

International Centre for Theoretical Sciences (ICTS) - A New Initiative in Indian Science

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The idea of the ICTS of the Tata Institute of Fundamental Research, naturally grew out of a strongly felt need in the Indian scientific community to enhance the research and education eco-system of Indian science.

There is a need in India today, to create an institution where researchers from India and from abroad can meet and interact for critical periods of time, in a relaxed and conducive atmosphere. These periods depend on the type of activity at ICTS that can range from rapid response short time workshops to programs lasting many months. Visits to ICTS can even be sabbaticals in which faculty members can bring along their students and post-docs.

The idea is to provide a facility that will enhance the creative process and lend a hand to the solution of some of the profound scientific problems of our times.

As past experience has shown, major breakthroughs do occur when problems are seen in a different light; and at times when there is a heterosis (or hybrid vigour) when different core disciplines are brought to bear on a given problem. This is natural because as we all know, it is the limitation of the human mind that caused a division of scientific activity we call Physics, Chemistry, and Biology! Mathematics is a bit different though it too, in my view, stems from our cognition of the material reality of the world around us. For these reasons, ICTS would like to run parallel programs in different disciplines. Currently there is an enormous amount of work going on at the interface of Physics, Biology, Mathematics and Computer Science in different combinations.

Besides its focus on being a facility to enhance research in the basic sciences, ICTS would like to contribute to the creation of scientific human resources.

We plan to have programs for school and college teachers, facilitate the development of educational material and also employ modern technology in the dissemination of educational material. We are also exploring the idea of a "Math Clinic" where students under some guidance grapple with solutions of mathematical problems from diverse areas of science, technology, finance, health and so on.

ICTS is also aware of the importance of the interface of "pure research" and applied science and technology, and of the importance of discussions of science and technology policy. All these diverse groups can meet and interact at ICTS.

While it is true that ICTS is a science institute, it will also make an effort to integrate science into the larger fabric of human activity and knowledge.

Hence we hope to invite people from the arts and civic society to give talks and to spend time with us and

enrich us.

How ICTS Happened

The genesis of ICTS owes itself to institutions like the Abdus Salam International Centre for Theoretical Physics (ASICTP) in Trieste, the Kavli Institute for Theoretical Physics (KITP) in Santa Barbara and the Newton Institute in Cambridge. Each of these institutions has overlapping but somewhat different missions.

The ICTP was originally created by Salam 45 years ago to help keep developing world scientists and students up-to-date in various areas of Physics and Mathematics.

ICTP also organises high-level research workshops and has a successful diploma program for bright students from developing countries. The KITP and the Newton Institute aim to promote scientific excellence and productivity at the highest level. At KITP, educational and outreach activities also go side by side with the scientific programs.

Scientists from India have been regular visitors to these institutions and they and their students have benefited enormously from their visits. The Indian science community has by now critical numbers in various areas to benefit from, and most importantly also sustain a centre inspired by these institutions, but planned according to its resources and needs.

ICTS Activities Since 2007

Programs:

Even before its permanent campus is ready, the ICTS started functioning from September 2007 and has had a very active start. During this period it has organised 49 programs over 607 program days. About 4000 people participated in these programs and about 1500 were from outside India. 11 more programs are planned for the near future. The programs range over many subjects: Physics, Astrophysics, Cosmology, Mathematics, Computer Science and their many branches. The programs are, till the permanent campus comes up, organised in various institutions across India. A complete list can be found at the ICTS website www.icts.res.in.

Most recently ICTS organised a program on “Scientific Discovery through Intensive Data Exploration”, which brought together experts from diverse areas like Computer Science, High Energy Physics, Astronomy, Bioinformatics, Weather and Climate, to share their expertise on a common platform. During this meeting ICTS organised a panel discussion of “IT Infrastructure in India”. Panellists included members from Academia and Industry.

