity of PEI particles on human monocytic (THP-1) and aortic endothelial cells (HAECs)



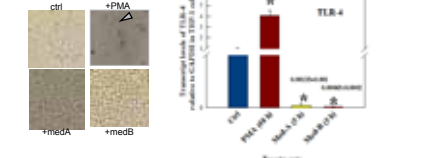
Cell viability THP-1 cells or HAECs pre-treated with poly(ether imide) microparticle extracts of medium-A and medium-B for 5 h as determined by MTT assay.

##### Intracellular ROS detection - Confocal microscopy



Representative fluorescence microscope images visualizing the amount of reactive oxygen species (ROS) generated in THP-1 cells without pre-treatment (A) and after exposure to arachidonic acid (B), medium-A (C) and medium-B (D) for 5 h.

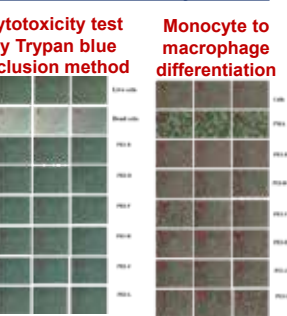
##### Monocyte to macrophage differentiation



Microscopic images visualizing the macrophage differentiation and gene expression by RT-PCR

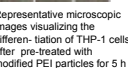
#### Effect of modified-I PEI particles on cultured monocytic cells

##### Cytotoxicity test by Trypan blue exclusion method



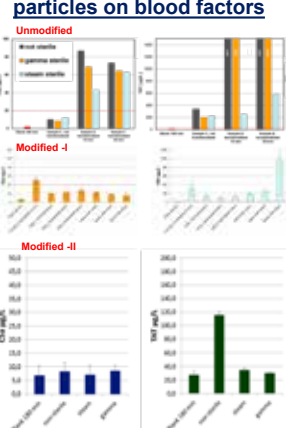
Cell viability THP-1 cells pre-treated with modified PEI particles for 5 h, filtered and determined by Trypan blue

##### Monocyte to macrophage differentiation



Representative microscopic images visualizing the differentiation of THP-1 cells after pre-treatment with modified PEI particles for 5 h

#### Effect of unmodified, modified-I and modified-II PEI particles on blood factors



##### Summary and Future direction

- The obtained results showed that steam sterilized PEI microparticles (unmodified and modified-II) did not exhibit cytotoxic or proinflammatory effects on cultured monocytic (THP-1) and endothelial (HAECs) cells.
- Whereas unmodified and modified-I particles activated blood coagulation factors.
- Modified-II particles did not activate blood coagulation factors.
- Modified-II particles should be examined for their uremic toxin adsorption capacity and their cytotoxic, inflammatory and apoptotic effects on monocytic cells, HAECs and HSMCs and also using animal (in vivo) models.

### References

[1] V. Jha, G. Garcia-Garcia, K. Isaki et al. (2013) Lancet 382 (9886): 260-272  
[2] U. Khanna (2009) Indian J Nephrol. 19(1): 1-4.  
[3] S. Lekawanvijit, AR. Komp, BH. Wang, DJ. Kelly, H. Krum, (2012) Circ. Res. 111: 1470-1483.  
[4] W. Albrecht, K. Lutzow, Th. Weigel, Th. Groth, M. Schoessig, A. Lendlein. (2006) Journal of Membrane Science 273: 106-115.  
[5] Kokkikipati PK, Kamsala RV, Bashyam L, Manthapuram N, Bitta P, Peddada V, Raghavendra AS, Tetali SD. (2013) J. Ethnopharmacol. 146: 456-64

### Publications

1. Basu S, Hauchela M, Weigel T, Kratz K and Lendlein A (2015) Integrated process for preparing porous, surface functionalized polyetherimide microparticles. *Polym Adv Technol* 26: 1447-55  
2. Tetali SD, Jankowski V, Lutzow K, Kratz K, Lendlein A, Jankowski J. (2016) Adsorption capacity of poly(ether imide) microparticles to uremic toxins. *Clin Hemorheol Microcirc* 61(4):657-65  
3. Kumar RK, Basu S, Lemke HD, Jankowski J, Kratz K, Lendlein A, Tetali SD. (2016) Effect of extracts of poly(ether imide) microparticles on cytotoxicity, ROS generation and proinflammatory effects on human monocytic (THP-1) cells. *Clin Hemorheol Microcirc* 61(4):667-80.  
4. Kumar RK, Basu S, Lemke HD, Jankowski J, Kratz K, Lendlein A, Tetali SD. Influence of nanoporous poly(ether imide) particle extracts on human aortic endothelial cells. (in preparation)

Acknowledgements

Reddi Kiran Kumar (SRF) and Vamsy K. Damiseti (JRF) are recipients of fellowship from IGSTC funded project (Grant No. IGSTC/NPORE/SDT/2012). Indo-German Science and Technology Centre (Grant No. IGSTC/NPORE/SDT/2012) and German Federal Ministry for Education and Research (BMBF), (Grant No s 01DQ13006A, 01DQ13006B and 01DQ13006C) are acknowledged for financial support. Funding bodies UGC-SAP, DBT-CREBB and UPE are thanked for providing central facilities required to carry out research work at University of Hyderabad in the Dept. of Plant Sciences and School of Life sciences.

Department of Plant Sciences, School of Life Sciences, University of Hyderabad, Hyderabad 500 046, India.  
Contact: Dr. Sarada D. Tetali, e-mail: tetali@uohyd.ac.in; (or) saradakanakagiri@gmail.com

Imparting drought stress-tolerance to crop plants by heterologous transfer of high altitude plant protection mechanisms



### The Project

In the upcoming years, crop production will be facing an increased demand by the growing and changing world population on the one hand and strong limitations by increasing abiotic stresses, like drought and temperature changes caused by the global climate change on the other hand. Thus, breeders and plant scientists have to provide crop varieties with higher yield, improved yield stability and stress tolerance traits to maintain and increase a sustainable crop production. In order to enable and maintain growth of plants in the future changing and more extreme environmental conditions, it is required to identify novel mechanisms to improve drought tolerance of crops.

To reach this, in this 2 + 2 project plants were modified to express stress-induced genes from plants growing at extremely high altitudes of India. Such genes have been identified by the Indian partner at IHBT and were transformed in the model plant Arabidopsis thaliana (CSIR-IHBT, India) and in crops (Oilseed rape (OSR), Deutsche Saatveredelung AG (DSV AG), Germany and corn, Krishidhan Research Foundation Private Limited, India).

In the end, nine different genes/gene combinations from plants growing in high altitude were transformed in 14 independent Arabidopsis lines, 6 genes in crops (OSR). Growth of these genetically modified plants in mild drought stress conditions was analysed with state-of-the-art plant phenotyping technologies at ForschungszentrumJuelich with image analysis methods to quantify a drought tolerance mediated by the transgene. All nine different genes or combinations of

genes were investigated in the model plant Arabidopsis for improvement of growth under mild drought stress; an improved drought tolerance could not be detected. Three lines expressing the transgenes in OSR have been characterised for growth under mild drought stress, also not showing significant changes indicating drought tolerance. To characterise the growth in extreme drought stress, novel technologies have been developed to quantify changes in morphology (Arabidopsis), or yellowing of the leaves (oilseed rape) in extreme drought stress, as it occurs especially in India.

The three transgenic rapeseed lines were investigated for changes in yellowing during drought stress, but no improvement of drought tolerance by the transgenes was observed. However, physiological and biochemical analyses showed that transgenic arabidopsis overexpressing CsTLP improved drought tolerance.

Transgenic Arabidopsis overexpressing a transcription factor RaWRKY exhibited improvement in seed yield. Transgenic arabidopsis co-over-expressing PaSOD and RaAPX showed improved lignification of the vascular tissue that was associated with improvement of stress tolerance. Transcriptome of Potentillaatrosanguinea was deciphered and also using the Caraganajubata, we solved a long standing question on the molecular mechanism of high altitude plants which makes them to thrive in cold desert at high altitude. Promoters of several stress responsive genes were cloned from Rheum australe.



## Project Investigators Partnering Institutions



**S Kumar**  
Institute of Himalayan Bioresource Technology  
Palampur



**A Wiese - Klinkenberg**  
Forschungszentrum Jülich GmbH



**M S Kuruvina Shetti**  
Krishidhan Research Foundation Pvt. Ltd  
Maharashtra



**Dieter Stelling**  
Deutsche Saatveredlung AG  
Lippstadt

## Progress Achieved

- ❖ Establishment of controlled field comparable stress conditions (FZJ) - A phenotyping protocol for the identification of mild drought tolerant growth has been established. Technologies for the phenotyping of extreme drought stress in Arabidopsis and OSR have been developed.
- ❖ Identification and isolation of stress specific promoters & genes and construction of expression constructs (IHBT, KRFPL) - High altitude plants *Caraganajubata* and *Potentillaatrosanguinea* were sequenced for expressed genes using SOLEXA sequencing; also, a suppression subtracted library was prepared, sequenced and analysed for *Caraganajubata*. (IHBT); -Stress induced genes of high altitude plants were identified (IHBT); -Putative Promoters of stress inducible genes were cloned from *Rheum australe* (IHBT); -Gene expression constructs for the identified stress induced genes from high altitude plants have been cloned into expression vectors for transformation in Arabidopsis and crop plants. KRFPL cloned SOD and Succinyl-CoA-ligase in marker free vector for transformation of maize (IHBT/KRFPL).
- ❖ Development of transgenic plants: Model and crop plants (IHBT, KRFPL, DSV, FZJ) -Six transgenes were transformed in oilseed rape (OSR) (DSV); -Homozygous lines were identified for one transgene (Succinyl-CoA-Ligase) (DSV/FZJ); -A 4th OSR line was genotyped and single insertion lines were identified for future drought stress phenotyping (WRKY) (DSV/FZJ); -Nine genes or combinations in the model plant *Arabidopsis thaliana* were provided for phenotyping (IHBT); -Arabidopsis expressing transgenes (CstLP, RaWKY, PaSOD, PaSOD+RaAPX) were evaluated

for their performance under abiotic stresses (IHBT).

- ❖ Phenotyping impact of high altitude plants genes on stresstolerance (FZJ, DSV, KRFPL) -Three OSR lines were characterized for growth in drought stress conditions (FZJ); -14 independent lines of transgenic *Arabidopsis* have been phenotyped for growth in mild stress (FZJ); -Phenotyping and quantification of the plants response to extreme stress has been performed to also identify and quantify tolerance against extreme drought, this is still under further development (FZJ); -Yield of transgenic OSR lines was quantified during seed production, deviation from standard yield was re-investigated for one line, but not confirmed in second yield quantification (FZJ/DSV).

## Publications:

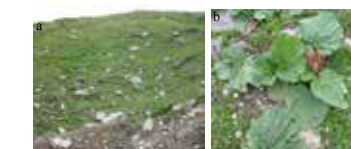
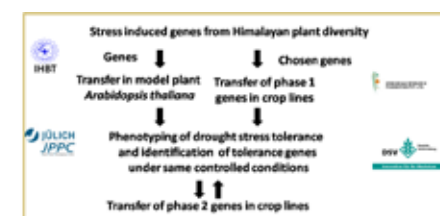
- ❖ Conference contribution (Poster): Jessica Knüfer, Christoph Briese, Marcus Jansen, Silke Kleinen, Alexander Putz, Sanjay Kumar, Dieter Stelling, Ulrich Schurr, Anika Wiese-Klinkenberg "A non-invasive imaging procedure to identify drought-stress tolerant oilseed rape plants expressing genes from high altitude plants" Interdrought IV, 2nd to 6th September 2013 in Crown Perth, Western Australia
- ❖ Conference contribution (Poster): Jessica Knüfer, Christoph Briese, Marcus Jansen, Silke Kleinen, Alexander Putz, Sanjay Kumar, Dieter Stelling, Ulrich Schurr, Anika Wiese-Klinkenberg "Imaging oilseed rape plants expressing genes from high altitude plants under severe drought conditions" 3rd International Plant Phenotyping Symposium 17th to 19th February 2014, Chennai, Indien
- ❖ Presentation of the Project with Deutsche Welle (DW) "Future now - Innovations shaping tomorrow (2010): <http://futurenow.dw-world.de/english/category/gm-plants/>.

## Imparting drought stress-tolerance to crop plants by heterologous transfer of high altitude plant protection mechanisms

## Introduction

Crop production is facing an increased demand by the growing and changing world population on the one hand and strong limitations by increasing abiotic stresses, like drought and temperature changes caused by the global climate change on the other hand. To enable and maintain growth of plants in the changing and more extreme environmental conditions, it is required to identify novel genes and mechanisms to improve stress tolerance of crop plants. The present project was carried out to transfer the chosen stress-induced genes isolated from plants growing and surviving in high altitude stress experiencing extreme cold, drought and high light in the model plant *Arabidopsis thaliana* (CSIR-IHBT, Palampur). Transgenic plants were analyzed in the Juelich Plant Phenotyping Centre (Forschungszentrum Juelich, FZJ, Germany) for their growth under controlled and drought stress conditions in a most field-comparable environment. Finally, genes providing a stress tolerance to the model plants were transferred to high quality crop plants by Krishidhan Research Foundation Pvt. Ltd. (KRFPL, India) and Deutsche Saatveredelung AG (DSV, Germany). Transgenic crop plants were further characterized for drought tolerance in Forschungszentrum Juelich.

## Project Planning



A typical niche (a) of *Rheum australe* (b) at Rohtang Pass (Western Himalaya, India)



A typical niche (a) of *Potentilla atrosanguinea* (b) at Kunzum Pass (Western Himalaya, India)

A glimpse of Himalayan plant species and their habitat.

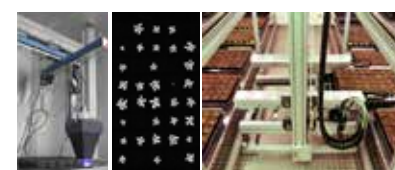
Planned activities by the four partners.

Planned exchange of various components between the partners.

## Major Achievements

## Established controlled field comparable stress conditions (FZJ)

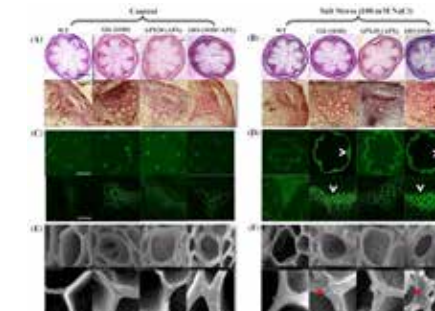
- Established a phenotyping protocol for the identification of mild drought tolerant growth.
- Developed technologies for the phenotyping of extreme drought stress in Arabidopsis and OSR.



Arabidopsis Phenotyping: GROWSCREEN-Fluoro (left). Middle pictures masks for the quantification of rosette areas and growth, combined with fluorescence imaging to measure photosynthesis parameters. Pictures acquired with Maxi-PAM camera moving in x- and y-direction over 40 pots (left). Right: automated growth chamber with plant carrier system to automatically transfer plant trays to measurement in GROWSCREEN Fluoro.

## Developed transgenic plants: Model and crop plants (IHBT, KRFPL, DSV, FZJ)

- Six transgenes were transformed in oilseed rape (OSR) (DSV)
- Homozygous lines were identified for one transgene (Succinyl-CoA-Ligase) (DSV/FZJ).
- A 4th OSR line was genotyped and single insertion lines were identified for future drought stress phenotyping (WRKY) (DSV/FZJ).
- Arabidopsis expressing transgenes (CstLP, RaWKY, PaSOD, PaSOD+RaAPX) were evaluated for their performance under abiotic stresses (IHBT).



Overexpression of SOD and APX leads to enhanced lignin deposition in stem of *Arabidopsis*. a, b Transverse stem sections were stained with safranin-O for lignin. c, d Lignification pattern under control and salt stress. e, f Sections observed under scanning electron microscope.

Plant Molecular Biology: DOI 10.1007/s11103-015-0301-6

## Partners of the project

CSIR Institute of Himalayan Bioresource Technology (CSIR-IHBT)  
Dr. S. Kumar/Dr. P.S. Ahuja  
Institute of Himalayan Bioresource Technology  
, 176061 Palampur, India

Forschungszentrum Juelich GmbH (FZJ)  
Dr. A. Wiese - Klinkenberg  
Forschungszentrum Juelich GmbH  
Leo-Brandt Str.  
52428 Juelich, Germany

Krishidhan Research Foundation Pvt. Ltd (KRFPL)  
Dr. M.S. Kuruvina Shetti  
Krishidhan Research Foundation Pvt. Ltd  
Krishidhan Bhawan, Jalna, -431 231  
Maharashtra, India

Deutsche Saatveredelung AG (DSV AG)  
Dr. D. Stelling  
Deutsche Saatveredelung AG  
Dr. Dieter Stelling, Weissenburger Str. 5  
59557 Lippstadt, Germany

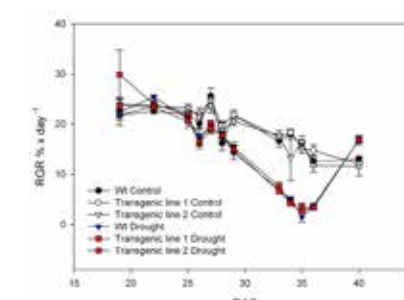
## Identified and isolated stress specific promoters &amp; genes and constructed expression constructs (CSIR-IHBT, KRFPL)

- High altitude plants *Caraganajubata* and *Potentilla atrosanguinea* were sequenced for expressed genes using SOLEXA sequencing.
- Stress induced genes and promoters were identified for generating transgenics (IHBT).
- KRFPL cloned SOD and Succinyl-CoA-ligase in marker free vector for transformation of maize (IHBT/KRFPL).



## Phenotyped impact of high altitude plants genes on stress tolerance (FZJ, DSV, KRFPL)

- Three OSR lines were characterized for growth in drought stress conditions (FZJ).
- Fourteen independent lines of transgenic *Arabidopsis* have been phenotyped for growth in mild stress (FZJ).
- Phenotyping and quantification of the plants response to extreme stress has been performed to also identify and quantify tolerance against extreme drought (FZJ).
- Yield of transgenic OSR lines was quantified during seed production, deviation from standard yield was re-investigated for one line, but not confirmed in second yield quantification (FZJ/DSV)



Drought stress growth response: Relative rosette area growth rates (RGR %/day) in control conditions and during emerging mild drought stress. Effect of a transgene in *Arabidopsis*, two independent transgenic lines 1 and 2. DAS = days after sowing.





## Biotechnological approaches to improve chickpea crop productivity for farming community and industry



Source : Project Archives

### The Project

The basic objectives of the project are:

Chickpea (*Cicerarietinum* L.), an important grain legume crop of high nutritive value is mostly grown in low-input and on residual moisture in Indian and semi-arid regions of Sub-Saharan Africa. India is the largest producer and largest consumer of chickpea. However India imports at least 40% of the international chickpea production. Due to insufficient rainfall in arid and semi-arid growing areas, the crop often suffers from drought. Terminal drought globally is the major constraint for chickpea production. In the past, breeding efforts to improve drought tolerance have been hindered due to its quantitative genetic basis and our poor understanding of the physiological basis of yield under water-limited conditions. Recent advances in chickpea genomics including the genome sequence, unraveled gene networks and genetic variation controlling valuable traits in elite breeding populations.

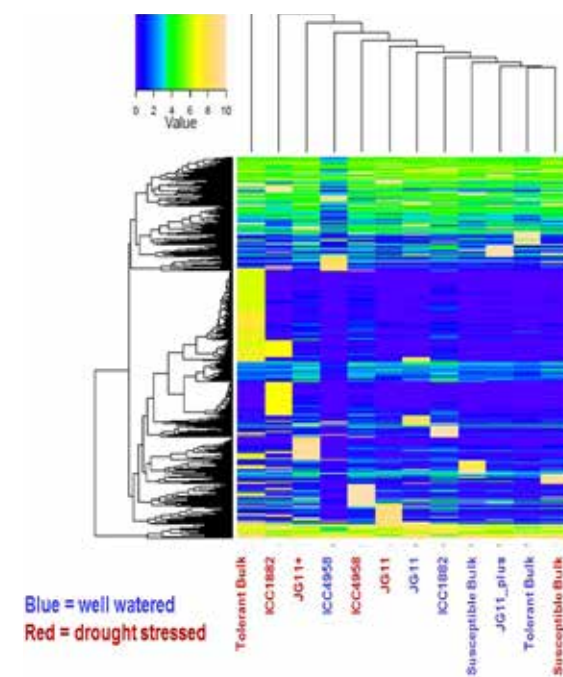
- ❖ Identification of candidate genes associated with drought tolerance in chickpea

- ❖ Quantitative real time PCR (qRT-PCR) assays for candidate drought-responsive genes in chickpea
- ❖ Perfect gene-based markers associated with drought tolerance in chickpea
- ❖ Relevant statistical packages and bioinformatics tools for data analysis



Control

Drought stress



Massive Analysis of cDNA Ends (MACE) –Differential gene expression profiles

### Project Investigators



Rajeev Varshney  
ICRISAT, Hyderabad



Manash Chatterjee  
BenchBio private Limited  
Vapi

### Partnering Institutions



Gunter Kahl  
Goethe Universitat Frankfurt Main,  
Frankfurt



Peter Winter  
General Manager, GenXPro GmbH,  
Frankfurt

### Progress Achieved

This project explored the resources developed (eg. in a different project, ICRISAT produced >400,000 ESTs from chickpea genotypes using next-generation sequencing (NGS) technologies), with the help of expertise available at University of Frankfurt / GenXPro in Germany and ICRISAT/ BenchBio in India to identify candidate genes for drought tolerance in chickpea. In this context, a transcriptome assembly (ca. 60,000 contigs) was generated and 3,000 dehydration stress-responsive genes involved in major drought-stress signalling cascades were identified. Robust drought-responsive candidate genes were identified from MACE libraries and 50 qRT-PCR assays for drought-responsive candidate genes were studied. Furthermore, KASPar assays were developed for 2,005 SNPs and a high-density molecular map of chickpea comprising 1,328 loci was developed. In addition, an Integrated SNP Mining and Utilization (ISMU) pipeline, a computational tool for identifying SNPs in NGS data sets was developed. This project eventually helped to enhance breeding efficiency for developing superior chickpea varieties with higher yield under rainfed conditions.

- ❖ A transcriptome assembly (ca. 60,000 contigs) has been generated and 3,000 dehydration stress-responsive genes involved in major drought-stress signalling cascades were identified (GXP and ICRISAT).
- ❖ Robust drought-responsive candidate genes identified from MACE libraries and 50 qRT-PCR assays for drought-responsive candidate genes designed (UF)
- ❖ KASPar assays were developed for 2,005 SNPs and 384 SNP genotyping data was generated on the reference set consisting of 301 accessions. High-density molecular map of chickpea comprising 1,328 loci was developed. high resolution gene expression profiles identified through MACE libraries

- ❖ ISMU pipeline, a computational tool for identifying SNPs in Next Generation Sequencing (NGS) data sets was developed.

#### Publications:

- ❖ Azam S, Rathore A, Shah TM, Telluri M, Amindala B, et al. (2014) An Integrated SNP Mining and Utilization (ISMU) Pipeline for Next Generation Sequencing Data. PLoS ONE 9 (7): e101754.
- ❖ Afonso-Grunz F, Molina C, Hoffmeier K, Rycak Lukas, Kudapa H, Varshney RK, Drevon J, Winter P, Kahl G. (2014) Genome-based analysis of the transcriptome from mature chickpea root nodules. Frontiers in Plant Science 5: 325.
- ❖ Varshney RK\*, Song C, Saxena RK, Azam S, Yu S, Sharpe A, Cannon S, Baek J, Rosen BD, Tar'an B, Millan T, Zhang X, Ramsay LD, Iwata A, Wang Y, Nelson W, Farmer AD, Gaur PM, Soderlund C, Penmetsa RV, Xu C, Bharti AK, He W, Winter P, Zhao S, Hane JK, Garcia NC, Condie JA, Upadhyaya HD, Luo MC, Thudi M, Gowda CLL, Singh NP, Lichtenzveig J, Gali KK, Rubio J, Nadarajan N, Dolezel J, Bansal KC, Xu X, Edwards D, Zhang G, Kahl G, Gil J, Singh KB, Datta SK, Jackson SA, Wang J, Cook DR (2013) Draft genome sequence of chickpea (*Cicerarietinum*) provides a resource for trait improvement. Nature Biotechnology 31:240–246.
- ❖ Kudapa H, Ramalingam A, Nayakoti S, Chen X, Zhuang W, Liang X, Kahl G, Edwards D, Varshney RK (2013) Functional genomics to study stress responses in crop legumes: Progress and prospects. Functional Plant Biology 40(12): 1221-1233
- ❖ Hiremath PJ, Kumar A, Penmetsa RV, Farmer A, Schlueter JA, Chamarthi SK, Whaley AM, Carrasquilla-Garcia N, Gaur PM, Upadhyaya HD, KaviKishor PB, Shah TM, Cook DR and Varshney RK (2012). Large-scale development of cost-effective SNP marker assays for diversity assessment and genetic mapping in chickpea and comparative mapping in legumes. Plant Biotechnology Journal 10: 716–732. ●





# Biotechnological approaches to improve chickpea crop productivity for farming community and industry

Rajeev Varshney<sup>1,\*</sup>, Himabindu Kudapa<sup>1</sup>, Mahendar Thudi<sup>1</sup>, Pooran Gaur<sup>1</sup>, Fabian Grunz<sup>2</sup>, Günter Kahl<sup>2</sup>, Björn Rotter<sup>3</sup>, Peter Winter<sup>3</sup>, Manash Chatterjee<sup>4</sup>

<sup>1</sup>International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Hyderabad, India; <sup>2</sup>Goethe-Universität Frankfurt, Frankfurt am Main, Germany; <sup>3</sup>GenXPro GmbH, Frankfurt am Main, Germany; <sup>4</sup>BenchBio Private Limited, Gujarat, India

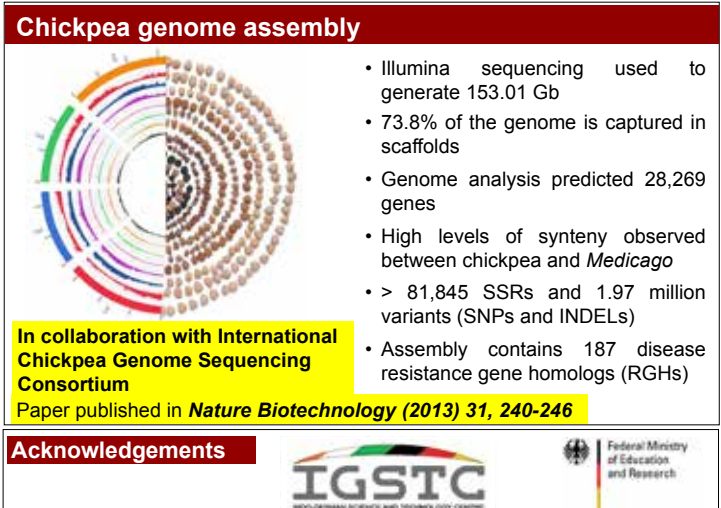
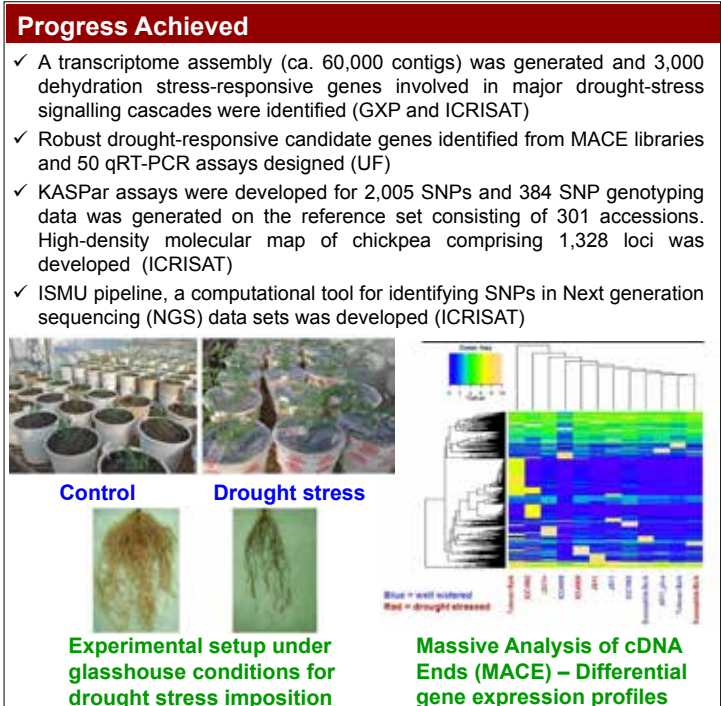
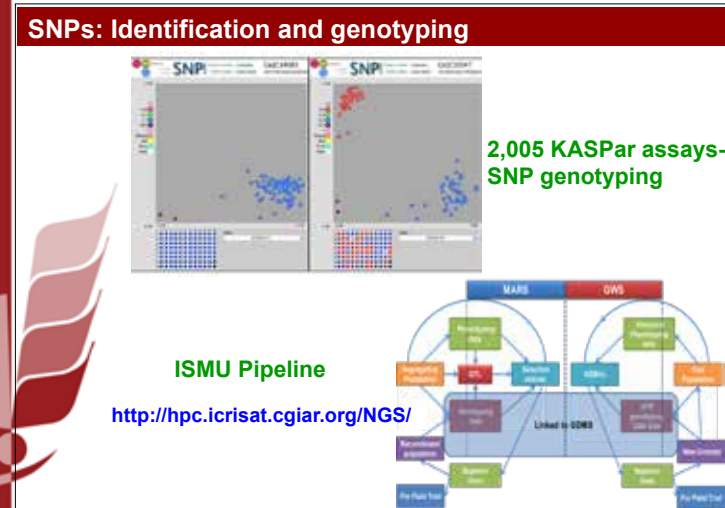
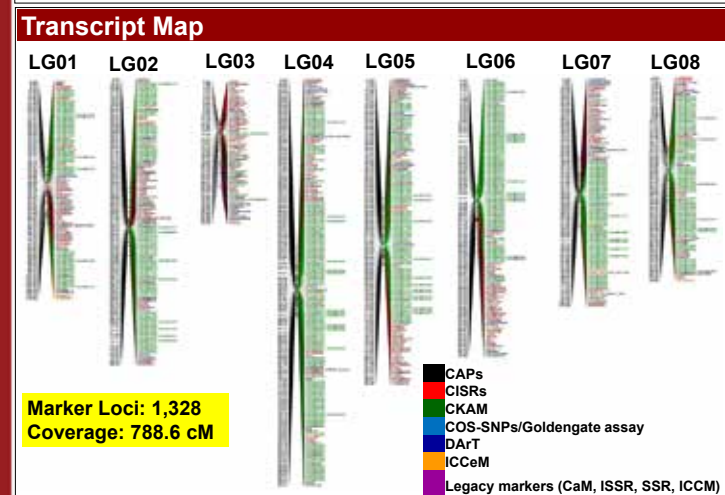
\*Address for correspondence: r.k.varshney@cgiar.org



**The Project** Chickpea (*Cicer arietinum* L.), an important grain legume crop of high nutritive value is mostly grown in low-input and on residual moisture in Indian and semi-arid regions of Sub-Saharan Africa. India is the largest producer and consumer of chickpea. However India imports at least 40% of the international chickpea production. Terminal drought globally is the major constraint for chickpea production. In the past, breeding efforts to improve drought tolerance have been hindered due to its quantitative genetic basis and our poor understanding of the physiological basis of yield under water-limited conditions. Recent advances in chickpea genomics including the genome sequence, unraveled gene networks and genetic variation controlling valuable traits in elite breeding populations. This project explored the resources developed (eg. in a different project, ICRISAT produced >400,000 ESTs from chickpea genotypes using next-generation sequencing (NGS) technologies), with the help of expertise available at University of Frankfurt / GenXPro in Germany and ICRISAT/ BenchBio in India to identify candidate genes for drought tolerance in chickpea. In this context, a transcriptome assembly (ca. 60,000 contigs) was generated and 3,000 dehydration stress-responsive genes involved in drought-stress signalling cascades were identified. Robust drought-responsive candidate genes were identified from Massive Analysis of cDNA Ends (MACE) libraries and 50 qRT-PCR assays for drought-responsive candidate genes were studied. Furthermore, KASPar assays were developed for 2,005 SNPs and a high-density molecular map comprising 1,328 loci was developed. In addition, an Integrated SNP Mining and Utilization (ISMU) pipeline, a computational tool for identifying SNPs in NGS data sets was developed. This project eventually helped to enhance breeding efficiency for developing superior chickpea varieties with higher yield under rainfed conditions.

**Objectives**

- ❖ Identification of candidate genes associated with drought tolerance in chickpea
- ❖ Quantitative real time PCR (qRT-PCR) assays for candidate drought-responsive genes in chickpea
- ❖ Perfect gene-based markers associated with drought tolerance in chickpea
- ❖ Relevant statistical packages and bioinformatics tools for data analysis



## Developing sustainable transgenic crop plants for drought or a combination of drought & heat stress by manipulating aba & ascorbate- gultathione pathways



Source : shutterstock

### The Project

The basic objectives of the project were:

- ❖ In vitro gene pyramiding and construction of plant transformation vector with all the genes, i.e. Superoxide dismutase (SOD), Ascorbate peroxidase (Apx), Monodehydroascorbatereductase (MDHAR), Dehydroascorbatereductase (DHAR) and Glutathione reductase (GR), encoding for enzymes involved in ascorbate-glutathione pathway (at ICGB).
- ❖ Preparation of constructs for manipulating ABA levels under drought using key genes of ABA metabolism and catabolism as well as alterations for ABA signaling to elevate hypersensitivity to ABA under drought (at IPK Germany).
- ❖ Transformation of selected maize lines through Agrobacterium- mediated transformation (at Nuziveedu Seeds (P) Ltd).
- ❖ Transformation and characterization of primary transgenic barley lines and double haploid transgenic plants and screening barley transgenic plants for terminal drought tolerance (at IPK and SURL, Germany).

- ❖ Molecular analysis of transgenic maize plants for stable integration of transgenes and their expression at both RNA and Protein levels (at both ICGB and Nuziveedu Seeds (P) Ltd components).
- ❖ Validation of selected transgenic maize and barley events for their stress adaptation in the greenhouse under different stress conditions (at ICGB, Nuziveedu Seeds (P) Ltd and IPK).
- ❖ The enhanced productions of Reactive Oxygen Species (ROS) in response to drought stress are effectively deactivated in multiple redox reactions by the ascorbate-glutathione pathway enzymes expressed in transgenic maize to combat drought stress induced cellular damage (at ICGB and Nuziveedu Seeds (P) Ltd.).
- ❖ The genetic manipulation of drought stress responsive ABA levels in transgenic plants for subsequent expression of drought stress adaptive genes through ABA mediated signaling pathway to sustained plant growth and productivity under drought stressed agro-climatic condition (at IPK, ICGB and Nuziveedu Seeds (P) Ltd.).



Figure - Tolerant green transgenic (left) and completely dried non-transgenic (right) maize plants under drought stress given in pot experiment



## Project Investigators Partnering Institutions



**M K Reddy**  
International Centre for Genetic  
Engineering and Bio Technology  
(ICGEB), New Delhi



**P Sateesh Kumar**  
Nuziveedu Seeds (P) Ltd.  
Hyderabad



**N Sreenivasulu**  
Leibniz Institute for Plant Genetics and  
Cultivated Plant Research  
Gatersleben



**Janes Weyen**  
Saaten-Union Resistenzlabor GmbH  
Leopoldshöhe

## Progress Achieved

- The objective within this project was the combination and pyramiding of genes increasing tolerance against drought and heat stress in spring barley and maize. Therefore, transgenic lines with optimized biosynthesis pathway of the plant hormone abscisic acid (ABA, Figure 1), the ABA signaling pathway and the Glutathione-Ascorbate metabolism were generated (IPK, ICGEB and Nuziveedu Seeds).
- After initial characterization several lines were selected, grown in the greenhouse and crossed together (project partner Saatenunion). The progeny were raised as



Figure – Cob size and pigmentation in transgenic (A-C) and non-transgenic (D) maize lines

donor plants for the production of doubled haploid (DH-) lines. DH-lines were produced via in vitro tissue culture. Doubled haploid plants have the advantage of being genetically stable. They do not segregate in the further generations and are completely homozygous. That makes them ideal tools for further investigation of genes of interest. Seeds were sown under greenhouse conditions at IPK Gatersleben for further analysis under control and defined drought stress settings. Selected Lines showed a stable yield under drought stress conditions.

