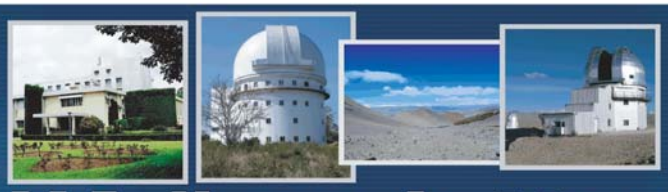

IIA Newsletter

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In this issue...

Vainu Bappu Memorial Lecture

The first Vainu Bappu Memorial Lecture was delivered by Professor E. N. Parker of the University of Chicago at the IIA Auditorium on January 4, 2007. The title of his talk was ***The Sun, Space, Cosmic Rays and Climate***.

In the talk, Professor Parker gave a broadbrush view of the physical properties of the Sun and of its interaction with the interplanetary space environment and its effect on the terrestrial climate. He said that the visible Sun is an opaque shroud around the nuclear core, where energy is generated through the fusion of protons into helium nuclei. The core luminosity is eleven orders of magnitude higher than the surface luminosity of the Sun. The outward flow of this energy through the shroud manifests as the thermal radiation that leaves the solar surface. Professor Parker remarked that thanks to helioseismology and to the theoretical work of John Bahcall and others, today the model of the solar interior is accurate to within 0.2% of the actual conditions that prevail. John Davis's experiments on the solar neutrino emission gave the first indication of a nonzero rest mass of the neutrino. The story of the Sun would have ended with these remarkable investigations, were it not for the solar convective zone that occupies about 2/7th in radius of the outer body of the Sun. Professor Parker emphasised that the convection zone or CZ introduces meridional circulation,causes the Sun to rotate nonuniformly and generates solar magnetic fields. These, in turn, give rise to a variety of solar phenomena which affect the environment of the solar system and impact on the solar-terrestrial relations. According to Professor Parker, there is much physics that has to be still figured out for the generation of magnetic fields in the Sun.

The magnetic fields are carried bodily with the streaming ionized gas of the Sun. The bipolar magnetic regions appearing on the visible surface indicate the presence of a strong azimuthal magnetic field deep in the CZ. The bands of azimuthal magnetic field migrate towards the equator, the successive bands having opposite sign so that the overall field reverses on a 9 - 14 year basis, resulting in the familiar 11-year magnetic cycle of the Sun. The convective generation of the magnetic field exhibits the curious property of waxing and waning over periods of decades. Professor Parker mentioned several recorded periods in the past that were periods of solar inactivity, e.g. the Sporer Minimum of 1450 - 1550, the Maunder Minimum of 1645 - 1715, the Dalton Minimum of 1870 - 1890 etc.

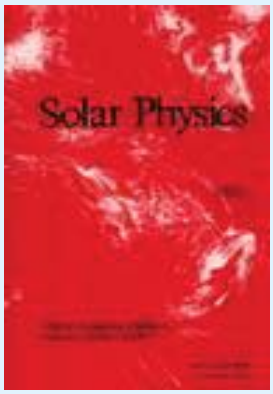
John Eddy had pointed out the close correlation between the mean annual temperature in the northern hemisphere and the level of sunspot activity, the cold spells on the Earth correlating with the minima in solar activity. Much of the historical data came from the measurements of radiocarbon in tree rings, the increased amounts of radiocarbon in the terrestrial atmosphere, indicating a decline in solar activity.

The heliosphere, as Professor Parker described it, is the region created by the supersonic solar wind, a continued hydrodynamic expansion of the million degree solar corona. The expanding corona carries the local magnetic field along with it, stretching the solar field out through the heliosphere to distances beyond a hundred astronomical units. The field is well ordered starting out radially near the Sun and becoming strongly spiralled beyond the orbit of the Earth. The Galactic cosmic rays,consisting mostly of protons with a sprinkling of smaller numbers of heavier nuclei, represent a gas that is relativistically hot, inflating the magnetic fields that lie along the spiral arms of the Galaxy. Their intensity at Earth varies as the Sun orbits around the Galaxy and oscillates across its mid-plane.The outward sweep of the magnetic fields in the solar wind substantially reduces the cosmic ray intensity at Earth, the reduction increasing with the level of solar magnetic activity. In the concluding part of his lecture, Professor Parker described how the cosmic ray intensity correlates inversely with the solar activity, with the radius of the heliosphere, and with the waxing and waning of the geomagnetic field. The total solar irradiance also shows a variation of a few tenths of a percent, in phase with the magnetic activity. Professor Parker said that the solar luminosity variation is enough to account for only a quarter of the thermal response of the terrestrial climate. There must be some other more powerful effect operating as well.

The audience sat spellbound as Professor Parker delivered the fascinating talk.Earlier, Professor B V Sreekantan,Chairman of the IIA Governing council, presented Professor Parker with a scroll of honour.

Siraj Hasan on the Editorial Board of Solar Physics

A Journal for Solar and Solar-Stellar Research and the study of Solar-Terrestrial Physics



Report on the Second UN/NASA Workshop on the International Heliophysical Year 2007 and Basic Space Science

The Second UN/NASA Workshop on the International Heliophysical Year 2007 (IHY) and Basic Space Science was held in Bangalore, India, from 27 November to 1 December 2006. IIA hosted the Workshop on behalf of the Government of India. The main objective of the Workshop was to provide a forum to comprehensively review preparations for IHY and related recent scientific and technical results in order to: (a) develop the basic science of heliophysics through cross-disciplinary studies of universal processes; (b) determine the response of terrestrial and planetary magnetospheres and atmospheres to external drivers; (c) promote research on the Sun-heliosphere system outward to the local interstellar medium; (d) foster present and future international scientific cooperation in the study of heliophysical phenomena; (e) preserve the history and legacy of the International Geophysical Year on its fiftieth anniversary; and (f) communicate unique results of the International Heliophysical Year to the scientific community and the general public.

Researchers and educators from a large number of countries were invited by the United Nations, NASA and IIA to participate in the Workshop. There were participants from universities and research institutions, observatories, national space agencies, planetariums and international organisations. More than 150 participants from 30 Member States of the UN were represented at the Workshop: Algeria, Austria, Bangladesh, Brazil, Bulgaria, Cameroon, Canada, China, Egypt, Ethiopia, France, Germany, India, Indonesia, Iraq, Japan, Kenya, Malaysia, Mexico, Nigeria, Peru, Republic of Korea, Russian Federation, South Africa, Sri Lanka, Switzerland, Syrian Arab Republic, United Arab Emirates, United Kingdom of Great Britain and Northern Ireland and United States of America. The overall preparations for the Workshop were carried out by an international scientific organising committee, a national advisory committee and a local organising committee.

At the opening of the Workshop, statements were made by the Director of IIA, the Chairman of the Governing Council of IIA, the Director of the National Institute of Advanced Studies on behalf of the Government of India and by representatives of the IHY secretariat, NASA and the Office for Outer Space Affairs of the Secretariat. The Workshop was divided into plenary sessions, each focussing on a specific issue. Presentations by invited speakers, describing the status of their results in organisation, research,education and outreach related to IHY, were followed by brief discussions.

Eighty papers were presented by invitied speakers from both developing and industrialised countries. Poster sessions and working groups provided an opportunity to focus on specific problems and project in preparation for the IHY 2007 and basic space science.

The following topics were addressed at the Workshop: (a) the status of preparations for the International Heliophysical Year, including for the United Nations Basic Space Science initiative, at the national, regional and international levels; (b) solar surface phenomena; (c) dynamics of the chromosphere and transition region; (d) coronal studies; (e) corona and interplanetary medium; (f) terrestrial atmosphere; (g) non-extensive statistical mechanics; (h) IHY/UN Basic Space Science instrument donors; (i) IHY/UN Basic Space Science instrument hosts; (j) IHY science in developing nations; and (k) astrophysical data systems and virtual observatories.

The Workshop introduced the database project as part of the IHY Tripod triple-element concept to promote basic space science in developing nations. There was consensus that the database project would be a focus topic during the following workshop in June in Japan.The database project would modify the IHY Tripod concept by replacing the instrument and observation elements by database and analysis tools. It was recommended that IHY schools be organised at the same venue as the workshops in order to facilitate workshop participants'attendance, thereby contributing to the capacity-building effort. The Workshop suggested that virtual observatories could enhance IHY investigations and recommended that IHY/UN Basic Space Science investigators make use of them to augment their data sources.

