भातासं सूचनापत्र

IIA Newsletter

खण्ड 17 सं 1 | भारतीय ताराभौतिकी संस्थान | जून 2012

Volume 17 Number 2 | Indian Institute of Astrophysics | June 2012

In this issue...

Remembering Professor J. C. Bhattacharyya

Professor J. C. Bhattacharyya during his early years at IIA.

Professor J C Bhattacharyya, who passed away in Delhi on June 4, 2012, was the director of IIA from December 1983 to August 1990. Although his formal appointment came only towards the end of 1983, he had been carrying out all the duties of the director since April 1982, when the incumbent director Professor M K Vainu Bappu left Bangalore on a four-month long visiting assignment at the European Southern Observatory. Professor Bappu passed away in Munich in August 1982 due to complications following a heart bye-pass surgery.

The period of Professor Bhattacharyya's directorship is marked by the singular achievement of the successful completion and commissioning of the indigenous 234-cm optical telescope in Kavalur, a monumental and painstaking effort, which Professor Bhattacharyya led from the front. The telescope project was originally conceived by Professor M K Vainu Bappu, and although the complete design and a large part of the fabrication of the instrument and its housing was accomplished by 1982, a substantial amount of work still remained at the time of Professor Bappu's totally unexpected and premature death. The responsibility of completing the project fell on Professor Bhattacharyya's shoulders and he accepted the challenge with unfailing dedication.

During Bappu's directorship Bhattacharyya played a very effective supporting role and helped Bappu in both administrative and technical matters. He joined the Astrophysical Observatory in Kodaikanal in 1964 as its Assistant Director or `A.D.' for short. After the birth of IIA, when the post of an assistant director no longer existed, the older employees, who continued in IIA, still referred to him as `AD'. During Bappu's frequent absence from Kodaikanal or from Bangalore later, Bhattacharyya took charge of the affairs of the observatory and the institute. He became quite conversant with the government rules and procedures and he followed them almost to a fault in discharging his duties. Bappu trusted him fully and Bhattacharyya did not disappoint him ever.

In 1973, Professor V Radhakrishnan, then director of the Raman Research Institute, Bangalore offered Bappu the use of office rooms and laboratory space in the buildings of the RRI campus since IIA's own buildings in Koramangala were not yet ready. Bhattacharyya started the Bangalore office at RRI and also set up his electronics laboratory there. Technical people working under him as well as some skeletal administrative staff along with a few senior scientists were transferred from Kodaikanal to Bangalore. Soon after, IIA went on a massive recruitment drive and many new people joined as scientists and engineers. A large fraction of them opted for a posting in Bangalore. To all these people (it includes the present writer), Bhattacharyya was their immediate boss. He helped them settle down to their new job. He found for himself living accommodation in the cramped surroundings of Kumara Park West. He missed the luxury of living in Kodaikanal where he used to stay in the same bungalow as John Evershed when he was the director of Kodaikanal Observatory.

J. C. Bhattacharyya at the 40 inch telescope

In Bangalore, Bhattacharyya was busy developing some fast recording techniques in his laboratory. The optical observatory in Kavalur had burst into the international scene already in 1972 with its successful participation in the international collaboration on the occultation by *Ganymede of the star* SAO 186800 which indicated the existence of an atmosphere around the Jovian satellite. Bhattacharyya had led the campaign at the newly installed 102-cm Zeiss telescope in Kavalur. Encouraged by this success, he embarked on a project of developing a fast photometer in the visible band with millisecond time resolution to be used for lunar occultation studies. In March 1977, the rare opportunity of observing the occultation of a faint star by the planet Uranus presented itself. It was expected to be a slow event and Bhattacharyya used a photomultiplier with appropriate filters and a conventional amplifier to observe the event at the Zeiss telescope. His observation coupled with those of others from the southern hemisphere and from the air-borne Kuiper Astronomical Observatory led to the discovery of a ring system around Uranus. The curious story of this important discovery has been described by Bhattacharyya himself in an article in the Bulletin of ASI (1997, BASI 25, 29-36). The discovery brought Bhattacharyya well deserved recognition and earned him the fellowship of the Indian National Science Academy. Bhattacharyya continued to observe occultation events with the equipment he designed.

Observation of a lunar occultation event of the Alpha Virginis system led to some unexpected results which were never published. After Bappu's death as his administrative responsibilities increased considerably and with the added task of seeing the 234-cm telescope project through to its successful completion, Bhattacharyya's own research activities slowly tapered off. However, he continued to supervise the doctoral work of several students. He also encouraged R Rajamohan to start a project on discovering near-earth asteroids using the existing facilities in Kavalur. The project took off in 1987-88 and led to the discovery of six main-belt asteroids. Twenty years later, in 2008, on Rajamohan's request, one of them, asteroid (8348)1988 BX, was named `Bhattacharyya' by IAU's Committee on Small Body Nomenclature.

In 1977, at the request of his friends, Bhattacharyya wrote his maiden popular article in Bengali on the discovery of the Uranian ring system. The article was published in the well known Bengali weekly *Desh* and caught the attention of its wide readership. That the writer had a great talent in describing specialised scientific matter to the layman in a lucid language was quite obvious in this first publication. Bhattacharyya too enjoyed the exercise. He continued to write such popular articles sporadically during his working life, becoming rather prolific after his retirement when he became Emeritus. He wrote for *Desh, Jnan o Vignan, Kishor Jnan Vignan*, all published from Calcutta, and also in some other magazines published from Tripura and Midnapore. These articles are a delight to read and through them knowledge of the modern science of astrophysics was spread far and wide in the eastern regions of the country. The articles had a great impact on the younger generation and when interviews were conducted in Bangalore and other Indian cities for admission to the doctoral programmes of research institutes, a large contingent of student aspirants from Bengal was always present and when probed, they invariably said they were attracted to astronomy and astrophysics because of Bhattacharyya's writings. Bhattacharyya also wrote in English for *Science Today*, *Science Age* etc.Bhattacharyya foresaw the need of having a strong Ph D programme in IIA and initiated steps towards establishing one months before his retirement.

During his directorship an internal re-organisation took place and a faculty of the institute was constituted by the governing council with senior scientists as its members. The job of the faculty was to advise the director on all important scientific and technical matters. Bhattacharyya was quite happy about this development and during his time the IIA faculty met very regularly and functioned quite effectively.

Bhattacharyya believed in doing things by consensus and he seldom imposed his authority. He also started a monthly scientific meeting where the on-going research of individuals and groups was presented and discussed. Everyone got a chance to speak on one's work and discuss its progress.

Bhattacharyya ensured that the discussions took place in the right scientific spirit in a friendly atmosphere. He never missed a monthly meeting and sitting in the front row he always busied himself in taking down copious notes of the proceedings. If these notes are preserved, one would find in them a chronicle of the progress of scientific research in IIA during the nineteen eighties.

Bhattacharyya also introduced several staff welfare measures which greatly benefitted the employees. A contributory medical scheme was introduced for staff members and their dependents and arrangements were made with some of the leading hospitals of Bangalore to provide medical treatment to the staff on a credit basis. A panel was created of specialist doctors in Bangalore. Staff members were permitted to consult them and receive treatment. He was deeply concerned about proper housing of the staff. With the escalating rents in Bangalore city and the failure on the part of IIA to acquire additional land to build staff quarters, finding houses was becoming a burdensome job. It was due to Bhattacharyya's persistent efforts that the governing council permitted official requisitioning of houses for the staff of the institute. This helped a large number of the employees to find residential accommodation in the upmarket Koramangala area where IIA is located.

Bhattacharyya was unostentatious in his living style. He was fond of music and literature and loved to quote from his favourite authors. He was gifted with a rare sense of humour and was an excellent raconteur. After he moved to Bangalore, he had to often visit Kodaikanal on official duty. His residence had been converted into the campus guest house by then but on those visits he always occupied his old bedroom. In the evenings, he would sit with the other guests by the fireplace in the parlour and regale the audience with stories and anecdotes.

In January 1975, Professor Kasinath Nandy of the Royal Observatory, Edinburgh visited Kodaikanal for about three weeks and delivered a course of lectures on interstellar dust. Bhattacharyya was assigned the task of hosting Professor Nandy. He was a gracious and wonderful host. On occasions he even took charge of the kitchen and displayed his culinary skills in preparing some delectable dishes. In the daytime serious science was discussed while in the evenings there was always time for relaxed chatting or *adda*. Both Nandy and Bhattacharyya excelled in narrating incidents, experiences of their travel and association with people and could talk on a wide variety of subjects. They held forth in the parlour of Evershed Hall in the evenings keeping the rest of the gathering enthralled. There were occasions when Bhattacharyya would recite from memory an entire prose-poem of Tagore from *Lipika* without ever faltering. Those who were lucky enough to be present in Kodaikanal those few weeks would surely recall the time as one of the fun times of their life. After he became director, such occasions became rarer as he was weighed down by the pressures of directorship.