- The Indian component adopting Agrobacterium mediated transformation and transformed entire ascorbate-glutathione pathway encoding genes into maize plants for effective deactivation of reactive oxygen intermediate (ROI) molecules to protect the transgenic maize from the oxidative damage. In addition, modulated the expression levels of ABA, the major phytohormone and an essential messenger to trigger the expression of stress adaptive genes under drought stress by simultaneously over expressing NCED6 and a receptor protein kinase under appropriate promoters to enhance production of ABA at the same time to prevent the leaf senescence for improved seed setting and grain filling. Elite transgenic lines were selected after field and lab level screening with basta and methylviologen treatments respectively. In selected lines, morphological, physiological and biochemical characterization was done by doing pigment analyses, ion leakage, lipid peroxidation and enzyme assays under the induced oxidative stress condition with methyl viologen in lab and also by simulated drought stress experiments in poly house. Significant difference was observed between transgenics and control plants (Figure 2). Stable yields were observed in some lines and enhanced cob length and pigmentation were observed in others (Figure 3). ●



International Centre for Genetic  
Engineering and Biotechnology



Nuziveedu Seeds (P) Ltd

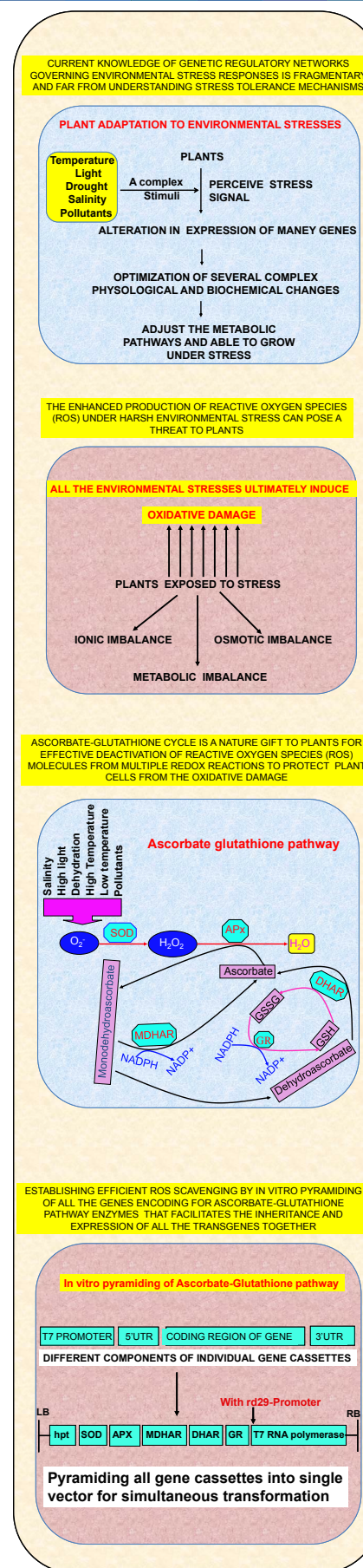
## Developing Sustainable Transgenic Crop Plants Tolerant for Drought or a Combination of Drought and Heat Stress By Manipulating ABA signaling and Ascorbate-Glutathione pathways



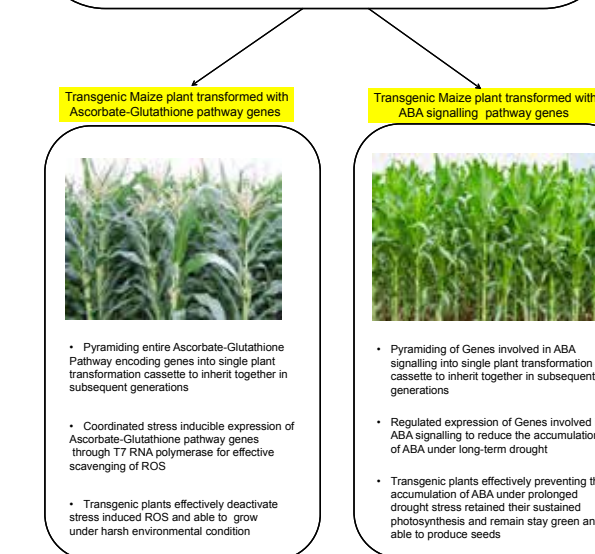
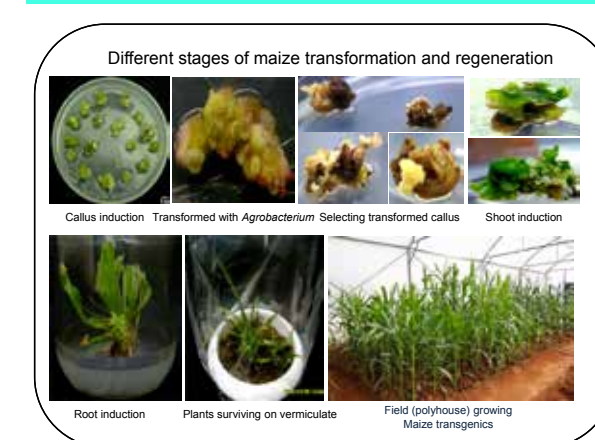
Leibniz Institute of Plant Genetics  
and Crop Plant Research



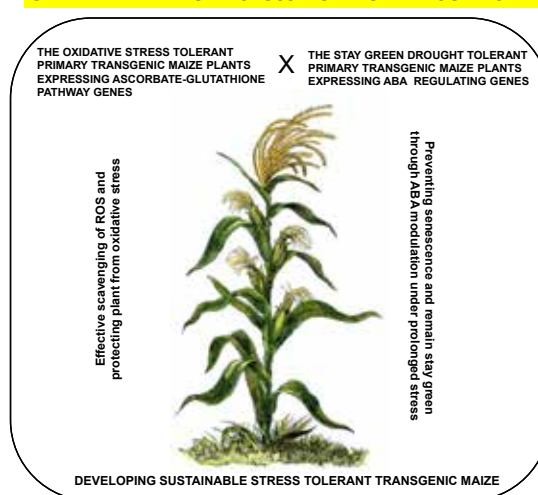
Saaten-Union  
Resistenzlabor GmbH



## AGROBACTERIUM MEDIATED MAIZE TRANSFORMATION AND REGENERATION

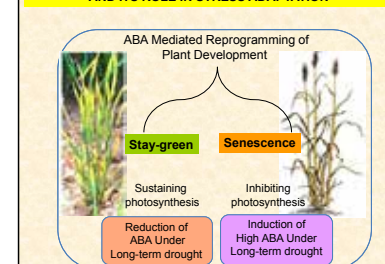


## GENE PYRAMIDING BY CROSSING TWO TRANSGENIC LINES

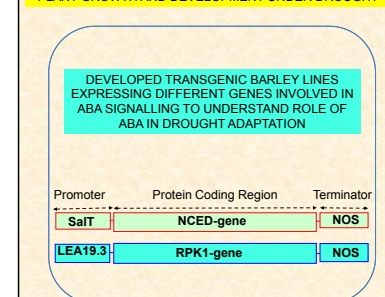


WORK DONE UNDER INDIAN COMPONENT

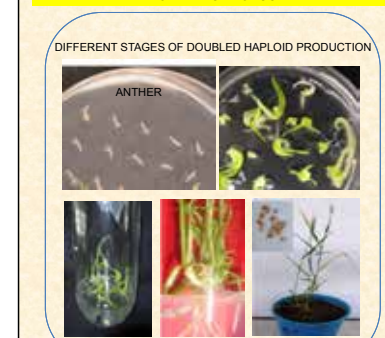
## THE IMPACT OF PLANT HORMONE ABSICISCI ACID (ABA) AND ITS ROLE IN STRESS ADAPTATION



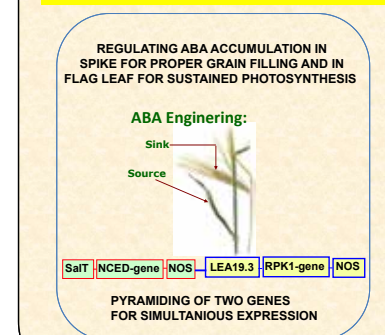
## REGULATED EXPRESSION OF ABA TO UNDERSTAND PLANT GROWTH AND DEVELOPMENT UNDER DROUGHT



## PYRAMIDING OF GENES INVOLVED IN ABA SIGNALLING AND GENERATED TRANSGENIC LINES THAT SHOWED STRESS TOLERANCE AND SUBSEQUENT DOUBLED HAPLOID LINES PRODUCED



## IN VITRO PYRAMIDING OF SELECTED GENES FOR THE TISSUE SPECIFIC REGULATED EXPRESSION OF ABA FOR PROPER GRAIN FILLING AND SUSTAINED PHOTOSYNTHESIS DURING TERMINAL DROUGHT





## Compact linear fresnel reflector technology (CLFR) for solar thermal power generation and process heat



### The Project

The objective of the project is to develop a low cost concentrating collector for production of medium temperature heat, designed for Indian climate, cost and production conditions.

Specifically this project envisages setting up of a CLFR based low cost high efficiency solar thermal rooftop collector demonstration plant and integrating the same with an existing thermal power unit. It involves

#### Expected deliverables:

- ❖ Design and development of all the critical components like primary mirror system, secondary concentrator, receiver mounting, tracking system, heat exchangers, evaporators etc.
- ❖ Design and analysis of structural system,
- ❖ Fabrication of the components of the system, assembly, erection and commissioning at site,
- ❖ Testing & integration of the system in the existing

thermal power plant at Manuguru, to address all the above aspects and quantify the efficiency and cost.

### Progress Achieved

- ❖ Conceptual design to meet the requirements arrived at and frozen.
- ❖ Detailed configuration design and analysis carried out.
- ❖ No major or critical bottle necks in the design seen as per the analysis.
- ❖ Fabrications issues of the components were addressed.
- ❖ Mirror bending and bonding experiments were successful, validating the design concept
- ❖ A prototype of a single reflector was fabricated and tested for focussing accuracy.
- ❖ Detailed design drawings were created for discussions with Thermax on further work towards assembly and integration requirements between the different modules.

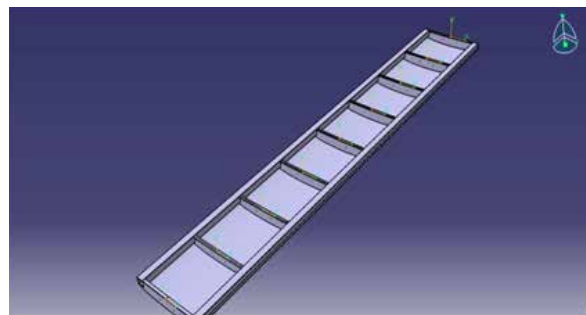


Fig 1: 3D model of primary reflector support structure without mirror

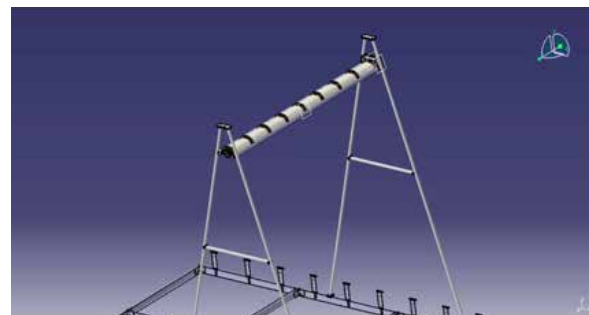


Fig 2: 3D model of Secondary reflector held on the A frame

### Project Investigators Partnering Institutions



P M Mujumdar  
IIT Bombay  
Mumbai

Werner Platzer  
Fraunhofer ISE  
Freiburg



R R Sonde  
Thermax Global  
Pune

Thomas Kuckelkorn Schott  
Solar Cspgmbh  
Mainz



- ❖ Engineering drawings were created in collaboration with and support of the Thermax team, for taking up the fabrication of the components and modules of the actual demonstration pilot plant through external vendors.
- ❖ The effect of possible springback and loading mechanisms to compensate for the same was studied through a nonlinear analysis.

#### Publications:

- ❖ This report gives a summary of the work done by the project team at IIT Bombay, and its contributions to the project along with Thermax and other partners towards successful implementation of

the demonstration pilot plant based on the CLFR concept for application of solar thermal power hybridization with conventional thermal power plant. All the objectives of the project have been successfully met. A new and novel conceptual and detailed design of the primary collector unit of the plant was evolved as a part of the project. The concept was successfully implemented and tested as a part of the actual demonstration plant, alongside another design from the Thermax team based on a more conventional approach. Both designs were supported by a detailed high fidelity analysis based on the finite element method.●





# Reduction of earth metals in chalkopyritebased solar cells

## Project Investigators Partnering Institutions



**Sarang Ingle**  
IIT Kanpur  
Kanpur



**Roland Scheer**  
Martin-Luther-University  
Halle



**Nagesh Kini**  
Thermax  
Pune



**Ralf Sorgenfrei**  
Manz CIGS technology GmBh  
Schwabisch Hall

## The Project

- ❖ Model process for CIGS growth with reduced layer thickness and preserved or improved photovoltaic properties
- ❖ Model process for Kesterite growth with reduced layer thickness and preserved or improved photovoltaic properties
- ❖ Report on scientific and economic potential of both approaches and benchmarkingProgress of the project.

## Progress Achieved

CZTS thin films obtained through solution route have been successfully obtained over the molybdenum coated soda-lime glass substrate (1 inch-square surface area). Film deposition parameters have been optimized in order to obtain films that are free of macro-cracks, have minimal pin-holes, and have the desired stoichiometry, which is, copper poor and zinc rich.

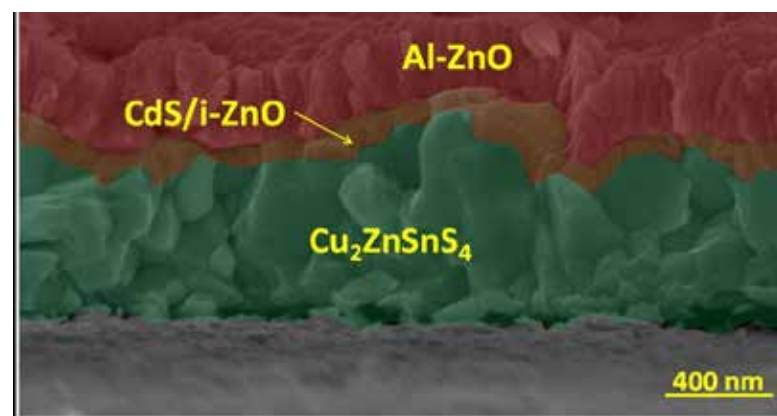
A complete photovoltaic device (area 0.25 cm<sup>2</sup>) has been fabricated by sputter deposition of intrinsic zinc oxide (i-ZnO), chemical-bath deposition

of cadmium-sulfide (CdS), and sputter deposition of aluminum doped zinc-oxide (AZO) in that order on the CZTS film.

The best cell fabricated so far shows open circuit voltage (Voc) of 0.47V and short-circuits current density (Jsc) of 1.38 mA/cm<sup>2</sup>. In the efficiency table by M. A. Green et al. CZTS device1 with highest reported efficiency has Voc = 0.6585, Jsc = 20.43 mA/cm<sup>2</sup>.

### Any other relevant points:

- Sputtering system and IR furnace have been installed.



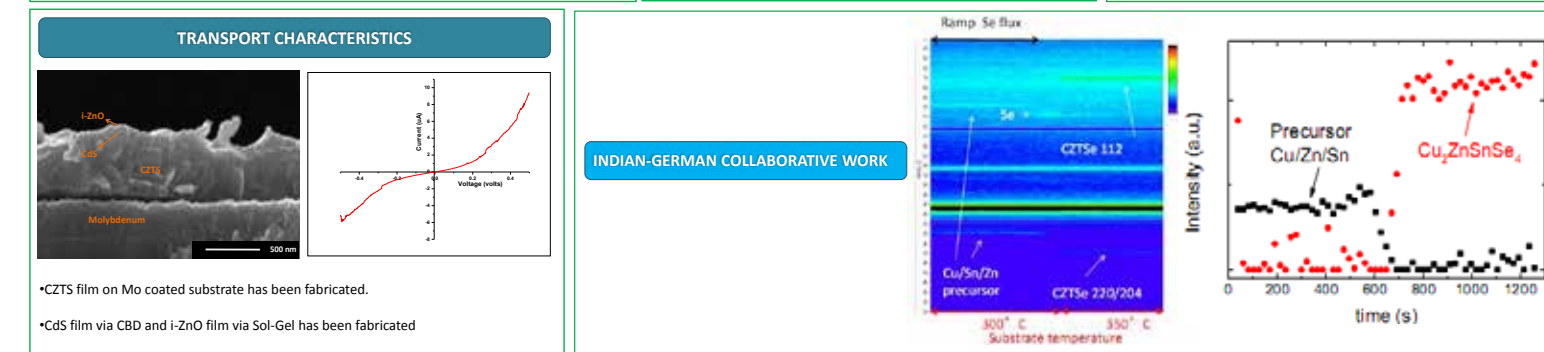
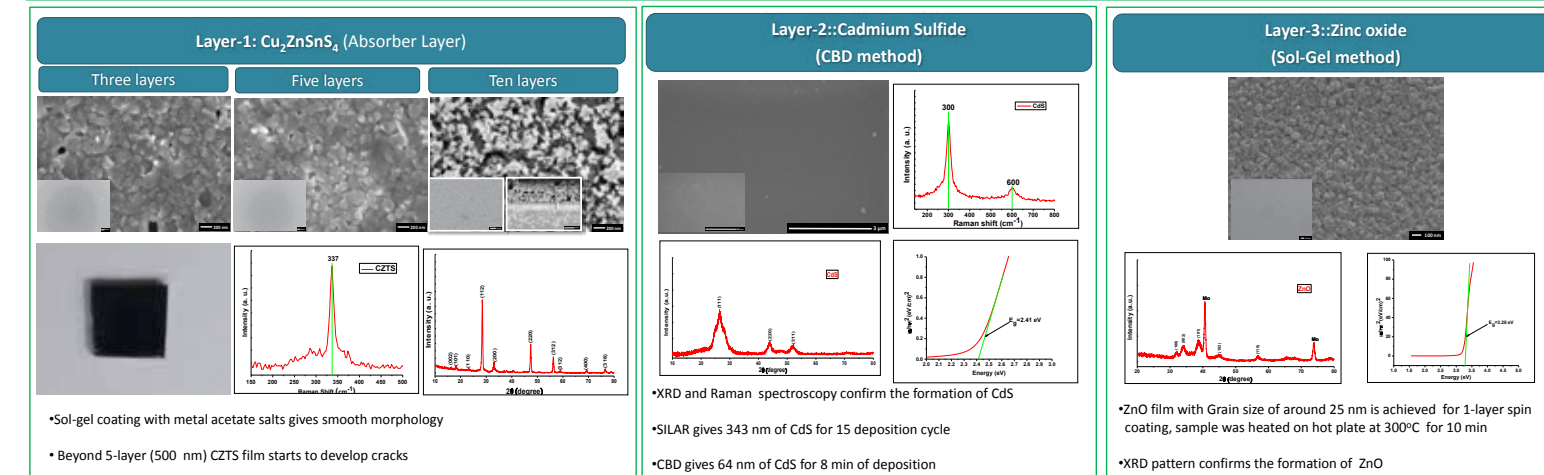
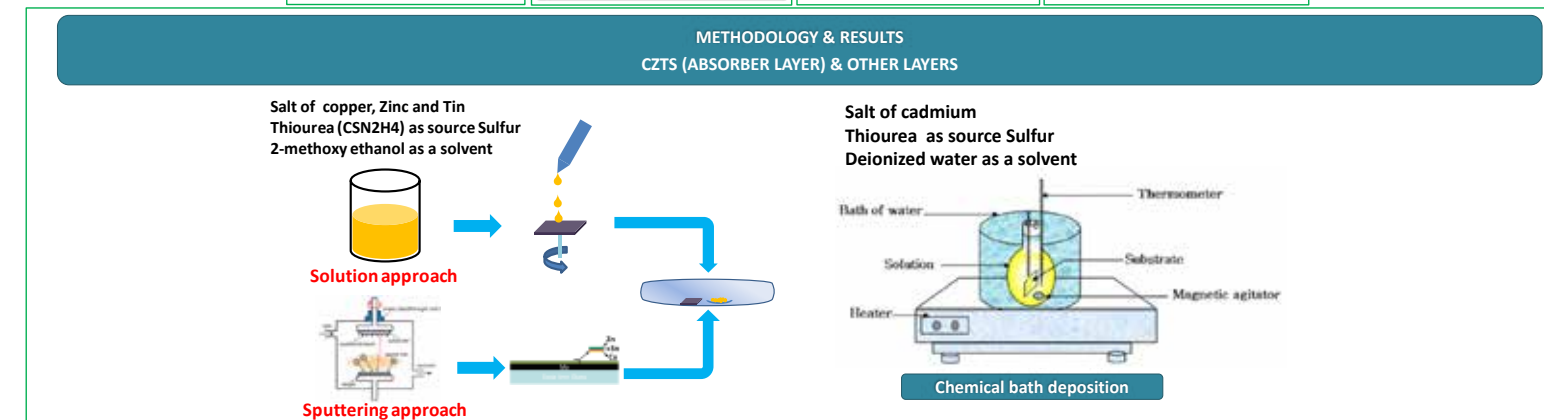
Cross Section of CZTS Solar Cell



## Reduction of Earth Metals in Chalcopyrite-based Solar Cells



| MOTIVATION   | SOLAR CELL STRUCTURE | BAND DIAGRAM | CURRENT EFFICIENCY STATUS  |
|--|----------------------|--------------|--|
| Earth abundant metal chalcogenites material Cu <sub>2</sub> ZnSnS <sub>4</sub> (CZTS) based solar cell is consider to be an alternative to Cu(In,Ga)S <sub>2</sub> (CIGS) absorber material based solar cells. It uses Zinc and Tin in place of Gallium and Indium making it low cost material for solar cell application. |                      |              | <ul style="list-style-type: none"> <li>• Highest Efficiency achieved with CZTSSe is 12.6% [1].</li> <li>• Current highest achieved efficiency with CIGSe is 20% [2].</li> <li>• The goal of present investigation is to understand the efficiency limiting factors in CZTSSe, and thus devise an approach for improving its efficiency.</li> </ul> |



| ACKNOWLEDGEMENT   | REFERENCES  |
|---|---|
| • Authors would like to thank Indo-German Science and Technology Center (IGSTC) for the funding to carry out this work. | <ol style="list-style-type: none"> <li>1) Wei Wang et. al. Adv. Energy Mater. 2014, 4, 1301465</li> <li>2) Philip Jackson et. al. prog. Photovolt: Res. Appl. 2011; 19:894-897</li> </ol> |



Project sponsored by



Indo-German Science & technology Centre



## Flexible printed integrated disposable electronics

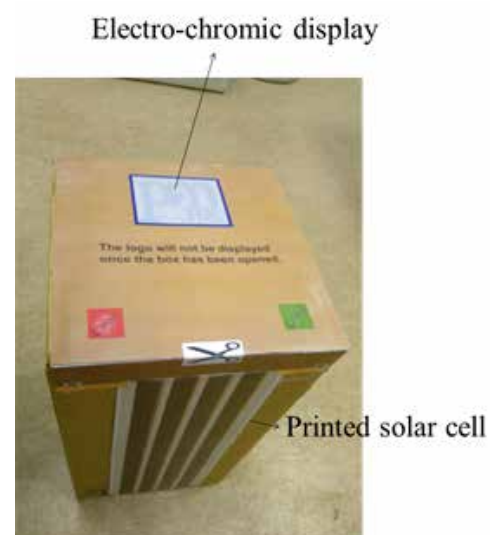


### The Project

Printed electronics has developed as a promising research area, as it provides the possibility to produce large quantities of low-cost flexible electronic devices by means of conventional mass printing technologies. Production costs decrease and numerous applications, e.g. solar cells, antenna, sensors, etc., become possible. Even though remarkable progress has been made in research for printed electronic components in recent years, the integration of multiple electronic components into multifunctional systems is much less mature. The FLEXIPRIDE project, which is funded by BMBF within its initiative to strengthen international cooperation in education and research, aims at producing such multifunctional systems, which facilitate numerous novel applications. In particular, different application scenarios

are to be developed on the basis of mass printing technologies: solar-based energy sources and security seals.

The project deliverables have been based on a yearly basis. At the end of the project a demonstrator with printed solar cell and an active RFID with printed antenna with printed connectors will be presented. A device model will be developed to simulate the circuits and the individual components like solar cells, Transistors and electrochromic or light emitting displays in the circuit. An optical system using different sensors and methods for defect detection will be developed. Another optical system to measure the thickness of the printed layers will also be developed and effort will be made to combine defect detection and thickness measurement in one system to be mounted on the printing machine.



### Project Investigators



**Yashowanta Mohapatra**  
IIT Kanpur  
Kanpur



**Ashokka Agarwal**  
Anil Printers Pvt. Ltd  
Nasik

### Partnering Institutions



**Arved Hübler**  
Chemnitz University of Technology  
Chemnitz



**Klaus Riemer**  
Chromasens GmbH  
Konstanz

### Progress Achieved

- ❖ First oscillating EC-display with simple astable multivibrator and conventional electronics components reached.
- ❖ Integrated security tag with EC-display, battery and switch button.
- ❖ Spin-off "Pakutronic" transferred in company saralon with six employees and first customised products.
- ❖ Integration of inline inspection system in R2R printing machine.
- ❖ Optical analyzing of defect positions in ground metal electrode.
- ❖ New 3PV solar cell layout (8 stripes, 4V) for HMI2015 is working.
- ❖ First connection technologies for full printing integration of demonstrator investigated.

#### Publications:

- ❖ Investigation of the degradation mechanisms of a variety of organic photovoltaic devices by combination of imaging techniques—the ISOS-3 inter-laboratory collaboration, Energy Environ. Sci., 2012, 5, 6521-6540
- ❖ Prof. Dr. Arved C. Hübler: Printed Solar Cells on Paper - Alternatives for the future, Bio Electronics 2014, Kirchberg/Kitzbühel, Austria
- ❖ Moazzam Ali, Deep Prakash, Tino Zillger, Pradeep Kumar Singh, and Arved Carl Hübler: Printed Piezoelectric Energy Harvesting Device. Advanced Energy Materials (2013)

#### General public relation activities:

- ❖ Roadshow "The DWIH New Delhi – Excellence on Tour!", New Delhi, India, 2013/2014

- ❖ Meeting „Opportunities and Innovation in Electronics and IT“, Dresden, September 2014
- ❖ Elektronik auf Papier (engineering people #8 2014) PMTUC 24.11.14
- ❖ Preparation of Industriemesse Hannover, April 2015

Another result of the project is the foundation of the company SARALON. It is a spin-off from the pmTUC. SARALON works on the development of electrochromic displays, circuitries and batteries by using conventional printing machines. With this strategy electronics can be produced in a simple and cost-effective way.





## Flexible Printed Integrated Disposable Electronics (FLEXIPRIDE)

### Objective of the Project

The aim of this project is to combine the different printed electronic elements into a single functioning device. Existing Roll to Roll mass printing processes of Gravure and Flexography which are used for printing of labels, packages, plastic bags etc will be investigated and optimized for printing electronic elements. This will open up a whole new field of applications using different printed electronic components. This project aims at delivering a prototype for a security label which can be placed on a package.



Fig 1. Example of one area of application for a printed label as a security seal

### Task of each partner

**pmTUC** – The objective of this project is to optimize the paper printed solar cell to achieve higher efficiencies and to improve the lifetime of the cells by encapsulating or laminating it with a protective coating against UV radiation, water vapor and oxygen.

**Chromasens** - will take up the task of development of an inline system to inspect and control the quality of roll-to-roll printed functional layers and printed electronic devices. The inline system will detect structural defects and inhomogeneity in layer thickness by optical methods.

**IIT Kanpur** - Simulation of the paper printed solar cell from the pmTUC to evaluate the performance and suggest improvements in parameters like layer thickness, roughness and material properties for further improvement in the efficiency and to increase power output of the 3PV cells

**Anil Printers** – Anil printers with its expertise in Radio Frequency Identification Tags (RFID) will look into the printing of antennas for RFID tags by using inexpensive conductive inks. Antenna parameters like Antenna design, conductivity of the printed layers and Q value will be tested optimized.

### Partner collaboration

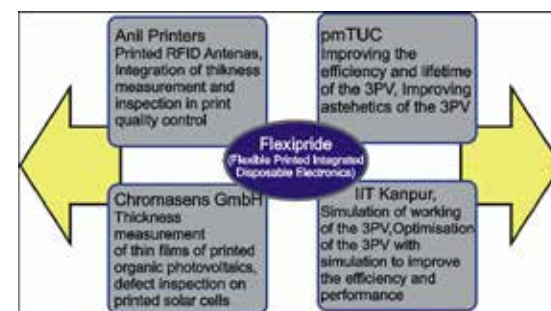


Fig 2. The collaboration between the partners and their work areas.

### Partners

4 Partners - 2 Academic and 2 Industry partners

TU Chemnitz, Germany (Co-ordinator)



Chromasens GmbH, Germany



IIT Kanpur, India,



Anil Printers, India



Project supported by the



Project Duration : 01.08.2012 - 31.07.2015

**Institute for Print and Media Technology  
at Chemnitz University of Technology [pmTUC]**

Institute for Print and Media Technology at Chemnitz University of Technology [pmTUC]  
Reichenhainer Straße 70 09126 Chemnitz, Germany Tel.: +49-(0)371-531 236 00  
Fax: +49-(0)371-531 236 19 Email: pminfo@mb.tu-chemnitz.de www.pm.tu-chemnitz.de/pm



## Resource and energy reliability by co-digestion of veg-market and slaughterhouse waste



### The Project

The project objectives are to demonstrate the feasibility of sustainable resource and energy reliability by co-digestion of veg-market and slaughterhouse waste in India and its potential for global realization. In a pilot project conducted in Chennai, Tamil Nadu, India on the premises of an existing biogas plant currently operated by the project partner RamkyEnviro Engineers Ltd. and in close vicinity to the Koyambedu Wholesale Market Complex, the German and Indian partners apply their common developed innovative approach with the following deliverables:

- ❖ Demonstration of the feasibility of recovery of bioenergy from slaughterhouse waste, fruit- and vegetable market waste and other organic wastes in urban areas in a sustainable way
- ❖ Integration of advanced anaerobic processes in the

economic, social and natural environment in context to India

- ❖ Establishment of a sustainable supply chain for the generation of energy through anaerobic treatment of slaughterhouse waste, fruit- and vegmarket waste and other organic wastes generated in Chennai City as substrates.
- ❖ Avoiding emission of Methane into environment by reducing the disposal of organic wastes in open dumps and also reducing the odour nuisance and other land and water pollution.
- ❖ Contribution to local energy supply through generation of bioenergy and also generation of bio-fertilisers/soil conditioner with rich nutrient contents (N, P, K) thus making this energy recovery as sustainable with generation of additional income.



Fig 1: Project Partners visiting a vegetable market for inspecting waste created



## Project Investigators Partnering Institutions



**S V Srinivasan**  
CSIR - CLRI  
Chennai

**Dirk Weichgrebe**  
Gottfried Wilhelm Leibniz Univ  
Hannover



**M Goutham Reddy**  
Ramky Enviro Engineers Ltd.  
Chennai

**Titus Lehmann**  
Lehmann - UMT GmbH  
Pöhl



- ❖ Establishment of employment opportunities, both at the biogas plant as well as along the supply and product chain
- ❖ Supporting German companies in accessing the Indian market
- ❖ Economic assessment and construction of a prototype system
- ❖ Training of qualified staffs for operation and concepts for vocational training

A joint study is conducted with various combinations for co-digestion of wastes from slaughterhouses and fruit- and veg-markets and, if available and required, supplemented by other organic wastes from hotels, food industry, etc. The investigation is performed by laboratory scale tests at CLRI accompanied by ISAH. Suitable combinations of substrate as well as available state-of-the-art technologies are evaluated and used as a data basis for the design of an adapted pilot plant. The pilot plant will include biogas production and the bio-extrusion process, which increases the bioavailability due to cell disruption by means of bio-extrusion(patented technology by LEHMANN-UMT).

Furthermore an objective is to evaluate the possibility of processing the produced digestate to fuel or fertilizer. The digestate residuals, which are produced in large amounts by high loading rates, can be dewatered with the LEHMANN-UMT solid separator (bio-extrusion system) and used directly as fertilizer or pelletized to renewable fuel.

Within this project, the project partners are ensuring a close knowledge transfer for the operational personnel during the pilot scale study. Sustainability assessment of the process and the marketable product qualities using Life Cycle Assessment (LCA) as well as carbon footprints investigations are carried out alongside the value added chain. Sustainable ways for biogas and digestate utilization are investigated. Herewith material and energy flows are optimized, as well as biogas upgrading and usage efficiency. To ensure the acceptance of this project among various stakeholders, and to confirm the exemplarity of this project, capacity building by demonstration workshops/ training programme is organised. The first meeting of all the project partners are being planned during the first week of May, 2016. ●



Fig 2: Biogas production tests in batch reactor



## Current Scenario



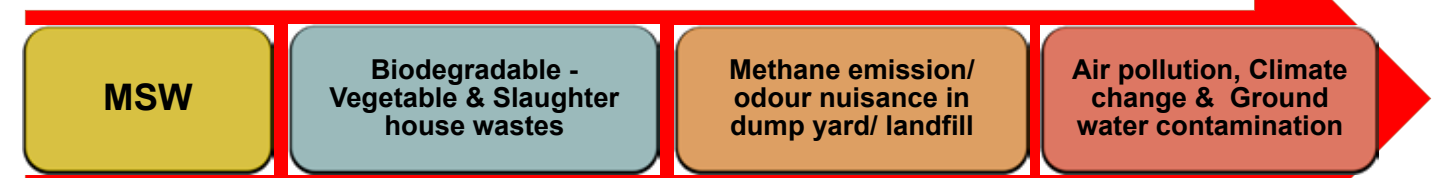
Urbanization



Municipal Solid Waste (MSW)



Current disposal



**Urgent need for treatment of organic fractions of MSW  
(Vegetable market and slaughter house wastes)**

## Objectives

- Bilateral standardization of BMP evaluation methods (lab scale studies)
- Co-digestion of vegetable market, slaughter house and food wastes from canteens and hotels
- Design and implementation of pilot scale treatment at Chennai with innovative pre-treatment (bio-extrusion) at onsite circumstances
- Generation, purification and bottling of Biogas
- Potential utilization of digestate as nutrient
- Sustainability assessment of the process using LCA approach

## Expected outcome

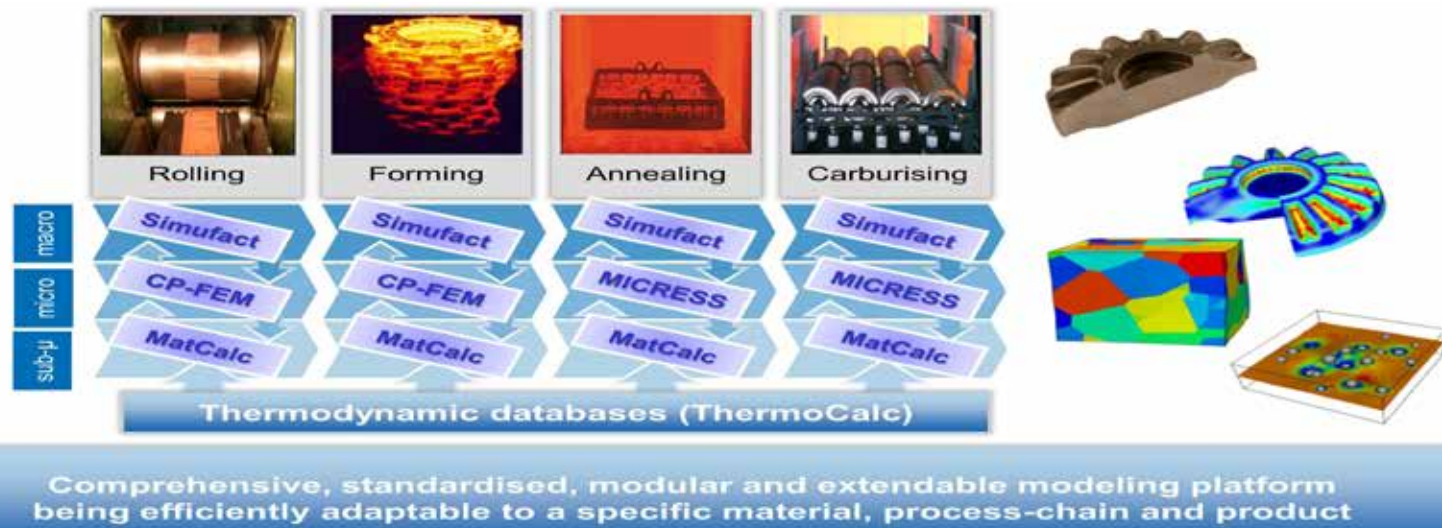
- Address the growing energy demand and MSW treatment and disposal issues in India
- Identifies suitable substrate combinations for anaerobic co-digestion of slaughter house waste with veg-/fruit-market wastes in lab & pilot-scale
- Adaptation of appropriate German technology for sustainable energy production by co-digestion to Indian conditions with enhancement of biogas yield through pre-treatment with bio-extrusion
- Biogas upgrading technology for effective mobility and affordable utilisation
- To recover valuable products from the digested waste as nutrient rich bio-fertilizer
- Sustainability assessment by LCA
- Model concept for sustainable MSW management for Co-digestion of slaughterhouse and veg-market/other waste in India

**Sustainable option  
for  
Smart Cities**





## Combined process and alloy design of a micro-alloyed DP forging steel based on integrative computational materials engineering

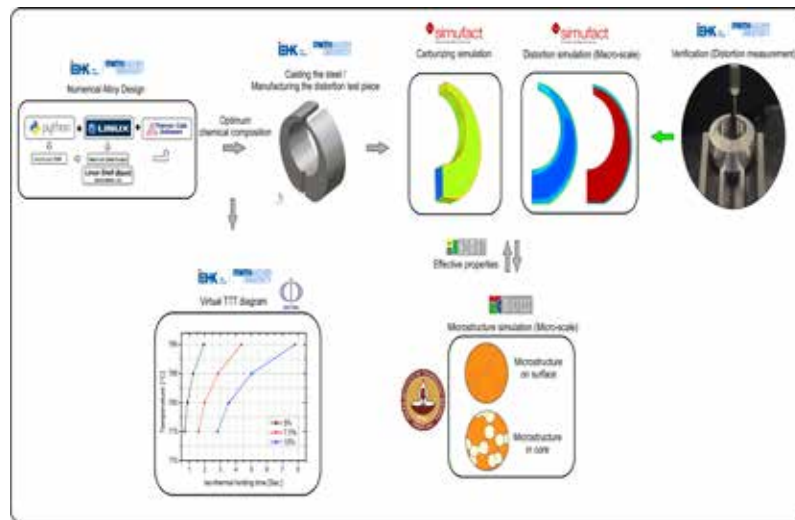


### The Project

Because machinability is important simultaneously with strength in gears used in the transmissions and suspensions of automobiles and construction equipment, the majority of gears used in these applications are manufactured by a process of forging and machining followed by surface hardening by carburization, using case hardening steels. In recent years, higher strength in these gears has been strongly desired from the viewpoints of weight reduction and downsizing. In automotive applications, heat-treatment distortion of gears has also become a problem due to demand for reduced noise. This project aims at the development of an energetic production of forged gears with dual phase microstructure leading to reduced distortion.