It was suggested that in nations such as India, it could be beneficial to establish a separate fund that could be used for IHY-related activities. It was agreed that it would be necessary to establish an international working group on the use of the GNU data language (GDL). GDL was expected to become part of the International Heliophysical Year legacy and to be used worldwide for scientific computation free of cost.The Workshop recommended the establishment of a worldwide system of ADS mirror sites under the auspices of the IHY in order to support IHY science investigations by improving access to this resource by developing nations.The Third UN/ESA/NASA Workshop on the IHY and Basic Space Science will be hosted by the Japanese National Astronomical Observatory on behalf of the Government of Japan in Tokyo from 11 to 15 June 2007. Proceedings of the conference will be published in a future issue of the Bulletin of the Astronomical Society of India.

Ambiguity in the physics of coronal loops

Occurrence of a total solar eclipse provides an excellent opportunity to study the very faint outer atmosphere of the Sun. But the small duration of the event, of the order of a few minutes of totality,restricts the investigation of some of the important features of the solar corona, such as variations in the line profiles along the coronal loops, which are very important to understand the heating of the corona to a million degrees. Invention of the coronagraph has helped to some extent in getting around this limitation.But the low efficiency of the detectors has remained a problem in studying the weak signal against the strong background of scattered disk light.The observations in the EUV and soft x-ray part of the spectrum using space-based instruments have contributed immensely to our knowledge about the solar corona. Again limitations on the size of the space-based instruments and the availability of a lesser number of photons at these wavelengths do not permit us to obtain the desired high spatial and spectral resolution. Some recent developments in technology have helped us revive the interest in the ground-based observations using a solar coronagraph.

Generally, the coronal loops are considered to be isothermal in nature. The magnetic pressure is believed to be high compared to the gas pressure in the loops and these are thin structures, magnetically shielded from other temperature loops. Increase in the width of the coronal emission lines with height has been interpreted in terms of an increase in non-thermal velocities with height due to coronal waves. Do our systematic observations of coronal emission lines confirm this scenario?

We have made systematic observations of coronal structures in 4 emission lines in the visible wavelengths with the 25-cm Coronagraph of Norikura Observatory in Japan from 1997 to 2004, choosing two emission lines simultaneously; 6374Å [Fe X] & 7892Å [Fe XI]or 6374 Å [Fe X] & 5303 Å [Fe XIV] or 6374 Å [Fe X] & 10747 Å [Fe XIII]. We have also observed a coronal structure in these 4 lines using one line at a time as shown in the figure below. There is similarity between all these images

obtained but there is more similarity between the structures observed in the [Fe X] and [Fe XI] lines than between one of these and any of the other lines.This is understandable as both these lines represent plasma at a temperature of about one million degree K. Again, coronal structures observed in [Fe XIII] and [Fe XIV] emission lines are similar as both these lines represent plasma at a temperature of about two million degrees K.

It is generally believed that the widths of coronal emission lines increase with height above the limb but we discovered that the width of the [Fe XIV] line decreases with height along the coronal loops.Width of the [Fe X] line increases with height above the limb whereas that of the [Fe XI] line shows an increase but with a lesser slope. Width of [Fe XIII] line shows negligible change with height.

All these observations indicate that the variation in line width is related to the temperature of the ion the line represents. An emission line from an ion that has a maximum abundance at a temperature greater than 1.6 MK shows a decrease in the line width with height while one from an ion that has a maximum abundance at a temperature less than 1.6 MK shows an increase in the width with height. Slope of the variation depends on the associated temperature and is negligible for emission lines that peak around 1.6 MK.The trend in the variation of the line width is independent of the shape,size and topology of the coronal loops. To expand on this further, width of the [Fe XIV] line decreases in all types of loops – small or big; open or closed; face-on or end-on; radial or non-radial, while the width of the [Fe X] line increases with height. The magnitude of the variation may be different for different coronal loops, because it may depend upon the underlying magnetic field, density, temperature etc. The FWHMs of [Fe X] and [Fe XIV] emission lines do not show any change with height after a distance of about 250 arc sec and the normalised ratio is 1 suggesting that the plasma at larger heights is at uniform temperature and non-thermal velocities. The distance may depend on the physical properties of the coronal structure.

We found that the intensity ratio of [Fe XI] to [Fe X] line generally increases with height above the limb indicating an increase in temperature with height. The intensity ratio of [Fe XIII] to [Fe X] line shows small variations with height above the limb. One would have expected a larger variation with height considering the similar change in temperature with height as observed from the variation in [Fe XI] to [Fe X] line ratio and from the abundances of the ions as a function of temperature. To our surprise the intensity ratio of [Fe XIV] to [Fe X] line decreased with height above the limb, whereas following the above-mentioned logic it should have increased with height rather steeply. The decrease in this intensity ratio implies that the looptop is cooler if observed in the [Fe XIV] emission line.

Figure caption: Intensity distribution in the coronal structure observed in different temperature plasma from 1 - 2 MK

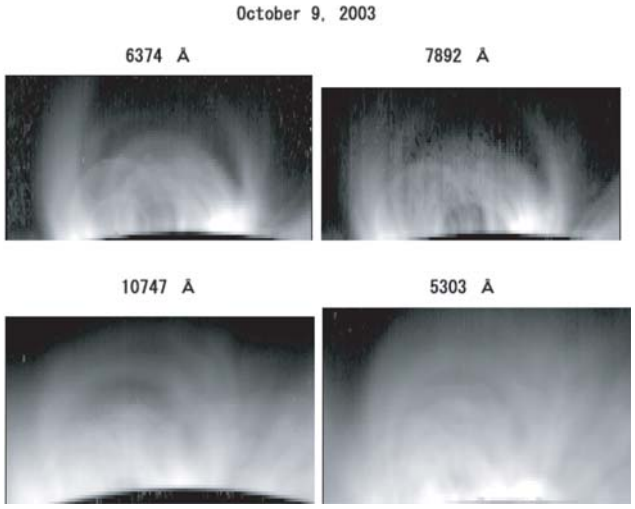
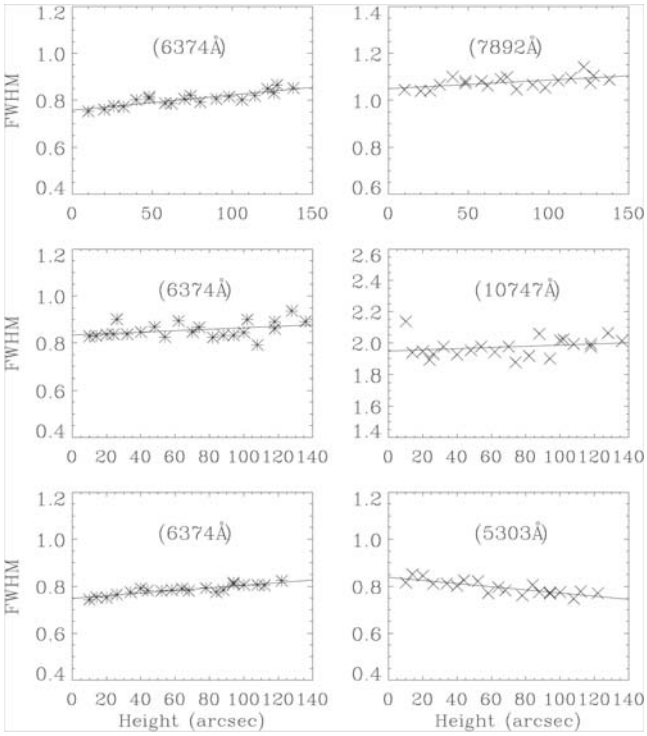


Figure caption: Typical variations of line-width of coronal emission lines with height above the limb along coronal loops.



The observed variations considering one line at a time can be explained. Increase in the width of the [Fe X] line may be explained in terms of an increase in the non-thermal velocity due to the existence of waves as has been done most of the time in the case of this line and other similar EUV emission lines.Similarly, the decrease in the width of the [Fe XIV] line with height may be explained in terms of dissipation of waves. The

assumption here is that the different types of plasma behave differently but we have shown that the different temperature plasmas are correlated.

The monotonic increase in temperature or non-thermal velocity with height above the limb cannot explain simultaneously the observed variations in line widths and intensity ratios with height in all the lines. The observed variations can be explained if we assume that the thin coronal loops are not magnetically shielded. Plasmas at different temperatures interact with each other, probably due to collision and the whole of plasma attains uniform temperature and non-thermal velocity at larger heights. This does not go well with the existing theories and physics about the coronal loops.

