भातासं सूचनापत्र

IIA Newsletter

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March 2012

In this issue...

The Second Visit of the IIA Scientific Advisory Committee

Members of the Scientific Advisory Committee (SAC) with the Director of IIA (from left to right): George Joseph, N. Kumar, Nigel O. Weiss, S. S. Hasan, Michael Dopita, Dimitar Sasselov and S. Ananthakrishnan.

The Scientific Advisory Committee (SAC) visited the Institute for the second time from March 5 through March 9, 2012. Its previous visit was in March 2010. The composition of the Committee is as follows: Nigel O. Weiss, FRS (Chair), Michael Dopita, Dimitar Sasselov, N. Kumar, George Joseph and S. Ananthakrishnan. Several individual and group presentations were scheduled in order to give the Committee a flavor of multifarious prgrammes and facilities of the Institute. In addition, interactive sessions were held with individual scientists and various groups.

The sessions on March 5 included a Report by the Director, Overview of Academic Activities (Dean), Graduate Studies & Training Programmes (Chair, BGS), followed by presentations on new programmes: the proposed National Large Solar Telescope, and the Visible Emission-Line Coronagraph on board Aditya-1. Discussions on the new programmes continued through the second day, with presentations on the UltraViolet Imaging Telescope, Hanle Echelle Spectrometer, update on Indian participation in the Thirty Meter Telescope Project, and a proposal to participate in the GALEX project. This was followed by an overview of activities of the four Group Committees, and visits to the new computer centre, various laboratories, the library and archives.

Students interacting with members of the Science Advisory Committee.

On March 7, there were presentations on two other facilities: the Gauribidanur Radioheliograph, and the Indian Astronomical Observatory, Hanle. Four young scientists made presentations on their research and development activities: R.K. Banyal (Development of Adaptive Optics), P. Chingangbam (Probing the Statistical Properties of the CMB), G. Pandey (Studies on Hydrogen-Deficient Stars), and A. Goswami (Studies on Carbon-Enhanced

SAC at Data Center (left) and at Students Lab (Integrated PhD).

The Committee visited CREST Campus and in particular the M.G.K. Menon Laboratory for Space Sciences where the flight model of UltraViolet Imaging Telescope is undergoing final calibration and integration.

SAC Members visit the Optics Lab at CREST Campus.

SAC Members witnessing a test launch of a balloon at CREST campus. These balloon flights will provide a test-bed for future space instruments.

Metal-Poor Stars and Galactic Chemical Evolution).

The Committee was also apprised of the activities of the administration and new civil works that include the I.Ph.D. laboratories, additional rooms for students on campus and the guest house cum conference centre at Kodaikanal, that is nearing completion..

The SAC had interactive sessions on March 7, with students, post-doctoral fellows, and several individuals and groups. There was also a photography session organized with staff and with students that afternoon.

Finally, The Committee visited the CREST campus on March 8, and in particular, the M.G.K. Menon Laboratory for Space Sciences where the flight model of UltraViolet Imaging Telescope is undergoing final calibration and integration.

-Tushar Prabhu
Dean, IIA

Vainu Bappu Memorial Lecture: The Chaotic Dynamo in the Sun

The Vainu Bappu Memorial Lecture Award for the year 2012 was awarded to Professor Nigel O. Weiss, FRS, University of Cambridge, Cambridge, UK. This was the 5th time the VBM Lecture was awarded, and it was held on the evening of the 9th of March, 2012 in the Auditorium on campus at IIA, Bangalore. Following a high tea in the West Lawns of the Institute, the event started with Siraj S. Hasan, director of IIA, introducing Nigel Weiss, reading out the award citation and handing over the roll of honour and a bouquet to Weiss. Weiss titled his lecture as *'The Chaotic Dynamo in the Sun'*, in which he gave a masterly account of what we have learnt so far on the origins of cyclic magnetic activity of the Sun as controlled by a non-linear magnetohydrodynamic dynamo operating within it.

Nigel O. Weiss receives the Vainu Bappu Memorial Lecture award for 2012 from Siraj Hasan, Director, IIA.

Weiss focussed on the progress in modeling the nonlinear dynamical behaviour of the solar dynamo, and especially the longer time scale modulation of it, as revealed by, for example, the 17th century grand minimum called Maunder minimum. He discussed how proxy data allow the record to be extended back for almost 10,000 years, and the chaotic nature of such modulations.He related the transitions from periodic oscillations to chaotically modulated cycles to those seen in idealized nonlinear model calculations, and explained that such transitions are an intrinsic feature of these dynamos. He reasoned that future behaviour cannot be readily predicted. Pointing out that the Sun's activity has been abnormally high for the past 60 years, he noted that the feeble start of the current cycle might suggest that this episode is coming to an end.

Nigel Weiss is Emeritus Professor of Mathematical Astrophysics in the Department of Applied Mathematics and Theoretical Physics (DAMTP) at the University of Cambridge, and a Fellow of Clare College. He is a Fellow of the Royal Society (1992) and a former President and Gold Medallist of the Royal Astronomical Society. He obtained his PhD in geophysics under Sir Edward Bullard but his research has focused on solar and stellar magnetic fields, on magnetoconvection and on nonlinear dynamics. Much of his work has involved numerical computation, studying idealized model systems that have grown increasingly complex as computers became more powerful. Lately,

Weiss has focussed his research on furthering the understanding of peculiar variations in the solar cycle properties in terms of chaotic dynamics. Weiss has mentored a large number of PhD students and several of them have established themselves as leaders in the fields of astrophysical fluid dynamics.

Weiss has visited the Indian Institute of Astrophysics several times and has served as Chair of the Institute's Scientifc Advisory Committee.

- S. P. Rajaguru

Carbon Abundances and $^{12}C/^{13}C$ Ratios for R Coronae Borealis Stars

R Coronae Borealis (RCB) stars are a rare class of F- and G-type supergiants with their remarkable photometric and spectroscopic peculiarities. The photometric peculiarity is that, they undergo optical decline upto several magnitudes at unpredictable times, and this fading is attributed to the formation of dust in the line-of-sight. Spectroscopic peculiarity is that, they have very weak or undetectable H-Balmer lines in their spectra, indicating that they have a very H-poor atmosphere. This hydrogen deficiency but not the propensity to undergo optical declines is shared by other rare classes of stars: extreme helium (EHe) stars at the hotter end and hydrogen-deficient carbon (HdC) stars at the cooler end of the RCB temperature range.

Keys to understanding origins of H-deficient stars come from the determination and interpretation of the surface chemical composition. There are two scenarios in contention which may be responsible for the origin of these stars. In one dubbed the double degenerate (DD) scenario, a helium white dwarf merges with a carbon-oxygen (C-O) white dwarf, and an alternative scenario dubbed the final flash (FF) scenario involves a single post-asymptotic giant branch (AGB) star experiencing a final helium shell flash which causes the H-rich envelope to be ingested by the He shell. The chemical composition studies on RCB stars favour the DD rather than the FF scenario. The carbon abundances and the $^{12}C/^{13}C$ ratios in these stars play a key role in understanding their origin and evolution.

