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The 19th Bicentennial Commemorative Public Lecture

Madhav Gadgil, renowned ecologist and professor at the Agharkar Research Institute, Pune, delivered IIA's 19th Bicentennial Commemorative Public Lecture on 'Major Transitions in Evolution', on the 3rd April, 2009. A packed audience at the IIA auditorium that included academics, college students and members of the public, attended the lecture.

The Bicentennial Commemorative Public Lectures at IIA were begun in 1987, to celebrate 200 years since the first astronomical observations of 1786 in Madras which were the very beginnings of the long history of the Institute. Madhav Gadgil is among the country's foremost ecologists, who was largely responsible for introducing quantitative investigations in ecology and animal behaviour, as well as viewing humans as an integral component of ecosystems. He founded the Centre for Ecological Sciences in the Indian Institute of Science, Bangalore, has held faculty positions at Harvard University, University of California Berkeley and Stanford University, and has also served on the Science Advisory Council to the Prime Minister of India. He is a recipient of numerous prestigious awards, including the Volvo Environment Prize, Harvard University's GSAS Centennial Medal, the Padma Shri and Padma Bhushan.

At the lecture, Madhav Gadgil was introduced by his collaborator and renowned historian, Ramachandra Guha, who described the speaker as epitomising the tradition of broad intellectual enquiry that was patriotic but not nationalist, that was polyglot, and that spanned several disciplines.

In his lecture, Madhav Gadgil described the saga of life on earth as a continuous expansion and diversification, occupying a greater range of habitats and utilizing newer forms of resources. Most importantly, there has been an overall trend from simpler to more complex life forms and their interactions. He outined the nine major transitions in evolution. The first eight are strictly biological: from individual replicating molecules becoming populations of replicating

molecules in protocells, from independent replicators to chromosomes, from RNA to DNA genes and protein enzymes, from bacterial cells to cells with nuclei and organelles, from asexual clones to sexual populations, from single-celled organisms to multicellular ones, the emergence of animals with nervous systems, and the emergence of animal colonies with non-reproductive castes. This evolutionary process gave rise to two other forms of replicating entities besides genes, namely, memes (behaviour patterns) and artifacts. The development of memes has led to the ninth major transition, that from primate societies to human societies with symbolic languages.The development of artifacts has brought us to the threshold of a tenth major transition, from language-based human societies to a human society with global access to the entire stock of human knowledge.

Annual In-house Scientific Meeting

The scientists and students of IIA gathered at the Annual In-House Scientific Meeting on 17th April, 2009 to discuss their research. In a programme that was spread over the whole day, several recent scientific results were presented in the areas of solar, stellar, Galactic and extragalactic astrophysics, fundamental physics and instrumentation.

Discussions at the In-house Scientific Meeting, IIA

There were two special features in the in-house meeting this year. The first was the announcement of the winners of the 'Outstanding Research Paper Awards for the year 2008', Gajendra Pandey, Eswar Reddy and Devendra K. Sahu.

The Outstanding Research Paper Awardees (left to right) Gajendra Pandey, Devendra Sahu and Eswar Reddy with the Director, Siraj Hasan (3rd from left).

The second was the special evening lecture by C. Sivaram. The Director, Siraj Hasan, described his outstanding contributions to science communication, especially in teaching and in communicating with the public. Professor Sivaram then spoke on "Decades of Communicating Science at All Levels". He regaled the audience with an exciting talk, which included fascinating insights and anecdotes and seasoned with humour all through, which was a fitting conclusion to the meeting in the International Year of Astronomy.

