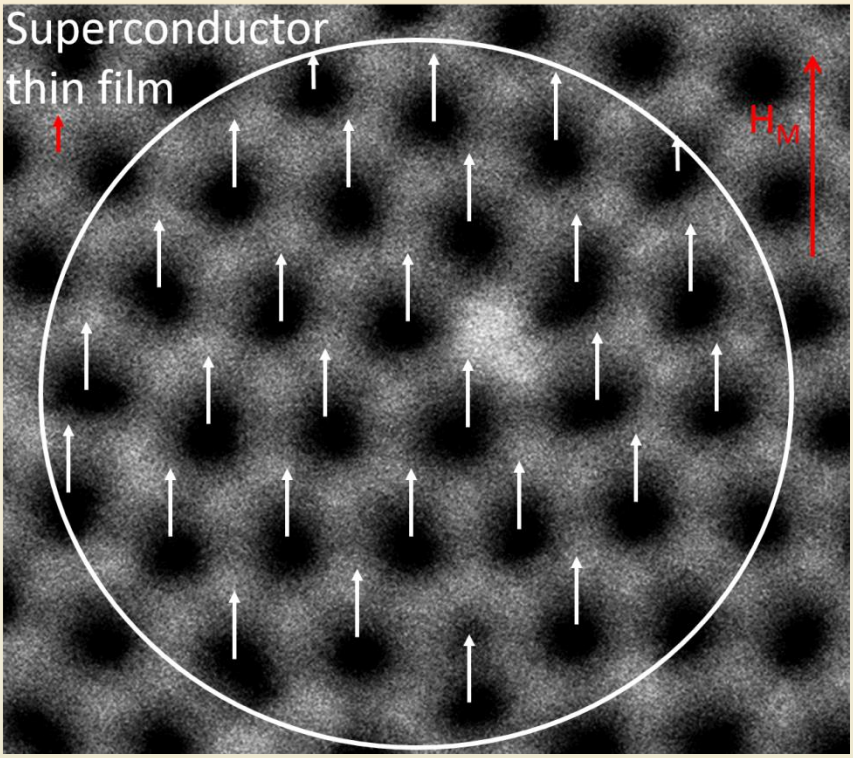
University of Mumbai & Department of Atomic Energy

CENTRE for EXCELLENCE IN BASIC SCIENCES



Annual Report

2016-2017

University of Mumbai

Nurturing talent...promoting excellence
मौलिक विज्ञान प्रकर्ष केन्द्र

राष्ट्र की सेवा में परमाणु
प ऊ वि
DAE
ATOMS IN THE SERVICE OF THE NATION

UM-DAE CEBS

Annual Report
(April 2016 - March 2017)

University of Mumbai (UM) – Department of Atomic Energy (DAE)

Centre for Excellence in Basic Sciences (CEBS)

Director's Message

The University of Mumbai & Department of Atomic Energy (UM-DAE) Centre for Excellence in Basic Sciences (CEBS) has had yet another successful year, thus completing ten years of its existence, on the campus of the University of Mumbai at Kalina.

This year, the sixth batch of students graduated after successfully completing their Integrated M.Sc. programme of the Centre. It is very satisfying to note that almost all the students who have passed out from CEBS, till now are currently pursuing their Ph.D. in prestigious institutions. The number of students securing admission to CEBS is increasing progressively, and today it stands at 45 plus 2 from J&K per year. The Centre has been gaining in popularity across the country, as can be seen from the fact that, the number of students registering for its entrance test, namely, the National Entrance Screening Test (NEST), which is conducted jointly by CEBS and NISER-Bhubaneshwar, a sister institution of DAE with similar mandate, has increased from 3300 in the first year to more than 60,000 in the last year.

As a part of its academic activities, CEBS organizes workshops, seminars, public lectures, refresher course etc, and sometimes, jointly with the University of Mumbai. It has also started a student's exchange Programmes with other institutions. Our formal interaction with York University is progressing very well and this year three students went to York to carry out the ninth semester project in the Physics and Chemistry streams. Likewise, a formal Student Exchange Programme with University College, London (UCL) is also in the pipeline. Besides, our students are also going to other institutions in India and abroad for their Projects. This year 90% of the students did their ninth semester projects in institutions and universities abroad like RIKEN (Japan), EPFL (Switzerland), University of Stuttgart (Germany), University of Waterloo (Canada), Aarhus University (Denmark), University of York (UK), Rockefeller University (USA), University of Helsinki (Finland), Max Plank Institute (Germany), Centre for Genomic Regulation (Barcelona), University of Muster(Germany), Institute for Research in Biomedicine (Barcelona), University of British (Canada), University of Victoria (Canada) and University of Heidelberg (Germany). This reflects the international visibility of the Centre.

One of the hallmarks of CEBS is its Visitors' Programme. This year Prof. Robin Michael Catchpole from Institute of Astronomy, Cambridge visited CEBS for carrying out collaborative research and he also taught courses to our students.

CEBS has been making efforts to establish modest research facilities, with the limited resources it has at the moment. In this context, instruments such as Isothermal Titration Calorimetric (ITC), Fluorescence Spectrophotometer, UR-visible Spectrophotometer, Infra-red Spectrophotometer, Fast Protein Liquid Chromatography have been established for use of Chemistry and Biology research. In addition to carrying out research at CEBS, the faculty members of CEBS collaborate with scientists in other research institutions and avail of facilities that do not currently exist in CEBS. Students from institutes across India come to CEBS to carry out semester-long projects under the guidance of our core faculty and to avail of the laboratory facilities here. The faculty members at CEBS have been able to produce excellent

research publications in reputed international journals. The productivity has been increasing steadily and during the last year, 70 papers have been published in reputed International Journals. The faculty members have successfully secured grants for their research projects amounting to Rs. 17,411,400/- from external funding agencies such as DST, DBT, BRNS. etc.

The students at CEBS have initiated various academic and social activities such as Jigyasa, Ragnarock, Dhwani sports competitions, etc which have attracted students from other colleges in the city. Our students also participate in a competitive sporting event called IISM where students from IISERs, IISc, NISER etc compete. As a part of their social commitment, students from CEBS have been organizing blood donation camps in our campus.

The construction work of the permanent buildings of CEBS has been completed and shifting of laboratories has also made a beginning. By next semester i.e. August 2017 Physics and Biology laboratories will operate from the permanent building of CEBS.

A major administrative achievement during the last year was submission of the papers, to the Registrar Society to register CEBS as a 'Society' under the 'Society Registration Act 1860' and as a 'Trust' under the 'Public Trust Act 1950'. This will give a legal status to the Centre which enables it to receive Endowments, Grants in perpetuity from DAE, and also Grants from other funding agencies.

This document lists all the activities and accomplishments of the Centre during the last one year.

I am thankful to the Brochure Committee for preparing this document.

R. V. Hosur
Director

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1. Governing Council and Academic Board of the Centre

Governing Council of the Centre

CEBS is managed by a Governing Council consisting of the following members:

Dr. Sekhar Basu Secretary to the Government of India Department of Atomic Energy, and Chairman, Atomic Energy Commission Anushakti Bhavan, C. S. M. Marg Mumbai – 400 001	Chairperson
Dr. Sanjay Deshmukh Vice - Chancellor University of Mumbai Fort Campus, Mumbai – 400 032	Co-Chairperson
Dr. Anil Kakodkar Former Chairman Atomic Energy Commission	Member
Dr. Vijay Khole Vice-Chancellor Amity University Navi Mumbai – 410 206	Member
Shri. K. N. Vyas Director Bhabha Atomic Research Centre Trombay, Mumbai – 400 085	Member
Dr. Sandip P. Trivedi Director Tata Institute of Fundamental Research Homi Bhabha Road Mumbai – 400 005	Member
Dr. Devang Khakhar Director Indian Institute of Technology, Bombay Powai, Mumbai – 400 076	Member

Pro Vice Chancellor University of Mumbai Fort Campus, Mumbai – 400 032	Member
Finance & Accounts Officer University of Mumbai Fort Campus, Mumbai – 400 032	Member
Joint Secretary (A&A) Department of Atomic Energy Anushakti Bhavan, C.S.M. Marg Mumbai – 400 001	Member
Joint Secretary (Finance) Department of Atomic Energy Anushakti Bhavan, C.S.M. Marg Mumbai – 400 001	Member
Prof. R. V. Hosur Director, UM-DAE CEBS University of Mumbai Kalina Campus, Mumbai – 400 098	Member Secretary
Shri. K. P. Balakrishnan Registrar, UM-DAE CEBS University of Mumbai Kalina Campus, Mumbai – 400 098	Non-member Secretary

Academic Board of the Centre

The academic activities of the Centre are designed and overseen by the Academic Board of the Centre whose current members are:

Prof. M. S. Raghunathan Former IIT B- Chair, Academic Board Indian Institute of Technology – Bombay Powai, Mumbai – 400 076	Chairperson (From May 01, 2016)
Prof. S. M. Chitre Distinguished Professor UM-DAE CEBS University of Mumbai Kalina Campus, Mumbai – 400 098	Member (Chairperson till April 30, 2016)

Prof. J. Maharana — Member
Formerly, Institute of Physics
Sachivalaya Marg
Bhubaneshwar, Orissa - 751 005

Prof. J. V. Narlikar — Member
Formerly, Inter-University Centre for
Astronomy and Astrophysics (IUCAA)
Post Bag 4, Ganeshkhind
Pune University Campus, Pune - 411 007

Prof. Arvind Kumar — Member
Formerly, Homi Bhabha Centre for Science
Education (HBCSE), V. N. Purav Marg
Mankhurd, Mumbai – 400 088

Dr. Swapan Ghosh — Member
Raja Ramanna Fellow
Former Head, Theoretical Chemistry Section
Bhabha Atomic Research Centre
Trombay, Mumbai – 400 085

Prof. Dipan Kumar Ghosh — Member
Formerly, Indian Institute of Technology – Bombay
Powai, Mumbai – 400 076

Prof. N. Mukunda — Member
Centre for High Energy Physics
Indian Institute of Science
Bangalore – 560 012

Prof. P. Dongre — Member
Department of Biotechnology
University of Mumbai
Kalina Campus, Mumbai – 400 098

Prof. R. R. Puri — Member
Indian Institute of Technology – Gandhinagar
B103, Sukun Chandkedha
S. G. Road, Ahmedabad – 382 424

Prof. G. D. Yadav — Member
Vice Chancellor
Institute of Chemical Technology

Mumbai – 400 019	
Prof. Anil Karnik Department of Chemistry University of Mumbai Kalina Campus, Mumbai – 400 098	Member
Prof. A. K. Srivastava Department of Chemistry University of Mumbai Kalina Campus, Mumbai – 400 098	Member
Prof. Deepak Dhar Indian Institute of Science Education and Research (IISER)-Pune Dr. Homi Bhabha Road, Pashan, Pune - 411 008	Member
Dr. S. K. Apte Former, Head Bio-Medical Group Molecular Biology Division Bhabha Atomic Research Centre Trombay, Mumbai - 400 085	Member
Prof. Anuradha Mishra Head, Department of Physics University of Mumbai Kalina Campus, Mumbai – 400 098	Member
Prof. R. V. Hosur Director UM-DAE CEBS University of Mumbai Kalina Campus, Mumbai – 400 098	Member - Secretary
Shri. K. P. Balakrishnan Registrar, UM-DAE CEBS University of Mumbai Kalina Campus, Mumbai – 400 098	Non-member Secretary
HoD of Computer Science University of Mumbai Kalina Campus, Mumbai – 400 098	Special Invitee

2. Faculty

2.1 Core Faculty

DEPARTMENT OF BIOLOGY		
Name of the faculty	**Designation**	**Courses taught in the Academic Year (2016-2017)**
Prof. Jacinta D'Souza	Associate Professor	Biology - I (B 101) Biology - II (B 201) Biology Laboratory (BL 501) Biology Project Coordinator (BPR 701) Advanced Techniques in Biology (BE 1002)
Dr. Manu Lopus	Reader 'F'	Cell Biology - I (B 301) Cell Biology - II (B 502) Animal Physiology (B 602) Biology Laboratory (BL 601) Advanced Techniques in Biology (BE 1002) Remedial Course in Biology
Dr. Subhojit Sen	Ramalingaswami Fellow	Biology Laboratory Coordinator (BL 101, BL 201, BL 601, BL 701) Molecular Biology (B 401) Biology Reading Project (BPR 701) Biology Semester Project (BPR 801) Advanced Techniques in Biology (BE 1002)
Dr. V. L. Sirisha	Assistant Professor	Biology Laboratory (BL 601, BL 701) Plant Physiology (B 603)
Dr. Ishita Mehta	DST Inspire Faculty	Biology - I (B 101) Cell Biology - I (B 301) Biology - II (B 201) Biology Laboratory (BL 401, BL 501, BL 601) Advanced Techniques in Biology (BE 1002)
Dr. Siddhesh Ghag	DST Inspire Faculty	Biology - I (B 101) Biotechnology - I (B 701) Biotechnology - II (B 804) Biology Laboratory (BL 801)
Dr. Patricia Pinto	Research Associate - I	Biology Laboratory Coordinator (BL 101, BL 201, BL 601, BL 701)
Dr. Sanith C.	Research Associate - I	Biology Laboratory (BL 101, BL 201)

Dr. Vishalsingh Chaudhary	Research Associate - I	Biology Laboratory (BL 301)
Dr. Shraddha Mehta	Research Associate - I	Virology (B 801)
Dr. Venkataraman Rao	Research Associate - I	Plant Physiology (B 603) Biology Laboratory (BL 601)

DEPARTMENT OF CHEMISTRY		
Name of the faculty	**Designation**	**Courses taught in the Academic Year (2016-2017)**
Prof. Swapan Ghosh	Distinguished Professor	Chemistry - II (C 201) Quantum Chemistry (C 501) Physical Chemistry –I (CB 403) Group Theory (C 401) Mathematics - III (CB 301) Advanced Theoretical Chemistry (CE 1003)
Prof. Neeraj Agarwal	Associate Professor	Chemistry Laboratory (CL 101, CL 201) Analytical Chemistry (CB 501) Chemistry Laboratory (CL 501)
Dr. Basir Ahmad	UGC Assistant Professor	Biochemistry - I (CB 302) Chemistry Laboratory (CL 501) Biophysical Chemistry (CB 601) Chemistry Laboratory (CL 601) Protein Chemistry and Conform Disease (CE 1004)
Dr. Mahendra Patil	Assistant Professor	Organic Chemistry - I (CB 303) Chemistry Laboratory (CL 301) Chemistry Laboratory (CL 401) Organic Chemistry - III (C 603)
Dr. Sinjan Choudhury	Assistant Professor	Chemistry Laboratory (CL 101) Chemistry Laboratory (CL 601) Biophysical Chemistry (CB 601)
Dr. Avinash Kale	Visiting Assistant Professor	Biophysical Chemistry (CB 601) Chemistry Laboratory (CL 301) Group Theory (C 401) Chemistry Laboratory (CL 601)
Dr. Manish Patil	Research Associate - I	Chemistry – I (C 101) Chemistry Laboratory (CL 401)
Dr. Sunita Patel	Visiting Scientist – II	Chemistry Laboratory (CL 301) Protein Chemistry and Conform Disease (CE 1004)
Dr. Veera Mohana Rao	SERB Post-doctoral Fellow	Mathematical - III (CB 301) Advanced NMR Spectroscopy (CE 1006)

		Chemistry Laboratory (CL 501)
Dr. Vaibhav Kumar Shukla	SERB Post-doctoral Fellow	Advanced NMR Spectroscopy (CE 1006) Chemistry Laboratory (CL 401) Chemistry Laboratory (CL 501)
Dr. Kavitha Rachineni	SERB Post-doctoral Fellow	Introductory Spectroscopy (CBP 401) Chemistry Laboratory (CL 201)
Dr. Anusri Bhattacharya	Research Associate - I	-

DEPARTMENT OF MATHEMATICS		
Name of the faculty	**Designation**	**Courses taught in the Academic Year (2016-2017)**
Prof. Balwant Singh	Emeritus Professor	Commutative Algebra (M 702) Advanced Commutative Algebra and Applications (ME 1004)
Dr. Swagata Sarkar	Research Associate – II	Foundations (M 301) Physical Mathematics (PM 601) Algebraic Topology (M 803)
Dr. Anuradha Nebhani	Research Associate – I	Algebra - I (M 303) Algebra - IV (M 602)
Dr. Chaitanya Senapati	Research Associate – I	Differential Topology (M 804)

DEPARTMENT OF PHYSICS		
Name of the faculty	**Designation**	**Courses taught in the Academic Year (2016-2017)**
Prof. S. M. Chitre	Distinguished Professor	Fluid Mechanics (P 701) Astronomy and Astrophysics (P 801)
Prof. R. Nagarajan	Emeritus Professor	Physics Laboratory (PL 101, PL 201, PL 401) Electronics and Instrumentation (G 201, GL 201)
Prof. P. C. Agrawal	NASI Senior Scientist	Advanced Physics Laboratory (PL 801)
Prof. Gopal Krishna	NASI Senior Scientist	-
Prof. Vijay Singh	Raja Ramanna Fellow	Physics – I (P 101) Physics - II (P 201)
Prof. Manohar Nyayate	Senior Scientist	Physics Laboratory (PL 101, PL 201, PL 401, PL 501, PL 601) Physics - II (P201)
Prof. Sujit Tandel	UGC Associate Professor	Statistical Techniques and Applications (G 401) Nuclear Physics (P 601)

		Advanced Physics Laboratory (PL 701)
Prof. Ameeya Bhagwat	Associate Professor	Numerical Analysis (PM 501) Numerical Methods Laboratory (PML 501) Physical Mathematics (PM 601)
Dr. Sangita Bose	Reader 'F'	Condensed Matter Physics - I (P 602) Advance Physics Laboratory (PL 701)
Dr. Ananda Hota	UGC Assistant Professor	Astronomy and Astrophysics (P 801)
Dr. Manojendu Choudhury	Assistant Professor	Computer Basics (G 101) Computer Laboratory (GL 101) Statistical Techniques and Applications (G 401) Numerical Analysis (PM 501) Numerical Methods Laboratory (PML 501) Advanced Physics Laboratory (PL 801)
Dr. P. Brijesh	Assistant Professor	Physics Laboratory (PL 101, PL 401, PL 501, PL 601) Mathematics - I (M 101) Mathematical Physics (P 304) Plasma Physics (PE 1014)
Dr. Bhooshan Paradkar	Assistant Professor	Classical Mechanics (P 302) Fluid Mechanics (P 701) Plasma Physics (PE 1014)
Dr. Alpa Dashora	UGC Assistant Professor	Physics Laboratory (PL 201)
Dr. Neelam Upadhyay	PI-DST Project	Mathematics – I (M 101) Mathematics - II (M 201)
Dr. Tripti Bameta	DST Inspire Faculty	Physics – I (P 101) Glimpses of Contemporary Sciences (P 303) Mathematical Physics – II (P 401) Numerical methods Laboratory (GL 401)
Dr. Sanved Kolekar	DST Inspire Faculty	-
Dr. Sreemoyee Sarkar	DST Inspire Faculty	Physics – I (P 101)
Dr. Jayashree Roy	Research Associate - I	Advanced Physics Laboratory (PL 801)
Dr. Sushil Samant	Research Associate - I	Computer Basics (G 101) Computer Laboratory (GL 101) Numerical methods Laboratory (GL 401)
Dr. Dinesh Negi	Research Associate - I	-
Dr. Shobha Surve	Research Associate - I	Physics Laboratory (PL 201)

2.2 Adjunct Faculty

Name of the faculty	Affiliation	Courses taught in the Academic Year (2016-2017)
Prof. H. C. Pradhan	Raja Ramanna Fellow Bhabha Atomic Research Centre (BARC), Mumbai	Ethics in Science and Intellectual Property Rights (H 601) History and Philosophy of Science (H 301)
Prof. S. Kailas	Raja Ramanna Fellow Bhabha Atomic Research Centre (BARC), Mumbai	Reactor Physics and Radiation Sciences (P 704)
Dr. Srinivas Krishnagopal	Bhabha Atomic Research Centre (BARC), Mumbai	Classical Mechanics (P 302) Accelerator Physics (P 802)
Dr. Sudhir R. Jain	Bhabha Atomic Research Centre (BARC), Mumbai	Waves and Oscillations (P 304) Glimpses of Contemporary Sciences (P 303) Dynamical Systems & Foundation of Statistical Mechanics (PE 1002)
Prof. Lokesh Tribedi	Tata Institute of Fundamental Research (TIFR) Mumbai	Atomic and Molecular Physics (P 603)
Prof. Sreerup Raychaudhuri	Tata Institute of Fundamental Research (TIFR) Mumbai	Particle Physics (P 804)
Dr. D.K. Palit	Bhabha Atomic Research Centre (BARC), Mumbai	Introductory Spectroscopy (CBP 401)
Prof. G. Ravindrakumar	Tata Institute of Fundamental Research (TIFR) Mumbai	Quantum Optics (PE 1013)
Prof. Narasimhan Chari	D.J. Sanghvi College	Graph Theory (M 504) Mathematics II (M 201) Computational Mathematics – III (M 805)
Prof. C.S. Rajan	Tata Institute of Fundamental Research (TIFR) Mumbai	-
Prof. Raju V. Ramanujan	School of Materials Science and Engineering, Singapore	-

2.3 Distinguished Guest Faculty

Name of the faculty	Affiliation	Stream	Courses taught in the Academic Year (2016-2017)
Prof. S. S. Jha	*Formerly* TIFR, Mumbai	Physics	Quantum Mechanics – I (P 402) Quantum Mechanics – II (P 502)
Prof. Chandrashekhar Khare	University of California (Los Angeles)	Mathematics	-

2.4 Visiting Faculty

BIOLOGY STREAM		
Name of the faculty	**Affiliation**	**Courses taught in CEBS Academic Year (2016-2017)**
Dr. Aditya Akerkar	SIES College, Mumbai	Biodiversity (B 503)
Dr. Aparna Kotekar	iGenetic Diagnostics Pvt Ltd	Molecular Biology (B 301, B 401)
Dr. Bhaskar Saha	St. Xaviers College, Mumbai	Animal Physiology (B 602) Developmental Biology (B 703)
Dr. Deepak Modi	National Institute of Research in Reproductive Health, (NIRRH), Mumbai	Cell Biology – II (B 502)
Dr. Devashish Rath	Bhabha Atomic Research Centre (BARC), Mumbai	Bioinformatics (B 803)
Dr. Champakali Ayyub	Tata Institute of Fundamental Research (TIFR), Mumbai	Biology Laboratory (BL 501)
Dr. Fatema Bhinderwala	Sophia College, Mumbai	Developmental Biology (B 703) Biology Laboratory (BL 701)
Dr. G. K. Rao	*Formerly,* Central Institute of Fisheiry Education, Mumbai	Genetics & Biostatics (B 501)
Dr. Girish Maru	Tata Memorial Centre, Mumbai	Cancer Biology (BE 1005)
Dr. Madhavan Gopalan	SIES College, Mumbai	Neurobiology (B 802)
Prof. M. M Johri	*Formerly* Tata Institute of Fundamental Research (TIFR), Mumbai	Plant Physiology (B 603)
Dr. Mahesh	Bhabha Atomic Research	Biochemistry – II (CB 402)

Subramanian	Centre (BARC), Mumbai	
Dr. Mandar Karkhanis	South Indian Welfare Society College	Biology - I (B 101) Biology - II (B 201) Microbiology (B 604) Genetics and Biostatistics (B 501)
Dr. Muktikanta Ray	Bhabha Atomic Research Centre (BARC), Mumbai	Bioinformatics (B 803)
Dr. Nabila Sorathia	Sophia College	Biology Laboratory (BL 801)
Dr. Pradnya Rao	Institute of Forensic Science, Mumbai	Forensic Science (BE 1008)
Dr. Rajendra Shinde	St Xavier's College, Mumbai	Biodiversity (B 503)
Dr. Rahul Chaudhari	Indian Institute of Technology (IIT-B), Mumbai	Biology - I (B 101) Biotechnology - I (B 701) Biology - II (B 201) Biotechnology - II (B 803)
Prof. S. Sivakami	*Formerly,* University of Mumbai	Biochemistry - II (CB 302) Biochemistry - II (CB 402)
Dr. Sandeepan Mukherjee	Haffkine Institute, Mumbai	Virology (B 801)
Dr. Shatrupa Sinha	Tata Institute of Fundamental Research (TIFR), Mumbai	Imaging technology in biological research (B 704) Cancer Biology (BE 1005) Advanced Techniques in Biology (BE 1002)
Dr. Vainav Patel	National Institute of Research in Reproductive Health, (NIRRH), Mumbai	Immunology - I (B 601) Immunology - II (B 702)

CHEMISTRY STREAM		
Name of the faculty	**Affiliation**	**Courses taught in CEBS Academic Year (2016-2017)**
Dr. Alok Samanta	Bhabha Atomic Research Centre (BARC), Mumbai	Atomic and Molecular Spectroscopy (C 601) Advanced Theoretical Chemistry (CE 1003)
Prof. Evans Coutinho	Bombay College of Pharmacy, Mumbai	Molecular Modeling and Drug Design (CE 1001)
Dr. Gail Carneiro	Sophia College, Mumbai	Quantum Chemistry - II (C 503)
Dr. Gomati Sridhar	KVS Menon College, Mumbai	Organic Chemistry – I (CB 303) Organic Chemistry - III (C 602)
Dr. Kathi Sudarshan	Bhabha Atomic Research Centre (BARC), Mumbai	Nuclear Chemistry (C 604)

Dr. KRS Chandrakumar	Bhabha Atomic Research Centre (BARC), Mumbai	Nanomaterials and Soft Condensed Matter (CE 1002)
Dr. Lakshamy Ravishankar	V.G.Vaze College of Arts, Science & Commerce	Quantum Chemistry II (C 503)
Prof. M. Sudarsanam	*Formerly*, University of Mumbai	Chemistry Laboratory (CL 101, CL 201) Chemistry Laboratory (CL 501) Analytical Chemistry (CB 501)
Dr. M. V. Hosur	*Formerly*, Bhabha Atomic Research Centre (BARC), Mumbai	X Ray Crystallography (CE 1005)
Dr. Niharendu Choudhury	Bhabha Atomic Research Centre (BARC), Mumbai	Advanced Theoretical Chemistry (CE 1003)
Dr. P. A. Hassan	Bhabha Atomic Research Centre (BARC), Mumbai	Nanomaterials and Soft Condensed Matter (CE 1002)
Dr. R. K. Vatsa	Bhabha Atomic Research Centre (BARC), Mumbai	Physical Chemistry – I (CB 403)
Dr. Rahul Tripathi	Bhabha Atomic Research Centre (BARC), Mumbai	Nuclear Chemistry (C 604)
Dr. S. Kannan	Bhabha Atomic Research Centre (BARC), Mumbai	Inorganic Chemistry - II (C 502) Inorganic Chemistry - III (C 602)
Dr. S. K. Kulshreshtha	*Formerly* Bhabha Atomic Research Centre (BARC), Mumbai	Inorganic Chemistry – I (C 301)
Dr. Tanuja Parulekar	SIWS College	Organic Chemistry – I (CB 303) Organic Chemistry – III (C 603)
Dr. Vinayak Rane	Tata Institute of Fundamental Research (TIFR), Mumbai	Atomic and Molecular Spectroscopy (C 601)