High-resolution optical spectra of RCB/HdC stars are obtained from the W. J. McDonald Observatory and the Vainu Bappu Observatory. The (0,1) and (0,0) C_2 Swan bands are used to derive the ^{12}C abundances, and the (1,0) $^{12}C^{13}C$ band to determine the $^{12}C/^{13}C$ ratios. The carbon abundances derived from C I lines are about a factor of 4 lower than that of the adopted model atmosphere, as reported by Asplund et al. (2000, A&A, 353, 287) and was dubbed as 'carbon problem'. To further explore the 'carbon problem', we have derived the carbon abundances using the C_2 Swan bands (see Figure 1). The carbon abundances derived from C_2 bands are independent of the carbon abundances adopted for the construction of model atmospheres, and hence, eliminates the 'carbon problem'. The C abundances derived from C_2 Swan bands, for the RCB and HdC sample are about 10 times lower than their close relatives, the EHe stars. This mismatch, if not a reflection of different modes of formation, implies that the C abundances for RCB and HdC stars are subject to a systematic error. Nonetheless, that the carbon abundances derived from C_2 Swan bands are the real measure of the carbon abundances in these stars cannot be ruled out.

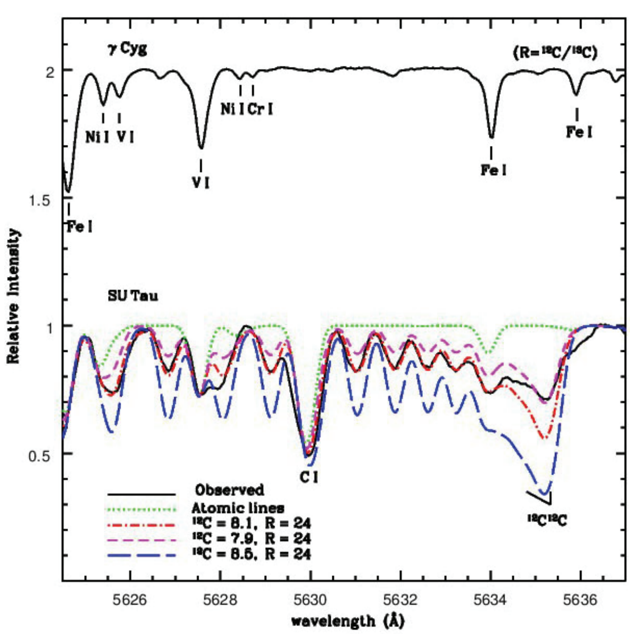

Figure 1 . Observed and synthetic spectra of the (0, 1) C_2 band for SU Tau. The spectrum of gamma Cyg is also plotted as a reference for atomic lines.

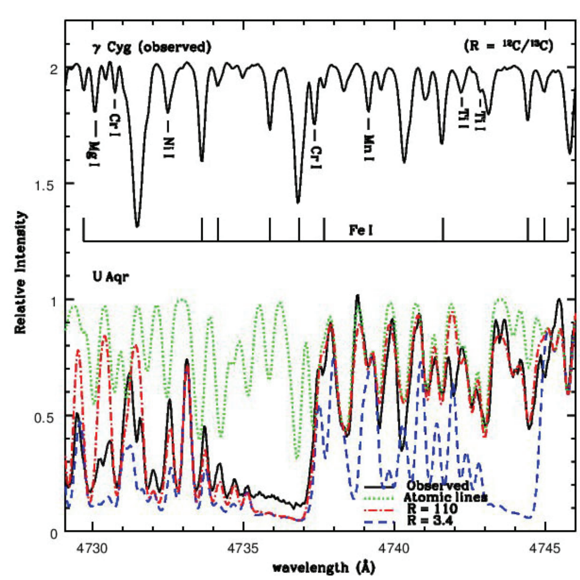

Figure 2. Observed and synthetic spectra of the (1, 0) C_2 bands for U Aqr. The spectrum of gamma Cyg is also plotted as a reference for atomic lines.

Since, the $^{12}C^{13}C$ (1,0) and $^{12}C^{12}C$ (1,0) bandheads are well separated, the (1,0) C_2 Swan band is used to determine the $^{12}C/^{13}C$ ratios (see Figure 2). The $^{12}C/^{13}C$ ratios are determined for 12 RCB and 4 HdC stars. From our results, the majority RCB stars and all HdC stars are having high value of $^{12}C/^{13}C$ ratio, as expected for DD scenario. But, the two minority RCBs: VZ Sgr and V CrA, are having low $^{12}C/^{13}C$ ratios similar to the CN-cycle equilibrium value.

This work is done in collaboration with Gajendra Pandey and David Lambert and has been published in the ApJ, 747, 102, 2012.

- B. P. Hema

Publications

January - March 2012

Golovin A.,... along with 9 authors, **Parihar P. S.,** Henden A., Sergeev A., Zaitsev S. V., Karpov N., 2012. *FR Cnc revisited: photometry, polarimetry and spectroscopy. MNRAS 421, 132-148*

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

Murthy J., Henry R. C., Holberg J. B., 2012. *Voyager Observations of the Diffuse Far-ultraviolet Radiation Field. ApJS 199, 11*

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

Hsieh H. H., ... along with 33 authors, **Bhatt B. C., Sahu D. K.,** Kaiser N., Chambers K. C., Hodapp K. W., Magnier E. A., Price P. A., Tonry J. L., 2012. *Discovery of Main-belt Comet P/2006 VW$_139$ by Pan-STARRS1. ApJL 748, L15*

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

Sivaram C., Arun K., 2012. *Some Unique Constants associated with Extremal Black Holes. Ap&SS 338, 1-2*

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Mathew B., Banerjee D. P. K. Ashok N. M., **Subramaniam A.,** Bhavya B., Joshi V., 2012. *Studies of a possible new Herbig Ae/Be Star in the Open Cluster NGC 7380. RAA12, 167-176*

Suryanarayana G. S., 2012. *Coronal Type II Bursts and Interplanetary Type II Bursts: Distinct Shock Drivers. New Astronomy 17, 117-129*

Paul K.T., **Subramaniam A.,** Mathew B., Mennickent R. E., Sabogal B., 2012. *Study of candidate Be stars in the Magellanic Clouds using near-infrared photometry and optical spectroscopy. MNRAS 2507*

Arellano Ferro, A., Bramich D. M., Figuera Jaimes R., **Giridhar S., Kuppuswamy K.,** 2012. *The unusually large population of Blazhko variables in the globular cluster NGC 5024 (M53). MNRAS 420, 1333-1346*

Kumar D., Gangadhara R. T., 2012. *Relativistic Model on Pulsar Radio Emission and Polarization. ApJ 746, 157*

Anusha L. S., Nagendra K. N., 2012. Polarized Line Formation in Multi-dimensional Media. *V. Effects of Angle-dependent Partial Frequency Redistribution. ApJ 746, 84*

Beers, T. C., **... along with 11 authors, Sivarani T.,** Wilhelm R., Yanny B., York D. G., 2012. *The Case for the Dual Halo of the Milky Way. ApJ 746, 34*

Sivaram, C., Arun K., 2012. *Some aspects of rotational and magnetic energies for a hierarchy of celestial objects. apss 337, 767-771*

Palacios A., Parthasarathy M.,**Bharat Kumar Y.,** Jasniewicz G., 2012. *Weak G-band stars on the H-R diagram: clues to the origin of the Li anomaly. A&A 538, A68*

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

First, published online 31 January, 2012

Singh V., Risaliti G., Braito V., **Shastri P.,** 2012. *Suzaku X-ray spectral study of the Compton-thick Seyfert galaxy NGC 5135. MNRAS 419, 2089-2094*

Reddy A. B. S., Giridhar S., Lambert D. L., 2012. *Comprehensive abundance analysis of red giants in the open clusters NGC 752, 1817, 2360 and 2506. MNRAS 419, 1350-1361*