Seismic Dissection of a Sunspot: Insights into its magneto-acoustic environs

A problem of major importance in solar physics is the determination of subsurface magnetic and thermal constitutions of sunspots. A solution to this problem would also necessarily address the dynamics of heat and material flow in and around sunspots, and hence would have far reaching implications for the magnetohydrodynamics of solar and stellar magnetism. Helioseismology uses the observed solar surface oscillations - the signatures that the interior propagating acoustic waves leave upon reflection at the photosphere -- to 'see' the inside of the Sun. Local helioseismology, especially the technique of time-distance helioseismology (Duvall et al. 1993), is capable of providing 3-d views of the solar interior locally. Results from such 3-d tomographic imaging of subsurface layers of sunspots, albeit with highly simplified treatment of interactions between the magnetic field and acoustic waves, show shallow (upto about 3 Mm) depths with decreased sound speed while the deeper region, from 4 Mm down to about 18 Mm, with an increased sound speed (with a maximum change of about 1 - 2 % (Kosovichev and Duvall 1999). Continuing developments in local helioseismology have since identified several "surface" contributors to seismic measures (Braun 1997, Schunker et al. 2005, Lindsey & Braun 2005), that arise from near-surface direct interactions of p modes with the magnetic field of a sunspot. However, such interactions have so far not been fully understood and accounted for in helioseismic inversions, and hence any inferences on sub-surface perturbations have been deemed unreliable.

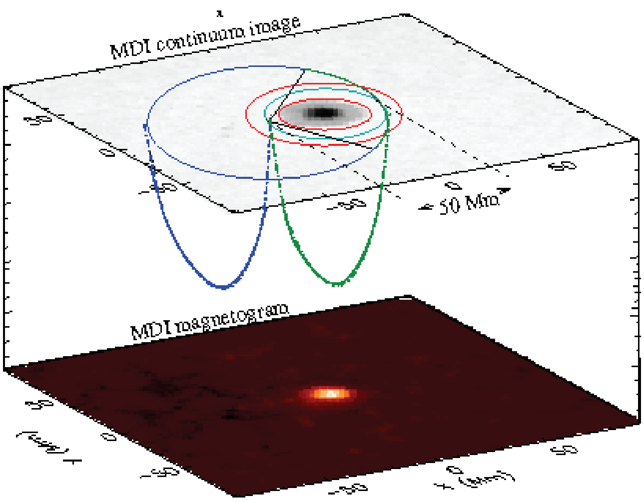

Figure-1: Depiction of wave-path and time-distance helioseismic measurement geometry used for the controlled experiments described in this work.

Use of oscillation signals observed within sunspots is known to be one of the primary sources of surface effects in sunspot seismology (Braun 1997), as well as the associated observational errors (Rajaguru et al. 2007) and systematics in the analysis procedure (Rajaguru et al. 2006). The apparent seismic signals that the near-surface strong magnetic field of active regions contribute to local helioseismic measurements have been described as a 'showerglass effect' (Lindsey & Braun 2005a): the upcoming acoustic waves in active regions undergo strong near-surface phase perturbations resulting in impairment of their coherence, similar to the blurring of images seen through a commercial showerglass. In this work, we have attempted to get around this blurring by simply avoiding oscillation signals observed within the magnetized region of the sunspot: we achieve this through a combination of surface- and deep-focus wave-path geometries that largely avoid wavefield observed within a sunspot (Figure 1). Here, we perform time-distance helioseismic measurements using data from the Michelson Doppler Imager (MDI) onboard SOHO: a large sunspot (NOAA AR9057, diameter ~32 Mm) that crossed the central meridian on 28 June, 2000 and observed by SOHO/MDI in the full-disk resolution mode has been chosen for this study.

We perform two different sets of travel time measurements (Figure 1) for a surface travel distance of 50 Mm over wave frequency bands of 1 mHz centered at every 0.25 mHz interval between 2.5 and 5 mHz: (1) a deep-focus geometry involving wave-paths (green color) connecting diametrically opposite points on the cyan colored circle (a thin annulus, in reality), with foci falling under the umbral area at about a depth of 17 Mm, and (2) surface-focus geometry for wave-paths with foci falling in the annular area bounded by the red circles outside of the sunspot, i.e. in the apparently non-magnetic or weakly magnetized region, and with the end points falling over the large circle (with blue and green portions). The surface magnetogram of the region is shown at the bottom of the box in Figure 1. The green and blue portions for the circle or annulus corresponding to the end points of surface-focus wave paths separate them into those that cross the sunspot underneath it from those that do not, respectively. We find the changes or perturbations in travel times by subtracting the corresponding deep- and surface-focus travel times over a quiet-Sun patch at the same latitude some distance away from the spot. We denote the perturbations in deep-focus travel times as $\delta\tau^{df}$, and those in surface focus times as $\delta\tau^{sfs}$ and $\delta\tau^{sfq}$ for wave-paths that do (green) and that do not (blue) cross the spot, respectively.