— Jagdev Singh

Contribution of Solar Chromospheric Features to Ultraviolet (UV) Irradiance Variability

It is well known that the radiative output of the Sun is one of the main driving forces of the terrestrial atmosphere and climate system.Thus the study of the changes in the solar energy flux has become a major topic of interest. Although the long-term change in total solar irradiance (the solar energy flux integrated over the entire spectrum) can be considered to be one of the major natural forces of the Earth's climate system, the study of the UV irradince variability is an equally important issue in Solar Physics.For more than 2 to 3 decades, the solar irradiance (both bolometric and at various wavelengths) has been monitored from several satellites.It is known that the solar energy flux changes over a solar cycle.It has also been shown that the long-term irradiance variations are related to the changing emission of bright magnetic elements (Foukal and Lean,1988,Kariyappa and Pap 1996, Sol. Phys. 167, 115, Kariyappa 2000, JAA 21, 293, Kariyappa et al. 2005, BASI, 33, 364), whereas the short-term irradiance variations are directly associated with active regions as they evolve and move across the solar disk (Lean 1987, JGR 92, 839). The difference between the observed and the model irradiance variability has not been well explained and further investigations are required. The current irradiance models are based on full-disk integrated flux, such as radio flux, Ca II K1 index, He I equivalent width, but not from spatially resolved features of the Sun. In order to identify and understand the underlying physical mechanisms of solar irradiance variability and to estimate the contribution of various chromospheric features to UV irradiance, a detailed analysis of spatially resolved data from the ground and from space is required.

The Ca II H and K lines are widely used to study the solar chromospheric structures and these lines are very sensitive to the variations in temperature and the magnetic field strength. Thus they are excellent indicators of the chromospheric structural changes related to solar magnetic activity. The chromospheric images obtained in Ca II H and K lines from ground have been used as a proxy to understand the variability of UV irradiance measured in the Mg II h and k lines from space satellites.The main features which are responsible for chromospheric emission seen in the Ca II H and K lines are the plages, the network, internetwork and background chromospheric regions.These features will have a one-to-one spatial correspondence with the underlying photospheric magnetic elements. However, separating out these features from the images is one of the unresolved problems in Solar Physics.

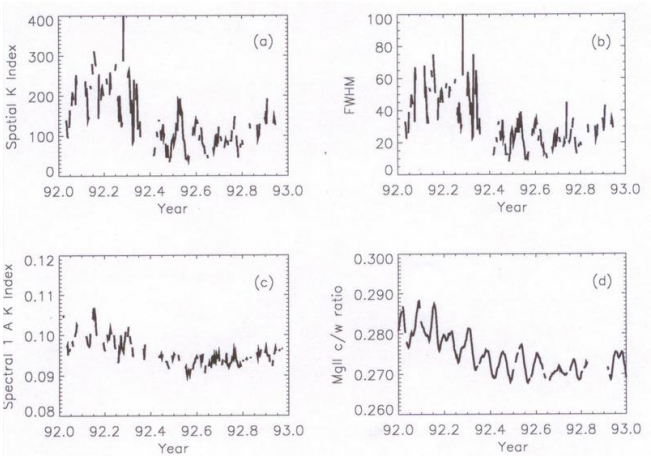


Fig 1. Time series of (a) spatial K index, (b) full width at half maximum (FWHM), (c) NSO/Sac Peak spectral K index, and (d) NOAA9/SBUV2 MgII c/w ratio for the time interval of 1992.

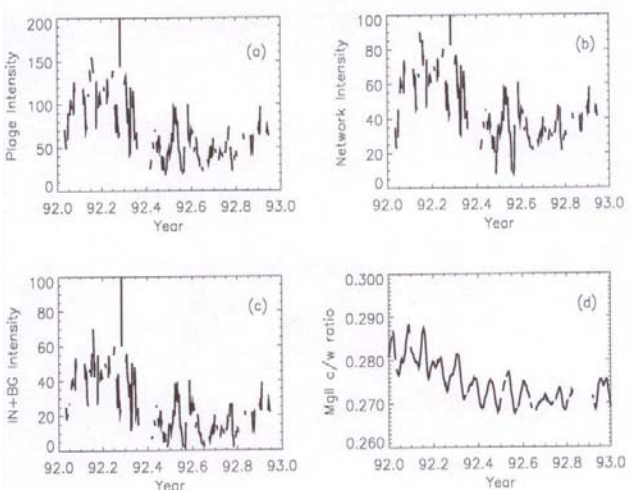


Fig 2. Time series of intensity of (a) plages, (b) network, (c) internetwork + background regions, and (d) NOAA9/SBUV2 MgII c/w ratio for the time interval of 1992.

An attempt has been made to segregate the chromospheric features from the images of Ca II H and K lines (images have been obtained from NSO/Sac Peak) using the "Histogram Method" (Kariyappa

and Pap 1996, Sol. Phys. 167, 115).The new indices (such as the spatial K index, FWHM of the histogram taken for the full-disk image, the quiet Sun intensity, the intensity and area of the features) of the images corresponding to the various chromospheric features have been derived using this method. It has been established, for the first time, that the new indices will be used for measuring and describing the chromospheric activity in the K line.It is shown that the intensity of all the chromospheric features is well correlated with UV irradiance variability measured in Mg II h & k lines.The contribution of an individual feature to Ca II K irradiance variability has been estimated from the intensity time series data and it was found that about 50 % of the Ca II K irradiance variability results from plage, about 32 % from the network, and about 18% from the combined internetwork + background regions. In addition, the results show that the intensity of the quiet Sun will be varying with the solar cycle and is very dynamic and is crucial for developing an understanding of the chromosphere itself. It is also one of the important contributors to the variations of the UV irradiance. Besides the plages, a significant portion of the variations observed in the UV irradiance is related to the changing emission of the network, internetwork and background regions and hence they will play an important role in contributing to the variation in UV irradiance which should be considered in the irradiance models.

— R. Kariyappa

Variable Na I Components in the ISM towards Vela Supernova Remnant

An area of the sky shown in Figure 1 (left panel)and earlier investigated by Cha & Sembach(2000) has been surveyed to map the velocity of the Interstellar Medium around the Vela Supernova Remnant and to study the time scale and length scales of the variability of the ISM. This is the area where the SNR is actively interacting with the surrounding ISM. The area contains a host of early-type stars at and beyond the distance of the remnant. About 60 stars were already observed in the Ca II H & K and Na I D lines by Cha & Sembach (2000) in 1993, 94 and 96. Multiple epoch survey in these lines would bring out the variability of the interacting diffuse clouds. Apart from the Na I D lines, we have tried,in this survey, to also include the K I lines and have searched for the presence of CH, CH^+, Li I and diffuse interstellar bands (DIBs).

High resolution spectroscopic observations were carried out with the fibre-fed VBT echelle spectrometer at a resolving power of 72000. This resolution is about the same as that used by Cha & Sembach which enables an easy comparison with their study. The observations presented here were obtained in 2004 and 2007. In this report data are presented on the Na I D lines in five stars which are distributed across the field.The Na I D line region is affected by telluric lines, which have to be corrected for. Figure 1 (right panel) illustrates the correction for these features.

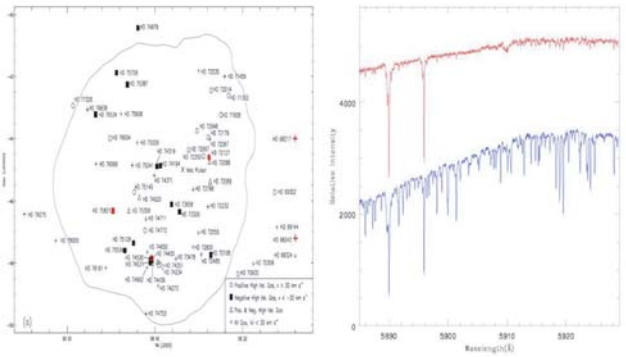


Figure 1

The equivalent widths of the various components are obtained by Gaussian fits.Figure 2a shows our observations of HD 72127A, obtained in 2004 and 2007.In Figure 2b, the Na I D line profiles and the profile of K I 7698 line in HD 74455 are displayed. The ratio K I/Na I is very small unlike in the diffuse ISM.