#### The main goals of the project were:

- ❖ Numerical design of alloy composition
- ❖ Experiments on thermomechanical process simulation
- ❖ Microstructural phase and grain size characterization
- ❖ Precipitation characterization
- ❖ Precipitation modelling on Nano scale during hot forming



- ❖ Microstructure evolution modelling during thermomechanical processing
- ❖ Microstructure transformation modelling during cooling
- ❖ Model implementation and parallelization
- ❖ Link of models
- ❖ Multi scale modelling of hot forming process chain
- ❖ Benchmark and validation trials
- ❖ Management and reporting

### Project Investigators Partnering Institutions



Gandham Phanikumar  
IIT Madras  
Chennai



B P Gautham  
Tata Consultancy Services  
Pune



Ulrich Prah  
RWTH Aachen University  
Aachen



Ralph Bernhard  
Simufact Engineering GmbH  
Hamburg

### Progress Achieved

Design of alloy composition completed; Identification of model data/ all tools have been started.

- ❖ **Carburization experiment/simulation-** Vacuum carburizing has been gaining importance as a modern, environmentally-friendly and cost-effective method of surface hardening in the global machinery, automobile and aviation industry. The carburizing carrier gas is Acetylene ( $C_2H_2$ ) and high pressure Nitrogen gas ( $N_2$ ) is used as quenching medium. In order to simulate the carburization process, a series of boost-diffusion simulations have been conducted by means of a programmed Python code as an interface and DICTRA software package.

- ❖ **Microstructural design towards reduced distortion-** Usually, the final microstructure of the carburized and quenched components is comprised of almost Martensite plus Bainite. In the context of this project it has been proved that the evolution of ferrite can lead to a reduced heat-treatment distortion of the specimens which is an unavoidable phenomenon accompanied with hardened components. The microstructural evolution of the carburized specimens has been predicted through MICRESS®. A set of parametric study has been conducted by varying the carbon

composition, so that the effect of the phase transformation on microstructure at various distances across the sample can be captured

- ❖ **Simulation of the distortion in Macro-scale-** According to the experimentally obtained results, the carbon diffusion module has been successfully developed in Simufact. Further, the influence of

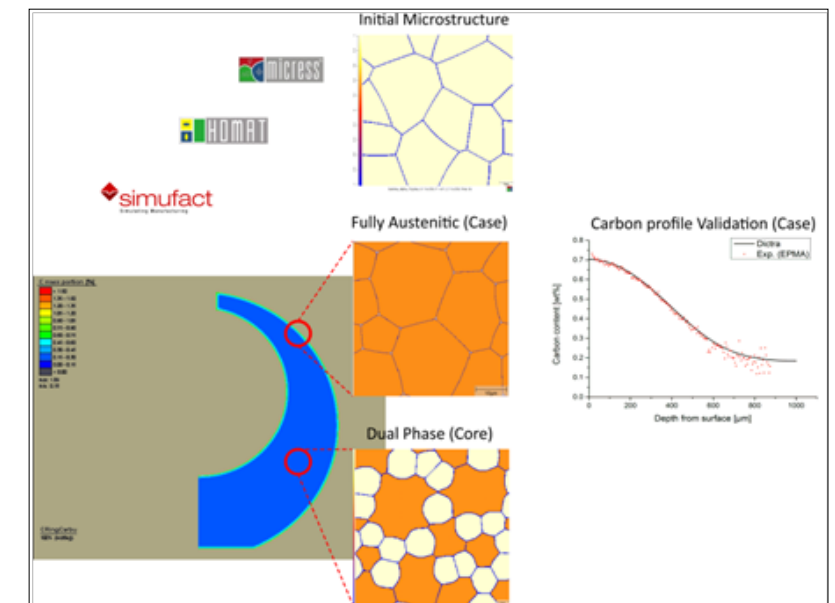


Figure 1. Microstructural evolution of the carburized component during cooling to hardening temperature

the enriched carbon layer on the subsequent phase transformation has been simulated and the effect of internal microstructure on the heat treatment-induced distortion has been demonstrated. ●







TATA  
CONSULTANCY SERVICES  
Experience century

## Combined Process and Alloy Design of a Micro-alloyed DP Forging Steel based on Integrative Computational Materials Engineering (DP-Forge)



simufact  
Enabling Manufacturing

### Introduction

**Objective:** ICME approach for the design of a microalloyed dual phase gear

- Goals:
- Develop an ICME based simulation platform for design of gear material and processes
  - Linking relevant simulation tools along the process chain & across the length scales
  - Identification of parameters for all relevant models by means of tailored experiments
  - Validation of the ICME platform concept by design of a new dual phase steel for forged and carburised gears with the potential of reduced distortion
  - Validation of this new combined steel and carburising concept on laboratory scale



ICME approach-link across and along process chain  
[Ref: Schmitz, G. and Prah, U., 2012, ICME: Concepts and Applications of a Modular Simulation Platform]

Core and Case of a gear

### Numerical Alloy Design

Selection of chemical composition with criteria

- Dual phase steel in core & martensite in case
- With highest  $\Delta T$  (between  $A_{e3}$  and  $A_{cm}$ )
- Good Hardenability

| Chemical Composition (mass%) | C    | Si   | Mn   | Cr   | Mo   | Ni    | Al    | N |
|------------------------------|------|------|------|------|------|-------|-------|---|
| Steel                        | 0.18 | 0.46 | 0.75 | 0.30 | 0.10 | 0.002 | 0.007 |   |



Role of silicon in shifting the curves up & left  
[Ref: Kazuaki et al., JFE 23 (2009), 24-29]

Image Courtesy: IEHK

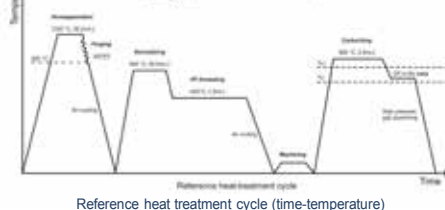
### Heat Treatment Cycle

- Heat treatment cycle for forged & carburized gear
- Carburization depth targets: 0.3-0.5 mm
- Surface hardness targets: 57-63 HRC (C=0.7%)
- Modified Navy C Ring sample for macro scale experiments



Modified Navy C Ring sample

Vacuum furnace

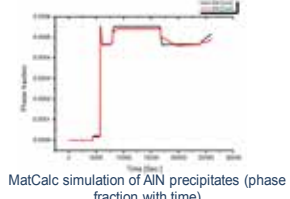


Reference heat treatment cycle (time-temperature)

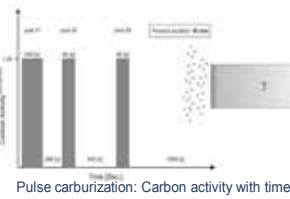
Image Courtesy: IEHK

### Simulations and Experiments at Sub-micro Scale

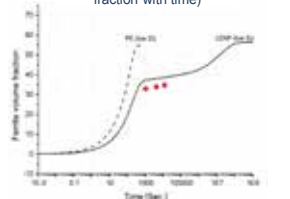
- MatCalc simulation to study the evolution of Aluminium Nitride(AIN) precipitates
- DICTRA based simulations for diffusion and phase transformation
  - Volume fraction of ferrite with time during inter-critical annealing at 775°C
  - Carbon content with depth during pulse carburizing at 950°C
- Experiments: dilatometry and EPMA
- LENP(Local Equilibrium Negligible Partitioning) aligns closely with experimental results



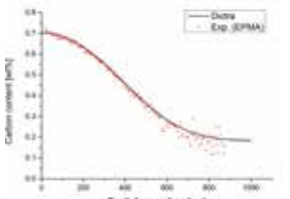
MatCalc simulation of AIN precipitates (phase fraction with time)



Pulse carburization: Carbon activity with time



Volume fraction of ferrite with time during inter-critical annealing at 775 °C: DICTRA and Dilatometry trials



Pulse carburization at 950 °C: Carbon content with depth from surface

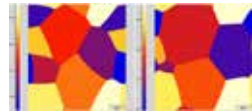
Image Courtesy: IEHK

### Microstructure Evolution

- Multi-Phase Field Modeling of microstructure evolution performed using Micress
- $\gamma - \alpha$  transformation during inter-critical annealing at 775°C simulated using Micress
- Microstructure(volume fraction of ferrite) studied across length from core to case
- Grain growth during carburization at 950°C simulated in Micress



Initial microstructure using voronoi tessellation and final micro-structure after annealing at 775 °C  
(Image courtesy: IEHK)



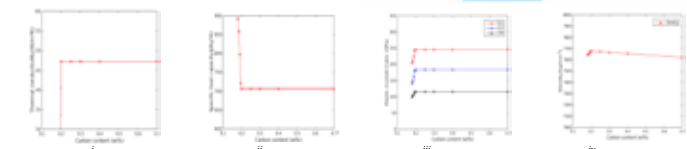
Grain growth at core during carburization at 950 °C for 2 hours



Microstructure(volume fraction of ferrite) from core to case: starting stage of inter-critical annealing at 775 °C.  
i. C=0.18% ii. C=0.195% iii. C=0.197% iv. C=0.198%  
Image Courtesy:MME

### Effective Properties with Homogenization

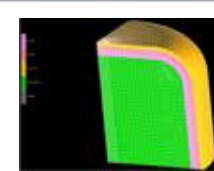
- Effective properties of simulated microstructure(RVE) using Asymptotic Homogenization in HOMAT
- Thermo-elastic properties generated using HOMAT
- Flow curves to be obtained using Abaqus and Gleeble trials



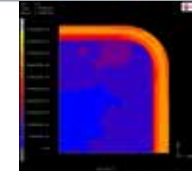
Effective properties from core to case at start of inter-critical annealing:  
i. Thermal conductivity ii. Specific heat capacity iii. Elastic moduli iv. Density

Image Courtesy:MME

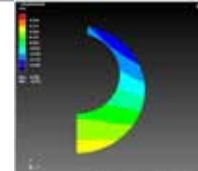
### Macroscale Simulation Trials in Simufact



Dummy model with the initial distribution of C-atoms



Residual stresses after hardening (von Mises)



Distortion in a C Ring sample  
Image Courtesy: Simufact

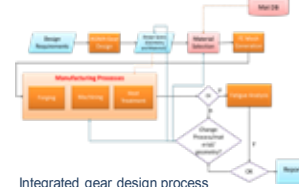
### ICME Platform: TCS-PREMAP

**Platform for Realization of Engineering Materials and Products(PREMAP)**

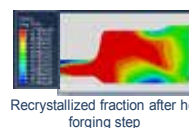
Use of TCS PREMAP for integration of simulation tools and execution of simulation workflows for ICME based development



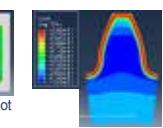
TCS PREMAP platform interface



Integrated gear design process



Recrystallized fraction after hot forging step



Martensite fraction distribution after heat treatment



Integrated gear design process workflow realized on TCS PREMAP platform

Image Courtesy: TRDDC(TCS)

## Visualization of automated multi-sensor NDT assessment of concrete structures



Source : Project Archives

### The Project

The regular inspection of concrete structures is necessary to assess their condition and get data to serve as a base for planning maintenance and repair. Concrete inspection for structure (damages) and material properties (deterioration) is not possible with a single method approach. Effects of deterioration processes and structural changes are non-uniform in nature and must be addressed by a multi-method approach. Robot and scanner systems have facilitated the collection of high quality multi-sensory

data. Nevertheless, individual sensor data is often independently analyzed and compared against the data from other sensors at decision level. Thus, the potential of multi-sensory information is typically not fully realized. Fusing multi-sensory data can close this gap and pave the way for automated evaluation of multimodal data sets. Honeycombing defects (Honeycombs are porous volumes of coarse grain aggregates bonded together by cement) are formed when the fresh concrete ingredients segregate and also due to poor workmanship. Detection

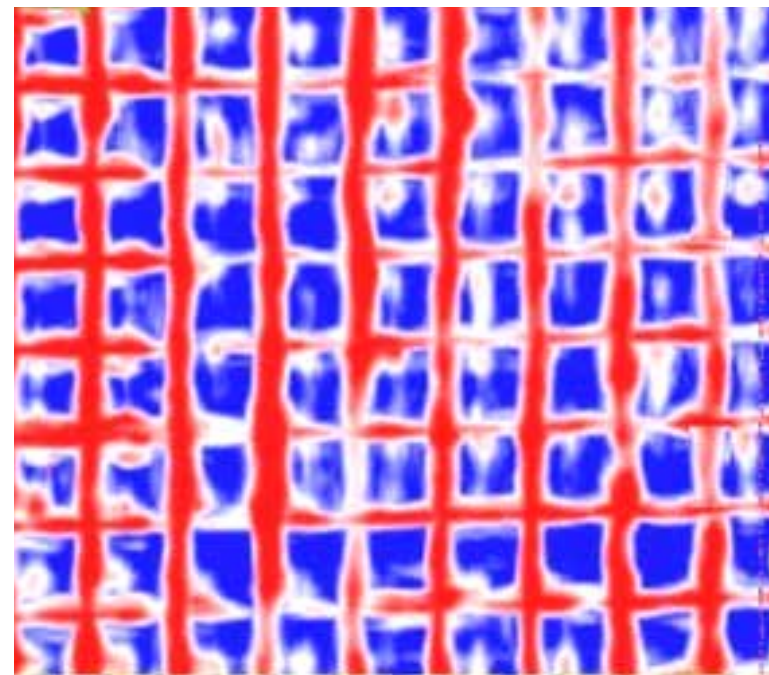
and characterization of honeycombs is a challenging inspection task due to their strong variability in size, shape, position, orientation and density. Moreover, unlike voids of the comparable size, honeycombs introduce a gradual and volumetrically distributed change in material properties

The main goals of the project were:

- To develop and Implement automated scanner system for data collection using multi-sensor (Ground Penetrating Radar(GPR), Ultrasonic Pulse Echo (UPE), and Impact Echo (IE)).

- Development of software tool for visualization of data using data fusion technique by combining radar, ultrasonic pulse echo and impact echo.

- Evaluation of various inclusions, defects, thickness and voids in concrete structures using multi-sensor techniques.



Top Reinforcements obtained with radar

NDT-DATA-FUSION



## Project Investigators Partnering Institutions



**P. Srinivasan**  
CSIR-SERC  
Chennai

**Thomas Kind**  
BAM  
Berlin



**Krishna Mohan Reddy**  
Lucid Software Limited  
Chennai



**Andre Molkenstein**  
Specht, Kalleja + Partner GmbH  
Berlin

## Progress Achieved

A systematic approach for fusion of multi-sensory nondestructive testing (NDT) data was developed to improve the detectability of honeycombs by fusing the information from the three different sensors. A prototype (demonstrator) was developed at BAM (GER) and was delivered to CSIR-SERC (IND). Tests in laboratory and preliminary field tests were carried out with this demonstrator. Data was collected on a number of large scale concrete specimens containing distinct built-in honeycombing defects and varying thickness. The description of the concept for software integration and outline of the visualization concept has just begun. A description of the technology, which enables the scanner to move in its foreseen grid and schedule, has already been made. The system is able to acquire data from commercially available sensors. The collected data is display to the operator immediately. Data Processing (filtering, noise removal etc.) has been implemented for UPE and GPR data. Fig. 1 shows the data collection using automated scanner with radar and UPE on a large concrete slab containing different sizes of honeycombs with two layers of reinforcement mesh. Field tests under consideration of typical practical problems were performed in diaphragm walls and parking garages. The evaluation of the performance of the approach will be conducted as soon as the experimental investigations are completely evaluated.

The automated scanner has been erected on the vertical face of a concrete wall in the laboratory using suction feet and trial runs were performed. Measurements are being planned on a large scale I-girder beam of 20 m span as part of the field studies. Investigations for the nondestructive testing of pitting corrosion have been initiated. The schedule for this experiment includes multi sensor reference measurements in the beginning. Afterwards the chloride is induced to the concrete and pitting corrosion is initiated on pre-defined locations. Afterwards new features indicating pitting corrosion are to be found. Corrosion data in field was already collected and will be evaluated after the laboratory investigations are completed.

## Publications:

- ❖ P. Srinivasan, & S.G.N. Murthy, "State of the art in the automated scanning of NDT in concrete" CSIR-SERC Research Report No. R & D -02 CLP-004-RR-01, December 2013
- ❖ P. Srinivasan, & S.G.N. Murthy, "Evaluation of voids and reinforcement in thick concrete slabs using radar and ultrasonic pulse echo", CSIR-SERC Research Report No. R&D-02 CLP-0041, May 2014
- ❖ C.Völker and P.Shokouhi, "Multi sensor data fusion approach for automatic Honeycomb detection in concrete," NDT&E, Vol. no.71, pp .54-60, April 2015.
- ❖ P. Srinivasan, D. Ramakrishnan, S. Maruthi, "Determination of spacing and radius of rebar in concrete specimen", CSIR-SERC Research Report No. R&D-03, CLP-0041, May 2015
- ❖ C. Völker and P.Shokouhi, "Clustering Based Multi sensor data fusion for Honeycomb detection in concrete", Journal of NDE, 01/2016; 34(4):34:32 1-10, September 2015.
- ❖ P. Srinivasan, S.G.N Murthy, D. Ramakrishnan and K. Vasanth, "Evaluation of Thickness and Defects in Diaphragm Walls Using Impact Echo", International Journal of Applied Engineering Research (IJAER), Volume 10, Number 62(2015), Special Issues, pp.428-430.
- ❖ P. Srinivasan, S.G.N Murthy, D. Ramakrishnan and K. Vasanth, "Evaluation of Thickness and Defects in Diaphragm Walls Using Impact Echo", International Journal of Applied Engineering Research (IJAER), Volume 10, Number 62(2015), Special Issues, pp.428-430.
- ❖ Visualization of automated multi-sensor NDT assessment of concrete structures (NDT Data Fusion) - Poster presented at the IGSTC Annual Event, 2016. ●



# VISUALIZATION OF AUTOMATED MULTI-SENSOR NDT ASSESSMENT OF CONCRETE STRUCTURES (NDT DATA FUSION)



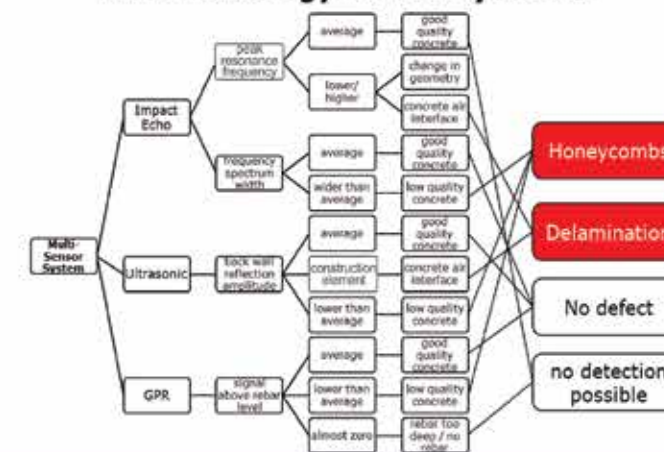
## The project :

- Regular inspection of concrete structures is necessary to assess their condition and to get data to serve as a base for planning maintenance and repair.
- Concrete inspection for structure (damages) and material properties (deterioration) is not possible with a single method approach.
- Effects of deterioration processes and structural changes are non-uniform in nature and must be addressed by a multi-method approach.

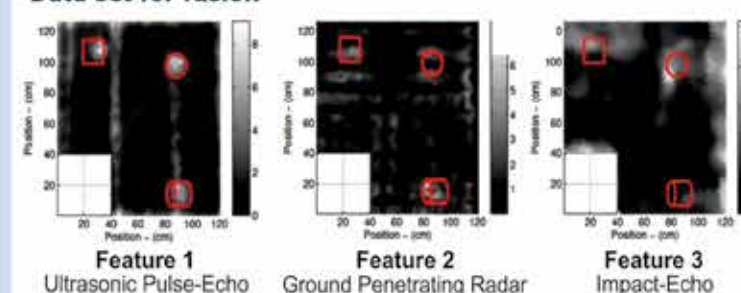
## Project goals:

- Development and implementation of automated scanner system for multi sensor data collection
- Development of software tool for visualization using data fusion techniques
- Validation at laboratory level and application in field investigations

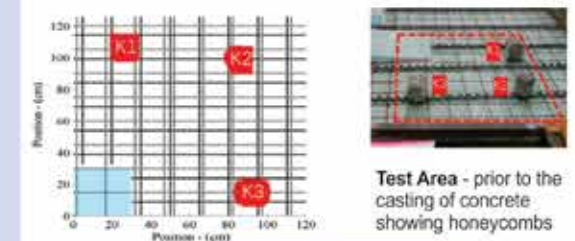
## Fusion strategy for honeycombs



## Data set for fusion

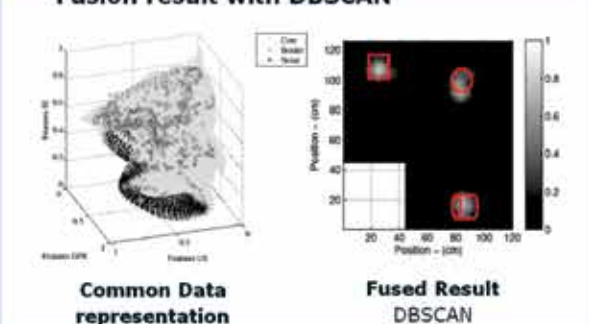


## Laboratory Investigations



Field measurement using Automatic Scanner

## Fusion result with DBSCAN



## Progress achieved:

- Automatic scanner able to acquire data from commercially available sensors was developed at BAM (GERMANY) and installed at CSIR-SERC (INDIA). Data Processing (filtering, noise removal etc.) has been implemented
- Different voids (honeycombs and pitting corrosion) have been addressed in laboratory investigations
- Field tests under consideration of typical practical problems were performed in parking garages, diaphragm walls etc.
- Part of the work has been published in NDT&E International, Journal of Nondestructive Evaluation, International Journal of Forensic Engineering, International Journal of Applied Engineering Research and in conferences.

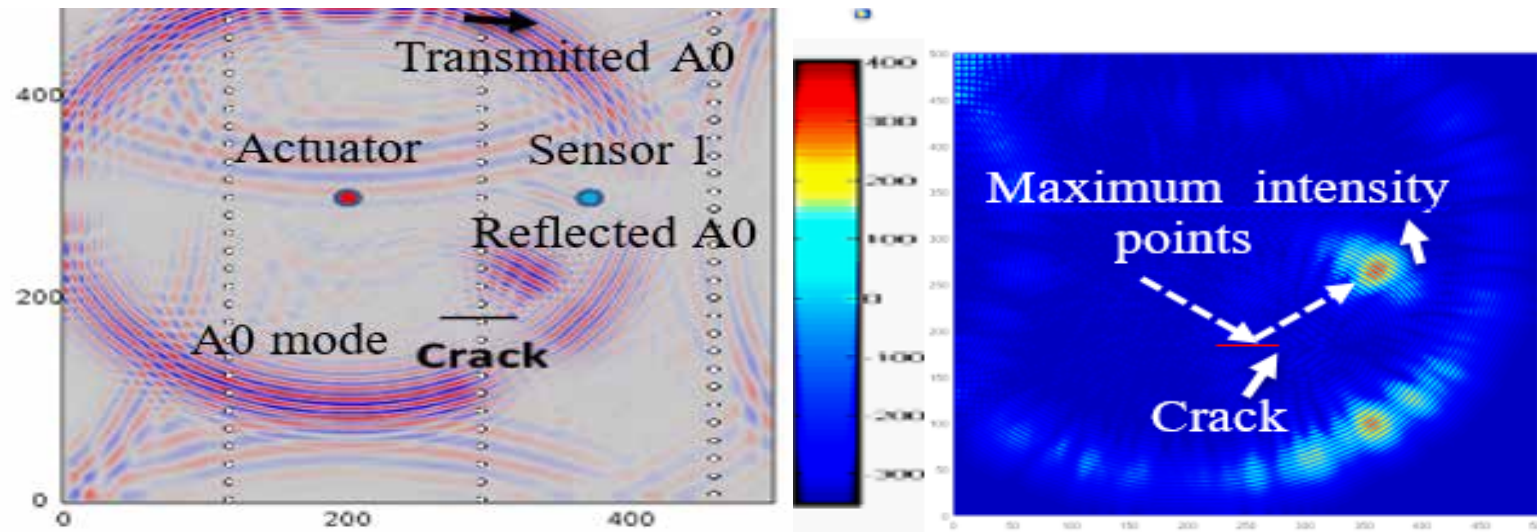
## References :

- C. Völker, P. Shokouhi, "Multi sensor data fusion approach for automatic Honeycomb detection in concrete", NDT&E int. 71, 54-60 (2015).
- C. Völker, P. Shokouhi, "Clustering based multi sensor data fusion for honeycomb detection in concrete", Journal of Nondestructive Evaluation 34, 34:32 1-10 (2016).
- P. Srinivasan, K. Ravisankar, S. Thirugnanasambandam, "Forensic evaluation of a large reinforced concrete specimen using radar and ultrasonic pulse echo", International Journal of Engineering, USA, Volume 1, No. 3/4, pp.198 - 208 (2013).
- Srinivasan, P. Murthy S.G.N, Ramakrishnan, D, Vasanth, K. "Evaluation of Thickness and defects in diaphragm walls using Impact Echo", International journal of Applied Engineering Research, Volume 10, Number 62, Special Issues, pp.428-430 (2015).
- Srinivasan, P. Murthy S.G.N, Ramakrishnan, D, Vasanth, K. "Evaluation of Diaphragm walls With Ultrasonic Pulse Echo and Impact Echo - A Case Study".
- Srinivasan, P. Murthy S.G.N, Ramakrishnan, D, Wiggenshauser, H. "Rapid NDT Assessment of Concrete Structures using Multi-sensor".





## Integration of non-destructive evaluation based ultrasonic simulation



### The Project

A means to optimize structural design and specifically the structural health monitoring (SHM) systems associated to those is achieved by simulation. Many of the simulation tools and algorithms for SHM have been developed at disparate locations and for specific applications. The wide field of SHM encompassing subjects such as materials, structures, fatigue and fracture, physical principles of non-destructive testing (NDT), and possibly much more requires a thorough configuration of networked simulation tools and algorithms leading to something being considered as an open platform for SHM systems simulation and configuration. The main objective of INDEUS is therefore to:

- ❖ establish a simulation platform in non-destructive evaluation (NDE) with an emphasis on SHM;
- ❖ facilitate the understanding of physical parameters travelling through arbitrary structures;
- ❖ identify an optimum transducer configuration for structures to become self-monitoring in the sense of SHM.

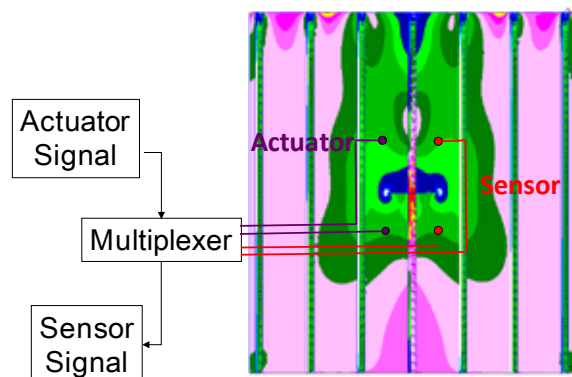


Fig. 1: Principle of a SHM system presented on the simulation result of the damage probability in a stiffened panel of an aircraft fuselage

### Progress Achieved

- ❖ A simulation platform developed by integrating simulation data across various existing tools and analyzing the data through an SHM simulation software developed.
- ❖ Ultrasonic wave based techniques for inspection of defects in structural components were simulated and the simulation results were validated with prototypic testing in India and Germany.
- ❖ NDE inspection of various types component was successfully simulated using the simulation platform and process.
- ❖ Probabilistic approach for damage growth simulation due to fatigue loading was incorporated in the simulation platform
- ❖ SHM sensor system consisting of a network of piezoelectric transmitters and receivers integrated on the structure was optimized with the help of probabilistic damage information from simulation and ultrasonic simulation data as guiding information.
- ❖ Inspection of a repaired structured with composite material patch was simulated and the test results were validated through testing of a prototype stiffened panel of aircraft fuselage skin.
- ❖ The overall outcome from the project is the simulation platform and the demonstrated processes that will help to create SHM based concept of designing structures and develop necessary process for realizing such concept in actual hardware to meet emerging application needs in aerospace and infrastructure health monitoring.

#### Publications:

- Integration of Non-Destructive Evaluation based

### Project Investigators Partnering Institutions



D Roy Mahapatra  
Indian Institute of Science  
Bangalore



Dwarakanath Krishnamurthy  
Tech Mahindra  
Bangalore



Christian Boller  
Universität des Saarlandes  
Saarbrücken



Rainer Franke  
Materialforschung und Anwendungstechnik GmbH  
Dresden

Ultrasonic Simulation (INDEUS) – A Means for Simulation in SHM, Christian Boller, D. Roy Mahapatra, Ramanan Sridaran Venkat, Nitin Balajee Ravi, Nibir Chakraborty, Rakesh Shivamurthy, Keerthy M. Simon, SHM Journal (under review) Dec 2016.

- A Study of Effectiveness of an SHM Sensor System for Fatigue Damage Inspection, Nitin B Ravi, Nibir Chakraborty, Mirko Steckel, Punith Betagiri, Padmanaban Raghuraman, Rakesh Shivamurthy, Ramanan S Venkat, D Roy Mahapatra, Christian Boller, 8th European Workshop on Structural Health Monitoring (EWSHM 2016), 5-8 July 2016, Bilbao, Spain.
- Simulation Based Optimization of Sensor Network for SHM of Complex Structures, Nitin B Ravi, Nibir Chakraborty, D Roy Mahapatra, 8th European



Fig. 2: Experimental validation of crack propagation under fatigue stress in stiffened panels of an aircraft fuselage

- Workshop on Structural Health Monitoring (EWSHM 2016), 5-8 July 2016, Bilbao, Spain.
- Ultrasonic Guided Wave Simulation Performance Evaluation for QNDE-SHM Processes Nitin B Ravi, Ramanan S Venkat, Nibir Chakraborty, D Roy Mahapatra, Christian Boller, 8th European Workshop on Structural Health Monitoring (EWSHM 2016), 5-8 July 2016, Bilbao, Spain.
- Integration of Non-Destructive Evaluation based Ultrasonic Simulation (INDEUS) A Means for Simulation in SHM, Christian Boller, D Roy Mahapatra, Ramanan S Venkat, Nitin B Ravi, Nibir Chakraborty, Peter Starke, Mirko Steckel, Dwarakanath Krishnamurthy, 8th European Workshop on Structural Health Monitoring (EWSHM 2016), 5-8 July 2016, Bilbao, Spain.
- Ultrasonic Guided Wave Sensor Network Optimization for Monitoring Rivet Line, Nitin B. Ravi, Nibir Chakraborty, D. Roy Mahapatra, 10th International Workshop on Structural Health Monitoring 2015 (IWSHM 2015), 1-3 September 2015, Stanford, USA
- Optimized Actuator/Sensor Combinations for Structural Health Monitoring: Simulation and Experimental Validation, 1-3 September 2015, Stanford, USA, C. Boller, N. B. Ravi, N. Chakraborty, G. S. Kamalakar, K. Ukirde and D. Roy Mahapatra, 10th International Workshop on Structural Health Monitoring 2015 (IWSHM 2015), 1-3 September 2015, Stanford, USA.
- Modeling ultrasonic NDE and guided-wave-based structural health monitoring, Nitin B Ravi, Vivek T Rathod, Nibir Chakraborty, D Roy Mahapatra, Ramanan Sridaran, Christian Boller, SPIE Smart Structures and Materials+ Nondestructive Evaluation and Health Monitoring, 2015, April 1, Proc. SPIE, 9437, Structural Health Monitoring and Inspection of Advanced Materials, Aerospace, and Civil Infrastructure 2015, 94371V.