Noting that all the annuli (cyan color) for deep-focus measurements with foci underneath the umbra fall within the annular region bounded by the red circles around the spot, a simple way to check if $\delta\tau_u^{df}$, where the subscript u denoting the umbral area average, indeed come from depths around the foci would be to project or convolve the surface-focus travel times $\delta\tau^{sfs}$ and $\delta\tau^{sfq}$ over the deep-focus annuli (cyan color). We denote the resulting averages as $\delta\tau_u^{sfs}$ and $\delta\tau_u^{sfq}$.

We show the results in Figure 2, as plots of $\delta\tau_u^{sfs}$, $\delta\tau_u^{sfq}$ and $\delta\tau_u^{df}$ against the wave frequency ν. In the limiting case of zero contributions to travel time perturbations from layers below a few Mms and all major contributions coming from surface magnetic effects, it is clear that $\delta\tau_u^{sfs}$, $\delta\tau_u^{sfq}$ and $\delta\tau_u^{df}$ all would have approximately the same values. However, results in Figure 2 show that the deep-focus perturbations $\delta\tau_u^{df}$ are more than twice that of $\delta\tau_u^{sfq}$, and are of similar values as $\delta\tau_u^{sfs}$, which are for wave-paths that cross the spot at depth. Since the sign of

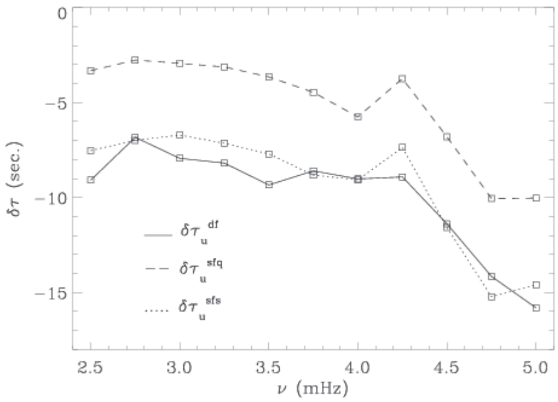

Figure-2: Comparison of deep-focus and projected surface-focus travel times over an annular region shown in Figure 1.

travel time changes are negative, these results mean that waves crossing the spot at depths (about 17 Mm) are travelling more than twice faster than those that do not, as compared to quiet-Sun. More importantly, the differences between the surface- and deep-focus perturbations do not show any significant ν (or wavelength) dependence, and hence argue against any wave diffraction effects due to the sunspot magnetic field.

Reliable three dimensional tomographic imaging of the whole depth range of sub-surface layers of a sunspot is hard to achieve without having to use waves skipping at distances smaller than the size of a sunspot and hence without explicitly taking into account the magnetic field - p mode interactions. Since we lack a suitable model for such interactions and it has been quite clear from various studies (Lindsey et al. 2007 & references therein) that significant seismic contributions arise due to surface magnetic field interactions, physical, instrumental and systematic, most sunspot local seismic inversions have suffered from unreliable depth descrimination of flow and sound speed structures. Here, we have attempted a completely heliosiesmic diagnostic approach to checking the extent of surface magnetic effects. We believe that results presented in Figure 2 provide observational evidences for an extended depth region of faster wave propagation beneath sunspots. We however note that the detected signals in the deep-focus geometry are just at the marginal limit, wherein we are just about being able to detect the faster sound speed region below the spot. More detailed analyses involving further control experiments and results are discussed at length in a paper getting finalised for publication in the Astrophysical Journal. (To appear in the Astrophysical Journal, 2009).

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- S. P. Rajaguru

Sharpening the Blur: Wavefront Sensing and Correction using Spatial Light Modulators

In the optics laboratory at the CREST campus of IIA, an unconventional wavefront sensing device, viz., the liquid crystal spatial light modulator, was successfully tested for its ability to retrieve the phase of an incident wavefront of light, with the ultimate aim of using such devices to improve telescope image quality through Adaptive Optics (AO) techniques.