Rao S. S., Giridhar S., Lambert D. L., 2012. *Chemical composition of a sample of candidate post-asymptotic giant branch stars. MNRAS 419, 1254-1270*

Singh V., Shastri P., Athreya R., 2012. *Seyfert Galaxies: Radio Continuum Emission Properties and the Unification Scheme. JAA, 32, 497*

Carollo D., Beers T. C., Bovy J., **Sivarani T.,** Norris J. E., Freeman K. C., Aoki W., Lee Y. S., Kennedy C. R., 2012. *Carbon-enhanced Metal-poor Stars in the Inner and Outer Halo Components of the Milky Way. ApJ 744, 195*

Sampoorna, M. 2012. *Polarized Partial Frequency Redistribution in Subordinate Lines. I. Resonance Scattering with Collisions. The Astrophysical Journal 745, 189*

Ramesh, R., Kathiravan, C., Barve I. V., Rajalingam M., 2012. *High Angular Resolution Radio Observations of a Coronal Mass Ejection Source Region at Low Frequencies during a Solar Eclipse. ApJ 744, 165.*

Subramanian S., Subramaniam A., 2012. *The Three-dimensional Structure of the Small Magellanic Cloud. ApJ 744, 128.*

Pradeep Chitta L., Jain R., **Kariyappa R.,** Jefferies S. M., 2012. *Observations of the Interaction of Acoustic Waves and Small-scale Magnetic Fields in a Quiet Sun. ApJ 744, 98.*

Gopal-Krishna, Mhaskey M., **Mangalam A.,** 2012. *On the Injection Spectrum of Relativistic Electrons in High-redshift Radio Galaxies. ApJ 744, 31.*

Sivaram C., Arun K., 2012. *Enigmatic aspects of entropy inside the black hole: what do falling comoving observers see ? APS&S, 337, 169-172.*

*** Names in bold-faces are authors from IIA**
$ IIA Repository

PhD Awarded

Smitha Subramanian was awarded the Ph D degree for her thesis titled *Stellar Populations in the Magellanic Clouds* by the Calicut University. She worked for her thesis under the supervision of Annapurni Subramaniam.

The Large Magellanic Cloud (LMC) and Small Magellanic Cloud (SMC) are two nearby galaxies located at a distance of 50 kpc and 60 kpc respectively. They are known to have interactions with each other as well as with our Galaxy. Different stellar populations (Cepheids: age ~100 Myr, Red Clump stars (RC stars): age ~2-9 Gyr and RR Lyrae stars (RRLS): age>10 Gyr) in the LMC and the SMC are studied in order to understand the structure and evolution of the Magellanic Clouds (MCs). The quantitative estimates of the structural parameters of the MCs are derived. The structural changes in the two galaxies as a function of time are identified. The parameters estimated and tracked over the age of the MCs are line of sight depth, inclination and major axis. The LMC disk is found to be formed around 10-12 Gyr as a result of a major merger and it has not evolved much through ages. We did not find a prominent stellar halo for the LMC. The SMC is dwarf galaxy and it experienced a major merger around 4-5 Gyr which distributed the older and intermediate age stars in a spheroidal component and formed the extended gas disk. As the MCs experienced major merger events individually at different epochs we suggest that the LMC and the SMC are formed and evolved separately and were interacting with each other only in the last 4 Gyr or less.

News on UVIT Project

The process of assembly of the two telescopes of UVIT has progressed to a high level from January to March 2012. The telescope for NUV (200-300 nm) and VIS (320-550 nm) is fully assembled, and the other telescope for FUV (130-180 nm) has been partly assembled. The telescopes are designed to give images with <1.8" FWHM in a field of ~ 28', and the tests show that NUV/VIS-telescope meets these requirements. A picture of the NUV/VIS-telescope is shown in Figure1 and Figures 2 & 3 show the results of a test on focal position.

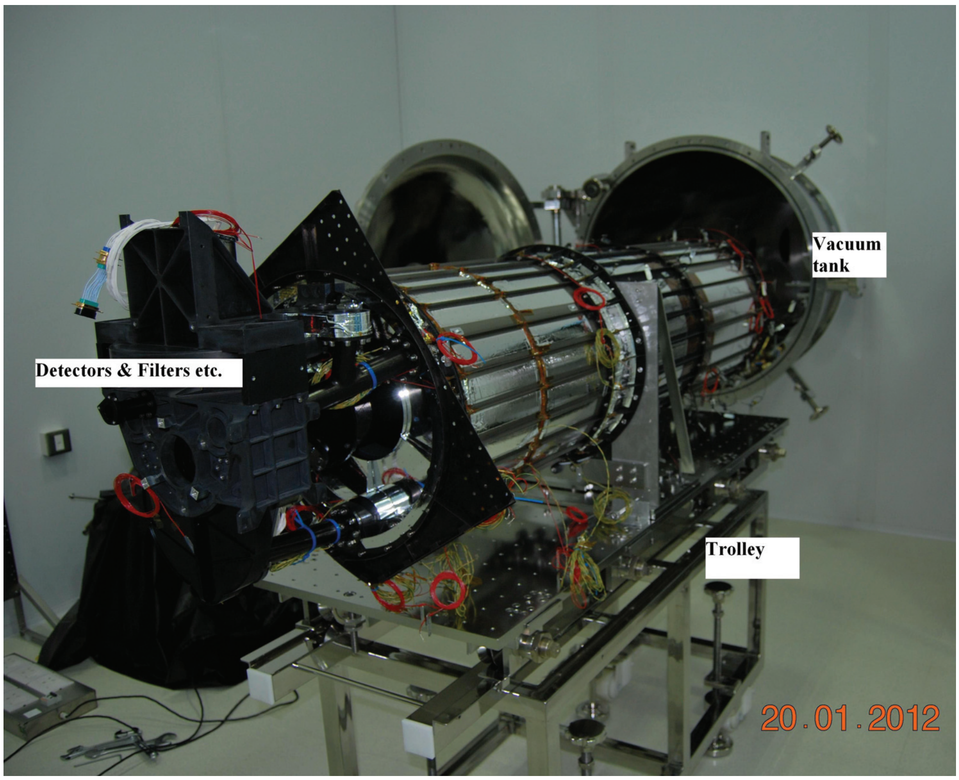


Figure 1. The photograph shows NUV/VIS-telescope while it is being introduced in the vacuum chamber for tests.

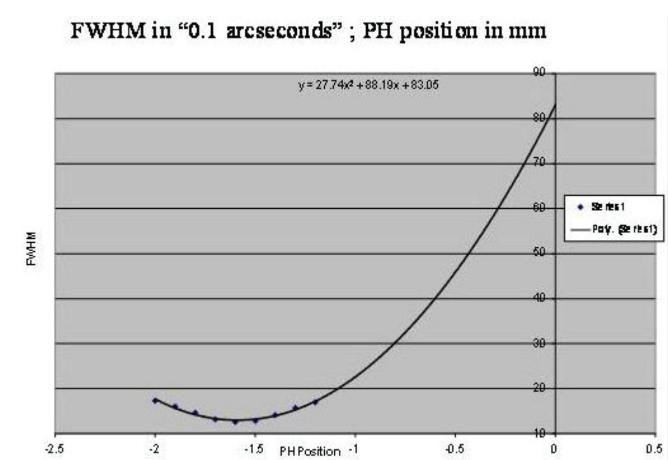


Figure 2. The plot shows FWHM of the image in NUV channel for a collimated beam, as the focus is shifted (X-axis in units of "mm"). The best focus is seen at ~ - 1.6 mm with a FWHM of ~ 1.4".