MATHEMATICS STREAM		
Name of the faculty	**Affiliation**	**Courses taught in CEBS Academic Year (2016-2017)**
Prof. Ajit Kumar	Institute of Chemical Technology (ICT), Mumbai	Computational Mathematics - I (M 305) Computational Mathematics - II (M 405, M605)
Prof. Alladi Subramanyam	Indian Institute of Technology (IIT-B), Mumbai	Stochastic Analysis (M 703) Probability Theory (M 605)
Prof. Amitava Bhattacharya	Tata Institute of Fundamental Research, Mumbai	Combinatory and Enumeration (ME 1002)

Dr. Anshu Gupta	Inter-University Center for Astronomy and Astrophysics, Ganeshkhind, (IUCAA) Pune	Partial Differential Equations (M 704) Differential Geometry and Applications (M 603)
Prof. Inder K. Rana	Indian Institute of Technology (IIT-B), Mumbai	Analysis - II (M 401) Analysis - III (M 501)
Dr. Joseph Amalnathan	Bhabha Atomic Research Centre (BARC), Mumbai	Mathematics I (M 101)
Prof. Jyotsa Dani	*Formerly,* St. Xavier College, Mumbai	Elementary Number Theory (M 403) Analysis - I (M302)
Prof. K. D. Joshi	*Formerly,* Indian Institute of Technology (IIT-B), Mumbai	Algebra - II (M 402)
Dr. Kiran Kolwankar	R. J. College, Ghatkopar	Differential Equations and Dynamic Systems (M 604)
Prof. M. G. Nadkarni	University of Mumbai	Introduction to Ergodic Theory (ME 1001)
Prof. Mahadeo Bakre	*Formerly,* University of Mumbai	Differential Geometry and applications (M 603) Functional Analysis (M 701)
Prof. Parvati Shastri	Indian Institute of Technology (IIT-B), Mumbai	Algebraic Number Theory (M 802)
Prof. R. C. Cowsik	*Formerly,* University of Mumbai	Discrete Mathematics (M 304) Analysis – IV (M 601)
Dr. Richard D'Souza	Bhabha Atomic Research Centre (BARC), Mumbai	Mathematics - I (M 100) Mathematics - I (M 200)
Prof. Saradha N.	*Formerly,* Tata Institute of Fundamental Research (TIFR), Mumbai	Analytic Number Theory (ME 1003)
Prof. S. Krishnan	Indian Institute of Technology (IIT-B), Mumbai	Representation Theory of Finite Groups (M 705)
Dr. Shameek Paul	*Formerly, CEBS*	Topology - I (M 404) Topology – II (M 503)
Dr. Sivaguru	Tata Institute of Fundamental Research (TIFR), Mumbai	Fourier Analysis (M 801)

PHYSICS STREAM		
Name of the faculty	**Affiliation**	**Courses taught in CEBS Academic Year (2016-2017)**
Prof. A. K. Raina	*Formerly,* CEBS & Tata Institute of Fundamental	Mathematical Physics - II (P 401)

	Research (TIFR), Mumbai	
Dr. Anwesh Majumdar	Homi Bhabha Centre for Science Education (HBCSE), Mumbai	Electromagnetism (P 303)
Prof. Arvind Kumar	*Formerly,* Homi Bhabha Centre for Science Education (HBCSE), Mumbai	Quantum Mechanics - III (P 702) General Relativity & Cosmology (PE 1004)
Prof. Dipan Ghosh	Indian Institute of Technology (IIT-B), Mumbai	Quantum Computing & Information (PE 1007) Classical Mechanics - II (P 502)
Prof. G. Mukhopadhaya	Indian Institute of Technology, Mumbai	Statistical Mechanics (P 703) Electromagnetism (P 403)
Prof. Kailash Rustagi	Indian Institute of Technology, Mumbai	Classical Electrodynamics (P 604)
Dr. Karthik Subbu	Mithibhai College	Applied Electronics Laboratory (GL 201, GL 301)
Dr. Kartik Patel	Bhabha Atomic Research Centre (BARC), Mumbai	Computational Electrodynamics (PE 1010)
Prof. Laxmi Natarajan	*Formerly,* University of Mumbai	Atomic and Molecular Physics (P 603)
Prof. Nilmani Mathur	Tata Institute of Fundamental Research, Mumbai	Particle Physics (P 804/ PE 1001)
Prof. P. Shashidhran	Vertak College, Mumbai	Applied Electronics Laboratory (GL 201, GL 301)
Dr. Praveen Pathak	Homi Bhabha Centre for Science Education (HBCSE), Mumbai	Physics - II (P201)
Prof. Rajan Chitalay	Mithibai College, Vile Parle	Electronics and Instrumentation (G201, GL 201)
Dr. S. K. Singh	Bhabha Atomic Research Centre (BARC), Mumbai	Reactor Physics and Radiation Sciences (P 704)
Dr. Sanjeev Kumar	*Formerly,* CEBS	Physics Laboratory (PL 501, PL 401)
Dr. Tushima Basak	Mithibai College, Vile Parle	Physics Laboratory (PL 301, PL 401)
Dr. T. Padmanabhan	Inter-University Center for Astronomy and Astrophysics, (IUCAA) Pune	General Relativity & Cosmology (PE 1004)

Dr. Wendrich Soars	Vikash College, Mumbai	Physics Laboratory (PL 101, PL 201) Applied Electronics Laboratory (GL 201, GL 301)

General subjects etc.		
Name of the faculty	**Affiliation**	**Courses taught in CEBS Academic Year (2016-2017)**
Prof. Nilufer Bharucha	*Formerly,* University of Mumbai	Communication Skills (H 101, H 201) World Literature (H 401)
Dr. N. S. Basavaiya	Bhabha Atomic Research Centre (BARC), Mumbai	Earth Science and Energy & Environmental Sciences (G 501)
Prof. Sridhar Rajeswaran	Centre for Advance Studies in India	Communication Skills (H 101, H 201) World Literature (H 401)
Dr. S. K. Arora	Bhabha Atomic Research Centre (BARC), Mumbai	Earth Science and Energy & Environmental Sciences (G 501)

3.1 Administration

Director	Prof. R. V. Hosur
Registrar	Mr. K. P. Balakrishnan
Wardens	Dr. Avinash Kale (Boys) Dr. Sinjan Chaudhary (Girls) Dr. Veera Mahana Rao –Co-warden (Boys) Dr. Swagata Sarkar- Co-warden (Girls) Dr. Vaibhav Kumar Shukla – Resident Warden
Consultants	Dr. Jayant Kayarkar (Admin & Accounts) Mr. Kishore Menon (PR & Students Matter) Mr. Milind Ashrit (Finance) Mr. Deepak P Hate (Purchase) Dr. Rajendra Agarkar (Medical Advisor)
Office Superintendent	Ms. Swati V. Kolekar (Admin) Ms. Vaishali M. Kedar (Admin) Ms. Rupali Shringare (Finance) Ms. Neha Dandekar (Finance)
Assistants	Ms. Veena Naik (Purchase & Store) Mr. Nitesh Kadam (Hostel Assistant Ms. Divya Sukumaran (Multi Skill) Ms. Vaibhavi Nerurkar (Finance) Mr. Maharajan Thevar (Infrastructure)
Systems Assistant	Mr. Prashant Gurav
Technician	Mr. Tushar Bandkar (Electrical)
Library Attendant	Mr. Amit Shetkar Mr. Shankar Kadam
Office Attendant	Mr. Maruti Khot Mr. Bhushan Deshpande

3.2 Laboratory Staff

Scientific Assistants	Mr. Kanak Gawde (Biology) Ms. Sonali Shiriskar (Chemistry) Mr. Ajayweer Gautam (Biology) Mr. Nikhil Kadlag (Biology)

Laboratory Attendants	Mr. Ram M. Soure (Physics) Mr. Dinesh B. Desai (Physics) Mr. Santosh Sood (Biology) Ms. Rupesh Kamtekar (Chemistry) Mr. Abhay Bakalkar (Physics & Computer) Mr. Harish Hira Singh (Biology) Mr. Abhijit Ghag (Chemistry) Mr. Sandesh Kolambe (Chemistry)

3.3 Laboratory staff engaged in research

Junior Research Fellow (JRF)	Mr. S. Gholam Wahid (Physics) Ms. Poulomi Roy (Physics) Mr. Plawan Das (Mathematics) Ms. Swati Dixit (Chemistry)
Senior Project Assistant (SPA)	Ms. Marilyn Sequeira (Biology) Ms. Pradnya G. Parab (Physics) Mr. Domnic Colvin (Chemistry) Ms. Samridhi Phatak (Chemistry)
Junior Project Assistant (JPA)	Mr. Snehal Kaginkar (Biology) Ms. Tejashree Mahaddalkar (Biology) Ms. Pooja Potdar (Biology) Ms. Prabhjyot Bhui (Physics) Ms. Neha Vispute (Chemistry) Ms. Shreyada Save (Chemistry) Ms. Anuradha Kharde (Chemistry)

4. Students

4.1 Student intake

The intake of students is based on the nation-level entrance test, called the National Entrance Screening Test (NEST) that is held in several Centres all over India. Students who have passed their 12th standard or equivalent examination from any board in India are eligible to enroll for the test. This year, the test was conducted in 120 centres all over India.

National Entrance Screening Test (NEST)

Year	No. of Students enrolled for the NEST	No. of Students appeared for the NEST	No. of students admitted in CEBS	No. of students remained in I Semester
2007	5,600	3,300	21	19
2008	8,200	7,000	20	11
2009	14,105	12,036	25	21
2010	16,686	9,453	30	25
2011	14,500	9,691	35	28
2012	15,099	10,775	35	34
2013	24,543	19,436	35	23
2014	45,519	29,645	35	33
2015	46,615	31,076	45	40
2016	**54,511**	**37,662**	**47**	**39**

4.2 Students admitted in the academic year 2016-17:

Sr. No.	M/F	Name of the Student	State of Origin
1	M	Akhil Sudarsan	Kerala
2	M	Ameya Uday Nagdeo	Maharashtra
3	F	Babli Adhikary	West Bengal
4	M	Banavath Bharath Naik	Andra Pradesh
5	M	Devarakonda Yogeshwar	Telangana
6	M	Dipesh Kumar Pradhan	Odisha
7	M	Gangishetty Krishna Chaitanya	Telangana
8	M	Gokul Krishna GS	Kerala

9	M	Gursahib Singh Sethi	Himachal Pradesh
10	M	Hardeep Singh	Punjab
11	M	Indranil Das	Jharkhand
12	M	Jeevan Kumar Gochhayat	Uttarpradesh
13	M	Kamisetti Ravi Teja	Telangana
14	M	Kanav Mahajan	Jammu & Kashmir
15	M	Kola Srinivas	Odisha
16	M	Kumar Abhilash	Bihar
17	M	Quasran Ahmad Malik	Maharashtra
18	M	Manush M	Kerala
19	F	Nishat Rathore	Rajasthan
20	M	Raheel Hammad	Jammu & Kashmir
21	M	Rahul Gupta	Chattisgarh
22	M	Rashmi Ranjan Sahu	Odisha
23	M	Rishabh Kaurav	Madhya Pradesh
24	M	Rohit Somanchi	Telangana
25	M	Sandeep V	Tamilnadu
26	M	Sarthak Mathur	Rajasthan
27	M	Sukant Chamoli	Uttarakhand
28	M	Tellam Venkata Rakesh	Andhra Pradesh
29	F	V Nivedita	Tamilnadu
30	F	Vimisha Yadav	Haryana
31	F	Shamishtha Shilpi Das	Tripura
32	M	Sarthak Joshi	Madhya Pradesh
33	M	Sparsh Sinha	Delhi
34	M	Mayank Kumar Pal	Uttar Pradesh
35	M	Vijay Sharma	Rajasthan
36	M	Shashank Tiwari	Rajasthan
37	M	Pratyush Bhatnagar	Uttar Pradesh
38	M	Ashutosh Dash	Odisha
39	M	Saptarshi Mondal	West Bengal

4.3 State wise distribution students admitted in the year 2016-17:

State of origin	No. of students admitted
Andhra Pradesh	02
Bihar	01
Chhattisgarh	01
Delhi	01
Harayana	01
Himachal Pradesh	01

Jammu & Kashmir	02
Jharkhand	01
Kerala	03
Madhya Pradesh	02
Maharashtra	02
Odisha	04
Punjab	01
Rajasthan	04
Tamil Nadu	02
Telangana	04
Tripura	01
Uttar Pradesh	03
Uttarakhand	01
West Bengal	02
Total	**39**

4.4 Students graduated (M.Sc. Five Year Integrated) in the year 2016:

Roll No.	Name	Specialization
B011513	Mr. Akshay Malwade	Biology
B011518	Ms. Neha Mohanpuria	Biology
B011522	Ms. Anushree Ray	Biology
B010409	Mr. Kasuba Krishna Chaitanya	Biology
C011501	Mr. Anil Kumar	Chemistry
C011528	Ms. Sumalata Sonavane	Chemistry
C011529	Mr. Tinku Kumar	Chemistry
M011503	Mr. Joji Benny	Mathematics
M011504	Mr. Ashok Choudhary	Mathematics
M011507	Ms. Divya	Mathematics
M011510	Mr. Karan Kathuria	Mathematics
M011519	Mr. Vishal Padwal	Mathematics
M011525	Mr. Praneel Samanta	Mathematics
P011502	Mr. Ajay C. J.	Physics
P011505	Mr. Prashant Kumar Chauhan	Physics
P011506	Mr. Swami Vivekanandaji Chaurasia	Physics
P011514	Mr. Ayush Kumar Mandwal	Physics
P011515	Mr. Bhishek Manek	Physics

P011516	Mr. Somendu Kumar Mourya	Physics
P011520	Mr. Anurag Patel	Physics
P011523	Mr. Mohammad Saifullah	Physics
P011524	Mr. Saket Suman	Physics
P011526	Ms. Phalguni Shah	Physics
P011527	Mr. Ankush Singhal	Physics
P011531	Mr. Abhijith Varma	Physics

4.5 Students placements who graduated in the year 2016:

Name of the Student	Specialization	Current Placement
Mr. Akshay Malwade	Biology	Ph. D. at the Institut Pasteur, Paris, France
Ms. Neha Mohanpuria	Biology	Ph. D. at Gustave Roussy, France
Ms. Anushree Ray	Biology	Ph. D. at Tata Institute Fudamental Reserah, Mumbai
Mr. Kasuba Krishna Chaitanya	Biology	Visiting scientist at European Molecular Biology Laboratory (EMBL) Germany
Mr. Anil Kumar	Chemistry	Project Assistant at UM-DAE CEBS
Ms. Sumalata Sonavane	Chemistry	Internship NCBS, Bangaluru
Mr. Tinku Kumar	Chemistry	Information not available
Mr. Joji Benny	Mathematics	Junior Research Fellow at Mathematics Department, IIT-Madras, Chennai.
Mr. Ashok Choudhary	Mathematics	Information not available
Ms. Divya	Mathematics	Information not available
Mr. Karan Kathuria	Mathematics	Ph. D. at Universität Zürich, Switzerland, USA
Mr. Vishal Padwal	Mathematics	Northwestern University, USA
Mr. Praneel Samanta	Mathematics	Ph. D. at University of Iowa, USA
Mr. Ajay C. J.	Physics	Ecole Polytechnique Federal de Laussane (EPFL)- Lausanne, Switzerland
Mr. Prashant Kumar Chauhan	Physics	Graduate Fellow at Johns Hopkins University, USA
Mr. Swami Vivekanandaji Chaurasia	Physics	Ph. D. at Theoretical Physics Institute, Germany
Mr. Ayush Kumar Mandwal	Physics	Ph. D. at University of Calgary, Canada
Mr. Bhishek Manek	Physics	Ph. D. at University of California, Santa Cruz, USA
Mr. Somendu Kumar Maurya	Physics	Ph.D. at University of Waterloo, Canada

Mr. Anurag Patel	Physics	Ph. D. at Inter-University Accelerator Centre, New Delhi
Mr. Mohammad Saifullah	Physics	Studying Commercial Pilot License (CPL)
Mr. Saket Suman	Physics	Ph. D. at Technische Universitat Darmstadt, Germany
Ms. Phalguni Shah	Physics	Ph. D. at Department of Physics and Astronomy, Northwestern University, USA
Mr. Ankush Singhal	Physics	Ph. D. at Max Planck Institute of Colloids and Interfaces, Germany
Mr. Abhijith Varma	Physics	-

4.6 M.Sc. dissertation projects done by final year students:

Sr. No.	Name of the Student	Guide	Brief Title
Biology			
1.	Nikhil Sathyan	Prof.Seth Darst (Rockefeller University)	Structural studies of a novel transcription factor and σ66 via an in-vivo assembled σ66-RNA polymerase holoenzyme
2.	Anirudh V. Pillai	Dr. P.V. Shivaprasad (NCBS, Bangaluru)	miRNA analysis in Oryza spp. and phenotyping of varios Oryza spp. varieties.
3.	Swagat S Pradhan	Dr. Anu Wartiovaara, Dr. Christopher Jackson (University of Helsinki, Helsinki, Finland)	Deciphering Mitochondrial stress responses
4.	Harsha Vardhan Rao	Dr. Martin Denzel (Max Planck Institute for Biology of Ageing)	Forward genetic screen to identify new gene mutations affecting ageing
5.	Prasad Chandrakant Kalamkar	Dr.Narayan Rao AVSS (BARC)	Detection of cancer mutations through microarray systems
6.	Abhishek Howlader	Dr. Milind Vaidya (ACTREC, Mumbai)	Role of biomoleculeTAP63 in malignant tongue keratinocytes (AW13516)
7.	Pratik Kumar Mandal	Prof. Maria del Mar Dierssen Sotos (Centre for Genomic Regulation, Barcelona)	The role of astrocytes in Down syndrome: Implications in synaptic plasticity and hippocampus-cortex connectivity

Chemistry			
8.	Ankur	Dr. Xavier Salvatella (Institute for Research in Biomedicine Barcelona)	Studying the intramolecular interaction of different domains of androgen receptor Protein.
9.	Aishwarya Mishra	Dr. Urs Hafeli (University of British Columbia)	Development of an alzeheimer imaging agent
10.	Sagnik Dutta	Prof. Dennis Hore (University of Victoria)	Sum frequency Generation Vibrational Spectroscopy of Protein Adhesion on Metal surfaces
11.	Kumud Soni	Dr. Laishram R Singh (Dr. B. R. Ambedkar Center for Biomedical Research)	Effect of macromolecular crowding on protein folding and function.
12.	Vaishakh Vij	Prof Lorenz Cederbaum (University of Heidelberg)	Inter atomic coulombic decay (ICD)
13.	Sangeeth Saseendran	Dr. Ravindra Venkatramani (Tata Institute of Fundamental Research, Mumbai)	Computational modeling of Metal-Molecule contact for estimating single Molecule conductance
14.	Prateek Soni	Vinod C Prabhakaran (National Chemical Laboratory, Pune)	Selectivity and activity control for the Cinnamaldehyde hydrogenation over Pd nanocrystals
15.	Kaarunya Dhevi	Dr. Derek Wann (University of York, UK)	Gas Phase Structure of Ferrocene from Quantum Chemical Studies and Electron Diffraction
16.	Anjitha S. G.	Dr. Terry J. Dillon (University of York, UK)	Kinetic Study of the Reaction between O2 + Acetyl/Other Similar Molecules
Mathematics			
17.	Duttatrey Srivastava	Ravi Raghunathan (IIT-B)	Analytic Number Theory
18.	Deepak Kamlesh	Christopher Deninger (University of Munster)	Non-abelian p-adic Hodge Theory
Physics			
19.	Mr. Ankit Kumar Kumawat	Dr. D. C. Biswas (BARC)	Excited 0^+ States and deformed Structures in the transitional nucleus ^{98}Zr
20.	Mr. Rohit Vaidya	Prof. Tahei Tahara (RIKEN, Japan)	Probing the Bimolecular Dynamics in the Microsecond to Second Time Region Using scanning 2D Florescence

			Lifetime Correlation Spectroscopy
21.	Mr. Salman Alam	Prof. Shankar Ghosh (TIFR)	Study of Shear Wave Through Granualr System
22.	Mr. Akshay K.	Prof. Tobias Kippenberg, (EPFL, Switzerland)	Non-Reciprocal Devices Microwave Circuit Optometrics
23.	Mr. Rishabh Gupta	Prof. K. P. Singh (TIFR)	Fabrication of Thin Films for Bragg's Reflectivity
24.	Mr. Naman Agarwal	Dr. Henrik Ronnow (EPFL, Switzerland)	Electric Field Effect on Skyrmion Phase in Chiral Lattice Ferrimagnet Cu_2OSeO_3
25.	Mr. Sanu Mishra	Prof. Martin Dressel (University of Stuttgart, Germany)	Studying Superconductivity in Copper Doped Niobium Thin Films Using Teragertz Spectroscopy
26.	Mr. Amulya Ratnakar	Prof. Rajdeep Sensarma (TIFR)	Amplitude and Phase Fluctuation in a Disordered Superconductor
27.	Ms. Lamia Yasir Varawala	Prof. Tomasz Paterek (University of Waterloo, Canada)	Bell's Inequality in Time
28.	Ms. Aswathi K. Sivan	V.K. Mutta, Olof Karis (Uppsala University, Sweden)	Magneto Optic Kerr Effect Microscopy of Domain Walls in Magnetic Nanowires
29.	Mr. Sachin Prabhakr	Prof. G. Ravindra Kumar, TIFR	Study of Hot Electron Transport in Solids and Multi Mega Gauss Magnetic Field Measurements
30.	Mr. Sanchit Sablok	Prof. Hans O U Fynbo (Aarhus University, Denmark)	Role of Neutrals and Density Gradients in Stellar Atmospheres
31.	Mr. Kamal Sant	Prof. Thomas F Krauss (University of York, UK)	The Chirped Grating Biosensor
32.	Mr. John Regis	Prof. S. M. Chitre, Dr. Bhooshan Paradkar (CEBS)	Role of Neutrals and Density Gradients in Stellar Atmospheres

4.7 Ph. D. Programme

The following CEBS students are registered for their Ph.D from University of Mumbai. Since Ph.D. Programme not formally approved at CEBS, the students are registered with Faculty member of University of Mumbai, but their research work is carried out at CEBS under the guidance of a CEBS Faculty member. It is hoped that this program, together with other academic programs, will start soon.

Name of the student	Guide in CEBS	Guide under whom registered
Ms. Pradnya Parab	Dr. Sangita Bose	Under process
Mr. S. Gholam Wahid	Prof. Sujit Tandel	Under process
Mr. Plawan Das	Prof. Balwant Singh	Under process

5. Awards & Honors

Swapan Ghosh

- Awarded D.Sc. (Honoris Causa) by Kalyani University, West Bengal (2016).

Siddhesh Ghag

- National Academy of Sciences, India (NASI) - Young Scientist Platinum Jubilee Award (2016) for Excellence in the field of Plant Sciences, Agriculture and Environment.

Veera Mohana Rao

- CBMR-NMRS Gold Medal Award, presented during the APNMR-NMRS conference held at IISc, Bangalore, 2017, for Excellence in the field of NMR spectroscopy.
- Young Investigator award, presented during the ICMRBS, conference held at Kyoto, Japan, 2016, for Excellence in the field of NMR spectroscopy.

Vaibhav Kumar Shukla

- Young Investigator award, presented during the ICMRBS, conference held at Kyoto, Japan, 2016, for Excellence in the field of NMR spectroscopy.

5.1 Other recognition like travel award, memberships of committees, Societies etc.

Alpa Dashora

- Reviewer for international journals like J. Alloys and Compounds, J. Material Science, International J. of modern Physics B.

Ameeya Bhagwat

- Member of the organizing committee of DAE – BRNS Symposium on Nuclear Physics, SINP (Kolkata) 2016.
- Member of the Syllabus Committee for M.Sc. Programme at the University Department of Physics, University of Mumbai for Quantum Mechanics, Mathematical Physics and Numerical Methods, Nuclear Physics.

Ananda Hota

- Member of the National SKA India Science Working Group.
- Reviewer for the GMRT Time Allocation Committee.

Avinash Kale

- Member, Advisory Board of Hon. Shri. Babanrao Pachpute Vichardhara Trust's Parikrama Group of Institutions, Ahmadnagar, Kashti.
- Member, Board of Studies of School of Biotechnology and Bioinformatics, D. Y. Patil University, Navi Mumbai.

- Member, Ad hoc Board Studies in Biophysics, University Department of Biophysics, University of Mumbai.

Basir Ahmad

- Managing editor of a special issue entitled "Prevention of amyloid aggregation using small molecules" in the Frontiers in Bioscience.
- Member, American Chemical Society.
- Member, Ad hoc Board Studies in Biophysics, Department of Biophysics, University of Mumbai.
- International Referee for the Netherlands Organisation for Scientific Research (NWO) Grant Proposal.
- International Referee for Iran National Science Foundation (INSF) Grant Proposal.

Bhooshan Paradkar

- Referee work for international plasma physics journals such as Physics of Plasma and Plasma physics and controlled fusion.

Gopal Krishna

- Member on the IAU Commission 40 Working Group on "Historical Radio Astronomy".
- Member, IUCAA Governing Council.

Jacinta D'Souza

- DST(SERB) Travel award of Rs. 1,12,04/- to attend the Gordon Research Conference: New Concepts in Cell Death Research: From Basic Mechanisms to Clinical Opportunities, held from 3rd-8th July, 2016 in Catalunya, Spain.

Kavitha Rachineni

- Life membership, National Magnetic Resonance Society of India (NMRS).

Manojendu Choudhury

- National Coordinator of the Indian National Astronomy Olympiad (INAO) 2016.
- IUCAA-Associate at the Inter-University Centre for Astronomy and Astrophysics (IUCAA), Pune.
- Reviewer for the ASTROSAT Time Allocation Committee.
- Referee for INSPIRE Fellowship Proposals.

Manu Lopus

- Member, American Chemical Society.
- Member of the National Academy of Sciences, Allahabad (NASI).
- Guest Editor, Current Topics in Medicinal Chemistry.

Neeraj Agarwal

- Member of the National Academy of Sciences India, Allahabad (NASI).

Neelam Updhyay

- Member of the Syllabus Committee for M.Sc. Programme at the University Department of Physics, University of Mumbai for Nuclear Physics.