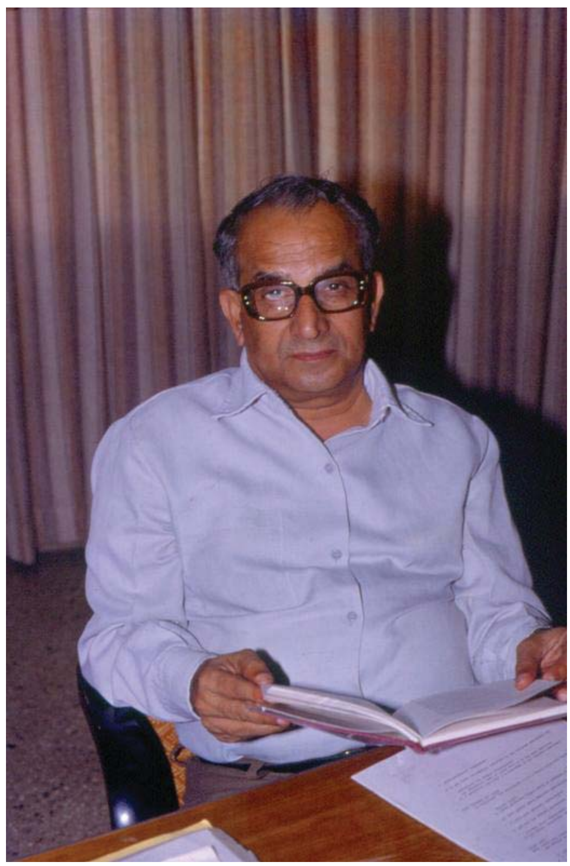
At the end of August 1990, Bhattacharyya retired from the directorship. His association with IIA continued till 2006, as he served as an Emeritus Professor and an Honorary Professor till 1997 followed by a ten-year stint as a member of the governing council. He stopped coming to IIA on a daily basis when he gave up his emeritus status. With his departure from the scene, a vital link with IIA's past was lost.

- D. C. V. Mallik

Professor J. C. Bhattacharyya (1 September 1930 – 4 June 2012)

The news of the passing away of Professor J.C.Bhattacharyya was received with profound grief by the astronomical community and by all those in IIA in particular. He was a very close senior colleague and friend of mine.The threads of our lives were interwoven for over five decades and his passing away has left a void in my life.

Jagadish Chandra Bhattacharyya (fondly known among his colleagues as JCB) was born on September 1, 1930 in Calcutta. After his Master's degree in electronics from the Calcutta university, he spent a year at the Institute of Radio physics and Electronics (Calcutta University) doing electronics instrumentation under Professor S. K. Mitra, a person highly respected by the community of atmospheric physicists for his research work in Ionospheric physics. He joined the Indian Meteorological department in 1954 and worked in the Radar laboratory, New Delhi for about a year when he was transferred to the Instrumentation Division in Poona (now known as Pune) office. From the beginning the Department had ear marked him for the ionospheric division at Kodaikanal as the successor to Mr.B.N.Bhargava, who was to be posted elsewhere on promotion. As a preparation for this, he was deputed to the Radio Research Station, Slough, U.K. for training for about a year, where he worked on ionospheric problems - one of which was to study the behavior of ionosphere during a total solar eclipse. Little did he imagine at that time that he would be an astronomer in the future years although he knew that he would be posted to Kodaikanal.On his return to Poona office from Slough, he took charge of the workshop where many of the meteorological instruments including the radiosondes were being manufactured and tested before installation at the out stations. Besides,there were the remote operating instruments where he introduced his innovative ideas to improve their performance.He was transferred to Kodaikanal in July 1964.Bappu inducted him into the realm of astronomy, starting with building a solar magnetograph of the Babcock type similar to the one that had been in operation at the solar telescope of the Mt.Wilson observatory since a few years. This proved to be very challenging job in spite that some of the critical components had already been procured and kept ready by Bappu. Bhattacharyya built this instrument with the limited laboratory facilities, but backed by the inspiration and professional help from Bappu. With the magnetograph, first of its kind in the country, he measured weak magnetic fields on the disc of the sun over extended periods of time and investigated extensively the nature of their distribution and dynamics. The magnetograph added a new dimension to the facilities at the telescope. One of the important problems of the day was to study the propagation characteristics of the waves associated with the velocity oscillations in the photosphere (broadly referred to as the 5-minute oscillations) and their role in the propagation of non-thermal energy to the corona to maintain its high temperature. Using the magnetograph in the velocity mode (where it could measure Doppler shifts corresponding to 20 m/sec), he studied the properties of these oscillations their time evolution characteristics in prominent lines such as the Mg b lines using good continuous observations lasting for several hours. On most of the days, I was also with him at the telescope for taking turns to ensure an uninterrupted record and later in reducing these data. He submitted his thesis to Calcutta University and was awarded D.Phil degree.



Another project he embarked upon with Bappu was to build cold boxes for cooling the photomutipliers used for stellar photometry so as to increase their sensitivity and spectral coverage. They could come up with a modest version of cold box that used dry ice only after laboring for a few years. Once the path to full success was in sight they started on making a photon counting photometer using readymade counters and timers. This was also the time when the Kodaikanal Observatory was transformed into an autonomous institution as Indian Institute of Astrophysics and the installation of the 102 cm reflector started at Kavalur by the German engineers. He with Bappu andJayarajan was busily engaged in every step while the installation was in

J. C. Bhattacharyya with M. G. K. Menon.

J. C. Bhattacharyya with students of Joint Astronomy Programme of I I Sc.

progress and in addition to mastering the working of the control system of the telescope. In the nights, he used to test the newly built pulse counting photometer at the 24-in telescope and in the first few months of 1972 he had got a very reliable system ready for serious observations.

The installation of the 102 cm reflector marks a major milestone in the history of the development of the Institute.Within a month, the new telescope was used to observe the occultation of a star by Ganymede, Jupiter's largest satellite using the photon counting system perfected only a couple of months ago. The observations led to the detection of an atmosphere for Ganymede and it was also possible to assign an upper limit for the density of its atmosphere. From the encouragement provided by the first success, he planned for a still faster recording system – with a resolution better than a millisecond for occultation observations. He with Kuppuswamy employed such a system for observing the event of the occultation of a star by planet Uranus on the night of March 10/11, 1977 that led to the remarkable discovery of the ring system around Uranus. This inspired him to start a regular programme of observing stellar occultation events by planets that was very successfully pursued in the later years by his student Vasundhara. He also initiated a programme in 1987 to search for near Earth asteroids with Rajamohan as the lead astronomer (who chose the name *"Kalki"* for this project) , using the Schmidt telescope at Kavalur that led to the discovery of six asteroids.

The 102 cm reflector was a stepping stone, for Bappu, towards realizing his long cherished intense desire for a 100-in class telescope and that too to be built using the resources within the country.Battacharyya and Jayarajan were integral part of this large telescope project right from the very beginning (1975) starting with the first consultation meeting with the Tata Consulting Engineers. He was chosen as a member of the 234 cm Telescope Project Management Board along with a few more experts and to be in charge of the control system and computer for operating the telescope. The Governing Council had given its approval for the fabrication of the 234 cm aperture telescope and its erection at the Kavalur campus. Accordingly, the civil construction of the dome building and the fabrication of the telescope mount had commenced and were in progress. In May 1982, Bappu left for the European Southern Observatory, Garching. He was scheduled to proceed from there to the General Assembly meeting of the Astronomical Union at Patras, Greece, as its President. But he passed away at the Munich hospital just before the start of the Patras meeting. In Kavalur, the dome building had just been completed, the telescope mount and mechanical sub assemblies were under fabrication at Walchandnagar Industries and the 234-cm blank was on the grinding table at the optical shops at Bangalore. As the second in command the responsibility of completing the gigantic project, from that juncture, slid in JCB's shoulders. In his words, he was in the same plight of a sailor of a ship caught up in a violent storm and with its captain missing. Besides wiping our tears, Prof. M. G. K. Menon, infused confidence and provided all the guidance and support needed to take the project forward to succeeful completion. Although, the first light viewing and photography using the prime focus camera were done in October 1985, there were countless unanticipated problems relating to control systems and electronics. These were systematically analysed and rectified stage by stage very effectively by a team led by R. Srinivasan under JCB's guidance and a smooth operation of the telescope with an overall performance to the level of full satisfaction of all users was achieved and demonstrated to the astronomical community. The late Shri Rajiv Gandhi, the then Prime Minister of India, named the 234

-cm telescope as the ``Vainu Bappy Telescope'' and renamed the Kavalur Observatory as the ``Vainu Bappu Observatory'', in a brief inauguration ceremony hosted by M.G.K. Menon and JCB which was arranged in the telescope building on January 6, 1986. This is the tribute that the Nation, Governing Council and astronomers and staff of IIA gave to Bappu.

In the midst of these duties, JCB also helped the students of Bappu to complete their Ph D theses, in addition to helping his own students. He also initiated the development of detector systems employing charged couple devices (CCD) to replace photographic plates for imaging and registering spectra.With Srinivasan and his team of young and energetic engineers, the project proceeded on a fast track that one CCD camera could be commissioned for imaging at the Vainu Bappu Telescope with in a short time. With his encouragement and support, more such units were got ready for other telescopes in Kavalur and the 2m Himalayan Chandra telescope at Mt. Saraswati, in Hanle with large format CCD camera systems.

Another area of his interest was solar eclipses. The two-man team – Bappu and JCB – conducted two experiments during the total solar eclipse of March 7, 1970 at Mexico. He operated the long focus camera and obtained coronal photographs of exquisite quality on photographic emulsions, that show a wealth of coronal features with great clarity. It was from the coronal spectrogram obtained by them at this eclipse that the first evidence for the presence of the cool component embedded in the million degree hot corona was obtained. Again during the total solar eclipse of February 16, 1980, in Karnataka, he took a very active part. He gave talks at several institutions within India on solar eclipses and the scientific results obtained from them as well as to the general public stimulating their interest in such phenomena and explaining the safe ways to view the corona during the eclipse.

He was an elected Fellow of the Indian Academy of Sciences, Indian National Science Academy, the National Academy of Sciences, India and the Institution of Electronics and Telecommunication Engineers. He was the President of Commission 9 on "Instruments and Techniques" of the International Astronomical Union for the term 1989 – 1991. He was also member of Commision 50 on " Protection of Existing and Potential Observatory Sites '' and of Commission 12 on "Solar Radiation and Structure" of the IAU. He was the President of the Astronomical Society of India for the term 1986 – 1988. He was awarded in 1990 the UGC-Hari Om Ashram Trust Award for Physics Sciences. He was the recipient of the "S. K. Mitra Birth Centenary Award '' of the Indian Science Congress Association at its 92nd Session (January 3 - 7, 2005). In August 2008, the Committee for Small Body Nomenclature of the IAU named one of the six asteroids discovered at the Kavalur observatory under the Project ``Kalki '' as `` Bhattacharyya'' in recognition of the support and encouragement he provided for this Project. He delivered several prestigious lecture awards including Professor M. N. Saha Memorial Lecture, IPA-P.A. Pandya Memorial Lecture, Prof. S.V.C.Aiya Memorial Lecture etc.