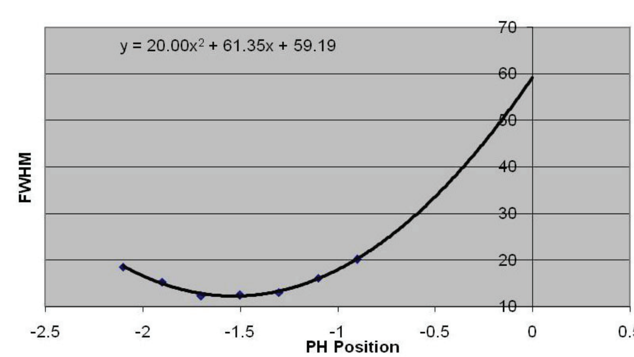


Figure 3. The plot shows FWHM of the image (Y-axis in units of 0.103) in VIS channel for a collimated beam, as the focus is shifted (X-axis in units of "mm"). The best focus is seen at ~ - 1.5 mm with a FWHM of ~ 1.3".

-S. N. Tandon

National Science Day

National Science 2012 was celebrated at IIA on 28 February 2012. Altogether 124 students participated from six schools in Bangalore. The schools that participated from Koramangala were Baby Mona School, Chinmaya School, National Public School, Seema School. Govt. High School from Madivala and MSR Vidyaniketan from Mathikere also participated. The programmes started with a drawing competition in the morning for the students. After the competition, the students were taken around the campus by IIA student volunteers to locations where various experiments and displays were setup.

Sujan Sengupta delivering a popular lecture titled `Search for Another Earth'.

They were (1) Observing the sun with the 3 inch telescope. (2) Radio observations of the sun. (3) A visit to the Photonics Laboratory. (4) Various Scientific experiments in Optics etc. (5) An exhibition of posters and models.

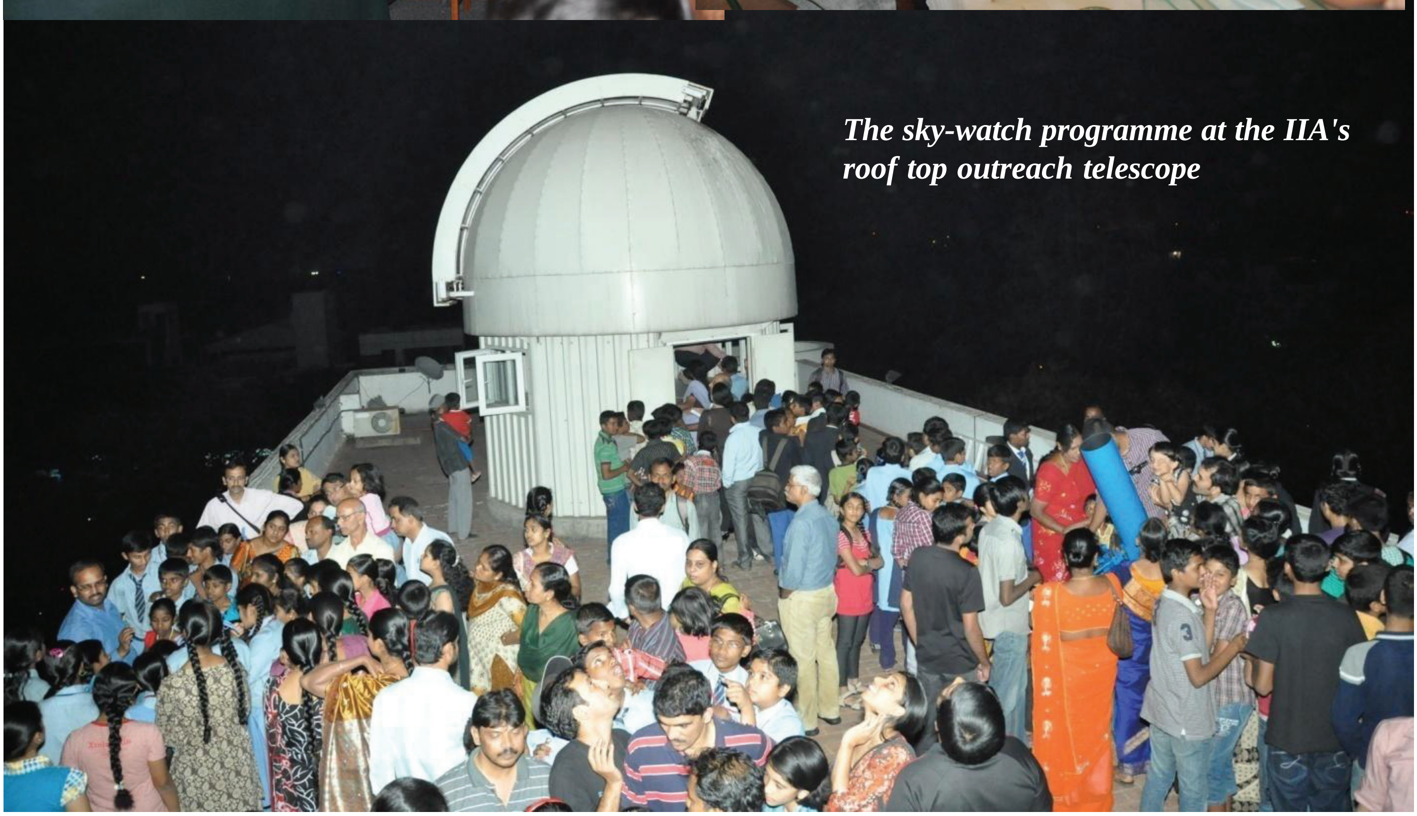
After this a quiz competition was conducted for the students, in which the students participated enthusiastically. Following the quiz competition, there was the prize distribution to the winners in the drawing and quiz competitions. First prize for the drawing competition was won by Sneha of 9th standard, Chinmaya School, Koramangala and the second prize was won by Sneha Majumdar of 8th standard, National Public School and third prize was won by Amar of 8th standard of Baby Mona School, Koramangala. Pavithra of 9th standard, MSR Vidyaniketan, Mathikere, Mahin Mundra of 8th standard, National Public School, Koramangala and Harish of 9th standard, Govt. School, Madivala won the consolation prizes. In the quiz competition, National Public School won the first prize and Chinmaya School won the runners-up prize.

The forenoon programme ended with a talk titled *"History of Astronomy: A Glimpse"*, which was delivered by Gajendra Pandey.

The second part of the programme started at 4.30pm with

HEAVENS

ABOLISHED



The sky-watch programme at the IIA's roof top outreach telescope

Top left: Gajendre Pandey giving a talk titled "History of Astronomy: A Glimpse".

Top right: Experimental demonstration being conducted by R. K. Banyal and B.Ravindra.

a play titled *Heavens Abolished* presented by the students of IIA. This is based on Bertolt Brecht's play "Galileo".This was followed by a popular lecture by Sujan Sengupta titled *Search for Another Earth*. Following the lecture, a skywatch programme was arranged at the rooftop observatory of the IIA in which the public participated in large numbers. The skywatch programme was co-ordinated by Padmakar Parihar and Kuppuswamy.

Students and staff of IIA volunteered and made the programme a grand success. They were also helped by the volunteers from the Bangalore Astronomical Society.