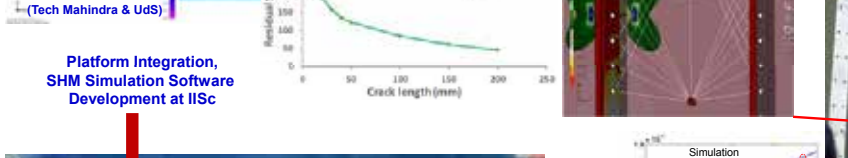
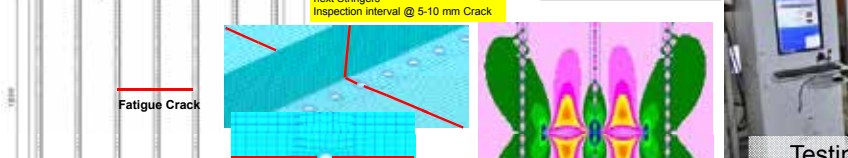
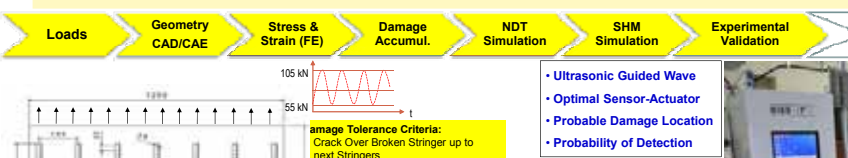
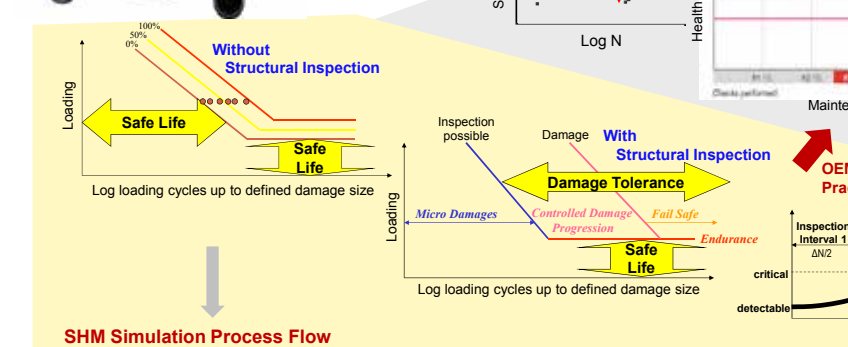


Tech  
Mahindra

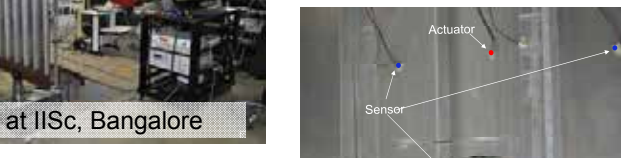
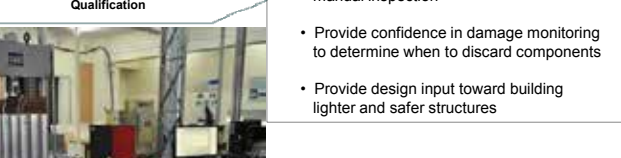
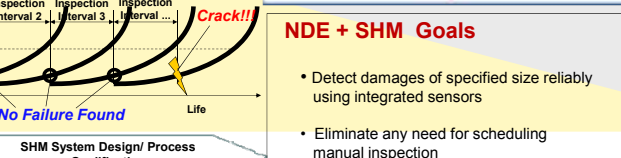
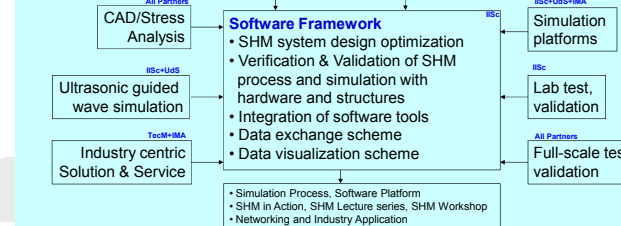




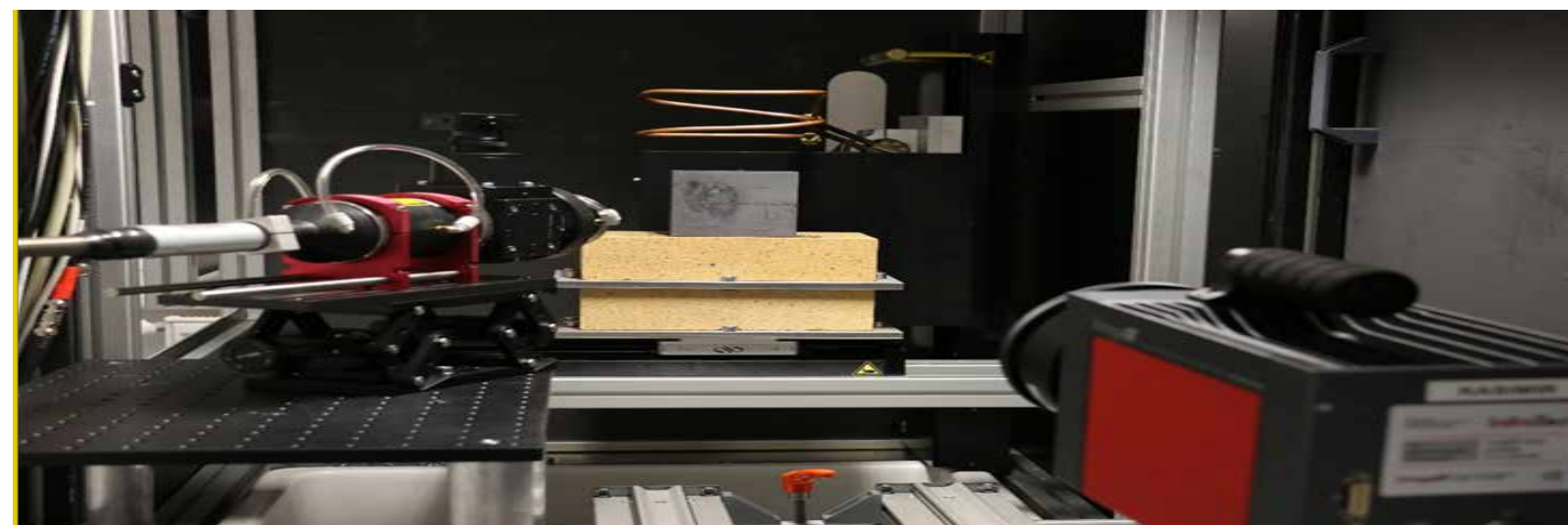
### Structural Failure and Damage Tolerance



### Project at a Glance



## Advanced manufacturing process monitoring using in-line laser thermography - AMPLAST



### The Project

The project will deliver new and improved NDE measurement methodologies capable of providing measurements of the state of the process and the product, under hostile manufacturing conditions, that would otherwise be impossible. The technique to be developed in this proposed project involves the novel complementary utilization of laser based excitation and the spatially and temporally resolved detection of the transient thermal flux radiation from regions of interest and to consequently obtain key material and process related parameters that pertain to the state of the manufacturing process/product. Some of the measured parameters include surface and sub-surface cracks, surface and sub-surface temperatures, anisotropy, surface hardness, etc. The work will eventually lead to the creation of new sensing methodologies for the in-situ measurement of parameters that critically influence the performance of the manufacturing process and the manufactured product. The development of advanced process measurement and monitoring technologies will lead to cost savings by reducing rejects during production, improving the quality of the products through improved real-time process control, and assist in the efforts of core industries to improve productivity by reducing downtime. Plant and product safety and reliability will improve as measurement resolution and reliability improves, with improved procedures becoming integrated into relevant standards.

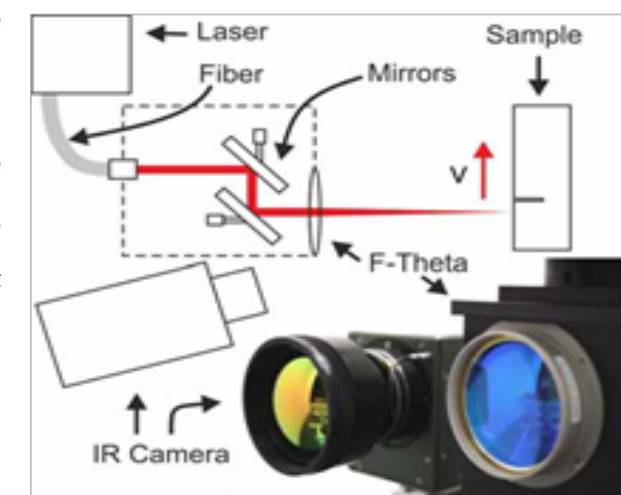


Fig. Experimental Schematic

AMPLAST



## Project Investigators Partnering Institutions



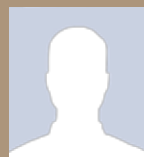
**Krishnan Balasubramaniam**  
IIT Madras  
Chennai



**C V Krishnamoorthy**  
IIT Madras  
Chennai



**Mathias Ziegler**  
BAM  
Berlin



**S Alavudeen**  
Dhvani Research and Development Solutions  
Pvt Ltd, Chennai



**Matthias Krauß**  
InfraTec GmbH  
Dresden

## Progress Achieved

- ❖ development of Laser-thermographic testing method for the detection of surface cracks at hostile environmental conditions as found in industrial steel production
- ❖ evaluation and characterization of the crack detection method
- ❖ optimization and characterization of the crack detection method
- ❖ optimization of the crack detection schemes (analysis algorithm, on-line capability)
- ❖ implementation of an on-site testing system; validation under industrial production environments (field study)
- ❖ development, validation and optimization of theoretical models and simulation themes for an enhanced understanding of the method
- ❖ development and evaluation of a Lab system allowing anisotropy measurements, accompanied by theoretical modelling and simulations for a validation of the experimental results
- ❖ Laser-thermographic testing setup was established and characterized allowing measurements under controlled conditions which match realistic production environments
- ❖ first experiments prove the general operability of the concept and allow preliminary estimations on performance and reliability
- ❖ algorithms for analyzing the acquired data were developed and tested
- ❖ FEM simulations were established for a comparison and evaluation of the experimental results
- ❖ a set of experimental data was acquired for a parametric evaluation of the method

## Any other relevant points:

- Honorable Minister at Ministry of Science and

Technology Dr. Harsh Vardhan visited BAM (Germany) and witnessed AMPLAST research in August 2016.

- Workshop + Project Meeting 21-22.6.2016 at BAM in Berlin; visit of company headquarter InfraTec GmbH in Dresden (Germany)

## Publications:

- U. Sreedhar, C. V. Krishnamurthy, K. Balasubramaniam. Heat diffusion in Polycrystalline Materials- A microstructure based material model: Quantitative Infrared Thermography Conference QIRT-Asia, Mahabalipuram, India, July 6-10, 2015.
- P. V. Nithin, U. Sreedhar, C. V. Krishnamurthy, M. Zeigler, P. Myrach and K. Balasubramaniam. In-line Laser Thermography for Crack Detection: A Numerical Approach: Quantitative Infrared Thermography Conference QIRT-Asia, Mahabalipuram, India, July 6-10, 2015.
- Nithin Puthiyaveetil, Sruthi Krishna, Renil Kidangan, Sreedhar Unnikrishnakurup, C V Krishnamurthy, Mathias Zeigler, Philipp Myrach and Krishnan Balasubramaniam. In-line laser thermography for crack detection at elevated temperature: A Numerical modeling study, Quantitative Infrared Thermography Conference QIRT Gdańsk, Poland, July 4-8, 2016
- Mathias Ziegler, Benjamin Polonski, Sreedhar Unnikrishnakurup, Nithin Puthiyaveetil, Krishnan Balasubramaniam, Philipp Myrach. Thermographic Crack Detection in Hot Steel Surfaces, 19th World Conference on Non-Destructive Testing (WCNDT 2016), Munich, Germany, 13-17 June 2016.
- Nithin Puthiyaveetil, Renil Kidangan, Sreedhar Unnikrishnakurup, C V Krishnamurthy, Mathias Zeigler, Philipp Myrach and Krishnan Balasubramaniam. In-line laser thermography for fast detection of defects at elevated temperature, Non-Destructive Evaluation 2016, Thiruvananthapuram, India, Dec 15th to 17th 2016. ●



# Advanced Manufacturing Process Monitoring using in-line Laser Thermography (AMPLAST)



## MAIN GOAL OF AMPLAST

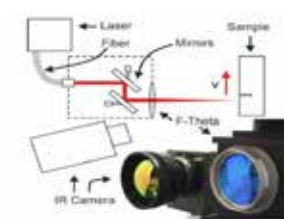
**CREATE** quantitative, rapid, and non-destructive laser thermographic testing techniques **FOR** in-line manufacturing process monitoring that can withstand difficult processing environments **AND** allow for reliable measurements adding value to industries

## MOTIVATION FOR MAIN OBJECTIVE

- Manufacturing industries (primary and secondary stages) require process monitoring through measurement of critical product (materials) parameters
- Such measurements must be quantitative and are required to be performed at appropriate stages of manufacturing in order to reduce waste and to improve performance and production rates
- The measurements must be NON-INTRUSIVE, NON-CONTACT AND NON-DESTRUCTIVE and must be able to handle the speed of production
- The measurements must be tolerant to the hostile processing environment
- Capable for Defect detection, product + material properties determination, Application of different material system

## PROCESS CAPABILITY OF LASER THERMOGRAPHY

## CRACK DETECTION



- Surface scan with high-power laser beam
- Simultaneous detection of temperature inhomogeneity pointing towards the presence of surface breaking cracks
- Sensitivity is comparable to standard magnetic particle and dye penetration testing (performed off line and in contact)
- Non-contact & online/inline capabilities

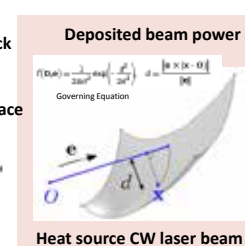
## RESEARCH PLAN - MAJOR STRUCTURE

- WP 1: Study 1 - Detection of surface cracks in steel billets in hot
- WP 2: Study 2 - Anisotropy of Rolled Steel Sheets
- WP 3: Study 3 - Temperature measurements during heat treatment in Furnace
- WP 4: Implementation of the user friendly software system

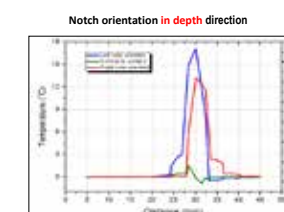
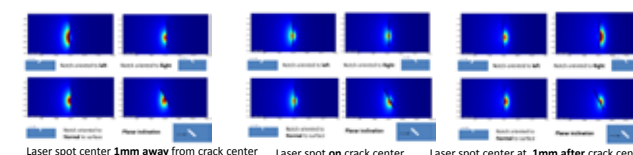
## WP 1: DETECTION OF SURFACE CRACKS IN STEEL BILLETS IN HOT CONDITION

## 3D MODELING : EFFECT OF CRACK ORIENTATION IN CRACK DETECTION

- Model created in Comsol Multiphysics 5.1
- A notch is introduced perpendicular to the block surface
- Block material is Stainless steel
- A laser spot is used to scan over the metal surface
- Physics Used : Heat transfer in solids
- Heat conduction equation  $\nabla \cdot (k \nabla T) + \rho C_p \frac{\partial T}{\partial t} = q$  where  $q = \frac{P}{A}$
- Initial surface temperature: 300K

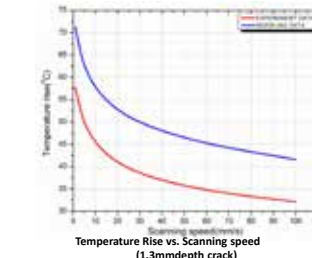


## HEAT DISTRIBUTION PATTERN NEAR TO THE CRACK

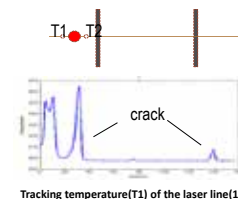


- Heat retentivity is more when the notch is oriented towards the scanning direction.
- There is a marginal variation in temperature rise in the case of inclined cracks compared to normal

## EXPERIMENTAL VALIDATION



- A Laser beam is used to scan over the Cracks having different crack depths
- 10W laser Power is used
- Various Scanning speed 1,10,100 mm/s
- Uncoated ST37 steel having emissivity 0.3
- Noted the temperature distribution along the laser path



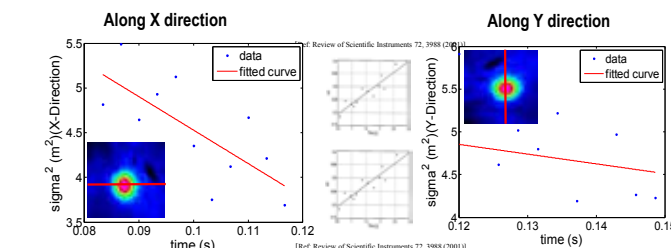
Both simulation and experimental data giving almost comparable results, there is some variation in temperature rise mainly due to the emissivity variation

## WP 2: ANISOTROPY OF ROLLED STEEL SHEETS

## THERMAL DIFFUSIVITY MEASUREMENTS

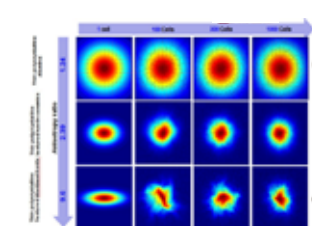


- Spatially Resolved method
- It is for in-plane thermal diffusivity measurement
- A sample of thickness L is heated using a Gaussian pulse
- The angular coefficient of the straight line describing the Gaussian widening as
- A function of time is eight times the thermal diffusivity of the material



- The slope will be negative as the reducing radius of the spot is taken for calculation
- Hence absolute value of the slope is taken for calculating thermal diffusivity
- Horizontal Diffusivity is 3.9891 m²/s Vertical Diffusivity is 2.4256 m²/s

## 2D FE MODELING TO STUDY THE ANISOTROPY FACTOR OF ROLLED METAL SHEETS



- As an initial step to study the anisotropy in rolled steel a microstructural based material model is developed. implemented using the commercial FEM software COMSOL Multiphysics.
- The first column results corresponds the single crystal domain and rest for different number of crystals.
- It is observed that the anisotropic effect is vanishing when the heat passes through different orientations. The averaging taking place and this effect increases with the increase in number of cells in the domain.

## VISIBLE OUTPUTS

- P. V. Nithin, U. Sreedhar, C. V. Krishnamurthy, M. Zeigler, P. Myrach and K. Balasubramaniam. In-line Laser Thermography for Crack Detection: A Numerical Approach: *Quantitative Infrared Thermography Conference QIRT-Asia*, Mahabalipuram, India, July 6-10, 2015.
- U. Sreedhar, C. V. Krishnamurthy, K. Balasubramaniam. Heat diffusion in Polycrystalline Materials- A microstructure based material model: *Quantitative Infrared Thermography Conference QIRT-Asia*, Mahabalipuram, India, July 6-10, 2015.
- P. V. Nithin, U. Sreedhar, C. V. Krishnamurthy, M. Zeigler, P. Myrach and K. Balasubramaniam. The Effect of Surface Breaking Crack Orientation Detection Capability : A Laser Thermography Numerical Modeling Approach: NDE-2015, Hyderabad, India, November 26-27, 2015



## Design and development of hollow crankshaft for automobiles



Fig : Shaft Prototype

### The Project

The awareness of climate change and the limited availability of resources demands reconsideration of the resources used in vehicle production. Also according to the current scenario of automotive industries, designers are focusing on the development of lightweight, compact and high pressure engines. This demands downsizing of the engine components without compromising its strength. The consistent use of lightweight components in conventional automobile leads to a reduction in fuel consumption and also to a reduction in CO2 emissions.

The objective of the project is development of a new, innovative design for lightweight crankshaft (an automobile engine component) and efficient manufacturing process of the developed lightweight crankshaft. Real prototypes will be produced by appropriate and cost effective manufacturing technologies. With the help of the prototypes, achievable effects regarding lightweight design, increase of manufacturing efficiency, cost

minimization, its performance etc. will be validated and further potentials will be estimated.

Another objective of the project is strengthening of Scientific Cooperation between Indian and German Partners.

#### The main goals of the project were:

- ❖ Design - Definition of specifications, shaft design, design evaluation (simulation) / optimization (if required)
- ❖ Development of Process Chain - identification / evaluation of processes, feasibility studies / optimization, definition of appropriate process chain
- ❖ Realization of prototypes - Design / construction / testing of required tools / rigs, prototyping, optimization Loops (if required)
- ❖ Evaluation of Prototype Shafts - Prototype tests (test rigs, real cars), identification of optimization approaches, optimization loops (if required)

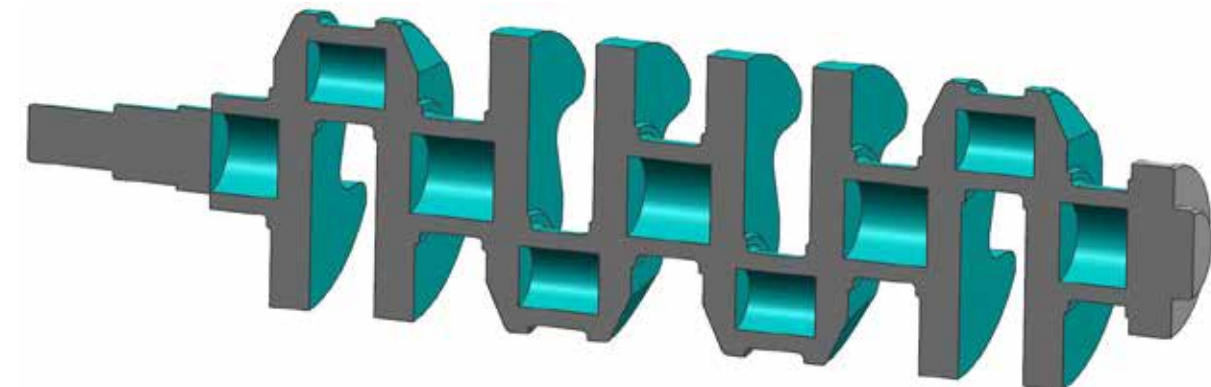


Fig. 1 Hollow Crankshaft

### Project Investigators Partnering Institutions



Naresh C Murmu  
CSIR- CMERI  
Durgapur



Rajkumar P Singh  
Bharat Forge Ltd  
Pune



A Sterzing  
Fraunhofer – IWU  
Chemnitz



I Seidel  
Seidel Werkzeugbau GmbH  
Erbisdorf

### Progresss Achieved

- ❖ Base Crankshaft Finalization –The crankshaft is selected based on its application, engine capacity, number of cylinders, annual production volume and possible weight reduction. The possible weight reduction for selected crankshaft is around 20 to 25%.
- ❖ Conceptual Design and Manufacturing Process - We did literature survey over patents, publication and published articles on Hollow crankshaft. Based on the literature survey, we have developed various conceptual designs. The finalized conceptual design was evaluated on the basis of manufacturing feasibility, strength, stiffness and cost etc. Along with the conceptual design the appropriate and feasible manufacturing process chain was also developed.
- ❖ Crankshaft Material Selection - The material selection for crankshaft was done based on manufacturing process (forging, machining and welding) involved and required metallurgical parameters. Micro-alloyed steel is suitable as it contains micro-alloying elements which precipitates at higher temperature and restricts uneven grain growth. The resulting grain structure achieved in finely distributed grains without external heat treatments. This resulted into better mechanical and fatigue properties.
- ❖ Hollow Crankshaft Segment Dummies – Using cutting technologies to prepare hollow rod bearing dummies and joining technology to realize 1-cylinder dummies out of selected material, two series of test specimen could be manufactured for testing of torsion and bending life-cycle-investigations. The

results can be compared to the done Finite Element Analysis and used to optimize whole process chain.

- ❖ Crankshaft Geometrical Design – Using 3D CAD modeling and Finite Element Analysis, the crankshaft geometrical design was finalized. Optimizing various geometrical parameters of crankshaft, the weight reduction (around 25%) is achieved without compromising its strength and stiffness. The finalized lightweight geometrical design was analyzed against various crankshaft design criteria's like bending & torsional stresses, bending and torsional rigidities, bearing reactions, balancing, deflection in bending etc. Residual stresses due to the joining process were realized by the Finite Element Simulation on the crankshaft model using Goldak's double ellipsoidal heat source model. Sequential thermal and mechanical analysis has been carried out to approximate the residual stresses. Transient thermal analysis for a duration of 370s (189s for moving the heat source and remaining time for cooling purpose) has been performed.
- ❖ Prototype manufacturing – The forging design of hollow crankshaft prototypes is in final steps. After finalizing the forging design, the tools and dies will be manufactured.
- ❖ Testing of prototypes – The bending and torsion fatigue testing of base crankshaft is running on the test rig. The results of this will help in comparing with the results of prototype fatigue testing and further optimization to the design based on the comparison. Along with fatigue testing the engine testing of full hollow crankshaft prototype is also planned. ●





## Objective:

The aim of the project is to develop new innovative lightweight “Hollow Crankshaft Design” having better strength & stiffness characteristics.

### KEY FEATURES

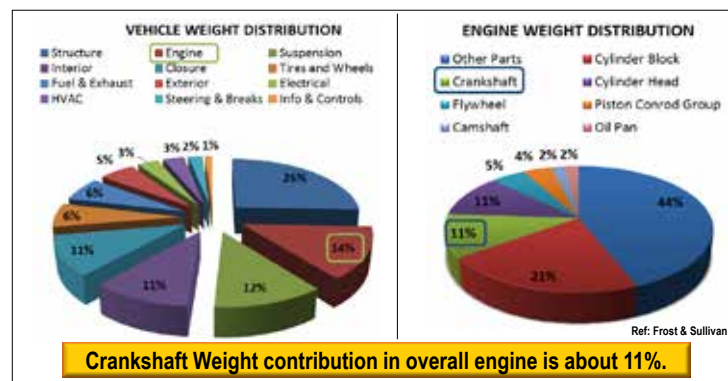
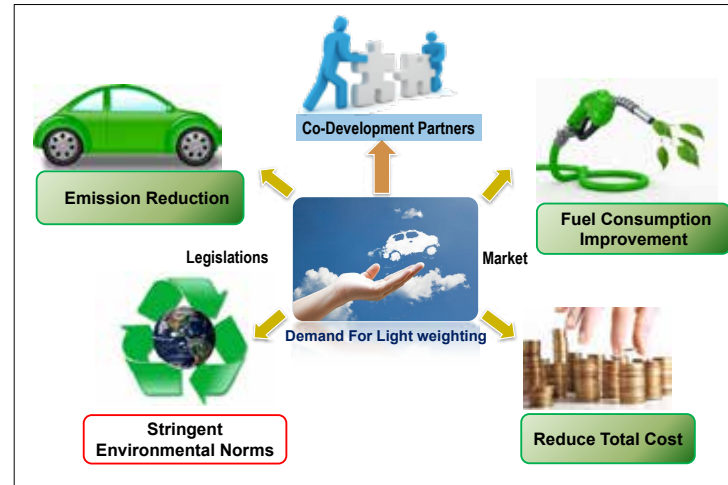
- Lightweight design keeping Strength & Rigidities intact.
- Minimization of Material & Energy inputs.
- Use of Innovative Technologies.
- Modified Prototype Design for Higher Series Flexibility.

### APPROACH

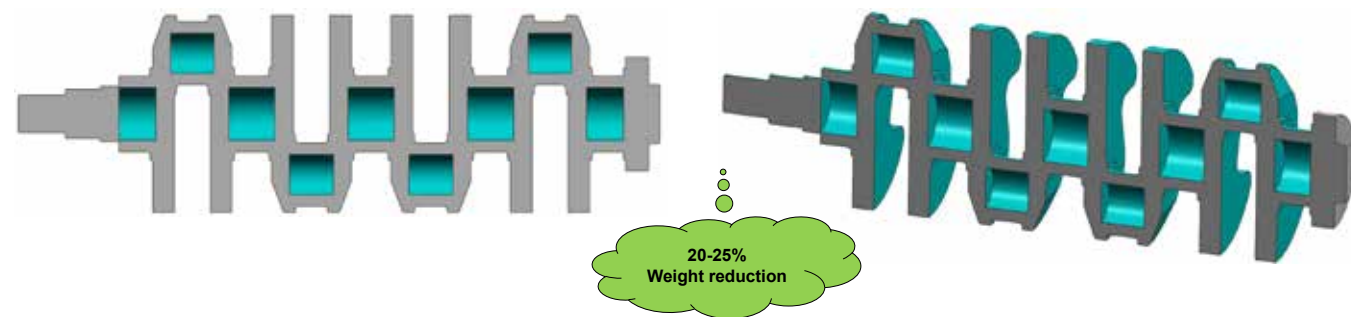
- Selection of relevant demonstrator shaft (Utility Vehicle).
- Conceptual design.
- Theoretical evaluation and optimization.
- Realization of prototype.
- Proof of required characteristics/function and effects.
- Fatigue & Engine Testing Validation.

### BENEFITS

- Innovative Lightweight crankshaft Design.
- Engine Emission reduction.
- Better Engine Performace.
- Minimization of Fuel Consumption (Operation).



Crankshaft Weight contribution in overall engine is about 11%.



20-25%  
Weight reduction

Manufacturing using Forging and Fabrication Process

## Design of selective nanoporous membrane bioreactor for efficient production of bio-butanol from lignocellulosic sugars



Source : Shutterstock

### The Project

Rising demand for fuels, increasing cost of production, dwindling supply of fossil resources, and negative impact of fossil fuels on the planet have led to massive efforts being launched across the globe for development of technologies that would provide sustainable alternative. Liquid biofuels are essential and the world has decided generally to move rapidly from the food-competing first generation bio-fuels to second generation alternatives viz. bio-ethanol, bio-butanol. The project focuses on designing bioreactor for efficient production of bio-butanol. The essential requisites for making bio-butanol cost competitive are access to cheaper cellulosic fermentable sugars as raw material and better cost of production through higher yield on sugars, higher volumetric rate of production and cheaper recovery/purification technologies. The objective of the project is to design a selective nanoporous membrane bioreactor for efficient production of bio-butanol from lignocellulosic sugars. Membranes, membrane process and fermentation will be adapted to each other and optimized before fermentation and membrane preparation will be scaled up to a semi technical scale. The integration of the novel membrane with high butanol/water selectivity and high butanol permeance with the bioreactor (fermenter) will

enable: (1) continuous recovery of butanol from bioreactor thereby giving butanol production at higher rate without inhibition or toxic effects on the metabolizing cells, and (2) continuous upgrading of butanol from low concentration broth of < 1 wt% to > 8 wt%. The direct combination of the new membrane technology with continuous FBR based fermentation is allowing energy and cost efficient butanol production. It opens the opportunity of using sugar derived from lignocellulosic agricultural residues for sustainable and economic 2nd generation bio fuels. Expected deliverables are.

- ❖ development of organophilic zeolite and mixed matrix membrane and membrane characterization by micro-characterization and separation tests in synthetic mixtures;
- ❖ building required membrane housing and basic engineering;
- ❖ fabrication of the membrane plant and integration with ICT fermenters;
- ❖ integrated fermentation-recovery runs process optimization at 5L scale;
- ❖ scale up to Pilot level at 500-5000L scale.

SeNaMeB



## Project Investigators Partnering Institutions



**Arvind Mallinath Lali**  
Institute of Chemical Technology  
Mumbai

**H Richter**  
Fraunhofer - IKTS  
Dresden



**Sanjeev G Patil**  
Privi Biotechnologies Pvt. Ltd.  
Navi Mumbai

**P Mund**  
Atech Innovations GmbH  
Gladbeck



## Progress Achieved

- Hydrophobic zeolite membranes designed by seeding of tubular ceramic substances with small zeolite crystals (silicalite). Membrane is prepared by mixing small zeolite particles (which are produced by milling and followed by hydrothermal treatment) with PDMS. Characterization and testing of membranes has been done by SEM/FESEM, EDX, N<sub>2</sub>-porosimetry. Based on dimensions and performance of membrane, biobutanol reactor has been designed and the corresponding

equipment has been acquired. Bioreactor is used for fermentative production of butanol. It serves as an experimental tool to test cell recycle and proposed membrane extractive fermentation. Pervaporation membrane assembly, automated heating, cooling and vacuum assembly, off-line gas analyzer, aseptic networking of reactor and membranes and micro filtration membrane assembly are the components of bioreactor which has been acquired and assembled for functional lab-scale prototype. Further milestones are on track and expected to be as per the timeline. ●

## Design of Selective Nanoporous Membrane Bioreactor for Efficient Production of Bio-butanol from Lignocellulosic Sugars - SeNaMeB

Arvind Lali<sup>1</sup>, Aruna Agrawal<sup>1</sup>, Hannes Richter<sup>2</sup>, Marc Villvock<sup>2</sup>, Manish Petkar<sup>3</sup>, Peter Mundt<sup>4</sup>

<sup>1</sup>DBT-ICT Centre for Energy Biosciences, Institute of Chemical Technology, Mumbai, India

<sup>2</sup>Fraunhofer Institute of Ceramic Technologies and Systems, Hermsdorf, Germany

<sup>3</sup>Privi Biotechnologies Pvt. Ltd. (A wholly owned business of Privi Organics Limited), Mumbai, India

<sup>4</sup>Atech Innovations GmbH, Gladbeck, Germany



Privi Organics Limited

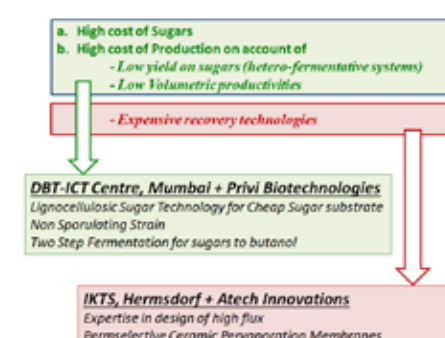


## Genesis of the Proposal

- N-Butanol: Potential Biofuel; Useful chemical and solvent
- Current demand as Chemical > 1 million ton/year
- All demand met through petro-source
- Butanol derived from Renewable Feedstock preferred
- Potential Route: Fermentation of Sugars to Butanol
- Current Bio-Butanol Technology suffers from
  - High cost of Sugars
  - High cost of Production on account of
    - Low yield on sugars (hetero-fermentative system)
    - Low Volumetric productivities
    - Expensive recovery technologies

**Targeted Innovations**

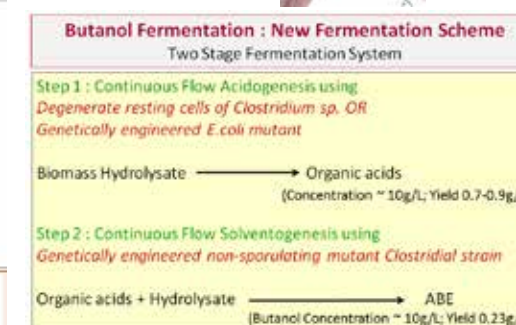
## The IGSTC Project - SeNaMeB



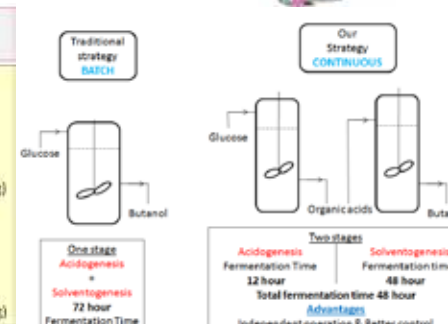
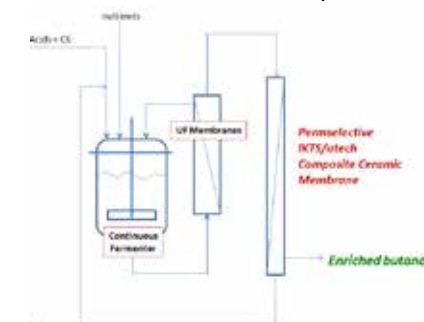
## Chemical Processing Innovation



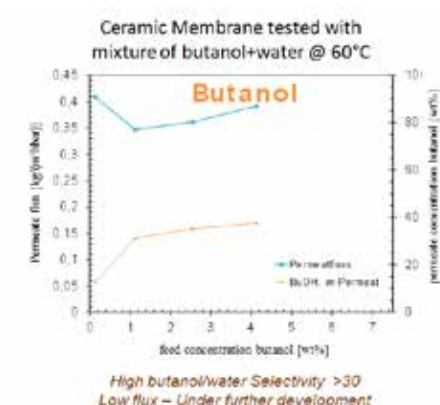
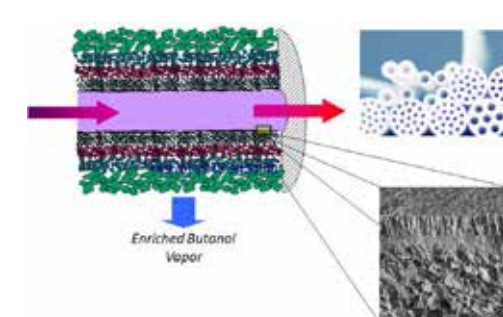
## Biological Innovation



## Technology Innovation

Separation Process Innovation  
Membrane BioReactor System

## Innovation in Membrane Material Technology



**Fraunhofer**  
IKTS

**atech**  
innovations  
gmbh



# Architecture-aware timing analysis and optimization of safety-critical automotive software



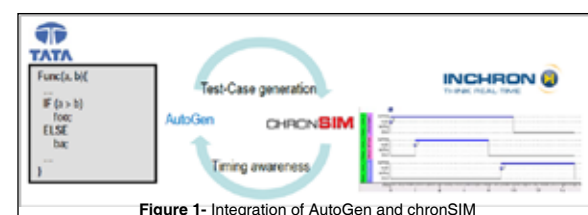
## The Project

Automotive software development is concerned with careful translation of mathematically proven control laws into concurrent communicating software tasks running on complex networks of processors. With 50-100 computing elements, numerous sensors and actuators, kilometers of cabling, and more than 100 M lines of code, automotive control is one of the most complex cyber-physical systems in existence.

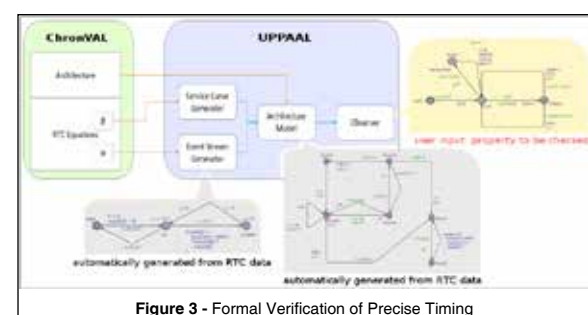
With our increased reliance on safety critical automotive features, the task of establishing the correctness of the implementation is a verification nightmare. While model based development practices have to some extent streamlined the reliable development of such

systems, guaranteeing timing correctness remains the biggest verification challenge, considering the stringent real time nature of automotive control.

