



# Indian Institute of Astrophysics Bangalore 560034

The Indian Institute of Astrophysics (IIA) traces its origin to a small private observatory during 1786 at Madras (Chennai), which led to the establishment of the Solar Observatory in 1899 at Kodaikanal. In 1971, the Kodaikanal Observatory was made into an autonomous institution under the Department of Science & Technology, Government of India. With a rich history of over 200 years, IIA is a premier institute in the country devoted to basic research, instrumentation and training in astronomy, astrophysics and related physical sciences.



*The Indian Institute of Astrophysics, Bangalore.*

## Research Programmes:

**Sun and the Solar System** - Solar activity, sunspots, prominences, solar chromosphere, comets, asteroids, eclipse observations, radio observations of the solar corona.

**Stellar Physics** - Formation and evolution of stars, chemical abundance of elements, planetary nebulae, planetary rings, stellar atmospheres, star clusters, stellar variability, binary stars, novae, supernovae, brown dwarfs, galactic structure, interstellar dust.

**Extragalactic Astronomy** - Star formation in galaxies, clusters of galaxies, active-galactic nuclei, quasars, gamma-ray bursts.

**Theoretical Astrophysics and related Physics** – Solar and stellar physics, nucleosynthesis in stars, radiative processes and magneto-hydrodynamics in astrophysical objects, compact stars and accretion disks, interstellar medium, structure of neutron stars, black hole physics, structure and dynamics of galaxies and star clusters,

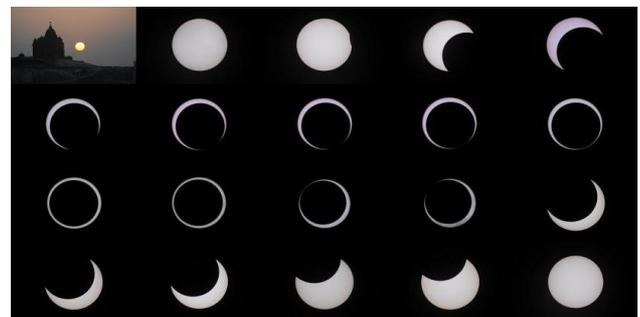
general theory of relativity, cosmology, astro-particle physics, atomic and molecular physics.

## Facilities:

**Kodaikanal Observatory:** This Observatory has been the principal center of activity in observational solar physics, for over a century. At present, the main facility is the solar tower tunnel telescope fitted with a spectrograph, which is in regular use since 1962; a spectro-polarimeter has also been added. This observatory has a unique collection of the Sun's photographic images archived over the last hundred years. These images are now being digitized to study the finer details of the Sun, Sun-weather pattern etc. Daily observations of the solar photosphere and chromosphere are being obtained as a part of the synoptic study. It was in this Observatory, John Evershed discovered the radial motion in sunspots, now known as the Evershed effect, in 1909.



*The solar tower tunnel telescope at the Kodaikanal observatory.*



*The 2010 annular solar eclipse observed by the IIA astronomers from Kanyakumari, India.*

**Vainu Bappu Observatory (VBO):** Situated at Kavalur, this Observatory has telescopes of various sizes – 38 cm, 50 cm, 75 cm, 102 cm, and 234 cm Vainu Bappu Telescope (VBT). The VBT is equipped with different focal plane instruments: medium and high resolution spectrographs such as Fiber-fed Echelle spectrograph, OMR spectrograph, and SILFID spectrograph, optical imager, and speckle interferometer. The 102 cm telescope is equipped with Echelle spectrograph, UAGS, polarimeter and imager. Among the major discoveries from VBO are: i) atmosphere around Jupiter's satellite Ganymede in 1972; ii) rings around Uranus in 1977; and iii) six asteroids.

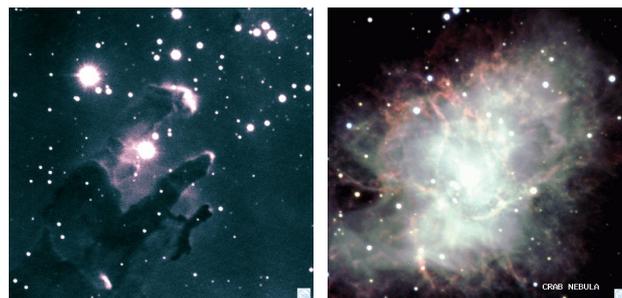


The 234 cm Vainu Bappu Telescope (VBT), Kavalur (left) and enhanced pictures of Comet 9P / Tempel1 obtained with the VBT (right).