R. V. Hosur

- Chairperson, INSPIRE Faculty selection committees.
- Member, DBT-IISc review committee.
- Member, DBT-JNCASR review committee.
- Member, NASI young scientist award selection committee.
- Member, NASI Fellowship Scrutiny Committee.
- Member, Editorial Board, The Scientific World Journal.
- Member, Editorial Board, International Journal of Chemistry.
- Member, Council, International Society of Magnetic Resonance (ISMAR).
- Member, DBT Task Force on Modern Biology.

R. Nagarajan

- Member, Subject Board, Dept. of Physics, University of Mumbai.
- Member, Syllabus committee for Electronics, Dept. of Physics University of Mumbai.

Siddhesh Ghag

- Reviewer for PLoS ONE journal.
- Member, Indian Society of Plant Pathologists.
- Member, Promusa Bioversity International.

Subhojit Sen

- Reviewer for Biomedical Research Journal.
- Member, Indian Science Congress.
- Member, International Review Board, The Humsafar Trust.

Swapan Ghosh

- Council Member (2015-2017), Indian National Science Academy, New Delhi.
- Member of the Faculty Selection Committee Meeting, SRM University, March 13-14, 2017.
- Member, DST-INSPIRE Faculty Selection Committee (Chemistry), INSA, May 19-20, 2016.
- Member, Local Organizing Committee in the Symposium on "Modern Trends in Molecular Magnets", held at IIT, Bombay, May 19-21, 2016.
- Member of Faculty Selection Committee Meeting, HBCSE, TIFR, on July 20, 2016.
- Member of Faculty Selection Committee Meeting, IIT, Patna, on Oct 3, 2016.
- Member, DST Swarnajayanti Fellowship Selection Committee Meeting, IASc, Bangalore, on August 20, 2016.
- Member, Academy Summer Research Fellow Selection Committee, Indian Academy of Sciences, Bangalore, December 21-22, 2016.

- Member, Advisory Committee in the Theoretical Chemistry Symposium 2016, held at University of Hyderabad, during December 15-18, 2016.
- Member, Advisory Committee for the "International Conference on Energy Materials", held at Vidyasagar University, Midnapore, W.B., 2017.
- Member, Editorial Board of the "Journal of Computational Methods in Sciences and Engineering".

Sunita Patel

- Member, National Magnetic Resonance Society, India.
- Member, Indian Biophysical Society, India.

Sreemoyee Sarkar

- "DST SERB Travel Grant to attend workshop on neutron star named "Exploring different phases of neutron star using transport coefficients" at Institute for Nuclear Theory (University of Washington), Seattle, July, 2016.

Sujit Tandel

- Member of Organizing Committee of DAE-BRNS Symposium on Nuclear Physics, 2017 (Thapar University, Patiala).

V. L. Sirisha

- Member, Physiological Society of America, U.S.A.
- Member, International Society of Applied Phycology, Australia.
- Member, Society of Applied Biotechnology (SAB), India.
- Member, Society of Biological Chemists, India.

Veera Mohana Rao

- DST-SERB, international travel award (INR 67500/-) for attending the 27th International Conference on Magnetic Resonance in Biological Systems (ICMRBS) held at Kyoto, Japan during August 21– 26, 2016.
- CICS international travel award for attending the 27th International Conference on Magnetic Resonance in Biological Systems (ICMRBS) held at Kyoto, Japan August 21– 26, 2016.
- Life membership, National Magnetic Resonance Society of India (NMRS).

Vaibhav Kumar Shukla

- DBT-CTEP, international travel award (INR 52000/-) for attending the 27th International Conference on Magnetic Resonance in Biological Systems (ICMRBS) held at Kyoto, Japan during August 21– 26, 2016.
- CICS international travel award for attending the 27th International Conference on Magnetic Resonance in Biological Systems (ICMRBS) held at Kyoto, Japan during August 21– 26, 2016.
- Life membership, National Magnetic Resonance Society of India (NMRS).

Vijay Singh

- Major resource person for the International Physics Olympiad programme (HBCSE, Mumbai).
- Member of Executive Committee for the Asian Physics Olympiad programme (IAPT, Delhi) and Astronomy Olympiad programme.
- Resource person for the National Initiative on Undergraduate Science (NIUS) Physics, HBCSE, Mumbai.

6.1 Research activities of Department of Biology

Jacinta D'Souza

Identification, Isolation and Characterization of Multiprotein Complexes:

A Multiprotein Complex (MPC) is a group of 2/more associated polypeptide chains forming a quaternary structure linked by non-covalent interactions. MPCs perform a vast array of biological functions and are broadly classified as stable and transient. The Protein-Protein interactome laboratory has been using the biflagellated, unicellular alga *Chlamydomonas reinhardtii* for addressing their research interest on MPCs.

Identification and isolation of stable FAP174-AKAP240 complex from the Cilium:

Cilia are thin extra-cellular organelles of motility and sensory perception. Although the mechanistic details of motility remain elusive, the dynein-driven motility is known to be regulated by various kinases and phosphatases. A-kinase anchoring proteins (AKAPs) are scaffolds that bind to a variety of such proteins that possess domain for interaction and is a contiguous stretch of amino acid residues known as the Dimerization Docking (D/D) domain. Of the two AKAPs that the *C. reinhardtii* flagella harbor, a MYCBP-1 orthologue, namely, Flagellar Associated Protein (FAP174) binds to AKAP240. Using an immunoprecipitation assay, seven other partners to this complex that is rich in adenylate kinases was isolated. This C2-based complex is being characterized; *fap174* null mutant isolated and 2 constructs made for conducting high-throughput sub-flagellar localization studies

(V.G. Rao, Shraddha Mehta, Pinfen Yang and J.S. D'Souza).

By means of electrophoresis of recombinant proteins with an increasing concentration of DTT, MALDI-TOF, FT-IR, and micro-Raman spectroscopy, it has been identified that the D/D domain resides in and around C46. In silico methods helped identify the neighbouring aa of C46, viz. A39, L40, Y42, and L47 that might be involved in dimerization. The secondary structure of FAP174 showed the presence of four α-helices, helix B contains two VLV stretches at positions 21–23 and 25–27. Mutating these stretches to alanines followed by native gel electrophoresis of the respective recombinant proteins indicated their role in oligomerization. The results imply that FAP174, unlike most of the other AKAP-interacting proteins, harbours two different domains, one for dimerization and the other for oligomerization. (Yogesha Ashtkar, V.G. Rao, E.V. Martis, Evans Coutinho, Holger Gohlke, Santhosh C. and J.S. D'Souza). Further, a 2-Dimensional electrophoretic approach has been undertaken to compare the proteomes of WT and *fap174 C. reinhardtii* mutant.

(Shraddha Mehta and J.S. D'Souza).

Identification of transient protein complexes involved in the stress-induced physiology of *C. reinhardtii*: a question of survival versus death:

The vegetative cells of *C. reinhardtii* when exposed to abiotic stress conditions respond differentially. The pathways that contribute to such a response remain elusive. A Systems Biology approach towards addressing this problem was iniatiated and have

conducted an RNA sequence analysis so as to create a database of transcripts that are annotated. Meanwhile, cells exposed to KCl form clusters that have live cells within them. *(J.S. D'Souza).*

Given this differential response, a crucial question of stress-induced survival and death in *C. reinhardtii* emanates. In order to dissect this phenomenon, three molecules have been selected: (1) a Caspase-3-like protein (CrMC2) that might be promoting the PCD process: The CrMC2 gene was cloned, the protein over-expressed in *E. coli* and its expression induces cell death. (Kasuba CK, Pinki Gehlot, Aakifa Ansari and JS D'Souza) (2) a GSK3β protein that might play a decisive role in leading the cells to a necrotic or an apoptotic type of cell death upon exposure to stress (Sirisha VL, Ashwathi Nair, Prasad C. Kalamkar and JS D'Souza) (3) exploring the survival role of a BolA protein. In order to identify the molecular complex of CrBolA protein; the several GRX's from *C. reinhardtii* have been cloned, individually expressed in *E. coli* and purified for conducting a one-to-one interaction study. Up-regulation of BolA with abiotic stress in *C. reinhardtii* has now been confirmed.
(D.K. Khona and J.S. D'Souza).

Collaborative work:

i. **Preparation of Ag and Au nanoparticles and their applications:** Ag and Au nanoparticles have been prepared using two novel methods and these are being explored for their applications
(Sourabh Mehta, H. Muthurajan, and JS D'Souza).

ii. **Inhibition of strand breakages upon exposure of DNA to ultrashort pulses of intense laser light:** This laboratory in collaboration with the Mathur laboratory at TIFR showed that damage to DNA in an aqueous medium is induced by ultrashort pulses of intense laser light of 800 nm wavelength. Salts such as KCl and NaCl have been used to show that this damage can be inhibited.
(Marilyn Sequeira, JS D'Souza, JA Dharmadhikari, AK Dharmadhikari, Parinda Vas and D. Mathur).

Manu Lopus

Identification of novel antitubulin agents that do not induce typical mitotic arrest in cancer cells:

The research in Experimental Cancer Therapeutics and Chemical Biology laboratory has identified a novel mechanism of drug action that relies on S-phase arrest followed by tubulin disruption. They found a noscapinoids, VinPhe-nos significantly inhibits clonogenic propagation of MDA-MB-231 breast cancer cells. However, unlike the majority of tubulin-binding agents, it did not induce mitotic arrest; instead, it prolonged S-phase. Although prolonged presence of the drug show some disruption of cellular microtubule architecture, it did not affect microtubule recovery after cold-induced depolymerization. VinPhe-Nos, nevertheless, induced acetylation and bundling of microtubules. Their data suggests that rational modification of parent compound can alter its mechanism of action on cell cycle and that VinPhe-Nos can be investigated further as a less-toxic, S-phase-preferred, cytostatic anticancer agent.

Discovery of a novel chemotherapeutic strategy against tubulin isotype-mediated drug resistance:

The laboratory has made an exciting finding that may pave way for treating one of the challenging forms of cancer drug resistance, namely, tubulin-isotype mediated drug resistance. In cancers showing this mode of resistance, a variant of tubulin, beta III tubulin, has been shown to be over expressed. This overexpressed variant counters antitubulin agents by altering the dynamic instability parameters of the microtubules to the advantage of the cancer cells. In collaboration with Prof. Pradeep Naik, JUIT, it has been found that the natural product beta-sitosterol, and a synthetic derivative of the alkaloid noscapine can specifically target this very isotype and effectively inhibit cancer cell proliferation. Indicating its antimetastatic potential, β-SITO strongly inhibited cell migration. Immunofluorescence imaging of β-SITO-treated MCF-7 cells exhibited disruption of the microtubules and chromosome organization. Far-UV circular dichroism spectra indicated loss of helical stability in tubulin when bound to β-SITO. Docking and MD simulation studies, combined with MM-PBSA and MM-GBSA calculations revealed that β-SITO preferentially binds with specific β-tubulin isotype (βIII) in the αβ-tubulin dimer. Both these β-tubulin isotypes have been implicated in drug resistance against tubulin-targeted chemotherapeutics. The data show that the tubulin-targeted anticancer potential of β-SITO, and its potential clinical utility against βIII isotype-overexpressing neoplasms. Their subsequent studies have identified Vin-Phe noscapine possessing similar property. In fact, VinPhe-Nos showed several fold higher affinity binding to the isotype than the parent compound noscapine.

Other Projects:

1. The laboratory has been investigating the clinical utility and the modulation of cell signalling pathways by peptide-stabilized gold nanoparticles. 2. Elucidating the molecular details of the working of ancient ayurvedic formulations in cancer cells. 3. Another project in collaboration with Dr. Neeraj Agarwal's lab, UM-DAE CEBS, focuses on photodynamic antitumor theranostics and their mechanism of action in cancer cells.

V. L. Sirisha

The plant metabolism and metabolomics laboratory interest focuses on identification and characterization of medicinally important bioactive compounds from plants and microorganisms, understanding their coordination with stress response programs and elucidating the regulation of metabolic pathways. The lab uses various integrated approaches that include plant biology, metabolomics, functional genomics and biochemistry in order to understand and elucidate the metabolic pathway regulators of plant and algal primary and secondary metabolism. The biosynthetic mechanistic pathways of these therapeutically useful compounds would be deciphered and improve their production by metabolic engineering. The current projectes in the lab are as follows:

Isolation and characterization of bioactive sulfated polysaccharides from green chlorophyte *Chlamydomonas reinhardtii:*

The biomedical industry is in constant need of innovative biomaterials. Typically, the most common materials in demand are natural polymers. This is due to their biocompatibility and biodegradability. More specifically, and given the chemical and biological diversity found in the marine environment, this becomes an area of significant interest. Moreover, these materials also potentially pose a lower risk of illness to humans. In particular, different algae species in the marine environment contain sulfated polysaccharides that offer numerous health benefits through a variety of biological activities. Such polysaccharides do not have equivalents in the terrestrial plants. Since there is growing interest in their applications especially in health-related fields, understanding, isolating and characterizing the sulfated polysaccharides from a green chlorophyte *Chlamydomonas reinhardtii* was taken. In the current study sulfated polysaccharides from *C. reinhardtii* were isolated by hot water method using 80% alcohol. The semi purified sulfated polysaccharides found to contain 68% of carbohydrate, 16% reducing sugars, 52% non-reducing sugars, 2% of protein, 30% of sulphate content, 35% of uronic acid, 4% of ash and 11% of moisture. The carbon, hydrogen, nitrogen and sulfur content were 33.19%, 5.91%, 7.21% and 3.75%. The structural feature of sulfated polysaccharides were studied through FT-IR spectral analysis. Further the sulfated polysaccharide showed total antioxidant activity of 11.62-75% at 1-8 mg/ml, 38%-77% at 0.01-1mg/ml DPPH radical scavenging activity, 22.29%-80.9% at 0.01-1mg/ml, hydroxyl radical scavenging activity, 9.8%-81% at 0.01-6 mg/ml, ABTS scavenging activity, 34.5%-67.6% at 1-8 mg/ml, ferrous chelating ability and significant reducing potential was detected at 0.05- 2 mg/ml concentration respectively. The sulfated polysaccharides from *C. reinhardtii* also showed efficient anticancer activity. They showed significant inhibition of breast cancer cell proliferation at 100-400ug/ml concentration. Clonogenic assay also showed reduced number of colonies with increases concentration of Cr-Sps. These Cr-Sps also found to induce apoptosis in breast cancer cell lines as identified by characteristic DNA ladder.

(Sanith. C, Manu Lopus, V.L.Sirisha)

***In vitro* biophysical investigation on the inhibition of protein fibrillation and dissolution of fibrils by algal sulfated polysaccharides:**

Amyloidosis are a group of protein aggregation diseases which results due to misfolding, aggregation and accumulation of amyloid-forming proteins. The various amyloidosis related diseases include Alzimer's, Parkinsons disease, Huntington's, Diabete type-II etc. The current treatment for these disease are synthetically designed drugs or those obtained from terrestrial plants. But because of sustainable failure of the existing conventional drugs coupled with severe side effects, there is an urgent need of alternate drug candidates from natural sources. Marine ecosystem produces very rich source of potential natural compounds with a broad range of distinctive pharmaceutical activities. It is known that many marine algae species contain sulfated polysaccharides (SPs) and their lower molecular weight oligosaccharide derivatives which are biocompatible, biodegradable and have been shown to offer numerous health benefits. These algal SPs have high nutritional value and pose anti-malaria, anticoagulant, anti-inflammatory, anti-viral, anti-malaria, antiparasitic, antioxidant, anti-thrombotic, antilipidemic properties which make them suitable for nutraceutical, pharmaceutical and cosmeceutical purposes. Even though

efforts have been made to understand the therapeutic potentials of SPs, their therapeutic potential against protein fibrillation associated diseases has not been explored well. In the present study, biophysical characterization of sulfated polysaccharides from *C.reinhardtii* were carried out. Preliminary experiments with crude polysaccharide extract from *C. reinhardtii* clearly showed complete inhibition of protein aggregation of hen egg white lysozyme and also diseased protein i.e. α-synuclein in a concentration dependent manner. With further screening and validation of these carbohydrates from different algae, it is possible to unlock their immense potential to act as alternative therapeutic agents for prevention of protein fibrillation/aggregation related disorders.
(Sinjan Choudhary and V. L. Sirisha)

Metabolic profiling of the green chlorophyte *C. reinhardtii* under various abiotic stress conditions:

Algal taxonomic diversity and their ability to adapt to different environmental conditions have created a significant commercial opportunity to exploit algal metabolic compounds in the foods, cosmetics, horticultural, pharmaceutical industries. It is reported that plants/algae produce secondary metabolites as weapons to combat stresses. It is possible that the response can well be tuned to achieve a balance between enhancement of dietary phytochemicals that offer plant/algal protection and health benefits and acceptability of the produce by exposing them to controlled doses of stressors. This would require a better understanding of the link between stressors and secondary metabolites, and an understanding of the stress-induced alterations in the secondary metabolites and metabolic pathways. By understanding the metabolic profile of *C. reinhardtii* under different abiotic stress conditions, it helps to understand how this ecologically important alga adapts to changes in environmental conditions, and to engineer algae for production of useful compounds.
(V.L. Sirisha)

Siddhesh Ghag

Crop plants are susceptible to a wide range of pathogens which are responsible for huge economic losses world over threatening food security. Management of these plant pathogens is of utmost importance to minimize this loss. Banana is the fourth most important food crop after the major cereal crops and is the staple food of the people in the developing regions of the world. The production is severely affected by diseases caused by fungi and viral pathogens. Fusarium wilt disease (caused by *Fusarium oxysporum* f. sp. *cubense* (Foc)) is one such disease which is spreading rampantly and devastating banana plants in the major banana growing regions. Studying the pathogen profile and developing disease resistant banana plants is necessary to manage this disease effectively.

Studying the role of SGE1 in Fusarium wilt disease of banana:

Transcription factors are unique set of proteins which are able to bind to specific sequences contained in the promoter and regulates the expression of downstream genes. Particular repertoire of proteins are synthesized and secreted when *Fusarium* infects banana

plants. These proteins are regulated by some distinctive class of transcription factors. Six Gene Expression 1 (SGE1) is one such transcription factor which regulates the expression of SIX (secreted in xylem) genes which are known to be involved in Fusarium wilt infection. The genes involved in pathogenesis (including SIX genes) are known to be located on the separate chromosomes called lineage specific chromosomes in related form species of *Fusarium*. The SGE1 gene present on the core chromosome gets induced when *Fusarium* interacts with banana tissues and activates the genes on this lineage specific chromosomes, thereby activating the infection process. Studying the upstream and downstream regulation of SGE1 will help us in disease modelling and thereby aid in developing better management strategies. The aim of this research project was to functionally annotate SGE1 and its associated partners. The *SGE1* ORF contains no introns and encodes a protein of 330 amino acids. *In silico* sequence analysis revealed that the N-terminus (amino acids 1-180) contains a TOS9 (COG5037) and a Gti1_Pac2 family domain (Pfam09729) and is conserved in the fungal kingdom. The Gti1 and TOS9 in *Schizosaccharomyces pombe* regulates gluconate uptake and transport whereas Pac2 controls sexual development. SGE1 belongs to the same group as *Histoplasma capsulatum* Ryp1, *Botrytis cinerea* Reg1 and *Candida albicans* Wor1 which are identified as key regulators of dimorphic switching. The C-terminal region however does not represent any conserved domain but have an unusual long proline-glutamine repeat stretch probably required for transcriptional activation. In order to examine *SGE1* gene function in Foc, the *FocSge1* will be deleted by replacing it with the hygromycin B resistance gene cassette. The deletion vector pCSN44Sge1KO was constructed by inserting the two flanking sequences of *FocSge1* into two sides of the hygromycin resistance (*hph*) gene in the pCSN44 vector. The upstream 1000 bp flanking sequence fragment of *FocSge1* was amplified and inserted into the *Not*I-*Xma*I site upstream of the *hph* cassette of the pCSN44 vector. Subsequently, the 998 bp downstream flanking sequence fragment of *FocSge1* was amplified and cloned into the *Xho*I-*Kpn*I site downstream of the *hph* cassette. The fragment sequences and orientation was checked by restriction digestion and sequencing. The resulting *FocSge1* deletion vector pCSN44Sge1KO was transformed into protoplasts of Foc. Hygromycin was added to a final concentration of 50 µg/mL for selecting the transformants. Putative *FocSge1* deletion mutants are being screened by PCR.

Dr. Subhojit Sen

Environmental insults experienced early during one's lifetime can lead to diseases later, as an adult (eg. cancer, diabetes, obesity etc):

Dr. Sen's group is interested in querying the accumulation of molecular memories, created by environmental insults (eg. diet, smoking, etc), which eventually pushes a normal cell towards cancer. Their recent discoveries have led to identify epigenetic mechanisms and pathways involving DNA Methylation (DNMTs) and Histone modifications (HDACs and Polycomb) which respond to reactive oxygen species (ROS, inflammation model). The central hypothesis that, changes in stem cells creates long term memory and predisposes us to cancer, is rooted in the observation that these epigenetic complexes silence tumour suppressor genes in human cells, thereby creating a fertile ground for selection of cancer specific mutations. The laboratory is actively developing human cell line based and alternate

unicellular, models to describe a conservation of these mechanisms, the latter having prospects towards developing cheaper high throughput assays which will lead to discovery of new epigenetic drugs against cancer and other diseases.

Mammalian models:

Recent studies have identified both H2A.Z (histone vairant) and bivalent chromatin (combinatorial histone modification) as epigenetic signatures that antagonize cancer DNA methylation in stem cell models. Using genome wide mapping of these marks, the group proposes a role for 'Bivalent nucleosomes' at promoters of tumour suppressor genes, that helps in maintaining a poised state of transcription which is prone to silencing, due to environmental insults. This understanding of how stem cells react to the environment and the discovery of molecular markers, might provide a useful path to target both diagnostic and prognostic strategies to prevent normal cells from turning cancerous. These preliminary studies are vital in designing new assays that can detect such events upon environmental damage to the epigenome.

Studies in the single celled algal model *Chlamydomonas*:

Dr. Sen's group has developed multiple vectors that involves a dual reporter strategy to track epigenetic changes, in algal and plant models. Using these they designed an epigenetic assay in *Chlamydomonas,* which phenotypically tracks changes in gene expression, especially gene silencing. Kaginkar *et al* (submitted) demonstrated that DNA methylation plays a role in silencing of transgenes in *Chlamydomonas*, a feature that can be exploited to develop a high throughput assay. In addition, DNA methylation inhibitors (Decitabine) have been used to demonstrate how reversal of transgene silencing can affect these phenotypes. Finally, using these strategies Potdar *et al* (submitted) have developed a novel assay that creates MNase derived nucleosomal ladders from cell wall plus wild type strains of *Chlamydomonas*, which in turn opens up a wide range of transgenerational epigenetic queries, hitherto impossible in this model system. An in silico approach to gene discovery in *Chlamydomonas* and been able effectively used to identify yet undescribed epigenetic genes, some of which we are currently being analysed using protein modeling approaches. One such query involving homology modeling of the *Chlamydomonas* polycomb protein (Ez) helped predict enhancement of epigenetic silencing of both Polycomb and HDAC pathways, by the divalent metal ion Zinc. Using multiple environmental insults by divalent metal ions, the group has successfully demonstrated that both Zn and Cu alters epigenetic memories (transgene silencing) in *Chlamydomonas*, a process that can be interfered by established epigenetic drugs (DNA methylation inhibitors and Histone deacetylation inhibitors). This design provided a cost-effective phenotypic screen for epigenetic activity of plant derived compounds, using which they identified Cinnamic acid as a potential HDAC inhibitor. In summary, the studies are now poised, not only to develop functional conservation of a human cancer mechanisms in a unicellular algal model, but also devise high-throughput screening strategies that can discover novel compounds from ayurvedic and indigenous plant sources, which can then be tested on human cancers for efficacy.

Upnishad Sharma (CBS), Ria Khetan (DY Patil), Smriti Vasvani (St. Xaviers) performed their dissertation projects as part of the above described work during 2016-17.

6.2 Research Activities in Department of Chemistry:

Dr. Avinash Kale

At present there are multiple projects running in Structural Biology and Biochemistry laboratory. The synopsis about them is as follows:

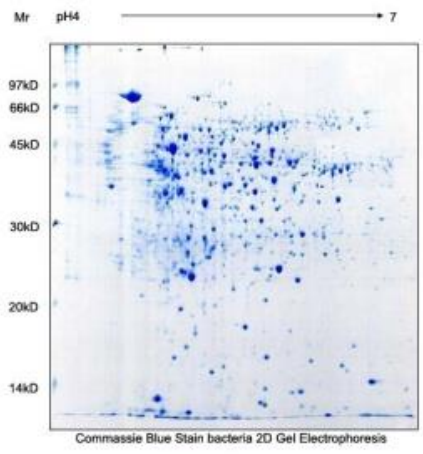
Understanding Actin polymerization dynamics/regulation in Apicomplexans:

The aim of this project is to try and understand the effect of small molecular weight compounds on actin polymerization dynamics. The other goal is to establish the regulation of actin polymerization by the regulators in apicomplexans. The milestones achieved so far as follows:

1) Purification for actin from Bovine muscle is optimized.
2) Currently, the lab is working towards understanding the polymerization process for Actin using Biophysical techniques.
3) Testing the effects of small compounds and to set up co-crystallization at IIT, Bombay is underway. The group collaborates with Dr. Prasenjit Bhaumik (IIT, Bombay) on this project. Trials so far has yielded crystals for five different complexes.
   Additionally, work is in progress on a manuscript of a review article titled: "Actin regulation in Apicomplexan: the structural, functional, and evolution story so far". The group also collaborates with Dr. Supreet Saini (IIT, Bombay) to prepare a mathematical model to understand the actin regulation in Apicomplexan (*Plasmodium falciparum*). Above figure is generated using pdb structure 3U4L.
   (*Samridhi Pathak and Avinash Kale*)

Isolation and identification of the novel bacterium having mosquito larvae-cidal activity:

This project is aimed at isolating and identifying the novel gram-positive bacterium from nature, which exhibits the mosquito larvae-cidal activity. The milestones achieved:



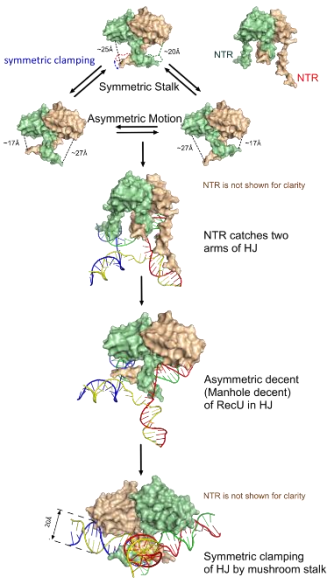
Commassie Blue Stain bacteria 2D Gel Electrophoresis

1) Mosquito breeding facility has been successfully developed at Haffkine Institute.
2) Ethical clearance for the project has been obtained.
3) About 300 bacterial isolates have been collected from different locations of Mumbai and its suburban areas.
4) High throughput screening is in process to test the larvae-cidal activity of these strains. The lab observed differential toxicity for nine of the strains against culex larvae.
5) Optimization on differential proteomics (Figure 1) at Haffkines to understand the differential toxicity of the bacterial strains was done successfully.