AO techniques attempt to correct in real-time, distortions in the wavefront of the light incident on a telescope. These distortions arise because of non-uniformities in the propagating medium. AO assemblies require a wavefront sensor, a wavefront corrector and a control algorithm.

The spatial light modulator (SLM) is a pixelated device, which can modulate the phase and amplitude of an incident wavefront of light. Although not commonly used for wavefront correction, it has advantages of high resolution, phase reliability, compactness and ease of operation, among others. The SLM can also be used as a wavefront sensor by addressing its pixels in such a way that it behaves as a Hartmann mask. Conventionally, wavefront sensing uses a static lenslet array in a Shack-Hartmaan sensor. In the experiments at IIA, on the other hand, an electrically addressed 2-D marix of diffractive optical lenses was used. Standard centroiding and reconstruction algorithms were implemented on SLMs to test their phase retrieval ability.

Spatial light modulators LC-2002, Hex-127 and LC R-720 were characterized for their phase response as a function of the applied gray-scale. A resolution chart was used as an object and known Zernike aberrations were imposed in the path of the beam using LC-2002 SLM. The aberrations were compensated by imposing the corresponding Zernike conjugate on Hex-127 SLM. The

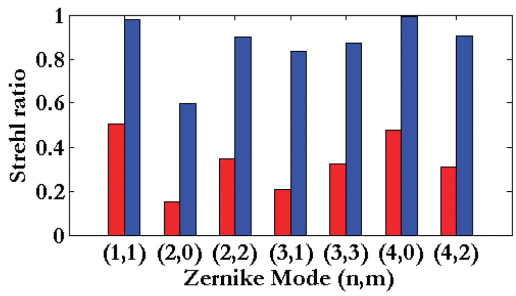


Figure-1: The improved quality of the corrected image original (without aberration), distorted and compensated images were recorded and the improvement in the Strehl ratios can be seen in the histogram shown in Figure 1.

By projecting an array of Fresnel Zone plates, the SLM LC-2002 was used as a wavefront sensor. LC R-720 was used for the tilt production of different magnitudes across a single sub-aperture of the sensor and the corresponding position of the focal spot was measured using the iteratively weighted centroiding technique. Within experimental errors the behavior of the sensor was found to be linear with the applied phase differences as shown in Figure 2.

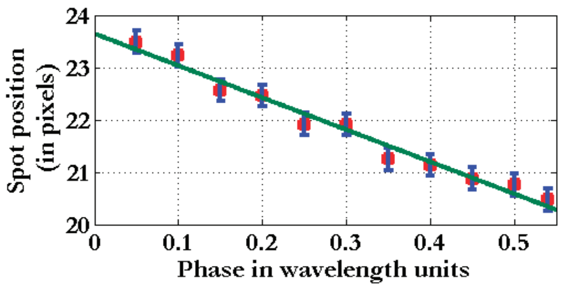
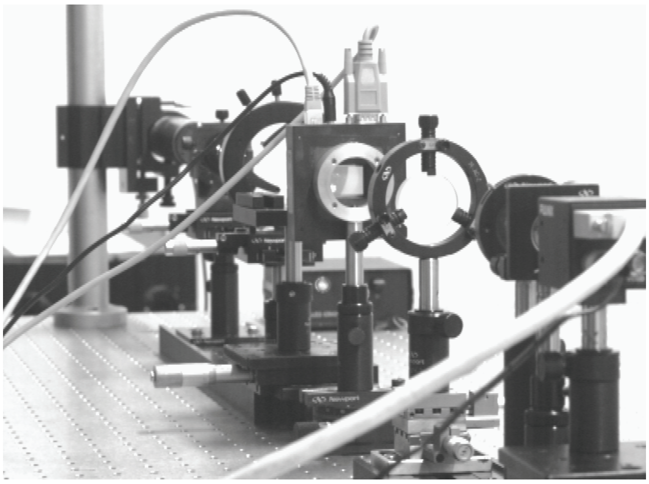


Figure-2: The position of the focal spot showing a linear relationship with the applied phase

A long focal length digital lenslet array was simulated by addressing the calculated phase profile under a thin lens and paraxial approximation. This lenslet array also showed a linear behavior with the applied phase. Both the lenslet arrays were calibrated for their alignment errors and temporal instabilities.

