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Reaching out to the sky

It is well-known that the golden age of Indian astronomy dated from the time of Aryabhatta in the fifth century to Bhaskara II in the twelfth century. During this period of history Europe was passing through the Dark Ages and the Arabian scholars enjoyed a healthy interaction with Indian astronomy. Then, after a relatively static phase lasting about eight centuries, Indian astronomy had a renaissance in the colonial period with inputs coming from the French and the British. The Madras Observatory, established in 1786, was the progenitor of the Kodaikanal Observatory, which is now part of the Indian Institute of Astrophysics in Bangalore. During the first quarter of this century modern physics took roots in India and Satyendra Nath Bose and Meghnad Saha, both contemporaries in Bengal, laid the foundations of theoretical physics and astrophysics. N R Sen in Calcutta and V V Narlikar in Benares (now Varanasi) were the pioneers of research in general relativity in the 1940s.

At the time of independence the premier observational institution in India was in Kodaikanal. The emphasis was on solar observations, although small telescopes existed for stellar and planetary astronomy as well. There were, however, two other optical observatories by the end of the 1950s. The first one had already been built before independence in 1901, in the princely state of Hyderabad, ruled by the Nizam, and was named the Nizamiah Observatory. The second one was set up in Naini Tal, a small town in the foothills of the Himalayas, through the initiative of Dr Sampurnanand, who was the Chief Minister of the State of Uttar Pradesh. Known as the Uttar Pradesh State Observatory, it recently celebrated the silver jubilee of its 1.08 metre Sampurnanand telescope. Despite limited resources, new telescopes have been appearing on the scene over the last few decades. Thus, apart from the Sampurnanand Telescope, similar size telescopes were erected in Hyderabad and Kavalur in the early seventies. Kavalur, in Tamil Nadu, now has the 2.3 metre Vainu Bappu Telescope, named after the founder director who modernised the establishment by shifting the centre of activities from Kodaikanal to the newly created Indian Institute of Astrophysics (IIA) in Bangalore. The IIA now controls the telescope system at Kavalur.

Thanks to the encouragement given by Homi Bhabha, the founder Director of the Tata Institute of Fundamental Research (TIFR) in Bombay (renamed Mumbai), the newly emerging science of radio astronomy made a debut in India. The radio telescope at Ootacamund (shortened to Ooty, the Indian name is Udhagamangalam) owes its genesis to Govind Swarup who set up the radio astronomy group at the TIFR in the mid-sixties. The Ooty Radio Telescope is a cylindrical array of parabolic antennas extending to a distance of over 550 metres. One of its major studies was of angular sizes of extragalactic radio sources, determined by the occulting of radio sources by the moon. A grander project, again the brainchild of Swarup, is the Giant Metrewave Radio Telescope at Khodad, about 90 kilometres from Pune. With 30 parabolic dishes, each of 45 metres diameter, spread in a Y-shaped arrays over several kilometres, it is billed as the largest metrewave radio telescope in the world. A triumph of indigenous technology, this telescope is expected to provide important information about the formation of proto-galaxies in the universe and pulsars.

India's space programme, which started with modest balloon experiments for cosmic rays studies in the 1940s under the initiative of Bhabha, later grew under the guidance of Vikram Sarabhai at the Physical Research Laboratory, Ahmedabad and at

Probing the universe has been an old interest and Indians now have new means to do it

Thumba in Kerala, where the Vikram Sarabhai Space Centre now plays a key role in rocket technology. There is a modern satellite applications centre in Ahmedabad abd satellite manufacturing facility in Bangalore.From its modest beginnings the space programme has grown to an internationally competitive level. Apart from the application-oriented satellites (for remote sensing and communications), the space programme has also led to space astronomy. For example, a satellite containing an X-ray detector is now operating and has produced interesting data on the possible existence of a black hole.

Astrophysics

India has traditionally been strong in theory, perhaps because of the importance given to philosophy in our ancient roots! The developments in the field of observational astronomy have been matched by the growth of strong theoretical schools as well as by the work of individuals who excelled in their work. For example, P C Vaidya, one of the earliest students of V V Narlikar, is a well-known name among relativists the world over, for his work on the Vaidya Solution. A K Raychaudhury, a self-taught relativist, is equally known for the Raychaudhury Equation that paved the way for the later work of Roger Penrose and Stephen Hawking.

While relativity and cosmology have been the strong points of Indian scientists, the new generation of scientists has been coming forward with work in high energy astrophysics and extragalactic astronomy. Models of active galactic nuclei and quasars, computer simulations of how large-scale structures evolved in the universe, data analysis techniques for use in the forthcoming gravitational wave detectors, modelling of black holes in X-ray binaries, the study of pulsar models, helioseismology and analyses of the solar interior are areas in which the Indian community of astrophysicists is carrying out competitive world class research.

Encouraged by Nehru's far-seeing policy of supporting high quality pure research, and following the lead of Shanti Swarup Bhatnagar and Homi Bhabha, several research institutions were built in post-independence India. While they flourished, it became gradually clear that the Indian university system was fast losing out in the race for excellence in science. As a measure to redress the balance, the University Grants Commission took a decision in the mid-1980s to create a number of centres of excellence in the university sector, whose primary aim would be to nucleate and promote research, development and teaching in subject areas for which major facilities were lacking in individual universities.

Known as Inter-University Centres, these institutions are of relatively recent origin, but already their positive impact on the university scene is noticeable. The Inter-University Centre for Astronomy and Astrophysics (IUCAA), set up at Pune in 1988, sets out to be a centre of excellence in research in astronomy and astrophysics. Like the International Centre for Theoretical Physics at Trieste, it holds pedagogical programmes for university staff and students. And like the Royal Institution in Great Britain, it also has programmes for bringing science to the masses, particularly to school children.

Facilities

IUCAA has several advanced level facilities at the disposal of its university users, ranging from a do-it-yourself instrumentation laboratory for making the back-end instruments for telescopes, to a data centre which has the latest astronomical data available in the public domain, and a well-equipped library. Its small core faculty of ten or so members are experts in their chosen branches of astronomy and astrophysics.

As part of its research programmes, IUCAA is now planning to set up a two metre optical telescope with the latest available technology which will provide Indian universities with opportunities to carry out frontier level research in optical astronomy. IUCAA is probably the only institution of its kind where, on the one hand, a group of over 500 school children attend lecture demonstrations, while on the other, 20-30 university faculty members and students huddle together with half a dozen experts drawn from India and all over the world to study the latest developments in astronomy and astrophysics.

For IUCAA's mandate calls for a long-term approach: to have good research and teaching in a university tomorrow, one must motivate school children today. ■