Additionally, working towards the structure analysis of the recombinant Binary toxin, BinA and initial crystals are obtained for BinA. Work on optimizing the crystals for data collection is underway.
(*Dr. Rahul Chavan and Dr. Avinash Kale*)

Structural studies of Holliday Junction resolvase, RecU from *B.subtilis:*

The 3.2A crystal structure of a protein-DNA complex was successfully identifed. The current focus of the research is on working towards the Small Angle X-ray Scattering (SAXS) and fluorescence data to understand the flexibility of the protein. In addition, work is also in progress towards molecular dynamic simulations (on super computer Param Yuva-II) to better understand the interaction of RecU with Holliday junction. The manuscript on this subject is accepted for publication in Nucleic Acid Research (NAR).



(*Dr. John Rafferty, University of Sheffiled, United Kingdom and Dr. Avinash Kale*)

Basir Ahmad

Multi-angle and multidisciplinary attack on Late-life diseases:

The major goal of Dr. Basir's research is to understand the molecular mechanism of formation, inhibition and disintegration of protein aggregates. Protein aggregation is the process by which proteins misfold, stick to each other and form fibrillar and/or amorphous aggregated species. The formation of proteins aggregates is associated with a spectrum of human diseases of dramatic social impact such as Alzheimer's and Parkinson's diseases, type 2 diabetes, cataract, cystic fibrosis and many others amyloidoses. The aggregation inhibition study deals with the cessation of the process of the aggregation, whereas, the disintegration study deals with dissociation of pre-formed aggregates into monomers and or non-toxic oligomers. Various natural, semi-synthetic and synthetic small molecules were used for inhibition and disintegration studies. Knowledge gained from these investigations may help

1. To elucidate the physicochemical features of protein folding
2. To understand molecular and biochemical basis of aggregation based diseases
3. To develop drugs to prevent the progression of aggregation disease and cure the pre-existing disease.

It is believed that a molecule that is capable of both preventing conversion of native protein into aggregate and disintegrating pre-formed aggregates into monomer would be an ideal drug candidate for treating aggregation based disease. Various broad range of biophysical

and imaging methods, including UV/Visible spectrophotometry, fluorescence, circular dichroism, TEM etc. were employed for the in vitro studies.

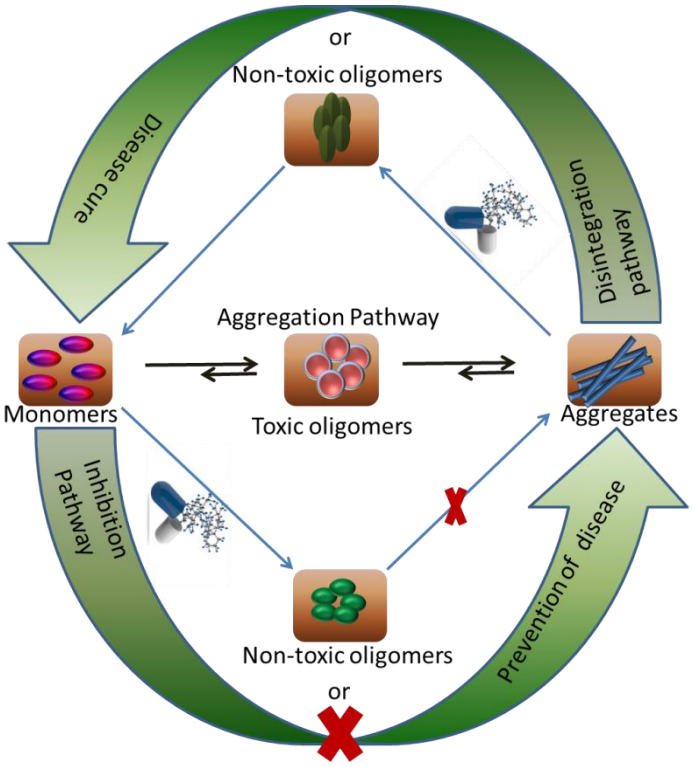


Fig.1. Therapeutic strategies of Dr Basir's Lab for protein aggregation diseases.

Mahendra Patil

Research program in Dr. Patil's group is devoted to the field of organic chemistry and catalysis. The lab combines elements of computational chemistry and organic synthesis to devise new catalytic strategies for organic conversions. Detailed mechanistic investigations of reactions play a crucial role in catalyst designing and method development for the organic conversions. The group employs a suite of computational tools to investigate the mechanism of reactions, and to identify the factors responsible for the reactivity and selectivity of the reaction. Insights obtained through computational investigations are used to design new catalyst or to develop new synthetic methodologies.

The research mainly focuses on solving problems in organic, bioorganic and organometallic chemistry using experimental and computational methods (Fig.1). In this endeavor, collaborations with a number of other researchers in synthetic chemistry and biology at CEBS and around the world.

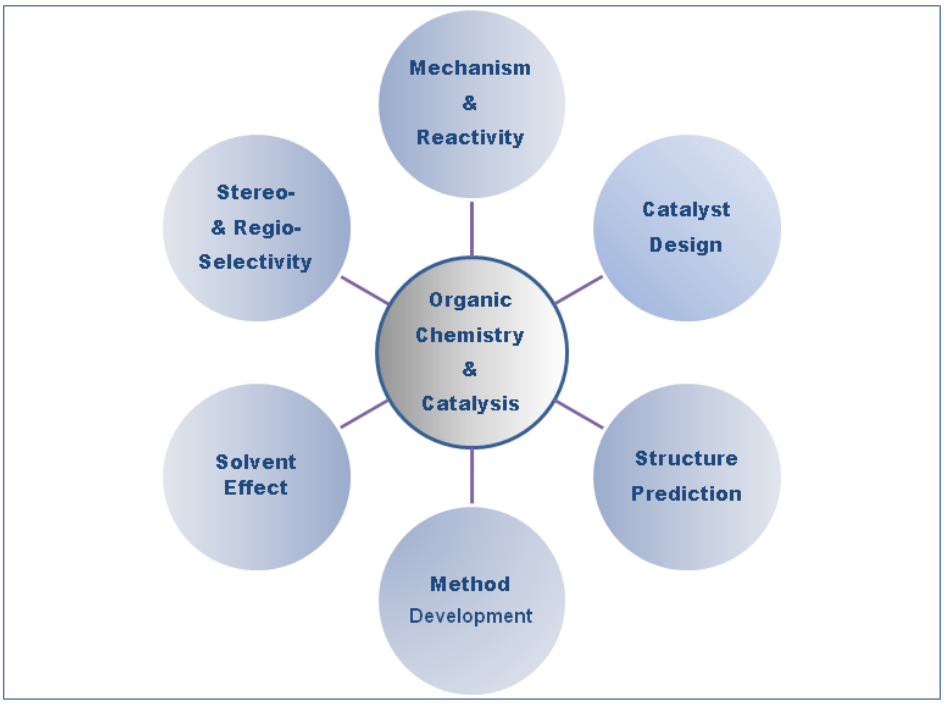


Fig 1. Research activities in Dr. Patil's group

Mechanism of the α-Ketoacid Hydroxylamine Amide Forming Ligations:

Computational investigations of α-ketoacid-hydroxylamine amide-forming (KAHA) ligation of O-unsubstituted (type-I) and O-benzoyl substituted (type-II) hydroxylamine have revealed a distinct mechanistic pathway for the KAHA ligation reactions. Instead of pathway involving lactone and oxiridine intermediate for the reaction of O-unsubstituted hydroxylamine and ketoacids (type-I KAHA), that had been proposed in the experimental studies, the computational results favors the pathway which involves migration of the hydroxy group (-OH) to the adjacent carbon in one of the key steps. The new pathway of type I KAHA reaction explains the distribution of ^{18}O label in the final product (amide) that is observed in ^{18}O labeling experiments of type-I ligation reaction. A coherent mechanistic course is also identified for the reaction of O-benzoyl substituted hydroxylamine and ketoacids (type II KAHA) reaction. The proposed pathway for the type-II KAHA ligation reaction proceeds with the retention of oxygen atom of keto group of ketoacids rather than hydroxylamine in the final product (amide). These findings are in consistent with the results of ^{18}O lebeling experiments performed by Bode and coworkers on the KAHA reactions (Fig.2).

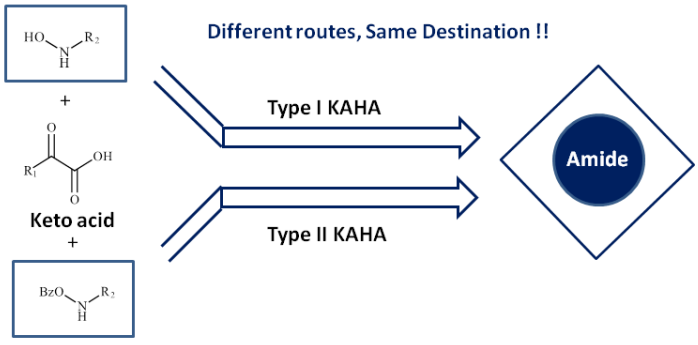


Fig 2. Ketoacid-hydroxylamine amide-forming (KAHA) reactions

Direct C–H Arylation of Heteroarenes:

Over the years, direct C–H arylation of (hetero) arenes has received considerable attentions of organic chemists. However, most of the catalytic direct C–H arylation reactions require forcing reaction conditions such as high temperature, need of strong oxidants, and use of strong acids. On the contrary, free radical C–H arylation reactions involving diazonium salt or aryl hydrazine as a precursor of aryl radical are demonstrated to operate under mild reaction conditions albeit, with a limited success. Guided by mechanistic analysis of reactions, anew strategies were developed for the direct C–H arylation of heteroarenes using *in situ* generated diazonium compounds in the presence of hydrogen peroxide as an additive. The scope and limitation of this method were examined for several electron deficient aniline and electron rich heteroarenes (Fig.3).

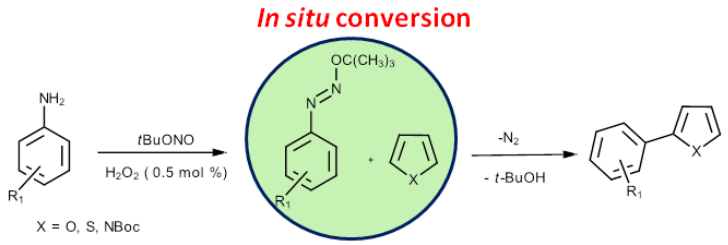


Fig 3. Direct C – H Arylation of heteroarenes with different anilines

Neeraj Agarwal

Nucleophilic substitution of BODIPy:

Nucleophilic substitution on 3-bromo/3,5-dibromo-4,4'-difluoro-8-(aryl)-4-bora-3a,4a-diaza-s-indacene (BODIPy), substituted with anisyl or thienyl at meso positions, with neat pyrrole afforded the mono and di-pyrrolesubstituted BODIPys in good yields. Very large bathochromic shifts, upto ~180 nm in absorption maxima (581-682 nm), and fluorescence maxima (606-695 nm) were observed. Electrochemical studies were carried out to find the oxidation potential and eventually HOMO and LUMO energy levels were calculated with help of photophysical data. Theoretical studies provided the insight on the electron density distribution in these dyes. Theoretical and experimental photo-physical studies in different solvents were correlated to find the substituents effects on BODIPY.

BODIPy derivatives as anion sensors:

Imidazoaryl-BODIPy derivatives were synthesized and characterized for anion sensing applications. Absorption and emission methods were used to monitor the sensing of different anions. The results showed that these sensors interact with F^- selectively and strongly as compare to other halides and hence are capable of detecting F^- easily, in very small amount (4.3×10^{-6} M). To understand the interaction of anions with sensors ^1H NMR titrations were carried out. It was found that anion interacts with N-H which results in the change in the absorption and emission properties. Binding constant for F^- was found to be

high, 4642900 M^{-1}. For environmental applications and qualitative analysis detection of F^-, CN^- and OH^- by these sensors in doped polymer films is also shown.

Acridone based donor-acceptor derivatives:

A series of new donor-acceptor molecules based on acridone-amine containing four aryl substituted 2,7-diaminoacridones were synthesized in good yields using palladium catalysed Buchwald-Hartwig C-N amination. Their absorption, photoluminescence and electrochemical properties were investigated in solution and in thin films. Photophysical properties were found to be affected by electron donating capability of substituents on diaryl amines. Absorption showed an intramolecular charge transfer transitions (ICT) in a range of 447-479 nm. These acridone amine derivatives emit in green region (500-527 nm). Reversible oxidation wave were observed for these derivatives in cyclic voltammetry. The HOMO (-4.95 to -5.11 eV) and LUMO (-2.36 to -2.56 eV) energy levels were calculated. Their fluorescence quantum yield were found to be high, also, fluorescence life time is measured which gives two components and indicates the delayed fluorescence. Hence we believe that these compounds are having potential to be used as thermally activated delayed materials in optoelectronic devices.

(Collaboration -Rajesh Kamble, Department of Chemistry, University of Mumbai)

Non-fullerene imidazoaryl substituted small organic materials were desgined and synthesized, which is to be used as electron acceptor in OPV. Imidazoaryl core is chosen due to its (i) ease of synthesis (ii) good absorption in broad visible region with suitably substituted groups, (iii) intramolecular charge transfer and aggregation in solid state leading to further increase in absorption width. It was shown that the synthesized imidazoaryl derivatives have absorption in 500 nm range, exhibited a band gap of ~3.0 eV, their E_{LUMO} are found at ~ -3.6 eV. Morphology of vacuum deposited thin films were studied using field emission scanning electron microscopy (FESEM). Electron and hole mobilities of these molecules were estimated in space–charge limited regime. For one of these molecules, a moderately good hole mobility was found to be ~ 10^{-4} $cm^2 V^{-1}s^{-1}$.

(Collaboration -Mohammad Muneer (AMU) and Sangita Bose, UM-DAE CEBS)

Ferrocene catalysed C-H arylation:

Recently, C-H arylation of aryl, heteroaryl and BODIPY was developed using ferrocene as catalyst. Heteroaryl diazonium salts and aryl substrates were used with ferrocene to in this non Pd mediated C-H arylation. Its detailed reaction mechanism was studied. This reaction proceeds with the radical intermediate which was proved by the control reactions with radical scavengers, DFT calculations, cyclic voltammetry and EPR methods.

Synthesis and studies of imidazoanthraquinone derivatives for applications in organic electronics:

Imidazoanthraquinone derivatives having extended pi-conjugation were synthesized and characterized. Palladium catalyzed Suzuki-Miyaura and Sonogashira couplings were employed to synthesize these derivatives. Photophysical and electrochemical studies were

carried out for new imidazoanthraquinone derivatives. Absorption and emission maxima were observed in a wide visible range. Photophysical studies show charge transfer complex formation in these compounds. Cyclic voltammetry provided good estimate of reduction and oxidation potential of these compounds and evetually HOMO and LUMO energy levels. Electrochemical studies reveal the low lying E_{LUMO} at ~ -3.7 eV for these compounds. The donor–acceptor architecture and HOMO–LUMO energies were further studied using DFT calculations. E_{LUMO} of these compounds were taken into account and photoquenching experiments were carried in presence of electron donor P3HT. These experiments suggest that these compounds can be used as electron acceptor in heterojunction solar cells.
(Sajeev Chacko, Department of Physics, University of Mumbai and Rajesh Kamble Department of Chemistry, University of Mumbai)

R. V. Hosur

Novel multidimensional NMR pulse sequences have been developed for rapid acquisition of multidimensional NMR data in small molecules and proteins alike. These rely on use of non-uniform sampling schemes, Hadamard encoding/decoding and appropriate data manipulation. High resolution has been achieved by pure shift methods. The folding pathway and its implication to function of Cyclophillin of yeast (CPR3) has been investigated. Synergistic effects of some osmolytes on the fibrillation process of proteins has been investigated. The effects of Triphala extracts on the dissolution of fibrils and inhibition of protein fibrillation has been investigated. These have therapeutic implications.

NMR pulse sequences:

The importance of Hadamard encoding pulses in selective 1D-PSYCHE-TOCSY is discussed for the chemical shift analysis of complex natural products, at ultra-high resolution. Herein, a H_4 Hadamard matrix in the 1D-PSYCHE-TOCSY was adapted and observed a ~ 2 fold enhancement in S/N, when compared to the conventional 1D-PSYCHE-TOCSY recorded while refocusing only one spin. This enhancement in the S/N facilitates observation of very weak long-range chemical shift correlations from Hadamard encoded PSYCHE-TOCSY (HE-PSYCHE-TOCSY), which is almost impossible in the conventional 1D-PSYCHE-TOCSY. The proposed method will have a significant impact on structure determination of complex isolated/ synthetic natural products.
(*Veera Mohan Rao Kakita and R. V. Hosur)*

Equilibrium folding/unfolding of CPR3:

A detailed characterization of the unfolding of yeast mitochondrial cyclophilin (CPR3) induced by urea was reported. It is seen that unfolding proceeds via two intermediates, I1 and I2. The I1 state has native like secondary structure and shows strong ANS binding due to increased exposure of solvent accessible cluster of non-polar groups. Thus, it has some features molten globule. The I2 state is more unfolded, but retains some residual secondary structure, and shows weak ANS binding. Chemical shift perturbation analysis (CSP) by ^{1}H-^{15}N heteronuclear single quantum coherence spectra reveals disruption of the tertiary contacts among the regions present close to the active site in the first step of

unfolding, i.e. N-I1 transition. Regions showing high CSPs in the N-I1 transition match with the regions showing high RMSD in the NMR structure of protein, which showed the presence of two states (open and closed) in the ensemble. This indicates that I1 state has some structural similarity with the functionally relevant "open state". Both the intermediates, I1 and I2 showed propensity to self-associate under stirring conditions, but their kinetic profiles are different; the native protein did not show any such tendency under the same conditions.
(Vaibhav Kumar Shukla, Jai Shankar Singh, Basir Ahmad, Ashutosh Kumar, Ramakrishna V. Hosur).

Synergistic effects of Proline and Sorbitol on protein fibrillation:

In this study an interesting synergistic effects of proline and sorbitol, two well known chemical chaperones, in the inhibition of fibrillation of two proteins, insulin and lysozyme was reported. A combination of many biophysical techniques has been used to understand the structural morphology and modes of interaction of the chaperones with the proteins during fibrillation. Both the chaperones establish stronger polar interactions in the elongation and saturation stages of fibrillation compared to that in the native stage. However, when presented as a mixture, it was seen as a contribution of hydrophobic interactions. Thus, a co-operative adjustment of polar and hydrophobic interactions between the chaperones and the protein surface seems to drive the synergistic effects in the fibrillation process. In insulin, this synergy is quantitatively similar in all the stages of the fibrillation process. These observations would have significant implications for understanding protein folding concepts, in general, and for designing combination therapies against protein fibrillation, in particular.
(Sinjan Choudhary, Nand Kishore and R. V. Hosur).

S. K. Ghosh

Development of New Theoretical Tools:

(a) **Nonequilibrium Dynamics in Condensed Phase**: Development of a new theory by mapping the dynamics in multi-dimensional space to a one-dimensional description, leading to tremendous simplicity and computational economy has been continued and a novel generalized density functional theory, with energy or other parameter as the argument for the density variable, is arrived at. This approach is able to incorporate the effect of initial preparation of the state in the kinetic equation for photoexcited dynamical processes in condensed phase *(with Alok Samanta of BARC)*.

(b) **Development of Dynamical Density Functional Theory using Zwanzig's Approach**: It is well known that Zwanzig's projection operator based approach for deriving kinetic equation for any phase space variable has been succesful. The present work involves the application of this technique to derive time-dependent density functional theory for classical systems. The connection and possible extension to quantum mechanical systems is now being explored.

Computational Design of Novel Materials:

This research aims at designing new molecules and materials with tailored properties as well as providing insight into experimentally observed properties and phenomena. Within this broad perspective, the research carried out during the current period involves design of new materials of relevance to Hydrogen Energy, in particular (a) hydrogen storage and (b) hydrogen production through water splitting.

(a) Development of materials for hydrogen storage: Computational design of novel materials has been carried out for reversible storage of hydrogen in molecular form. Several metal decorated nanostructures have been considered for this purpose and the curvature of the nanostructure and aromaticity criteria have been shown to play an important role. The effect of curvature of the nanostructure on their properties and interaction with hydrogen has been investigated in details.

(b) Development of photocatalyst for hydrogen production through water splitting: Computational design of novel materials as potential catalyst for water splitting has been carried out. (i) The band gap engineering of NaTaO3, $SrTiO_3$, $KNbO_3$, $NaNbO_3$ and $KTaO_3$ has been carried out using density functional theory and a charge compensated codoping strategy to improve the photocatalytic activity under visible light. Thus, for $NaTaO_3$ codoping with (N, F) in addition to (Mo, N); for $SrTiO_3$ co-doping with partners like (Sb, N), (Rh, Sb) or (La, F); for $NaNbO_3$, codoping with (W, N) are found to lead to band gap lowering to match the visible range. They also satisfy the thermodynamic criteria for the overall decomposition of H_2O, as indicated by the relative position of its band edges with respect to water redox levels. The band gap engineering approach through codoping has thus been shown to lead to enhanced visible light photocatalytic activity of several materials. (ii) Besides the metal oxide systems, metal free catalysts involving s-triazine based graphitic carbon nitride systems have also been considered to evaluate their potential as photocatalyst for splitting of water. Metal decoration (using Ag and its four atom cluster) is shown to be more effective due to shift in the absorption band towards the visible region, and no formation of mid-gap states. *(with K. Srinivasu and B. Modak of BARC)*

Theoretical Studies on Soft Matter:

(a) **Nucleation, self-assembly & confinement effect**: The development of density functional theoretic approach to nucleation and self-assembly, has been continued to obtain an analytical expression for the size-dependent free energy of formation of a liquid drop from the vapor, by using a model diffuse density profile. The dynamics of nucleation phenomena is now being investigated using the predicted nucleation barrier, which is not only smaller but also has stronger dependence on the supersaturation. The result is expected to be a significant improvement over the classical nucleation theory based result. The possibility of the prediction of the conditions for obtaining desired size distribution in the context of preparation of nanoparticles in solution is being explored. Also the effect of confinement on the nucleation phenomena is being investigated.

(b) **Study of the red and blue shifts in hydrogen bonded systems**: Computational investigations of hydrogen bonding, with regard to the most common red shift in the vibrational frequency, as well as the less common blue shift has been carried out in several hydrogen bonded systems. A few new correlations of the frequency shifts with the

calculated electrostatic parameters are proposed, thereby generating new insight into both types of the frequency shifts. Thus, the frequency shifts in X—H--Y hydrogen bonded systems at different H—Y distances are shown to correlate well with the Mulliken charges on H and Y, with the positive and negative charges on Y correlating with the blue and red shift of the frequency of X—H vibration, respectively. The role played by charge transfers at other parts of the interacting system is also investigated. *(With Mitradip Das of NISER)*

Sinjan Choudhary

Synergistic Inhibition of Protein Fibrillation by Proline and Sorbitol: Biophysical Investigations:

Protein aggregation and accumulation of aggregated proteins are responsible for various diseases which have been collectively named as protein conformational disorders (PCDs). Osmolytes are small organic molecules and promote protein folding, enhance protein stability and hence they are also known as chemical chaperones. The present work focuses on understanding the possible synergy of proline and sorbitol on protein fibrillation by using spectroscopic, microscopic and calorimetric techniques. Interestingly, a significant synergy between the effects of proline and sorbitol has been observed. Such a phenomenon would have important implications for combination therapy with different types of drugs.

Effects of Triphala and Guggul aqueous extracts on inhibition of protein fibrillation and dissolution of preformed fibrils:

Ayurveda is one of the oldest system of medicines and is based on the natural products for the treatment of a variety of diseases. Triphala and guggul are ancient and long-established polyherbal medicines from ayurveda, well known for their anti-inflammatory, anticarcinogenic, antiapoptopic and many other beneficial properties. In this project the anti-amyloidogenic properties of these ayurvedic medicines have been studied using a combination of spectroscopy and microscopy. Both triphala and guggul inhibit lysozyme fibrillation; triphala is more effective in preventing fibrillation than guggul as shown by ThT fluorescence kinetics studies. A significant synergy was observed in the actions of these two ayurvedic herbal medicines. In addition, both the herbal extracts have also dissolved preformed lysozyme fibrils significantly. The current work has significant therapeutic implications and will provide directions to the developments of new generation phytopharmaceuticals which can be used alone or in combination with any other kinds of drugs.

Biophysical characterization of the interactions of novel designer drugs and natural products with tubulin:

Beta-sitosterol (β-SITO), a phytosterol present in many edible vegetables, has been reported to possess antineoplastic properties and cancer-treatment potential. It has been shown previously that it binds at a unique site (the 'SITO-site') on tubulin. In this study, the anticancer efficacyof β-SITO against invasive breast carcinoma was investigated. β-SITO inhibited MCF-7 cell viabilityby up to 50%, compared to vehicle-treated control cells. The phytosterol strongly inhibited cell migration, indicating its antimetastatic potential. Far-UV

circular dichroism spectra indicated loss of helical stability oftubulin when bound to the phytosterol. The data indicate the tubulin-targeted anticancer potential of β-SITO, and itsmolecular preferences to different β tubulin isotypes.
(Collaboration -Manu Lopus, UM-DAE CEBS)

Unravelling the inhibitory activity of Chlamydomonasreinhardtii sulphated polysaccharides against α-Synuclein fibrillation:

Misfolding, aggregation and accumulation of amyloid-forming proteins leads to varieties of protein aggregation diseases known as amyloidoses. Marine ecosystem produces very rich source of potential natural compounds with a broad range of distinctive pharmaceutical activities. In the view of the above background, the potential of marine algal sulphated polysaccharides against Parkinson's diseases has been explored. In order to check anti-amyloidogenic properties of the crude SPs extract of *C. reinhardtii*, thioflavinT (ThT) binding assay was performed. The results demonstrated that the polysaccharides inhibit α-synuclein aggregation/fibrillation. The results also demonstrate that sulfated polysaccharides have potential to dissolve α-synuclein fibrils. Pursue of this project will open up a way for development of new phytopharmaceuticals.
(*Collaboration -V. L. Sirisha, UM-DAE CEBS*)

Effects of antioxidants melatonin and glutathione on human serum albumin aggregation: biophysical studies:

In this project, the effects of two compounds melatonin and glutathione, two major antioxidants in blood plasma, on the aggregation of human serum albumin (HSA) has been studied using a combination of different biophysical tools. Both compounds pose anti-oxidative properties andare naturally synthesized by cell. Thioflavin T (ThT) binding assay suggests that melatonin is very effective against HSA aggregation as it causes delay in the onset of aggregation and decrease in extent of aggregation in a concentration dependent manner.On the other hand glutathione was not as effective against HSA aggregation. The results indicate that any suitably designed drug which mimic melatonin or which can enhance melatonin production inside the body would have significant therapeutic value against HSA aggregation borne diseases.