Phase retrieval from slope measurements was performed using the Vector Matrix multiply algorithm (VMM) and Fourier methods for different sampling geometries. Sampling geometries suggested by Hudgin, Fried and Southwell were studied. Monte-Carlo simulations were performed to evaluate the performance of the phase reconstruction algorithms. Simulations consist of the generation of phase screens of different coherence length, estimating the effect of placing a Shack-Hartman Sensor, measurement of slopes from the obtained spot pattern, evaluating phase screens from the measured slopes using VMM and Fourier methods and comparing the results with the input random phase screen via the correlation coefficient. The VMM reconstructor performed best for Shack-Hartmann geometry with 85% correlation. The Fourier method gave 79% correlation for the same geometry and was faster compared to VMM method and found to be less sensitive to sensor resolution.

There is always a finite time delay in wavefront correction after sensing, called the servo lag error, which makes it increasingly harder to follow the distortions induced by rapidly varying atmospheric conditions in a closed loop. A possible solution to this problem is to progressively predict future wavefronts from the information of the immediate past. This prediction helps in improving the



The experimental set up where the spatial light modulator as a Shack-Hartmann Sensor

performance of adaptive optics systems. A prediction technique for atmospherically distorted phase screens was developed using time-series data mining and was tested. The prediction technique developed shows an improvement of 6% over correction without prediction. These results were presented at the 27th Astronomical Society of India Meeting, February 2009, Bangalore, and at the conference Trends in Optics and Photonics, March 2009, University of Calcutta.

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- A Vyas, M B Roopashree, R Banyal and B R Prasad

DIMM at the Vainu Bappu Observatory

Installing the DIMM telescope tower at the Vainu Bappu Observatory

A Differential Image Motion Monitor telescope was installed at the Vainu Bappu Observatory in May, to continuously monitor the "astronomical seeing" of the observatory site.

Astronomical seeing is the blurring of astronomical images observed through the earth's atmosphere, which perturbs the wavefronts of the light from astronomical objects, thus smearing the images obtained on earth and limiting their sharpness even with the biggest of telescopes. However, images from large telescopes could be further blurred by turbulence in the atmosphere within their domes. The new DIMM telescope will provide measurements of the site seeing for comparison with the image quality obtained by the 1-metre Zeiss telescope and 2.3metre Vainu Bappu Telescope at the observatory. A secondary goal of the DIMM observations is to monitor the atmospheric extinction.

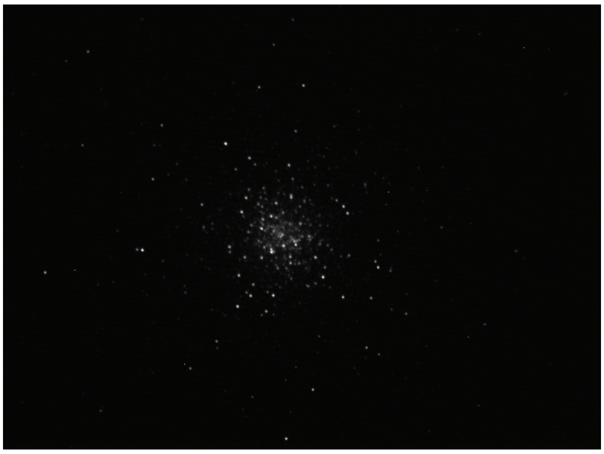
A happy team on top of the installed DIMM telescope tower and dome

The VBO DIMM telescope, manufactured by DFM Egineering in Longmont, Colorado, USA, has a diameter of 40cm, and an F/9 Cassegrain focus which gives an image scale of 56 arsec/mm. The telescope is housed in a clamshell-dome which is at a height of 13 metres above the ground at the top of a steel tower. The telescope is equipped with a camera with a 1600x1200 pixel CCD detector and the five standard broad-band filters (U, B, V, R and I). The telescope is designed to allow for remote control operations via the internet. Several trial data have been obtained and their validation is in progress.

