THE INDIAN INSTITUTE OF ASTROPHYSICS

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The principal observing facilities of the Institute are located at Kodaikanal and Kavalur on two hill ranges, the Palni Hills and the Javadi Hills respectively, in the southern part of India. The Kodaikanal Observatory is located at an altitude of 2343 metres and a latitude of 10° 14′ N. The Kavalur Observatory is about three hundred kilometres further north at an altitude of 800 metres and a latitude of 12° 34′ N. There are two other centres of activity of the Institute of very recent origin; an optics, electronics and data analysis laboratory at Bangalore and the site of a proposed large low frequency array at Kulathur.

A hundred and eighty three years ago, the East India Company, having resolved to establish an observatory at Madras "for promoting the knowledge of Astronomy, Geography and Navigation in India", authorized its immediate construction. Two 3½ feet focus achromatic telescopes with triple object glass by Dolland, a transit instrument and two astronomical clocks with compound pendulums, one of which by Shelton functions even today as an excellent time keeper, formed the nucleus of instrumentation that fostered subsequent astronomical endeavours at this centre. At the end of the nineteenth century the observational activity was shifted from Madras to Kodaikanal. The near two hundred years of its existence have seen many changes of administrative control, organization and name, but with a continuity maintained of astronomical activity that has intensified over the different fields of astronomy.

Positional astronomy dominated the efforts at Madras for a major part of the nineteenth century. With its access to the soutern hemisphere, and the advantage that necessarily must have existed by virtue of its early presence on a totally unexplored scene, the Madras observations of position form the first information we have of stars in the far south. With N. R. Pogson at the helm of affairs, there was a greater emphasis towards visual observations of variable stars, their discovery and observation and establishment of magnitude sequences in their immediate vicinity. Many variable stars and minor planets were discovered during this period of visual observation.

The fascinating spate of discoveries that have emerged since 1860 from the application of the spectroscope to light received from celestial bodies has witnessed much participation of a pioneering nature from the observatories at Madras and Kodaikanal. Studies of cometary spectra led to the discovery of the characteristic tail bands in the near ultraviolet. Very high dispersion studies of Sirius and Achernar showed line broadening features that appeared related to macroturbulent phenomena on the solar surface. Observations of Venus spectra, the spectra of novae and interpretation of stationary absorption features in terms of an interstellar gaseous medium are all highlights of the early years of stellar spectrography at Kodaikanal.

With the availability of the Kavalur observing facility having clear skies and very fine seeing conditions, the Institute has a wide range of activity in stellar spectroscopy.

All activity of the past years, since the 40-inch telescope (made by Carl Zeiss, Jena) has been in operation, have been at the Cassegrain focus of the Ritchey-Chrêtien system. These cover a wide range of spectrographic dispersion from 5000 Å/mm to 9 Å/mm. Microspectra of quasistellar sources, the discovery of O and B stars as well as the very red stars to faint limits of detection in selected galactic fields, the search for blue objects that may be related to X-ray sources, are programmes currently in progress with the lowest available dispersion. With intermediate dispersions in the range 45-450 Å/mm much activity centres on studies of rotational velocities in stellar associations, radial velocity variation of selected binary systems, and the study of integrated spectra of clusters and galaxies. Cassegrain high dispersion spectroscopy utilizes two systems that function in the 9 Å-14 Å/mm range. One is a conventional Littrow system and the other an echelle with a fast Schmidt Camera system. These provide current facilities for the study of stellar chromospheres and the estimation of macro- and micro-turbulent velocities in stellar atmospheres. The first of the coude cameras of the coude spectrograph will be in operation in the next few months. The coude focus is designed to accommodate light beams of aperture upto twenty inches when gratings of these sizes become available; the next five years will see a 12 inch beam in operation that would make coude spectroscopy with the 40 inch a highly efficient procedure.

Direct photography with the 40 inch in its normal f/13 Ritchey-Chrêtien mode and with the two transformation systems that yield f/6 and f/2 performances of the 47′ field is a principal facility for the galactic and extragalactic research programmes of the Institute. The main theme is the study of spiral tracers in our own and external galaxies. The reach of the telescope into the southern hemipshere gives it the great advantage of working in most of the regions of the southern Milky Way which is of great interest and which have been little explored.

Photoelectric measurements with broad band and narrow band techniques form an important tool in present day astronomical research. Both techniques using filters have been in use at Kavalur with the 15 inch and 24 inch telescopes. Low disperson and high dispersion scanners form important accessories available or which are currently under construction at the Institute. In combination with pulse counting and on-line computing techniques these furnish a quick means of spectrum evaluation with high accuracy.

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Solar research has been a principal forte of the Institute from the earliest days of solar physics. The expeditions from the Madras observatory to the celebrated eclipses of 1868 and thereafter have contributed much to the early discoveries on the physics of the solar atmosphere. Pogson's teams detected the hydrogen lines in emission in the prominences as well as the presence of a bright yellow line that was identified later as due to helium. Pogson was also the first to show that flash spectra of the chromosphere could be observed at annular eclipses of the sun. Eclipse teams have been supported by the Institute for the total eclipses of 1868, 1871, 1898, 1922, 1935, 1952, 1955, 1963 and 1970. In the most recent eclipse, in particular, emission lines signifying low temperature regions have been detected in the corona around 1.6 $R_\odot$, calling for the postulate of a hot and cold filamentary structure of the solar corona in coexistence.

Spectrographic and white light photography of the sun have been a continuous activity at Kodaikanal since 1901. The Institute thus possesses in its plate stacks a record of solar behaviour for over six solar cycles that is an inestimable storehouse of valuable data on the Sun.

By far the most important contribution made to solar physics from Kodaikanal is the discovery of a systematic outflow of gases in the penumbral regions of sunspots, that is now commonly known as the Evershed effect. This forerunner of subsequent studies on the interaction of magnetic fields and flow of ionized gase is a classic in solar observation that has called for combination of astute observer, good equipment and fine seeing.

Present resources at the Institute for solar research stress much on high image and spectral resolution. The tower telescope enables the spectral study of features as small as a second of arc or about 700 kms on the solar surface. The spectral resolution of 600,000 together with photographic plate, magnetometer and photoelectric photometer makes possible detailed line profile studies of single features on the solar surface. Recent efforts with this instrumentation and the battery of three spectroheliographs have been in the study of temporal and spatial characteriastics of photospheric and chromospheric features.

In an area of human endeavour which is at the forefront of the horizons of human knowledge, progress is rapid and depends considerably on the quick adaptation made of recent technological developments. Light gathering power, sites with a minimum of disturbance in the atmopshere, and the most efficient use of the photons of light obtained: these are the stringent requirements imposed on the astronomer willing to accept the challenge of the universe. The Institute has commenced work on a 90 inch telescope that will be operational by 1980. The first step towards a major optical instrument will, we hope, be the forerunner of developments of greater magnitude in the decades to follow.

Astronomical Events

Dedication ceremony of the 104 cm telescope of the Uttar Pradesh State Observatory, Nainital, made by V. Carl Zeiss of Jena, by Professor M.G.K. Menon, F.R.S., Director, Tata Institute of Fundamental Research, Chairman, Electronics Commission of India, and Secretary to Government of India, Department of Electronics, was held on Thursday, 7 June 1973. The Governor of Uttar Pradesh, His Excellency Shri Akbar Ali Khan presided over the function.

PSR 1831-04 is the hundredth pulsar to be discovered so far. It was discovered at Jodrell Bank, which has the distinction of discovering the largest number of pulsars so far, thirtyeight to be precise.