“The key to national prosperity, apart from the spirit of the people, lies, in the modern age, in the effective combination of three factors, technology, raw material and capital, of which the first is perhaps the most important, since the creation and adoption of new scientific techniques can, in fact, make up for a deficiency in natural resources, and reduce the demands on capital. But technology can only grow out of a study of science and its applications.”

Opening statement of the Government of India's Scientific Policy Resolution, 1958, of which Homi Bhabha was one of the chief architects.

TATA INSTITUTE OF FUNDAMENTAL RESEARCH

“I sincerely believe that this Institute can make a great contribution to the scientific knowledge of mankind…
You may perhaps feel that advanced physics, mathematics, astrophysics are particularly abstract subjects, research in which is unlikely to produce material or practical results within a reasonable period of time.
I should, however, like to point out that most of the great practical advances in science, and, therefore, in industry, have had their origins in fundamental research, without which they would have been impossible or would have been long delayed.”

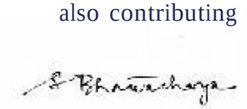
Excerpt from J.R.D. Tata’s letter to an industrialist friend, seeking support for the TIFR venture in 1945.

Text conceived by Indira Chowdhury, Uma Mahadevan, Spenta R. Wadia, TIFR.
Contributions by Archives, Photography and Public Relations, TIFR.
Photography by Nrupen Madhvani.
Designed and Printed by Anisha Heble, Ka Designs.
Front Cover - Bust of Homi Bhabha by B Vithal
and *The Dead and the Dying* by Krishen Khanna, TIFR Collection.

Painting in White, V.S. Gaitonde, TIFR Collection
On facing page *Ragmala,* M.F. Hussain, TIFR Collection

The Tata Institute of Fundamental Research, which now enters the seventh decade of its existence, has grown to become one of the premier research institutions in the country. Founded as a national centre for the study of nuclear science and mathematics, the institute has, over the decades, fulfilled its mission of producing internationally acclaimed basic research, with its activity spanning all branches of natural and mathematical sciences as well as science education. In addition, it has been the birthplace of numerous initiatives and institutions that are now engaged in frontier activities of applied sciences and technology around the country. TIFR has also played a key role in nurturing young scientists, especially those with exceptional promise, as well as in forming a core knowledge base in science education. The institute has remained committed to the pursuit of excellence, global engagement, and responsible governance. As envisioned by its founders, TIFR has emerged as a national resource and a symbol of modern India.

As we enter the new century and the new millennium, rapid changes are taking place in the country and around the world. Exciting advances in modern technology, many of these fuelled by an equally brisk advancement in the basic sciences, have brought new challenges. TIFR remains fully engaged in meeting these challenges through research in the basic sciences, thereby not only bringing prestige to the nation but also contributing to the material well-being of its people.



S. Bhattacharya
Director, TIFR

TATA INSTITUTE OF FUNDAMENTAL RESEARCH (TIFR)

TIFR, MUMBAI CAMPUS

The Tata Institute of Fundamental Research is equipped with a fully computerized library, large central workshop, in-house low temperature facility, and an auditorium with a seating capacity of over 1000. The institute is also supported by a quality technical services group and an able administration.

The main campus houses one of the finest collections of contemporary Indian art.

- School of Mathematics
- School of Natural Sciences
  - Department of Theoretical Physics
  - Department of High Energy Physics
  - Department of Condensed Matter Physics and Materials Science
  - Department of Nuclear and Atomic Physics
  - Department of Chemical Sciences
  - Department of Astronomy and Astrophysics
  - Department of Biological Sciences
- School of Technology and Computer Science

TIFR CENTRES

- National Centre for Radio Astrophysics (NCRA) Pune
- National Centre for Biological Sciences (NCBS) Bangalore
- Homi Bhabha Centre for Science Education (HBCSE) Mankhurd, Mumbai

TIFR FIELD STATIONS AND CAMPUSES

- Cosmic Ray Laboratory (CRL), Ooty
- Radio Astronomy Centre (RAC), Ooty
- National Balloon Facility Hyderabad
- Centre for Applicable Mathematics, Bangalore
- Gravitation Laboratory Gouribidnur
- Giant Metre-Wave Radio Telescope (GMRT), Khodad
- High Energy Gamma Ray Observatory, Panchmarhi
- Centre for Computational Mathematics, Pune

> “The Institute's task will never end, for the frontiers of knowledge will always lie ahead. A relentless pursuit of excellence has characterized and indeed made possible the Institute’s achievements, progress and international recognition. May that spirit, instilled in all those who worked with Homi Bhabha, be ever maintained and inspire in the years to come even those to whom he will be but a legend.”
>
> JRD Tata, Foreword to Silver Jubilee Report of TIFR, 1970.