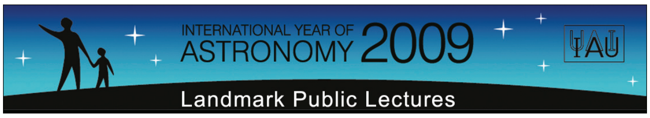
The team of Ashok Pati, P U Kamath, M Kemkar, Ramachandra Reddy, V K Subramaniam, F Gabriel and the VBO technical team completed the erection of the telescope tower in November, 2008, and installed the

A view of the DIMM telescope in its dome

dome and telescope in May, 2009. The DFM team members Ian Huss and Mark Kelly also participated in the installation.



A raw image of the globular cluster Messier 3 imaged with the DIMM telescope with an exposure of 30 seconds using the R filter (2 May, 2009)



On the occasion of the International Year of Astronomy, IIA launched a special series of public lectures to highlight landmark discoveries in astrophysics. The lectures are intended to describe the work of eminent scientists who have not only made oustanding contributions to the advancement of astrophysics but also have had a special impact on human society.

Hans Albrecht Bethe: A Giant in Physics and a Statesman in Nuclear Disarmament

The Landmark Public Lecture series was inaugurated by a lecture on Hans Bethe by R. Rajaraman, Professor at Jawaharlal Nehru University, New Delhi, on the 13th March, 2009. A student of Hans Bethe, the speaker recalled the extraordinary sweep that Hans Bethe's scientific contributions had, encompassing several areas

of quantum physics, nuclear physics and statistical mechanics. It was for his work on the energy production in stars that Hans Bethe was awarded the Nobel Prize in Physics in 1967.

This problem had existed since the middle of the 19th century. The sun, with a mass of $M_{sun} = 10^{33}$ gms, is known to radiate energy at the rate of $L_{sun} = 3.8\times 10^{26}$ Joules per second, enough to evaporate all our oceans in just about 10 seconds! Chemical and mechanical generation of energy could not be quantitatively reconciled with the age of the solar system inferred from the radioactive sources available on earth. Thus the question of this large source of energy became an enigma to the community of physicists.

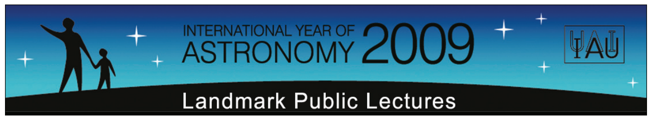
It was at a gathering of astrophysicists and physicists brought together by George Gamov in 1938, to which Edward Teller persuaded Hans Bethe to come, that a detailed exploration of theoretical ideas, experimental data and astrophysical observations related to the energy production in stars occurred. That thermonuclear reactions are plausible candidates was understood since the early 1930's, but clearly those ideas had to be taken further. Taking back with him the outcome of the discussions at this meeting Hans Bethe came up with the C-N-O cycle as the source of energy in heavier stars, and calculated in detail both the energy production and the temperature dependence, which could correctly explain the high rate of energy production in stars.

Describing Hans Bethe as a prominent figure in the second generation of "20th century greats" in theoretical physics, Rajaraman noted that the Bethe style of work was one with extraordinary achievements without displaying any passionate fervour or intensity. This, the speaker said, was very characteristic of Bethe's personality. His depth of understanding and the intellectual prowess were so formidable that Bethe was capable of solving many scientific problems on his train journeys.

Concerning Bethe's contributions in the public domain, Professor Rajaraman characterized them as statesmanlike. Bethe had contributed to the making of the nuclear bomb, by being the Head of the Theoretical Physics Division of the Manhattan Project. He was conscious of his role in it and also of the dangers of nuclear weapons. In this conflict he remained a figure of moderation, i.e., he did not join the crusade against the weapons but looked for steps that would be acceptable to the political establishments and yet mitigate the threat of war. Contributions from such moderate pragmatists too should be put on record as significant steps towards the final goal of abolishing the weapons of mass destruction, Professor Rajaraman said.

The lecture was attended by a large audience comprising the scientific community, students, teachers and members of the public. The speaker was introduced by Siraj Hasan, Director, IIA, who recalled the days when he was a student of Professor Rajaraman at the Delhi University. He also explained the aims of the Landmark series of lectures, in terms of the perspectives of the IYA 2009.

- Sabyasachi Chatterjee



The second lecture in the IYA09 Landmark Public Lecture Series, was a lucid delivery by S. Balachandra Rao titled "Classical Indian Astronomy - Some Landmarks", on the evolution of mathematical and astronomical concepts in early India.