Sunita Patel

Unravelling disordered-to-ordered transition by side-specific mutation in the intrinsically disordered protein, Hahellin:

Recently, a protein Hahellin is identified in the genome of a marine bacterium called *Hahella chejuensis* based on its conserved sequence signature with that of a βγ-crystallin. The protein has been characterized by NMR spectroscopy as an intrinsically disordered protein, which upon Ca^{2+}-binding undergoes a drastic structural transformation and acquires a typical βγ-crystallin fold. Recently, characterization of the intrinsically disordered states of Hahellin in the absence of Ca^{2+} by the combined use of NMR spectroscopy and REMD simulation to have heterogeneous mixture of native-like and far-native conformations has been successfully done. The study concluded that cluttering of negatively charged residues

in the Ca^{2+} binding sites impart repulsive interactions in the absence of Ca^{2+} which caused the protein to take multiple conformations. Currently, studying three mutants of Hahellin which are apo-hahellin-S41R, apo-hahellin-S80R and apo-hahellin-S41R-S80R by mutating a negatively charged residue in the Ca^{2+} binding site to a positively charge residue is underway. The study aims to provide the mechanistic insight into the conformational transition from disordered-to-ordered state.

Mechanism of amyloid fibril formation in the G-helix of myoglobin protein:

Apo-myoglobin (heme-free) is a small α-helical protein found in the muscle. This protein is reported to form amyloid fibrils *in-vitro* having a cross β-structure at a higher temperature (338 K), or in the presence of a denaturant or a point mutation. The isolated full-length G-helix of myoglobin (CH_3CO-IKYLEFISQAIIHVLHSR-NH_2) is also shown to form fibril at 333 K and pH 5. However, the mechanism governing such fibril formation was not discussed. Therefore, to understand amyloid fibril formation in the G-helix of myoglobin, we performed MD simulations on this peptide. The preliminary MD simulation results showed that the G-helix independently form an asymmetrical β-hairpin starting from its α-helical conformation. The tetrameric state of asymmetrical hairpin starting from the double layered parallel orientation resulted into anti-parallel orientation which is stabilized by several inter-strand main chain hydrogen bonds. Further analysis and some new simulations are in progress.

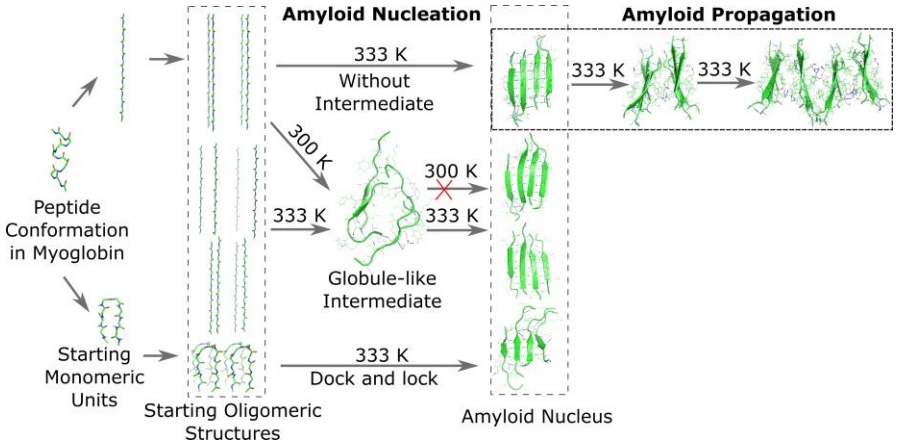


Fig. 1. Mechanism of amyloid fibril formation in Ac-IKYLEFIS-NMe of myoglobin G-helix.

Characterization of the intrinsically disordered Hahellin through cleavage analysis:

Hahellin is an IDP in the absence of Ca^{2+}. However, it adopts a well-ordered βγ-crystallin fold upon binding to Ca^{2+}. IDPs normally take part in signalling and regulatory functions. Therefore, for such proteins a tight control of their temporal existence in that functional state and its clearance thereafter needs to be maintained for proper cellular functioning. Having highly heterogeneous conformational states is an added advantage because such highly unfolded states may easily be acted upon by proteases and degraded thus easing its clearance, when its need in the cellular process is over. Degradation of IDPs is often carried out by several proteases. Preliminary investigations reveal specific cleavage pattern for intrinsically disordered Hahellin while no cleavage observed for Ca^{2+} bound Hahellin under identical conditions. It is not clear yet whether the external proteases do the

cleavage or the IDP itself undergo the cleavage. Here, we are investigating the disordered state of Hahellin by analyzing the cleavage fragments employing MALDI-TOF, MS-MS and amino acid sequencer. The study aims to understand the intrinsic disordered nature of Hahellin which further be extended to other IDPs having similar characteristic.

6.3 Research activities of Department of Mathematics

Anuradha Nebhani

Let V be a vector space of dimension m over an infinite field K. Let q be a quadratic form associated with V. Consider the r^{th} tensor product $V^{\otimes^r}$ as a representation of the special orthogonal group $SO(V)$. Brauer had described a diagrammatic algebra corresponding to the commutant of $End_{SO(V)}V^{\otimes^r}$ when K is the complex field. Eventually, the diagram algebra has been named the even Brauer algebra and denoted by $D_r(m)$. Schur-Weyl duality deals with the commutants of $SO(V)$ and the even Brauer algebra. The vector space $V^{\otimes^r}$ acts as a representation of the even Brauer algebra over the complex field, as described by Brauer. When the two factors K and q are changed, the algebra $D_r(m)$ also changes. The definition of the algebra $D_r(m)$ over a general infinite field which is quadratically closed, has been obtained. The aim is to remove the constraint of quadratic closure. Also, the following objective is to define the matrix in $End_{SO(V)}V^{\otimes^r}$ corresponding to any diagram from $D_r(m)$ over any infinite field for a general quadratic form q.

Simultaneously, the intention is to study the semisimplicity of these algebras over infinite fields. Basically, the relationship between the dimension of the vector space and the tensor power should determine whether the algebra is semisimple or not.

Swagata Sarakar

Degree Problem: Let G_1 and G_2 be simple, complex, classical algebraic Lie groups with associated compact groups of the type SO(2k+1) and SO(2k), where k is greater than or equal to 2, such that both G_1 and G_2 are of the same type. What can be the possible degrees of maps from G_1/P_1 to G_2/P_2, where P_1 and P_2 are maximal parabolic subgroups?

At present, study of maps between spaces of the form G/P, where G is of the form SO(2k+1) or SO(2k), (k is an interger greater than or equal to 2), with a view towards calculating the possible degrees of such maps is underway.

The study the endomorphisms of cohomology algebras of spaces G/P , of the above form is also planned.

(Samik Basu, Indian Association for Cultivation of Science, Kolkata and Swagata Sarkar)

The computation of the higher homotopy groups of spaces that are a wedge of spheres with a cell attached is tried.

(Samik Basu, Indian Association for Cultivation of Science, Kolkata , Shilpa Gondhali, BITS, Pilani, Goa Campus and Swagata Sarkar)

Study of the homotopy type of function spaces is a well-established and active area of research. Various techniques are studied in rational homotopy theory, with a view towards studying the algebras modelling the rational homotopy type of function spaces *map(X,Y)* and *map^{*}(X,Y)* (of free and pointed type respectively), where X and Y are finite CW-complexes. *(Rekha Santhanam, IIT-Bombay and Swagata Sarkar)*

6.4 Research Activities of Physics Department

Accelerator, Laser and Plasma Simulation (ALPS) Laboratory
S. Samant, B. Paradkar, P. Brijesh, S. Krishnagopal

Plasma Astrophysics:

The formation of sharp current sheets due to the presence of neutrals and density inhomogeneity in the solar atmosphere is studied. These current sheets, typically associated with the steep gradients in the magnetic field profiles, are of interest as they can serve as ideal sites for dissipation of solar magnetic field energy through the process of magnetic reconnection. MHD calculations predict that the magnetic field profile steepening due to the density inhomogeneity is active up to middle of the chromosphere whereas the neutrals through a process of ambipolar diffusion play a crucial role in the upper chromosphere of the Sun. This work is carried out as M.Sc. thesis project of CEBS student Mr. Regis John.

The group is also working on physics of large-scale meridional flows in the solar convection zone. These flows are particularly interesting as they are considered to an important driver for the solar dynamo process. It is believed that the solar differential rotation is maintained due to the balance of the advection of angular momentum by these meridional circulation flows and the transport of momentum by the turbulence in the solar convection zone. Therefore, currently the focus is on theoretical formulation of turbulent momentum fluxes (Reynolds stresses) in the solar convection zone.
B. Paradkar (in collaboration with Prof. S. M. Chitre)

Laser-Plasma Accelerator driven X-Ray Free-Electron Laser:

In the laser-plasma scheme of accelerating electrons, experiments have demonstrated the production of high brightness beams using a downward transition in the plasma density. The ALPS Group in CEBS has vigoroursly pursued the understanding of the underlying physics using computer simulations. In the past, it was shown how the downward density transition leads to controlled injection of electrons and how multiple upward density transitions can be exploited to control the acceleration process, resulting in a 1.2 GeV electron beam that is bright enough to drive a soft X-ray Free-Electron Laser (FEL) at a wavelength of 4 nm. However an experimentally realistic scenario involves the deleterious effects of the exit-plasma density gradient and free-space beam transport on the final electron beam quality that was not taken into account in the earlier simulations. A comprehensive start-to-end simulations were performed to investigate the effect of these parameters. It was found that further optimization of these parameters is necessary for

controlling beam divergence to enable free-electron lasing. A laser-plasma lens was implemented in the start-to-end simulations to transport the beam over a distance of 30 cm to the FEL undulator without significant degradaition in beam quality. FEL simulations show that this compact density-tailored laser-plasma accelerator, when coupled to an undulator of length 100 m, lases at a wavelength of 4 nm with a saturated power of 40 MW.
(S. Samant, P. Brijesh, S. Krishnagopal)

Particle-in-Cell (PIC) Code Development:

The physics of field ionization through tunneling process is incorporated into the indigenously developed 2-dimensional Electromagnetic Particle-In-Cell code AGASTHII. With this modification, the ionization injection process in the laser wakefield electron acceleration is simulated and benchmarked with the existing codes. In addition, introduction of accelerator physics module into the code is currently under process to perform integrated simulations of laser-plasma accelerator and the beam transport components.
(S. Samant, B. Paradkar, S. Krishnagopal)

Alpa Dashora

Study of 2D MXene Cr_2C material for hydrogen storage using density functional theory:

Hydrogen storage capacity of 2D MXene Cr_2C has been studied using density functional theory. Possibility to adsorb H_2 molecule on Cr_2C surface at various sites has been studied. Among the studied adsorption sites on Cr_2C surface, few sites were found suitable for chemisorption and physisorption of H_2 molecules. Few of the studied sites are also found to be suitable for Kubas-type interaction, which is useful for reversible hydrogen storage at ambient conditions. Electronic structure calculations and charge transfer analysis have been done to understand the interactions of adsorbed hydrogen with the Cr_2C layer. It has been found that the total hydrogen storage capacity of Cr_2C is 7.6 wt.% in which 1.2 wt.% of H is due to the chemisorption, 3.2 wt.% is bonded with Kubas-interaction and remaining 3.2 wt.% is bonded through weak electrostatic interactions (with binding energy of 0.26 eV/H_2 and charge transfer of 0.09 e^- to H atom from Cr atom). Thus the reversible hydrogen storage capacity at ambient conditions (controlled by hydrogen bonded with energies ranging from 0.1 to 0.4 eV/H_2, in the present case through Kubas and weak electrostatic interactions) is 6.4 wt.% which is greater than the 2017 DoE recommended target value of 5.5 wt.%.

From the detailed computational study, it was found that there are possible sites in Cr_2C on which H atom and H_2-molecules can be bonded via chemisorption, physisorption, weak electrostatic interaction and Kubas interaction. It may be noted that the adsorbed H_2 molecule with binding energy range of 0.2 to 0.6 eV/H_2 can be adsorbed and desorbed under near-ambient conditions. Thus, H_2-molecules bonded by weak electrostatic interaction and Kubas interaction can be adsorbed and desorbed at moderate temperatures. In the present work, the binding energies of H_2 molecule in first layer on Cr_2C are calculated to be 0.14 eV/H_2, also the increase of H_2 molecule bond length from 0.74 Å to 0.85 Å (~10 %) confirms the Kubas interaction with 3.2 wt.% H. On adding a second layer of H_2 molecules, no major variation in H_2 bond length suggest no Kubas-type interaction, however the binding energy is in the desired range (0.26 eV/H_2) with significant charge transfer of 0.09 e^-

from Cr to lower H atom of H_2 molecule by weak electrostatic interaction (with 3.2 wt.%) is also good for reversible H_2 storage material at ambient conditions. Similar increase in the binding energy on adding H_2 molecule was observed in past for such 2D structures. In the present case, the average binding energy of all the layers is 0.20 eV/H_2. The binding energy values are also close to the earlier reported values for binding energy of first layer of Ti_2C (0.27 eV/H_2) and V_2C (0.24 eV/H_2), and higher than Sc_2C (0.16 eV/H_2). In the case of Ti_2C, using molecular dynamics, authors have suggested that the H_2 molecule bound by Kubas interaction with binding energy of 0.27 eV can be easily adsorbed and released in the temperature range of 300-400 K. Therefore, the binding energies obtained in the present case are also suitable for moderate temperature adsorption-desorption. In the present study it is found that the maximum gravimetric storage capacity of H_2-molecule was obtained as 7.6 wt.%, through which 3.2 wt.% was due to Kubas interaction on both sides of Cr_2C layer, 3.2 wt.% H_2 adsorbed by the binding energy of 0.26 eV/H_2 (with weak electrostatic interaction) and remaining 1.2 wt.% was adsorbed through chemisorption (Fig. 1). Therefore, the total H_2-stoarge capacity for reversible H_2-storage at ambient condition (through weak electrostatic and Kubas interactions) is better than the other studied materials having MXene structure, such as Ti_2C (3.4 wt.%), Sc_2C (3.6 wt.%), etc. In addition, by considering the H_2 attached with weak electrostatic interaction, the total reversible H_2-storage capacity (6.4 wt.%) is higher than the US-DOE target of 2017.

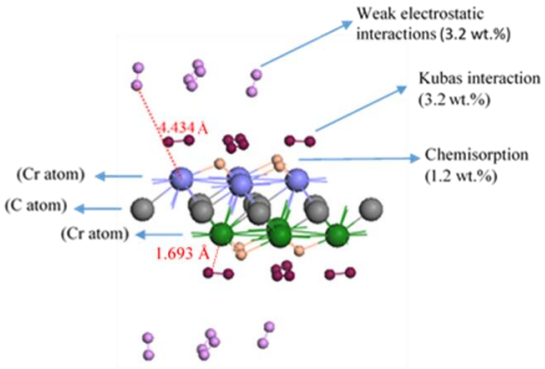


Figure 1: Interaction of H atom and H_2 molecule on Cr_2C layer at different sites.

(Collaboration - Prof. D.C. Kothari, Department of Physics, University of Mumbai, Mumbai. Dr. Nainesh Patel, Department of Physics, University of Mumbai, Mumbai Prof. Antonio Miotello, Dipartimento di Fisica, Università degli Studi di Trento, Italy)

Interaction of TiO_2 nanocluster with graphene oxide (GO): Experimental and theoretical investigations:

Go-TiO_2 composites are gaining importance because of their applications in various fields and also due to their stability. To understand the interfacial interaction between GO and TiO_2, various GO-TiO_2 models were considerd through simulations. The calculated optical properties of theoretical models were compared with experimentally synthesized RGO-TiO_2 composite. Optical absorption spectra indicated enhancement in visible region for RGO-TiO_2 nanocomposite when compared to that of TiO_2. The variation in optical properties of RGO-TiO_2 cluster with degree of functionalization was also studied. It was observed that in GO-TiO_2 model with optimum OH groups, new states were formed within

the band gap which could be responsible for enhanced absorption in visible region (Fig.2 and 3).

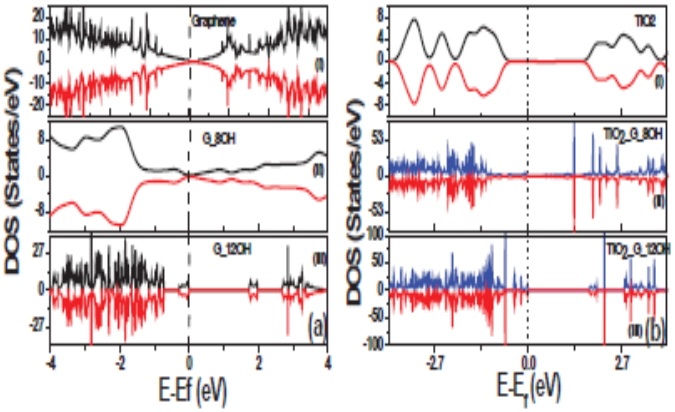


Figure 2: DOS calculations for (ai) Graphene, (aii)G_8OH, (aiii) G_12OH, (bi) TiO_2, (bii) TiO_2-G_8OH and (biii) TiO_2-G_8OH.

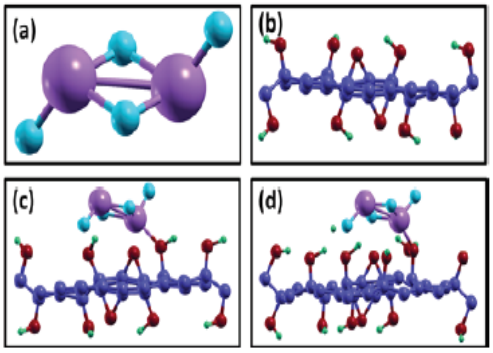


Figure 3: Optimized structures of (a) TiO_2 nanocluster, (b) G_8OH layer, (c) TiO_2 on G_8OH composite and (d) TiO_2 on G_12OH composite.

Temperature dependent magnetic Compton profiles and first-principles strategies of quaternary half-Heusler alloy $Co_{1-x}Cu_xMnSb$ ($0 \leq x \leq 0.8$):

Temperature dependent experimental Compton profiles of quaternary alloys $Co_{1-x}Cu_xMnSb$ (x=0.0, 0.2, 0.6 and 0.8) when decomposed into constituent profiles show that the sp-electron spin polarization is antiferromagnetically coupled to Mn-3d moments. The orbital magnetic moments derived from combination of magnetic Compton profiles (MCPs) and magnetization measurements are found to be small. Moreover, the first-principles full potential-linearized augmented plane wave (FP-LAPW) calculations have been performed to validate the experimental investigations of spin moments and half-Heusler properties. Present experimental and theoretical work show major role of Mn atoms in building-up the absolute spin moments. The MCP data and spin-projected density of states derived from FP-LAPW computations show an increase in sp-d interaction in conduction region on increasing the Cu concentration. Further, Ruderman-Kittel-Kasuya-Yosida-type hybridization and antiferromagnetic superexchange interactions are witnessed in the reported alloys.

(Collaboration -Prof. B.L. Ahuja, Departmnet of Physics, M.L.S. University, Udaipur)

Ameeya Bhagwat

An exact quantum mechanical treatment to study the phenomena of cluster emission from a variety of nuclei has been developed. The approach assumes that the preformed cluster is a point particle moving in a Gamow state under the effective cluster – daughter interaction potential. The method is found to be fairly general. The half lives of cluster as well as α decay phenomena thus obtained are found to be in good agreement with the experiment. These results have been published. The work has been extended to the domain of superheavy elements with a focus on cluster and alpha emission from them.

(Collaboration - Prof. Roberto Liotta)

The important problem of contribution of non – local effects in the optical model, particularly for loosely bound projectiles at low energies are being investigated. Nonlocality in scattering potential leads to a nonhomogeneous scattering equation. We have developed two new methods to treat nonlocality in scattering. One of these methods is iterative, and the other is a direct method that involves expansion of the nonlocal kernel into its moments. The former method, using the mean value theorem of integral calculus, converts the nonlocal term to a local term, thus reducing the nonhomogeneous equation to a homogeneous equation. The local term, equivalent to a local potential, is energy independent and contains elements of nonlocality through the integrated kernel. The method has been shown to be applicable for a range of kernel functions, and can be profitably applied to a variety of potentials. The results thus obtained are found to be in excellent agreement with the experiment, atleast over the enrgy range of 0.1 MeV to ~30 MeV neutron – nucleus scattering processes. These results have been written up, and the paper has been submitted for publication. The framework has been extended to include Coulomb potential, and the results are found to be in excellent agreement with experiment. The work on the direct solution to nonhomogeneous scattering equation by expanding kernel function into its moments has also been completed, and the article has been composed.
(Collaboration - Dr. Neelam J. Upadhyay, CEBS and Prof. B. K. Jain, Ex BARC)

Comprehensive calculation of ground state properties of a large number of even even nuclei has been carried out using the Gogny D1S force within the extended Thomas Fermi scheme. It is found that the calculated self consistent potentials and densities can be parameterised as Fermi distributions. As the next step, the parameterised potentials and densities are used to calculate the smooth part of energy and the shell corrections within the Wigner - Kirkwood semi classical averaging scheme. The shell corrections thus obtained, along with a simple liquid drop prescription is found to yield a reasonably good description of ground state masses for nuclei spanning the entire periodic table. These results are being written up for publication.
(Collaboration - Prof. Peter Schuck, IPN Orsay, France, Prof. Xavier Viñas and Prof. Mario Centelles University of Barcelona, Spain).

Systematic calculations of superheavy region from Z=100 to Z=150 and N/Z ratio ranging from 1.19 to 2.70 have been carried out within the framework of the Relativistic Hartree Bogolyubov model. It has been shown that the possible upper limit on the periodic table could be Z=146, which is at variance with predictions of sophisticated atomic many body calculations.
(Collaboration -Profs. Y. K. Gambhir and Mohini Gupta, MCNS, Manipal)

Ananda Hota

Galaxy transformations: From blue-star forming spirals to red-and-dead ellipticals:

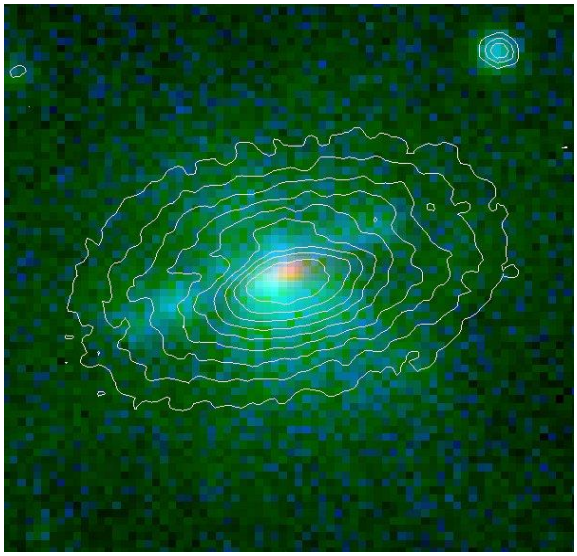


Fig 1. NGC1482, UV-optical-IR image of the post-merger early-type galaxy with a Superwind outflow. Cold gas showing outflow (150 km/s)is shown in the next Fig 2. Blue and green shows UV, IR in red and optical in contour

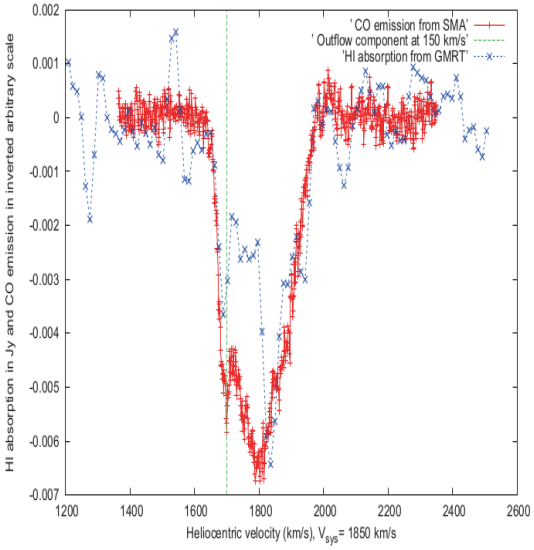


Fig 2. Neutral atomic hydrogen (21cm HI line absorption) and cold molecular (^{12}CO J =2-1) gas emission (inverted) from centre of NGC1482. Observation was done using GMRT (india) and SMA (Hawaii, USA). Outflowing gas component is marked with a vertical green line.

NGC1482 has been investigated using two interferometric radio telescopes, Giant Meterwave Radio Telescope (GMRT; India) and Submillimetre Array (SMA; Hawaii, USA), and data from Ultraviolet (UV) space telescope GALEX (NASA-JPL-CalTech, USA), IR data from 2Micron All Sky Survey (2MASS) and Spitzer Space Telescope (NASA-JPL-CalTech, USA). This post-merger early-type galaxy shows (Fig. 1-2) huge tidal tails and yet-to-merge two nuclei. Central starforming region around the nuclei drive a fast hourglass-shaped Superwind outflow out of the stellar bulge (north-south orientation). SMA observations of Carbon monoxide gas (^{12}CO J=2-1 spectral line) tracing cold molecular hydrogen clouds showed the central region to be gas-rich and fueling the star formation (Fig. 3). Along with this an additional component of outflowing molecular gas was seen coinciding with the blue-shifted HI-absorption component, seen earlier with the GMRT. This outflow of cold atomic and molecular gas is going to remove fuel of future star formation and eventually may transform the early-type merger-remnant to a red-and-dead elliptical galaxy. NGC1482 serves as an unique laboratory to investigate role of feedback in galaxy evolution in-action.

(Name of the Collaborators -Prof. Chiranjib Konar, Amity University, Noida, India, Dr. Sravani Vaddi ,NCRA\TIFR, Pune, India, Prof. C.S. Stalin,IIA, Bangalore, India, Prof. Satoki Matsushita, ASIAA, Taiwan & ALMA Observatory, Chile, Prof Kohno Kotaro , University of Tokyo, Japan, Dr.

Daniel Espada, NAOJ, Japanm, Dr. Youichi Ohyama ,ASIAA, Taiwan
Prof. Soo-Chang Rey ,Chungnam National University, South Korea)

In search of faint and fuzzy relics of past black hole activities:

It is well known that detecting and characterizing faint and fuzzy emission in multi-wavelength astronomical data can be done more efficiently by citizen-scientists than automated computer algorithms or machine learning processes. Unlike in UV, optical or IR images, such irregular low signal-to-noise ratio features become more tricky for interpretation specially in angular-scale sensitive radio interferometric survey images like that of NVSS and FIRST from VLA (USA) and TGSS from GMRT (India). Hence to look for faint fuzzy relic evidences of old relativistic magnetised plasma emitted by past accretion activity of supermassive black holes, a short-term radio-astronomy workshop was designed to train the citizen scientists interested in making cosmic discoveries.