HISTORY

1 June 1945	TIFR starts functioning at the Cosmic Ray Research Unit on the campus of the Indian Institute of Science, Bangalore, with support from the Sir Dorabji Tata Trust.
19 December 1945	TIFR inaugurated at Kenilworth, a bungalow on Pedder Road, Bombay, by Sir John Colville, then Governor of Bombay.
15 August 1947	India gains independence from British Rule.
1948	Atomic Energy Commission (AEC) of the Government of India set up, under the Chairmanship of Dr Homi Bhabha.
1949	As TIFR grows, it shifts again, to Old Yacht Club Building (former home of Royal Bombay Yacht Club) near Gateway of India. Initially, research was carried out in areas in which Dr Bhabha had a direct interest: Cosmic Rays and High Energy Physics, Theoretical Physics and Mathematics.
1953	Nuclear, Electron Magnetism Group formed.
1954-62	Institute's present main campus developed on 15 acres of sea-front land in Colaba, South Bombay.
1954	Work begins in Computer Science and Technology.
1955-56	Government of India signs tripartite agreement with the Government of Bombay Province and the Sir Dorabji Tata Trust.
4 March 1958	Scientific Policy Resolution placed before Parliament by Prime Minister Jawaharlal Nehru.
15 January 1962	TIFR main campus buildings formally inaugurated by Prime Minister Jawaharlal Nehru.
1962	Molecular Biology group formed.
1963	Radio Astronomy group formed.
1964	Basic Dental Research unit set up.
mid 1960s	Low Temperature Physics and Semiconductor Groups formed.
1966	Tragic loss of Dr Bhabha in an air crash. Professor M.G.K. Menon becomes Director of the Institute
1974	Homi Bhabha Centre for Science and Education founded with a grant from the Sir Dorabji Tata Trust.
1975	Professor B.V. Sreekantan becomes Director of the Institute.
1987	Professor V. Singh becomes Director of the Institute.
1989	National Centre for Radio Astrophysics (NCRA) moves to Pune.
1990	National Centre for Biological Sciences (NCBS) begins work at Bangalore.
1997	Professor S.S. Jha becomes Director of the Institute.
2002	Professor S. Bhattacharya becomes Director of the Institute.
2003	TIFR attains "Deemed University" status.

Abstract, V.S. Gaitonde, TIFR Collection

Homi Bhabha, the man who primarily set up TIFR, is remembered by those who knew him as an extraordinary man, a distinguished scientist, a deeply cultured person and an able administrator. In realizing his vision of the Institute, he took bold steps to attract talented people and gave them the freedom to pursue their research activities.

Initially, research was carried out in areas in which Dr Bhabha had a direct interest: Cosmic Rays and High Energy Physics, Theoretical Physics and Mathematics.

Promising young scholars were recruited, and by specialising in various fields, they gradually expanded the range and the depth of the Institute's activities. This resulted in the creation of new groups devoted to Nuclear Physics, Condensed Matter Physics, Astronomy and Astrophysics, Computer Science and Geophysics, and, later, Chemical Physics, Molecular Biology, Radio Astronomy and Science Education.

RESEARCH

SCHOOL OF MATHEMATICS

Mathematics is among the earliest disciplines in the history of mankind; at TIFR too it has been pursued from its very inception.

The work of the School of Mathematics has led to a variety of important new theorems, concepts, techniques and conjectures that have enriched the discipline. In addition to its research activities, the School and its members are actively engaged in advanced training in mathematics through summer schools for university teachers and young students, and through interaction with universities.

Areas of research in pure mathematics at the Mumbai campus include Number Theory, Algebraic Geometry, Lie Groups, Algebra and Ergodic Theory. Applicable mathematics is pursued at the Bangalore Centre, particularly the study of Partial Differential Equations.