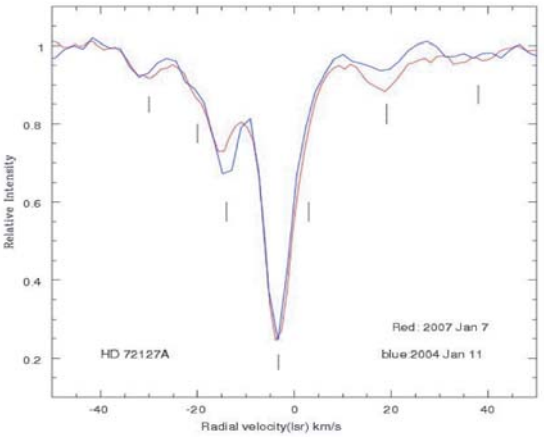


Figure 2a

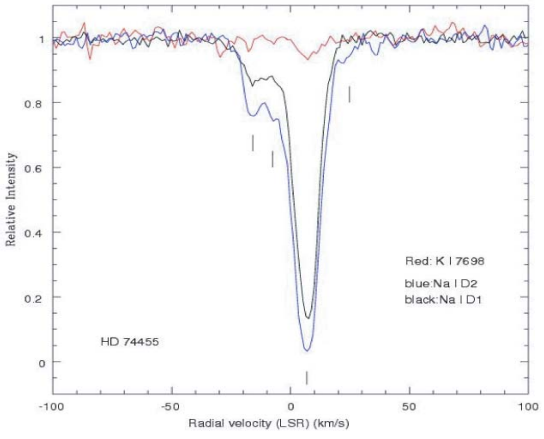


Figure 2b

In Figures 3a to 3f the comparison of our profiles with those of Cha & Sembach is shown.

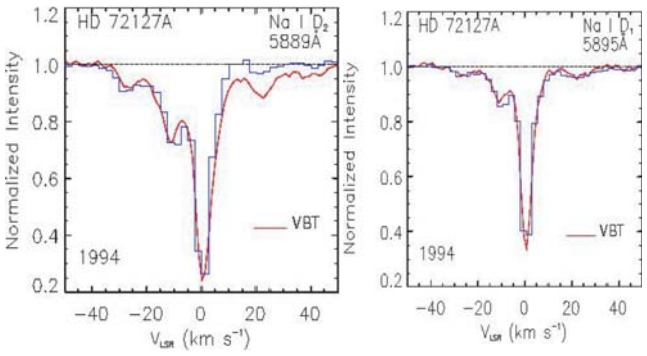


Figure 3a *Figure 3b*

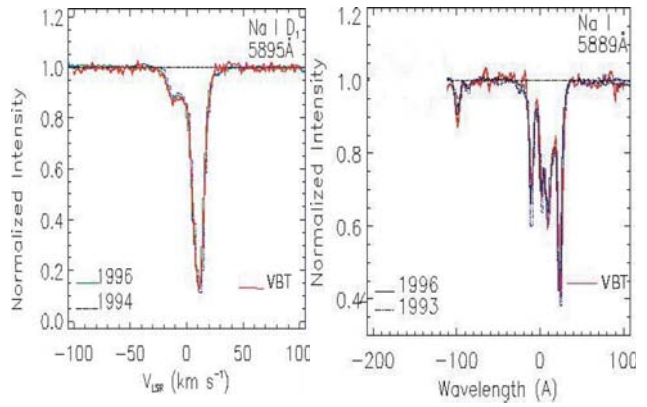


Figure 3c *Figure 3d*

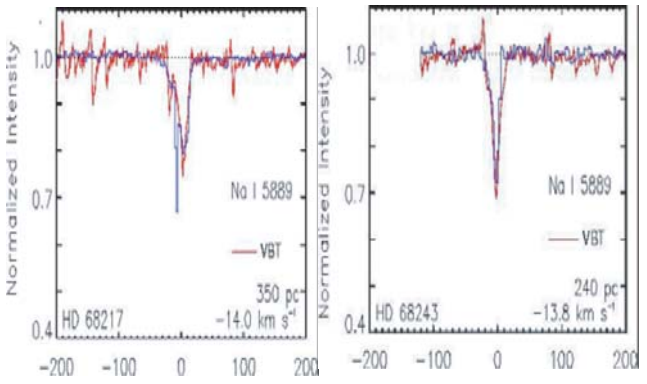


Figure 3e *Figure 3f*

Figure 4 shows the radial velocity of the components in all the five stars across the field. Note the high velocity components in distant stars HD78251 (-100 km/s) and HD72127A which has both red and blue component at 30 and -40 km/s. Variable components are present in almost all the five stars.

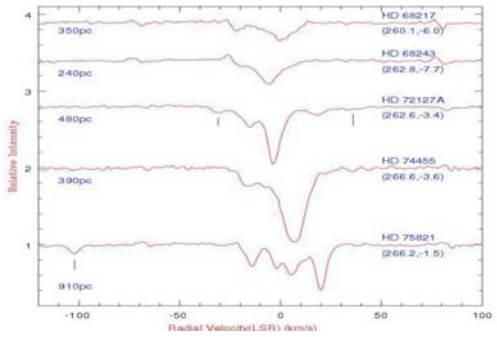


Figure 4

Table 1 shows the measurements in the past along with the present results.

Table 1.Radial Velocities (V_{LSR}) & Eq.widths of Na I D line components in ISM towards HD 72127A.

1971-77 km/s mA	1981-88 km/s mA	1994 km/s mA	2004 km/s mA	2007 km/smA
	-28 16 ..8	-28 13 .. 6	-27 12 ..6	-27 14 ..6
	-21 8 ..4			
	-13 23 ..12	-19 18 ..6	-16 13 ..4	-16 12 ..5
	-6 66 ..32	-9 46 ..26	-10 48 ..29	-10 43 ..18
-1 50 ..25	-1 120 ..61	1 102 ..82	0 100 ..81	1 109 ..76
	4 50 ..25		7 21 ..15	7 18 ..9
	21 25 ..13	22 6 ..6	21 16 ..4	22 23 ..9
	41 8 ..4			39 6

Cha & Sembach found 3 stars out of 13 to be variable in 3 years gap. Our observations after 10 to 13 years show 5 out of 5 are variable in either velocity or eq.width. We hope to continue and map the velocity field more thoroughly.

REFERENCE:

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Rao, N.K., Sriram,S., et al. 2005, Asian J. of Phy. 13,267.

— N. Kameswara Rao, S. Muneer, K. Jayakumar, G. Pandey

High Resolution Spectroscopy Of HR3117 - A new Zeta Oph Variable Star?

HR 3117 is an early B star (B3 IVp) with T_{eff} = 17200, log g=3.54 and is suspected to be a Beta Cephei star with a period of 2h 20m.It was also thought to be a peculiar star because of the prominence of the Si II lines in its spectrum. However, the recent catalogue of Beta Cephei stars excludes this star on the grounds that Hipparcos light curve shows no variability in excess of 3 mmag. (Stankov & Handler 2005). Leone & Catanzaro (1998) studied the star spectroscopically and claim that it is not peculiar. Their abundance analysis shows that the star has solar abundances (including Si and S), although they also find a factor of ten overabundance of Neon, with respect to the solar abundance.Leone & Catanzaro also claim from their spectroscopy obtained on 4 nights in 1995 (with a resolving power of 13000) that the star is not a spectrum variable. Leone (1994) identified the star as a definite x-ray source from Grillo et al's catalogue of B stars. Our spectra initially showed profile variations in Helium lines (Rao et al 2005).So, what sort of an object is this?

In order to answer this question, we have observed the star using the VBT Echelle Spectrometer at a resolving power of 70,000 on several nights in 2004, 2005, 2007.The star was also monitored spectroscopically for 2-3 hours on a few nights based on the period originally suggested for its light variations. In our study, the S/N ratio is 70 to 100 for any indiviual spectrum. The combined spectra (on a single night) has S/N of 300 to 600. These spectra were used for line identifications.

RESULTS :

a) Profile Variations:

Unlike previous nvestigations, at our resolution, we do see profile variations in several lines, sometimes in hours but conspicuously from night to night. This is illustrated by the He I 6678 a line.

Figures 1 & 2 show the variations over a period of 3 hours - note how the dip (extra absorption) on the blue side (-32 km/s) has disappeared or moved to the red side (+37 km/s).

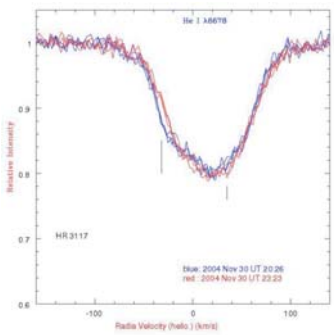


Figure 1

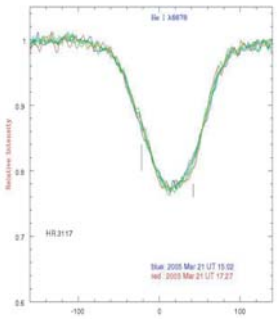


Figure 2

However, on other occasions the profiles are stable as is evident in Figure 3. Conspicuous changes do occur in a day.