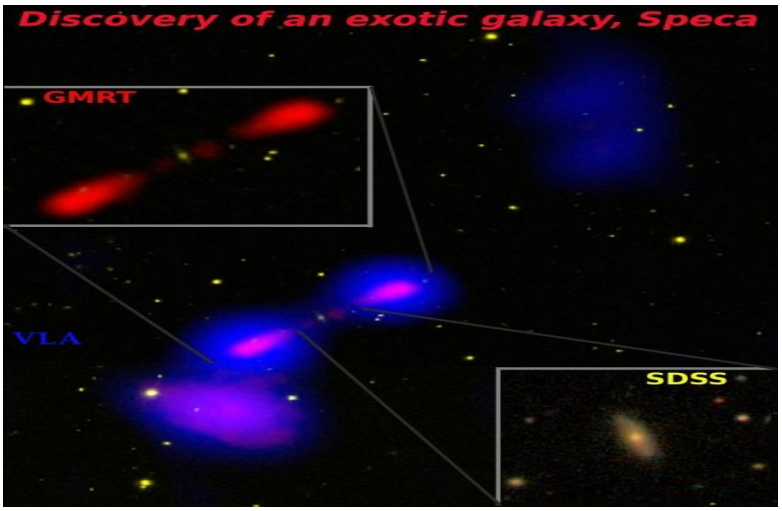


Fig 3: Press release NSF(USA): https://www.nsf.gov/news/news_summ.jsp?cntn_id=121556

The workshops were hosted by various Govt of India institutes like IoP (DAE, Bhubaneswar), HRI (DAE, Allahabad), Nehru Planetarium (NMML, Delhi), Vigyan Prasar (DST, Delhi) and #eAstroLab, UM-DAE CEBS (Mumbai). The primary data used was TIFR GMRT Sky Survey (TGSS) from the Giant Meterwave Radio Telescope of the National Centre for Radio Astrophysics, Tata Institute of Fundamental Research, Department of Atomic Energy (Govt of India). GMRT is not only three times bigger than the most productive radio telescope of the world VLA (USA) making it most sensitive but also operate at low radio frequencies which is perfect to detect old/relic plasma and black hole activities of distant past (early in the history of our Universe). Both the TGSS DR5 and Alternative Data Release (ADR1) data were used to discover relic lobes beside any galaxy or any radio galaxy with or without FR I/II structure. The exotic galaxy Speca (Fig. 3), served not only as an educational example but also as inspiration to make international news-making discoveries with the GMRT. Several episodic radio galaxies have been discovered in the process. Why black holes stop ejecting radio jets for millions of years and start again is

poorly understood process. It could be due to a new episode of fueling the accretion disk or merger between two super massive black holes (gravitational wave released during such an event was discovered this year by LIGO). In some cases spin of the black hole changes after merger leading to X-shaped radio galaxies. Many new such X-shaped radio galaxies have also been discovered by this trained citizen-scientists or e-astronomers of this citizen-science collaboratory. GMRT Time Allocation Committee has awarded 25 hours of observing time to this proposal (GOOD-RAC-4) for follow up observation of the objects discovered. Ultimate aim is to discover and understand the nature of first supermassive black holes and galaxies, be they at the centres of clusters as cD galaxies or Speca-like rare "living fossils" avoiding merger with galaxies and clusters.

(Collaborators: Prof. Chiranjib Konar mAmity University, Noida, India, Prof C. H. Ishwara-Chandra, Prof Preeti Kharb, Dr. Sravani Vaddi , NCRA-TIFR, Pune, India, Prof Joydeep Bagchi , IUCAA, Pune, India, Prof. C.S. Stalin ,IIA, Bangalore, India, Prof Veeresh Singh,PRL, Ahmedabad, India)

Gopal Krishna

A novel search campaign for the elusive 'radio-quiet BL Lacertae objects:

Using the 1.3-metre optical telescope of ARIES (Naini Tal), I have continued to lead this research project which I started in 2012 with the aim to find the long-sought elusive miniscule population of 'radio-quiet' BL Lac objects. Discovery of such an object would bring a paradigm shift in our understanding of the Active Galactic Nuclei (AGN). A novel search strategy, which employs rapid fluctuations in optical brightness (within a few hours) as a signature of BL Lac is currently being followed. Our results have been published in 5 papers appearing in the prestigious international journal, Monthly Notices of the Royal Astronomical Society (MNRAS). So far, they have found two good candidates and another two candidates, which we are pursuing for confirmation via optical polarimetry.

Multi-wavelength Variability Study of the Classical BL Lac Object PKS 0735+178 on Timescales Ranging from Decades to Minutes:

This work is carried out in collaboration with former PhD student Dr A. Goyal. The goal is to characterise and compare the flux variability of BL Lac objects in the optical, radio and Gamma-ray bands, on time scales ranging from *minutes to decades*. Such a vast coverage of temporal scale has not been carried out previously. The first result have recently been published which focus on the BL Lac object PKS 0735+178 and findings were interpreted in terms of a model where the blazar variability is generated by the underlying single stochastic process (at radio and optical frequencies), or a linear superposition of such processes (in the Gamma-ray regime).

Presently, similar study is pursued for another BL Lac object OJ287, which is a strong candidate for a binary of supermassive black holes.

Reviewing 25-years of intra-night optical monitoring of Active Galactic Nuclei at ARIES:

At the First Indo-Belgian conference held at ARIES in Nov. 2016, an invited review talk on the above research topic was presented. The novelty of this project lies in the

extension of the intra-night optical monitoring to the major non-blazar types of powerful Active Galactic Nuclei. This activity was initiated by Prof. Gopal Krishna in 1991 and has since spread over to a dozen countries across 4 continents. This study has ensured India a lead role internationally even with the use of the modest size optical telescopes that are available in the country. The work done in this field in India (mainly at ARIES) has resulted in 101 publications in refereed international journals and received close to 2000 citations. The review will be published in the Bulletin of Liège Royal Society of Sciences, under the title 'Optical monitoring of Active Galactic Nuclei from ARIES'.
(Authors: Gopal-Krishna (CBS/NASI, India) & Paul J. Wiita (TCNJ, USA)).

Manojendu Choudhury

High energy astronomy:

Study of compact objects with emphasis on the Galactic stellar compact objects in binary systems and related physics of the accretion-ejection phenomenon. The compact objects comprise chiefly of the neutron star binaries (including accretion powered pulsars) and the stellar mass black hole binary systems. The compact objects accrete matter from the companion star and eject a fraction of the matter in the form of jets and winds. The central engine of tis accretion-ejection system is still not understood. Our research comprise chiefly of the X-ray study of these sources from various satellite observatories, including the Indian observatory ASTROSAT.
(Collaborators: PC Agrawal, Jayashree Roy from CEBS, and the rest of the ASTROSAT team comprising of various institutes).

Neelam Upadhyay

Nonlocality in scattering process:

The nucleon-nucleus interaction is known to be nonlocal in nature. This nonlocal character arises because of the many-body effects such as the virtual excitations in the nucleus and the exchange of the nucleons within the interacting system. Incorporation of nonlocality leads to a nonhomogeneous scattering equation. A new method has been developed to treat nonlocality in scattering. Its novelty, unlike the existing methods, is that it converts the nonlocal term to a local term, thus reducing the nonhomogeneous equation to a homogeneous equation. The local term, equivalent to a local potential, is energy independent and contains elements of nonlocality through the integrated kernel. We determine the accuracy of this method by using an iterative scheme initiated by the homogeneous equation. This method is used to study the neutron scattering off different targets spanning the entire periodic table in the energy range 0.1-10 MeV, which are of astrophysical interest. The calculated results reproduce the experimental measurements. Further, it has been found that the differences in the total cross sections obtained by solving homogenized Schrödinger equation and those obtained after iterations are always less than 5% in the energy range 0.1-10 MeV, irrespective of the system. This reaffirms robustness of the proposed scheme.
(Group: N. J. Upadhyay, A. Bhagwat and B. K. Jain at CEBS)

Extension to include spin-orbit coupling:

Extension of above scheme to include spin-orbit coupling is underway.

(Group: N. J. Upadhyay, A. Bhagwat and B. K. Jain at CEBS).

R. Nagarajan

Laser scattering studies in Ferrofluids:

Ferrofluids (FF) are of importance in basic science and in application. Light scattering studies provide information on microstructure and dynamics of the particles in the fluid. We continued our studies of forward laser scattering in aqueous magnetic fluids. Commercial samples (EMG 507, EMG 607, EMG 707 and EMG 807), of 10 nm Fe_3O_4 nanoparticles in aqueous medium, from Ferrotec, Singapore, with known magnetic properties, were investigated. Hydrodynamic parameters, such as, hydrodynamic diameter, drift velocity, diffusion coefficient, were measured using Nanoparticle Tracking Analysis (NTA) technique. Forward laser scattering was studied by passing a He-Ne laser beam (633 nm, 10 mW) after the onset of magnetic field applied perpendicular to the incident laser beam. Linear vertical streak is pattern is observed in the scattering pattern, indicating formation of magnetic field driven self-assemblies of magnetic nanoparticles in the form of chains and bundle. Time dependence of formation of the streak was investigated at different magnetic field strengths (15 mT, 25 mT, 50 mT and 75 mT). Our results showed that EMG 707 and EMG 807 have a fast response (within 10 seconds of the application of external magnetic field). EMG 507 was found to be slowest in its response to the external magnetic field. No vertical streak was observed up to 150 seconds, at 15 mT and 25 mT, indicating that either the self-assemblies are very small in size or self-assemblies are not formed in the observed time duration. EMG 607 showed an intermediate response as compared to the other samples. Intensity of linear streak increased linearly with time at fields 15 mT, 25 mT and 50 mT, but showed a faster growth at 75 mT with tendency to saturate (response similar to EMG 707 and EMG 807). We have interpreted the observed behavior in forward scattering from magnetic fluids to hydrodynamic parameters apart from those of magnetic parameters. Our studies show that magnetic fluids with higher drift velocities and smaller hydrodynamic diameter (EMG 707 and EMG 807) favor fast self-assembly of magnetic nanoparticles. This has implications for choosing suitable magnetic fluid for applications.

(Principal investigator: S. Radha, Dept. Phys., UoM; Co-investigators: R. Nagarajan, Chintamani Pai, Dept. Phys., UoM; Collaborator R.V. Ramanujan, NTU, Singapore, Vijay Kumar Varma, NTU, Singapore)

Sangita Bose

Superconductivity in Nb-Cu nano-composites and nano-alloys:

The main objective of the current project is to investigate the role of phase fluctuations in the destruction of superconductivity in granular films with array of Josephson junctions in relation with the coupling between the grains. Nb-Cu is an immiscible binary system, which is known to be quenched into a metastable alloy phase by suitable growth conditions. It is shown that by growing Nb-Cu films by magnetron sputtering at a substrate temperature above the crystallization temperature of Nb and Cu,

the system forms 3D granular films irrespective of the composition. The evolution of superconducting properties in these 3D granular films as a function of composition is studied. The results indicate that superconductivity is influenced by the coupling between the grains and phase fluctuations between them affects the temperature at which the global phase coherence sets in the film. Currently, measurements are carrying out to measure the superfluid stiffness of these materials to convincingly establish the role of phase fluctuations in these systems.

(Collaborators: Dr. Pratap Raychaudhuri, Vivas Bagwe and Bhagyashree Chalke (TIFR) (Sample structural characterization by SEM, EDX and magnetic field measurements done at TIFR)

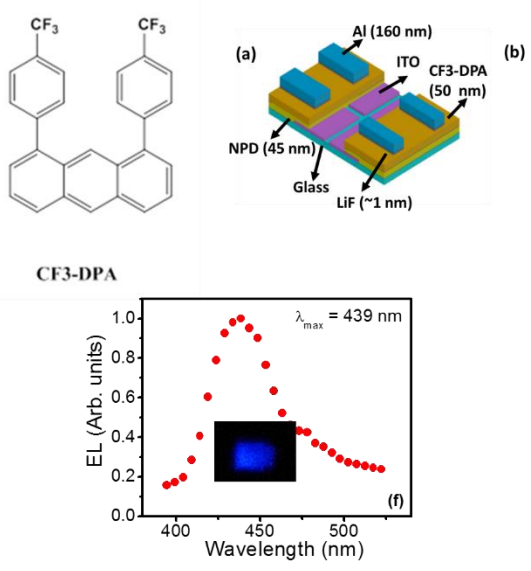
Soft Point Contact Andreev reflection Spectroscopy:

The technique of "soft point contact" Andreev reflection spectroscopy (PCAR) is developed at CEBS that can be used with a cryogen free system. In this technique an In is pressed on the superconductor and the transport across the interface is studied. (Schematic of the "soft point contact" shown). This spectroscopic technique is very useful to probe superconductors, in particular to estimate its energy gap and to determine the symmetry of the order parameter. This technique is not sensitive to mechanical vibrations and hence can be used in a cryogen free platform increasing its accessibility to users having no access to cryogenic liquids. Through the experiments on large number of superconducting films it is shown that the PCAR spectra below the T_c of In showed sub-harmonic gap structures consistent with the theory of multiple Andreev reflection (MAR) and a zero bias conductance (ZBC) anomaly associated with the Josephson supercurrent. Furthermore, it is demonstrated that small area, low transparency ballistic contacts are required to obtain reliable spectroscopic data. One limitation of the technique arises in large area contacts where the superconducting proximity effect (SPE) reduces the value of the superconducting energy gap.

Organic Electronic devices:

One of current research interests of the group lies in making devices for organic electronics.

OLEDs: In one of the projects, the deep blue OLED devices were grown (Image of the device emitting in deep blue is shown in the adjoining figure) where the active layer was flouromethyl substituted 1, 8 diaryl anthracene (structure shown in the adjoining figure) which emits at 432 nm in solution. The devices were fabricated with different geometries (optimized geometry show in the adjoining figure) with different hole transporting layers and optimized to give maximum luminance with low turn on voltage. *(Manuscript submitted).*



(Collaborators: Prof. Neeraj Agrawal (CEBS)

S. M. Chitre

The research effort was largely aimed at formulating an approach to a turbulence closure model based on the mixing-length prescription incorporating effects due to buoyancy, shear & rotation. The model is able to reproduce several classical instabilities including shear, magnetorotational and baroclinic instabilities within the framework of linear growth theories with nonlinear decay. The development of closure model will enable computation of the Reynolds stresses and turbulent transport coefficients to understand phenomena operating in planets, stars and accretion discs. It is now proposed to study the nature of enhanced meridional flow in the outer radiative zones of stars on account of convective anisotropy leading to a significantly increased mixing in the interior of massive rotating stars It will be demonstrated from scaling and symmetry considerations that the helioseismically observed radial and latitudinal differential rotation in the solar interior could be the result of multiple angular momentum transport mechanisms. such as anisotropic turbulence, thermal wind balance and stresses due to the meridional flow, even in the presence of rapid rotation and turbulent magnetic fields.

The expressions for Reynolds stresses in the framework of Boussinesq approximation in the governing hydrodynamical equations were derived using the linear growth rates of unstable modes. This input will be used in the equation for the angular momentum transport by Maxwell stresses, Reynolds stresses and meridional circulation to infer the magnetic field as well as circulation flow pattern in the interior of the Sun. An attempt is being made to set up a phenomenological model of the solar activity cycle based on an order-of-magnitude scaling analysis of the coupling between rotation and magnetic field. This could serve as a plausible mechanism to account for the exchange of time-varying rotational energy as demonstrated helioseismically by torsional oscillations through bulk of the convection zone and the magnetic energy .variation observed over the solar cycle. This work was in collaboration with Bhooshan Paradkar. During his stay in Cambridge, Kumar Chitre visited York University to review the exchange programme between York and his Centre in the campus of Mumbai University.

Sreemoyee Sarkar

Transport Properties of Color-Superconducting phases in Neutron Star core:

The first calculation of the shear viscosity for two-flavor plane wave (FF) color superconducting quark matter are presented. This is a member of the family of crystalline color superconducting phases of dense quark matter that may be present in the cores of neutron stars. The low energy quasi-particles that play an important role in transporting momentum and energy at low temperature are indentified. Due to the large density of states near the Fermi surface, the up (u) and down (d) quarks, and the electrons dominate transport properties if they are gapless. The blue u and d quarks, and the electrons do not participate in pairing and their viscosity is the same as in the 2SC phase, calculated earlier.

The up red-down green-up green-down red (ur-dg-ug-dr) quarks pair and form Bogoliubov quasi-particles. The main difference between the two-flavor FF and the 2SC phase is that the spectra of Bogoliubov quasi-particles feature gapless modes near surfaces

that form the boundaries of crescent shaped blocking regions. The technical advance made in the paper is the calculation of their viscosity (Fig.1).

The other low energy modes, the phonons are Landau damped and do not contribute significantly to energy-momentum transport at low temperatures. By comparing the strength and the ranges of the particles that mediate quark interactions it is concluded that the dominant mechanism of scattering of the ur-dg-ug-dr Bogoliubov quasi-particles in the two-flavor FF phase is the exchange of transverse t1, t2 and t3 gluons which are Landau damped. In particular the longitudinal t1, t2 and t3 gluons are Debye screened and can be ignored. The Landau damping is anisotropic. The key result is that the viscosity of the ur-dg-ug-dr quarks in the LOFF window is reduced by a factor of roughly 10^{-2} compared to the viscosity of unpaired quarks interacting via Landau damped transverse gluons as can be seen from the plot attached below.

This is a surprising result. In the 2SC phase the ur-dg-ug-dr quarks are fully gapped and are frozen. In the FF phase the geometric area of the gapless surface is reduced by pairing. But at the same time the phase space for collisions is also reduced by the square of the geometric factor. Hence this simple argument suggests that the shear viscosity should be comparable to that for unpaired quarks. Indeed this is precisely what happens if the interaction between the quarks is assumed to be mediated by Debye screened longitudinal gluons corresponding to the broken generators. For long range interactions, however there is an additional effect due to the increase of the density of states satisfying the energy conservation equation due to small velocities over a part of the Fermi surface. The collision integral is enhanced and the shear viscosity is reduced. This effect is particularly pronounced for t1, t2, t3 gluons as explained in detail in our manuscript.

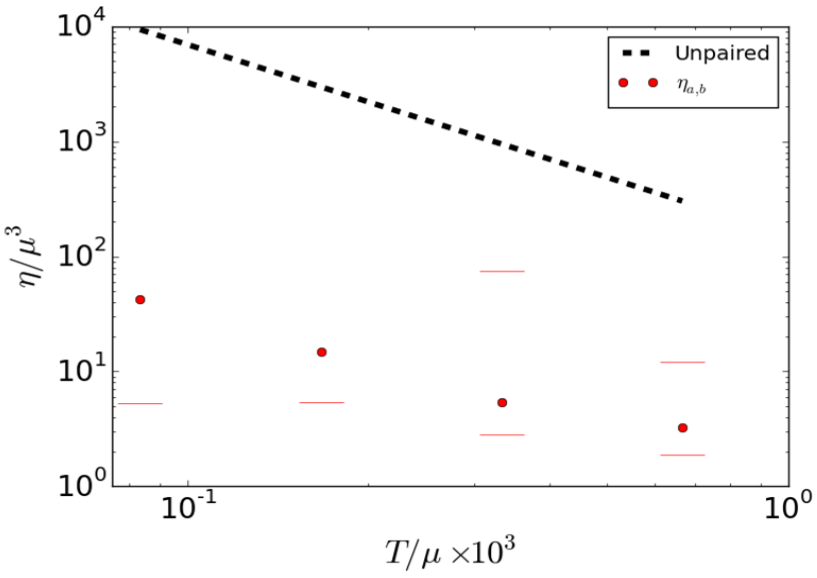


Fig. 1: Shear viscosity of Bogoliubov quasiparticles for anisotropic pairing as a function of temperature

(Collaborator: Prof. Rishi Sharma, TIFR)

Dynamical evolution of Heavy quark in a longitudinally expanding QCD plasma:

In recent years there has been a spurt of advancement of research in the field of the

hot and highly dense object created in the collider experiments. Till date there are a number of exciting results from both RHIC and LHC like elliptic flow, observed HBT radii etc., which eventually determine the properties of produced QGP. Heavy quarks are important tool to probe the nature of the dense medium produced in collider experiments. Heavy flavours are born at quite early stage of the collision and owing to their large masses, production at intermediate stages are strictly suppressed. Their evolution history is encoded in the transport coefficients and hence their spectrum observed in the final stage detectors provide us the information about the dense medium produced in between. One of the major outcomes that unfolds from the RHIC is the produced medium is not too far from equilibrium but it can be described by the ratio of shear viscosity coefficient to the entropy density . Hence, ideal hydrodynamics demands modifications to incorporate non-zero shear viscosity and theory of viscous hydrodynamics becomes important. The effect of non vanishing value of viscosity are many folds, apart from modification of expansion of the medium by viscous hydrodynamics,one has to consider the modifications to the local momentum distribution functions and the matrix elements. The formalism is developed for collisional and radiative energy loss in a longitudinally expanding QCD medium which eventually provides us the heavy flavour spectrum detected in the experiments. The manuscript is in preparation and going to be communicated soon.
(Collaborator: Prof. Subrata Pal, Chandrodoy Chattopadhyay, TIFR)

Sujit Tandel

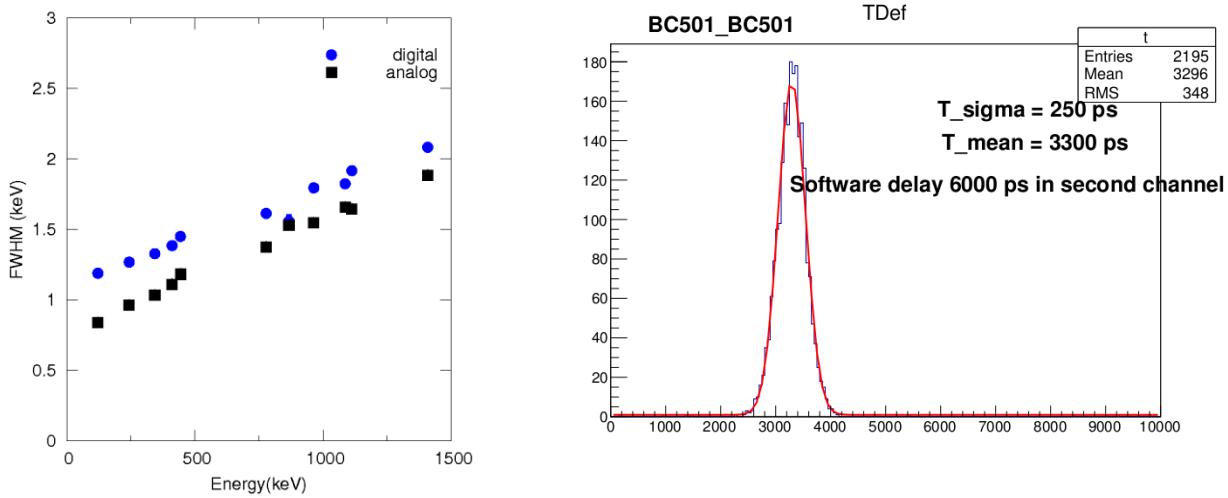
The Nuclear Physics Laboratory at CEBS comprises Prof. Sujit K. Tandel (UGC Associate Professor), Dr. Dinesh Negi (Research Associate), S. Gholam Wahid (JRF under DST INSPIRE), Poulomi Roy (JRF under BRNS Research Project) and Abhay Bakalkar (Laboratory Attendant). The following M.Sc. students have ongoing or completed projects during 2016-17: Vikas Bothe, Kartikeya Sharma, Anton S. Iyer (all CEBS) and Atul Prajapati (Department of Physics, University of Mumbai).


Left panel: Some Nuclear Physics Laboratory members at CEBS. Right panel: CEBS faculty and students during group experiment at Inter-University Accelerator Centre, New Delhi (August 2016).

A brief summary of the work performed by the group during 2016-17 is included below.

1) In-house development of state-of-the-art measurement techniques for data acquisition using a digital signal processing system coupled with high-resolution semiconductor and

sub-nanosecond timing scintillation radiation detectors is carried out. Coincidence measurements using a variety of detectors have been successfully completed and the next stage comprising offline measurements of metastable states in nuclei are being planned. Some results are displayed below.



Left panel: Comparison of the energy resolution with analog and digital systems. Right panel: Coincidence time resolution of two BC501 (liquid scintillation) detectors obtained using the digital data acquisition system procured from CAEN under the BRNS funded research project.

2) Study of metastable states (isomers) in multiple Tl isotopes with mass number A~200 using accelerator-based facilities and large gamma detector arrays like the Indian National Gamma Array and Gammasphere. This has provided fundamental information on the structure of nuclei in the vicinity of ^{208}Pb, the heaviest doubly-magic nucleus in the periodic chart of elements.

3) Additionally, *K* isomers have been studied in the isotopes ^{180}Hf and ^{188}Pt. These have provided important insights into the phenomenon of *K* isomerism and shape evolution in nuclei. In ^{180}Hf, *K* isomers are observed to be the favored excitation mode at high spin. In ^{188}Pt, novel coexistence between prolate and oblate shapes along with the observation of a *K* isomer is noted.

4) Further, the structure of neutron-rich Pt and Hg isotopes has been investigated and excited states at high angular momentum have been established.