From 1956 on, the International Mathematical Union instituted an International Colloquium at TIFR. Held every 4 years, the colloquium is a major international event where important results and discoveries are presented in areas of research in which the School of Mathematics has made significant contributions.

SCHOOL OF NATURAL SCIENCES

Department of Theoretical Physics

Theoretical Physics is among the first research areas pursued at TIFR. Physics deals with the properties of matter and its complex manifestations.

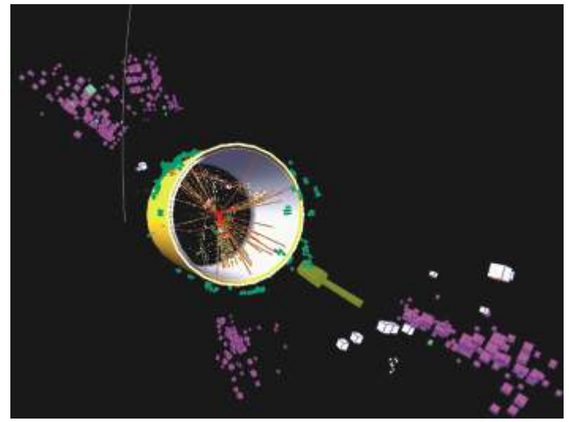
Elementary particle physics deals with the fundamental theory of matter at very short distances. Its questions relate to the elementary constituents of matter and the forces between them. These basic governing laws of nature and their future completion (in String Theory) will provide a theory of the universe from the shortest distances and earliest times to the present vastness and age of the cosmos. Theoretical physicists at TIFR are involved in this fundamental quest.

However, the progression from basic laws to their manifestation in the world we see around us (“the beauty of the earth, the paragon of animals”) is another fundamental quest in physics. When large numbers of particles are involved in any phenomena, the effective laws of nature governing those phenomena need to be understood and formulated. This understanding and discovery is as fundamental as the discovery of the fundamental laws that govern elementary particles. TIFR theorists are also involved in this search.

Department of High Energy Physics

Reflecting the international nature of science, the Department of High Energy Physics continues the early tradition of experimental research in Cosmic Ray Physics at the Institute, actively participating in large collaborative experiments involving scientific organisations from various countries. The first deep underground experiments were performed in collaboration with Japanese scientists. Further collaborations include those with the CERN (European Laboratory for Particle Physics) in Geneva, Fermilab at the University of Chicago, and KEK, Japan. An India-based Neutrino Observatory is also being planned.

The National Balloon Facility, Hyderabad, has become a major centre for scientific ballooning and exports balloons to various agencies in technologically advanced countries.



Department of Nuclear and Atomic Physics

Research in nuclear physics started in the late fifties with a small group, which became the Department of Nuclear and Atomic Physics. The department is now a leading centre of nuclear research in the country.

Research in atomic and molecular sciences has been given a major thrust in the last few years. A heavy-ion accelerator, the Pelletron, installed on the Mumbai campus in the early nineties, has enabled investigations of the properties of nuclear matter at high excitation energies and angular momenta. A superconducting linear accelerator has been developed to boost the energies of particles available from the pelletron, to enhance the access to the nuclear landscape. This facility is run in collaboration with BARC and is used by a number of research institutions and university departments. Ultrashort (femtosecond) lasers, producing very high peak powers, are being used to explosively ionize matter and study its behavior under extreme conditions.

Seagulls and Sail, J.A. Sabawala, TIFR Collection

Department of Condensed Matter Physics and Materials Science

The study of the magnetic properties of solids begun in the early fifties subsequently led to the formation of the Department of Condensed Matter Physics and Materials Science.

Areas of research include studies in magnetism, superconductivity, semiconductor physics, thin films and nanomaterials.

The discovery of borocarbides, a new type of high-temperature superconductor, has had an international impact. Novel optoelectronic devices based on semiconductors have been designed and laser techniques have been used to fabricate high quality superconducting thin films.