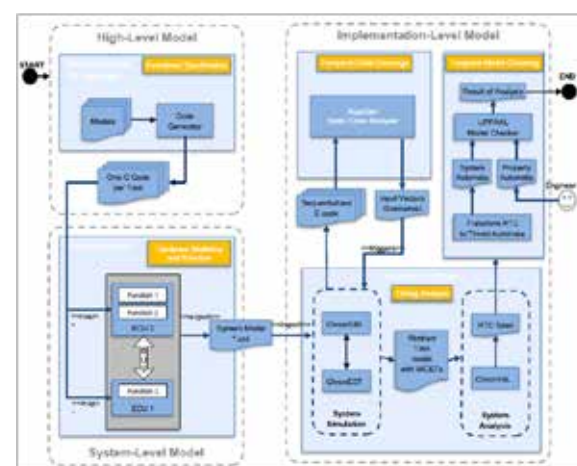
This project brings together valuable expertise in automotive engineering from Germany with software development and verification expertise from India, towards a common goal, namely to come up with a methodology and tool flow for establishing timing convergence in automotive cyber-physical control. As we approach the completion of this challenging task, we present the forthcoming tool flow – the first of its kind – by integrating components developed by all four partners.



**Figure 1-** Integration of AutoGen and chronSIM



### Figure 3 - Formal Verification of Precise Timing



**Figure 2 - AUTOSAFE Tool Chain**

Project Investigators Partnering Institutions



**Partha Chakrabarti**  
IIT Kharagpur



**Pallab Dasgupta**  
IIT Kharagpur



**Samarjit Chakraborty**  
TU Munich



**Arun Bahulkar**  
Tata Research Development and Design Center  
Pune



**Karsten Albers**  
INCHRON GmbH  
Potsdam

## Progress Achieved

In model driven development process for embedded control software, once model validation phase is over, code generated for each control task is mapped to a computational unit (ECU) on the platform on which it will execute. The code executes on the ECU at discrete intervals of time and – in each execution it analyses the data obtained from the sensors and determines the actuation levels to ensure that the plant remains within acceptable bounds of behaviour.

The modelling phase assumes the underlying computational environment to be ideal. In reality, with automotive platforms having 50-100 ECUs and complex networking, the sensor-control-actuation flow is far from ideal. One particularly annoying ramification of the non-ideal nature of the compute environment is in its inability to meet timing requirements, which has a direct impact on control performance and thereby the safety of critical control functionalities. Our goal is to develop a tool flow where the impact of the non-idealities of the compute platform on a control task can be predicted a-priori, leading to the automatic generation of a timed model of the control – the timed model can then be subjected to formal analysis to determine whether it guarantees acceptable control performance.

The overall tool flow relies on existing offerings from TRDDC and INCHRON combined with three important developments that have come out of this project. Figure 2 outlines the tool flow. The model development process is based on standard Matlab Simulink/SF platforms, as is prevalent in current industrial practice. This is followed by code generation. The generated code is passed on to the INCHRON tool suite along with a model of the platform developed in Enterprise Architect. The INCHRON tool suite is tailored towards evaluating the platform induced delay variations for the given platform and the controller code, which includes worst case execution time analysis of the

code and message passing delays, scheduler overheads, delays induced through pre-emption of tasks, etc. However, its analysis is statistical in nature and may not always hit the corner case scenarios of the code. This is where the combination of the TRDDC tool, AutGen with the INCHRON tool, chronSIM, provides some unique benefits

**Publications:**

- i. Aritra Hazra, Priyanka Ghosh, Satya Gautam Vadlamudi, P. P. Chakrabarti, Pallab Dasgupta: Formal Methods for Early Analysis of Functional Reliability in Component-Based Embedded Applications. *Embedded Systems Letters* 5 (1): 8-11 (2013).
- ii. Santhosh Prabhu M, Aritra Hazra and Pallab Dasgupta, Reliability Guarantees in Automata Based Scheduling for Embedded Control Software, *IEEE Embedded Systems Letters (ESL)*, vol. 5, no. 2, pp. 17-20, 2013.
- iii. Kajori Banerjee, Pallab Dasgupta, Acceptance and Random Generation of Event Sequences under Real Time Calculus constraints, In *Proc of Design Automation and Test in Europe (DATE)*, Dresden, 2014.
- iv. Santhosh Prabhu M, Aritra Hazra, Pallab Dasgupta and P. P. Chakrabarti, Handling Fault Detection Latencies in Automata-based Scheduling for Embedded Control Software, In *Proc. of IEEE Multi-Conference on Systems and Control (MSC)*, August 2013.
- v. Kajori Banerjee, Santhosh Prabhu M and Pallab Dasgupta, Debugging Assertion Failures in Software Controllers using a Reference Model, In *Proc. of 6th India Software Engineering Conference (ISEC)*, 2013.
- vi. Aritra Hazra, Priyanka Ghosh and Pallab Dasgupta, Reliability Annotations to Formal Specifications of Context-Sensitive Safety Properties in Embedded Systems, In the *Forum on Specification and Design Languages (FDL)*, Vienna, Austria, September 2012





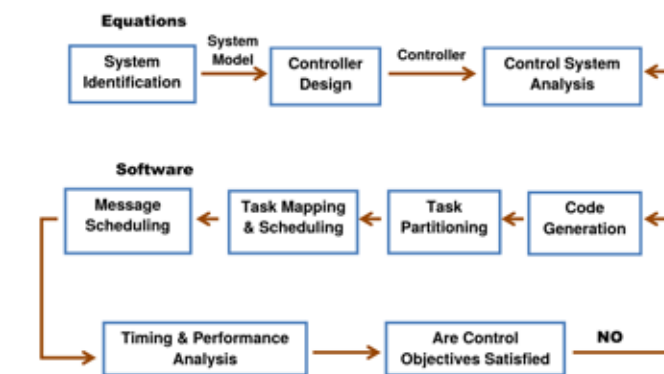


- vii. RajorsheeRaha, SoumyajitDey, P. P. Chakrabarti, PallabDasgupta, Multi-mode Sampling Period Selection for Embedded Real Time Control, Design Automation Conference (Poster), San Francisco, 2014.
- viii. SumanaGhosh, PallabDasgupta, Formal Methods for Pattern Based Reliability Analysis in Embedded Systems, In Proc. of 28th Int. Conf. on VLSI Design and 14th Int. Conf. on Embedded Systems, Jan 2015.
- ix. RajorsheeRaha, AritraHazra, AkashMondal, SoumyajitDey, P.P. Chakrabarti, PallabDasgupta. Synthesis of Sampling Modes for Adaptive Control, In Proc. of IEEE Int. Conf. on Control System, Computing and Engineering, Penang, Malaysia, Nov 2014.
- x. AnandYeolekar: Improving Dynamic Inference with Variable Dependence Graph. RV 2014: 301-306.
- xi. AnandYeolekar, DivyeshUnadkat: Assertion Checking Using Dynamic Inference. Haifa Verification Conference 2013: 199-213.
- xii. AnandYeolekar, DivyeshUnadkat, VivekAgarwal, Shrawan Kumar, R. Venkatesh: Scaling Model Checking for Test Generation Using Dynamic Inference. ICST 2013: 184-191
- xiii. Licong Zhang, Reinhard Schneider, Alejandro Masrur, Martin Becker, Martin Geier, SamarjitChakraborty: Timing challenges in automotive software architectures. 36th International Conference on Software Engineering (ICSE), 2014
- xiv. Licong Zhang, Dip Goswami, Reinhard Schneider, SamarjitChakraborty: Task- and network-level schedule co-synthesis of Ethernet-based time-triggered systems. ASP-DAC 2014: 119-124
- xv. Reinhard Schneider, Dip Goswami, SamarjitChakraborty, Unmesh D. Bordoloi, PetruEles, ZeboPeng: Quantifying Notions of Extensibility in FlexRay Schedule Synthesis. ACM Trans. Design Autom. Electr. Syst. 19(4): 32 (2014)
- xvi. Dip Goswami, Reinhard Schneider, SamarjitChakraborty: Relaxing Signal Delay Constraints in Distributed Embedded Controllers. IEEE Trans. Contr. Sys. Techn. 22(6): 2337-2345 (2014)
- xvii. Matthias Kauer, Sebastian Steinhorst, Dip Goswami, Reinhard Schneider, Martin Lukasiewicz, SamarjitChakraborty: Formal verification of distributed controllers using Time-Stamped Event Count Automata. ASP-DAC 2013: 411-416
- xviii. Dip Goswami, SamarjitChakraborty, PurandarBhaduri, Sanjoy K. Mitter: Characterizing feedback signal drop patterns in formal verification of networked control systems. CACSD 2013: 13-18
- xix. Dip Goswami, Martin Lukasiewicz, Matthias Kauer, Sebastian Steinhorst, Alejandro Masrur, SamarjitChakraborty, S. Ramesh: Model-based development and verification of control software for electric vehicles. DAC 2013: 96
- xx. Georg Georgakos, Ulf Schlichtmann, Reinhard Schneider, SamarjitChakraborty: Reliability challenges for electric vehicles: from devices to architecture and systems software. DAC 2013: 98
- xxi. Martin Geier, Martin Becker, Daniel Yunge, Benedikt Dietrich, Reinhard Schneider, Dip Goswami, SamarjitChakraborty: Let's put the car in your phone! DAC 2013: 143
- xxii. Reinhard Schneider, Licong Zhang, Dip Goswami, Alejandro Masrur, SamarjitChakraborty: Compositional analysis of switched Ethernet topologies. DATE 2013: 1099-1104
- xxiii. Dip Goswami, Alejandro Masrur, Reinhard Schneider, Chun Jason Xue, SamarjitChakraborty: Multirate controller design for resource- and schedule-constrained automotive ECUs. DATE 2013: 1123-1126

### Executive Summary

- This project brings together valuable expertise in automotive engineering from Germany with software development and verification expertise from India, towards a common goal, namely to come up with a methodology and tool flow for establishing timing convergence in automotive cyber-physical control.

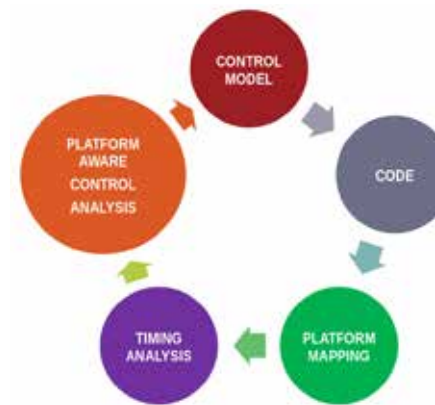
### AUTOMOTIVE SOFTWARE DEVELOPMENT CYCLE



- Control Development Phase
- Software Development Phase

### Why is the AUTOSAFE tool flow significant?

- AUTOSAFE develops the notion of platform aware control analysis.
- Built-in formal methods guarantee early resolution of timing issues.
- ISO-26262 recommends the use of formal methods to prove safety of critical systems.



- CHALLENGE: Developing a cohesive formal verification tool chain

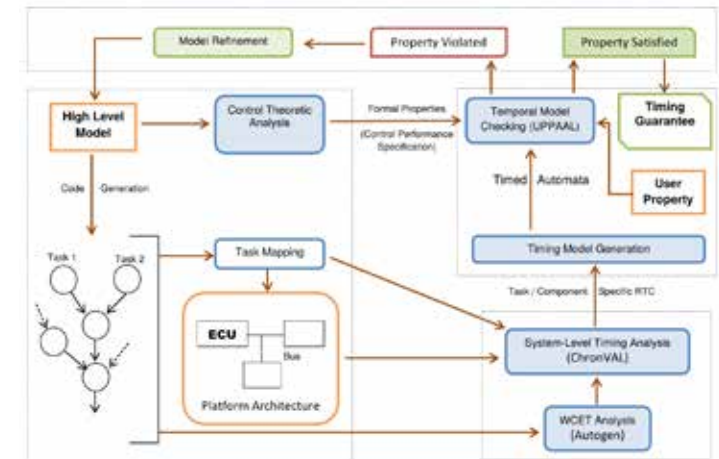
### AUTOSAFE Goals

- Formalization of Bandwidth versus Control Performance Trade-offs
- Advanced Platform Modeling
- Formal Validation of Control
- Reliability of Control
- Synthesis of Automated Control

### Publications

- DAC, DATE, ASPDAC, ICSE, ACM TODAES, IEEE Trans. Control Systems Technology, ASP-DAC, CACSD, ICCSCE, MSC, FDL, ESL, VLSID, etc.

### The AUTOSAFE Methodology



- APSEC 2015

### Research Highlights

- TU Munich:
  - New Timing Analysis Techniques: ICSE 2014, DATE 2013 and ASPDAC 2014
  - New Scheduling Techniques: ACM TODAES 2014
  - Platform-timing-aware design of Control Software: IEEE Trans. Control Systems Technology 2014, ASP-DAC 2013, CACSD 2013 and DATE 2013
  - Exploratory Research: DAC 2013
- IIT Kharagpur:
  - Stimulus Generation using Real Time Calculus (RTC): DATE 2014
  - Multi-mode Sampling for Computationally Efficient Control: DAC 2014, ICCSCE 2014, MSC 2015
  - Incorporating Reliability in Control Design and Scheduling: FDL 2012, ESL 2013, MSC 2013, VLSID 2015

### Joint Activities

#### AUTOSAFE Workshop 2013



TRDDC, Pune, India

#### AUTOSAFE Workshop 2014



TU Munich, Germany

#### Joint Tutorial at ESWEK 2014



New Delhi, India

#### AUTOSAFE Workshop 2015



IIT Kharagpur, India

### AUTOSAFE: What next ?

- To prepare the blueprint for an "INDO-GERMAN CENTRE ON AUTOMOTIVE SOFTWARE AND CONTROL" for collaborative R & D between industry and academia



## Upcoming IGSTC Projects

LOW-COST EMERGENCY POWER SYSTEM BASED ON PRINTED SMART SUPERCAPS (LOWCOSTEPS)



MULTIPLEXED, LABEL-FREE FIBER OPTIC BIOSENSOR ARRAY SYSTEM FOR WATERBORNE PATHOGEN DETECTION (MULTI-WAP)



ONLINE-INDICATION OF PATHOGEN-LIKE POLLUTION IN WATER BY FECAL PIGMENT ANALYSIS (FEC-ONLINE)



CLUSTER-COMPOSITE NANOFIBRE MEMBRANES FOR RAPID, ULTRA-TRACE DETECTION OF WATERBORNE CONTAMINANTS (CANDECT)



DNA BIOCHIP FOR ON-SITE WATER PATHOGEN DETECTION INCLUDING VIABILITY AND ANTIBIOTIC RESISTANCE TESTING (WATERCHIP)



NANOSTRUCTURED HYBRID TRANSPARENT NETWORK ELECTRODES FOR LARGE AREA VISIBLY TRANSPARENT SOLAR CELLS (METNETWORK)







Joint Workshops  
**Platform for Research Networking**



## Electrochemical storage systems: Synergy of material design and modeling

Kharagpur, India  
17-20, February  
2016



## Recent advancement in online/remote water quality monitoring and management technologies

Chennai, India  
2 - 4 February  
2016



### Workshop Coordinators



**Amreesh Chandra**  
IIT Kharagpur



**Ulrike Krewer**  
Technical University Braunschweig

### Background

The development of next generation supercapacitors and Li-ion batteries is now heavily dependent of the paradigm shift in conventional materials design and device fabrication strategies used to obtain such energy storage devices. The joint workshop aims to bring together the leading groups from the two countries to deliberate and put forward a clear road map for developing the next generation storage technologies.

### Agenda, Participation and Deliberations

45 Indian and 8 German participants took part in vigorous discussions in the workshop held at Indian Institute of Technology Kharagpur. Participants were from premier research institutions like IITs, BARC, Central Universities and TU Braunschweig etc.

#### Academic highlights of the event:

- I. Highlights of scientific and technical presentations/deliberations:
  - ❖ Road map for development of new storage technologies was discussed.
  - ❖ More synergy between theory, simulation and experiments needs to be developed.
  - ❖ More open source documents need to be shared amongst the consortia members.
  - ❖ Efficient sharing and use of existing facilities need to be ensured.
- II. New developments presented at the event:
  - ❖ Most of the speakers shared their recent/ongoing work (unpublished) being pursued in their groups.
  - ❖ New ab-initio theoretical and simulation strategies being

investigated to understand the behavior of energy systems.

- ❖ The need and strategies that can be used to fabricate, tune and tailor nanoparticles ranging from hollow to hierarchical.
- III. Major recommendations of the event:
  - ❖ Each subgroup formed during the Programme should try to submit a joint proposal to initiate long term collaboration.
  - ❖ It is important to once again start focusing on basic research as a major breakthrough is required to bring quantum jump in the energy storage systems.
  - ❖ Simple material structures may have to be replaced by hierarchical structures for ensuring improvement in performance.
  - ❖ It would be useful if theoretical models can be developed, which can predict; to some extent, the type of materials that would be useful for different energy storage technologies. This will save time, cost and wastage of expensive raw materials.

### Specific outcomes of the Workshop

The important and specific outcomes of the workshop:

- ❖ Preparation, submission and publication of "white paper" or "current opinion" on the topics discussed during the workshop.
- ❖ To explore the possibility of organizing the follow up workshop, where the core participants/ member remain the same.
- ❖ Submission of joint projects by forming consortia of sub teams that were formed during the workshop.
- ❖ Exchange visits of student and faculties.
- ❖ Sharing of resources and facilities.

### Workshop Coordinators



**T Subramani**  
Anna University



**D Karunandidhi**  
SIET Coimbatore



**H C Rafiq Azzam**  
RWTH Aachen

### Background

Indo-German Science and Technology Centre (IGSTC) workshop on "Recent advancement in online/remote water quality monitoring and management technologies" was conducted at Department of Mining Engineering, Anna University, Chennai, India during 2-4 February 2016 to provide a platform for the exchange of knowledge and experiences in water and waste water quality monitoring technologies with focus on online and remote methods in various spatial scales and for different contaminants and contaminant sources. Continuous monitoring of available sources in term of quantity and quality is the need of the hour for both Germany and India to provide safe drinking water. Therefore it is needed to develop new advanced remote technologies for the monitoring of water and waste water quality across different temporal and spatial scales.

### Agenda, Participation and Deliberations

Discussions were made on the existing satellite and sensing systems, airborne and unmanned systems, and ground-based systems for the remote monitoring of water and waste water quality. Interactions were also made for the development of wireless based real-time water quality monitoring technologies. Hydrological modeling and remote sensing based discharge monitoring linking water quantity to contaminant loads and pathways were presented by the experts.

Remote sensing techniques for monitoring the variation of turbidity, temperature, nutrients, pathogens, dissolved oxygen and contaminants with respect to space and time were dealt in this workshop. Focus was given for the dispersion of industrial pollutants/effluents as well as diffused pollution. Discussions were made on "water quality and proxies" such as algae blooms, upwelling, fish dying etc.

Integrated remote and online water quality data, its transformation into information for decision-making and public participation were also included in the deliberations. Finally existing global and national online water quality monitoring platforms and data portals and look for the potential linkages between Germany and India as well as opportunities of downscaling to particular catchments or water bodies were discussed.

### Conclusions and Recommendations

- ❖ Forming a core joint working group (Germany and India)
- ❖ Identifying strengths of each partners
- ❖ Determining direct and indirect, organic and inorganic dynamic and static, natural and artificial sources of pollution
- ❖ Formulating a multifaceted, in-situ, spaceborne and airborane, multi-sensor, multi-scale online monitoring mechanism
- ❖ Assigning different task to partners based on their strength
- ❖ Exchange of technology and sharing of knowledge



## Decentralized approach for wastewater management & septic tank management reality - Solutions & innovation in the Indian water sector

Karlsruhe, Germany  
22-24, February  
2016



### Workshop Coordinators



**Sreekrishnan Trichur Ramaswamy**  
IIT Delhi



**Erhard Hoffmann**  
Karlsruhe Institute of Technology Karlsruhe

## New generation sensors for unsaturated soils and water technology

Bochum, Germany  
24-25 February  
2016



### Workshop Coordinators



**D N Singh**  
IIT Bombay



**Tom Schanz**  
Ruhr-Universität Bochum

### Background to the Workshop

Compact decentralized wastewater treatment units are the need of the hour in unplanned urban poor localities. Such plants, if based on treatment technology like Aerobic or Anaerobic Rotating Biological Contactors (RBCs) are best suited for this kind of localities. Research was carried out and presented in the workshop as well as river water management principles which are planned for future support (decentralized treatment units). Germany's technology development in this area would certainly assist Indian researchers and stakeholder to test such a plant at pilot scale. Delhi Jal Board can participate and provide material support at one if its existing treatment facility to test such a unit. A workshop was organised by XXXXX to

### Agenda, Participation and Deliberations

During the course of the workshop, presentations were made and technical discussions and elaborations held on decentralized wastewater treatment processes and their relevance. It ensued that decentralized wastewater treatment plants are relevant both for isolated communities as well as for metros with unplanned growth.

It was agreed that any decentralized sewage treatment process would necessarily be of low energy and land requirements, easy to operate and resilient to fluctuations

in input sewage quality and, to a certain extent, quantity. The site visit carried out as part of the joint workshop also included visit two operating "Rotating Biological Contactor (RBC)" systems as well as one RBC design and fabrication facility. Discussions on possibility of using the RBC, with necessary design modifications to carry out the treatment through the anaerobic route. In addition to the inherent advantages of the RBC, this will also be energy positive, or, at least energy neutral. It is planned to communicate with the GIZ office in Delhi regarding the implementation of the RBC.

### Outcomes of the Workshop

The bottleneck of success in wastewater-management in India is not the absence of appropriate process technology and civil constructions, neither the availability of sufficient investment finance but sustainable operations and maintenance. Research and development of technology based solutions to improve the situations should not be limited to natural sciences or process technology or civil engineering only. It should, wherever possible, go along with an applied research about the social-cultural conditions and applicable business-models including financing models to make sure that facilities, utilities which are installed will lead to the desired success in regular and long-term operations.

### Background

The workshop provided a platform for bringing together scientists and industrial companies from both countries to enhance the transfer of knowledge, research and development (R&D) activities in the field of Water Technology and Unsaturated Soils.

### Agenda, Participation and Deliberations

The workshop provided a platform for bringing together scientists and industrial companies from both countries to enhance the transfer of knowledge, research and development (R&D) activities in the field of Water Technology and Unsaturated Soils.

Apart from lectures the workshop consisted of a guided visit of the laboratory of the Chair of Foundation Engineering, Soil and Rock Mechanics. On the second day a common session providing a summary of the first workshop day was followed by parallel sessions of technical presentations. The workshop culminated with a common final discussion with all workshop participants.

### New developments presented at the event

One of the new sensors for Unsaturated Soils applications presented was the fixed-matrix porous ceramic disc

sensor MPS 6 (Decagon devices) for measuring soil suction was presented. Another new development was in the use of numerical optimization tools for improvement of monitoring strategies. These tools are promising for better design and planning of monitoring concepts for any geotechnical and geo-environmental applications. Technology' developments presented at the workshop were simple and low-cost optical read out formats for biosensors for food, environmental and warfare contamination, the advanced water quality biosensors for arsenic.

Specific Outcomes  
As a result from the discussions during the workshop, the idea of the establishment of an "Centre for Geoenvironmental Research and Innovation" was raised. Outcomes of the discussions of the 'Water Technology' group of the workshop led to immediate practical actions e.g. transfer of the AquacheckTestkit to Pune, Water Pollution Board, start of bilateral collaboration and plans for installation of a Aquacheck/LAVARIS office in Bangalore, export of water treatment units to Bangalore, joint proposal submission of German and Indian partners for Water Technology Initiative of Department of Science and Technology, ARSOLux measurements at TERI University in India etc.





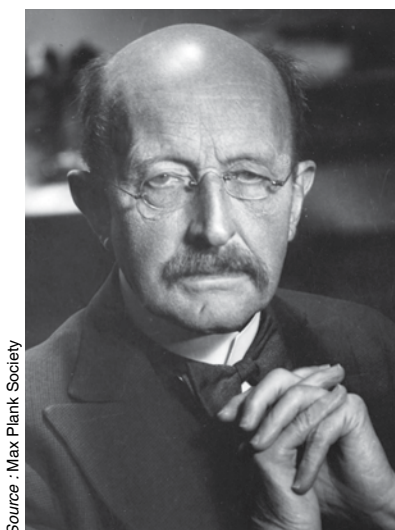
DST-Max Planck Programme  
**Connecting Excellence**





## DST–Max Planck Society Programme

### Connecting Excellence



Source : Max Planck Society

The Department of Science & Technology (DST), Govt. of India and Max Planck Society (MPG), Germany have collaborated, through an agreement signed in 2004, to constitute and operationalise DST–Max Planck Society Programme.

Running since year 2004, the DST-Max Planck Society Programme has two flagship initiatives under its umbrella aimed at creating opportunities for collaboration and sustained interactions with S&T research priorities.

IGSTC has been entrusted with the responsibility of implementing the DST/ MPG Programme from Indian side.

## Max Planck Partner Groups at Indian Institutes

The “Partner Group” is an instrument created by the Max Planck Society (MPG) for the purpose of strengthening the ties between Max Planck Institutes and research institutes from other countries. Partner Group is a mechanism to intensify cooperation between individual scientists through jointly conceptualized and implemented S&T research projects.

The “Max Planck Partner Group at Indian Partner Institute” has been developed as an instrument for supporting collaborative research in target areas prioritized on the basis of their relevance to immediate problems and interests of institutions involved from both sides.

Partner Groups are headed by Indian scientists who return to India after completing their extended research residency at a Max Planck Institute. Partner Groups allow the involved scientists to lead appropriately equipped research groups in order to continue their research activities in close co-operation with their former German hosts.

Each Partner Group is supported to the tune of €20000 per year by MPG with a matching contribution of equivalent ₹ amount by the DST. Grants are expected to be utilized, as far as possible, for the purpose of creating MPI like facilities at the respective Indian host institutions.

Science cannot solve the ultimate mystery of nature. And that is because, in the last analysis, we ourselves are part of nature and therefore part of the mystery that we are trying to solve.

Max Planck



### Structural Biology of vesicular trafficking: Screening of putative Rab5 GAPs for their role in Rab5 to Rab7 conversion



**Sunando Datta**  
IISER Bhopal

**Marino Zerial**  
MPI of Molecular Cell Biology and  
Genetics, Dresden



### Genetic Diversity Studies: Studies on human salivary microbiome in Indian populations and its implications in human genetic diversity studies, health sciences and evolutionary biology



**Madhusudan Reddy**  
CDFD Hyderabad

**Mark Stoneking**  
MPI for Evolutionary Anthropology,  
Leipzig



### Gravitational Wave Physics: Searching intermediate mass black holes in gravitational wave window



**Archana Pai**  
IISER Trivandrum

**Bernard Schutz**  
MPI for Gravitational Physics, Golm



### Chemical Ecology: The role of small-RNA pathways in plant defense against insect herbivores



**Shree Prakash Pandey**  
IISER Kolkata

**Ian Thomas Baldwin**  
MPI for Chemical Ecology, Jena



### Glyconano –technology: Carbohydrate capped nanoparticles as tumor specific drug delivery system



**Raghavendra Kikkeri**  
IISER Pune

**Peter H. Seeberger**  
MPI of Colloids and Interfaces, Potsdam



### Centre for cosmology and gravity



**S. Shankaranarayanan**  
IISER Trivandrum

**Hermann Nicolai**  
MPI for Gravitational Physics, Potsdam



### Atmospheric Chemistry and composition: Tropospheric OH reactivity and VOC measurements within India



**Vinayak Sinha**  
IISER Chandigarh

**Jos Lelieveld**  
MPI for Chemistry, Mainz



### Polymer research: Developing new conjugated materials for optoelectronic devices



**Parameswar K Iyer**  
IIT, Guwahati

**Klaus Müllen**  
MPI for Polymer Research, Mainz



### Data management and mining: Search and mining over large scale graphs



**Srikanta Bedathur**  
Indraprastha Institute of  
Information Technology, Delhi

**Gerhard Weikum**  
MPI of Informatics, aarbrücken



### Asymmetric organocatalysis: New aminocatalytic asymmetric transformations



**Subhas C Pan**  
IIT Guwahati

**Benjamin List**  
MPI for Kohlenforschung  
Muelheim an der Ruhr



### Atmospheric Sciences: Characterising the properties of biological aerosol particles under different environmental and seasonal conditions over the Indian tropical region : assessment for possible climatic & health impacts



**Sachin S Gunthe**  
IIT Madras

**Ulrich Pöschl**  
MPI for Chemistry, Mainz



### Regulation of RNA splicing by a novel ubiquitin related protein



**Shravan K. Mishra**  
IISER Mohali

**Stefan Jentsch**  
MPI of Biochemistry  
Martinsried





### Coupling and dynamics of solar atmosphere



**Durgesh Tripathi**  
Inter-Univ Centre for Astronomy and  
Astrophysics, Pune

**Sami K Solanki**  
MPI for Solar System  
Research, Lindau



### Role of cellular membranes in stress signalling and protein homeostasis maintenance



**Swasti Raychaudhuri**  
CSIR- CCMB Hyderabad

**F Ulrich Hartl**  
MPI of Biochemistry,  
Martinsried



### Multifunctional hybrid nanostructures for alternative energy systems



**Amreesh Chandra**  
IIT Kharagpur

**Katharina Landfester**  
MPI for Polymer Research Mainz



## Max Planck - India Fellowship/Mobility Grant

Max Planck-India Visiting Fellowship is a distinction for highly qualified and talented scientists. The Fellowship is awarded to scientifically outstanding, promising young Indian scientists.

Individuals selected for the award get the opportunity to work with Scientists at the Max Planck Institute (MPI) relevant to their area of expertise for up to 2 months a year for four consecutive years.

Fellowship holders receive from MPG a sum of €3,000 per year, for up to four years, with Indian side providing travel support for each research stay.

| S. No            | Fellow  | MPI Counterpart  | Field of Research / Title   |
|------------------|---|--|---|
| <b>CALL 2011</b> |   |  |   |
| 1                | <b>Dr Srinivasan Krishnamurthi</b><br>Institute of Microbial Technology<br>Chandigarh | <b>Prof Bremen Rudolf Amann</b><br>MPI for Marine Microbiology<br>Bremen               | Polyphasic taxonomic characterization of marine bacteria and analyses of the microbial diversity in Indian marine waters using culture-independent approaches |
| 2                | <b>Dr Suneel Kateria</b><br>Delhi University<br>Delhi                                 | <b>Prof Wolfgang Gaertner</b><br>MPI for Bioinorganic Chemistry<br>Mülheim             | Deciphering the role of the flanking N- and C-terminal regions in the modulation of photocycle kinetics of a LOV domain of a marine algal phototropin         |
| 3                | <b>Dr Sandeep Kaur</b><br>Delhi University<br>Delhi                                   | <b>Prof Matthias Stein</b><br>MPI for Dynamics of complex technical systems, Magdeburg | Transition metal dithiolato complexes as functional models for hydrogenases   |
| <b>CALL 2012</b> |   |  |   |
| 4                | <b>Dr Koushik Dutta</b><br>IISER<br>Bhopal  | <b>Dr Georg G Raffelt</b><br>MPI for Physics<br>München                                | Inflationary cosmology and its connection to particle physics   |
| 5                | <b>Dr Naveen Chandra Bisht</b><br>NIPGR<br>New Delhi                                  | <b>Prof Jonathan Gershenzon</b><br>MPI for Chemical Ecology<br>Jena                    | Investigating the role of glucosinolate content towards plant fitness in <i>Brassica juncea</i>   |
| 6                | <b>Dr Subbulakshmi Chidambaram</b><br>Vision Research Foundation<br>Chennai           | <b>Prof Reinhard Jahn</b><br>MPI for Biophysical Chemistry<br>Goettingen               | Dissecting the regulatory role of Adiponectin signalling in human retinal synaptic vesicle trafficking under physiological and pathological conditions        |
| <b>CALL 2013</b> |   |  |   |
| 7                | <b>Dr P Anil Kumar</b><br>Institute of Microbial Technology<br>Chandigarh             | <b>Prof Friedrich Widdel</b><br>MPI for Marine Microbiology<br>Bremen                  | Physiology of mixotrophic planktonic bacteria   |



|                  |   |   |   |
|------------------|---|---|---|
| 8                | <b>Dr Satya Pal Nehra</b><br>Deenbandhu Chhotu Ram Univ<br>of Sci & Tech, Murthal | <b>Prof Dwayne Miller</b><br>MPI for Dynamics and Structure<br>of Matters<br>Hamburg      | Preparation and Characterization<br>of Semiconductor Photocatalysts<br>for Surface Reaction Dynamics<br>Study and their Applications  |
| 9                | <b>Dr Richa Rai</b><br>Banaras Hindu University<br>Varanasi                       | <b>Prof Jonathan Gershenzon</b><br>MPI for Chemical Ecology<br>Jena                       | Application of metabolite,<br>transcript and flux measurements<br>to investigate the effect of<br>elevated ozone and carbon<br>dioxide on yield and pest<br>protection of C3 and C4 crops   |
| 10               | <b>Dr Kamal P Singh</b><br>IISER Mohali   | <b>Prof J M Rost</b><br>MPI for Physik Komplexer<br>Systeme, Dresden                      | Sub-fs control of photo-<br>dynamics in atoms/molecules<br>using shaped XUV pulses  |
| <b>CALL 2014</b> |   |   |   |
| 11               | <b>Dr N Ramesh Kumar</b><br>NIIST<br>Thiruvananthapuram                           | <b>Prof Ian Thomas Baldwin</b><br>MPI for Chemical Ecology<br>Jena                        | Identification and functional<br>characterization of seed borne<br>bacterial endophytes of <i>Nicotiana<br/>attenuata</i> and the elucidation of<br>their transmission to the progeny<br>using culture-dependent and-<br>independent approaches |
| 12               | <b>Dr Areejit Samal</b><br>Institute of Mathematical<br>Sciences, Chennai         | <b>Prof Jürgen Jost</b><br>MPI for Mathematics Sciences<br>Leipzig                        | Computational methods for<br>identifying and analyzing design<br>features of metabolic networks   |
| 13               | <b>Dr. Arjun Bagchi</b><br>IISER<br>Pune  | <b>Prof Stefan Theisen</b><br>Gravitational Physics<br>Golm                               | Minkowskian Holography  |
| 14               | <b>Dr V Pramitha</b><br>IIT Madras  | <b>Prof Joachim P Spatz</b><br>MPI for Intelligent Systems<br>Stuttgart                   | Direct patterning of vortex<br>generating diffractive optical<br>elements on fibre tip using a<br>focused ion beam  |
| 15               | <b>Dr Karthik V Raman</b><br>IISc Bangalore                                       | <b>Prof Klaus Kern</b><br>MPI for Solid State Research<br>Stuttgart                       | Tailoring interface spin transport:<br>towards molecular spintronics  |
| 16               | <b>Dr Srikant Sukumar</b><br>IIT Bombay   | <b>Prof Peter Benner</b><br>MPI for Dynamics of Complex<br>Technical Systems, Magdeburg   | Cooperative control and<br>consensus, nonlinear control,<br>adaptive control, time-varying<br>systems   |
| 17               | <b>Dr K Sowjanya Sree</b><br>Amity Univ, Noida                                    | <b>Prof David G Heckel</b><br>MPI for Chemical Ecology<br>Jena                            | Transcriptional responses<br>of <i>Helicoverpa armigera</i> to<br>the insecticidal mycotoxin,<br>Destruxin  |
| 18               | <b>Dr Venkat Gundabala</b><br>IIT Bombay  | <b>Prof Katharina Landfester</b><br>MPI for Polymer Research<br>Mainz                     | Water-based nanocomposite<br>coatings   |
| 19               | <b>Dr Anshu</b><br>Deenbandhu Chhotu Ram Univ<br>Sci & Tech, Murthal, Sonapat     | <b>Prof R J Dwayne Miller</b><br>MPI for the Structure and<br>Dynamics of Matter, Hamburg | Structure and Dynamics of<br>Functionalized and Catalysts<br>Modified Carbon Nanotubes<br>for Charge and Mass Transport<br>Applications   |



## Financial Statements Audit Report 2014-15



**SSAS & ASSOCIATES****CHARTERED ACCOUNTANTS**

Branch- D/147, Pushpanjali Enclave; Pitampura, Delhi-110034  
Tel: 91.11.27010841; 91.9868144009, email- [sansaxonline@gmail.com](mailto:sansaxonline@gmail.com)

Date : 28.09.2015

**INDEPENDENT AUDITOR'S REPORT**

To the Governing Body of  
**Indo-German Science and Technology Centre (IGSTC)**  
New Delhi

**Report on financial Statements**

We have audited the accompanying financial statements Indo Indo-German Science and Technology Centre, New Delhi (a society registered under Societies Registration Act, 1860) which comprise the Balance Sheet as at March 31, 2015, the Income and Expenditure Account, the Receipts and Payments Account for the year then ended and a summary of significant accounting policies and other explanatory information.

**Management's Responsibility for the Financial Statements**

Management is responsible for the preparation of these financial statements that give a true and fair view of the financial position and financial performance of the Society. This responsibility includes the design, implementation and maintenance of internal control relevant to the preparation and presentation of the financial statements that give a true and fair view and are free from material misstatement, whether due to fraud or error.