Tripti Bameta

Coupling of replisome movement with nucle-osome dynamics can contribute to the parent-daughter information transfer positioning of nucleosomes along the genomic DNA is crucial for many cellular processes that include gene regulation and higher order packaging of chromatin. The question that how nucleosome positioning information from a parent chromatin gets transferred to the daughter chromatin is highly intriguing. Recent experiments have indicated that, during replication, the movement of the replication fork is

strongly coupled to the nucleosome deposition behind it. Here it is argued that the interplay between nucleosome removal timescale at the replication fork and nucleosome sliding time behind the replication fork can give rise to an interesting phenomena where the daughter chromatin can inherit the precise nucleosome positioning of the parent, which may be heterogeneous along the genome.
This work is under review in Nucleic Acid Research.
Collaborators: Ranjith Padinhateeri (IIT Bombay)

Microtubule Length Regulation by Molecular Motors:

During the life span of a cell microtubule perform very dynamic tasks. For example, in the cell mitosis, mitotic spindles are formed and are segregated with the controlled length regulation of microtubules. Hence, the precise length control of the microtubules is a very important for cell survival. The length is controlled by various hydrolysis processes as well as with the assistance of kinesin family motors. A recent experimental study have shown that there are motors which assists the growth of microtubule. In this work, the role of these positive feedback motor in microtubule dynamics is studied.
Collaborators: Dipjyoti Das (Yale University, New Haven), Sandeep Trivedi (Harvard University , Cambridge)

Transcriptional Interference: A tool for gene regulation:

In this work, theoretical studies of complex RNAP-tra_c phenomena that are believed to play important regulatory roles in living cells are performed. These phenomena arise from simultaneous transcription of two over lapping genes either on the same DNA template or two genes on the two adjacent single strands of a duplex (double-stranded) DNA. In the former case, traf-c is entirely uni-directional although RNAPs transcribing different genes polymerize two distinct species of RNA molecules by starting (and stopping) at different sites on the same template DNA strand. In contrast, in the latter case, RNAP track in the two adjacent \lanes" move in opposite directions transcribing the respective distinct genes. In both these situations the phenomenon of suppressive inuence of one transcriptional process on the other is called transcriptional interference (TI). In general, a RNAP at the initiation, elongation or termination stage of transcription of one gene can suppress the initiation, or elongation (or induce premature termination) of that of the other gene by another RNAP. In other words, the stages of transcription of the two interfering RNAPs define a distinct mode of interference. Different modes of interference have been assigned different names like\occlusion", \collision", \sitting duck interference", etc. Many pairs of interfering transcription processes are known to form a bistable switch: switching ON a high level of transcription of one of the two genes can switch OFF the other by its suppressive effect and vice versa. Thus, the sense and anti- sense genes transcription itself makes a \self-regulatory" circuit. For this system, a unified theoretical framework that, for a given relative orientation of two genes, captures all possible modes of TI is developed.
(Collaborators - Mamata Sahoo, Indian Institute of Science Education and Research, Thiruvananthapuram, Kerala, India)

Brownian ratchet model for motors- interaction and co-operativity:

This work is in continuation of our recent publication in Physical review E. (Collaborators -*Mandar M Inamdar, IIT Bombay)*

7. Publications

7.1 Publications in peer reviewed Journals:

1. Mechanistic Insights into the Initiation step of the Base Promoted Direct CH Arylation of Benzene in the Presence of Additive
M. Patil
J. Org. Chem., 81 (2016) 632-639.

2. Ferrocene Catalysed Heteroarylation of BODIPy and Reaction Mechanism Studies by EPR and DFT methods
S.Dixit, M. Patil, N. Agarwal
RSC Advances, 6 (2016) 47491-47497.

3. Study of 2D MXene Cr_2C material for hydrogen storage using density functional theory
A. Yadav, **A. Dashora**, N. Patel, A. Miotello, M. Press, D.C. Kothari
Applied Surface Science, 389 (2016) 88-95.

4. Superheavy Nuclei and Beyond: A Possible Upper Bound of the Periodic Table
A. Bhagwat, Y.K. Gambhir and M. Gupta
Acta Physica Polonica, B, 47 (2016) 2003-2016.

5. Tracking Galaxy Evolution through Low-Frequency Radio Continuum Observations using SKA and Citizen-Science Research using Multi-Wavelength Data
A. Hota, C. Konar, C.S. Stalin , S. Vaddi, P.K. Mohanty, P. Dabhade, D. Bhoga , A. Sai, M. Rajoria, S. Sethi
Journal of Astrophysics and Astronomy, 37 (2016) 41.

6. From Nearby Low Luminosity AGN to High Redshift Radio Galaxies: Science Interests with Square Kilometre Array
P. Kharb, D.V. Lal, V. Singh, J. Bagchi , C.H. Ishwara Chandra, **A. Hota,** C. Konar, Y. Wadadekar, P. Shatri, M. Das, K. Baliyan, B. B. Nath and M. Pandey-Pommier
Journal of Astrophysics and Astronomy, 37 (2016) 34.

7. Differential proteomic analysis of respiratory samples from patients suffering from influenza
R. Chavan, S. Mukherjee, R. Dahake, **D. Colvin, A. Kale** and A. Chowdhary
Virus Disease, 27 (2016) 226–233.

8. Conformational dynamics of Peb4 exhibit "mother's arms" chain model: A molecular dynamics study
S.C. Dantu, S. Khavnekar, **A. Kale**
Journal of bimolecular Structure & Dynamics, 35 (2016) 2186-2196.

9. Physical basis for the ofloxacin-induced acceleration of lysozyme aggregation and polymorphism in amyloid fibrils
S.A. Muthu, N. Mothi, S.M. Shiriskar, R.R. Pissurlenkar, **A. Kumar**, **B. Ahmad**
Arch Biochem Biophys.;592 (2016) 10-19.

10. Intranight optical variability of radio-quiet weak emission line quasars -IV
P. Kumar, H. Chand, **Gopal-Krishna**
Monthly Notices of the Royal Astronomical Society, 461, (2016) 666-673.

11. Optical control of filamentation-induced damage to DNA by intense, ultrashort, near-infrared laser pulses
A. Dharmadhikari, J. Dharmadhikari, **K. C. Kasuba, H. Bharambe, J. S. D'Souza** and D. Mathur
Scientific Reports, 6 (2016) 27515.

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V.G. Rao, R. B. Sarafdar, T. S. Chaudhary, P. Sivadas, P. Yang P. M. Dongare and **J.S. D'Souza**
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J. Roy, P.C. Agrawal D. K. Dhedhia, R. K. Manchanda, P. B. Shah, V. R. Chitnis, V. M. Gujar, J. V. Parmar, D. M. Pawar, V. B. Kurhade
Experimental Astronomy Journal, 42(2016) 249-270.

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A. Shukla, K. Mannheim, V.R. Chitnis, **J. Roy**, B.S. Acharya, D. Dorner, G. Hughes, and A. Biland
The Astrophysical Journal, 832 (2016) 177.

15. Mechanism of Ylide Transfer to carbonyl compounds: Density Functional Theory Calculations
M. Patil, W. Thiel
Eur. J. Org. Chem., (2016) 830-839.

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S. Cheriyamundath, **T. Mahaddalkar,** S. Kantevari, and **M. Lopus**
Biomedicine & Pharmacotherapy, 86 (2016) 74-80.

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M. Pradhan, C. Suri, **S. Choudhary**, P.K. Naik, and **M. Lopus**

J Biomol Struct Dyn, (2016) 1-14.

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T. Mahaddalkar, N. Manchukonda, **S. Choudhary, S. Cheriyamundath, N. Mohanpuria**, S. Kantevari and **M. Lopus**
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19. Chemical synthesis, pharmacological evaluation and in silico analysis of new 2,3,3a,4,5,6-hexahydrocyclopenta[c]pyrazole derivatives as potential anti-mitotic agents
M. Maninder, D. Singh, **T. Mahaddalkar, M. Lopus**, P. Winter, Ahmad T. Ayoub, K. Missiaen, T. M. Tilli, M. Posdar, J. Tuszynski
Bioorganic Med Chem Lett, 26 (2016) 3855-3861.

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K.J. Jairaj, A. Nimesh, **S.Raj** and **N. Agarwal**
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S. Dixit, Q.T. Siddiqui, M. Muneer and **N. Agarwal**
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V.M. Rao Kakita, V.K. Shukla, M. Bopardikar, T.Bhattacharya, **R.V. Hosur**
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S. Choudhary, **S.N. Save**, N. Kishore, **R.V. Hosur**
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E. Judy, **S. Choudhary**, N. Kishore
Austin Biomol, 1 (2016) 1003.

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A. A. Thoppil, **S.Choudhary**, N.Kishore
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S.Sen, K. F. Block, A. Pacini, S. Baylin, H. Easwaran
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S.K. Tandel, P. Chowdhury, F. G. Kondev, R. V. F. Janssens, T. L. Khoo, M. P. Carpenter, T. Lauritsen, C. J. Lister, D. Seweryniak, S. Zhu, A. Deacon, S. J. Freeman, N. J. Hammond, G. D. Jones, E. F. Moore, J. F. Smith
Physical Review C, 94 (2016) 064304.

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M. Kumar Raju, P.V. Madhusudhana Rao, S. Muralithar, R.P. Singh, G.H. Bhat, J.A. Sheikh, **S. K. Tandel**, P. Sugathan, T. Seshi Reddy, B.V. Thirumala Rao, R.K. Bhowmik
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V. V. Parkar, V. Jha and **S. Kailas**
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S. Ghosh, **T. Bameta**, D. Ghanti, and D. Chowdhury
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A. Jain**, S.L. Vavilala**, P. Raghavendra, S. Singh and A. Jain
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V. K. Shukla, J. S. Singh, D. Trivedi, **R. V. Hosur** and A. Kumar
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V. M. Rao Kakita and **R. V. Hosur**

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B. Modak, P. Modak and **S.K Ghosh**
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S. Singh, S. Suman and **V. Singh**
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Joseph A Nathan and **V. Singh**
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T. Renstrøm, H.-T. Nyhus, H. Utsunomiya, R. Schwengner, S. Goriely, A. C. Larsen, D. M. Filipescu, I. Gheorghe, L. A. Bernstein, D. L. Bleuel, T. Glodariu, A. Görgen, M. Guttormsen, T. W. Hagen, B. V. Kheswa, Y.-W. Lui, **D. Negi**, I. E. Ruud, T. Shima, S. Siem, K. Takahisa, O. Tesileanu, T. G. Tornyi, G. M. Tveten, and M. Wiedeking
Phys. Rev. C 93, (2016) 064302.

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D. Negi, M. Wiedeking, E. G. Lanza, E. Litvinova, A. Vitturi, R. A. Bark, L. A. Bernstein, D. L. Bleuel, S. Bvumbi, T. D. Bucher, B. H. Daub, T. S. Dinoko, J. L. Easton, A. Gorgen, M. Guttormsen, P. Jones, B. V. Kheswa, N. A. Khumalo, A. C. Larsen, E. A. Lawrie, J. J. Lawrie, S. N. T. Majola, L. P. Masiteng, M. R. Nchodu, J. NAdayishimye, R. T. Newman, S. P. Noncolela, J. N. Orce, P. Papka, L. Pellegri, T. Tenstrom, D. G. Roux, R. Schwengner, O. Shirinda and S. Siem
Physical Review C 94 (2016) 024332.

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A.Shamlath, M. Shareef, E. Prasad, P. Sugathan, R. G. Thomas, A. Jhingan, S. Appannababu, A. K. Nasirov, A. M. Vinodkumar, K. M. Varier, C. Yadav, B. R. S. Babu, S. Nath, G. Mohanto, Ish Mukul, D. Singh, **S. Kailas**
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T. Mahaddalkar, P.K. Naik, **S. Choudhary,** N. Manchukonda, S. Kantevari, **S. Cheriyamundath**, and **M. Lopus**
J Biomol Struct Dyn, (2017) 2475-2484.

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T. Mahaddalkar and **M. Lopus**
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B. K. Sharma and **A. Bhagwat**
Acta Physica Polonica B, 48 (2017)195-205.

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S. Garge, **A. Nebhani**, S.Weyl
Lia Algebra, 27 (2017) 251-270.

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S. Khavnekar, S.C. Dantu., S. Sedelnikova, S. Ayora, J. Rafferty, and **A. Kale**
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S. Sonavane, S.Z. Haider, **A. Kumar**, **B. Ahmad**
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B. Ahmad, M.S. Borana, A.P. Chaudhary
Int J Biol Macromol, 100 (2017) 89-96.

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V.K. Shukla, J.S. Singh, **N. Vispute, B.Ahmad, A. Kumar, R.V. Hosur**
Biophys J., 112 (2017) 605-619.

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A.P. Chaudhary, **N.H. Vispute, V.K. Shukla, B Ahmad**
Biochimie. 132 (2017) 75-84.

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A. Goyal, L. Stawarz, M. Ostrowski, V. Larionov, **Gopal-Krishna**; P.S. Wiita, S. Joshi, M. Soida, I. Agudo
Astrophysical Journal, 837 (2017).

54. Defects in the ratios of dynein isoforms in the long-flagella mutants of *Chlamydomonas reinhardtii* cells
Marilyn Sequeira, Sapna S., Mustafa Motiwalla, **Venkatramanan Rao**, Toshiki Yagi and **Jacinta S. D'Souza**
Biochemical and Biophysical Research Communications, 482 (2017) 610-614.

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S.Parte, V.L. Sirisha and J.S. D'Souza,
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A. Kharade, M. Patil, M. Patil
ChemistrySelect, 2 (2017) 1711.

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Mahendra Patil
Org. Biomol. Chem., 15 (2017) 416-425.

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S. Pradhan, T. Mahaddalkar, S. Choudhary, N. Manchukonda, P.R. Nagireddy, S. Kantevari and **M. Lopus**
Curr Top Med Chem,17(2017) 2569-2574.

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S. Dixit and **N. Agarwal**
J. Photochem. Photobio. A: Chemistry, 343 (2017) 66-71.

60. Superconductivity in immiscible Nb–Cu nanocomposite films
P. Parab, V. Bagwe, B. Chalke, H. Muthurajan, P. Raychaudhuri, **S. Bose**
Superconductor Science and Technology 30 (2017) 055005.

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I. Roy, P. Chauhan, H. Singh, S. Kumar, J. Jesudasan, **P. Parab**, R. Sensarma, **S. Bose**, P. Raychaudhuri*
Physical Review B, 95 (2017) 054513.

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P. Parab, P. Chauhan, H. Muthurajan, **S. Bose**
Journal of Physics: Condensed Matter, 29 (2017) 135901.

63. Growth of nano-composites and nano-alloys of Cu-Nb thin films
P. Parab, P. Bhui, S. Bose
Thin Solid Films, 622 (2017) 148-152.

64. Genetically modified bananas: To mitigate food security concerns
S.B. Ghag, TR Ganapathi
Scientia Horticulturae, 214 (2017)91-98.

65. Effects of triphala and guggul aqueous extracts on inhibition of protein fibrillation and dissolution of preformed fibrils
S.N. Save, **S. Choudhary**
RSC Adv.,7 (2017) 20460-20468.

66. Improving visible light photocatalytic activity of $KTaO_3$ using cation-anion dopant pair
B. Modak and **S.K. Ghosh**
Solar Energy Materials and Solar Cells, 159 (2017) 590-598.

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B. Modak, K. Srinivasu and **S. K. Ghosh**
International J. Hydrogen Energy, 42 (2017) 2278-2287.

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S. Mukhopadhyay, D.C. Biswas, **S.K. Tandel**, S. Frauendorf, L.S. Danu, P.N. Prashanth, B. N. Joshi, G.K. Prajapati, B.V. John, Somnath Nag, T. Trivedi, S. Saha, J. Sethi, R. Palit, P.K. Joshi
Physical Review C, 96 (2017) 014315.

69. Mechanism of Initiation, Association and Formation of Amyloid Fibrils Modeled with the N-terminal Peptide Fragment, IKYLEFIS, of Myoglobin G-helix
S.Patel, Y.U. Sasidhar, K.V.R. Chary
J Phys Chem , 121 (2017) 7536-7549.

70. Sufficient conditions for the additivity of stall forces generated by multiple flaments or motors
T. Bameta, D.Das, D.Das, R. Padinhateeri and M.M. Inamdar
Phys. Rev. E, 95 (2017) 022406.

6.2 Publication in Conference proceedings:

1. A new way to study non-local effects
N. J. Upadhyay, A. Bhagwat and B. K. Jain
Proceedings of 61st DAE – BRNS Symposium on Nuclear Physics, SINP, Kolkata, India, 61 (2016) 620.

2. Transport coefficients in superfluid neutron stars
L. Tolos, C. Manuel, **S. Sarkar** and J. Tarrus
AIP Conf.Proc. 1701:1(2016) 080001.

3. Interaction of TiO_2 nanocluster with reduced graphene oxide: Theoretical and experimental investigations
A. Yadav, A. S. Gangan, B. Chakraborty, L. M. Ramaniah, M. Yadav, Y. Popat, **Alpa Dashora**, D. C. Kothari, M. Press and N. Patel
AIP Conference Proceedings, 1832 (2017) 120031.

4. Isomers and oblate collectivity at high spin in neutron-rich Pt isotopes
S.K. Tandel
European Physical Journal Web of Conferences 107, 03005 (2016).

8. Conference, Invited talks and Lecture given outside CEBS

8.1 Department of Biology

Jacinta D'Souza

Conference attended, Invited talks, presentations made:

- Presented a poster at the 16th International Conference on Cell and Molecular Biology of *Chlamydomonas*, in Catalunya, Spain held from July 3-8, 2016**.**
- Presented a poster titled, 'Stress-induced physiology of *Chlamydomonas reinhardtii*: a question of survival and death' at the Gordon Research Conference on Cell Death - New Concepts in Cell Death Research: From Basic Mechanisms to Clinical Opportunities held in Catalunya, Spain, held from July 3-8, 2016.
- Presented a poster (by PhD student, Mr. Venkatramanan G. Rao) titled, 'Molecular complexes in the central pair of the *Chlamydomonas* flagella' at the Cilia2016 'from human biology to human disease' meeting held at Amsterdam in Netherlands from October 4-7, 2016.
- Inaugural lecture of "Discover Science Lecture series" at the Institute of Sciences for the academic year 2016-17 on the 2nd of September 2016 on the topic, 'CRISPR: the new tool in gene editing'.
- At Department of Atomic and Molecular Physics, Manipal University held on September 23, 2016 on the topic, 'Cellular Cilia: our body's antennae'.
- Delivered a talk at the workshop on *Chlamydomonas reinhardtii*: the how, now and wow! under the aegis of Star scheme of DBT held at K. C. College titled, 'Probing *Chlamydomonas reinhardtii* for Multiprotein complexes on November 24, 2016.
- On the topic 'Multiprotein complexes: Biology's workhorse' as part of the NIUS-Biology camp on November 09, 2016.
- At Reliance R&D Centre, Reliance Industries Limited, Reliance Corporate Park, Ghansoli on the topic, 'Cellular Cilia: More than just an algal organelle', held on January 24, 2017.

Collaboration:

- Prof. Pinfen Yang from Marquette University, USA on "FAP174: an AKAP240-interacting protein from the green chlorophyte, *Chlamydomonas reinhardtii*".
- Prof. Deepak Mathur, Senior Professor at TIFR on "Effect of *in situ* generated radicals and free electrons on plasmid DNA".
- Dr. Santhosh Chidangil, HOD, Dept. of Atomic and Moleculer Physics, Manipal University on "Raman Spectroscopy of flagellar proteins".
- Prof. Cecilia Aarriano, Instituto de Tecnologia Química e Biológica, University of Lisbon, Portugal on "Phosphorylation status of *E. coli* BolA protein".

Seminar/workshop organized:

- Organized the teaching session (talk-cum-demonstration) 'Introduction to Flow Cytometry' for Semester 7 Biology students conducted by Dr. T. A. Nagarjuna of BD Biosciences on February 05, 2017.

- Organized a half-day GE Life Science Symposium at UM-DAE CEBS for UG/PG/PhD students, JPAs and Faculty of the Centre on 31st January, 2017.
- Organized a workshop on *Chlamydomonas reinhardtii*: the how, now and wow! under the aegis of Star scheme of DBT held at K. C. College on November 24, 2016.
- Organized a half-day seminar conducted by BD Biosciences held at UM-DAE CEBS for UG/PG/PhD students, JPAs and Faculty of the Biology Department on 14th June, 2016.

Manu Lopus

Invited Talks:

- Invited talk on Chemical Biology-based investigations of ligand tubulin interactions International Symposium on Computational and Experimental Studies of Microtubules and Microtubule- based Motor Proteins, organized by the Biophysical Society USA and Department of Biotechnology, Govt. of India, at Indian Institute of Technology Bombay, December 2016.
- Invited talk on Identification of beta sitosterol as a tubulin-targeted anticancer agent 7th International Conference on Stem Cells and Cancer, Margao, Goa, October 2016.
- Invited talk on Making of an anticancer drug , K J Somaiya College, Mumbai, July 2016.

Collaborations:

- Prof. Pradeep Naik, Sambalpur University, Odisha; Dr. Srinivas Kantevari, Indian Institute of Chemical Technology, Hyderabad on "Investigations on the antimetastatic potential and mechanisms of action of novel tubulin-targeted noscapinoids".
- Prof. Neeraj Agarwal, Chemistry, UM-DAE CEBS on "Development of potent BODIPy sensitizers for photo dynamic therapy, and elucidation of their cytotoxic mechanism in cancer cells".
- Dr. Sinjan Choudhary, UM-DAE CEBS on "Elucidation of the anticancer potential of Triphala and identification of its intracellular target".
- Dr. H. Muthurajan, National Centre for Nanoscience & Nanotechnology, University of Mumbai on "Alternation of cell signalling pathways by peptide-stabilized gold nanoparticles".

Siddhesh Ghag

Collaboration:

- Prof. N. S. Punekar, Indian Institute of Technology- Bombay, Mumbai on "Understanding the role of Fusarium pathogenicity factors in Fusarium wilt disease of banana".
- Prof. Jacinta D'Souza, UM-DAE CEBS, Mumbai on "Towards understanding the protein interactors of SGE1 in Fusarium-banana pathosystem".
- Dr. Pratiksha Alaag, National Facility for Biopharmaceuticals, Mumbai on "Understanding the functional significance of a Fusarium effector protein SIX1 involved in Fusarium wilt disease of banana".

- Dr. T. R. Ganapathi, Bhabha Atomic Research Centre, Mumbai on "Developing transgenic banana plants resistant to Fusarium wilt disease using biotechnological approaches".
- Dr. V. L. Sirisha, UM-DAE CEBS, Mumbai on "The untapped antifungal potential of algal sulfated polysaccharides to prevent Fusarium wilt disease in banana".

Subhojit Sen

Conferences:

- Attended International NextGen Genomics, Biology, Bioinformatics and Technologies (NGBT) Conference Cochin, India, SciGenom Research Foundation SGRF, 2016.
- Attended 7th Conclave of Ramalingaswami Fellows at IBSD, Imphal, 2017.

Invited Talks:

- Invited talk on "Combinatorial mapping of bivalent mononucleosomes genome wide: uncovering chromatin clues to cancer" at NGBT 2016, Sci Genomics, Cochin, 2016.
- Invited talk on"Ambivalent nature of Bivalent nucleosomes: clues leading from Stem cells to Cancer" at IISER Bhopal 2016.
- Invited talk on "Epigenetic study of Environmental influence on Quality of life" at IBSD Imphal, Conclave 2017.
- Invited talk on "The whole world has brown eyes - Understanding epigenetics to crack cancer" at TIFR Hyderabad Colloquium 2017.

Lectures given outside CEBS:

- "Reading DNA - Understanding genome language" delivered at the Science Movement Camp organised in Bhubaneswar, Odisha, 2016.

Collaborations:

- Prof. Hariharan Easwaran, Johns Hopkins Medical Inst., Baltimore, USA.
- Prof. Jacinta D'Souza, UM-DAE CBS on Developing *Chlamydomonas* vectors for epigenetic analyses.

V. L. Sirisha

Invited talks and conferences:

- Invited talk on " Understanding abiotic stress induced cell death physiology and induction of bioactive sulfated polysaccharides from green chlorophyte *Chalmydomonas reinhardtii*" at DAE Biologists and Allied scientists meet at Bhabha Atomic Research Centre (BARC), Mumbai, March 10-11, 2017.
- Poster presentation on "Antioxidant potential of sulphated polysaccharides extracted from Chlamydomonas reinhardtii", at "Society of Biological Chemists, Mumbai Chapter". (Aug 19th).

Collaborations:

- Dr. Sinjan Choudhary, UM DAE CEBS, Mumbai on "*In vitro* biophysical investigation on the inhibition of protein fibrillation and dissolution of fibrils by algal sulfated polysaccharides".
- Dr. Manu Lopus UM DAE CEBS, Mumbai on "Understanding the anticancer potential of sulfated polysaccharides extracted from *C. reinhardtii*".
- Dr. Siddhesh Ghag, UM DAE CEBS, Mumbai on "The untapped antifungal potential of algal sulfated polysaccharides to prevent *Fusarium* wilt disease in banana".
- Dr. Neelu Joshi, Dr. D. Y. Patil University on "Structural characterization and antioxidant potential of bioactive compounds from plants and algae".

8.2 Department of Chemistry

Avinash Kale

Conference attended, Invited talks:

- Given a lecture as an invited speaker ob "Bioinformatics: A logical approach" at D. Y. Patil University School of Biotechnology and Bioinformatics Industry Academia Meet – 2017; Perspectives on Industry Preparedness of students.

Lectures given outside CEBS:

- "Bio Crystallography & Magnetic Resonance Techniques (course code PSBP302)" to Department of Biophysics, University of Mumbai.
- "Elements of Bioinformatics & Chemoinformatics (Course code PSBP403)" to Department of Biophysics University of Mumbai.
- "Bio Crystallography & Magnetic Resonance Techniques to St. Xavier's College, Mumbai.

Collaboration:

- Dr. Abhay Chaudhary and Dr. Meera Ramya, Haffkine Institute, Mumbai, Dr. Soumen Manna, SINP, Kolkata. Dr. Prasenjit Bhaumik and Dr. Supreet Saini, IIT-B on "Larvaecidal toxicity".
- Dr. Supreet Saini and Dr. Sarath Chandra Dantu IIT-B, Dr. Lipi Thukral, IGIB, New Delhi, on "Actin polymerization dynamics / and resolvase".
- Dr. John B. Rafferty, University of Sheffiled, United Kingdom and Dr. Sylvia Ayora Centro Nacional de Biotecnologia–Consejo Superior de Investigaciones Cientificas, Campus Universidad, Autonoma de Madrid, Madrid, Spain on "Resolvases" .

Basir Ahmad

Collaborations:

- Prof. Lisa J Lapidus, Michgan State University, USA.
- Prof. Rizwan H Khan, Aligarh Muslim University, Aligarh.

Neeraj Agarwal

Collaborations:

- Prof. Mohammad Muneer, Chemistry, Aligarh Muslim University, Aligarh on "Organic electronics".
- Dr. Rajesh Kamble, Chemistry, University of Mumbai, Mumbai.
- Dr. Sajeev Chacko, Physics, University of Mumbai, Mumbai on "DFT calculations".
- Dr. Sangita Bose, CEBS, Mumbai on "Devices fabrication such as OLEDs, solar cells, OFETs".
- Dr. Manu Lopus, CEBS Mumbai on "Photodynamic therapy of cancers using BODIPy".

R. V. Hosur

Invited Talks:

- Moving Frontiers of Biological NMR at ICGEB, NMR workshop November 15, 2016.
- Some Recent Developments in NMR Methods and Applications, APNMR meeting at Bangalore, Plenary talk February 16, 2017.

Lectures/Colloquium Given outside CEBS:

- Advances in Protein NMR, Birla College Kalyan, July 2, 2016.
- Convocation address at IIT-Bombay Chemistry Dept, August 13, 2016.
- Lecture at ICGEB, NMR workshop, November 15, 2016.
- APNMR meeting at Bangalore, Plenary talk, February 16, 2017.
- National Science day lecture at AMITY University, Mumbai, February 28, 2017.
- Colloquium at IISER Trivandrum, March 3, 2017.
- Refresher course in Biotechnology, Mumbai University, March 6, 2017.
- NMR inauguration lecture, Karnatak University, March 11, 2017.
- CV Raman memorial Lecture, Karnatak University, March 11, 2017.