I met him first when I joined the Instruments Division, Poona, in November 1955 and we worked together till 1962 when I was deputed to work at the National Aeronautical Laboratory, Bangalore. We met again when I joined Kodaikanal Observatory in January 1965 and have been together since then. When it was decided in early 1973 to shift the head quarters of the Institute to Bangalore from Kodaikanal, as a first step, Bappu deputed him and me to start the Institute in the office space graciously provided at the Raman Research Institute by the late Radhakrishnan. Both of us drove in his car to Raman Research Institute from Kavalur and Bappu joined us from Kodaikanal. After occupying the office space allotted, we drove to Woodlands for lunch as part of the celebration. He assumed the responsibility of heading the Institute at a very crucial time and most unexpectedly. Simple in habits, he believed in honest, open and transparent problem solving. He had evolved a judicious mix of concern for work with equal concern for all his staff. This combined with a rational and compassionate approach he could find amicable solutions to many administrative problems. He possessed a phenomenal photographic memory that could recapture past events or experiences on scientific matters, electronic circuits or budgetary figures or personal incidents date-wise, vividly and in full detail, that failed him towards the last few years of his life. He was a very good story teller and his after dinner talks were a feature that was eagerly looked forward to by participants in scientific meetings. Being well versed in Sanskrit, he used to quote couplets or recall the experiences of the great Bengali social reformer, Ishwar Chandra Vidyasagar and derive consolation during moments of despair. After his retirement on August 31, 1990, he continued to be associated with IIA as CSIR Emeritus Professor (Sept 1, 1990 - Aug 31, 1993); IIA Emeritus Professor (1.9.1993 - 31.8.1996); Honorary Professor (1.9.1996 - 31.8.1997); Member of the IIA Governing Council (16-5-1997 - 31-3-2007) . He was a prolific writer of short articles in English and in Bengali for the use of college and school students and general public. He intensified this activity after he retired as the Director and completed many books in popular style. He derived pleasure in preparing the manuscripts using pen and paper rather than composing and editing on a computer. He was an ardent lover of cricket and card games. Reminiscing his tryst with astronomy and his experiences, he used to share with me his thoughts-he felt satisfied and above all considered himself fortunate to have had the opportunity of working in close association with Bappu for nearly three decades towards the promotion of astronomy in the country and establishing facilities for astronomical research that will be used by many in the generations to come. We could see the steady deterioration of his health caused by the diabetes. His determination to serve the community took him forward for a few more years. He was very keen to visit the new observatory at Hanle, Ladakh and fulfilled his dream of seeing for himself the remote controlled 2-m Himalayan Chandra Telescope' operating smoothly atop Mt Saraswati of the Indian Astronomical Observatory, Hanle in the year 2001. In the last few years of his life, when there was further deterioration in his health, and his wife had to bear the burden of frequent hospital errands, his daughter Mrs.Anuradha Mitra moved him to Delhi to live under her care. He breathed his last in the afternoon of June 4, 2012. I was told that he had a peaceful end. He leaves behind his wife, Mrs. Indira Bhattacharyya, a very lovable person, son, daughter, son-in-law and a grandson.

- K. R. Sivaraman

(with contributions from K.T. Rajan)

Patterns in the Cosmic Microwave Background Radiation

The cosmic microwave background (CMB) radiation holds vital clues about the early history of the universe. At first glance the temperature fluctuations look randomly distributed. The statistical nature of the fluctuations must be predominantly inherited from those of the primordial density fluctuations. Hence by probing it we are probing the physical mechanism that produced the primordial density perturbations. Current observations indicate that the temperature fluctuations are roughly Gaussian in nature. Searches for deviations from Gaussianity is a major quest of current andupcoming experiemnts. It is, however, not an easy task since various spurious observational effects can mask the true CMB signal.

One way to search for small non-Gaussian deviations of the CMB is to analyze its topological properties. This is done by first defining what are known as *excursion sets* defined as follows. Let *f* denote the CMB temperature anisotropy field and ν denotes *f* rescaled by its rms value. Then for each value of ν the set of all pixels that have values equal to or above ν is called an *excursion set*. This set consists of many *connected regions* into which thetemperature field `manifold' has fragmented, and *holes* within those regions, due to the excluded pixels. As we change ν, the topological properties of excursion sets change systematically, as shown in Fig.1.

In mathematics, for any given manifold the number of connected regions is called the first Betti number, β_0, and the number of holes is called the second Betti number, β_1. They are topological quantities. For the excursion sets they can be expressed as line integrals, $\beta_0 = 1/2\pi \int_{c+} K\, ds$ and $\beta_1 = 1/2\pi \int_{c-} K\, ds$, where K is the curvature of iso-temperature contours for each ν. C_+ denotes contours that enclose connected regions while C_- denotes contours that enclose holes. These expressions can be implemented numerically to find out their shapes for any random field. The genus, which is also a topological quantity, is given by $g(\nu) = \beta_0(\nu) - \beta_1(\nu)$.

Because of the fact that the functional dependence of β_0, β_1 and g on ν are very sensitive to the statistical nature of

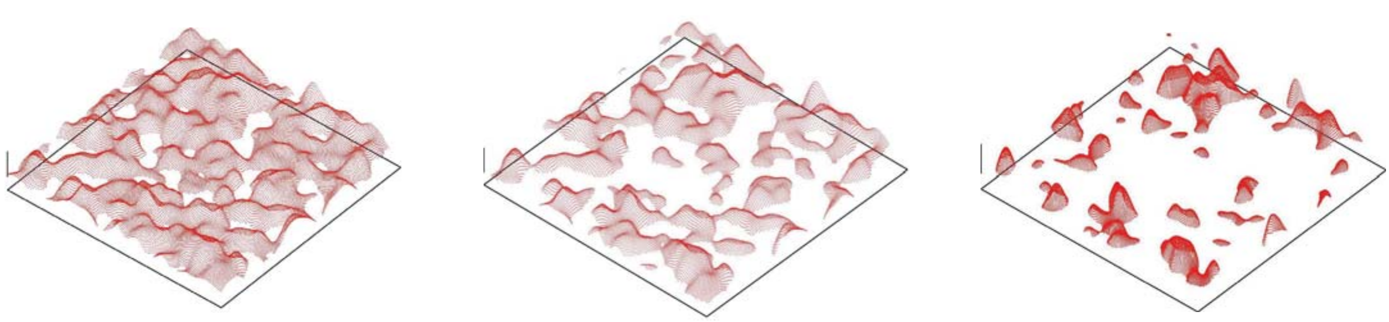


Figure 1: Left to right: excursion sets for ν = -0.5, 0, 1.

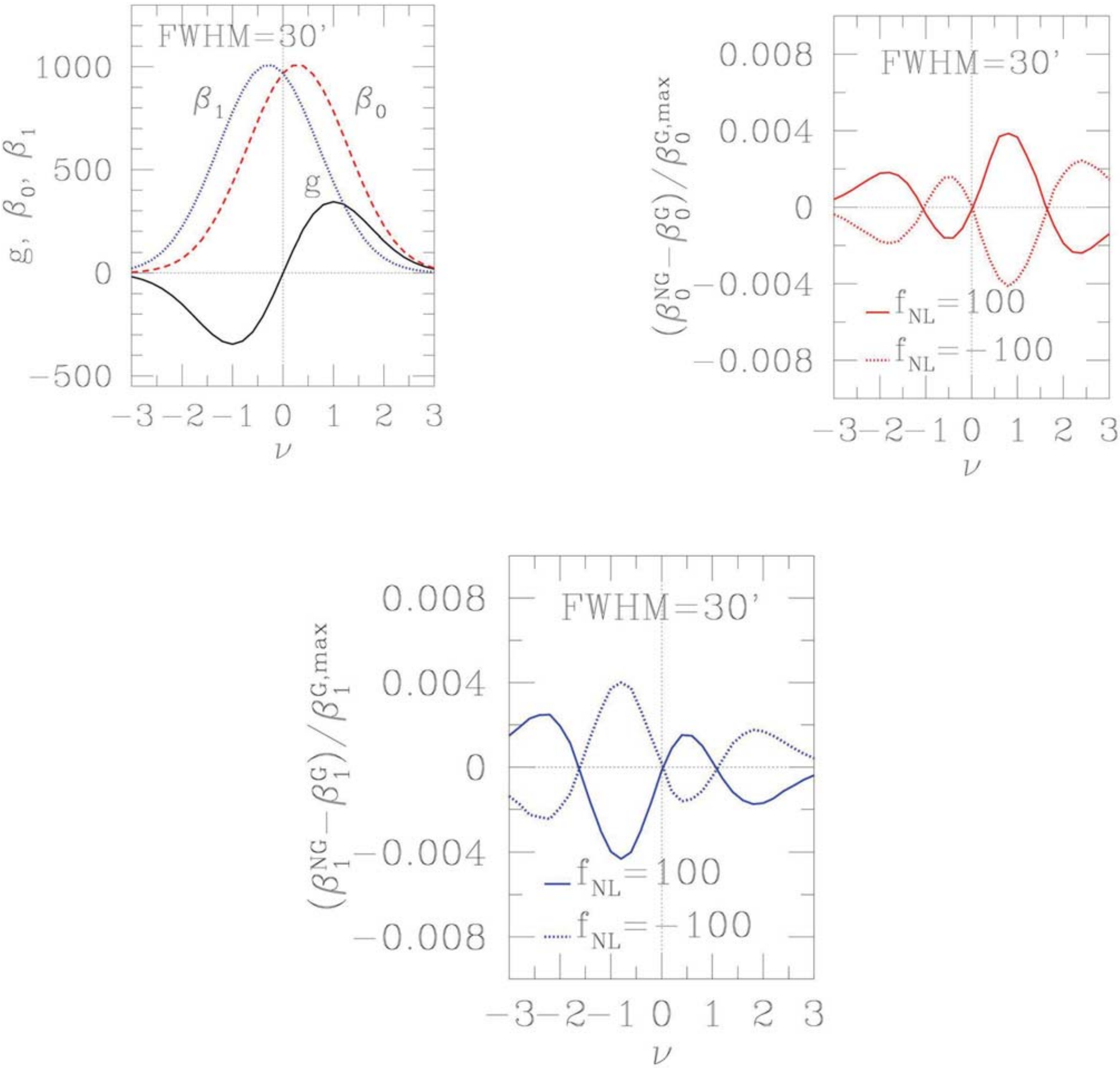


Figure 2 : Top left : β_0, β_1 and g for Gaussian CMB maps smoothed with FWHM = 30'. Top right : Non-Gaussian deviations of for β_0 for the values f_{NL}= ± 100. Bottom : Non-Gaussian deviations of b_1. The results are average over 200 simulations.