The volunteers from the IIA were: P. U. Kamath, S. S. Chandramouli, Amit Kumar S., N. Satyabhama, P. K. Mahesh, C. Kathiravan, J.P.Lancelot, R.K. Banyal, P. M.M. Kemkar, Manoharan, T. K. Muralidas, Annapurni S., G. Pandey, S. Chatterjee, Sujan K. Sengupta, P. S. Parihar, K. Kuppuswamy, B.C. Bhatt, S.P. Bagare, Arya Dhar, Avijeet Prasad, Samyaday Choudhury, Srinivasa Prasanna, Mousumi Das, Avinash Surendran,Prashanth Mohan, Nesar Nayak, Shubham Srivastav, Vaidehi Sharan Paliya, Joby, P. K., Rathna Kumar, S., Supriya, H. D., Sowmya, K., Sangeetha, C. R, Ramya, P, Chandrasekhar, Indu, Sajal Kumar, A. G. Sreejith.

- P. K. Mahesh

भारतीय खगोल वेधशाला, हैनले-लद्दाख

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

भारत में दूरबीन स्थल परीक्षण: इस प्रकार से हालांकि हमने दूरबीन निर्माण के क्षेत्र में तकनीकी दक्षता हासिल कर ली थी लेकिन हम महसूस कर रहे थे कि समय के साथ साथ वर्तमान स्थलों से हम इन दूरबीनों की दक्षता का सम्पूर्ण दोहन नहीं कर पा रहे हैं। बदलते वैश्विक वातावरण मौसम और बढती कृत्रिम रोशनी तथा अन्य बड़ी दूरबीन की आवश्यकता ने भारतीय खगोलज्ञों को सोचने के लिए मजबूर किया कि हमें अब अन्य दूरबीन स्थलों की खोज भी करनी चाहिये। नब्बे के दशक के पूर्वाद्ध में नैनीताल वेधशाला ने चार मीटर दूरबीन परियोजना का प्रारूप लिखा और उप हिमालयी क्षेत्रों में स्थल परीक्षण का कार्य शुरू किया। तदनुसार चार-पाँच जगहों पर बादलों की उपलब्धता एवम् मौसम से संबंधित प्रेक्षण कार्य शुरू किया। इन प्रेक्षणों के विश्लेषण द्वारा देवस्थल नामक स्थान को खगोलीय उपयोगिता के विस्तृत प्रेक्षणों के लिए चुना गया।

इसी दौरान लेह - लद्दाख में भी स्थल चयन का कार्य शुरू किया गया एवम् नीमू पहाड़ी को विस्तृत अध्ययन के लिए चुना गया। इस जगह पर मौसम,बादलों, सूक्ष्म तापान्तर विक्षोभ, दूरबीन दृश्य प्रतिबिम्ब तीक्षणता के प्रेक्षण विभिन्न उपकरण लगाये गये। सन् 1984-88 के दौरान एकत्रित जानकारी के विश्लेषणों से पाया गया कि नीमू एक शुष्क स्थान है लेकिन पहाड़ी के ठीक नीचे से सिन्धु नदी के कारण स्थानीय बादल ज्यादा बन रहे हैं और निष्कर्ष निकला कि लेह शहर एवम् आसपास की सैन्य इकाइयों से आकाश की पृष्ठ रोशनी खगोलीय प्रेक्षणों को प्रभावित कर सकती है जोकि निकट भविष्य में अवान्छनीय रूप से बढ़ भी सकती है। तत्कालीन विशेषज्ञ समिति ने हांलाकि नीमू पहाड़ी के लिए अपनी सहमति नहीं दी लेकिन यह संस्तुति दी कि अन्दरूनी लेह सम्भाग में खगोलीय दूरबीन स्थापना की अपार सम्भावनाएं हैं। यह सभी को ज्ञात था कि लद्दाख की परिस्थितियां काफी कठिन हैं और मूलभूत सुविधाओं का अभाव है अत: एक मजबूत एवम् समर्पित सर्वे टीम की जरूरत पर बल दिया गया। यह आशा की गयी कि यदि पूर्ण सहयोग किया जाय तो एक उत्कृष्ट उच्च तुंगता स्थित खगोल वेधशाला के लिए उपयुक्त स्थान खोजा जा सकता है।

इस दौरान 2.34 मीटर वेणु बप्पू दूरबीन के दुनियां के खगोल शात्रियों के लिए उपलब्ध होने के बाद भारतीय खगोल शात्रियों द्वारा पुन: अपनी बड़ी दूरबीन की आवश्यकता को मुखर किया। लेकिन यह सच्चाई भी थी कि हमें एक उत्तम खगोलीय स्थल की खोज भी करनी है क्योंकि उत्कृष्ट स्थल पर स्थित एक छोटी दूरबीन की वैज्ञानिक उपयोगिता और उत्पादकता एक औसत खगोलीय गुणों वाले स्थल पर बड़ी दूरबीन की उत्पादकता से कहीं ज्यादा और महत्वपूर्ण होती है। अति आधुनिक तकनीक से सुसज्जित वैज्ञानिक उपयोग के लिए उच्च कोटि की दूरबीन एवम् सम्बन्धित उपकरण के लिए बहुत धन एवम् मानवीय प्रयास की जरूरत होती है और इन सब प्रयासों से स्थापित दूरबीन का उच्च कोटि के अधिकतम प्रेक्षणों के लिए अधिकतम उपयोग लम्बे समय के लिए होना भी आवश्यक है तभी व्यय किये गये सन्साधनों और वैज्ञानिक प्रयासों की सार्थकता है।

विश्व में बड़ी दूरबीन को लिए उत्कृष्ट स्थल के बारे में हम पूर्व में उल्लेख कर चुके हैं कि बीसवीं सदी में स्थापित मौना कया स्थान आज भी दृश्य प्रकाश एवम् निकट अवरक्त वर्णक्रम में खगोलीय प्रेक्षणों के लिए एक आदर्श स्थान है। इस स्थान पर पिछले पचास सालों के दौरान बड़े व्यास वाली विभिन्न दूरबीनों की स्थापना हुई और वर्तमान में इस स्थान पर अन्य बड़ी दूरबीनों के लिए आवश्यक क्षेत्र की कमी होने लगी। अत: 21वीं सदी के दस्तक देने के दौरान ही खगोल शास्त्रियों ने विश्व के अन्य भू भागों में उच्च कोटि की खगोलीय गुणवत्ता वाले अतिरिक्त स्थलों को खोजने एवम् परिभाषित करने की विभिन्न परियोजनाओं में कार्य करना शुरू किया और उत्तरी चिली के शुष्क एवम् उच्च तुंगता वाले रेगिस्तान में उत्कृष्ट खगोलीय गुणों वाले बहुत सारे भू-भाग की खोज हुई जो विद्युत चुम्बकीय वर्णक्रम के दृश्य प्रकाशिक वर्णपटल के अतिरिक्त अवरक्त एवम् निम्न रेडियो तरंग वर्णपटल के खगोलीय प्रेक्षण भी प्राप्त कर सकते हैं। इनमें ला सेरेना, अटाकामा, अल्मा, सेरोपरनाल, सेरोआरमाजोन्स, सेरोतोलोलो इत्यादि प्रमुख

हैं जहां विभिन्न वेधशालाएं स्थापित की जा चुकी हैं और अन्य विशाल दूरबीन परियोजनाओं में कार्य हो रहा है।