S Balachandra Rao retired as professor of mathematics from National College, Bangalore, where he taught for 35 long years. His PhD research was in fluid mechanics. He has held several prestigious positions including, Fellow at the National Institute of Advanced Studies and Affiliate of the Research Advisory Council for History and Science, and is also on the the Editorial Board of the Indian Journal of History of Science, INSA, New Delhi. Currently, he is Honorary Director of the Gandhi Center of Science and Human Values at Bharatiya Vidya Bhavan, Bangalore. Besides being a renowned scholar in Sanskrit, Professor Rao has authored many books in English and Kannada the development of mathematics and astronomy in ancient India.

Professor Rao began his presentation by quoting a verse from the earliest known (~12-14c BC) astronomical text *Vedanga Jyotisha*, emphasizing the supreme importance given to astronomy and mathematics among all branches of knowledge since the Vedic times. He described the the Nakshatra system (comprising 27, or 28 if Abhijit is included) used for reckoning the days during the Vedic times, In the Vedas, apart from references to Jupiter (Brihaspati) and Venus (Vena), there is explicit mention of the conjunction of Jupiter with the star Tishya (Pushya, Delta Cancri) The *Vedanga Jyotisha* also contains records of many useful astronomical and calendar systems, but there is no mention of planets or weekdays or the zodiacal signs in the text.

The speaker emphasized the importance of mathematics in the development of astronomy in India. Systematic mathematical planetary astronomy, based on epicyclic theory, started with Aryabhata I (b.476 AD) and was further developed by great savants like Brahmagupta (628 AD), Manjula (or Munjala, 932 AD) and Bhaskara II (b.1114 AD). Ganesha Daivajna (1520 AD), in his book *Grahalaaghavam*, replaced the astronomical procedures involving trigonometric ratios sine and cosine by a very good algebraic approximation originally proposed by Bhaskara I (629 AD). *Panchanga* makers, for whom trigonometry was a big bugbear, considered *Grahalaaghavam* as a big boon! From about the fourteenth century onwards there was tremendous development in mathematics and astronomy in Kerala. Nilakantha Somayaji (1500 AD) proposed a quasi-heliocentric model of planetary motion, which precedes both Copernicus and Tycho Brahe. In this model, the planets move round the Sun, but the Sun itself orbits the Earth, a model that is actually mathematically feasible, and that to a great extent approximates the later Keplerian model.

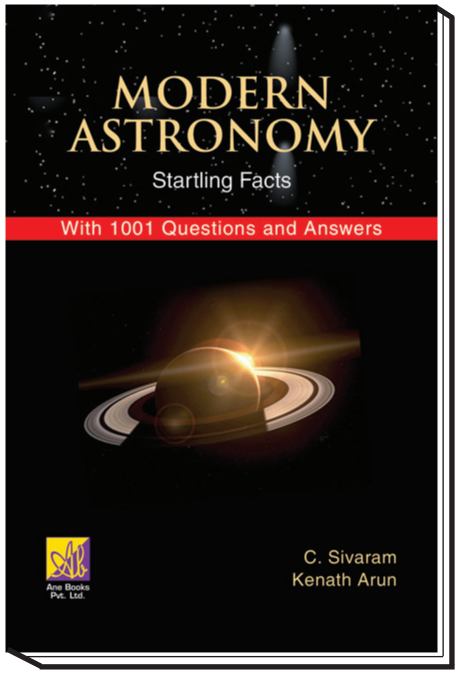
Apart from giving an amazingly good approximation of the value of π, Aryabhata was also the first Indian to propose the hypothesis of the spherical shape of the Earth and the rotation of the Earth about its axis. He also calculated the sidereal period 23h56m4.1s which is astonishingly close to the modern value. Aryabhata's major mathematical work, *Aryabhatiyam*, consisted of arithmetic and geometric progression, speherical and planar trigonometry, solution of simple, quadratic and 1st order indeterminate equations, sums of power series, units and measurements of time, computation of trigonometric ratios and tables of sines etc.