the random field they are well suited to look for the presence of non-Gaussian deviations in the CMB. In the literature, the genus is well studied. We have recently introduced the Betti numbers as a discriminant of different types of non-Gaussianity. Together they carry more information than the genus. We have numerically computed and studied the shapes of Betti numbers that arise due to non-Gaussian deviations of primordial density fluctuations predicted by inflation. In the top left panel of Fig. 2, β_0, β_1 and g are plotted as functions of ν, computed from Gaussian CMB simulations. The top right and the bottom panels of the same figure show the non-Gaussian deviation shapes of β_0 and β_1 respectively, computed using Gaussian and non-Gaussian simulations. The input non -Gaussianity is the primordial local type predicted by certain models of inflation and parametrized by one parameter f_{NL}. The shapes shown are characteristic of this type of non-Gaussianity. Different non-Gaussian models give different shapes of β_0, β_1 and g which can then be compared to measurements from observational data. Such detailed studies are currently underway.

- Pravabati Chingangbam

Anatomy of the Star Forming Complex Sh2-252 - A Multiwavelength Analysis

Sh2-252 is an optically visible extended H II region (n_e~ 9 cm^{-3}, size ~ 25 pc) ionized by an O6.5V star HD 42088. Radio observations at 5 GHz detected six compact H II (C H II) regions at different spatial locations within Sh2-252 (Felli et al. 1977), giving an indirect evidence of an emerging OB association. In this study, an attempt has been made to unravel the stellar contents of this region using deep optical, Hα survey, shallow NIR (2 MASS), MIR with *Spitzer* - IRAC (3.6-8.0 μm), MIPS (24 μm), 850 μm (SCUBA), 1.1 mm (Bolocam) and radio (GMRT) data along with spectroscopic observations (Jose et al. 2012a; 2012b). With these, we estimated the distance (~ 2.4 kpc) and identified 12 OB stars of spectral type earlier than B6 (> 5 $M_\odot$) within the nebula. The K_s-band surface density map shows five prominent embedded clusters associated with the sub-regions A, C, E, NGC 2175s and Teu 136. The hidden young stellar population of the complex has been explored using the NIR-MIR colour-colour analysis, exposing ~180 Class I and ~ 400 Class II young stellar objects (YSOs) for the first time, which shows that the region has statistically rich number of YSOs. Using theoretical isochrones and SED analysis, the YSOs are found to have an age spread of 0.1 - 5 Myr and mass range of 0.3 - 2.5 $M_\odot$ (Figure 1). The K_s-band luminosity functions for all the sub-regions are found to be similar and comparable to that of young clusters of age < 4 Myr. The initial mass functions for all the sub-regions in general are also found to be comparable to the Salpeter value.

Spatial distribution of the candidate YSOs shows a clear high concentration at the western outskirts of Sh2-252, mostly associated with the sub-regions A, C, E and F (Figure 2). The colour composite image of the western half of Sh2-252 at *Spitzer* bands (Figure 3) shows a semi-circular evacuated cavity at the center due to ionizing photons from O6.5V star, surrounded by a ring of PAH emission at 8 μm, possibly tracing the interface of ionized gas and molecular cloud. In a large scale we see a ring of molecular material at 1.1 mm aligned parallel to the outer extent of the ionization front of Sh2-252, and located just behind the bright PAH emission and also corresponds to the dark region at 24 μm. The ring is fragmented at various locations with fragments ~ 20-200 $M_\odot$, thus providing evidence of most compressed zone of the near-by molecular cloud. Several Class I/II YSOs are observed in this direction, with majority of them projected behind the PDR, in the vicinity of 1.1 mm emission. This configuration in the western direction of Sh2-252 more or less resembles the matter collected at the periphery of the H II region during the collect and collapse process of star formation. The predicted fragmentation time at which the star formation would take

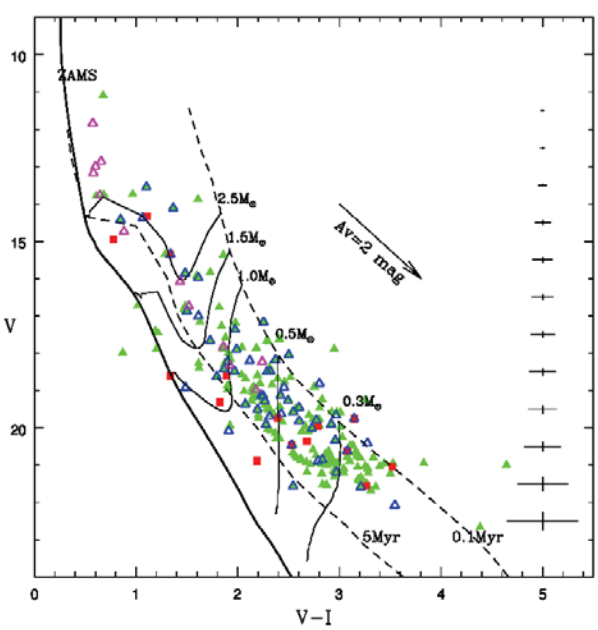


Figure 1. V/(V-I) CMD for the candidate YSOs (class I-red ; Class II-green; Transition disk sources- magenta; Hα sources-blue triangles) identified within Sh2-252. The locus of ZAMS (thick solid curve), PMS isochrones (dashed curves) and the evolutionary tracks for various mass bins (thin solid curves) are also shown.

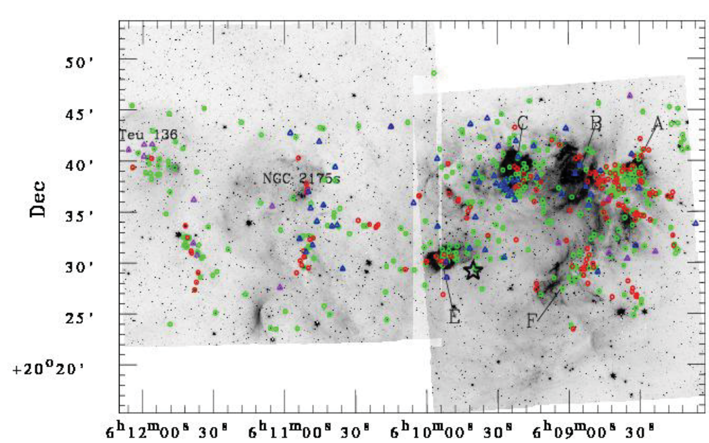


Figure 2. Spatial distribution of candidate YSOs in Sh2-252 (Class 1 - red; Class II - green; Transition disk - magenta; Hα sources - blue) over plotted on the 4.5 μm image. The sub-regions of Sh2-252 are marked.

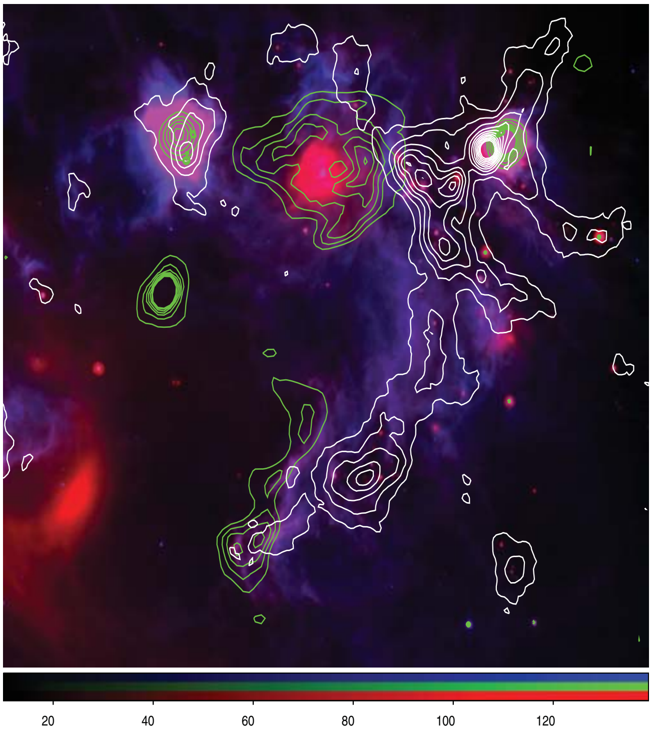


Figure 3. Colour composite image of the western half of Sh2-252, made from the Spitzer bands along with the 1.1 mm dust continuum emission map (white) and the low resolution radio continuum map at 1280 MHz (green).