**Auditor's Responsibility**

Our responsibility is to express an opinion on these financial statements based on our audit. We conducted our audit in accordance with the Standards on Auditing issued by the Institute of Chartered Accountants of India. Those Standards require that we comply with ethical requirements and plan and perform the audit to obtain reasonable assurance about whether the financial statements are free from material misstatement.



H. O : U-52/62, DLF Phase III, Gurgaon – 122002, Haryana

An audit involves performing procedures to obtain audit evidence about the amounts and disclosures in the financial statements. The procedures selected depend on the auditor's judgement, including the assessment of the risks of material misstatement of the financial statements, whether due to fraud or error. In making those risk assessments, the auditor considers internal control relevant to the Society in preparation and fair presentation of the financial statements in order to design audit procedures that are appropriate in the circumstances, but not for the purpose of expressing an opinion on effectiveness of the society's internal control. An audit also includes evaluating the appropriateness of accounting policies used and the reasonableness of the accounting estimates made by management, as well as evaluating the overall presentation of the financial statements.

We believe that the audit evidence we have obtained is sufficient and appropriate to provide a basis for our audit opinion.

**Opinion**

In our opinion and to the best of our information and according to the explanations given to us, the accompanying financial statements give a true and fair view of the financial position of Indo- German Science and Technology Centre (IGSTC) for the year ended March 31, 2015 in conformity with the accounting principles generally accepted in India.

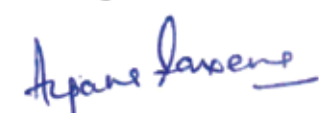
**Emphasis of Matter**

Without qualifying our opinion, we draw attention to:

**Reference point B) Notes to Financial Statements**

- **Note 2.** German expenditure towards research projects (Non- Shareable) amounting to Rs. 7,39,88,023/- are based on statement provided by Government of Germany (IB-BMBF).
- **Note 7.** German operational Expenditure amounting to Rs.34,88,870/- reflected in the financial statements are based on statement provided by Government of Germany (IB-BMBF) to the Centre.

For **SSAS & ASSOCIATES**,  
Chartered Accountants  
Firm Registration No: 08550N

  
**ALPANA SAXENA**  
Partner, Membership No. 095837  
Place : Delhi





**SCHEDULE ANNEXED TO AND FORMING PART OF THE BALANCE SHEET, THE INCOME & EXPENDITURE ACCOUNT AND THE RECEIPT & PAYMENT ACCOUNT FOR THE YEAR ENDED 31<sup>ST</sup> MARCH, 2015.**

**SCHEDULE- 'G'**

**ACCOUNTING POLICIES AND NOTES ON ACCOUNTS**

**Objectives of the Organisation**

The Indo German Science and Technology Centre (Society) established in India by the Governments of India and Germany, to facilitate and promote the interaction, in India and in Germany, of governments, academia and industry in science and technology. It is to build and improve research and technology synergies between countries, focusing primarily on natural, life, and engineering sciences. The centre was registered in India on 14<sup>th</sup> June 2010 under Societies Registration Act, 1860.

**A. SIGNIFICANT ACCOUNTING POLICIES**

**1. Accounting Period:**

Financials are reported from 01<sup>st</sup> April of a year to 31<sup>st</sup> March of the following year.

**2. Reporting currency and foreign currency transactions:**

The accounting currency of the Society is Indian Rupee. Separate Receipts & payment account, Income & Expenditure Account and Balance Sheet is drawn in Euro at the rate of exchange as prescribed by RBI on the Balance Sheet date i.e. 31.03.2015.

**3. Basis of preparation :**

The financial statements are prepared under the historical cost convention and have been changed from cash basis to the mercantile system of accounting. In the absence of any authoritatively established accounting principles for the specialised aspects related to societies not having any commercial activity, these statements have been prepared in accordance with the significant accounting policies as prescribed by the Institute of Chartered Accountants of India.

4. Any surplus of Receipt over Payment is carried forward to next year for utilization as per objectives of the IGSTC.

5. **Method of Accounting:** Accounts are maintained on mercantile basis.

**6. Grants Awarded:**

Grants to an awardee are recognized on the recommendation of the Scientific Council, approval by the Governing Body and with the final approval of both Indian and German Governments. Based on the commitments made to awardees in a year, aggregate grants are recognized as expenditure to the extent of payment made to each awardee during the year. Grants released for various research projects have been shown under the head "Scientific Expenses" in the "Income &

1



Expenditure Account" on the basis of disbursements made by the Centre. First year releases are made only on the basis of the approved Budget in the letter of sanction to the project. However, subsequent releases are made on the basis of approved budget in the letter of sanction and the statement of expenditure and the utilization certificate of the last releases of the previous years furnished by the institutions.

**7. Loans & Advances:**

Till the year 2013-14 Loans granted to Industrial partners of the awardees are treated as utilization of fund of the Centre. The overhead charges on the loans become due from the date of release of funds. However, the overhead charges accrued during the implementation period get amortised and recovered in maximum ten instalments. The recovery of overhead charges shall be accounted for as income during the year of receipt. Consequent upon switching over to mercantile system of accounting, balance of loan will be reflected as Loan and Advances during the financial year.

**8. Foreign Currency Transactions :**

**Transactions:** Foreign exchange transactions are recorded at the rate prevailing on the date of transaction.

**Translation to Euro:** Indian currency assets and liabilities at the year-end are stated at the rate of foreign exchange (euro) at the closing of financial year (31.03.2015).

**9. Grants Awarded - Recognition:**

Grants to an awardee are recognised as commitments based on recommendation of the Scientific Council and final approval of the Governing Body. Based on the commitments made to awardees in a year, aggregate grants are recognised as expenditure to the extent of payment made to each awardee during the year.

**10. Income Recognition:**

**Grants:** Grants from the two governments are (Department of Science & Technology of the Govt. of India and the Govt. of Germany (BMBF)) recognised in the Income & Expenditure Statements as Grant in Aid only on receipt of the funds from either side under the head Income in the Receipts & Payments Account and the Income & Expenditure Account.

**11. Fixed Assets:**

All the assets acquired for research projects remain with the institution where the research work is carried on. The Centre has, however, retained the right to transfer these assets to other institutions, if so required, on completion of the projects for which these assets were purchased. The expenditure on these assets has been accounted for in the Income and Expenditure Account under the head "Scientific Expenses". Hence, these assets have not been taken in the Balance Sheet of the Centre.

Fixed assets acquired by the Centre are stated at cost of acquisition less accumulated depreciation. The cost of an asset comprises of its purchase price and directly attributable costs of bringing the asset to working condition for its intended use.

During the year, the Centre has carried out the exercise of the physical verification of assets and no major discrepancies have come to notice.

2





12. All operational expenditure pertaining to German Government incurred in Germany are reported on the basis of statement of expenses.

13. All direct grant awards towards scientific projects by the German Government are neither recorded as receipt nor expenditure of the Centre, since the same are not received/ paid in India. However, the same is included in the "Notes to Accounts" on the basis of Statement received from Government of Germany.

#### B. NOTES TO ACCOUNTS:

1. Both governments have considered the allocation of equivalent amount of funds up to 10 million euros each to meet the objectives of the Centre and its running expenditure for an initial period of five years. The annual expenditure may be enlarged by mutual agreement. Out of the said contribution :

a) The Capital and Operating expenditure of the Centre and expenses on account of workshops, seminars, symposiums, preparatory visits, exploratory missions, etc shall be shared equally by the two Governments.

b) Expenditure for joint research projects shall be shared by the two Governments according to the distribution of costs for the respective parts of the project in each country.

2. During the period under reporting, the total expenditure till the reporting date are as under:

| S. No. | Nature of Expenditure                        | Amount (INR) | Amount (INR) |
|--------|--|--------------|--------------|
| I      | Establishment expenditure (Shareable )       |              | 1,81,86,528  |
|        | 1) Capital Expenditure                       | 1,02,390     |              |
|        | 2) Operational Expenditure                   | 1,80,84,138  |              |
|        | i) By IGSTC, Gurgaon : ₹ 1,45,95,267         |              |              |
|        | ii) By IB-BMBF : 34,88,870*                  |              |              |
| ii     | Scientific Workshop expenditure ( Shareable) |              | 76,088       |
|        | 1) By IGSTC, Gurgaon Rs. 12,96,895           | 76,088       |              |
|        | Less: refund received Rs. 12,20,807          |              |              |
|        | 2) By IB-BMBF                                |              |              |
| iii    | Total Shareable expenditure ( i + ii )       |              | 1,82,62,616  |
| iv     | Research Projects ( Non-shareable)           |              | 11,56,16,471 |
|        | 1) Paid by Indian Side to Indian Awardees    | 5,52,76,148  |              |
|        | 2) Paid by German Side to German Awardees    | 7,39,88,023  |              |
|        | Total Expenditure ( iii + iv )               |              | 13,38,79,087 |

(\*)As reported through IB/BMBF.



#### 3. Statement of Distribution of Shareable Expenses:

Amount in Rupees

| S. No. | Expenditure  | Total       | Allocable to Indian Side | Allocable to German Side |
|--------|--|-------------|--------------------------|--------------------------|
| 1      | Shareable expenditure                                      | 1,82,62,616 | 91,31,308                | 91,31,308                |
| 2      | Balance of contribution as on 1.4.2014 carried forward     |             | Nil                      | 1,27,03,623              |
|        | Net shareable expenditure                                  |             | 91,31,308                | (35,72,235)              |
| 3      | Contribution received from IB-BMBF during 2014-15          |             |                          | Nil                      |
|        | Balance of Contribution as on 31 <sup>st</sup> March, 2015 |             | Nil                      | (35,72,235)              |

#### 4. Status of Current Award Liabilities :

Amount in Rupees

| Awarded in 2+2 mode | Number of awards committed during the year | Amount committed | Amount released up to 31.3.2015 | Outstanding future commitments |
|---------------------|--|------------------|---------------------------------|--------------------------------|
| Indian Side         | 10   | 6,08,65,955      | 5,52,76,148**                   | 55,89,807                      |
| German Side         | 10   | 7,39,88,023      | 7,39,88,023***                  | -                              |
|                     | Total                                      | 13,90,93,226     | 12,92,64,171                    | 55,89,807                      |

(\*\*) includes Rs. 79, 78,750/- as loans given to industrial partners as per the terms of the agreement.

(\*\*\*) the project expense of the German side is for the period from 1.1.2014 to 31.12.2014

5. **Income Tax:** Income Tax Department [office of the Commissioner of Income Tax (E), New Delhi] has granted IGSTC registration under section 12A of the Income Tax Act, 1961 as General Public Utility vide their letter no CIT(E)/2014-15/DEL-IR24110-10122014/4089 dated 10/12/2014.

6. All expenditure and grant payment figures from the German Government side are reported in the Indian Currency at the exchange rates as per Reserve Bank of India as on the date of close of the financial year i.e. on 31<sup>st</sup> March, 2015 at Indian rupee at Euro 1 = Rupee 67.5104 .





7. All German expenditures reflected in the financial statements are based on the statements provided by the Govt. of Germany (IB-BMBF) to the Centre.

#### 8. Employees Welfare and other benefits:

- i. **Gratuity:** as per the rules under the Payment of Gratuity Act 1972,  
 ii. **Employee's Provident Fund:** Employees of Centre has been enrolled under the Employees Provident Fund Scheme of the Govt. of India (EPF). During the year 2014-15, IGSTC contributed Rs. 4,41,041 as employer's contribution to the EPF Account of the employees.

iii. **Leave Encashment:** As per the rule of Centre.

iv. As per the approval of Governing Body, all financial powers in respect of activities of the Centre is exercised by the Director after obtaining approval of the Governing Body.

v. There are no disputes / claims which are unsettled for a long time.

#### 9. Related parties Disclosures:

During the year no trust funds were utilized for the benefits of the settlers or the trustees other than reimbursement of expenses incurred by them.

10. An Extra Mural Programme under India-German (DST-MPG) Science & Technology Cooperation Programme by IGSTC under an agreement with Department of Science and Technology is being administered and managed from Indian side as per the approved activities under DST-MPG MOU signed by the Governments of India and Germany. A separate bank account, Statement of Expenditure & Utilisation Certificate are prepared and rendered to DST. The financial statements (Receipts & Payments Accounts, Income & Expenditure Accounts and Balance Sheet) are prepared separately and annexed to the Centre's financial statements.

11. Previous years' figures are rearranged/ regrouped wherever necessary.

### INDO GERMAN SCIENCE & TECHNOLOGY CENTRE BALANCE SHEET AS AT 31ST MARCH 2015

| Amount in INR                             |          |                                |                    |                                |                    |
|---|----------|--------------------------------|--------------------|--------------------------------|--------------------|
|   | Schedule | Amount as at<br>March 31, 2015 |                    | Amount as at<br>March 31, 2014 |                    |
| <b><u>SOURCE OF FUNDS</u></b>             |          |                                |                    |                                |                    |
| <b>Capital Fund</b>                       |          |                                |                    |                                |                    |
| Opening Balance                           |          | 8,44,40,067                    |                    | 7,82,02,214                    |                    |
| Add : Surplus/(Deficit)                   |          | 35,04,013                      | 8,79,44,080        | 62,37,853                      | 8,44,40,067        |
| <b>Current Liabilities</b>                |          |                                |                    |                                |                    |
|   | I        |                                | 60,64,494          |                                | 75,000             |
| <b>TOTAL</b>                              |          |                                | <b>9,40,08,574</b> |                                | <b>8,45,15,067</b> |
| <b><u>APPLICATION OF FUNDS</u></b>        |          |                                |                    |                                |                    |
| <b>Fixed Assets</b>                       |          |                                |                    |                                |                    |
| Gross Block                               | A        | 4,87,278                       |                    | 6,65,912                       |                    |
| Add: Addition during the year             |          | 1,02,390                       |                    |                                |                    |
| <b>Total</b>                              |          | <b>5,89,668</b>                |                    |                                |                    |
| Less : Sale during the year               |          | -                              |                    |                                |                    |
| Less: Depreciation                        |          | 1,28,234                       |                    | 1,78,634                       | 4,87,278           |
| Net Block                                 |          |                                | 4,61,435           |                                |                    |
| <b>Cash and Bank Balances</b>             |          |                                |                    |                                |                    |
| Cash in hand                              |          | 2,146                          |                    | 2,512                          |                    |
| Balance with Bank                         | J        | 7,64,57,993                    | 7,64,60,139        | 8,40,25,277                    | 8,40,27,789        |
| <b>Loans and Advances</b>                 |          |                                |                    |                                |                    |
|   | K        |                                | 1,70,87,000        |                                |                    |
| <b>TOTAL</b>                              |          |                                | <b>9,40,08,574</b> |                                | <b>8,45,15,067</b> |
| Accounting policies and notes on accounts | L        |                                |                    |                                |                    |

As per our report of even date.

For SSAS & ASSOCIATES  
Firm Registration No. 08550N  
Chartered Accountants

-sd-  
Alpana Saxena  
Partner  
Membership No. 095837

Place : New Delhi  
Date : 28 Sep. 2015

-sd-  
S. S. SENGUPTA  
MANAGER ACCOUNTS & ADMIN.

-sd-  
A. CHAKRABORTY  
DIRECTOR





**INDO GERMAN SCIENCE & TECHNOLOGY CENTRE**  
**INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31ST MARCH, 2015**

|  | Schedule | Amount for the year<br>ended March 31, 2015 | Amount for the year<br>ended March 31, 2014 |
|--|----------|---|---|
| <b>INCOME</b>  |          |   |   |
| <b>Grant-in-aid</b> : Contribution from Department of Science and Technology, Govt. of India |          | 6,00,00,000                                 | 3,00,00,000                                 |
| <b>Contribution</b> from Govt. of Germany  |          | -   | 2,19,39,015                                 |
| Contribution ( through expendiutre intimated by BMBF) from Govt. of Germany € 51678.62 )     |          | 34,88,870                                   | 43,20,392                                   |
| Interest from Bank Accounts Banks in India   |          | 23,79,869                                   | 43,31,062                                   |
| Disposal of old newspaper  |          | 1,044                                       | 230   |
| Unspent amount refunded from workshop  |          | -   | 1,95,109                                    |
| <b>TOTAL</b>   |          | <b>6,58,69,783</b>                          | <b>6,07,85,808</b>                          |
| <b>EXPENDITURE</b>   |          |   |   |
| Scientific Project Expenses of the Centre  | B        | 4,36,77,624                                 | 1,67,84,398                                 |
| Governing Body/ Scientific Council Expenses  | C        | 17,21,043                                   | 18,65,895                                   |
| Travelling Expenses (National & International)   | D        | 6,21,946                                    | 10,45,722                                   |
| Office Expenses  | E        | 1,04,88,603                                 | 1,03,95,512                                 |
| Salaries   | F        | 55,56,604                                   | 44,49,001                                   |
| Scientific Workshop Expenses of the Centre   | G        | 76,088                                      | 1,84,60,449                                 |
| Other Meetings / Conference  | H        | 95,628                                      | 13,68,344                                   |
| Depreciation on Fixed Assets   | A        | 1,28,234                                    | 1,78,634                                    |
| <b>TOTAL</b>   |          | <b>6,23,65,770</b>                          | <b>5,45,47,955</b>                          |
| Surplus/(Deficit) of Income over expenditure carried over to Balance Sheet                   |          | <b>35,04,013</b>                            | <b>62,37,853</b>                            |
| Accounting policies and notes on accounts  | G        |   |   |

As per our report of even date.

For SSAS & ASSOCIATES  
Firm Registration No. 08550N  
Chartered Accountants

-sd-  
Alpana Saxena  
Partner  
Membership No. 095837

-sd-  
S. S. SENGUPTA  
MANAGER ACCOUNTS &  
ADMIN.

-sd-  
A. CHAKRABORTY  
DIRECTOR

Place : New Delhi  
Date : 28 Sep. 2015

**INDO GERMAN SCIENCE & TECHNOLOGY CENTRE**  
**RECEIPT AND PAYMENT ACCOUNT FOR THE YEAR ENDED ON 31ST MARCH, 2015**

| Amount in INR   |          |   |                     |   |                     |
|---|----------|---|---------------------|---|---------------------|
|   | Schedule | Amount for the year<br>ended March 31, 2015 |                     | Amount for the year<br>ended March 31, 2014 |                     |
| <b>A. Opening balance</b>   |          |   |                     |   |                     |
| Cash in hand  |          | 2,512                                       |                     | 4,490                                       |                     |
| Cash at Bank  |          | 8,40,25,277                                 | 8,40,27,789         | 7,75,58,802                                 | 7,75,63,292         |
| <b>B. Receipts</b>  |          |   |                     |   |                     |
| <b>Grant-in-aid</b> : Contribution from Dept. of Science and Technology, Govt. of India |          |   | 6,00,00,000         | 3,00,00,000                                 |                     |
| <b>Contribution</b> from Government of Germany (  |          |   | -                   | 2,19,39,015                                 | 5,19,39,015         |
| Interest from Bank Accounts   |          |   | 23,79,869           | -   | 43,31,062           |
| Amount of Tax Deducted at Source (TDS)  |          |   | -                   | -   | 10,29,909           |
| Amount of GPF, HBA ,RGIS recovered on behalf of CSIR for A. Chakraborty, Director       |          |   | -                   | -   | 3,63,180            |
| Amount wrongly received in main A/c   |          |   | -                   | -   | 75,000              |
| Disposal of old newspaper   |          |   | 1,044               | -   | 230                 |
| Unspent amount refunded from workshop Call -2012  |          |   | 12,20,807           | -   | 1,95,109            |
| unspent amount refunded from ICGEB for IGSTC 2+2 Project                                |          |   | 1,01,331            | -   | -                   |
| <b>TOTAL</b>  |          |   | <b>14,77,30,840</b> |   | <b>13,54,96,797</b> |
| <b>Payments</b>   |          |   |                     |   |                     |
| <b>C. Project Expense ( Non -shareable)</b>   |          |   |                     |   |                     |
| Scientific project expenses of the Centre   |          |   | 5,52,76,148         |   | 1,67,84,398         |
| <b>D. Scientific Expense ( Shareable)</b>   |          |   |                     |   |                     |
| Scientific Workshop   |          | 12,96,895                                   |                     | 1,84,60,449                                 |                     |
| Other Meetings / Conference   |          | 95,628                                      | 13,92,523           | 13,68,344                                   | 1,98,28,793         |
| <b>E. Establishment Expense ( Sharable)</b>   |          |   |                     |   |                     |
| Governing Body/ Scientific Council Expenses   |          | 17,21,043                                   |                     | 18,65,895                                   |                     |
| Travelling Expenses (National & International)  |          | 6,21,946                                    |                     | 10,45,722                                   |                     |
| Office Expenses   |          | 65,36,205                                   |                     | 60,75,119                                   |                     |
| Salaries  |          | 38,25,707                                   |                     | 44,49,001                                   |                     |
| Purchase of Office Equipment  |          | 18,000                                      |                     | 21,375                                      |                     |
| Purchase of Furniture & Fixtures  |          | -   |                     | -   |                     |
| Purchase of Computer/Printer  |          | 84,390                                      | 1,28,07,291         | 5,199                                       | 1,34,62,311         |
| <b>D. Other Payments</b>  |          |   |                     |   |                     |
| TDS Payments  |          | 12,06,558                                   |                     | 10,29,909                                   |                     |
| Amount recovered on behalf of CSIR, Delhi   |          | 5,13,180                                    |                     | 3,63,180                                    |                     |
| MPG fellowship amount refunded but credited erroneously                                 |          | 75,000                                      | 17,94,738           | 417   | 13,93,506           |
| <b>E. Closing Balance</b>   |          |   |                     |   |                     |
| Cash in hand  |          | 2,146                                       |                     | 2,512                                       |                     |
| Bank Balances   |          | 7,64,57,993                                 | 7,64,60,139         | 8,40,25,277                                 | 8,40,27,789         |
| <b>TOTAL</b>  |          |   | <b>14,77,30,840</b> |   | <b>13,54,96,797</b> |
| Accounting policies and notes on accounts   | G        |   |                     |   |                     |

As per our report of even date.

For SSAS & ASSOCIATES  
Firm Registration No. 08550N  
Chartered Accountants

-sd-  
Alpana Saxena  
Partner  
Membership No. 095837

-sd-  
S. S. SENGUPTA  
MANAGER ACCOUNTS & ADMIN.

-sd-  
A. CHAKRABORTY  
DIRECTOR

Place : New Delhi  
Date : 28 Sep. 2015



**SCHEDULES FORMING PART OF THE BALANCE SHEET AND  
THE INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED ON 31ST MARCH 2015**

**Schedule ' A '  
Fixed Assets**

| S.NO | PARTICULARS              | Rate of Depreciation | GROSS BLOCK     |                          |                |             | Amount in INR   |                           |                                   |
|------|--------------------------|----------------------|-----------------|--------------------------|----------------|-------------|-----------------|---------------------------|-----------------------------------|
|      |                          |                      | Balance as on   | Addition during the year |                | SOLD DURING | TOTAL           | DEPRECIATION FOR THE YEAR | NET BLOCK BALANCE AS ON 31-3-2015 |
|      |                          |                      | 1-4-2014        | UPTO 30-09-14            | AFTER 30-09-14 | THE YEAR    |                 |                           |                                   |
| 1    | Computer and Peripherals | 60%                  | 79,920          | -                        | 84,390         | -           | 1,64,310        | 73,269                    | 91,041                            |
| 2    | Office Equipment         | 15%                  | 2,30,574        | 18,000                   | -              | -           | 2,48,574        | 37,286                    | 2,11,288                          |
| 3    | Furniture & Fixture      | 10%                  | 1,76,784        | -                        | -              | -           | 1,76,784        | 17,678                    | 1,59,105                          |
|      | <b>TOTAL</b>             |                      | <b>4,87,278</b> | <b>18,000</b>            | <b>84,390</b>  | <b>-</b>    | <b>5,89,668</b> | <b>1,28,234</b>           | <b>4,61,435</b>                   |
|      | Perivous Year            |                      | 6,39,338        | 8,699                    | 17,875         |             | 6,65,912        | 1,78,634                  | 4,87,278                          |

| Schedules  | Amount for the year ended<br>March 31, 2015 | Amount for the year ended<br>March 31, 2014 |
|--|---|---|
| <b>Schedule 'B'</b><br><b>Scientific Expenses of the centre (India Side)</b>                   |   |   |
| <b>Research Projects - Grant</b>   |   | 1,40,55,648                                 |
| 1 Compact Linear Fresnel Reflector (CLFR) for Solar Thermal Power and Process Heat -IIT Bombay | 14,08,493                                   |   |
| 2 Remsolar Project - IIT Kanpur  | 77,92,000                                   |   |
| 3 IN-DUES Project - IISC Bangalore   | 41,00,000                                   |   |
| 4 Nanotrans Project -University of Delhi   | 33,78,712                                   |   |
| 5 NDT - DATA -SERC, Chennai  | 18,30,000                                   |   |
| 6 Npore - Hyberabad  | 23,68,000                                   |   |
| 7 AMPLAST Project - IIT Madras   | 1,16,00,000                                 |   |
| 8 DNDHCSA Project - CSIR, CMERI  | 42,00,000                                   |   |
| 9 DP- Forge Project - IIT Madras   | 82,30,000                                   |   |
| 10 SeNaMeB Project - ICT Chennai   | 79,80,000                                   |   |
|  | 5,28,87,205                                 |   |
| Less : Unspent balance recived from ICGEB for IGSTC 2+ 2 Project                               | 1,01,331                                    | 5,27,85,874                                 |
| <b>Loan Given to industrial partners for Scientific Projects</b>                               |   | 27,28,750                                   |
| Less: Perivous Year releases of Loan   | 91,08,250                                   | -91,08,250                                  |
|  | <b>4,36,77,624</b>                          |   |
|  | <b>4,36,77,624</b>                          | <b>1,67,84,398</b>                          |

|  |                  |          |                  |
|--|------------------|----------|------------------|
| <b>Schedule 'C'</b><br><b>Governing Body/ Scientific Council Expense</b>                 |                  |          |                  |
| Governing Body Meeting ( VI GB in Germany , amount after adjustment of unspent of euro ) | 12,81,172        | 8,90,579 |                  |
| Scientific Council Meeting   | 4,39,871         | 9,75,316 | 18,65,895        |
|  |                  |          |                  |
|  | <b>17,21,043</b> |          | <b>18,65,895</b> |

|   |                 |          |                  |
|---|-----------------|----------|------------------|
| <b>Schedule ' D '</b><br><b>Travelling Expenses</b> |                 |          |                  |
| Travel with in India                                | 3,53,272        | 1,45,419 |                  |
| Travel Abroad                                       | 2,68,674        | 9,00,303 | 10,45,722        |
|   |                 |          |                  |
|   | <b>6,21,946</b> |          | <b>10,45,722</b> |

|  |                    |           |                    |
|--|--------------------|-----------|--------------------|
| <b>Schedule ' E '</b><br><b>Office Expense</b> |                    |           |                    |
| Advertisement Expense                          | 70,251             | 16,500    |                    |
| Transportation Expense                         | 5,50,272           | 4,62,633  |                    |
| Telephone & Internet Expenses                  | 2,44,417           | 2,18,452  |                    |
| Printing & Stationery                          | 1,08,714           | 95,065    |                    |
| Postage and Courier Expenses                   | 19,402             | 9,010     |                    |
| Office Rent                                    | 42,47,208          | 39,32,600 |                    |
| Staff Welfare Expense                          | 25,009             | 17,679    |                    |
| Electricity, Water & Other Maintenance charges | 7,01,127           | 7,24,721  |                    |
| Legal and Professional Expense                 | 7,18,686           | -         |                    |
| Miscellaneous Office Expenses                  | 3,14,647           | 5,98,460  |                    |
| Operational Expenses by IB-BMBF, ( € 51679)    | 34,88,870          | 43,20,393 | 1,03,95,513        |
|  | <b>1,04,88,603</b> |           | <b>1,03,95,513</b> |

**Schedule ' F '**

|   | Amount in INR |                  |           |                  |
|---|---------------|------------------|-----------|------------------|
| <b>Salaries</b><br>Salary including liability for Leave Salary contribution , Pension contribution , Rent and Licence fee for director, IGSTC | 54,57,675     |                  | 43,60,968 |                  |
| Medical   | 98,929        | 55,56,604        | 88,033    | 44,49,001        |
|   |               | <b>55,56,604</b> |           | <b>44,49,001</b> |

**Schedule 'G'**

|   | Amount in INR |               |
|---|---------------|---------------|
| <b>Scientific Workshop</b>  |               |               |
| <b>Indo German Joint Workshop</b>   |               |               |
| 1 Strategies and Concepts for Advanced Manufacturing ( INAE, Delhi )              | 2,01,588      |               |
| 2 Microbial ecology and application of incoulants in bio-control ( Ecology IARI ) | 36,212        |               |
| Surfactants and amphiphilic polymers in nanotechnology-On the way                 | 3,82,789      |               |
| 3 smarter formulations ( Poly - PU)   |               |               |
| Diagnostics and translational Genome sequencing in clinical and public            | 1,06,782      |               |
| 4 health microbiology ( Health - THSTI )  |               |               |
| Advances in Medical Technology towards Current Health Care Necessities            | 3,60,008      |               |
| 5 held in Manipal   |               |               |
| 6 Water and Wastewater Management for Sustainable ( Water -IITD)                  | 2,09,516      | 12,96,895     |
| Less: Unspent balance refunded  |               | -12,20,807    |
|   |               | <b>76,088</b> |

**Schedule ' H '**

|                                    |               |
|------------------------------------|---------------|
| <b>Other Meetings / Conference</b> |               |
| 1 Scientific Committee Meeting     | 95,628        |
|                                    | <b>95,628</b> |

**Schedule 'I'**

|  |                  |
|--|------------------|
| <b>Current Liabilities</b>                                     |                  |
| <b>Current Period Liabilities</b>                              |                  |
| 1 Leave Salary Contribution , HRA and Licence                  | 4,74,687         |
| Fee in respect of Director , IGSTC                             |                  |
| <b>Project Releases - Grants (instalments due in 2014-15 )</b> |                  |
| 1 IN - DUES  | 6,48,806         |
| 2 NANOTRANS  | 7,43,001         |
| 3 NDT DATA FUSION  | 18,30,000        |
| 4 NPORE  | 23,68,000        |
|  | 55,89,807        |
|  | <b>60,64,494</b> |
|  | <b>60,64,494</b> |

**Schedule "J"**

|                       |             |                    |
|-----------------------|-------------|--------------------|
| 1 Axis Bank           | 5,30,66,250 |                    |
|                       | 3,00,000    | 5,33,66,250        |
| 2 Axis Bank           |             | 9,47,349           |
| 3 Union Bank of India |             | 2,21,44,395        |
|                       |             | 7,64,57,993        |
|                       |             | <b>7,64,57,993</b> |

**Schedule "K"**

|                                |                    |
|--------------------------------|--------------------|
| <b>Loans and Advances</b>      |                    |
| Nuziveedu Seeds Pvt Ltd        | 29,01,250          |
| Krishidhan Research Foundation | 15,50,750          |
| Thermax Ltd                    | 60,00,000          |
| Bharat Forge                   | 60,75,000          |
| Dhvani Research Pvt Ltd        | 5,60,000           |
|                                | 1,70,87,000        |
|                                | <b>1,70,87,000</b> |



**SSAS & Associates****CHARTERED ACCOUNTANTS**

D-147, Pushpanjali Enclave Pitampura, Delhi-110034

Tel: 91.11. 27010841; 91.9868144009, Email: [sansaxonline@gmail.com](mailto:sansaxonline@gmail.com)

Date: 28.09.2015

**INDEPENDENT AUDITOR'S REPORT**

To the Governing Body of  
**Head, International Bilateral Cooperation Division (IBCD)**  
**& Co- chair, Indo- German Science and Technology centre,**  
**Department of Science & Technology, New Delhi**

**Report on financial Statements**

We have audited the accompanying financial statements of **Indo Indo-German Science and Technology Centre, with respect to EMR Programme concerning management and administration of Indo- German (DST-MPG) Science and Technology Centre, New Delhi** which comprise the Balance Sheet as at March 31, 2015, the Income and Expenditure Account, the Receipts and Payments Account for the year then ended and a summary of significant accounting policies and other explanatory information.

**Management's Responsibility for the Financial Statements**

Management is responsible for the preparation of these financial statements that give a true and fair view of the financial position and financial performance of the Society. This responsibility includes the design, implementation and maintenance of internal control relevant to the preparation and presentation of the financial statements that give a true and fair view and are free from material misstatement, whether due to fraud or error.

**Auditor's Responsibility**

Our responsibility is to express an opinion on these financial statements based on our audit. We conducted our audit in accordance with the Standards on Auditing issued by the Institute of Chartered Accountants of India. Those Standards require that we comply with ethical requirements and plan and perform the audit to obtain reasonable assurance about whether the financial statements are free from material misstatement.

An audit involves performing procedures to obtain audit evidence about the amounts and disclosures in the financial statements. The procedures selected depend on the auditor's judgement, including the assessment of the risks of material misstatement of the financial statements, whether due to fraud or error. In making those risk assessments, the auditor considers internal control relevant to the Society's preparation and fair presentation of the financial statements in order to design audit procedures that are appropriate in the circumstances, but not for the purpose of expressing an opinion on effectiveness of the society's internal control. An audit also includes evaluating the appropriateness of accounting policies used and the reasonableness of the accounting estimates made by management, as well as evaluating the overall presentation of the financial statements.

We believe that the audit evidence we have obtained is sufficient and appropriate to provide a basis for our audit opinion.

**Opinion**

In our opinion and to the best of our information and according to the explanations given to us, the accompanying financial statements give a true and fair view of the financial position of **Indo Indo-German Science and Technology Centre, with respect to EMR Programme concerning management and administration of Indo- German (DST-MPG) Science and Technology Centre, New Delhi** for the year ended March 31, 2015 in conformity with the accounting principles generally accepted in India.

**For SSAS & ASSOCIATES,**  
 Chartered Accountants  
 Firm Registration No: 08550N

  
**ALPANA SAXENA**  
 Partner  
 Membership No. 095837  
 Place : Delhi





**INDO - GERMAN SCIENCE & TECHNOLOGY CENTRE**  
**INDIA GERMAN (DST - MPG) Science & Technology Co-operation Programme**

**BALANCE SHEET AS AT 31ST MARCH 2015**

Amount in INR

|   | Schedule | Amount as at<br>March 31, 2015 |                  | Amount as at<br>March 31, 2014 |                  |
|---|----------|--------------------------------|------------------|--------------------------------|------------------|
| <b>SOURCE OF FUNDS</b>  |          |                                |                  |                                |                  |
| <b>Operational Reserve Fund</b>   |          |                                |                  |                                |                  |
| Opening Balance   |          | 1,043,633                      |                  |                                |                  |
| Add : Surplus/(Deficit)   |          | 1,271,279                      |                  | 1,043,633                      |                  |
|   |          |                                | 2,314,912        |                                | 1,043,633        |
| <b>Balance Funds of DST-MPG Programme</b>   |          |                                |                  |                                |                  |
| Balance funds out of receipts<br>from Department of Science and<br>Technology, Govt. Of India | A        |                                | 4,968,778        |                                | 293,100          |
| <b>TOTAL</b>  |          |                                | <b>7,283,690</b> |                                | <b>1,336,733</b> |
| <b>APPLICATION OF FUNDS</b>   |          |                                |                  |                                |                  |
| <b>Fixed Assets</b>   |          |                                |                  |                                |                  |
| Gross Block   | B        | 128,639                        |                  | 193,945                        |                  |
| Less: Depreciation to date  |          | 37,781                         |                  | 65,306                         |                  |
| Net Block   |          |                                | 90,858           |                                | 128,639          |
| <b>Current Assets</b>   |          |                                |                  |                                |                  |
| <b>Cash and Bank Balances</b>   |          |                                |                  |                                |                  |
| Cash in hand  |          | -                              |                  | 438                            |                  |
| Axis Bank Saving Bank Account   |          | 7,192,832                      | 7,192,832        | 1,207,657                      | 1,208,094        |
| <b>TOTAL</b>  |          |                                | <b>7,283,690</b> |                                | <b>1,336,733</b> |
| Accounting policies and notes on accounts   | D        |                                |                  |                                |                  |

As per our report of even date.