Public Lectures:

ICTS Public Lectures are an important part of the outreach of ICTS to the civic society. A galaxy of speakers have given public lectures to date.

Juan Maldacena, “Black Holes and the Structure of Space-time”.

Lyman Page, “Observing the Birth of the Universe”.

Joseph Silk, “Dark Matters”.

Marc Kamionkowski, “The Big Rip — A New Fate of the Universe”.

Francois Bouchet, “Oldest Image of the Universe”.

William Phillips, “Time, Einstein and the Coolest Stuff in the Universe”.

During the ICTS Inaugural Event in December 2009, each evening was celebrated with a Public Lecture:

Albert Libchaber, “The Origin of Life — from Geophysics to Biology”.

David Gross, “The Role of Theory in Science”.

Avi Wigderson, “The P versus NP problem — Efficient Computation and the Limits of Human Knowledge”.

Subrahmanyan Chandrasekhar Lecture Series:

ICTS has initiated the “Subrahmanyan Chandrasekhar Lectures” to commemorate the memory of a great physicist and astro-physicist. Eminent academicians delivered these lectures on important new developments in their areas of specialty. The first lecture in any series is aimed at a general scientific audience, while the remaining are aimed at specialists.

Ashoke Sen, “Extremal Black Holes in Strings Theory”.

The second series, “Black Holes — the Harmonic Oscillators of the 21st Century”, was delivered by **Andrew Strominger** in January 2010.

The third series of the lectures, “The Standard Model of Cosmology”, was delivered by **Lyman Page** in April 2010.

Ludwig Faddeev, “What Modern Mathematical Physics should be”.

Subir Sachdev, “The Quantum Phases of Matter”.

The following three Subrahmanyan Chandrasekhar Lectures are planned for the future:

Dam Thanh Son, “Applied String Theory”; *Uriel Frisch and Satya Majumdar, titles to be announced.*

ICTS Campus:

The permanent ICTS campus will come up in North Bangalore by mid 2013. About 14,000 sq m of built up area has been planned for the campus spread over 74,000 sq m of land. This campus will be self-

contained and will have world class facilities.

ICTS Family and Personnel:

Several academic members from various institutions in India are adjunct faculty members of ICTS. There is a large program committee of very active members who oversee the program proposals. The adjunct faculty, the program committee, and the future core faculty of ICTS will serve to catalyse a productive academic atmosphere. All this information can be found on the ICTS website.

How ICTS is Engaging with the International Community?

(1). International program organisers and participants:

Out of the 49 programs ICTS has organised, 21 programs were co-organised by the scientists affiliated to universities and research institutes outside India.

Over 1450 people from outside of India participated in these programs.

(2). ICTS provides a platform to host various collaborative programs and meetings:

The “Asian Winter Schools in Particles, Strings and Cosmology” are jointly organised every year by China, India, Japan and Korea. The idea is to create a Les Houches type of school for the Asian Region. The 4th school held in January 2010 was held in India. The previous schools were held in Korea, Japan and China.

The School covered various areas in String Theory, High Energy Physics and Cosmology. The audience consisted of senior graduate students as well as practicing researchers whose primary interest is in String Theory. The lectures covered a selection of basic areas as well as advanced topics at the forefront of current research. Other joint programs that are planned are the 2011 “Asian School on Lattice Field Theory”, the 2012 Number Theory Instructional Workshop and the “Pan-Asian Number Theory Conference”.

Future Engagements:

Once the ICTS campus is ready by mid 2013, it will indeed be possible to have a variety of thoughts on collaborations with similar and other institutions around the world. One idea is to have exchange visits by faculty and post-doctoral researchers. The ICTS will be participating in an initiative called “Mathematics of Planet Earth” during the year 2013. Programs in various areas of Earth and Biological sciences are already being planned in conjunction with various institutions in the world. ICTS is also planning Math programs during that year, primarily aimed at senior high school and college students, as part of its outreach and educational programs.

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