Figure 4 shows the profile on 2 successive nights. An absorption dip (+12 km/s) has moved to the red (+ 55 km/s). The equivalent width of these profiles is about the same - 457 and 459 mA. Certainly relative to the star's mean radial velocity (+ 19 km/s) the clump of gas is moving from the slightly blue side to the redder.

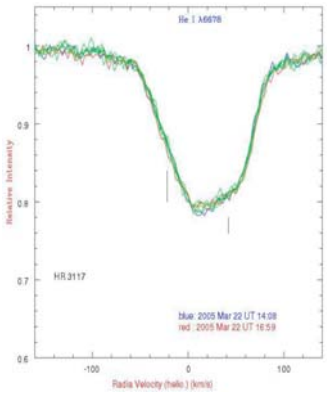


Figure 3

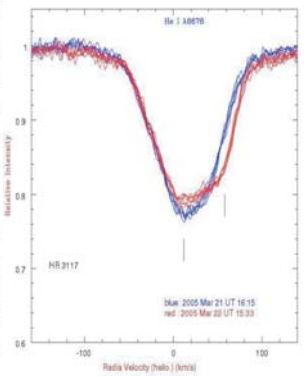


Figure 4

Figure 5 shows the mean profiles on 3 successive nights, a dip moving to the blue side in a day and coming back to about the same radial velocity the next day. Not only He I lines but other lines too show the migration of bumps in the profiles.Mg II 4481 A line is shown in Figure 6 - on four nights, Nov 18 & 30, and Dec 5 & 7, 2005. A bump occurs on the blue side of the profile on Nov 18. It is seen redward on Nov 30;it moved further to the red on Dec 5 (either the same bump or another one).

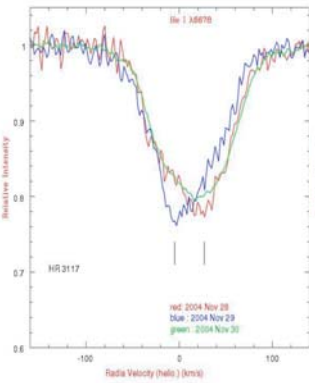


Figure 5

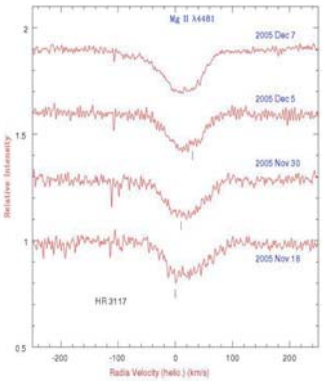


Figure 6

The mean equivalent width of He I 6678 measured on 10 nights spread over 2 years changed from 430 mA to 470 mA, on 3 successive nights it varied by only 12 mA. Even the radial velocity remains fairly constant (within 3-4 km/s). This behaviour is characteristic of the Zeta Oph class of objects, which shows migration of bumps across the profile due to non-

radial pulsations (Balona & Dziembowski 1999).The projected rotational velocity is estimated to be 65 km/s.

b) Transient Absorption features:

Apart from the usual expected B3 type absorption features (eg.He I, C II, Si III, Si II, S II, Ne I etc.), extra absorption features appear in HR 3117 on certain times in the spectrum, which seem to disappear in a day of so.

Figures 7 & 8 show the appearance of features at 6231.6 and 4933 on 2005 Dec 5 but not on the other 3 nights. We are yet to identify these features. Some of these features are seen on more than one night.Is the star infected with spots? Has the x-ray emission got any thing to do with this? We are continuing to monitor the star and the mysterious appearance of some absorption features in its spectrum to gain an understanding of what is going on.

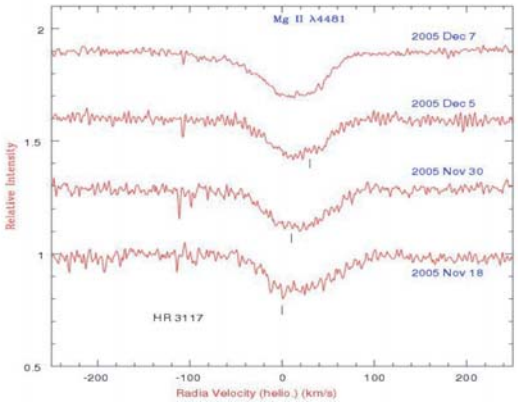


Figure 7

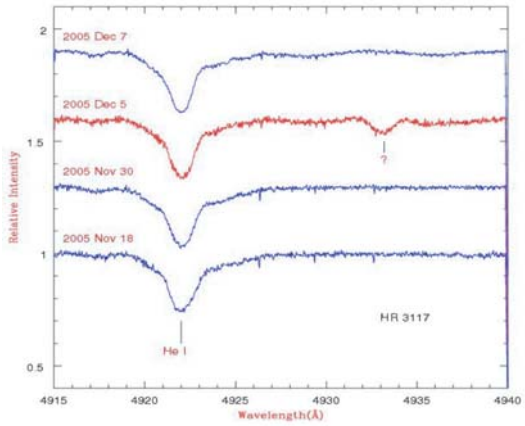


Figure 8

HR 3117 seems to belong to the class of Zeta Oph variables. It certainly is a spectrum variable. Its high neon abundance (Leone &Catanzaro 1998), if real,may provide a clue to its nature.

REFERENCES :

Balona,L.A. & Dziembowski,W.A., 1999,MNRAS, 309, 221
Leone, F., 1994, A&A, 286, 486
Leone, F. & Catanzaro, G., 1998, A&A, 331, 627
Rao, N.K., Sriram, S., Jayakumar,K., and Gabriel, F., 2005., J.Ap&A, 26,331
Stankov, A., & Handler, G., 2005, Ap.J, Supp.158,193

— K. Jayakumar, N. Kameswara Rao, S. Muneer, S. Sriram

Carbon-Enhanced Metal-Poor stars at high Galactic latitudes

Carbon-Enhanced Metal-Poor (CEMP) stars comprise about 20% of the metal-poor stars (with metallicity [Fe/H] $\leq$ -2.0) in the Galaxy.They exhibit large enhancements of carbon ([C/Fe] $\geq$ 1).The CEMP stars can be further subdivided into CEMP-s, CEMP-r and CEMP-r/s groups depending upon whether they exhibit enhancement of s-process, r-process or both r- and s-process elements respectively. The group CEMP-no consists of CEMP stars that do not exhibit any enhancement of r-process or s-process elements. In spite of several efforts, the nucleosynthetic histories and astrophysical sites associated with the formation of these stars are still unresolved.

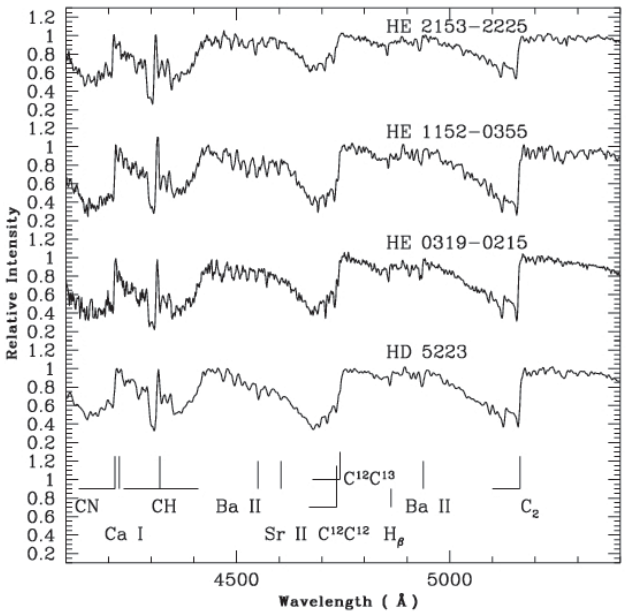
CH stars, that belong to CEMP-s group are characterized by the strong G band of CH in their spectra. The late-type CH stars are intrinsically low-metallicity AGB stars; they are the Population II analogues of N type C stars. Early-type CH stars are believed to be post-mass-transfer binaries (McClure & Woodsworth 1990, APJ,352,709).The chemical compositions of the early-type CH stars bear the signature of the nuclear processes operating in the low-metallicity companion AGB stars, provided they conserve the surface characteristics of the AGB stars. It is therefore important to search for these objects since they may provide a rich source of information for studying the early Universe, the early Galactic chemical evolution and the nucleosynthesis processes associated with their formation.

