

Information and Announcements



The Tata Institute of Fundamental Research

The Tata Institute of Fundamental Research (TIFR) was founded by the Cambridge-trained theoretical physicist Homi Bhabha, who returned to India in 1939. Bhabha wanted to establish a premier scientific research institution in the country of his birth, and in pursuit of this aim he wrote a letter to J R D Tata in 1943, detailing his vision for such an Institute and requesting support from the house of Tatas.

In the letter, Bhabha wrote “The scheme I am now submitting to you is but an embryo from which I hope to build up in the course of time a school of physics comparable with the best anywhere.” Support was forthcoming, and the Tata Institute started functioning in Bangalore in 1945. Since 1962, it is located at its permanent sea-front campus in Navy Nagar, Mumbai and is now funded primarily by the Department of Atomic Energy.

The initial areas of research were those in which Homi Bhabha had an active interest: cosmic ray physics and high energy physics, theoretical physics and mathematics. These activities then expanded to include fields such as nuclear physics, condensed matter physics, computer science and geophysics, and later molecular biology, radio astronomy and science education. While these groups were all part of the School of Physics, a separate School of Mathematics was started around 1950. New research areas of topical importance have been added at intervals since then.

TIFR has graduate course programmes, leading to the Ph.D. degree, in its various research disciplines. Students at M.Sc. level, or its equivalent, can apply to become research scholars. Those who are selected embark on a training programme, initially carried out through lecture courses, reading assignments and projects. Subsequently they begin working on an original research project under the guidance of an Institute member, culminating in the submission of a Ph.D. degree to the University of Bombay.



The School of Physics also offers a six-week visiting students' research programme (VSRP) in summer, to provide an opportunity for pre-M.Sc. students to participate in research activities at the Institute. A few students who perform exceptionally well in this programme are selected to join the Institute as research scholars on completion of their master's degree. A different summer programme is offered by the molecular biology group, and a large number of B. Tech. students attached to various institutions also carry out their engineering projects at TIFR.

Currently, research at the Tata Institute concentrates on a wide variety of frontier areas in physics, mathematics, computer science and molecular biology.

Experimental studies in astronomy and astrophysics are carried out using sophisticated instruments including ground-based, balloon-flown and satellite-borne telescopes. The force of gravitation is studied in precision experiments to determine its properties accurately and determine whether new and so far undiscovered fundamental forces exist.

In the field of condensed matter physics, properties of matter under extreme condi-



tions are investigated, including the fascinating forms of behaviour described as 'superfluidity' and 'superconductivity'. Such properties of matter are exciting both because they offer a window to the fundamental laws of nature, and because they are useful in developing advanced technologies which can change the way we live. Exciting breakthroughs have been made at TIFR in this area, including the discovery of a completely new class of superconductors ('borocarbides') and the discovery of re-entrant flux melting in certain superconducting materials. On the theoretical side, the discovery of a class of statistical models displaying a new kind of behaviour called 'self-organized criticality' is one of many important conceptual developments at TIFR.

Heavy-ion beams are produced in an accelerator called the Pelletron, and their interactions, which create exotic nuclei, permit the study of highly excited nuclear matter. Over the last two decades, major discoveries have been made at TIFR in the study of the dynamics of molecular collisions using sophisticated spectrometers.

The physics of elementary particles plays a decisive role in determining the most fundamental laws of nature, in terms of which all interactions can in principle be explained. In this area, scientists at TIFR are engaged in major ongoing collaborations at the two largest particle accelerators in the world: at CERN in Geneva, and at Fermilab in the U.S.A. The collaboration at Fermilab was involved in the recent discovery of a crucial fundamental particle, the 'top' quark.

Chemical physicists at TIFR use sophisticated lasers and other instruments to study biochemical reactions, the conductivity of polymers, and exotic phenomena such as 'electrobioluminescence'. Another frontline experimental technique is Nuclear Magnetic Resonance (NMR), used to probe structure formation and interaction of biological molecules.

Single-celled organisms like yeast and bacteria, and multicellular animals and plants, are investigated in the molecular biology laboratories of TIFR. The focus of their approach is on genetic mechanisms. Neurobiologists at TIFR are especially interested in genetics of the brain and behaviour.

Research into the foundations of quantum mechanics is one important theoretical activity. In theoretical high-energy and nuclear physics, the emphasis is on the description of elementary particle interactions, and on potential unified theories of all interactions like 'string theory'. The recent work of TIFR scientists on the microscopic



description of black holes has played a key role in resolving a longstanding issue.

Pure mathematicians carry out research in a variety of areas including algebra, geometry, group theory, measure theory, ergodic theory and number theory. Their work has led to many important new theorems, concepts, techniques and conjectures which have served to vastly enrich the discipline. One such landmark achievement at TIFR was the 'Narasimhan-Seshadri theorem' on vector bundles, proved in the sixties. Another class of important theorems proved here concerns the properties of discrete subgroups of Lie groups. The School of Mathematics also brings out publications based on lecture courses delivered by eminent mathematicians at the Institute.

Additionally, studies on combinatorial mathematics, graph theory and more applied areas of mathematics with direct application to physics and engineering are carried out at the TIFR Centre in Bangalore.

Research in computer science seeks to address basic issues, some practical and others highly abstract. Speech recognition, script recognition and speech synthesis are some of the areas where the work being done is likely to have immediate applications, while on the other side formal methods are applied to the study of computational geometry, the design of programming languages, computer architecture and parallel processing.

Three National Centres with area-specific research goals are operated by the Tata Institute. The Homi Bhabha Centre for Science Education, in Mumbai, works on curriculum development in science and mathematics, promotion of excellence amongst students, and the popularisation of science. The National Centre for Radio Astronomy, near Pune, has constructed the Giant Metrewave Radio Telescope, the world's most powerful telescope for radio astronomical research at metre wavelengths. The National Centre for Biological Sciences, in Bangalore, focuses on the study of large molecules and genetics. Interactions of large organic molecules and information storage and retrieval in biological systems are among the many topics of biological research to which this Centre is dedicated.

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Workshop on Vertebrate Reproduction

A workshop on 'Vertebrate Reproduction' sponsored by the DST is to be held at Karnatak University, Dharwad from 29th December 1997 to 12th January 1998. Topics range from the basics to the molecular aspects of reproductive biology. For further details contact (on or before September 15, 1997):

S K Saidapur, Professor of Zoology, Karnatak University, Dharwad 580 003
Fax: 0836-348047.

Conference on Graph Connections

A conference on 'Graph Connections' will be held from 28th to 31st January 1998 in the Cochin University. Combinatorics, Graph Algorithms, Applications to Coding Theory and Automata Theory are some of the topics covered. For further details contact:

A Vijaykumar, Convenor, Conference on Graph Connections, Department of Mathematics, Cochin University of Science and Technology, Cochin 682 022.
Phone: 0484-559 518, 555288, Fax:0484-532495, email:kpj@cochin.ernet.in

Science and Technology in Ancient India

Institute for Oriental Study, Thane is conducting a seminar on 'Science and Technology in Ancient India.' It will be held at Thorale Bajirao Peshawe Sabhagriha College Campus, Thane on 25th and 26th April 1998. For further details contact:

"Shivashakti", Dr. Badekar's Hospital, Naupada, Thane 400 602.
Phone: 542 1438, 542 3260; Fax: 544 2525