राष्ट्रीय बृहत् व्यास खगोलीय दूरबीन परियोजना: भारतीय सन्दर्भ में यदि हम बड़े व्यास वाली दूरबीन स्थापित करना चाहें तो हम अन्य देशों की तरह बाहरी भू-भागों में स्थित उत्कृष्ट स्थलों का प्रयोग नहीं कर सकते हैं क्योंकि यह हमारे राष्ट्र की सामाजिक - आर्थिक मान्यताओं के अनुकूल नहीं हैं । अत: हमें अपने सीमित संसाधनों के द्वारा भारतीय भू-भाग में ही उच्च कोटि की खगोलीय गुणवत्ता वाली जगहों की खोज करनी है। यहां इस बात को भी महत्ता दी गयी कि भारतीय प्रायद्वीप के एक बड़े भू-भाग में वर्ष के तीन से चार महीनों के दौरान मानसून की सक्रियता से वर्तमान में किसी भी वेधशाला की दूरबीनों को प्रेक्षणों के लिए प्रयुक्त नहीं कर पा रहे हैं और भारतीय खगोलविदों के लिए इस अवधि में उपलब्ध आकाशीय पिण्डों के शोध कार्य में आत्मनिर्भरता नहीं है। इस प्रकार से भारतीय ताराभौतिकी संस्थान, बेंगलौर की अगुवायी में सन् 1991-92 में भारतीय वृहत व्यास प्रकाशीय दूरबीन परियोजना का प्रारम्भ हुआ और राष्ट्रीय स्थल खोज एवम् परीक्षण कार्यक्रम की रूपरेखा तैयार कर सर्वे का कार्य शुरू हुआ। इस कार्य के लिए उपग्रह आधारित बादलों से सम्बन्धित सूचनाएं, भौगोलिक स्थिति, वातावरण, स्थानीय मौसम की जानकारी, नजदीकी उपलब्ध नागरिक सुविधाएं इत्यादि मानकों का अध्ययन किया गया और चिली की तरह ही भारत के मध्य-उच्च एवम् परा हिमालयी क्षेत्रों में सम्भावित खगोलीय गुणवत्ता वाले स्थानों को चिह्नित किया गया। खगोलविदों की अगुवायी में करीब बीस दलों ने इन सम्भावित स्थलों का विस्तृत दौरा किया और स्थानीय सुविधाओं, भौगोलिक एवम् मौसम की विभिन्न जानकारियों का आंकलन किया। इन सभी स्थलों से एकत्रित जानकारियों/आंकड़ों का खगोलीय एवम् अन्य तय मानकों के आधार पर विश्लेषण किया गया। परिणाम स्वरूप यह पाया गया कि परा हिमालयी क्षेत्र के उच्च स्थलीय शुष्क, सर्द लद्दाख में स्थित कुछ अन्दरूनी क्षेत्र खगोलीय गुणवत्ता के उच्च माप दन्डों पर खरे उतरते हैं। पूर्व में लेह लद्दाख में हुए सीमित परीक्षण के परिणामों ने भी इस परीक्षण में सहायता की। इस प्रकार से लद्दाख के चांगथांग भू-भाग में स्थित हैनले नामक स्थान को विस्तृत अध्ययन के लिए चुना गया।

हैनले, लद्दाख – एक परिचय: हैनले स्थान की कई स्थानीय एवम् भौगोलिक विशेषताओं और अन्य जानकारियों के प्रारम्भिक विश्लेषण के परिणाम काफी उत्साहवर्द्धक रहे । इस तरह हैनले में एक उन्नत खगोलीय वेधशाला की स्थापना की सम्भावनाओं को आगे बढ़ाने में मदद मिली। यह स्थान लेह नगर से 260 किमी दक्षिण पूर्व में तिब्बत सीमा से लगे चांगथांग क्षेत्र में स्थित है। यहाँ जाने के लिए हम पहले सिन्धु नदी के किनारे-किनारे लेह से पूर्व दिशा में प्रारम्भिक 200 किमी पक्की सड़क से यात्रा करते है। फिर हम लोमा नामक स्थान पर दक्षिण को मुड़ जाते हैं और हैनले नदी के साथ साथ मरूस्थलीय मैदान में लगभग 50 किमी की यात्रा कर हैनले घाटी में प्रवेश करते हैं जहाँ शताब्दियों पुराना हैनले वौद्ध मठ हमारा स्वागत करता है। सामने ही समुद्र सतह से 14000 फीट की ऊँचाई पर विशाल नीलाम्बकुल तल फैला नजर आता है। इसी तल के बीचों बीच एक उभरे हुए द्वीप की तरह है ' *दिग्पा रत्सा री* ' अर्थात् ऊपर से चिडिया की नजर से देखने पर बिच्छू के उभरे आकार की पहाड़ी। इस पहाड़ी के सर्वोच्च स्थान की समुद्र सतह से ऊँचाई 15000 फीट है। यही स्थान भारतीय खगोल शास्त्र के लिए एक अहम् पड़ाव माना गया।

प्रथम दृश्यता आधर पर विभिन्न कारण इस स्थान के चयन में सहायक रहे। परा हिमालयी क्षेत्र में होने के कारण यहाँ मानसून बादल नहीं के बराबर पहुँच पाते हैं। स्थानीय लोगों से मालूम चला कि साल भर मौसम लगभग साफ रहता है। शुष्कता अधिक है। बहुत कम वर्षा होती है। स्थानीय आवादी बहुत कम है, इस प्रकार मानव जनित प्रकाश एवम् अन्य प्रदूषण नगण्य माने गये। नागरिक सुविधाओं में आस पास कुछ गॉव और भारत तिब्बत पुलिस की एक कम्पनी स्थित थी । इन सभी कारणों ने इस चोटी को विस्तृत स्थल परीक्षण हेतु चुनने में मदद दी। सन् 1993-94 के दौरान विभिन्न खगोलविदों के दलों ने इस स्थान का कई बार संक्षिप्त दौरा कर कई उपकरणों की मदद से ऑकड़े एकत्रित किये और उत्साहजनक परिणामों के आधार पर विस्तृत खगोलीय परीक्षणों के लिए एक स्थायी स्टेशन स्थापित करने की संस्तुति की गयी।