Department of Chemical Sciences

The study of the magnetic properties of molecules, atoms and nuclei, begun in the early fifties in TIFR, was the genesis of the present Department of Chemical Sciences. Chemical sciences attempt to understand and manipulate the world around us by studying the structure and the dynamics of the molecules that constitute it. Chemistry has emerged as the major hub linking the laws, concepts and tools of physical sciences to the world of new biology and novel materials. The department is at the forefront of these interdisciplinary activities.

Researchers in the department are probing the structures of nucleic acids and proteins, the dynamics of protein folding and misfolding, the chemical basis of neuronal communication, the various biochemical pathways in living cells and the role of metal atoms in biological structures. They are also studying smaller molecules to understand the formation of hydrogen bonds and free radicals, and the routes towards synthesizing better electro-optic and bio-mimetic materials.

The institute is a leader in state-of-the-art NMR investigations. The National Facility for High Field NMR is extensively used by the drug industry and by other laboratories. A number of sophisticated optical instruments, such as a time-correlated-single photon-counting instrument, a multiphoton microscope and a fluorescence correlation spectrometer have been constructed in the department and also attract many external users.

Department of Astronomy and Astrophysics

The Department of Astronomy and Astrophysics at Mumbai, which began in the late sixties, carries out experimental studies over a wide range of wave lengths in the electro-magnetic spectrum. Infrared and optical wavelengths probe the dynamics of galaxies and star forming regions. X-ray and gamma rays shed light on black hole and neutron star binaries and on the nuclei of active galaxies.

The theorists study a variety of topics in astrophysics. Accretion disks around black holes and neutron stars, gravitational collapse in general relativity, gravitational lensing, neutron stars, pulsars, supernovae and the closer to home star, the sun.

Members of the department are actively involved in designing and building instruments for the first Indian multi-wavelength astronomy satellite (ASTROSAT), which will probe, among other things, the physics of black holes, which are among the most exotic predictions of Einstein's general theory of relativity.

Reclining Nude, M.D. Pandya, TIFR Collection

Department of Biological Sciences

In the early sixties, TIFR had already recognized the value of establishing a basic biology group in an Institute largely devoted to Physics and Mathematics. The group studied processes fundamental to the life sciences - the mechanisms of recombination, gene regulation and protein structure. This early success helped catalyse the growth of molecular biology in other research departments in the country. As the group grew in size, in the eighties and nineties, the areas of research diversified, although an underlying theme remained the use of genetics to dissect complex cellular processes. Currently, the group uses a variety of model organisms to study mechanisms underlying brain function and development, and the major determinants of parasitic infections.

School of Technology and Computer Science

TIFR pioneered computing in India by designing the nation's first computer, TIFRAC. Subsequent work at the institute on software development led to the formation of the National Centre for Software Technology (NCST), which is now a part of CDAC.

The importance of research in computer sciences and emerging technologies, led to the establishment of the School of Technology and Computer Science in the late 1990s.

Computer scientists from TIFR have also played an influential role in setting up computer-related institutions such as the Centre for the Development of Telematics (CDoT) and the Computer Maintenance Corporation (CMC).

NATIONAL CENTRE FOR RADIO ASTROPHYSICS (NCRA)

www.ncra.tifr.res.in

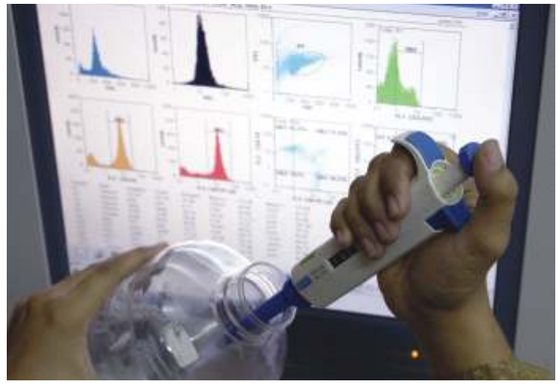
Areas of research include structure formation in the universe, millisecond pulsars, and the design and construction of radio telescopes including the control of large antennas.

NCRA, which is based in Pune, operates the cylindrical radio telescope at Ooty and also the Giant Metrewave Radio Telescope (GMRT) at Khodad near Narayangaon, the biggest of its kind in this range of wavelength. The GMRT is being used to investigate the epoch of structure-formation in the universe and to study millisecond pulsars. The telescope is used for observations both by Indian scientists and by international research groups.