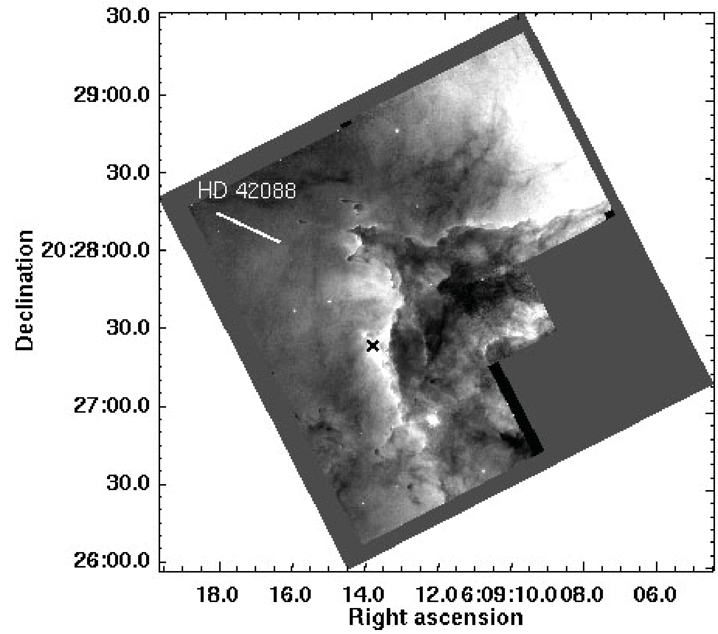


Figure 4. HST-WFPC2 image at 656nm of the region F. The direction of the ionizing source HD 42088 is shown. The black cross mark represents the location of the point source identified in the MIPS 24μm image.

place in the collected material at a radius of ~ 10 pc is found to be comparable to the difference in age of the ionizing star (~ 3-4Myr) and average age of the Class I/II YSOs projected on the shell (~ 0.5-1 Myr). The star formation in the shell is more likely due to gravitational instability in the collected material, such as seen in the massive condensation of RCW-120, where a chain YSOs are observed parallel to the ionization front. The radio source F is an extended one, with no internal heating source. The radio emission located ahead of the 8 μm emission (Figure 3) corresponds to the glowing gas in the optical image, thus, more likely due to the photo-evaporating gas from the surface of the cloud exposed to radiation. This phenomenon usually occurs when the massive star drives an ionization-shock front into the ISM, the external layers of the cloud exposed to radiation starts photo-evaporating, and can be seen as glowing layer of gas.
Apart from this, the high resolution HST image at Hα of region F (Figure 4) displays a number of `finger-tips' and `pillars' like fragments which are seen silhouetted against the bright background pointing towards the direction of HD 42088 giving an indirect evidence of massive star interaction. The most dense concentration of YSOs is in the close vicinity of the molecular clump located between the CH II regions A and B, with many YSOs of Class I nature (~ 10^5 yr), thus preferentially younger than the CH II regions A and B (~1-2 Myr). This clump is associated with water and methanol masers and does not show any radio emission (down to 0.4 mJy), suggesting that this is a site of high-mass star-forming protocluster at a very early evolutionary stage. We observed a cluster of YSOs, with the most massive one being ~ 8 $M_\odot$, thus reflecting it is indeed a site of cluster formation sandwiched between two relatively evolved CH II regions A and B. From these analyses and time scale involved, we argue that this region is undergoing a complex star formation activity and the massive star(s) of Sh2-252 is having a definite impact, resulting in new generation star formation and the region certainly deserves attention for high resolution molecular observations.

References

Jose, J., Pandey, A. K., Ogura, K. et al, 2012a, MNRAS, 424, 2486

Jose, J., Pandey, A. K., Samal, M. R. et al, 2012b, to be submitted

(This work has been presented in a conference on `Frontiers of star formation' held at ESTEC, The Netherlands, during 15 - 17 August, 2012).

-Jessy Jose

Publications

April - June 2012

(1) **Subramanian, P., Shukla, A.,** Becker, P. A. 2012, MNRAS 423, 1707-1710. *TeV blazar variability: the firehose instability ?*

(2) Frisch, H., **Anusha, L. S.**, Bianda, M., Holzreuter, **R., Nagendra,** K. N., Ramelli, R., **Sampoorna, M., Smitha, H.N.**, Stenflo, J.O., 2012, EAS Publications Series 55, 59-63.*Forward-scattering Hanle effect in the solar Ca i 4227 Å line.*

(3) Louis, R. E., Mathew, S. K., Bellot Rubio, L.R.,Ichimoto, K., **Ravindra, B.,** Raja Bayanna, A., 2012, ApJ, 752, 109, *Properties of Umbral Dots from Stray Light Corrected Hinode Filtergrams*

(4) **Ramesh, R.,** Lakshmi, M. A., **Kathiravan, C.,** Gopalswamy, N., Umapathy, S., 2012, ApJ, 752 *The Location of Solar Metric Type II Radio Bursts with Respect to the Associated Coronal Mass Ejections*

(6) **Chitta, L. P.**, van Ballegooijen, A.A., Rouppe van der Voort, L., DeLuca, E.E., **Kariyappa, R**., 2012, ApJ,752,48 *Dynamics of the Solar Magnetic Bright Points Derived from Their Horizontal Motions*

(7) Couvidat, S., **Rajaguru, S. P.,** Wachter, R., Sankarasubramanian, K., Schou, J., Scherrer, P. H. 2012., Solar Physics 278, 217-240 *Line-of-Sight Observables Algorithms for the Helioseismic and Magnetic Imager (HMI) Instrument Tested with Interferometric Bidimensional Spectrometer (IBIS) Observations*

(8) **Hiremath, K. M.,** Lovely, M. R., 2012, New Astr.,17, 392-398 *Toroidal magnetic field structure of the solar convective envelope inferred from the initial observations of the sunspots*

(9) Dupree, A. K., Brickhouse, N. S., Cranmer, S. R., Luna, G. J. M., Schneider, E. E., Bessell, M. S., Bonanos, A., Crause, L. A., Lawson, W. A., **Mallik, S. V.,** Schuler, S. C. and colleagues, 2012, ApJ 750, 73 *TW Hya: Spectral Variability, X-Rays, and Accretion Diagnostics*

(10) **Shukla, A.,** Chitnis, V. R., **Vishwanath, P. R.,** Acharya, B. S., **Anupama, G. C.**, Bhattacharjee, P., Britto, R. J., **Prabhu, T. P.,** Saha, L., Singh, B. B., 2012, A&A, 541,A140 *Multiwavelength study of the TeV blazar Mrk 421 during a giant flare.*

(11) **Smitha, H. N., Nagendra, K. N.,** Stenflo, J. O., Bianda, M., **Sampoorna, M.,** Ramelli, R., **Anusha, L.S.,** 2012.,A&A, 541, A 24 *J-state interference signatures in the second solar spectrum. Modeling the Cr i triplet at 5204-5208 Å*

(12) **Singh, J.**, **Belur, R**., Raju, S., Pichaimani, K., Priyal, M., Gopalan Priya, T., Kotikalapudi, A. 2012. RAA, Vol. 12, p. 201, 2012, Research in Astronomy and Astrophysics 12, 472 *Determination of the chromospheric quiet network element area index and its variation between 2008 and 2011*

(13) **Hiremath, K. M.,**2012, Planetary and Space Science 63, 8-14 *Magnetic Field Structure of Mercury*

(14) Paul, K. T., **Subramaniam, A.**, Mathew, B., Mennickent, R. E., Sabogal, B., 2012, MNRAS, 421, 3622-3640
Study of Candidate Be stars in the Magellanic Clouds using Near-Infrared Photometry and Optical Spectroscopy

(15) **Javaraiah, J.,** 2012. Astrophysics and Space Science 338, 217-226. *Solar Cycle Variations in the Growth and Decay of Sunspot Groups*

(16) ***Golovin, A.,*** *and 14 colleagues 2012,MNRAS, 421,132-148* *FR Cnc revisited: photometry, polarimetry and spectroscopy*

(17) **Singh, J., Ravindra, B.,** 2012, BASI, 40, 77 *Twin Telescope observations of the Sun at Kodaikanal Observatory*

(18) **Murthy, J.,** Conn Henry, R., Holberg, J.B., 2012, APJSS, 199, 11 *Voyager Observations of the Diffuse Far-ultraviolet Radiation Field*

(19) Gudennavar, S. B., Bubbly, S. G., Preethi, K., **Murthy, J.** 2012, ApJSS, 199, *8, A Compilation of Interstellar Column Densities*

(20) Hsieh, H.~H., and 41 colleagues 2012, ApJ 748, L15 *Discovery of Main-belt Comet P/2006 VW_{139} by Pan-STARRS1*

(21) **Hema, B. P., Pandey, G.**, Lambert, D. L.2012, ApJ, 747, 102 *The Galactic R Coronae Borealis Stars: The C_2 Swan Bands, the Carbon Problem, and the $^{12}C/^{13}C$ Ratio*

(22) **Sivaram, C.,** Arun, K., 2012, Astrophysics and Space Science 338, 1-2.*Some unique constants associated with extremal black holes*

*** Names in bold-faces are authors from IIA**
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Madras Observatory, the Origin of IIA, is attributed to the first false alarm of an extrasolar planet

As soon as the Copernican concept of Heliocentric world started getting recognization, it was predicted by several people including Sir Isaac Newton that stars similar to Sun should have planets around them. Serious attempts to detect extrasolar planets began as early as in nineteenth century. Historically, the first claim for the detection of extrasolarplanet was reported by Captain William Stephen Jacob (1813-1861) in 1855. Captain Jacob was the director of Madras Observatory of the East India Company during 1849-1858.The present Indian Institute of Astrophysics traces its origin to the Madras Observatory. In a scientific paper published in the Monthly Notices of the Royal Astronomical Society (*"On Certain Anomalies Presented by the Binary Star 70 Ophiuchi"*, Jacob, W. S. 1855, MNRAS, 15, 228 - 231), Captain Jacob suggested that the observed orbital anomalies in the binary star 70 Ophiuchi could be be explained if there was a planetary-mass object orbiting around one of the star. Subsequently, this suggestion was supported by astronomer Thomas Jefferson Jackson See of the University of Chicago in 1896 (*"Researches on the orbit of 70 Ophiuchi, and on a periodic perturbation in the motion of the system arising from the action of an unseen body"*,T. J. J. See, 1896, Astronomical Journal, 16, 17-23). Using the data taken from Leander McCormick Observatory of University of Virginia, See even deduced the orbital period of the planet to be 36 years. However, later on, F. R. Moulton demonstrated that such a three body system should be gravitationally unstable and subsequently it was found that the suggestion of Captain Jacob was a false alarm. The first confirmed exoplanet was reported by Michel Mayor and Didier Queloz of the University of Geneva in 1995 and since then 775 planets outside the solar system have been detected till date. False alarm for extrasolar planets still continues with Captain Jacob's suggestion recognized as the first one. Although it is now known that the analysis by both Jacob and See was erroneous, the possibility of a planet or a planetary system around 70 Ophiuchi is still not ruled out. Recently, a group of astronomers at McDonald Observatory in the US has put an upper limit on the mass of a planet or a planetary system around one of the stars in the 70 Ophiuchi binary system. Future observations, with more sophisticated instruments may reveal if 70 Ophiuchi indeed has a planet or not.