**Indian Astronomical Observatory (IAO):** During the last decade, the Institute has developed the IAO, at Hanle in the trans-Himalayan region at an altitude of about 4430 m above the mean sea level, which is the highest of its kind in the world. It has 2 m Himalayan Chandra Telescope (HCT) equipped with a faint object spectrograph camera, optical and infra-red imagers. This telescope is operated remotely from the Center for Research and Education in Science and Technology (CREST) at Hosakote near Bangalore, via a dedicated satellite link. A recent addition is the High Altitude Gamma Ray (HAGAR) array comprising of seven telescopes, each with seven mirrors, spanning a total area of 4.4 sq m.



The Himalayan Chandra Telescope (HCT), Hanle.



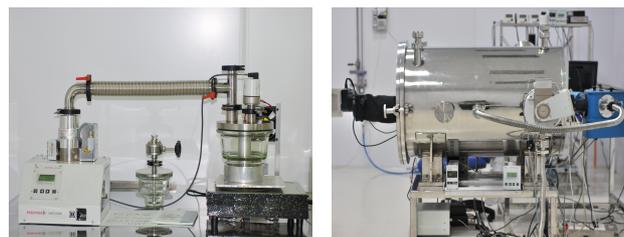
Pictures of the Eagle Nebula (left) and the Crab Nebula, a supernova remnant (right), obtained with the HCT.



The High Altitude Gamma Ray (HAGAR) array, Hanle.

**CREST campus:** The campus houses the control room for the remote operations of the 2 m Himalayan Chandra Telescope (HCT) at the IAO, Hanle and the HCT data archive. Laboratories for research and development in Laser physics are also housed in this campus. It is also planned to set up a Center for Advanced Astronomical Instrumentation.

**MGK Menon Laboratory for Space Sciences:** Situated at the CREST campus, this laboratory has all the critical facilities for integration, characterization and calibration of space optics, contamination monitoring, test and calibration of ultraviolet as well as visible large area detectors, vacuum facilities, etc. It has a state of the art ultra-clean room (class 300000 to 100) meeting ISO standards and on par with existing similar international facilities.

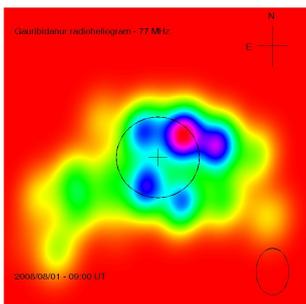


Space payload testing facilities at the MGK Menon laboratory.

**Gauribidanur Radio Observatory:** Operated jointly with the Raman Research Institute, Bangalore, the Observatory has a variety of radio telescopes: a low frequency antenna array functioning at 34.5 MHz for observations of radio emission from Sun, pulsars and other galactic, extra-galactic sources; a radio heliograph operating in the frequency range 40-120 MHz for imaging the solar corona in the height range of about 0.2-0.8 solar radii above the solar photosphere; a radio polarimeter for observations of circularly polarized emission in the above height range; a radio spectrograph for obtaining dynamic spectrum of the transient burst emission from the solar corona, again in the same height range. The aforementioned facilities at the Observatory are unique in their corresponding frequency range. In addition, the institute is also collaborating with the Instituto Nacional De Pesquisas Espaciais (INPE) for the construction of a decimeter radio telescope array in Brazil.



A section of the Gauribidanur radio heliograph (GRH).



Radio image of the solar corona obtained with the Gauribidanur radio heliograph prior to the solar eclipse of August 1, 2008.

**Photonics Division:** Located at IIA, Bangalore, the division has infrastructure for fabricating, testing and coating of medium and large high precision astronomical optics. It has developed the 234 cm primary mirror for the VBT. Besides meeting the optical requirements of the institute, the photonics division has been catering to

various external agencies like ISRO and BARC. Also, it has a metrology facility comprising of: long trace profilometer, a non-contact optical profiling instrument designed to measure the absolute figure to nanometer accuracy of flat, spherical and aspherical surfaces upto 900 mm, WYCO profilometer, ZYGO interferometer, digital spherometer, fiber-optic spectrometer, and scanning electron microscope.



The recently aluminized 234 cm VBT mirror.

**Electronics Division:** The Electronics Division of IIA is actively involved in the development of various software/hardware for use with the telescopes. Some of them are drive systems, automatic control of telescope dome, embedded systems for telescope control, micro-thermal monitoring system for atmospheric seeing, camera system for large format CCDs, CCD mosaicing, software for remote operation of telescopes, digital back end receiver for radio telescopes.