NATIONAL CENTRE FOR BIOLOGICAL SCIENCES (NCBS)

www.ncbs.res.in

Modern biology is guided by experimentation and interaction with the physical sciences on the one hand, and the medical and biotechnological fields on the other. The NCBS was established in a new campus in 1991 with a view to grow and expand efforts in these directions. The faculty at the centre are engaged in research ranging from examining nanoscale interactions in cells to systems biology and behavior. The centre supports an active teaching programme with a large number of workshops and courses with international participation.



HOMI BHABHA CENTRE FOR SCIENCE EDUCATION (HBCSE)

www.hbcse.tifr.res.in

The Homi Bhabha Centre for Science Education is involved in curriculum development, promotion of excellence in science and mathematics education and the popularisation of science.

HBCSE gives special emphasis to the problems of the underprivileged. The centre has contributed significantly to textbook writing at national and state levels; has carried out extensive fieldwork in rural, semi-urban and urban areas; and has a strong collaborative programme with several national networks.

Over the years HBCSE has also become a highly successful training centre for young students from India, chosen by the Government of India to participate in International Olympiads in mathematics, physics, astronomy, chemistry and biology.

GRADUATE STUDIES

The training of young scientists has always been considered an integral part of the academic activity at TIFR.

TIFR graduate students (working towards their PhD degree), have earned a world-wide reputation for their thorough grounding and research skills, which enables them to work in leading centres of research, both in India and abroad.

The institute also runs a well known Visiting Students Research Programme (VSRP) of 6 weeks duration every summer through which undergraduates experience the excitement of research.

The Institute has been awarded “Deemed University” status since June 2003.

Infrastructure and Facilities

TIFR has a fully computerized library that stocks more than 1,20,000 volumes, and subscribes to over 700 national and international research journals.

The large Central Workshop has specialized instrumentation facilities for high-precision computer-controlled design and fabrication of scientific devices.

The in-house Low Temperature Facility produces liquid helium and nitrogen for use in experiments.

In addition, the institute has a well-equipped auditorium with a seating capacity of over 1000.

The Technical Services Group and the Administration facilitate the smooth running of the Institute.

LOOKING AHEAD

As an institute of basic research, TIFR is unique not only in post-Independence India but also in the entire developing world. Over the decades, its scientists and mathematicians have made many fundamental contributions to the development of knowledge. The institute is regarded as a world centre for fundamental research.

TIFR has also contributed to nation building in many ways. It has been the cradle of the nation’s atomic energy programme; it has also been the birthplace of several national institutions and initiatives, including the NCST, ECIL, SAMEER, CMC and CDoT. Through the nurturing of bright young scientists, research in science education, and active public outreach, the institute has played an important role in building the nation’s scientific and technical base.

Ever since its inception, the nucleus of the academic community at TIFR has always drawn eminent scientists from all over the world. Students and faculty at TIFR have therefore always had the opportunity of interacting with the best minds in the fundamental sciences and in mathematics.

Similarly, whether by leading a host of departments, laboratories and institutes across the country and abroad, or by serving on policy-making bodies and academies, TIFR scientists continue to play a vital role in the development of other institutions, both in India and across the world.

“…It is in meeting (these scientists) and finding out what they have been doing, that I have felt so hopeful, so optimistic about the future of science in India.”

Jawaharlal Nehru, inauguration of TIFR buildings, 15 January 1962.

Michael Atiyah

Edward Witten, David Gross and Stephen Hawking.

Visitors to the institute include Nobel Laureates, Fields Medallists and other distinguished scientists.

James Watson with Obaid Siddiqui.

“If a country neglects basic research it is doomed to be always a follower and not a leader, and it will lose its most talented young scientists who will go elsewhere. Healthy science is like a healthy tree: you cannot destroy the roots and hope that the branches will flourish.”

David Gross, 2004 Nobel Laureate in Physics.

TATA INSTITUTE OF FUNDAMENTAL RESEARCH (TIFR)
Colaba, Mumbai 400 005, India Tel: 91 22 22804545 Fax: 91 22 22804610 / 11 Web: www.tifr.res.in