- Sujan Sengupta

(Link to the article by W. S. Jacob :
http://prints.iiap.res.in/handle/2248/5665 browse? type=subject&order=ASC&rpp=20&value=70+Ophiuchi)

भारतीय खगोल वेधशाला, हैनले – लद्धाख

2-मी हिमालय चन्द्रा दूरबीन के प्रथम 10 वर्ष के सफलतापूर्वक संचालन के अवसर पर हम-भारतीय खगोल वेधशाला, हैनले-लद्धाख - पर एक विस्तृत श्रृंखला का प्रकाशन पिछले अंक से प्रकाशित कर रहे हैं। आगे जारी है इसका अगला भाग

नवम्बर 1994 में पहला अभियान दल विभिन्न उपकरणों एवम् एक 20 इन्च परावर्ती दूरबीन के साथ लेह पहुँचा। लेह में स्वास्थ्य पर्यानुकूलन के लिए करीब एक सप्ताह रुखना आवश्यक था तभी दल के सदस्य हैनले की 15000 फीट ऊँचाई पर कार्य के लिए शारीरिक और मानसिक रूप से तैयार हो सकते हैं। यह पहला दल था इसलिए किसी भी प्रकार का जोखिम नहीं उठा सकते थे। लेह में इसी दौरान सदस्यों ने कड़ी ठंड में शून्य से नीचे तापमान एवम् उच्च तुंगता स्थित पहाड़ी जगहों पर स्वस्थ रहने और क्षमता पूर्वक कार्य करने के गुर भी सीखे। खगोलीय प्रेक्षणों और अन्य सम्बन्धित जानकारियाँ हासिल करने का उभ्यास भी किया। दिसम्बर के प्रथम सप्ताह में करीब 6-8 अनुभवी खगोल प्रेक्षकों ने हैनले में भारत तिब्बत पुलिस की अग्रिम चौकी परिसर के पास अपना एक अस्थायी प्रेक्षण केन्द्र स्थापित किया। भारत तिब्बत पुलिस विभाग ने इस कार्य में महत्वपूर्ण सहायता की। यह केन्द्र निर्वाचित **दिग्पा रत्सा रीपहाड़ी** के समीप तलहटी से करीब 4 किमी उत्तर में 14300 फीट पर स्थित था। क्योंकि हैनले एक अविकसित और एकान्त जगह है, आबादी भी बहुत कम, इसलिए इन कठिन परिस्थितियों में भारत तिब्ब्ति पुलिस विभागने ही कार्यरत् दल के सदस्यों की आवासीय भोजन और अन्य जरूरतों को पूरा किया।

जनवरी 1995 में 20 इन्च दूरबीन का संचालन भी आरम्भ हो गया। इस प्रकार से इस स्थान से क्षेत्र की बृहत् खगोलीय गुणवत्ता का वैज्ञानिक अध्ययन शुरू हो गया। अनवरत् दिन - रात मौसम की जानकारी, आसमान में बादलों की स्थिति, उनकी गहित एवम् आकार, वायु तापमान, सापेक्ष आर्द्रता इत्यादि का प्रेक्षण एकत्रित किया जाने लगा। 20 इन्च दूरबीन के फोकसमें लगाये गये सीसीडी कैमरा में

तारों के प्रेक्षण से प्रतिबिम्ब निर्माण की तीक्षणता का अध्ययन किया गया। यह कार्य निरन्तर चलता रहा एवम् समय-समय पर उपलब्ध आंकड़ों का विश्लेषण भी जारी रहा। जुलाई 1995 में वास्तविक चोटी पर एक स्वचालित मौसम केन्द्र की स्थापना की गयी जिससे हमें हर मिनट की मौसम सम्बन्धी जानकारी उपलब्ध हो गयी। 20 इन्च दूरबीन से युगल किरण पुन्ज विधि द्वारा प्रतिबिम्ब निर्माण में वायुमण्डलीय विक्षोभ के प्रकाशीय प्रेक्षणों का आंकलन किया गया। इस दौरान प्रेक्षण कार्य लगातार दूसरेसालभीजारी रहा। स्थानीय लोगों को भी इस कार्य में प्रशिक्षित किया। जुलाई 1996 में 20 इन्च दूरबीन भी 15000फीट ऊँचाईपर स्थापित कर वास्तविक चोटी से ही खगोलीय गुणवत्ता अध्ययन प्रारम्भ किया। इस दौरान एकत्रित आकड़ों के विश्लेषणों से आभास होने लगा था कि यह जगह वैज्ञानिक रूप से भी भारत में खगोलीय दूरबीन स्थापना के लिए एक उत्कृष्ट स्थान हो सकता है, अत: एक सम्पूर्ण वेधशाला के लिए आवश्यक मूल भूत सुविधाएं जुटाने का आरम्भिक प्रयास भी शुरू किया।

लदादाख क्षेत्र में भौगोलिक रूप से ग्रीष्म और शीत दो ही मौसम होते हैं। शीत काल में वर्ष के लगभग 6 महीने से जयादा अवधि तक लद्दाख का शेष भारतसे सड़क संपर्क कटा रहता है। लेकिन लद्धाख के अन्दुरूनी क्षेत्र में सड़क संपर्क हमेशा वर्ष भर बना रहता है । इसका मात्र एक शहर, लेह जो प्रशासनिक मुख्यालय भी है पूरेवर्ष वहाई यातायात से जुड़ा रहता है। इसीलिए सन् 1995 मई में लेह शहर में बड़ी दूरबीन परियोजना का कार्यालयएवम्कार्यकारी दल के लिए आवासीय सुविधा की व्यवस्था की गई। वर्ष 1996 के मध्य से हैनले में भी धीरे - धीरे चोटी के ठीक नीचे स्वयम् का आधार शिविर स्थापित करना शुरू किया और अक्तूबर1996 में पुलिस परिसर से अपना सभी संचालन आधार शिविर में स्थानांतरित कर दिया। आधार से ही हम चोटी पर पहुँचकर दूरबीन का संचालन कर अन्य ऑकड़ों को एकत्रित किया। इस दौरान सीमा सड़क संगठन द्वारा आवासीय सुविधा हेतु प्री फैब्रिकेटेड स्नो शैल्टर उपलब्ध कराये गए और इन्हें आधार शिविर और चोटी में स्थापित किया गया। सीमा सड़क संगठन ने आधार से चोटी पर पहुँचने के लिए सड़क मार्ग बनाने के लिए सर्वे भी प्रारम्भ किया।

<u>भारतीय खगोल वेधशाला का जन्म:</u> इस प्रकार दो वर्षों में एकत्रित सभी जानकारियों एवम् आकड़ों का बृहत् वैज्ञानिक विश्लेषण किया गया और यह पाया गया कि इस स्थान पर रात्रिकालीन आकाश साल में 260 - 280 दिनों तक उच्च कोटि के खगोलीय प्रेक्षणों के लिए उपलब्ध रहता है। मानसून अवधि में भी आसमान अधिक समय तक साफ रहता है। सापेक्ष आर्द्रता काफी कम है। वारिश एवम् बर्फ के कुल संकलित पानी का माप बहुत कम है। हवा की गति भी मान्य मात्रा से कम है और चोटी की भौगोलिक स्थिति एक आदर्श खगोलीय गुणों को इंगित करती है। इस अध्ययन की विस्तृत रिपोर्ट तैयार कर भारत सरकार को सौंपी गयी और हैनले में एक विश्व स्तर की उच्च तुंग खगोलीय वेधशाला बनाने का मार्ग प्रशस्त हुआ। हालांकि परिस्थितियाँ काफी कठिन थी और इस तुंगता पर सम्पूर्ण वेधशाला की स्थापना एक चुनौती थी इसलिए सन् 1997 में भारत सरकार द्वारा खगोलविदों की इस स्थान पर कार्य करने की क्षमता के परीक्षण के तौर पर एक अत्याधुनिक 2 मी व्यास की एक परावर्ती दृश्य प्रकाशीय और निकट अवरक्त वर्णक्रम दूरबीन की योजना की सहमति प्रदान की। भारतीय खगोलविदों ने इस चुनौती को सहर्ष स्वीकार किया और योजना को मूर्थरूप देने में जुट गये।