शेष अगले अंक में जारी

भुवन चन्द्र भट्ट

Fifty Years of Solar Tower Telescope at Kodaikanal Observatory

The International Council of Scientific Unions (ICSU) in 1952 proposed to observe the period from July 1957 to December 1958 as a International Geophysical Year (IGY). The proposal was to make coordinated effort to monitor various aspects of solar activity and study its effects on various facilities and activities on the earth. The solar cycle number 19, covering the period of 1957- 58 turned out to be most active cycle since the start of systematic observations of the sunspots with the invention of telescope and discovery of black spots on the sun, known as sunspots, by Galileo in 1610. Observational plans were firmed up and new instruments were planned to make comprehensive and coordinated observations of the sun to monitor the solar activity. At that time Kodaikanal observatory had (i) a 6-inch telescope to take the images of the sun in continuum to observe the sunspots (ii) a spectroheliograph to take the images of the sun in Ca-K and H-alpha line to study the chromospheric activity such as development and disappearance of filaments and prominences, solar flares, Ca-K plage areas etc. (iii) number of low resolution spectrographs to observe the absorption lines at the disc and study the velocity pattern especially in sunspots (Evershed flow) and emission spectra at the solar limb to study the prominences. To augment the observational facilities at the Kodaikanal observatory as a part of the IGY program, three new instruments were acquired (i) 24-inch three mirror coelostat with a 15-inch fixed telescope of 120 feet focus and a matching 60-feet spectrograph from Grubb Parson of England for the high resolution spectroscopy of the sun (ii) an 8-inch coronagraph to study prominences and solar corona and (iii) an extremely narrow band (passband 0.5 / 0.7 A) Lyot type filter to take the filtergrams of the sun in H-alpha line. The coelostat, 120-feet focus telescope and spectrograph were installed in the Solar Tower Telescope building. Making use of the slope of the area a 210-feet tunnel was constructed to house the telescope and the spectrograph with a view that temperature inside the tunnel will not change immediately with the rise of the sun and thus image quality will remain good for longer periods during the day. Because of this it is also known as Solar Tunnel Telescope and Solar Tunnel Tower Telescope. All the acquired three new instruments were inaugurated by Dr. P. Subbarayan, Union Minister for Transport and Communications, Government of India in the presence of Dr. A. K. Das (out going Director) and Dr. M. K. V. Bappu (newly appointed Director) on September 14, 1960. After initial tests some trail high spectral and spatial resolution spectra were taken. But it was not possible to make observations early in the morning as the coelostat was low and sun light did not fall on the first mirror till couple of hours after the sun rise.In September 1961 entire set up was dismantled, and the height of tower was raised by 6-feet. The modifications in the building were completed in the beginning of 1962 and the observations in the early morning when the seeing is good began in the middle of 1962. The spectrograph was designed to work in vacuum (low pressure) to obtain better quality spectra but the objective could not be achieved due to technical reasons. Here we are listing the major developments that occurred during the period and a detailed report is being prepared and will be published elsewhere. A photometer was developed to scan the spectra of molecular lines to study the Evershed flow. Magnetic line profiles were used to compensate the effect of magnetic fields while computing the velocity of the flows. Arvind Bhatnagar was awarded Ph. D. in 1966 for his studies on Evershed effect in sunspots made using the high resolution spectra obtained with the Solar Tower Telescope. Nirupama Raghavan investigated the line asymmetry in sunspots and line profiles of carbon molecules for her Ph. D. degree in 1968. J. C. Bhattacharyya used a magnetograph to measure the week magnetic and velocity field on the sun and found velocity oscillations on the sun with period around 5 minutes and was awarded Ph. D. in 1969. K. R. Sivaraman developed a Doppler compensator for analysing the high resolution spectra and submitted his Thesis on velocity oscillations in the solar atmosphere in 1972. Number of other students such as K. S. Balasubramaniam, K. Sankarasubramanian, V. Krishnakumar, K. Nagaraju and others have developed instruments to make polarization measurements of active regions on the sun and completed their Ph.D.'s successfully. K. Sundara Raman used the high resolution spectra of sunspots and images of the sun to complete studies on Dynamics of active regions and sunspots.About the additional instruments to the Solar Tower Telescope, a Doppler compensator was developed in 1969 to facilitate the analysis of large number of spectra obtained to study the intensity and velocity variations on the sun with high accuracy at that time. A


Solar Tunnel Telescope at Kodaikanal Observatory commissioned in 1960.

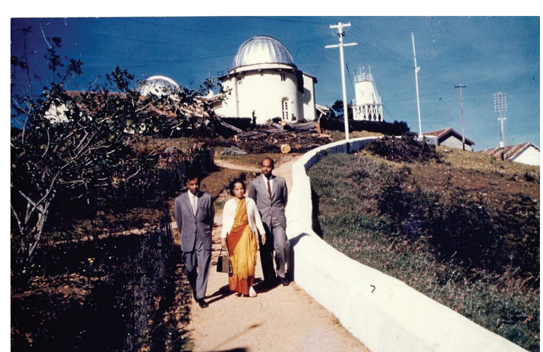
Figure 1. Solar TowerTelescope at Kodaikanal Observatory.

Figure 2. A two mirror 24-inch coelostat at the Solar Tower Telescope to track the sun and feed the sunlight to the 15-inch fixed telescope.

Figure 3. Sixty feet Littrow type spectrograph in the about 210 feet long tunnel of the Solar Tower Telescope.

magnetograph with the design used by Babcock was developed by J. C. Bhattacharyya in 1970 to measure the week magnetic fields and velocity with an accuracy of about 0.1 Km per second to study variations of these parameters with time. K. C. A. Raheem developed a high spectral and spatial resolution spectroheliograph to build the images of the sun in any of the absorption line in the visible part of the solar spectra and installed at the Solar Tower Telescope. A double line shifter was added to the instrument to determine the velocity fields using Leighton's technique. A beam splitter and polarising assembly were also developed in front of the entrance slit of the spectroheliograph to form two images of the same portion of the sun and in the same focal plan to measure the longitude component of the magnetic fields in the active regions of the sun using Leighton's technique. An image guider was also developed to compensate the drift of the image with time. The original control unit to derive motors to move and track the image of the sun on the slit of the spectrograph was replaced by a new control unit developed by R. Srinivasan and N. Shivaraj using the state-of the- art technology which has resulted in guiding the solar image and making the observations more efficiently. During the earlier periods observations were made using the photographic emulsions suitable to wavelength of interest. CCD cameras are being used since 1995 to record the spectra with higher photometric accuracy.On the observational side M. K. V. Bappu started a program to monitor the Ca-K line profiles of the sun as a star to study the solar variability with the phase of solar cycle in 1969 using the Solar Tower Telescope. He was the first to start such a program where as W.C. Livingston started a similar program in 1974. It was found that sun is variable star when observed in Ca-K line but observed line profiles with the phase of solar cycle could not be explained in terms of variation in solar activity. To investigate the reason for this discrepancy Jagdev Singh started a new program in 1986 to monitor Ca-K line profiles as a function of latitude and integrated over the visible longitudes with the phase of solar cycle. The observations obtained on daily basis and favourable sky conditions has created an unique data set over two solar cycles. The analysis of these data by G. Sindhuja will provide interesting results and a required calibration for more than 100 years of data obtained at Kodaikanal observatory since 1906. A large number of papers have been published using the data obtained with Solar Tower Telescope which will be discussed in detail in a separate article. The Figures 1, 2 and 3 show the building, coelostat and spectrograph, respectively of the Solar Tower Telescope. Finally it may be noted that large number of dignitaries including Prime Minister Jawaharlal Nehru, Prime Minister Indira Gandhi, Congress President Kamaraj Nadar and Nobel Laureate S. Chandrasekhar visited the Solar Tower Telescope and had a wonderful experience to see the details of features on the solar surface and sunspots and felt excited to see the H-alpha absorption line seen on disk on the sun turning into emission line in the upper chromospheric layers of the sun.

- Jagdev Singh & Christina Birdie



Prof.S.Chandrasekhar and his wife Mrs.Lalitha Chandrasekhar visited Kodaikanal Observatory on 28 November 1961.