We have undertaken a search for these objects from a large sample of field stars from HK and HES surveys using low-resolution spectroscopy. In an earlier study, Goswami (2005, MNRAS, 359, 531) reported spectral classification of ninety one objects from the Hamburg survey (Christlieb et al. 2001, A&A, 375, 366) based on low-resolution spectroscopy, using the OMR spectrograph at VBT, Kavalur and HFOSC at HCT, Hanle. This sample was shown to be comprised of different types of carbon stars, the main feature was, however, the detection of several potential CH stars

which comprise about 30% of the sample. Subsequently, high-resolution spectroscopic analysis of Subaru spectra of a number of these CEMP candidates confirmed their identification and detailed chemical composition studies have revealed one object HE 1305+0007 to be a 'lead star' belonging to the CEMP-r/s group (Goswami et al. 2006, MNRAS, 372, 343). The observed high abundance of the 3rd-peak s-process element lead (Pb) ([Pb/Fe] = +2.37) is an observational evidence of the occurrence of s-process nucleosynthesis at low metallicity.

We have continued with our search for CEMP stars and during the last two years (2005 - 2006) we have succeeded in acquiring spectra for another sixty one objects using both VBT at Kavalur and HCT at Hanle. Following the spectral criterea as detailed in Goswami (2005), we have conducted spectral classification for these objects. Spectroscopic analysis revealed twenty-one of them to be potential CEMP stars. In figure 1, we show three examples of these objects. Combined with our earlier results, this shows a total of fifty six potential CH star candidates in a sample of one hundred and fifty one objects from the Hamburg survey.

Figure 1: A comparison of the spectra of three potential candidate CH stars in the wavelength region 4100 AA, -5400 AA, with the spectrum of HD 5223, a well known classical CH star. Prominent features in the spectra are indicated.



-- Aruna Goswami

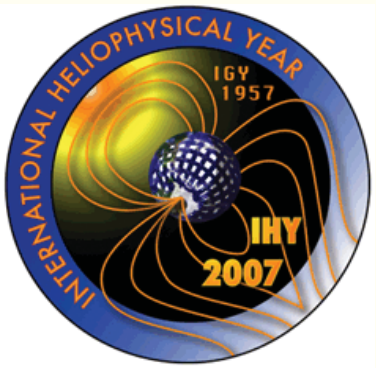
Indian Institute of Astrophysics

Rediscovering Tagore – Naya Theatre's RAJ-RAKT

Tagore as Raghupati in a production of *Visarjan* c. 1897

11th February 2007

Siraj Hasan has been elected a member of the IHY International Steering Committee which has the responsibility of overseeing the operations within IHY.



National Science Day (28 February 2007)

The National Science Day was celebrated in the Institute with great enthusiasm. Nearly 200 school children participated in the programme in the morning, which included a short movie on IIA titled *From Nungambakkam to Hanle*, observation of the Sun and sunspots through an appropriate telescopic arrangement in a tent set up for the purpose, a continuous movie show at the Seminar Room and an exhibition of colourful posters on astronomical objects and models of our telescopes. A table-top model of the TAUVEX payload was a special attraction.

The Institute wore a festive look with groups of children surrounding the scientist-volunteers at the solar tent in the lawns and at the exhibition area keeping them busy with their questions. The movie show which featured Cosmic Collisions produced by NASA's Outreach Programme and a locally produced film on the Life and Times of Albert Einstein drew considerable crowd. Senior graduate students were at hand to explain the show.

Jayant Murthy gave a scintillating talk on `*Science from Space -- Fifty Years of Space Flight*'. The year 2007 is special because it commemorates the golden jubilee of the beginning of the Space Age, which had started with the successful launch of the first artificial satellite, Sputnik I by the Soviet Union. Professor Murthy's talk touched upon all the important milestones of the last fifty years in the area of Space Sciences and the rich benefits that have accrued to Astronomy through the explorations from space. He also spoke on ISRO's plans to launch satellites for astronomical observations from space and IIA's special role in the design and operation of these payloads.

In the afternoon, science undergraduates from St Joseph's and Jyothi Nivas, two premier colleges of Bangalore visited the Institute. They too were shown the movie on IIA, then taken to the solar tent for observing the Sun and to the exhibition area. In addition, these students were taken to the Photonics Laboratory of IIA. Two slightly more technical talks, one on the Sun and IHY by Dipankar Banerjee and one on the Life and Death of Heavyweight and Lightweight Stars by Gajendra Pandey, exposed the students to some of the modern ideas and results on two important areas of Astronomy.

The evening programme started with a talk by **Ashok Pati** on Introducing the Night Sky. It was a fascinating powerpoint presentation on how one goes about looking at the night sky and what one finds there. Close-up views of planets and nebulae and galaxies were shown. This prepared the assembly for the real show which started at around 7 PM on the terrace of the Main Laboratory Annexe. A 14-inch automated Meade Telescope was set up for watching the sky at night. The skies were clear and about 40 people had gathered to look through the telescope. The Moon was in its waxing phase and rather bright. Among the planets Saturn was available for viewing. Other celestial objects like the Great Nebula in Orion and the Pleiades Cluster were ideally placed for early evening viewing and they added to the beauty of the celestial show. Senior graduate students of the Institute and a few scientists were around all the time to assist the viewers.

Celebrations of the Science Day were finally brought to a close beyond 9 PM. Watching the night sky through the Meade Telescope is going to be a regular feature of the Outreach Programme of the Institute. Please visit the IIA website to make sure you do not miss the next time the session is on.

Engineering students from Jagannath Institute of Technology and Management (JITM) observe solar flare at IIA's Gauribidanur Radio Observatory

IIA hosted 4 BTech students and a faculty member from JITM for a few days in December 2006 at the Gauribidanur Radio Observatory. Together with IIA staff, they assembled and tested the RadioJove kit (http://radiojove.gsfc.nasa.gov) that was donated to them by the Society of Amatuer Radio Astronomers (http://radio-astronomy.org) at Gauribidanur. They observed the 20.1 MHz counterpart of an X-class flare from the Sun on Dec 13 2006. Some interesting aspects of the 20.1 MHz data are shown in figure 1, and the X-ray lightcurve from the GOES satellite is shown in figure 2.

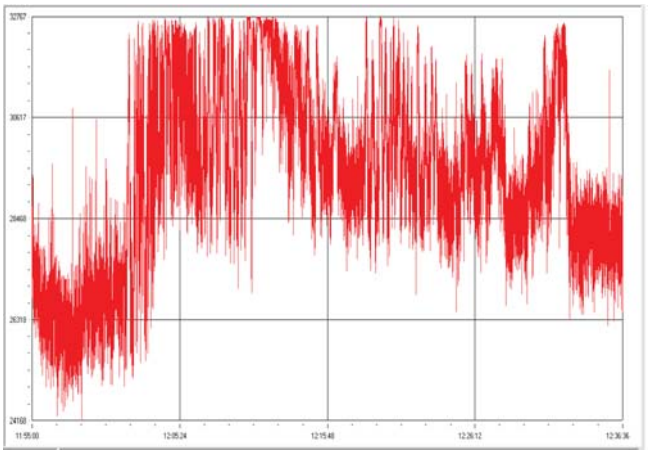


Fig 1. 20.1 MHz lightcurve observed by the JITM RadioJove instrument from 11:55 IST to 12:36 IST at IIA's Gauribidanur radio observatory. These are interesting post-flare radio pulsations following the X-class flare on the Sun at 02:40 UT (08:10 IST).

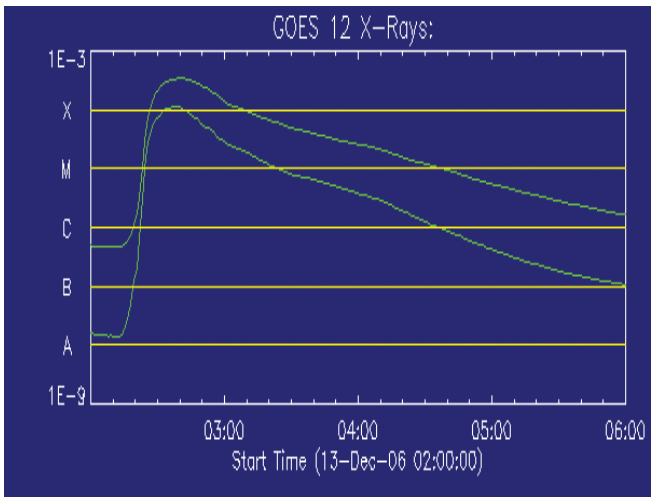


Fig 2. 1 — 8 Angstrom X-ray flux measured by the GOES satellite (http://www.sec.noaa.gov/today.html) on Dec 13, 2006. The X-class flare at 02:40 UT and the long decay is clearly evident.