इस दौरान हैनले में सभी प्रकार के आंकडे एकत्रित करने का कार्य जारी रहा। इस कार्य में कुछ अतिरिक्त महत्वपूर्ण परीक्षण भी जुड़ते गये। चोटी पर 100 फीट ऊँची टॉवर से वातावरण की सतहों पर सूक्ष्म ताप विक्षोभा के आकड़े एकात्रित करने का कार्य शुरू किया। दूरबीन भवन और छत के निमार्ण हेतु विशिष्ट सामग्री का आवश्यक अनूकूल परिस्थिति का परीक्षण किया गया। जम्मू एवम् कश्मीर सरकार ने सम्पूर्ण पहाड़ी के 650 एकड़ क्षेत्र को वेधशाला के लिए हस्तान्तरित किया। सीमा सड़क संगठन ने आधार शिविर पर अन्य मूलभूत आवासीय सुविधाओं का निर्माण किया गया। वाहनों आवागमन के लिए हैनले मठ से चोटी तक सड़क निर्माण शुरू किया। सितम्बर-अक्तूबर 1997 में चोटी के समीप ही जरूरी तकनीकी और अन्य सामान के भंडारण के लिए एक बड़े गोदाम का निर्माण किया गया।

इस प्रकार 16 अक्तुबर 1997 को हैनले की प्रस्तावित **दिग्पा रत्सा री** पहाड़ी को सरस्वती पर्वत का नाम दिया। इसी दिन तत्कालीन मामहित राज्यपाल, जम्मू एवम् कश्मीर राज्य जनरल के वी कृष्णाराव, परम विशिष्ट सेवा मैडल ने भारतीय खगोल वेधशाला की आधार शिला रखा 2 मी दूरबीन भवन का शिलान्यास किया।

<u>2 मी हिमालयन चन्द्रा दूरबीन का उद्‌भव:</u> इस दौरान बंगलौर मुख्यालय में 2 मी केसेग्रेइन फोकस तल दृश्य और निकट अवरक्त वर्ण कम दूरबीन के बारेमें और फोकस तल उपकरणों के बारे में गहन अध्ययन एवम् विचार विमर्श हुआ। इस प्रकार एक अत्याधुनिक तकनीक से लैस 2 मीटर दूरबीन निर्माण कार्य कमरीकी - आस्ट्रलियायी ईओएसटी कम्पनी को दिया गया। इस कम्पनी को भारतीय दल द्वारा प्रस्तावित दूरबीन को सुझायी गई विशिष्टताओं के आधार पर बनाने के लिए अनुबंधित किया।

आगामी तीन वर्षों में संथान के लिए एक आधुनिक वेधशाला की स्थापना का कार्य प्राथमिकता में रहा लेकिन हमारी अन्य गतिविधियॉ भी अबाध रूप से जारी रहती हैं। 1998 गर्मी में 14 इन्च मीड दूरबीन भी स्थापित की गयी थी और इससे खगोलीय आकड़े को और परिष्कृत रूप से लम्बी अवधि तक लेना संभव हुआ। इस सारी अवधि में स्थल परीक्षण के अन्य मौसम और बादल संबंधित प्रेक्षण बिना रूकावट के लगातार एकत्रित किये जाते रहे। एक सीमित दल हमेशा हैनले में रहा और अब इस कार्य में स्थानीय लोगों की मदद से स्थल परीक्षण कार्य बादलों की गणना इत्यादि का कार्य चलता रहा। मीड दूरबीन से युगल किरण पुन्ज विधि द्वारा प्रतिबिम्ब निर्माण में वायुमण्डलीय विक्षोभ के दृश्य प्रेक्षणों का आंकलन जारी रहा। लेह-हैनलेस्थित वैज्ञानिकों/इन्जिनियरों का हमेशा बंगलौर मुख्यालय संवाद होता रहा और 2 मी दूरबीन स्थापना की प्रगति समीक्षा में भाग लेकर आने वाले गर्मी के मौसम की सीमित अवधि में किये जाने वाले कार्यों के लिए आवश्यक संसाधनों को एकात्रित कर स्वयम् की तैयारी में जुटे रहते। यहॉ इस बात की जानकारी देना जरूरी है कि लद्दाख क्षेत्र में भौगोलिक रूप से ग्रीष्म और शीत दो ही मौसम होते हैं। इस प्रकार मई से लेकर अक्तूबर प्रथम सप्ताह तक ही

निर्माण सम्बन्धी गतिविधियां हैं और इसके बाद परियोजना से सम्बन्धित सक्रिय कार्यकलापों को विराम देना पड़ता है। लद्धाख में प्रत्येक जरूरी निर्माण सामग्री एवम् कार्यबल के लिए देश -प्रदेश के दूसरे हिस्सों पर निर्भर रहना पड़ता है। काम करने वाले प्रवासी मजदूर, राज मिस्त्री और अन्य विशेषज्ञ कार्य करने वाले लोग ठंड के आगमन और सड़क संपर्क बन्द होने से पहले लद्धाख से वापस चले जाते हैं। इस प्रकार जाड़ो का मौसम विशेष रूप से निर्माण कार्य के लिए सक्रिय नहीं रहता है। वर्ष 1997-2000के बीच की संक्षिप्त अवधि में ही सम्पूर्ण परियोजनाको मूर्थ रूप देने के लिए हमारे संस्थान के वैज्ञानिकों, खगोलविदों,इन्जीनियरोंएवम् तकनीशियनों ने महत्वपूर्ण योगदान किया। इस अवधिकेदौरान गर्मी के मात्र तीन सत्र गतिविधियों के हिसाब से बहुत सक्रिय रहे। 1998 सत्र से ही वेधशाला स्थापना का वास्तविक कार्य जोर शोर से प्रारम्भ हुआ। चोटी के लिए सड़क निर्माण शुरू किया गया। वेधशालाकी ऊर्जा जरूरतों के लिए डीजल जेनरेटरों को स्थापित किया। 160 किलोवाट क्षमता के दो सौर विद्युत संयन्त्र की शुरूआत की गयी। हैनले तथा बंगलौर के बीच संचार सुविधाओं का उच्चीकरणि किया गया। लेह स्थित कार्यालय और गैस्ट हाउस सुविधाओं का विस्तार किया। हैनले आधार शिविर में आवासीय आश्रय/कुटीरों का निर्माण किया।

वर्ष 1999-2000 के ग्रीष्म कालीन सत्र में बंगलौर से बहुत सारे विशेषज्ञ दलों ने हैनले का दौरा किया और लेह/हैनले में लम्बे समय तक प्रवास कर दूरबीन योजना के लिए मैकेनिकल, विविल,ऑप्तिकी, विद्युत एवम् वैद्युतिकी और कम्प्यूटर संचार से सम्बन्धित रूपरेखाओं पर चर्चा कर विभिन्न कार्यों को पूर्ण किया। चोटी पर दूरबीन स्थल को आधार शिविर एवम् हैनले मठ से सड़क मार्ग से जोड़ दिया और आवागमन और सामान परिवहन के लिए सुविधा हो गयी। इस प्रकार से सन् 2000 जून तक वेधशाला से सम्बन्धित लगभग सभी कार्य पूर्ण किये गये और सौर ऊर्जा, नत्रजन द्रवीकरण संयन्त्र, दूरभाष विनिमय केन्द्र, विद्युत नियन्त्रण एवम् कम्प्यूटर संचार और उपग्रह संचार उपकरणों का गहन परीक्षण कर प्रयोग के लिए जारी किये। 2 मी दूरबीन के लिए कंकीट स्तंभ, भवन एवम् डोम इत्यादि भी तैयार हो गया। आधार शिविर परिसर में एक सुविधापूर्ण आवास का भी निर्माण किया गया।

यहां इस बात का उल्लेख करना आवश्यक है कि इस सम्पूर्ण अवधि में स्थानीय प्रशासन से हम लगातार संपर्क में रहे और विभिन्न स्तरों पर सहयोग भी लिया। लद्धाख स्वशासी विकास परिषद् को हम लगातार परियोजनाकी प्रगति की जानकारी भी देते रहे। स्थानीय प्रशासन के साथ-साथ लेह स्थित भारतीय सेना 14 कोर मुख्यालय, भारतीय वायुसेना, भारतीय रक्षा अनुसंधान केन्द्र, सीमा सड़क संगठन एवम् भारत तिब्बत सीमा पुलिस इत्यादि संगठनों ने अपने संसाधनों के उपयोग की अनुमति देकर परियोजना के विभिन्न कार्यों के पूर्ण होने में महत्वपूर्ण निभायी। इस दौरान लद्धाख क्षेत्र के रहनेवाले प्रशिक्षित योग्य इन्जीनियरों और तकनीशियनों की खोज कर उन्हें गहन प्रशिक्षण दिया गया और परियोजना के हर पहलू से अवगत कराया गया इस प्रकार से वेशधाला से सम्बन्धित सभी सयन्त्रों/ उपकरणों की स्थापना में इन सभी की भागीदारी रही।