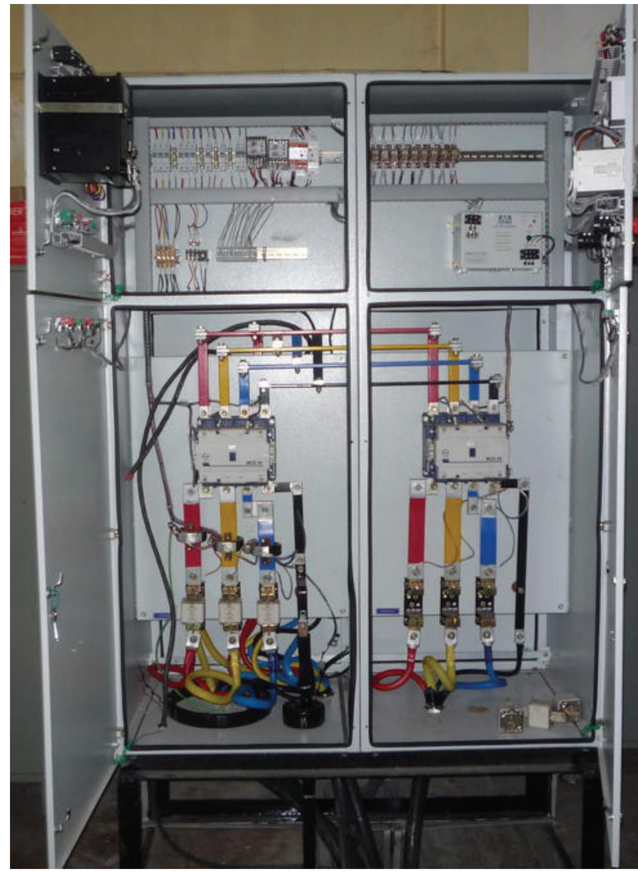
Upgrade of Infrastructure at Kavalur

New 320 KVA DG set installed in Power House , VBO, Kavalur.

Specification: -

The new radiator cooled 320KVA DG set

- *With Cummins Engine Model no: - NTA855-G2 developing 380BHP at 1500 RPM,*
- *Coupled with 380KVA Stamford alternator mounted on a iron channel base frame*
- *With a set of AVM pads*
- *Heavy duty air cleaner with acoustics skid*
- *Mounted fuel tank*
- *Residential silencers with bellows*
- *Starting batteries with connecting leads*
- *Powercom with DG set control*
- *AMF control panel with double breaker*



AMF Control Panel

- R. Vellai Selvi, C.Muthumariappan, P. Anbazhagan & OSD Electrical Staff

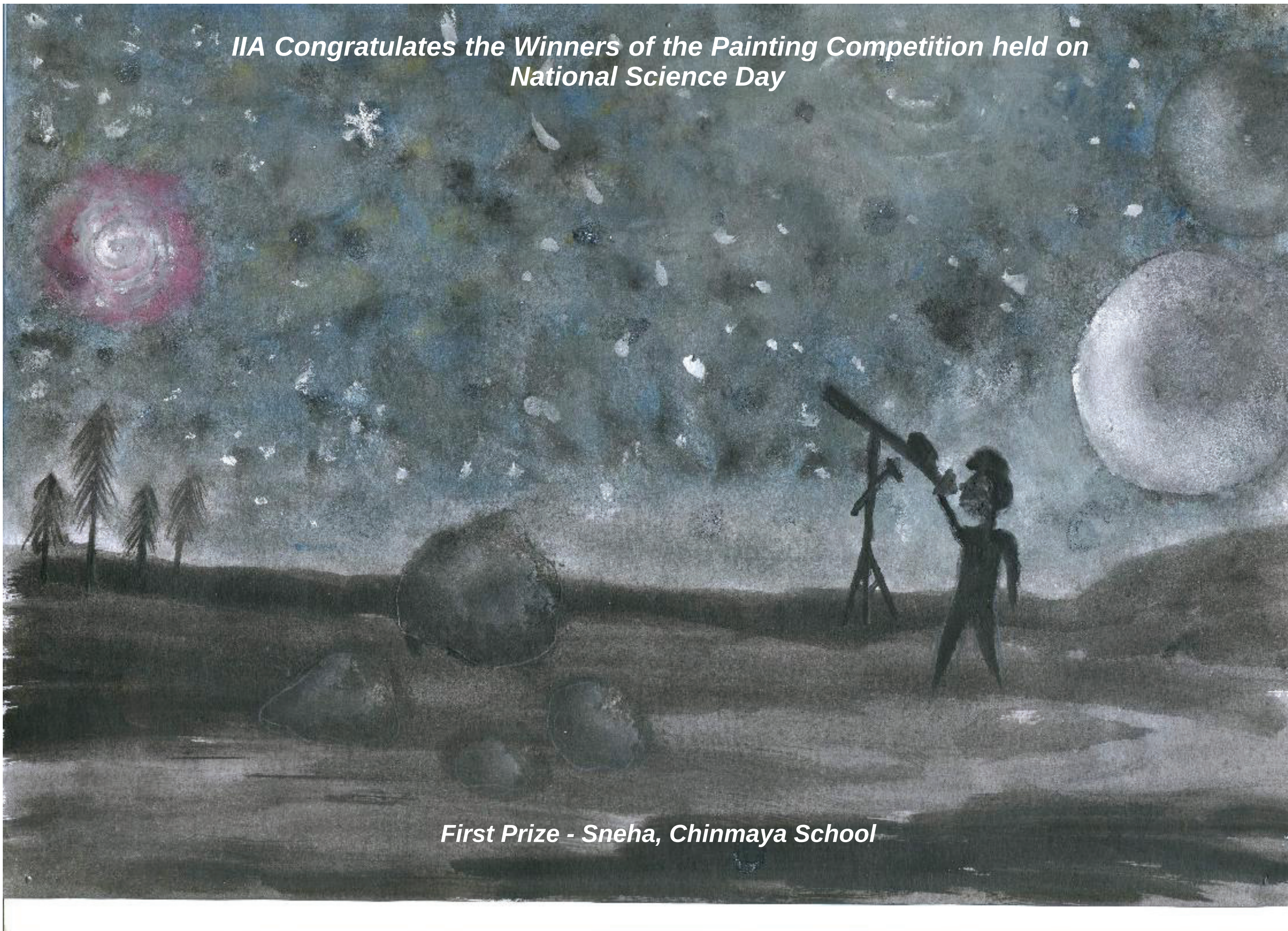
Farewell

IIA wishes all the best to ...

... Shri J. V. S. Visweswara Rao joined the services of IIA at Kodaikanal on 11th January 1982 as Research Assistant. He has been elevated to various positions and retired as Technical Officer 'B' on attaining the age of superannuation on the afternoon of 29th February, 2012.

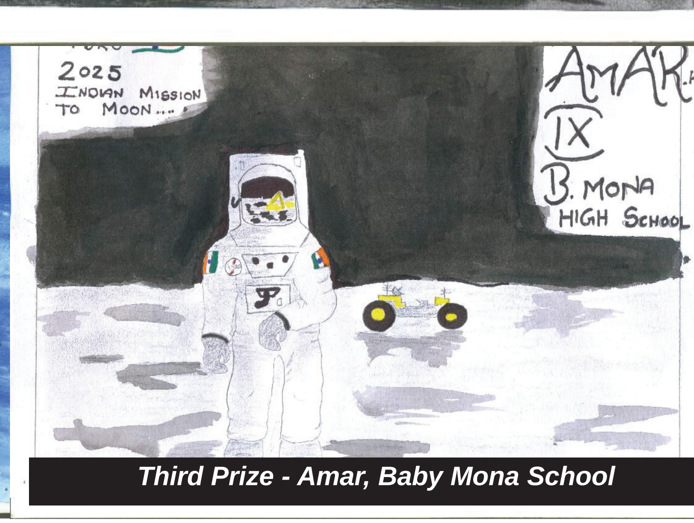
... Mrs Promila Jain joined the services of IIA at Bangalore 8th January 1996 as Lower Division Clerk on compassionate grounds. She was elevated to various positions. She retired on attaining the age of superannuation on the afternoon of 31st March, 2012.

IIA Congratulates the Winners of the Painting Competition held on National Science Day



First Prize - Sneha, Chinmaya School

Second prize -Sneha Majumdar National Public School



Third Prize - Amar, Baby Mona School

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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