-- Prasad Subramanian

Workshop on Physics and Astrophysics of Dust

A workshop on Interstellar Dust was organised by S.Chatterjee and H.C. Bhatt of IIA at the Vainu Bappu Observatory in Kavalur,from February 24 to 26, 2007. The aim was to discuss the formation, probes and the astrophysical implications of dust. A heterogeneous group of about 30 people — physicists, chemists, astronomers and mathematicians were brought together with a common purpose in mind — to solve the mysteries of dust grains in outer space.

After brief introductory remarks by Chatterjee, Part I of the workshop, Dust In Astrophysics, got under way. The characteristics of cometary dust were discussed and its difference from interstellar dust was emphasised (U.C. Joshi, PRL). Presence of dust in the atmospheres of brown dwarfs and of T Tauri type stars is generally inferred from infrared studies of these objects and through optical polarization studies. Some of the work currently being done in this area in IIA was highlighted (S.Sengupta, M.V. Mekkaden, IIA). A careful analysis of gas-phase abondances in diffuse clouds can yield valuable information on the amount of dust-forming material available in the ISM.A systematic effort in this direction (U. J. Sofia, Whitman College, USA) reveals that the amount of heavy elements available is not enough to produce the observed extinction. Doubts were cast on the once widely accepted Mathis-Rumpl-Nordsieck mixture with its power-law size distribution.The ubiquitous 218 nm feature may not be due to graphite after all! The first results on a survey of dust through infrared studies in the inner Milky Way were presented (S. Ganesh, PRL). Some of the observations were obtained from the Spitzer Telescope.

Evidence of dust in elliptical and lenticular galaxies was presented through extinction maps of these galaxies which were obtained from extensive photometric data (M.K.Patil, SRTM University, Nanded).Evidence of the presence of dust in starburst galaxies and in quasars was presented (P.Shastri, IIA).Heavy elements which the grains are composed of seem to have formed rather early in the history of the Universe since there appears to be substantial amounts of dust in high redshift quasars.Supernovae are thought to be responsible for producing the heavy elements and dust in these environments.

Part II of the Workshop dealt with the Physics and Chemistry of dust and several interesting topics e.g., heterogeneous chemistry on very small dust particles (J. Bhatt, Imperial College), crysatllization and morphology of grains (S. Chatterjee), dynamical aspects of the separation of dust and gas in various interstellar environments (H.C. Bhatt), spectroscopic

studies in the identification of dust species (S.L.N.G.Krishnamachari, JP Nagar, Bangalore) and the importance of the study of complex molecules in understanding the chemistry of dust (R.Chaudhuri, IIA) were discussed.

Part III of the Workshop dealt with Spectroscopy and Light scattering as Probes of interstellar dust. The theoretical modelling of the scattering process was discussed in several talks (D.B. Vaidya, Gujarat College,Ahmedabad; Ranjan Gupta,IUCAA; S.K. Sharma, SN Bose National Centre for Basic Sciences, Kolkata).The results of the application of the theory of Discrete Dipole Approximation to scattering by grains were discussed.The formal presentation of the talks closed with a description of a new effort on laboratory studies of light scattering by grains (A.Sen, Assam University, Silchar).At the end there was a discussion on the identification of possible areas of overlap between the various groups in the country.The informal atmosphere,the small number of participants and the quiet and beautiful environment of the Observatory all added to the success of the Workshop.

Mangalore Workshop

A one-day programme on Astronomy was organised on February 2, 2007 by the Physics Department of St. Aloysius College,Mangalore and the Mangalore Astro Club in collaboration with IIA.The appropriate title of `**The Fascinating Field of Astronomy**' was given to the programme.

The programme was inaugurated by St. Aloysius Evening College Principal Fr. Vincent Pinto while the College Science Faculty Dean, Prof Sridhara, welcomed the gathering. There were a total of three lectures, '***Stars and our Milky Way*** by Eswar Reddy, ***'The Interstellar Medium'*** by Jayant Murthy and ***'Galaxies in the Universe'*** by the Prajval Shastri.

There were over 200 participants that included college teachers and students, as well as high school teachers and students, who came not only from the city of Mangalore but also from other parts of Dakshina Kannada and Udupi districts to participate in the programme.

The response was very enthusiastic, with both the teachers and the students asking a lot of questions, which extended the scheduled discussion time to nearly 7 p.m. Stargazing was organised after that by enthusiastic members of the Astro Club.

-- Prajval Shastri

Mysore Workshop

A one-day workshop was organised at St. Philomena's College, Mysore, entitled, **'Windows to our Galaxy'** on January 23, 2007, under the Public Outreach Programme.The workshop was attended by 140 students of the college and was followed by a session of night-sky observation. After the formal inauguration by the Prinicipal of the College, Father Leslie Moras, H.C.Bhatt introduced the developments in astronomy in the early part of the last century, which led to the discovery of the true length scales of our Galaxy and the distribution of stars and other stellar systems within it.This was followed by a talk by S.Chatterjee on the application of Newtonian mechanics to understand the properties of the Galaxy.

The post-lunch session focused on the observational issues related to the study of galaxies. Easwar Reddy described the imaging and spectroscopic methods in the visible range while Prajval Shastri gave an account of the observational studies in the radio wavelengths. Jayant Murthy described how new opportunities of studies in the ultraviolet and infrared wavelengths were opening up due to space based telescopes.

All the speakers spoke on the opportunities that are available in IIA for pursuing a professional career in astronomy and how the prospective students can plan their studies to take up such a career.

The night-sky observations were conducted with a 14-inch Meade Telescope , which was carried to Mysore from the CREST campus of IIA. This programme was coordinated by S.Pukalenthi and V.Gopinath.The night-sky observations started at 7.15 in the evening and went on till 1AM in the early morning of January 24. It was attended by over 200 students and staff of the college.

The college provided the scientists from IIA with excellent facilities and the students evinced a great interest in the themes covered in the lectures as well as in the night-sky observations. Father Moras highlighted the importance of such interactive programmes and has offered to organise bigger and extended workshops in his college.

-S. Chatterjee

First Kodai - Trieste Workshop on

Plasma Astrophysics

'Indian Institute of Astrophysics'

Kodaikanal Observatory, India

August 27 - September 7, 2007

Website:http://www.iiap.res.in/kt1/

Professor David Lambert, director of The University of Texas at Austin's McDonald Observatory, and an honorary fellow of our Institute,has been awarded the *Henry Norris Russell Lectureship* for the year 2007.The lectureship is the highest honour that the American Astronomical Society confers on an astronomer for his lifetime achievement.The honour has been conferred on Lambert

"For contributions in the field of stellar Spectroscopy and abundances, which have profoundly influenced our knowledge of stellar evolution, nucleosynthesis and their effects on the chemical evolution of the Universe".

Dave Lambert, a regular visitor to IIA for more than one and a half decade was elected to the Honorary Fellowship of IIA in 2004.