इस दौरान कई विशेषज्ञों ने अमरीका दौरा कर प्रस्तावित दूरबीन के निर्माण एवम् संयोजन में हिस्सा लेकर यह सुनिश्चित किया कि यह हमारे द्वारा दिये गये मानकों के अनुसार हो और उनकी प्रयोगशाला में ही दूरबीन के संचालन से सम्बन्धित सभी प्रकार के परीक्षण किये गये। उनकी प्रयोगशाला में कुछ वैज्ञानिकों को दूरबीन के संचालन से सम्बन्धित तकनीक एवम् कार्य प्रणाली का प्रशिक्षण भी दिया गया। गहन परीक्षणों में खरा उतरने के बाद दूरबीन और अन्य सम्बन्धित सभी उपकरण को पैक कर समुद्री मार्ग से भारत भेजा। यह सामान जुलाई 2000 में भारतीय तट में गुजरात पहुँचा और वहाँ से सडक मार्ग द्वारा चन्डीगढ़ वायुसेना इकाई में भेजा गया। यह सभी सामान वायुसेना के आई एल -76 परिवहन विमानों में चढ़ाया गया। वायुमार्ग से अगस्त 2-4, 2000 की अवधिममेंललेह पहुँचा और भारतीय वायुसेना परिसर में उतारा गया। भारी सामान के बॉक्सों को विमान से उतारनेकके केन इत्यादि उपकरण और कार्यबल भारतीय सेना की पूर्ति एवम् सिगनल इकाइयों ने उपलब्ध कराये। इस दौरान सीमा सड़क संगठन ने लेह से हैनले तक सड़क मार्ग को भारी एवम् बड़े आकार के सामान के सुरक्षित परिवहन के लिए कई जगहों पर सड़क विस्तारीकरण/ चौड़ीकरण का कार्य किया। मार्ग में पड़ने वाले कई छोटे-बड़े पुलों का सुदृढ़ीकरण किया। दूरबीन के सभी पैक हिस्सों/बॉक्सों को भारतीय सेना और सीमा सड़क संगठन के विशेष परिवहन वाहनों में लाद कर सम्पूर्णदल ने 17 अगस्त 2000 प्रातः लेह से हैनले के लिए प्रस्थान किया। सम्पूर्ण मार्ग में सेना ने इस परिवहन दल को सूरक्षा प्रदान की। आसान परिवहल के लिए सेना द्वारा जगह पर विपरीत दिशा से आने वाले वाहनों को रोका गया। दल के किसी वाहन के फेल होने या रेत में धँसने की स्थिति के लिएराहन दल और केन उपलब्ध करायी। सीमा सड़क ने मोबाइल कर्मशॉप दल एवम् अतिरिक्त वाहन की व्यवस्था भी की। पूरे मार्ग में परिवहन के दौरान सेना द्वारा हर पल की स्थिति सम्बन्धित अधिकारियों तक पहुँचायी गयी। इस प्रकार से सभी वाहन सामान लेकर 18 अगस्त 2000 की शाम सुरक्षित हैनले 2 मी दूरबीन स्थल पहुँचे। सभी सामान को उतारकर एक सुविधाजनक जगह पर सुरक्षित रखा गया जहाँ से इन्हें दूरबीन भवन में आसानी से चढ़ाया जा सके।

इसी दौरान दूरबीन निर्माण की ईओएसटी कम्पनी के अमरीकी इकाई के कई इन्जीनियर और तकनीशियन हैनले पहुँचे और दूरबीन का संयोजन कार्य प्रारम्भ किया। सर्वप्रथम 2 मी दूरबीन के लिए बनाये गये कंकीट स्तंभ में भारी भरकम एजिमथ बेस को स्थापित किया और फिर इस पर दूरबीन के अलग अलग हिस्सों को जोड़ कर 2 मी व्यास का परावर्ती दर्पण समायोजित किया और एक सम्पूर्ण अत्याधुनिक तकनीक से सुसज्जित खगोलीय दूरबीन का जन्म हुआ। दूरबीन की सम्पूर्ण कार्य प्रणाली को सौर ऊर्जा संयन्त्र से जोड़ा गया। 26 सितम्बर 2000 की देर शाम इस दूरबीन को हैनले के आसमान की ओर इंगित किया और सुदूर अन्तरिक्ष से आकर प्रथम

प्रकाश पुन्ज ने 2 मी व्यास के परावर्ती दर्पण से केसेग्रेइन फोकस तल में प्रथम प्रतिबिम्ब का निर्माण किया। भारतीय खगोलिकी में यह एक ऐतिहासिक क्षण था। इस घटना के समय हैनले में भारतीय खगोलिकी के पुरोधा प्रोफेसर यशपाल की अनुवायी में कई महत्वपूर्ण वैज्ञानिक भी उपस्थित थे और इस प्रथम प्रकाश पुन्ज प्रेक्षण के साक्षी बने। इस प्रकार हिमालयनचन्द्रा दमरबीन का जन्म हुआ। यह नाम भारतीय मूल के नोबेल पुरस्कार विजेता प्रख्यात खगोलविद् चन्द्रशेखर सुब्रह्मनियम को याद करके दिया गया।

लेकिन असली चुनौती अभी समाप्त नहीं हुई थी। अमरीकी सदस्य प्रेक्षण से संबंधित आरम्भिक कार्य एवम् प्रशिक्षण देकर वापस चले गये। ठंड का मौसम शुरू हो गया था। तापमान शून्य से 5-10 डिग्री से नीचे तक जाने लगा था। डोम घुमाने के लिए आवश्यक स्वचालित व्यवस्था नहीं हो पायी थी और तीसरी मंजिल के प्रेक्षण तल में खुले आसमान में रहकर दूरबीन की स्थिति के अनुसार डोम घुमाने के लिए एक तकनीशियन का उपस्थित रहना आवश्यक था। दूरबीन नियन्त्रण कक्ष भी ठंड के लिए वातानुमूलित नहीं था। लेकिन संस्थान के समर्पित दल ने अगले पूरे 4-5 महीने के दौरान विभिन्न तकनीकों शैक हार्टमन विधि, समान्तर सरेखण विधि आदि द्वारा दूरबीन के परिचालन एवम् तीक्षण फोकस युक्त प्रतिबिम्ब निर्माण के लिए कई गहन परीक्षण किये। एकत्रित प्रेक्षणों का विश्लेषण कर लक्ष्य ग्रहण क्षमाता एवम् दूरबीन अनुगामिता सामर्थ्य का आंकलन किया।

शेष अगले अंक में जारी

-भुवन चन्द्र भट्ट

Transit of Venus

Following are the photos of Venus Transit of 6th June 2012 taken by Prasanna Deshmukh from Dept. of Applied Optics and Photonics, Calcutta University, Kolkata, India. All the photos were taken using CanonSX150IS digital camera and a Mylar filter (Without using Telescope).

-Prasanna Deshmukh

Farewell

IIA wishes all the best to ...

... Swapan Kumar Saha retired from the services of IIA on the afternoon of 31.5.2012. He retired at the age of 62 after a two year extension. He has joined the services of IIA at Kodaikanal on 10.01.1981 as Senior Research Assistant. He was elevated to various positions during his career at IIA, and retired as Professor.

... G. Narayana has voluntarily retired from IIA on 30.04.2012. He joined the services of IIA at Bangalore on 25.08.1982 as Helper "A" and retired as Laboratory Attendant "B".

... Alphonse Mary retired from IIA on the afternoon of 31.05.2012 on attaining the age of superannuation. She joined the services of IIA at Kodaikanal on 1.1.1973 as Lower Division Clerk. She was elevated to various positions and retired as Sr.Office Superintendent Gr.-II.

Retracing Transit of Venus - Connection to Madras Observatory

Transit of Venus that occurred in 1874 and 1882 and seen in India, drew enormous public and scientific interest. The Madras Observatory, being the premier centre for astronomy those days, made elaborate arrangements for transit observations.

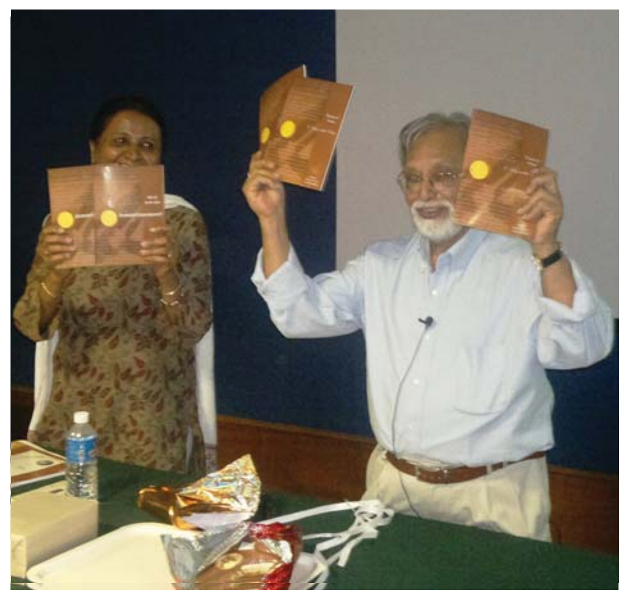
Chintamany Ragoonatha Chary, the first assistant at the Madras observatory, was a man who possessed an enormous knowledge of both traditional sidhanthic astronomy as well as modern astronomy. He undertook to describe this beautiful celestial event and educate the public. Ragoonatha Chary, with encouragement from N. R. Pogson, then the Government astronomer at the Madras Observatory, brought out a pamphlet. Originally written in Tamil, it described with illustrations the phenomenon of transits (over the Sun), their circumstances and how they are observed.

The Indian Institute of Astrophysics, has inherited this legacy and possesses copies of the pamphlet in English, Kannada and Urdu in its archives. The reprinted editions in English and Kannada versions of "Transit of Venus" were brought out by IIA Archives before the worldwide event of Transit of Venus on June 6, 2012.

This Archives publication was officially released by N. Kameswara Rao, former Senior Professor of IIA on the 25th May 2012, after his talk on *"Ragoonatha Chary and his Astronomy at Madras Observatory"* delivered at IIA.

-Christina Birdie,
Librarian, IIA

Chintamany Ragoonatha Chary



Release of the IIA Archives publication on "Transit of Venus" by Prof. N. K. Rao

Chandrasekhar Post-Doctoral Fellowship

The Director, IIA invites applications from exceptionally bright candidates with outstanding academic credentials for the award of 'Chandrasekhar Post-Doctoral Fellowships' in all areas of astrophysics. Applications are accepted at any time of the year. The fellowship is for an initial period of two years, extendable to three, with a monthly stipend of Rs.50,000/- to Rs. 55,000/- for candidates with up to 2 years post-doctoral experience and Rs 55,000/- to 60, 000/- for those with more than two years experience. An annual contingency grant of Rs.2,00,000/-, housing and medical benefits, and support for travel to Bangalore. More details are at http://www.iiap.res.in/postdoc.htm.

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