Sinjan Chaudhary

Conference and Invited talks:

- Invited talk on "Inhibition of protein fibrillation by small molecules and natural plant products: a search for new generation of combination therapy and phytopharmaceuticals." Bhabha Atomic Research Centre Mumbai, May 03, 2017.
- Invited talk on "Synergistic inhibition of insulin fibrillation byosmolytes: Biophysical investigations." DAE biologists meet 2017, BARC Mumbai.

Collaborations:

- Prof. R.V. Hosur and Dr. Manu Lopus, CEBS, Mumbai on "Effects of Ayurvedic medicines and natural products in inhibition of cancer".
- Dr. Manu Lopus, CEBS, Mumbai on "Biophysical characterization of the interactions of novel designer drugs and natural products with tubulin".

- Prof. R.V. Hosur, CEBS, Mumbai, "Effects of Ayurvedic medicines and natural products in inhibition of α-Synuclein fibrillation".
- Dr. V. L. Sirisha, CEBS, Mumbai, "*In vitro* Biophysical Investigation on the effects of algal sulfated polysaccharides on Inhibition of Protein fibrillation and Dissolution of fibrils".
- Prof. H.S. Misra, Molecular Biology Division, BARC, Mumbai on "Effects of *Cyanobacterial* extract on inhibition of protein aggregation/fibrillation".
- Prof. Nand Kishore, Department of Chemistry, IIT –B, Mumbai on "Unravelling the binding thermodynamics of natural plant products with human serum albumin."

Swapan Ghosh

Invited Lectures Delivered / Symposium attended:

- Delivered an invited talk in the National Symposium on Separation Science, held at IIT, Guwahati, during May 16-18, 2016.
- Delivered invited talk in the Symposium "Recent Advances in Theoretical Chemistry" held at Indian Institute of Science, Bangalore, during July 8-9, 2016.
- Delivered invited talk at the "National Symposium in Chemistry of Chemical Research Society of India" held at North Bengal University, Siliguri, during July 15-17, 2016.
- Delivered invited talk at the "Annual Meeting of Indian Academy of Sciences" held at IISER, Bhopal, during Nov 4-6, 2016.
- Delivered invited talk in the "Theoretical Chemistry Symposium" held at University of Hyderabad, during Dec 15-18, 2016.
- Served as Convener of the Minisymposium on "Computational Materials Science" in the "DAE Solid State Physics Symposium" held at KIIT University, Bhubaneswar, during Dec 26-30, 2016.
- Delivered invited talk in the Minisymposium on "Computational Materials Science" in the "DAE Solid State Physics Symposium" held at KIIT University, Bhubaneswar, during Dec 26-30, 2016.
- Delivered an invited lecture at the "International Conference on Complex Quatum Systems", held at BARC, during Feb 20-23, 2017.
- Delivered an invited Lecture at the International Conference on "Recent Advances in Many Electron Theories (RAMET 2017)", held at Goa, during Feb 9-12, 2017.
- Chaired a Scientific Session in the Symposium on "Modern Trends in Molecular Magnetism", held at IIT, Bombay, during May 18-21, 2016.
- Chaired a Scientific Session in the Symposium on "Ultrafast Spectroscopy 2016", held at BARC, during Nov 24-26, 2016.
- Chaired a Scientific Session at the "Interdisciplinary Symposium on Materials Chemistry" held at BARC during Dec 6-10, 2016.
- Chaired a Scientific Session at the "Theoretical Chemistry Symposium" held at University of Hyderabad, during Dec 15-18, 2016.

- Chaired a Scientific Session at the International Conference on "Recent Advances in Many Electron Theories (RAMET 2017)", held at Goa, during Feb 9-12, 2017.

Sunita Patel

Collaborations:

- Prof. Y. U. Sasidhar, IIT Bombay.
- Prof. K.V.R. Chary, TCIS Hyderabad.

8.3 Department of Mathematics

Anuradha Nebhani

Conference/ Seminar attended:

- Attended Bombay Mathematics Colloquium delivered by Prof. Chandrashekhar Khare held at the Jai Hind College on February 15, 2017.
- Attended the Graduate Students Conference in Algebra, Geometry and Topology held at Temple University, Philadelphia in May 2016.

Balwant Singh

Lecture given outside CEBS:

- Lecture given on "Dimension of an Algebraic Variety" at IISER Bhopal on January 27, 2017.

Swagata Sarkar

Lectures outside CEBS:

- Lecture given on Leray-Serre Spectral Sequence}, Geometry - Topology Seminar, IIT-Bombay, Mumbai, January 2017.

Conference/Workshops attended:

- Attended Workshop on J-holomorphic curves and Gromov-Witten Invariants, held at NISER, Bhubaneswar, July, 2017.
- Attended Topology - Geometry Seminar Series, IIT-Bombay, Mumbai, January - April, 2017.

Collaboration:

- Prof. Samik Basu, Indian Association of Cultivation of Science, Kolkata.
- Prof. Rekha Santhanam, IIT-Bombay, Mumbai.
- Prof. Shilpa Gondhali, BITS-Pilani, Goa Campus.

8.4 Department of Physics

Alpa Dashora

Lectures given outside CEBS:

- Provided hands-on training to Ph.D. student on various fist-principles based band structure codes at Compton Profile Laboratory, Department of Physics, M.L. Sukhadia University, Udaipur (Raj).

Collaboration:

- Prof. D.C. Kothari, Department of Physics, University of Mumbai, Mumbai, Dr. Nainesh Patel, Department of Physics, University of Mumbai, Mumbai, Prof. Antonio Miotello, Dipartimento di Fisica, Università degli Studi di Trento, Italy on "Study of new photocatalytic materials for water splitting and H_2 production using first-principles study".
- Prof. B.L. Ahuja, Departmnet of Physics, M.L.S. University, Udaipur on "Study of charge and spin momnetum density and electronic propeties of materials using Compton spectroscopy and first-principles study".

Ameeya Bhagwat

Lectures Given Outside CEBS:

- Taught a unit on Particle Physics to the University Department of Physics, University of Mumbai (M.Sc. - I) students, 2016.

Collaborations:

- Prof. Xavier Viñas and Prof. Mario Centelles, Department of Physics, University of Barcelona on "Wigner – Kirkwood Mass Formula".
- Prof. Ramon Wyss and Prof. Roberto Liotta, Department of Nuclear Physics, KTH Stockholm on "Wigner – Kirkwood Mass Formula, theories of alpha and cluster emission from heavy and superheavy nuclei".
- Prof. Wasi Haider and Dr. Manjari Sharma, Department of Physics, Aligarh Muslim University on "proton – nucleus scattering process".
- Prof. Peter Schuck, Groupe de Physique Théorique, Institut de Physique Nucléaire (IPN) Orsay, France on "Wigner – Kirkwood Mass Formula".
- Prof. Y. K. Gambhir, Department of Physics, IIT Bombay on "Relativistic mean field theory, superheavy nuclei".
- Prof. Mohini Gupta Manipal Institute of Natural Sciences on "superheavy nuclei".
- Dr. Neelam J. Upadhyay, CEBS and Prof. B. K. Jain (ex NPD, BARC).

Ananda Hota

Conference:

- Poster presentation on "Unifying feedbacks from kpc-scale radio-bubbles to Mpc-scale episodic radio lobes hosted in Spiral galaxies and results from RAD@home" at International Conference "Science for the SKA Generation" held at Hotel Cidade, Goa November 07-11, 2016.

- Oral presentation on"Tracking galaxy evolution through merger & feedback using GMRT and citizen-science - RAD@home"Attended an International Conference "SKA Pathfinders Radio Continuum Surveys 2016" hosted by NCRA-TIFR (Pune) at the International Centre Goa, November 03-05, 2016.
- Attended the National Conference, 35thAnnual Meeting of the Astronomical Society of India (ASI) hosted by Birla Institute of Scientific Research (BISR) at Jaipur, March 6-10, 2017.

Invited talk:

- Invited Talk at the Institute of Physics Bhubaneswar on "First Results from GMRT Observation of new Black-hole Galaxy Systems Discovered by RAD@home citizen-scientists" March 27, 2017.
- Delivered an Invited talk on "How Any BSc/BE Can Do research (#ABCDresearch) using GMRT telescope by joining Citizen-science CollaboratoryRAD@home (#RADatHomeIndia)"at National Institute of Science Education and Research, Bhubaneswar on March 28, 2017.

Lectures given outside CEBS:

- Delivered an Invited lecture on "Radio Astronomy: Any BSc/BE Can Do research using GMRT via RAD@home" at V.G. Vaze College, Mulund, Mumbai on February 16, 2017.
- Delivered nearly 150 hours of on-line interactive e-class lectures on Multi-wavelength Observational Extragalactic Astronomy to the undergraduate students of the nation (a nation-wide Inter-University network of 100+ citizen-scientists of RAD@homeCollaboratory).

Bhooshan Paradkar

Invited talk:

- Invited talk at the Laser Plasma Accelerator workshop held at International Centre for Theoretical Sciences, Bangalore, March 06-17, 2017.

Manojendu Choudhury

Invited talk:

- Invited talk on "Multi-wavelength View of X-ray Universe with ASTROSAT" at Charotar University of Science and Technology, Anand, Gujarat, July, 2016.
- Oral presentation titled "Mass Accretion and Binary Modulation" at international conference on Wide Band Spectral and Timing Studies of Cosmic X-ray Sources, TIFR, Mumbai, January, 2017.

Workshop:

- Participated in Workshop on Data Intensive Science, IUCAA, Pune, February 13-18, 2017.

Lectures given outside CEBS:

- Lectures given to the M.Sc. students at the Dept. of Physics, University of Mumbai, covering two units of the course on Galactic and Extra-galactic Astronomy, which is a part of the M.Sc. Physics curriculum.

Collaboration:

- Prof. A.R. Rao (TIFR), Prof. K P Singh and other colleagues from the CZTI-ASTROSAT team.
- LAXPC-ASTROSAT team comprising of Prof. J S Yadav (TIFR) and colleagues from various institutes.

Neelam Upadhyay

Lectures given outside CEBS:

- Shared M.Sc. Semester-IV elective course on Nuclear Reactions at University Department of Physics, University of Mumbai with Dr. Vivek Parkar from BARC for the duration of December 2016 to May 2017.

Collaboration:

- Dr. Ameeya Bhagwat, CEBS and Dr. B. K. Jain (ex NPD, BARC) on "studying nonlocal effects in scattering processes".

P. Brijesh

Conference/Workshop:

- Attended Laser-Plasma Acceleration Workshop and Discussion Meeting at International Centre for Theoretical Science (ICTS)-Bangalore, March 2017.
- Invited Resource Person and Mentor for the Summer Course in Experimental Physics (SCEP-2016) at Homi Bhabha Centre for Science Education (HBCSE-Mumbai).

R. Nagarajan

Lecture given outside CEBS:

- "Low Temperature and Superconductivity", delivered at Mukesh Patel School of Technology Management and Engineering, NMIMS University, Mumbai, 25th Oct. 2016.

Conference Poster presentations:

- Poster presentation on "Magneto-optical studies in aqueous magnetic fluids" (Chintamani Pai, Vijaykumar B. Varma, Radha S., R. Nagarajan, R. V. Ramanujan at Optofluidics 2016, July 24-27 2016, Beijing, China.
- Poster presentation on "Forward laser scattering studies with aqueous magnetic fluids" (Chintamani Pai, Vijaykumar B. Varma, Radha S., R. Nagarajan, R. V. Ramanujan) at 14th International Conference on Magnetic Fluids, July 4-8, 2016, Yekaterinburg, Russia.

Sangita Bose

Conference /Workshop:

- Deliver a talk on "Vortex Matching studies in superconducting films of NbN with periodic array of holes" at the workshop on "International Meeting on Highly Correlated Systems-IMHCS-2017" at Mahatma Gandhi University, Kerala, India during March 24-26 2017.

Lectures given outside CEBS:

- Lecture on "Science of Light" given at the DST INSPIRE Internship Programme at KIIT University, Bhubaneswar on February 17, 2017.

Collaborations:

- Prof. H. Muthurajan, Nano Science Center, University of Mumbai on "Superconducting properties on Nb-Cu nanocomposites and nano-alloys" and Low temperature electrical properties of a semiconductor bridge igniter".
- Prof. Pratap Raychaudhuri, TIFR on "Probing matching effects in NbN anti-dot array" and "Superconducting properties on Nb-Cu nanocomposites and nano-alloys".
- Dr. Ravi Singh, IISER, Bhopal on Point-contact Andreev Reflections studies in non-centrosymmetric superconductors Re_6Zr.
- Prof. Neeraj Agarwal, CEBS, Mumbai "Organic electronics: Materials for applications to OLEDs, Solar cells".

Sreemoyee Sarkar

Presentation:

- Oral Presentation on "Exploring different phases of neutron star using transport coefficients" at Institute for Nuclear Theory (University of Washington), Seattle, July, 2016.

Collaboration:

- Prof. Rishi Sharma, TIFR, Mumbai on "Physics of Neutron Star".
- Prof. Subrata Pal, Chandrodoy Chattopadhyay, TIFR Mumbai on "Heavy Ion Phenomenology".

Sujit Tandel

Invited talks at international conferences:

- Onset and evolution of octupole collectivity in heavy nuclei, International Workshop on Shapes and Dynamics of Atomic Nuclei: Contemporary Aspects, Sofia, Bulgaria, October 5-7, 2017.
- Role of quantum shell effects in the stability of superheavy nuclei, International Conference on Complex Quantum Systems, Bhabha Atomic Research Centre, Mumbai, India, February 20-23, 2017.
- Nuclear Structure and Stability of the Heaviest Elements, DAE-BRNS National Workshop on Radiochemistry and Applications of Radioisotopes, Mumbai, India, January 16-23, 2017.

- Oblate Deformation and Metastable States in Pt and Hg Isotopes, International Nuclear Physics Conference 2016, Adelaide, Australia, September 11-16, 2016.

Invited lectures at schools:

- Recoil Decay and Isomer Tagging, School on Experimental Techniques in Gamma-Ray Spectroscopy Inter-University Accelerator Centre, New Delhi, India, , April 25-29, 2016.

Conference organization:

- DAE-BRNS Symposium on Nuclear Physics, Thapar University, Patiala, December 20-24, 2017; Coordinator of one-day Orientation Session on Superheavy Element Research on December 19, 2017.

Collaborations:

- Inter-University Accelerator Centre, New Delhi.
- Bhabha Atomic Research Centre, Mumbai.
- Argonne National Laboratory, USA.
- Andhra University, Visakhapatnam.
- University of Massachusetts Lowell, USA.
- University of Manchester, UK.

Tripti Bameta

Conferences and AcademicVisits:

- Invited talk on "Non-additivity of stall forces is closely related to the violation of detailed balance condition in assembly of bio laments or molecular motors" in a Conference on "International Symposium on Computational and Experimental Studies of Microtubule and Microtubule based Motor Proteins", December 14, 2016.

Vijay Singh

Invited talks

- Invited talk on "The Golden Ratio and Centre of Mass" at Nehru Centre, Mumbai on September 17, 2016.
- Invited talk on "Indian Shining: the Saga of the Science Olympiads" at Yeshwant Rao Chavan Centre, Mumbai on September 21, 2016.
- Invited talk on "Why is it imperative for teachers to appreciate Science Education Research"at Workshop for Teachers, Institute for Chemical Technology, Mumbai during September 23-24, 2016.
- Two talks (I) "The Golden Ratio in Physics and Aesthetics" October 18, 2016 (II) "Science Education Research", October 21, 2016 at the Institute for Plasma Research, Gandhinagar.
- Talk on Science Career Options and Mechanics at the UGC HRD Refresher Course for Junior College Teachers Jhunjhunwala College, Ghatkopar, Mumbai, December 19, 2016.

9. Externally funded Research Projects:

Name of the Principal Investigator	Title of the Project	Funding Agency	Duration	Total Project Amount
Dr. Ameeya Bhagwat	Nuclear Structure Near the Limit of Stability	Department of Science and Technology (DST)	3 years 01.05.2015 to 30.04.2018	27,42,000/-
Dr. Sangita Bose	SERB Women Excellence Award	Science and Engineering Research Board (SERB)	3 years 01.07.2014 to 30.06.2017	18,00,000/-
Prof. Sujit Tandel	Low Energy photon spectroscopy and internal conversion studies	Board of Research in Nuclear Sciences (BRNS)	3 years 01.04.2015 to 31.03.2018	24,85,000/-
Dr. Mahendra Patil	Computational studies of synergistic catalysis: Reactivity, mechanism, stereo selectivity and catalyst screening	Science and Engineering Research Board (SERB)	3 years from 01.04.2014 to 31.03.2017	23,00,000/-
Dr. Sinjan Choudhary	Physico-chemical insights into the mode of action of small molecules in the prevention of aggregation/fibrilization of proteins: Quantative aspects	Science and Engineering Research Board (SERB)	3 years 14.07.2014 to 13.07.2017	23,30,000/-
Dr. Neelam Upadhyay	Identification of resonances in reactions of astrophysical interest	Science and Engineering Research Board (SERB)	3 Years 18.01.2017 to 17.01.2018	26,24,400/-

10. Colloquia 2016-2017:

CEBS organises colloquia on Tuesdays at 3.45 pm. on topics of academic interest by reputed speakers, researchers, scientist, etc. to facilitate exchange of ideas. The list of such colloquia held during 2016-17 is given below:

- August 09, 2016: Prof. Mandar Deshmukh, TIFR Mumbai, **"Nanomechanics with graphene drums in the strong coupling regime".**
- August 23, 2016: Prof. Hariharan P. Easwaran, Johns Hopkins Medical Institute, JHU, Baltimore, USA, **"Epigenetic basis of Cancer".**
- August 23, 2016: Prof. Avinash Khare, IISER Pune, **"Basic Constituents of Nature".**
- August 30, 2016: Prof. Sabyasachi Bhattacharya, TIFR, Mumbai, **"Memories of underdevelopment: Higher Education and India's Universities".**
- October 04, 2016: Prof. E. Chandrasekhar, Department of Earth Sciences, IIT-B, **"Wavelets and Fractals: A Geosciences Perspective".**
- October 18, 2016: Prof. Ramaswamy Subramanian, Institute for Stem Cell Biology and Regenerative Medicine (inStem), Bengaluru, **"Of Cockroach and bluefish - the power of observation and discovery in biotechnology".**
- October 25, 2016 : Prof. Dr. Abhay Chowdhary, Prof. & Head, Department of Microbiology, Grant Govt. Medical college & Sir JJ Hospital, Mumbai **" In wonderland of Vaccinology".**
- November 01, 216: Prof. Vijay A. Singh, Raja Ramanna Fellow, Centre for Excellence in Basic Sciences, **"The Golden Ratio, the Centre of Mass, and Aesthetics".**
- November 08, 2016: Dr. Greg Stachowski, Department of Astronomy, Institute of Physics, Pedagogical University of Krakow, Poland, **"Observing a changing sky".**
- November 15, 2016: Dr. Jayant Kayarkar, Consultant, UM-DAE CEBS, **"Emotional Intelligence and Performance".**
- January 10, 2017: Dr. Subhijit Sen, Ramalingaswami Fellow, UM-DAE CEBS, **"Epigenetics and Genome Language: Can a green algae help unravel cancer?"**
- January 24, 2017: Prof. M. S. Raghunathan, UM-DAE CEBS, Mumbai **"What are Bernoulli Numbers?"**

- January 31, 2017: Prof. C. V. S Rao, Scientist Consultant, Fusion Neutronics Laboratory, Institute for Plasma Research (I.P.R),DAE, **"Nuclear Fusion" – The World Scenario and Indian Efforts".**

- February 07, 2017: Dr. Pritha Ray, Imaging Cell Signaling and Therapeutics Lab, ACTREC, Tata Memorial Centre, Navi Mumbai , **"Association of Chemo resistance and Tumor recurrence with Cancer Stem Cells".**

- February 28, 2017: Prof. Chandrashekhar Khare, (UCLA), **"From Ramanujan's *t* Function to Fermat's Theorem".**

- March 07, 2017: Dr. A. K. Tyagi, Chemistry Division, BARC, **"Nuclear waste: A rich source of wealth".**

- March 28, 2017: Dr. Abhijit Majumder, IIT-B, **"Cell and its Surroundings: A Tug-of-War that determines Cell Fate"**.

11. Events

11.1 Meetings:

During the year 2016-2017, the following meetings were held:

A total eight Faculty Meetings were held during 2016-2017
22rd Meeting of the Governing Council: July 13, 2016
23th Meeting of the Governing Council: October 18, 2016
24th Meeting of the Governing Council: January 27, 2017
14th Meeting of the Academic Board : August 31, 2016
15th Meeting of the Academic Board: March 23, 2017

11.2 Academic events:

- **Foundation Day Programme:**

The 9th CEBS Foundation Day lecture was scheduled on September 20, 2016 in the Alkesh Dinesh Mody Auditorium, University of Mumbai, Kalina. Dr Anil Kakodkar, Dr. Sanajay Deshmukh, Dr. Vijay Khole have been invited. Welcome address given by Prof. R. V. Hosur. A speech on Evolution of CEBS was given by Prof. S. M. Chitre. On this occasion "A decade of Progress and Vision for the Future" book was released. Also, Dr. Sudhir Jain's book was released.

- **Public Lecture:**

As a publicly funded teaching-cum-research institute, CEBS has a social responsibility of inculcating a spirit of scientific temper in the masses. Lectures delivered by eminent academicians in a lucid style and at a level that is comprehensible to the average undergraduate student and general public, these lectures help to demystify esoteric scientific concepts and bring the excitement of science. CEBS has been regularly arranging public lectures since its inception. During the year under report, a lecture was arranged in the Marathi Bhasha Bhavan of the Mumbai University on August 16, 2016. Professor Cedric Villani, Directeur, Institut Henri Poincare, France, spoke on "Of Stars, Particles and Eternity".

- **Summer Associate Research Programme**

Summer Associate Research Programme during May 25 to July 20, 2016 (SARP-16) at CEBS. The programme encourages students from remote regions of India to apply for a research experience and throurgh on-line application procedure gives equal-opportunity to students of the nation to get selected to work in CEBS Labs. Six projects were offered by CEBS faculties for SARP-16. Nearly 200 students from all over India applied to the project of their choice and to get selected by the respective guides. Prof. P. C. Agrawal selected Mr. Baibhav Singari from NISER (Bhubaneswar) who worked on the project titled "Study of pulsation in accretion binaries using LAXPC data onboard ASTROSAT". Prof. Srinivas Krishnagopal selected Mr. Varun P. from IISER (Bhupal) who worked on the project titled

"Laser Plasma Acceleration of Particles". Prof. Neeraj Agarwal selected Mr. Ashwin Chaturvedi from IISER (Kolkata) who worked on the project titled "Synthesis of nanoaggregates of aromatic compounds using reprecipitation method ". Prof. M. Hemalatha selected Mr. Rushabh Gala from University of Mumbai who worked on the project titled "Proton-induced nuclear reactions". Prof. Ananda Hota selected six students, through on-line interaction, who had 1-2 week of short term face-to-face research training in his #eAstroLab and thereafter the advanced-level work continued over the interget. Title of the project is "Black-hole-galaxy-cluster co-evolution with the GMRT in SKA-era by e-education, e-project and e-research on India-scale: The RAD@home approach". Students who worked on this are Ms. Lavanya Nemani (Delhi), Mr. Kavil Mehta (Ahmedabad), Mr Ronaldo Laishram (Khangabok, Manipur), Mr Amlana Jyoti Biswal (Kandhamal, Odisha), Mr Piyush Jindal (Ghatsila, Jharkhand), Mr Baibhav Singari (Berhampur, Odisha).

11.3 Students' Activities

The primary aim of education is to foster all round development of a student and to fulfil these objectives, there is a prime need of striking a balance between syllabus, curriculum, and books. They actually complement the academic activities and help the students to develop a well-rounded personality. Recognizing this, CEBS has been actively supporting sporting, educational and cultural activities of its students. Given below are some of the activities of students ending March 2017.

Inter IISER Sports Meet (IISM)

IISM is a competitive sports meet that is open to students from all IISERs, NISER, UM-DAE CEBS, and IISc. Students of CEBS has been participating in IISM for the past two years. Last year, it was held at IISER, Kolkata from December 8 to 13, 2016. This is a keenly held competitive event and our students have been enthusiastically participating in sporting events like cricket, football, volley ball, badminton, athletics etc. Coaching facilities were made available to the students which helped them to improve their overall performance. M. Manush, a student, secured Gold medal in the 1500 meter race and Bronze in 5000 meter race.

ORIS

The art and cultural club of students organise a yearly event called ORIS. Last year, the event was held from March 10 -12, 2017.. This is a non-competitive event and is open to students and staff of CEBS and the Mumbai University. Individual and group activities are encouraged and students express their ideas through the medium of canvas, sketch and other decorations. This event coincides with an exhibition of photographs clicked by students. These are on display for a few days

Events like this not only divert the students from the daily schedule but also refresh the minds by letting them learn new things as well as interacting with each other. This brings together the members of CEBS and helps maintain the unity amongst students, which is very important for the growth and culture of a healthy environment.

Dhwani – Music Club

It is a platform for students to showcase their musical skills. All genres and skill levels can be seen here. This club arranges musical events – both vocal and instrumental. Apart from the annual event titled *Dhwani*, students occasionally organize inter-student events of different musical flavours. Dhwani is sort of the finale and students keenly participate in this event. Efforts are on to involve the Music Department of the University of Mumbai.

Science Club

The students have formed a Science Club, and they have a mission: To change the outlook laymen and students towards science, and to develop a scientific temperament in the present day society.

Eminent and academicians are invited to speak on a topic of their expertise and interact with the students of CEBS. Long-term academically focussed relationship between scientists, in an informal; fun-based atmosphere is an excellent idea for creating awareness of science among students. This program is usually conducted in the evening after classroom teaching sessions, and has been very popular among students and faculty.

Novellus – the Literary Club

Novellus, a latin term for fresh, new and tender, represents the spirit of eternal youth. The Inaugural edition for the year 2013 was released by Dr. Srikumar Banerjee. From them onwards, encouraged by the enthusiastic support from students and faculty, this magazine has become an annual issue. Students and staff contribute anecdotal articles, poems, opinions, features and even photographs. What can be contributed is limited only by imagination!

Other activities include ***Ragnaro***k, the annual sports competition for students of CEBS**, *e-Club***, a club formed by students for promotion of e-games.

Team Novellus

IISM

Music Club

UM-DAE Centre for Excellence in Basic Sciences
Health Centre Building, University of Mumbai
Vidyanagari, Mumbai 400098
Phone: 91-22-26524983; Fax: 91-22-26524982.
Web: www.cbs.ac.in