Observing programmes at the Vainu Bappu Telescope, Kavalur; January - March, 2007

S. No.	Observing Programme	Principal Investigator	Instrument	Night allocated		
				Jan	Feb	Mar
1	Asteroseismology of Procyon	N.K. Rao	Echelle	9 - 14		
2	Search for AlF molecular lines in Late type Stars	N.K. Rao	Echelle		4 - 6	
3	Spectroscopy of W UMa binary systems	P.V. Rao	OMR Spectr.	27 - 28		
4	Spectroscopy of Li rich K giants	Bharat Kumar	Echelle	29	1, 12-13	
5	Li rich K giants among Red Clump stars	Bharat Kumar	OMR Spectr.	25 - 26	19 - 20	26 - 28
6	Absorption lines of ISM in the direction of Supernova Remnants	S. Muneer	Echelle	2 - 3		
7	Li in metal poor dwarfs	Sushma Mallik	Echelle	18 - 19		4 - 5
8	Synoptic imaging survey of star forming regions	H.C. Bhatt	CCD Imager			17 - 22
9	Emission line stars in open clusters		OMR Spectr.	21 - 24	25 - 26	
10	YSOs in star forming regions	Rumpa Choudhury	OMR Spectr.	29 - 31	23 - 24	29 - 31
11	YSOs in star forming regions	Rumpa Choudhury	Echelle	15 - 17		15
12	SRD Variables	B.E. Reddy	Echelle		13 - 15	14
13	Beta Cephei stars	K. Jayakumar	Echelle	4 - 5	2 - 3	2 - 3
14	Search for low mass B,A,F type supergiants	G. Pandey	Echelle	8	7 - 8	10 - 11
15	T Tauri stars	M.V. Mekkaden	OMR Spectr.		21 - 22	24 -25
16	Stars with high IR excesses	S. Giridhar	Echelle		11 - 12	6 - 7
17	Interferometric studies of close binaries	S.K. Saha	Speck. Interfmtr.		17 - 18	
18	Spectroscopic study of Ap stars	S. Seetha	Echelle	6 - 7		
19	Stellar winds in RCrB stars	N.K. Rao	Echelle		9 - 10	8 - 9

Observing Programmes at Himalayan Chandra Telescope January - April 2007

S.No.	Observing Programme	Prinicipal Investigator	Night Allocated			
			Jan	Feb	Mar	Apl
1	Study of Initial Mass Function of Faint Young Open Clusters	G S D Babu Sujatha S. (MPBIFR, Bangalore)		27-28	27-28	6-7
2	Coordinated two-station Intranight optical monitoring of bright Radio OSOs.	Gopal Krishna (PI) (NCRA,Pune)	22-24	10-11	11-12	25-26
3	Low Resolution Spectroscopy of Field Stars:A Search for metal-poor objects.	Aruna Goswami P. Bama		8-9		8-9
4	CCD Photometry of RR Lyrae stars in Globular Clusters.	Sunetra Giridhar A..A.Ferro (IA-UNAM, Mexico)			9-10	10-11
5	Search for Li-rich K giants Among Red Clump Stars.	Bharat Kumar (PI) Eswar Reddy	30-31	6-7	7-8	29-30
6	Study of Individual emission line stars in selected open clusters.	Blesson Mathew Annapurni S	9 -12			
7	Optical spectroscopy of Classical, Recurrent and Symbiotic Novae.	G. C. Anupama	7- 8			27-28
8	Spectroscopic investigation Of Intermediate Polars.	Vishal Joshi (PI) D. P.K. Banerjee (PRL, Ahmedabad)	27	22-23		
9	Optical and Near IR Observations of Low Redshift Supernovae.	G. C. Anupama (PI) D. K. Sahu (Co-PI).	Accepted as a 'Target of opportunity' proposal			
10	Optical Observations of Supernovae in the Nebular Phase.	Dr. G.C.Anupama D. K. Sahu	13- 14	14-15	13-14	21-22
11	Exploration of disk accretion process in Taurus- auriga CTTS	Padmakar Parihar	28-29	24-26		
12	Optical Identification Of a couple of sources Discovered by GMRT	N.G.Kartharia (PI) Ishwar-Chandra (NCRA-TIFR)		20-21		
13	Search for optical emission from radio “arms”.	N. G. Kantharia (PI) T. P. Prabhu et al. (NCRA-TIFR)			17-18	
14	Optical monitoring of quasars with unusual characteristics	C. S. Stalin R. Srianand et al. (IUCAA, Pune			23-24	20
15	Near IR imaging of AGN Host galaxies. A feasibility study	C. S. Stalin D. K. Sahu				23-24
16	Multiwavelength Monitoring of nearby AGNs	C. S. Stalin (IIA, Bangalore) Ali Aghaee et al.(IAP, Paris)			25-26	
17	IMF studies of young open star clusters	Jessy Jose (PI) Dr. Anil K. Pandey (ARIES, Nainital)	25-26			
18	Spectrophotometry of Wolf Rayet Galaxies.	M. Chrisphin Karthick Dr. B.B. Sanwal (PI) (ARIES, Nainital)				12-14
19	Synoptic imaging survey of Star forming regions.	Harish Bhatt Rumpa Choudhury et al.	15-16	12-13		16-17
20	Spectroscopy of Bulge Dominated Low Surface Brightness Galaxies.	Mousumi Das (RRI, Bangalore) T. P. Prabhu, S. Ramya		18-19		
21	A Study of the host galaxies Of Gamma – ray burst sources	G.C. Anupama (PI) D. K. Sahu (Co-PI)	19		19	15
22	Study of star formation in the Blue compact Dwarf (BCD) Galaxies.	S. Ramya T. P. Prabhu D. K. Sahu	17-18	16-17	15-16	18-19
23	An Optical and Near-Infrared study of new FU Orionis and EX Orionis candidates	D. K. Ojha (PI) S. K. Ghosh, A. Tej (TIFR (DAA)) B.C.Bhatt	20-21			
24	The origin of long –term Variability in short period CVs: SDSS J080434.20+510349.2 and SDSS J123813.73-033933.0	G. H. Tovmassian (IA-UNAM, Mexico) G.C. Anupama, U. S. Kamath, D. K. Sahu			20-22	
25	Spectroscopic Studies of Low mass Pre main –Sequence stars in the vicinity of star forming Cluster NGC 1980.	Himali Joshi Ram Sagar et al. (ARIES, Nainital)	22-24			
26	Maintenance nights		1-6	1-5	1-6	1-5
27	IR camera characterisation				29-31	

2006 Kodai Winter School on Solar Physics

The school offered an intensive two weeks course in topics related to the Physics of the Sun. The school had a truly international character with both students and the lecturers from different parts of the globe participating. 38 students attended the course of which 24 are doing Ph.D. in Solar Physics. The rest were M.Sc students. This was the first formal course in Solar Physics for all of them. There were 42 lectures and 5 evening seminars and 10 observation oriented projects and three computer lab exercises.The students could observe the Sun with the existing facilities in the observatory. The Director, Prof.S.S.Hasan opened the school and Prof.S.M.Chitre delivered the inaugural talk giving an overview of the subject.

Course Director : H. M. Antia
Convener : K.E. Rangarajan

Topics and Instructors

Helioseismology	H. M. Antia, S. Basu
Solar dynamo theory and magnetic field	A. Rai Choudhuri
Photospheric processes and magnetic flux tubes	O. Steiner
Chromospheric dynamics and line formation	R. Hammer
Magnetohydrodyanamic waves	R. Erdelyi
Coronal Dynamics	V. Nakariakov
Energetic Phenomenon	N. Gopalswamy
Solar Wind	Ø. Lie-Svendsen
Activity	A. Ambastha
Observational techniques (optical)	K. R. Sivaraman
Observational techniques (radio)	P. K. Manoharan
Evening Seminars	***Speaker***
The Hot and the Cold of the Sun	Vinod Krishan
Acceleration and energy budget of the fast solar wind	Ruth Esser
Transition region dynamics	D. Banerjee
Coronal dynamics	Jagdev Singh
Radiative equilibrium in the Solar atmosphere	K.E. Rangarajan
Polarimetry techniques	Sankar Subramanian

Computer lab exercises were supervised by D. Banerjee and B. A. Varghese Experimental projects were supervised by S. Subramanian, K. E. Rangarajan, K.B. Ramesh and K. Nagaraju.
School website: http://www.iiap.res.in/kodsch

Computer Training Programme for Administrative Staff

A training programme in computer usage was organized in the Institute chiefly to initiate the younger generation of the administrative staff into a paperless, computer based work atmosphere and also to freshen up the knowledge of the seniors. While the theoretical part mostly dwelt on the definition and basic configurations of computer systems, the practical sessions aimed at providing basic training in the use of Windows based programmes and applications like MSWord and MSExcel. An introduction to the use and benefits of the internet and email was also given.

The classes originally planned as two sessions of lecture and four sessions of hands-on training by personnel from Penguin India Linux Solutions Pvt. Ltd. – spread out on two days on thirteenth and fourteenth February – were very useful and hence they were continued on fifteenth as well, on demand from the interested participants. Members of administration from Kodaikanal, Kavalur and Hosakote availed of the opportunity with great enthusiasm. Some more practical oriented classes for smaller groups of administrative staff are also planned with a view to fully equipping the administration towards a paperless future.

The training was organized by Dr.Prajval Shastri and is expected to serve as a preparatory step towards introducing e-administration in the Institute. This will greatly reduce paper-work in administration and would help maintain schedules in the implementation of projects while increasing the overall efficiency and participatory transparency.

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