**For SSAS & ASSOCIATES**

Firm Registration No. 08550N

Chartered Accountants

**-sd-**  
**Alpana Saxena**  
 Partner, Membership No. 095837

**-sd-**  
**S. S. SENGUPTA**  
 MANAGER ACCOUNTS & ADMIN.

**-sd-**  
**A. CHAKRABORTY**  
 DIRECTOR

Place : New Delhi

Date :

**INDO GERMAN SCIENCE & TECHNOLOGY CENTRE**  
**INDIA GERMAN (DST - MPG) Science & Technology Co-operation Programme**  
**INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31ST MARCH, 2014**

Amount in INR

|   | Schedule | Amount for the year<br>ended March 31, 2015 | Amount for the year<br>ended March 31, 2014 |
|---|----------|---|---|
| <b>INCOME</b>   |          |   |   |
| Allocation expense  |          | 1,731,642                                   | 371,862                                     |
| Unspent amount of project received  |          | 16,745                                      |   |
| Amount received from IGSTC main account<br>for fellowship, which was wrongly credited . |          | 75,000                                      |   |
| <b>TOTAL</b>  |          | <b>1,823,387</b>                            | <b>371,862</b>                              |
| <b>EXPENDITURE</b>  |          |   |   |
| Meeting Expenses  |          | 5,599                                       | 4,975                                       |
| Office Expenses   |          | 304,729                                     | 382,461                                     |
| Salaries  |          | 204,000                                     | 396,250                                     |
| Depreciation on Fixed Assets  | B        | 37,781                                      | 65,306                                      |
| <b>TOTAL</b>  |          | <b>552,109</b>                              | <b>848,992</b>                              |
| Surplus/(Deficit) of Income over expenditure  |          | 1,271,278                                   | -477,130                                    |
| Balance brought forward from balance sheet  |          |   | 1,520,763                                   |
| Balance carried over to balance sheet   |          | <b>1,271,278</b>                            | <b>1,043,633</b>                            |
| Accounting policies and notes on accounts   | E        |   |   |

As per our report of even date.

**For SSAS & ASSOCIATES**

Firm Registration No. 08550N

Chartered Accountants

**-sd-**  
**Alpana Saxena**  
 Partner, Membership No. 095837

**-sd-**  
**S. S. SENGUPTA**  
 MANAGER ACCOUNTS & ADMIN.

**-sd-**  
**A. CHAKRABORTY**  
 DIRECTOR

Place : New Delhi

Date :



**INDO GERMAN SCIENCE & TECHNOLOGY CENTRE  
INDIA GERMAN (DST - MPG) Science & Technology Co-operation Programme**

**RECEIPT AND PAYMENT ACCOUNT FOR THE YEAR ENDED ON 31ST MARCH, 2015**

| Amount in INR  |          |  |            |  |
|--|----------|--|------------|--|
|  | Schedule | Amount for the year ended March 31, 2015 |            | Amount for the year ended March 31, 2014 |
| <b>A. Opening balance</b>  |          |  |            |  |
| Cash in hand   |          | 438                                      | -          |  |
| Axis Bank Saving Bank Account  |          | 1,207,657                                | 1,208,094  | 5,595,192                                |
| <b>B. Receipts</b>   |          |  |            |  |
| Fund received from Dept. of Science and Technology , Govt of India towards MPG Programme |          | 23,538,812                               |            |  |
| Interst on saving bank account   |          | 184,926                                  |            |  |
| Amount received from IGSTC main account for fellowship, which was wrongly credited       |          | 75,000                                   |            |  |
| Unspent amount of project received   |          | 16,745                                   | 23,815,483 |  |
| <b>Total</b>   |          | <b>25,023,577</b>                        |            | <b>5,595,192</b>                         |
| <b>C. Payments</b>   |          |  |            |  |
| Grants Sanctioned and released as per MPG  | C        | 17,316,418                               |            | 3,718,621                                |
| Meeting Expenses   |          | 5,599                                    |            | 4,975                                    |
| Office Expenses  | D        | 508,729                                  |            | 778,711                                  |
| Purchase of Office Equipment   | B        | -  |            | 5,900                                    |
| Purchase of Computer & Printer   | B        | -  | 17,830,746 | 14,990                                   |
| <b>D. Closing Balance</b>  |          |  |            |  |
| Cash in hand   |          | -  | 438        |  |
| Axis Bank Saving Bank Account  |          | 7,192,832                                | 7,192,832  | 1,207,657                                |
| <b>Total</b>   |          | <b>25,023,577</b>                        |            | <b>5,731,291</b>                         |
| Accounting policies and notes on accounts  | D        |  |            |  |

As per our report of even date.

**For SSAS & ASSOCIATES**

Firm Registration No. 08550N  
Chartered Accountants

**-sd-**  
**Alpana Saxena**  
Partner, Membership No. 095837

**-sd-**  
**S. S. SENGUPTA**  
MANAGER ACCOUNTS & ADMIN.

**-sd-**  
**A. CHAKRABORTY**  
DIRECTOR

Place : New Delhi  
Date :

**INDO GERMAN SCIENCE & TECHNOLOGY CENTRE  
EMR Programme - Indo German (DST-MPG) Science & Technolgy Co-operation  
SCHEDULE FORMING PART OF BALANCE SHEET,INCOME & EXPENDITURE AND RECEIPT AND PAYMENT ACCOUNT FOR THE YEAR ON  
31ST MARCH,2015**

| Amount In INR   |   |                    |   |                  |
|---|---|--------------------|---|------------------|
|   | Amount for the year ended March 31,2015 |                    | Amount for the year ended March 31,2014 |                  |
| <b>Schedule - 'A'</b>   |   |                    |   |                  |
| <b>Balance Funds of DST-MPG Progamme</b>  |   |                    |   |                  |
| <b>Opening Balance</b>  | 2,93,100                                |                    | 42,47,484                               |                  |
| <b>Receipts</b>   |   |                    |   |                  |
| Fund received from Dept.of Science and Technolgy, Govt. of India towards MPG progamme | 2,35,38,812                             |                    | -                                       |                  |
| Interest on saving bank account   | 1,84,926                                | 2,40,16,838        | 1,36,099                                |                  |
|   |   | <b>2,40,16,838</b> |   | <b>43,83,583</b> |
| <b>Utilisation</b>  |   |                    |   |                  |
| Grant sanctioned and released as per MPG Progamme                                     | 1,73,16,418                             |                    | 37,18,621                               |                  |
| Allocation of management expenses   | 17,31,642                               | 1,90,48,060        | 3,71,862                                | 40,90,483        |
| Less: Excess of Management expense  |   | 49,68,778          |   | 2,93,100         |
|   |   | <b>49,68,778</b>   |   | <b>2,93,100</b>  |

**Schedule ' B '**

Fixed Assets

| Amount In INR |                    |                          |   |                  |                      |              |              |
|---------------|--------------------|--------------------------|---|------------------|----------------------|--------------|--------------|
| S. No.        | Particulars        | GROSS BLOCK              |   |                  |                      | DEPRECIATION | NET BLOCK    |
|               |                    | Balance as on 01.04.2014 | Additions during the Year upto 30.09.2014 | after 30.09.2014 | Sold during the year | Total        | For the Year |
|               |                    |                          |   |                  |                      |              |              |
| 1             | Computer & Moniter | 41,079                   | -   | -                | -                    | 41,079       | 24,647       |
| 2             | Office Equipment   | 87,560                   | -   | -                | -                    | 87,560       | 13,134       |
|               |                    |                          |   |                  |                      |              |              |
|               | Total              | 1,28,639                 | -   | -                | -                    | 1,28,639     | 37,781       |

**Schedule -'C'**

Amount In INR

|                            |   |                    |
|----------------------------|---|--------------------|
| <b>Partner Groups - PG</b> |   |                    |
| 1                          | Genetic Diversity studies - CDFD Hyderabad  | 12,03,161          |
| 2                          | Structural Biology of Vesicular Trafficking - IISER Bhopal                                | 10,30,464          |
| 3                          | Chemical Ecology - IISER Kolkata  | 12,14,087          |
| 4                          | Tropospheric OH Reactivity -IISER Mohali  | 12,42,560          |
| 5                          | Glyconano Technology - IISER Pune   | 8,17,378           |
| 6                          | Gravitational Wave - IISER Thiruvananrhapuram   | 10,57,798          |
| 7                          | Cosomolgy and Gravity - IISER Thiruvananrhapuram  | 11,98,439          |
| 8                          | Polymer Research - IIT Guwahati   | 5,89,000           |
| 9                          | Regulation of RNA splicing - IISER Mohali   | 13,50,000          |
| 10                         | Asymmertic Organcatalysis - IIT Guwahati  | 13,35,681          |
| 11                         | Atmospheric Science -IIT Madras   | 12,49,189          |
| 12                         | Celluar Membrances in stress singalling and protein homeostasis maintenance - CSIR - CCMB | 14,00,000          |
| 13                         | Multifunctional Hybrid Nanostructures for alternative energy                              | 13,00,000          |
| 14                         | Coupling and Dynamics of solar atmosphere - IUCAA Pune                                    | 13,50,000          |
|                            | <b>A. Total</b>   | <b>1,63,37,757</b> |



|  |                    |
|--|--------------------|
| <b>Fellowship</b>  |                    |
| 1 Polyphasic taxonomic Characterization of marine bacteria and analyses of the microbial diversity - IMT Chandigarh  | 75,000             |
| 2 Transition metal dithiolato complexes as functional modles for hydrogenases - University of Delhi  | 75,000             |
| 3 Deciphering the role of the flanking N- and C-terminal regions in the modulation of phtotocycle kinetics of a LOV domain of a marine algal phototorpin - University of Delhi South Campus  | 73,421             |
| 4 Preparation and Characterization of Semiconductor Photo catalysts for surface Reaction Dynamics Study and their applicatins - DBCRUST  | 75,000             |
| 5 Physiology of Mixotrophic Planktonic Bacteria - IMT Chandigarh   | 75,000             |
| 6 Inflationary cosmology and its connection to particle physics - Saha Institute of Nuclear Physics, Kolkata   | 74,278             |
| 7 Investigating the role of glucosinolate content forwards plant fitness in Brassica junceto - NIPGR , New Delhi   | 75,000             |
| 8 Inflationary cosmology and its connection to particle physics - Saha Institute of Nuclear Physics, Kolkata   | 80,962             |
| 9 Sub-fs control of photo -synamics in atoms using shaped XUV pulsesto -IISER Mohali   | 75,000             |
| 10 Applications of metabolite transcript and flux measurments to investigate the effect of elevated ozone and carbon dioxide on yield and pest protection of C3 and C4 crops - BHU , Banaras | 75,000             |
| 11 Direct patterning of vortex generating diffractive optical elements on fibre tip using a focused ion beam   | 75,000             |
| 12 Cooperative control and consensus - IIT Bombay  | 75,000             |
| 13 Water based nanocomposite dispersions as antimicrobial coatings - IIT Bombav  | 75,000             |
| <b>B. Total</b>  | <b>9,78,661</b>    |
| <b>TOTAL ( A+B)</b>  | <b>1,73,16,418</b> |

|                         |               |
|-------------------------|---------------|
| <b>Schedule -D'</b>     | Amount In INR |
| 1 Salaries              | 2,04,000      |
| 2 Miscellaneous Expense | 3,04,729      |
|                         | 5,08,729      |

Notes on Accounts

1. funds received under DST-MPG Programme vide MoU dated September, 2011 are being manged on behalf of DST as per the mandate given in the said MoU. Therfore the funds do not form part of grant/income of IGSTC

| 2. Status of Current Awards Liabilites |               |           |                  |                         |                         | Amount In INR           |                         |                         |
|--|---------------|-----------|------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|
| Particulars                            | No. of Awards | Committed | Amount Committed | Amount Released 2011-12 | Amount Released 2012-13 | Amount Released 2013-14 | Amount Released 2014-15 | Outstanding Commitments |
| Indian Principle Investigator          | 34            |           | 5,27,15,760      | 86,97,920               | 1,36,00,112             | 37,23,503               | 1,73,16,418             | 93,77,807               |



Financial Statements  
Audit Report 2015-16





**RAJEEV NEELAM & ASSOCIATES**  
Chartered Accountants

H.O. : D-2/16, Darya Ganj, New Delhi - 110002  
Phone : +91 11 23282925, 23263436  
E-mail : rajeevna@gmail.com

### INDEPENDENT AUDITOR'S REPORT

TO,  
THE MEMBERS OF GOVERNING BODY,  
Indo-German Science and Technology Centre (IGSTC) - Core  
New Delhi,

### REPORT ON THE FINANCIAL STATEMENTS

We have audited the accompanying financial statements of Indo German Science and Technology Centre, - Core, New Delhi, (A society registered under Societies Registration Act, 1960) which comprise the Balance Sheet as at March 31, 2016, the Statement of Income and Expenditure and the Receipts and Payments for the year then ended, and a summary of significant accounting policies and other explanatory information.

### Management's Responsibility for the Financial Statements

The IGSTC management is responsible for the preparation and presentation of these financial statements that give a true and fair view of the financial position, financial performance and receipts and payment of the IGSTC in accordance with the accounting principles generally accepted in India, including the Accounting Standards issued by the Institute of Chartered Accountants of India. This responsibility also includes maintenance of adequate accounting records in accordance with the provisions of the Indian Laws applicable to IGSTC for safeguarding its assets and for preventing and detecting frauds and other irregularities; selection and application of appropriate accounting policies; making judgements and estimates that are reasonable and prudent; and design, implementation and maintenance of adequate internal financial controls, that were operating effectively for ensuring the accuracy and completeness of the accounting records, relevant to the preparation and presentation of the financial statements that give a true and fair view and are free from material misstatement, whether due to fraud or error.

### Auditor's Responsibility

Our responsibility is to express an opinion on these financial statements based on our audit.

We have taken into account the provisions of the Indian Laws applicable to IGSTC, the accounting and auditing standards and matters which are required to be included in the audit report under the provisions of the said the Indian Laws and the Rules made thereunder.

We conducted our audit in accordance with the Standards on Auditing issued by the Institute of Chartered Accountants of India. Those Standards require that we comply with ethical requirements and plan and perform the audit to obtain reasonable assurance about whether the financial statements are free from material misstatement.

An audit involves performing procedures to obtain audit evidence about the amounts and the disclosures in the financial statements. The procedures selected depend on the auditor's judgement, including the assessment of the risks of material misstatement of the financial statements, whether due to fraud or error. In making those risk assessments, the auditor considers internal financial control relevant to IGSTC preparation of the financial statements that give a true and fair view in order to design audit procedures that are appropriate in the circumstances. An audit also includes evaluating the appropriateness of the accounting policies used and the reasonableness of the



Noida Office : A - 24, Sector - 14, Noida - 201301  
Phone : +91 0120 431 0582, E-mail : sanjeev.singhal@gmail.com

We believe that the audit evidence we have obtained is sufficient and appropriate to provide a basis for our audit opinion on the financial statements.

### Opinion

In our opinion and to the best of our information and according to the explanations given to us, the aforesaid financial statements give the information required by the Indian Law in the manner so required and give a true and fair view in conformity with the accounting principles generally accepted in India,

- In the case of the Balance Sheet, of the state of affairs of the IGSTC as at March 31, 2016;
- In the case of Income and Expenditure Account of the deficit of Income over expenditure; and
- In the case of Receipts and Payments Account of the receipts and payments for the year ended on that date.

### Qualification

- IGSTC has not provided for gratuity in accordance with the mercantile system of accounting which is against the accounting policy followed. The amount is not ascertained.
- Overhead charges recoverable on loans given to Industrial partner amounting to Rs. 1,56,780.00 relating to, for the period from the end of the moratorium period till the date of start of loan installment (a period of 6 months) has not been provided.

### Emphasis of Matter

Without qualifying our report, we draw attention to:

- Refer to note number 3 of notes to account regarding German expenditure towards research projects (non-sharable) amounting to Rs. 8,40,18,873 (Euro 1,118,827) that are based on statement provided by IB-BMBF, Government of Germany to the Centre.
- German operational expenditure amounting to Rs.39,65,653 (Euro 52808.13) reflected in the financial statement are based on statement provided by IB-BMBF, Government of Germany to the Centre.

### Other Matters

We did not audit the financial statement / information provided by IB-BMBF of Government of Germany. These information are unaudited and have been forming part of financial statement / notes to accounts.

### Report on Other Legal and Regulatory Requirements

1. we report that:

- We have obtained all the information and explanations which to the best of our knowledge and belief were necessary for the purposes of our audit.





- b) in our opinion proper books of account as required by law have been kept by the IGSTC so far as it appears from our examination of those books;
- c) the balance sheet, the income and expenditure account and receipts and payments account dealt with by this Report are in agreement with the books of account;
- d) in our opinion, the aforesaid Balance Sheet, Income and Expenditure Account and Receipts and Payments Account dealt with by this Report are prepared in accordance with the applicable Accounting Standards issued by the Institute of Chartered Accountants of India.

**For RAJEEV NEELAM & ASSOCIATES**  
Firm Registration No. 013787N  
Chartered Accountants

**RAJEEV K. GUPTA**  
Partner  
Membership No. 087128

Place : New Delhi  
Dated : 30<sup>th</sup> September, 2016



**INDO GERMAN SCIENCE & TECHNOLOGY CENTRE**  
**SCHEDULE FORMING PART OF BALANCE SHEET, INCOME AND EXPENDITURE ACCOUNT**  
**THE RECEIPT AND PAYMENT ACCOUNT FOR THE YEAR ENDED 31<sup>ST</sup> MARCH, 2016.**

**SCHEDULE- 'L'**  
**ACCOUNTING POLICIES AND NOTES ON ACCOUNTS**

**Objectives of the Organisation**

The Indo German Science and Technology Centre (Society) established in India by the Governments of India and Germany, to facilitate and promote the interaction, in India and Germany of government, academia and industry in science and technology. It is to build and improve research and technology synergies between countries, focusing primarily on natural, life, and engineering sciences. The centre was registered in India on 14<sup>th</sup> June 2010 under Societies Registration Act, 1860.

**I. SIGNIFICANT ACCOUNTING POLICIES**

- 1. Accounting Period**  
Financials are reported from 01<sup>st</sup> April of a year to 31<sup>st</sup> March of the following year.
- 2. Reporting currency**  
The functional currency of the Society is Indian Rupee. Separate Receipts & Payment account, Income & Expenditure Account and Balance Sheet are drawn in Euro at the rate of exchange as prescribed by RBI on the Balance Sheet date i.e. 31.03.2016.
- 3. Basis of preparation**  
Accounts have been prepared on accrual basis and accordingly income and expenditure are recognized as they are committed and relate to the accomplishments and efforts of the organization. All the transactions and other events are recorded in the period in which they occur as per accrual concept.
- 4. Any surplus / deficit arising in Income and Expenditure** is carried forward to next year for utilization / recovery as per the objectives of IGSTC.
- 5. Method of Accounting**  
Accounts are maintained on mercantile basis.
- 6. Grants Awarded**  
Grants are recognized as commitments of expenditure after recommendation of the Scientific Council and approval by the Governing Body. Based on the commitments made to awardees in a year, aggregate grants are recognized as expenditure to the extent of payment due to be made to each awardee during the year. Grants are released on the basis of the approved sanctioned tranches. Release after first year is made on the basis of the utilization certificate received from year to year.
- 7. Grants Awarded - Recognition**  
Grants are recognised as expenses on the basis of commitments as per the approved sanction terms and timelines for each year.



*[Signature]*



*[Signature]*



**8. Loans & Advances**

Balance of loans under the projects, including overhead charges due on such loans, are reflected as Loan and Advances.

**9. Foreign Currency Transactions**

**Transactions:** Foreign exchange transactions are recorded at the rate prevailing on the date of transaction.

**Translation to Euro:** Indian currency assets and liabilities at the year-end are stated at the rate of foreign exchange (euro) at the closing of financial year.

**10. Income Recognition**

**Grants:** Grants from the two governments are (Department of Science & Technology, Govt. of India and BMBF, Govt. of Germany) are recognised in the Income & Expenditure statements as Grant in Aid only on receipt of the funds from either side under the head Income in the Receipts & Payments Account and the Income & Expenditure account.

**11. Fixed Assets:**

All the assets acquired for research projects remain with the institution where the research work is carried on. The IGSTC has however retained the right to transfer these assets to other institutions, if so required, on completion of the projects for which these assets were purchased. The expenditure on these assets has been accounted for in the Income and Expenditure Account under the head "Scientific Expenses". Hence, these assets have not been taken in the Balance Sheet of the Centre.

12. Fixed assets acquired by the centre are stated at cost of acquisition less accumulated depreciation. The cost of an asset comprises of its purchase price and directly attributable costs of bringing the asset to working condition for its intended use. During the year, the Centre has carried out the exercise of the physical verification of assets and no major discrepancies have come to notice.

13. All operational expenditure pertaining to German Government incurred in Germany are reported on the basis of statement of expenses.

14. All direct grant awards towards scientific projects by the German Government are neither recorded as receipt nor expenditure of the Centre, since the same are not received/ paid in India. However the same is included in the "Notes to Accounts" on the basis of Statement received from BMBF, Government of Germany.

**B. NOTES TO ACCOUNTS:**

1. Both governments have considered the allocation of equivalent amount of funds up to 10 million euros each to meet the objectives of the Centre and its running expenditure for an initial period of five years. The annual expenditure may be enlarged by mutual agreement. Out of the said contribution :

a) The Capital and Operating expenditure of the Centre and expenses on account of workshops, seminars, symposiums, preparatory visits, exploratory missions, etc are shared equally by the two Governments.



*[Signature]*



*[Signature]*

b) Expenditure for joint research projects are shared by the two Governments according to the distribution of costs for the respective parts of the project in each country.

2. Total contribution, utilisation of funds and allocation of shareable expense are as under

| Contribution and Utilisation of funds to meet Shareable expenses  | Upto 31/3/2015 | During 2015-16 | Total Contribution / Utilisation |
|---|----------------|----------------|----------------------------------|
| <b>1) German side</b>   |                |                |                                  |
| a) Direct Expenses Incurred in Germany (##)   | 10,099,728     | 3,965,653      | 14,065,381                       |
| b) Funds Remitted to India for Expenses   | 40,376,460     | 11,638,658     | 52,015,118                       |
|   | 50,476,188     | 15,604,311     | 66,080,499                       |
| Less: Funds Utilised (Shareable)  | 43,649,955     | 14,579,856     | 58,229,811                       |
| <b>Balance Carried Forward</b>  |                |                | <b>7,850,689</b>                 |
| <b>2) Indian side</b>   |                |                |                                  |
| a) Grant Contribution   | 245,000,000    | 50,000,000     | 295,000,000                      |
| b) Accrued as interest and other receipts   | 8,727,909      | 5,128,974      | 13,856,883                       |
|   | 253,727,909    | 55,128,974     | 308,856,883                      |
| Less: Funds Utilised (Shareable)  | 43,649,955     | 14,579,856     | 58,229,811                       |
| Project Utilisation (Non Shareable)   | 129,421,542    | 50,969,667     | 180,391,209                      |
| <b>Balance Carried Forward</b>  |                |                | <b>70,235,864</b>                |
| <b>(##) Amounts as reported by BMBF</b>   |                |                |                                  |
| <b>Current year direct expense contribution of € 52808.13 by BMBF converted at @ Rs. 75.0955 per Euro</b> |                |                |                                  |

**3. Status of future commitments of Awards sanctioned**

| Awarded in 2+2 mode        | Number of awards committed | Amount Sanctioned    | Amount released up to 31.3.2015 | Amount committed in current year | Amount in INR                               |                                |
|----------------------------|----------------------------|----------------------|---------------------------------|----------------------------------|---|--------------------------------|
|                            |                            |                      |                                 |                                  | Reversal of commitment due to short closure | Outstanding future commitments |
| Indian side                | 25                         | 337,419,698          | 141,020,066                     | 52,731,420 (**)                  | 16,789,487                                  | 126,878,725                    |
| German Side (in INR) (***) | 25                         | 757,099,314          | 264,056,429                     | 84,018,873                       | -   | 409,024,012                    |
| German Side (in Euro)      | 25                         | 10,081,820           | 3,516,275                       | 1,118,827                        | -   | 5,446,718                      |
| <b>Total</b>               |                            | <b>1,094,519,012</b> | <b>405,076,495</b>              | <b>136,750,293</b>               | <b>16,789,487</b>                           | <b>535,902,737</b>             |

(\*\*) includes Rs. 59,25,000/- as loans given to industrial partners as per the terms of the agreement.

(\*\*\*) Converted at a RBI reference rate of exchange at close of financial year at Euro 1 = Rupee 75.0955

**4. Income Tax**

Income Tax Department [office of the Commissioner of Income Tax (E), New Delhi] has granted IGSTC registration under section 12A of the Income Tax Act, 1961 as General Public Utility vide their letter no CIT(E)/2014-15/DEL-IR24110-10122014/4089 dated 10/12/2014.



*[Signature]*



*[Signature]*



5. All German expenditure figures are reflected in the report as per information provided by IB-BMBF to IGSTC.
6. **Other disclosures**
- (i) **Gratuity:** Is payable as per the rules under the payment of Gratuity Act, 1972. However, no provision for the same has been made in the accounts as the same shall be accounted on actual payment.
- (ii) As per approval of Governing Body, all financial powers in respect of activities of the Centre are exercised by Director after obtaining approval of the Governing Body.
7. There are no disputes/claims which are unsettled for a long time.
8. **Related parties Disclosures:**  
During the year no trust funds were utilized for the benefits of the settlers or the trustees other than reimbursement of expenses incurred by them.
9. **Prior Period Expenses/ Income**  
Expenses due in previous year, but accounted for in the current year. Further overhead charges on loan relating to prior years were recognized as income during the current year in accordance with accrual system of account and recognition norms as per AS-9 of ICAI.

**Expenses**

| S no.         | Account head        | Amount    |
|---------------|---------------------|-----------|
| 1             | Office expenses     | 2,27,838  |
| 2             | Salaries            | 4,09,964  |
| 3             | Communication       | 22,146    |
| 4             | Project expenses    | 11,17,667 |
| 5             | Scientific workshop | 3,18,755  |
|               | Total               | 20,96,370 |
| <b>Income</b> |                     |           |
| 1             | Overhead charges    | 8,14,807  |

10. The previous year figures have been regrouped / rearranged wherever necessary to make them comparable with the current year figures.
11. There are no contingent liabilities during the reporting period.

**For RAJEEV NEELAM & ASSOCIATES**  
Firm Registration No. 013787N  
Chartered Accountants

**RAJEEV K. GUPTA**  
Partner  
Membership No. 087128

Place : New Delhi  
Dated: 30 SEP 2016



  
**SUNIL KUKREJA**  
Manager (A/c & Admin.)

  
**DR. CHADARAM SIVAJI**  
Director/ Scientist 'F', DST



**INDO GERMAN SCIENCE & TECHNOLOGY CENTRE - CORE**  
**BALANCE SHEET AS AT 31ST MARCH 2016**

|   |                         | Amount in INR           |                    |
|---|-------------------------|-------------------------|--------------------|
| Schedule                                  | As at<br>March 31, 2016 | As at<br>March 31, 2015 |                    |
| <b>SOURCE OF FUNDS</b>                    |                         |                         |                    |
| <b>Reserve fund</b>                       |                         |                         |                    |
| Opening Balance                           | 8,79,44,080             | 8,44,40,067             |                    |
| Add : Surplus/(Deficit)                   | (94,71,449)             | 35,04,013               | 8,79,44,080        |
| <b>Current liabilities</b>                | A                       | 1,16,74,336             | 60,64,494          |
| <b>TOTAL</b>                              |                         | <b>9,01,46,967</b>      | <b>9,40,08,574</b> |
| <b>APPLICATION OF FUNDS</b>               |                         |                         |                    |
| <b>Fixed assets</b>                       |                         |                         |                    |
| Gross block                               | B                       | 4,61,434                | 4,87,278           |
| Add: addition during the year             |                         | 30,358                  | 1,02,390           |
| <b>Total</b>                              |                         | 4,91,792                | 5,89,668           |
| Less: Depreciation                        |                         | 1,05,713                | 1,28,234           |
| Net Block                                 |                         | 3,86,079                | 4,61,435           |
| <b>Cash and Bank Balances</b>             |                         |                         |                    |
| Cash in hand                              |                         | 9,356                   | 2,146              |
| Balance with Bank                         | C                       | 6,71,81,535             | 7,64,57,993        |
|   |                         | 6,71,90,891             | 7,64,60,139        |
| <b>Loans and Advances</b>                 | D                       | 2,25,44,624             | 1,70,87,000        |
| <b>Prepaid Expenses</b>                   |                         | 25,373                  | -                  |
| <b>TOTAL</b>                              |                         | <b>9,01,46,967</b>      | <b>9,40,08,574</b> |
| Accounting policies and notes on accounts | L                       |                         |                    |

As per our report of even date.

**For RAJEEV NEELAM & ASSOCIATES**  
Firm Registration No. 013787N  
Chartered Accountants

-Sd-  
**RAJEEV K. GUPTA**  
Partner  
Membership No. 087128

-Sd-  
**SUNIL KUKREJA**  
Manager (A/c & Admin.)

-Sd-  
**DR. CHADARAM SIVAJI**  
Director/ Scientist 'F', DST

Place : New Delhi  
Date :



**INDO GERMAN SCIENCE & TECHNOLOGY CENTRE - CORE**  
**INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31ST MARCH, 2016**

|   |          | Amount in INR                        |             |                                      |             |
|---|----------|--------------------------------------|-------------|--------------------------------------|-------------|
|   | Schedule | For the year ended<br>March 31, 2016 |             | For the year ended<br>March 31, 2015 |             |
| <b>INCOME</b>   |          |                                      |             |                                      |             |
| <b><u>Grant-in-aid :</u></b>  |          |                                      |             |                                      |             |
| Contribution from Department of Science and Technology, Govt. of India                |          | 5,00,00,000                          |             | 6,00,00,000                          |             |
| Contribution from Govt. of Germany  |          | 1,16,38,658                          |             | -                                    |             |
| Contribution (through expenses intimated by BMBF) from Govt. of Germany (€ 52,808.13) |          | <u>39,65,653</u>                     | 6,56,04,311 | <u>34,88,870</u>                     | 6,34,88,870 |
| <b><u>Interest Income</u></b>   |          |                                      |             |                                      |             |
| Interest from Bank Accounts   |          | 39,05,164                            |             | 23,79,869                            |             |
| Interest on Income Tax Refunds  |          | <u>243</u>                           | 39,05,407   | <u>-</u>                             | 23,79,869   |
| Overhead Charges on Loans   |          |                                      | 12,17,760   |                                      | -           |
| Miscellaneous receipts  |          |                                      | 330         |                                      | 1,044       |
| Income Tax Refunds  |          |                                      | 5,477       |                                      | -           |
| <b>TOTAL</b>  |          | <u><b>7,07,33,285</b></u>            |             | <u><b>6,58,69,783</b></u>            |             |
| <b>EXPENDITURE</b>  |          |                                      |             |                                      |             |
| Scientific Project Expenses of the Centre   | E        | 5,09,69,667                          |             | 4,36,77,624                          |             |
| Governing Body/ Scientific Council Expenses   | F        | 29,42,418                            |             | 17,21,043                            |             |
| Travelling Expenses (National & International)  | G        | 7,73,545                             |             | 6,21,946                             |             |
| Office Expenses   | H        | 1,13,84,182                          |             | 1,04,88,603                          |             |
| Salaries  | I        | 63,11,768                            |             | 55,56,604                            |             |
| Joint Scientific Workshop   | J        | 73,62,181                            |             | 76,088                               |             |
| Other Meetings / Conference   | K        | 3,55,260                             |             | 95,628                               |             |
| Depreciation on Fixed Assets  | B        | 1,05,713                             |             | 1,28,234                             |             |
| <b>TOTAL</b>  |          | <u><b>8,02,04,734</b></u>            |             | <u><b>6,23,65,770</b></u>            |             |
| Surplus/(Deficit) of Income over expenditure carried over to Balance Sheet            |          | <u><b>(94,71,449)</b></u>            |             | <u><b>35,04,013</b></u>              |             |
| Accounting policies and notes on accounts   | L        |                                      |             |                                      |             |
| As per our report of even date.   |          |                                      |             |                                      |             |
| <b>For RAJEEV NEELAM &amp; ASSOCIATES</b>   |          |                                      |             |                                      |             |
| Firm Registration No. 013787N   |          |                                      |             |                                      |             |
| Chartered Accountants   |          |                                      |             |                                      |             |
| <b>-Sd-</b>   |          | <b>-Sd-</b>                          |             | <b>-Sd-</b>                          |             |
| <b>RAJEEV K. GUPTA</b>  |          | <b>SUNIL KUKREJA</b>                 |             | <b>DR. CHADARAM SIVAJI</b>           |             |
| Partner   |          | Manager (A/c & Admin.)               |             | Director/ Scientist 'F', DST         |             |
| Membership No. 087128   |          |                                      |             |                                      |             |
| Place : New Delhi   |          |                                      |             |                                      |             |
| Date :  |          |                                      |             |                                      |             |

**INDO GERMAN SCIENCE & TECHNOLOGY CENTRE - CORE**  
**RECEIPT AND PAYMENT ACCOUNT FOR THE YEAR ENDED ON 31ST MARCH, 2016**

|  |          |                                      | Amount in INR                        |             |
|--|----------|--------------------------------------|--------------------------------------|-------------|
|  | Schedule | For the year ended<br>March 31, 2016 | For the year ended<br>March 31, 2015 |             |
| <b>Opening balance</b>   |          |                                      |                                      |             |
| Cash in hand   |          | 2,146                                | 2,512                                |             |
| Cash at bank   |          | <u>7,64,57,993</u>                   | <u>8,40,25,277</u>                   | 8,40,27,789 |
| <b>Receipts</b>  |          |                                      |                                      |             |
| <b>Grant-in-aid :</b>  |          |                                      |                                      |             |
| Contribution from Department of Science and Technology, Govt. of India |          | 5,00,00,000                          | 6,00,00,000                          |             |
| Contribution from Govt. of Germany                                     |          | <u>1,16,38,658</u>                   | <u>-</u>                             | 6,00,00,000 |
| <b>Interest Received</b>   |          |                                      |                                      |             |
| Interest from bank accounts  |          | 39,01,860                            | 23,79,869                            |             |
| Interest on income tax refunds   |          | 243                                  | -                                    |             |
| Income tax refunds   |          | <u>5,477</u>                         | <u>-</u>                             | 23,79,869   |
| Overhead charges on loan   |          |                                      | 3,61,251                             | -           |
| <b>Unspent amount refunded from :</b>                                  |          |                                      |                                      |             |
| Workshop Call -2012  |          | -                                    | 12,20,807                            |             |
| ICGEB for IGSTC 2+2 Project  |          | <u>-</u>                             | <u>1,01,331</u>                      | 13,22,138   |
| Loans refunded   |          |                                      | 13,35,326                            | -           |
| Amount of tax deducted at source (TDS)                                 |          |                                      | 12,22,047                            | -           |
| Amount of GPF, HBA, RGIS recovered on behalf of CSIR                   |          |                                      | 5,43,180                             | -           |
| Miscellaneous receipts   |          |                                      | 330                                  | 1,044       |
| Amount received from DST-MPG account                                   |          |                                      | 2,832                                | -           |
| <b>TOTAL</b>   |          | <u><b>14,54,71,343</b></u>           | <u><b>14,77,30,840</b></u>           |             |
| <b>Payments</b>  |          |                                      |                                      |             |
| <b>Project Expense (Non-shareable)</b>                                 |          |                                      |                                      |             |
| Scientific project expenses of the Centre                              |          |                                      | 4,68,06,420                          | 5,52,76,148 |
| Loan for projects  |          |                                      | 59,25,000                            |             |
| <b>Scientific Expense (Shareable)</b>                                  |          |                                      |                                      |             |
| Joint scientific workshop  |          | 67,26,550                            | 12,96,895                            |             |
| Other meetings/conference  |          | <u>3,55,260</u>                      | <u>95,628</u>                        | 13,92,523   |
| <b>Establishment Expense (Shareable)</b>                               |          |                                      |                                      |             |
| Governing body/ scientific council expenses                            |          | 29,42,418                            | 17,21,043                            |             |
| Travelling expenses (national & international)                         |          | 7,73,545                             | 6,21,946                             |             |
| Office expenses  |          | 72,08,578                            | 65,36,205                            |             |
| Salaries   |          | 57,47,096                            | 38,25,708                            |             |
| Purchase of office equipment   |          | 30,358                               | 18,000                               |             |
| Purchase of computer/printer   |          | <u>-</u>                             | <u>84,390</u>                        | 1,28,07,292 |
|  |          | <u>7,65,15,225</u>                   | <u>6,94,75,963</u>                   |             |
| c/f  |          |                                      |                                      |             |



**INDO GERMAN SCIENCE & TECHNOLOGY CENTRE - CORE**  
**RECEIPT AND PAYMENT ACCOUNT FOR THE YEAR ENDED ON 31ST MARCH, 2016**

| Amount in INR   |                                      |                                      |             |
|---|--------------------------------------|--------------------------------------|-------------|
| Schedule  | For the year ended<br>March 31, 2016 | For the year ended<br>March 31, 2015 |             |
| b/f   | 7,65,15,225                          | 6,94,75,963                          |             |
| <b>Other Payments</b>                                   |                                      |                                      |             |
| TDS Payments  | 12,22,047                            | 12,06,558                            |             |
| Amount recovered on behalf of CSIR, Delhi               | 5,43,180                             | 5,13,180                             |             |
| MPG fellowship amount refunded but credited erroneously | -                                    | 75,000                               | 17,94,738   |
| <b>Closing Balance</b>                                  |                                      |                                      |             |
| Cash in hand  | 9,356                                | 2,146                                |             |
| Bank balances   | 6,71,81,535                          | 7,64,57,993                          | 7,64,60,139 |
| <b>TOTAL</b>  | <b>14,54,71,343</b>                  | <b>14,77,30,840</b>                  |             |

Accounting policies and notes on accounts L

As per our report of even date.