**Computer Centre:** The Computer Centre is equipped with Sun machines to meet the needs of the scientific community. The institute is also part of the National Grid initiative which gives 10 Mbps connectivity between major institutions across the country. The interal network within the campus is run on a CAT-5e backbone with wireless connectivity. It is proposed to set up a Center for Astronomical Data and Software (CADS) as well.

**Library:** The library has extensive collection of books and journals in the field of astronomy, physics, mathematics, electronics, computers and geophysics. Most of the journals are accessible electronically in the main library at Bangalore campus and libraries at the field stations. The library has established an Open Access Repository which includes all the publications of the institute. The IIA library is more than 200 years old and has set up a facility to include the archival contents in various forms. Hand-written manuscripts dating back to the period 1794-1812 of the erstwhile Madras Observatory Annual report are also archived.

## Upcoming/Proposed projects of the institute:

- 1.3 m optical telescope at Kavalur.
- A Major Atmospheric Cerenkov Experiment (MACE) telescope at Hanle.
- ASTROSAT – a multiwavelength space astronomy project.
- TAUVEK – an Indo-Israel collaborative project for ultraviolet observations from space.
- National Large Solar Telescope (NLST).
- ADITYA - space coronagraph for solar observations.
- Radio heliograph expansion project at the Gauribidanur observatory.
- Hanle Echelle Spectro Polarimeter (HESP).
- Development of adaptive optics and infrared sensor for astronomical imaging.

**Student Programmes:** A vigorous graduate program leading to Ph.D degree, summer programmes, visiting internship programme for students of others research institutions and universities are offered:

**Ph.D programme:** Students selected for this programme are offered Junior Research Fellowship (JRF) initially for a period of two years and Senior Research Fellowship (SRF) for the next three years. During the first year, they undergo course work on the basics of Astronomy & Astrophysics. The students register with the Pondicherry Central University, Puducherry for their Ph.D degree.

**Integrated M.Sc-Ph.D programme in Physics & Astrophysics, jointly with the Indira Gandhi National Open University (IGNOU) – New Delhi:** Selected students undergo two years of residential M.Sc programme conducted at IIA, Bangalore. Physics, optics and electronics laboratories have been specifically set up for this purpose. A student who has fulfilled the requirements for M.Sc degree and obtained the minimum qualifying marks may continue for the PhD programme.

**Integrated M.Tech-Ph.D (Tech.) programme in Astronomical Instrumentation, jointly with Calcutta University (CU) – Kolkata:** The M.Tech degree programme is a two year / four semester course. The classes for the first and second semesters are being held at the Department of Applied Optics and Photonics, CU. The third and fourth semesters comprise of internship at IIA laboratories and projects at IIA, Bangalore. A student who has fulfilled the requirements for M.Tech degree and obtained the minimum CGPA may continue for the Ph.D (Tech.) programme.

**Admission procedure:** Entry to the above programmes is through either of the following national level tests: IIA screening test (IIAST), Graduate Aptitude Test in

Engineering (GATE) exam, UGC-CSIR / NET exam for Junior Research Fellowship (JRF), and Joint Entrance Screening Test (JEST), followed by personal interview. Students selected under Joint Astronomy Programme (JAP) organized by the Indian Institute of Science (IISc), Bangalore are also eligible to join IIA for the Ph.D programme. Selected students are provided hostel accommodation, medical facilities and annual book grant.

**Visiting internship programme:** Students selected for this programme work on specific projects that form a part of the ongoing research at IIA. Based on the nature of the project, the selected candidates shall be asked to work either at the main campus of IIA in Bangalore or its field stations. Regular staff members working in colleges and universities are also provided opportunity to carry out Ph.D work under Faculty Improvement Programme (FIP).

**Summer Programmes:** The institute organizes summer programmes every year, wherein young students are exposed to research in Astronomy and Astrophysics. A school in Physics and Astrophysics is held every year at the Kodaikanal Observatory of the institute during May. In addition, students are also selected for independent projects at IIA, Bangalore during the months of May-July.



*BHASKARA – guest house cum students' hostel complex at Bangalore.*

**Other Academic Programmes:** The institute offers post doctoral fellowship, **Chandrasekhar post doctoral fellowship**, and visiting scientist position to young researchers.



Visit [www.iiap.res.in](http://www.iiap.res.in) for details.