**For RAJEEV NEELAM & ASSOCIATES**

Firm Registration No. 013787N  
Chartered Accountants

**-Sd-  
RAJEEV K. GUPTA**  
Partner  
Membership No. 087128

Place : New Delhi  
Date :

**-Sd-  
SUNIL KUKREJA**  
Manager (A/c & Admin.)

**-Sd-  
DR. CHADARAM SIVAJI**  
Director/ Scientist 'F', DST

**INDO GERMAN SCIENCE & TECHNOLOGY CENTRE - CORE**  
**SCHEDULE FORMING PART OF BALANCE SHEET, INCOME AND EXPENDITURE AND RECEIPT AND PAYMENT ACCOUNT FOR  
THE YEAR ON 31ST MARCH, 2016**

| Amount in INR                         |                         |                         |           |
|---------------------------------------|-------------------------|-------------------------|-----------|
|                                       | As at<br>March 31, 2016 | As at<br>March 31, 2015 |           |
| <b>Schedule 'A'</b>                   |                         |                         |           |
| <b>Current Liabilities</b>            |                         |                         |           |
| TDS payable                           | 83,900                  | -                       |           |
| Creditors for expenses                | 78,114                  | -                       |           |
| Project/ workshop commitments payable |                         |                         |           |
| Project - grants                      | 97,53,054               | 55,89,807               |           |
| Workshops                             | 6,35,631                | -                       | 55,89,807 |
| Other liabilities                     |                         |                         |           |
| Staff salaries                        | 3,14,948                | -                       |           |
| Employee benefit expenses             | 6,74,108                | 4,74,687                |           |
| IT admin charges                      | 1,15,500                | -                       |           |
| Payable to DST - MPG                  | 2,832                   | -                       |           |
| Telephone expenses                    | 16,249                  | -                       | 4,74,687  |
|                                       | <b>1,16,74,336</b>      | <b>60,64,494</b>        |           |

**Schedule 'B'**

**Fixed Assets**

| S. No. | Particulars         | GROSS BLOCK                 |                           |                     |                 | DEPRECIATION    | NET BLOCK                   |
|--------|---------------------|-----------------------------|---------------------------|---------------------|-----------------|-----------------|-----------------------------|
|        |                     | Balance as on<br>01.04.2015 | Additions during the Year |                     | Total           | For the Year    | Balance as on<br>31.03.2016 |
|        |                     |                             | upto<br>30.09.2015        | after<br>30.09.2015 |                 |                 |                             |
| 1      | Computer & Printers | 91,041                      | -                         | -                   | 91,041          | 54,625          | 36,416                      |
| 2      | Office Equipment    | 2,11,287                    | 16,090                    | 14,268              | 2,41,645        | 35,177          | 2,06,468                    |
| 3      | Furniture & Fixture | 1,59,106                    | -                         | -                   | 1,59,106        | 15,911          | 1,43,195                    |
|        | <b>TOTAL</b>        | <b>4,61,434</b>             | <b>16,090</b>             | <b>14,268</b>       | <b>4,91,792</b> | <b>1,05,713</b> | <b>3,86,079</b>             |
|        | Perivous Year       | 4,87,278                    | 18,000                    | 84,390              | 5,89,668        | 1,28,234        | 4,61,434                    |

| As at<br>March 31, 2016 | As at<br>March 31, 2015 |
|-------------------------|-------------------------|
|-------------------------|-------------------------|

**Schedule 'C'**

**Balances with Banks**

**Saving Bank Accounts**

|   |             |             |
|---|-------------|-------------|
| Axis Bank A/c No. 910010034609799           | 3,42,77,936 | 5,30,66,250 |
| Axis Bank A/c No. 911010026562072           | 86,22,781   | 9,47,349    |
| Union Bank of India A/c No. 349902010043192 | 60,29,932   | 57,95,840   |

**Fixed Deposits**

|                     |                    |                    |
|---------------------|--------------------|--------------------|
| Axis Bank           | 4,08,116           | 3,00,000           |
| Union Bank of India | 1,78,42,770        | 1,63,48,554        |
|                     | <b>6,71,81,535</b> | <b>7,64,57,993</b> |



| INDO GERMAN SCIENCE & TECHNOLOGY CENTRE - CORE<br>SCHEDULE FORMING PART OF BALANCE SHEET, INCOME AND EXPENDITURE AND RECEIPT AND PAYMENT ACCOUNT<br>FOR THE YEAR ON 31ST MARCH, 2016 |  |  |             |
|--|--|--|-------------|
|  | Amount in INR                                |  |             |
|  | As at<br>March 31, 2016                      | As at<br>March 31, 2015                      |             |
| <b>Schedule 'D'</b>  |  |  |             |
| <b>Loans and Advances</b>  |  |  |             |
| Loan to industries   | 2,16,76,675                                  | 1,70,87,000                                  |             |
| Overhead charges receivables on loans  | 8,56,509                                     | -  |             |
| TDS Income Tax -A.Y 16-17  | 3,304  | -  |             |
| Recovery of expense from CSIR  | 8,136  | -  |             |
|  | <u>2,25,44,624</u>                           | <u>1,70,87,000</u>                           |             |
|  |  |  |             |
|  | <b>For the year ended<br/>March 31, 2016</b> | <b>For the year ended<br/>March 31, 2015</b> |             |
| <b>Schedule 'E'</b>  |  |  |             |
| <b>Scientific expenses of the centre (India Side)</b>  |  |  |             |
| <b>Research Projects - Grant</b>   |  |  |             |
| <b>Call 2010</b>   |  |  |             |
| CLFR   | -  | 14,08,493                                    | 14,08,493   |
| <b>Call 2011</b>   |  |  |             |
| REMSOLAR   | 16,42,000                                    | 77,92,000                                    |             |
| IN-DUES  | 42,00,000                                    | 41,00,000                                    |             |
| NPORE  | 22,26,219                                    | 23,68,000                                    |             |
| NANOTRANS  | -  | 33,78,712                                    |             |
| NDT DATA FUSION  | 3,91,448                                     | 18,30,000                                    | 2,08,77,205 |
| <b>Call 2012</b>   |  |  |             |
| AMPLAST  | 47,50,000                                    | 1,16,00,000                                  |             |
| DNDHCSA  | 15,50,000                                    | 42,00,000                                    |             |
| DP- Forge  | 18,80,000                                    | 82,30,000                                    |             |
| SeNaMeB  | 25,80,000                                    | 79,80,000                                    |             |
| RESERVES   | 43,90,000                                    | -  | 3,20,10,000 |
| <b>Call 2014</b>   |  |  |             |
| MIRDI  | 77,50,000                                    | -  |             |
| SIBAC  | 94,50,000                                    | -  |             |
| SOUND4ALL  | 1,01,60,000                                  | -  | -           |
|  | 5,09,69,667                                  | 5,28,87,205                                  |             |
| Less: Less unspent balance received from projects  | -  | 1,01,331                                     |             |
|  | 5,09,69,667                                  | 5,27,85,874                                  |             |
| Less : Loans accounted as expenditure in earlier years   | -  | 91,08,250                                    |             |
|  | <u>5,09,69,667</u>                           | <u>4,36,77,624</u>                           |             |
| <b>Schedule 'F'</b>  |  |  |             |
| <b>Governing body/ Scientific council expense</b>  |  |  |             |
| Governing body meeting   | 15,22,796                                    | 12,81,172                                    |             |
| Scientific council meeting   | 14,19,622                                    | 4,39,871                                     |             |
|  | <u>29,42,418</u>                             | <u>17,21,043</u>                             |             |

| INDO GERMAN SCIENCE & TECHNOLOGY CENTRE - CORE<br>SCHEDULE FORMING PART OF BALANCE SHEET, INCOME AND EXPENDITURE AND RECEIPT AND PAYMENT ACCOUNT<br>FOR THE YEAR ON 31ST MARCH, 2016 |                                      |                                      |
|--|--------------------------------------|--------------------------------------|
|  | Amount in INR                        |                                      |
|  | For the year ended<br>March 31, 2016 | For the year ended<br>March 31, 2015 |
| <b>Schedule 'G'</b>  |                                      |                                      |
| <b>Travelling Expenses</b>   |                                      |                                      |
| Travel within India  | 2,48,322                             | 3,53,272                             |
| Travel abroad  | 5,25,223                             | 2,68,674                             |
|  | <u>7,73,545</u>                      | <u>6,21,946</u>                      |
| <b>Schedule 'H'</b>  |                                      |                                      |
| <b>Office Expense</b>  |                                      |                                      |
| Office rent  | 43,18,650                            | 42,47,208                            |
| Electricity, water & other maintenance charges   | 7,44,026                             | 7,01,127                             |
| Transportation   | 5,81,764                             | 5,50,272                             |
| Telephone and internet   | 3,02,553                             | 2,44,417                             |
| Printing & stationery  | 3,51,740                             | 1,08,714                             |
| Postage and courier  | 9,817                                | 19,402                               |
| Staff welfare  | 27,278                               | 25,009                               |
| Advertisement  | 56,112                               | 70,251                               |
| Legal and professional   | 7,93,723                             | 7,18,686                             |
| Miscellaneous  | 2,32,866                             | 3,14,647                             |
| Operational Expenses by IB-BMBF * (€ 52,808.13)  | 39,65,653                            | 34,88,870                            |
|  | <u>1,13,84,182</u>                   | <u>1,04,88,603</u>                   |
| * Refer to note number '5' of the Schedule 'M(II)'   |                                      |                                      |
| <b>Schedule 'I'</b>  |                                      |                                      |
| <b>Salaries</b>  |                                      |                                      |
| Salaries and allowances  | 59,04,750                            | 50,16,634                            |
| Contribution to employees provident fund   | 2,73,832                             | 4,41,041                             |
| Medical reimbursement /medical insurance   | 1,33,186                             | 98,929                               |
|  | <u>63,11,768</u>                     | <u>55,56,604</u>                     |
| <b>Schedule 'J'</b>  |                                      |                                      |
| <b>Joint Scientific Workshop</b>   |                                      |                                      |
| Call -2012   | 3,18,755                             | -                                    |
| Call-2014  | 70,43,426                            | 12,96,895                            |
|  | 73,62,181                            | 12,96,895                            |
| Less : Unspent balance received  | -                                    | 12,20,807                            |
|  | <u>73,62,181</u>                     | <u>76,088</u>                        |
| <b>Schedule 'K'</b>  |                                      |                                      |
| <b>Other meetings / conference</b>   |                                      |                                      |
| Due diligence meeting  | 3,33,121                             | -                                    |
| Project promotion meeting  | 22,139                               | 95,628                               |
|  | <u>3,55,260</u>                      | <u>95,628</u>                        |





**RAJEEV NEELAM & ASSOCIATES**  
Chartered Accountants

H.O. : D-2/16, Darya Ganj, New Delhi - 110002  
Phone : +91 11 23282925, 23263436  
E-mail : rajeevna@gmail.com

## INDEPENDENT AUDITOR'S REPORT

TO,  
THE MEMBERS OF GOVERNING BODY,  
Head, International Bilateral Cooperation Division (IBCD) &  
Co-Chair, Indo-German Science and Technology Centre (IGSTC)  
Department of Science & Technology,  
New Delhi,

### REPORT ON THE FINANCIAL STATEMENTS

We have audited the accompanying financial statements of Indo German Science and Technology Centre, New Delhi, with respect to EMR Programme concerning management and administration of Indo – German (DST – MPG) Science and Technology Centre, New Delhi which comprise the Balance Sheet as at March 31, 2016, the Statement of Income and Expenditure and the Receipts and Payments for the year then ended, and a summary of significant accounting policies and other explanatory information.

### Management's Responsibility for the Financial Statements

The IGSTC management is responsible for the preparation and presentation of these financial statements that give a true and fair view of the financial position, financial performance and receipts and payment of the IGSTC in accordance with the accounting principles generally accepted in India, including the Accounting Standards issued by the Institute of Chartered Accountants of India. This responsibility also includes maintenance of adequate accounting records in accordance with the provisions of the Indian Laws applicable to IGSTC for safeguarding its assets and for preventing and detecting frauds and other irregularities; selection and application of appropriate accounting policies; making judgements and estimates that are reasonable and prudent; and design, implementation and maintenance of adequate internal financial controls, that were operating effectively for ensuring the accuracy and completeness of the accounting records, relevant to the preparation and presentation of the financial statements that give a true and fair view and are free from material misstatement, whether due to fraud or error.

### Auditor's Responsibility

Our responsibility is to express an opinion on these financial statements based on our audit.

We have taken into account the provisions of the Indian Laws applicable to IGSTC, the accounting and auditing standards and matters which are required to be included in the audit report under the provisions of the said the Indian Laws and the Rules made thereunder.

We conducted our audit in accordance with the Standards on Auditing issued by the Institute of Chartered Accountants of India. Those Standards require that we comply with ethical requirements and plan and perform the audit to obtain reasonable assurance about whether the financial statements are free from material misstatement.

An audit involves performing procedures to obtain audit evidence about the amounts and the disclosures in the financial statements. The procedures selected depend on the auditor's judgement, including the assessment of the risks of material misstatement of the financial statements, whether due to fraud or error. In making those risk assessments, the auditor considers internal financial control relevant to IGSTC preparation of the financial statements that give a true and fair view in order to design audit procedures



Noida Office : A - 24, Sector - 14, Noida - 201301  
Phone : +91 0120 431 0582, E-mail : sanjeev.singhal@gmail.com

that are appropriate in the circumstances. An audit also includes evaluating the appropriateness of the accounting policies used and the reasonableness of the accounting estimates made by the management, as well as evaluating the overall presentation of the financial statements.

We believe that the audit evidence we have obtained is sufficient and appropriate to provide a basis for our audit opinion on the financial statements.

### Opinion

In our opinion and to the best of our information and according to the explanations given to us, the aforesaid financial statements give the information required by the Indian Law in the manner so required and give a true and fair view in conformity with the accounting principles generally accepted in India,

- In the case of the Balance Sheet, of the state of affairs of the IGSTC as at March 31, 2016;
- In the case of Income and Expenditure Account of the deficit of income over expenditure; and
- In the case of Receipts and Payments Account of the receipts and payments for the year ended on that date.

### Report on Other Legal and Regulatory Requirements

1. we report that:

- We have obtained all the information and explanations which to the best of our knowledge and belief were necessary for the purposes of our audit.
- In our opinion proper books of account as required by law have been kept by the IGSTC so far as it appears from our examination of those books;
- the balance sheet, the income and expenditure account and receipts and payments account dealt with by this Report are in agreement with the books of account;
- In our opinion, the aforesaid Balance Sheet, Income and Expenditure Account and Receipts and Payments Account dealt with by this Report are prepared in accordance with the applicable Accounting Standards issued by the Institute of Chartered Accountants of India.

For RAJEEV NEELAM & ASSOCIATES  
Firm Registration No. 013787N  
Chartered Accountants



**RAJEEV K. GUPTA**  
Partner  
Membership No. 087128

Place : New Delhi  
Dated : 30<sup>th</sup> September, 2016



**INDO - GERMAN SCIENCE & TECHNOLOGY CENTRE**  
**INDIA GERMAN (DST - MPG) Science & Technology Co-operation Programme**  
**BALANCE SHEET AS AT 31ST MARCH, 2016**

|   |                         | Amount in INR           |                         |
|---|-------------------------|-------------------------|-------------------------|
| Schedule  | As at<br>March 31, 2016 | As at<br>March 31, 2015 |                         |
| <b>SOURCE OF FUNDS</b>  |                         |                         |                         |
| <b>Operational Reserve Fund</b>   |                         |                         |                         |
| Opening balance   | 23,14,912               | 10,43,633               |                         |
| Add : Surplus/(Deficit)   | <u>(14,41,252)</u>      | <u>8,73,660</u>         | 23,14,912               |
| <b>Balance Funds of DST-MPG Programme</b>   |                         |                         |                         |
| Balance funds out of receipts from Department of Science and Technology, Govt. Of India | A                       | 4,86,328                | 49,68,778               |
| <b>TOTAL</b>  |                         | <u><b>13,59,988</b></u> | <u><b>72,83,690</b></u> |
| <b>APPLICATION OF FUNDS</b>   |                         |                         |                         |
| <b>Fixed Assets</b>   |                         |                         |                         |
| Gross block   | B                       | 1,38,858                | 1,28,639                |
| Less: depreciation to date  |                         | <u>35,423</u>           | <u>37,781</u>           |
| Net block   |                         | 1,03,435                | 90,858                  |
| <b>Current Assets</b>   |                         |                         |                         |
| Due from IGSTC, Main Account  |                         | 2,832                   | -                       |
| <b>Cash and Bank Balances</b>   |                         |                         |                         |
| Cash in hand  |                         | -                       | -                       |
| Axis bank saving account (Reserve Fund A/c)   |                         | 10,25,353               |                         |
| Axis bank saving account  |                         | <u>2,28,367</u>         | <u>71,92,832</u>        |
| <b>TOTAL</b>  |                         | <u><b>13,59,988</b></u> | <u><b>72,83,690</b></u> |

Accounting policies and notes on accounts

E

As per our report of even date.

**For RAJEEV NEELAM & ASSOCIATES**

Firm Registration No. 013787N  
Chartered Accountants

-Sd-  
**RAJEEV K. GUPTA**  
Partner  
Membership No. 087128

Place : New Delhi  
Date :

-Sd-  
**SUNIL KUKREJA**  
Manager (A/c & Admin.)

-Sd-  
**DR. CHADARAM SIVAJI**  
Director/ Scientist 'F', DST

**INDO GERMAN SCIENCE & TECHNOLOGY CENTRE**  
**INDIA GERMAN (DST - MPG) Science & Technology Co-operation Programme**  
**INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31ST MARCH, 2016**

|  |                                      | Amount in INR                        |        |
|--|--------------------------------------|--------------------------------------|--------|
| Schedule   | For the year ended<br>March 31, 2016 | For the year ended<br>March 31, 2015 |        |
| <b>INCOME</b>  |                                      |                                      |        |
| Allocation expense   | 2,49,892                             | 17,31,642                            |        |
| Unspent amount of project received   | -                                    | 16,745                               |        |
| Amount received from IGSTC main account for fellowship, which was wrongly credited | -                                    | 75,000                               |        |
| <b>TOTAL</b>   | <u><b>2,49,892</b></u>               | <u><b>18,23,387</b></u>              |        |
| <b>EXPENDITURE</b>   |                                      |                                      |        |
| Scientific committee meeting expenses  | -                                    | 76,966                               |        |
| Meeting expenses   | -                                    | 5,599                                |        |
| Office expenses  | 1,32,991                             | 66,762                               |        |
| Salaries   | 3,92,000                             | 3,65,000                             |        |
| Depreciation on fixed assets   | B                                    | 35,423                               | 37,781 |
| <b>TOTAL</b>   | <u><b>5,60,414</b></u>               | <u><b>5,52,108</b></u>               |        |
| Surplus/(Deficit) of Income over expenditure                                       | (3,10,522)                           | 12,71,279                            |        |
| Recovery of Excess Allocation of management expense in the year 2014-15            | 10,38,985                            | -                                    |        |
| Unspent balance received back wrongly treated as income in earlier year            | 91,745                               | 11,30,730                            | -      |
| Balance carried over to balance sheet  | <u><b>(14,41,252)</b></u>            | <u><b>12,71,279</b></u>              |        |

Accounting policies and notes on accounts

E

As per our report of even date.

**For RAJEEV NEELAM & ASSOCIATES**

Firm Registration No. 013787N  
Chartered Accountants

-Sd-  
**RAJEEV K. GUPTA**  
Partner  
Membership No. 087128

Place : New Delhi  
Date :

-Sd-  
**SUNIL KUKREJA**  
Manager (A/c & Admin.)

-Sd-  
**DR. CHADARAM SIVAJI**  
Director/ Scientist 'F', DST



**INDO GERMAN SCIENCE & TECHNOLOGY CENTRE**  
**INDIA GERMAN (DST - MPG) Science & Technology Co-operation Programme**  
**RECEIPT AND PAYMENT ACCOUNT FOR THE YEAR ENDED ON 31ST MARCH, 2016**

| Amount in INR   |          |                                      |                                      |             |
|---|----------|--------------------------------------|--------------------------------------|-------------|
|   | Schedule | For the year ended<br>March 31, 2016 | For the year ended<br>March 31, 2015 |             |
| <b>Opening balance</b>  |          |                                      |                                      |             |
| Cash in hand  |          | -                                    | 438                                  |             |
| Axis bank saving account  |          | 71,92,832                            | 12,07,657                            | 12,08,094   |
| <b>Receipts</b>   |          |                                      |                                      |             |
| Fund received from Dept. of Science and Technology, Govt of India towards MPG Programme |          | -                                    | 2,35,38,812                          |             |
| Interest on saving bank account   |          | 1,87,242                             | 1,84,926                             |             |
| Amount received from IGSTC main account for fellowship, which was wrongly credited      |          | -                                    | 75,000                               |             |
| Unspent amount of project received  |          | 6,96,760                             | 16,745                               | 2,38,15,483 |
| <b>TOTAL</b>  |          | <b>80,76,834</b>                     | <b>2,50,23,577</b>                   |             |
| <b>Payments</b>   |          |                                      |                                      |             |
| Advance to IGSTC main account   |          | 2,832                                | -                                    |             |
| Grants sanctioned and released as per MPG   | C        | 62,47,290                            | 1,73,16,418                          |             |
| Scientific committee meeting expenses   |          | -                                    | 76,966                               |             |
| Meeting expenses  |          | -                                    | 5,599                                |             |
| Salaries  |          | 3,92,000                             | 3,65,000                             |             |
| Office expenses   | D        | 1,32,991                             | 66,762                               |             |
| Purchase of computer & printer  | B        | 48,000                               | -                                    | 1,78,30,745 |
| <b>Closing Balance</b>  |          |                                      |                                      |             |
| Cash in hand  |          | -                                    | -                                    |             |
| Axis bank saving Account  |          | 12,53,720                            | 71,92,832                            | 71,92,832   |
| <b>Total</b>  |          | <b>80,76,834</b>                     | <b>2,50,23,577</b>                   |             |

Accounting policies and notes on accounts

As per our report of even date.

**For RAJEEV NEELAM & ASSOCIATES**

Firm Registration No. 013787N  
Chartered Accountants

-Sd-  
**RAJEEV K. GUPTA**  
Partner  
Membership No. 087128

Place : New Delhi  
Date :

-Sd-  
**SUNIL KUKREJA**  
Manager (A/c & Admin.)

-Sd-  
**DR. CHADARAM SIVAJI**  
Director/ Scientist 'F', DST

**INDO GERMAN SCIENCE & TECHNOLOGY CENTRE**  
**INDIA GERMAN (DST - MPG) Science & Technology Co-operation Programme**

**SCHEDULE FORMING PART OF BALANCE SHEET, INCOME AND EXPENDITURE AND RECEIPT AND PAYMENT ACCOUNT**  
**FOR THE YEAR ON 31ST MARCH, 2016**

| Amount In INR  |                         |                         |             |                    |
|--|-------------------------|-------------------------|-------------|--------------------|
|  | As at<br>March 31, 2016 | As at<br>March 31, 2015 |             |                    |
| <b>Schedule - 'A'</b>  |                         |                         |             |                    |
| <b>Balance Funds of DST-MPG Programme</b>  |                         |                         |             |                    |
| <b>Opening Balance</b>   | 49,68,778               | 2,93,100                |             |                    |
| <b>Receipts</b>  |                         |                         |             |                    |
| Fund received from Dept. of Science and Technology, Govt. of India towards MPG programme | -                       | 2,35,38,812             |             |                    |
| Interest on saving bank account  | 1,87,242                | 51,56,020               | 1,84,926    | 2,40,16,838        |
|  |                         | <b>51,56,020</b>        |             | <b>2,40,16,838</b> |
| <b>Utilisation</b>   |                         |                         |             |                    |
| Grant sanctioned and released as per MPG Programme                                       | 54,58,785               |                         | 1,73,16,418 |                    |
| Allocation of management expenses  | 2,49,892                |                         | 17,31,642   |                    |
|  | 57,08,677               |                         | 1,90,48,060 |                    |
| Less: Excess of Management expense   | (10,38,985)             | 46,69,692               | -           | 1,90,48,060        |
|  |                         | <b>4,86,328</b>         |             | <b>49,68,778</b>   |

**Schedule 'B'**

Fixed Assets

| S. No. | Particulars         | GROSS BLOCK                 |   |                     | DEPRECIATION<br>For the Year | NET BLOCK<br>Balance as on<br>31.03.2016 |
|--------|---------------------|-----------------------------|---|---------------------|------------------------------|--|
|        |                     | Balance as on<br>01.04.2015 | Additions during the Year<br>upto<br>30.09.2015 | after<br>30.09.2015 |                              |  |
| 1      | Computer & Printers | 16,432                      | -   | 48,000              | 24,259                       | 40,173                                   |
| 2      | Office Equipment    | 74,426                      | -   | -                   | 11,164                       | 63,262                                   |
|        | <b>Total</b>        | <b>90,858</b>               | <b>-</b>  | <b>48,000</b>       | <b>35,423</b>                | <b>1,03,435</b>                          |
|        | Previous Year       | 1,28,639                    | -   | -                   | 37,781                       | 90,858                                   |



**INDO GERMAN SCIENCE & TECHNOLOGY CENTRE**  
**INDIA GERMAN (DST - MPG) Science & Technology Co-operation Programme**

**SCHEDULE FORMING PART OF BALANCE SHEET, INCOME AND EXPENDITURE AND RECEIPT AND PAYMENT ACCOUNT FOR**  
**THE YEAR ON 31ST MARCH, 2016**

|  | Amount In INR                        |                                      |
|--|--------------------------------------|--------------------------------------|
|  | For the year ended<br>March 31, 2016 | For the year ended<br>March 31, 2015 |
| <b>Schedule -'C'</b>   |                                      |                                      |
| <b>Grants Sanctioned and released as per MPG</b>   |                                      |                                      |
| <b>Partner Groups</b>  |                                      |                                      |
| 1 Genetic Diversity studies - CDFD Hyderabad   | 6,00,000                             | 12,03,161                            |
| 2 Structural Biology of Vesicular Trafficking - IISER Bhopal                                 | 9,89,478                             | 10,30,464                            |
| 3 Chemical Ecology - IISER Kolkata   | 7,55,000                             | 12,14,087                            |
| 4 Tropospheric OH Reactivity -IISER Mohali   | 9,38,887                             | 12,42,560                            |
| 5 Glyconano Technology - IISER Pune  | -                                    | 8,17,378                             |
| 6 Gravitational Wave - IISER Thiruvananthapuram  | 3,87,723                             | 10,57,798                            |
| 7 Cosmology and Gravity - IISER Thiruvananthapuram   | 9,73,475                             | 11,98,439                            |
| 8 Polymer Research - IIT Guwahati  | 8,10,700                             | 5,89,000                             |
| 9 Regulation of RNA splicing - IISER Mohali  | -                                    | 13,50,000                            |
| 10 Asymmetric Organ catalysis - IIT Guwahati   | -                                    | 13,35,681                            |
| 11 Atmospheric Science -IIT Madras   | -                                    | 12,49,189                            |
| 12 Cellular Membranes in stress singalling and protein homeostasis maintenance - CSIR - CCMB | -                                    | 14,00,000                            |
| 13 Multifunctional Hybrid Nanostructures for alternative energy systems - IIT Kharagpur      | -                                    | 13,00,000                            |
| 14 Coupling and Dynamics of solar atmosphere - IUCAA Pune                                    | -                                    | 13,50,000                            |
|  | <b>54,55,263</b>                     | <b>1,63,37,757</b>                   |
| Less: unspent amount refunded *  | 6,20,865                             | -                                    |
| <b>A. Total</b>  | <b>48,34,398</b>                     | <b>1,63,37,757</b>                   |

\* This includes Rs. 16,745 refund of unspent amount the projects in the earlier year, accounted as income in financial year 2014-15.

**Fellowship**

|  |                 |                 |
|--|-----------------|-----------------|
| 1 Deciphering the role of the flanking N- and C-terminal regions in the modulation of photocycle kinetics of a LOV domain of a marine algal phototropin                      | 75,000          | 73,421          |
| 2 Transition metal dithioato complexes as functional models for hydrogenases   | 72,109          | 75,000          |
| 3 Dissecting the regulatory role of adiponectin signalling in human retinal synaptic vesicle trafficking under physiological and pathological conditions                     | 75,000          | -               |
| 4 Investigating the role of glucosinolate content towards plant fitness in Brassica juncea   | 75,000          | 75,000          |
| 5 Inflationary cosmology and its connection to particle physics  | 48,154          | 1,55,240        |
| 6 Physiology of mixotrophic planktonic bacteria  | 75,000          | 75,000          |
| 7 Application of metabolite, transcript and flux measurements to investigate the effect of elevated ozone and carbon dioxide on yield and pest protection of C3 and C4 crops | 71,764          | 75,000          |
| <b>c/f</b>   | <b>4,92,027</b> | <b>5,28,661</b> |

**INDO GERMAN SCIENCE & TECHNOLOGY CENTRE**  
**INDIA GERMAN (DST - MPG) Science & Technology Co-operation Programme**

**SCHEDULE FORMING PART OF BALANCE SHEET, INCOME AND EXPENDITURE AND RECEIPT AND PAYMENT ACCOUNT**  
**FOR THE YEAR ON 31ST MARCH, 2016**

|   | Amount In INR                        |                                      |
|---|--------------------------------------|--------------------------------------|
|   | For the year ended<br>March 31, 2016 | For the year ended<br>March 31, 2015 |
| <b>b/f</b>  | <b>4,92,027</b>                      | <b>5,28,661</b>                      |
| 8 Complex Networks and Systems Biology  | 75,000                               | -                                    |
| 9 Tailoring interface spin transport: towards molecular spintronics   | 75,000                               | -                                    |
| 10 Agricultural Microbiology  | 75,000                               | -                                    |
| 11 Transcriptional responses of Helicoverpa armigera to the insecticidal mycotoxin, Destruxin                                   | 75,000                               | -                                    |
| 12 Polyphasic taxonomic Characterization of marine bacteria and analyses of the microbial diversity                             | -                                    | 75,000                               |
| 13 Preparation and Characterization of Semiconductor Photo catalysts for surface Reaction Dynamics Study and their applications | -                                    | 75,000                               |
| 14 Sub-fs control of photo -dynamics in atoms using shaped XUV pulsesto   | -                                    | 75,000                               |
| 15 Direct patterning of vortex generating diffractive optical elements on fibre tip using a focused ion beam                    | -                                    | 75,000                               |
| 16 Cooperative control and consensus  | -                                    | 75,000                               |
| 17 Water based nanocomposite dispersions as antimicrobial coatings  | -                                    | 75,000                               |
| <b>Total</b>  | <b>7,92,027</b>                      | <b>9,78,661</b>                      |
| Less: unspent amount refunded *   | 1,67,640                             | -                                    |
| <b>B. Total</b>   | <b>6,24,387</b>                      | <b>9,78,661</b>                      |
| <b>TOTAL ( A+B)</b>   | <b>54,58,785</b>                     | <b>1,73,16,418</b>                   |

\* This includes Rs. 75,000 refunded unspent from the projects in the earlier year, wrongly taken into the income of financial year 2014-15.

**Schedule -'D'**

**Office Expenses**

|                        |                 |               |
|------------------------|-----------------|---------------|
| Communication Expenses | 8,484           | 15,191        |
| Tours & Travels        | 64,489          | 25,376        |
| Printing & Stationery  | 17,850          | 5,758         |
| Advertisement Expenses | -               | 20,000        |
| Miscellaneous Expense  | 42,168          | 437           |
|                        | <b>1,32,991</b> | <b>66,762</b> |

**Schedule -'E'**

**Accounting Policies and Notes to Accounts**

**A. Accounting Policies**

**Income recognition and Accounting for Expenditure**

- 1 Accounts have been prepared on accrual basis and accordingly incomes and expenditure are recognized as they are committed and relate to the accomplishments and efforts of the organization. All the transactions and other events are recorded in the period in which they occur as per accrual concept.

Notes

INDO GERMAN SCIENCE & TECHNOLOGY CENTRE  
INDIA GERMAN (DST - MPG) Science & Technology Co-operation Programme

SCHEDULE FORMING PART OF BALANCE SHEET, INCOME AND EXPENDITURE AND RECEIPT AND PAYMENT ACCOUNT  
FOR THE YEAR ON 31ST MARCH, 2016

- 2 Funds received under DST-MPG Programme vide MoU dated September, 2011 are being manged on behalf of DST as per the mandate given in the said MoU. Therefore the funds do not form part of grant/income of IGSTC. Considering the fact, all funds received on account for such activities are treated as advances for meeting the proposed activity and also to cover the related direct and indirect administrative costs. Therefore, the receipt and utilization against the respective programmes are not considered as Income or Expenditure of IGSTC. However, the costs of administration for running these extramural programmes are recovered from the fund so received, on the basis of approval given by DST at 4% of the total project amount released during the year. The residual programme grants not utilized during the year are carried forward as current liability for fulfilling commitments in coming financial year.
- 3 Interest income is recognized on accrual basis for all Deposits with the banks and is treated as part of contribution from DST for DST MPG Program.
- 4 Fixed Assets are stated at their original cost less accumulated depreciation but including freight, duties, taxes and other incidental expenses relating to acquisition and installation.
- 5 Depreciation of Fixed Assets has been provided on written down value method on a pro-rata basis at the rates as prescribed under the Income-tax Rules, 1962.

B. NOTES TO ACCOUNTS:

- 1 Commitments amounting to Rs. 1,93,16,885/- have been made under various undergoing programmes at the close of the Financial year, to that extent the current available funds are encumbered to meet the future commitments.

| Total Future Commitments |               |                            |             |
|--------------------------|---------------|----------------------------|-------------|
| Heads                    | Partner Group | Fellowship /Mobility Grant | Total       |
| Call 2010                | 77,50,364     | -                          | 77,50,364   |
| Call 2011                | -             | 1,58,909                   | 1,58,909    |
| Call 2012                | 41,65,130     | 2,64,246                   | 44,29,376   |
| Call 2013                | 40,50,000     | 7,53,236                   | 48,03,236   |
| Call 2014                | -             | 21,75,000                  | 21,75,000   |
| Total Future Commitments |               |                            | 1,93,16,885 |

- 2 Prior Period Expenses / Income:  
Expenses due in previous year but accounted for in the current year

| Particulars | Amount      |
|-------------|-------------|
| Salaries    | 1,93,000.00 |

- 3 There is no contingent liability as on 31st March, 2016
- 4 The previous year figures have been regrouped/ rearranged wherever necessary to conform to current year figures.

For RAJEEV NEELAM & ASSOCIATES

Firm Registration No. 013787N  
Chartered Accountants

-Sd-  
**RAJEEV K. GUPTA**  
Partner  
Membership No. 087128

-Sd-  
**SUNIL KUKREJA**  
Manager (A/c & Admin.)

-Sd-  
**DR. CHADARAM SIVAJI**  
Director/ Scientist 'F', DST

Place : New Delhi  
Date :



Notes

Contact Points



**A Chakraborty**  
Tel: + 91-1244929400  
E-mail: director.igstc@igstc.org



**Martin Goller**  
Tel: + 49-22838211407  
E-mail: martin.goller@dlr.de



**P V Lalitha**  
Tel: + 91-1244929400  
E-mail: lalitha.pv@igstc.org



**Sara Sabzian**  
Tel: + 49-22838211420  
E-mail: sara.sabzian@dlr.de

*IGSTC through the lens.....*



**IGSTC Secretariat**

Indo-German Science & Technology Centre  
Plot No. 102, Institutional Area  
Sector - 44, Gurgaon - 122003, India  
Tel: +91-1244929400  
Fax: +91-1244929411  
E-mail: [info.igstc@igstc.org](mailto:info.igstc@igstc.org)

[www.igstc.org](http://www.igstc.org)

**German Project Office**

(IGSTC German Office)  
German Aerospace Center (DLR-PT)  
Heinrich-Konen-Str. 1  
53227 Bonn, Germany  
Tel: +49-22838211407