Many western scholars view ancient Indian astronomy as merely a set of mathematical conjectures and theoretical manipulations, undermining the observational work that was done. The speaker dispelled this unfair criticism by pointing out many chapters devoted to astronomical instrumentation and empirical work in the writings of Aryabhata and his successors. Classical Indian astronomers understood the geometry of eclipses and conjunctions, and frequently updated the parameters to maintain accuracy up to the later medieval period. The system stagnated during the colonial period, but the speaker applauded the efforts of stalwarts like Samrat Chandra Sekhara Simha of Orissa, Venkatesha Ketkar of Bagalkote, Karnataka, and T S Kuppanna Sastry in the revival of astronomy in the latter part of the 19th century and the early part of the 20th century.

- Ravinder K Banyal

INTERNATIONAL YEAR OF ASTRONOMY 2009 — IAU

Modern Astronomy - Startling Facts



On the occasion of the International Year of Astronomy, C. Sivaram of IIA and Kenath Arun of Christ College, Bangalore, have written a book called 'Modern Astronomy: Startling Facts', published by Ane Books, New Delhi. The book is intended for the non-specialist as well as for students and introduces a wide range of topics in astrophysics, from the Solar system to Dark Energy. A special feature of the book is the 'Astronomy Quiz' with a thousand-and-one interesting historical and technical astrophysics trivia.

INTERNATIONAL YEAR OF ASTRONOMY 2009 — IAU

'Shaikshanika Habba'

About 700 teachers who had gathered from all over Karnataka in the city of Bidar for the 'Shaikshanika Habba' or Education Festival, were exposed to exciting concepts of astronomy that they could take back to their schools to supplement the material in their curricula. The festival, which took place on the 6th and 7th of March, was organised by the Bharatiya Gyan Vigyan Parishat and supported by the governmental 'Sarva Shiksha Abhiyan' programme. At the session devoted to astronomy, Prajval Shastri of IIA gave a lecture that covered Galileo's work, the goals of the International Year of Astronomy, the gender question and the significance of the 'She is an Astronomer' project, and concepts in astronomy that could be taught in the class room and outside that would bring to children in schools the fascination of both exploring the cosmos and using the scientific method. The extensive discussions that followed made it clear that these teachers were deeply interested in broadening the educational experience of the children, and that astronomy could form an accessible yet exciting route towards this goal.

100 Hours of Astronomy at Lalbagh

About 500 people from all walks of life participated in celebrating the International Year of Astronomy by viewing the beauty of the Moon and Saturn through telescopes at the Lalbagh gardens in Bangalore, during the first week of April. IIA set up a sky-watching programme and interaction with the public as part of this world-wide celebration of '100 Hours of Astronomy'.

The '100 Hours of Astronomy' programme (2-5 April 2009) was an occasion for observatories and astronomers world-wide, professional as well as amateur, to organise activities for the public. IIA stationed its six-inch and fourteen-inch telescopes at the foot of the rocky hillock in Lalbagh gardens after dusk on the weekend of 4th and 5th April. Both Lalbagh regulars and those that specifically came for the star- party thronged and queued up in large numbers for a telescopic view of the sky. Curiosity and enthusiasm drove some people to visit on both days.

While Bangalore's skies preclude viewing of most of the interesting astronomical objects because of the high-levels of light pollution, the public were still able to view the Moon, its craters and Saturn, which has its beautiful rings currently oriented virtually edge-on to us. Scientists present fielded a variety of questions, about the Moon, its exploration with space missions, planets, telescopes, eclipses and 'super-natural' phenomena. The event exemplified the spirit of 'The Universe, Yours to Discover'.

100 Hours of Astronomy Webcast

The Himalayan Chandra Telescope of IIA at Hanle, participated in the 'Around the World in 80 Telescopes', a live 24-hour webcast from some of the most advanced ground-based and space observatories around the planet, and were featured at 00:10 IST on the 4th April, 2009. This programme was part of the '100 Hours of Astronomy' corner-stone project of the IYA 2009.

100 Lectures

In IIA's series of 100 public lectures:

* Dipankar Banerjee: *Our nearest Star, the Sun, Lamdon Model Senior Secondary School, Leh (1 March)*
* Sabyasachi Chatterjee: *How Thick is our Galaxy? St.Xavier's College, Kolkata (4 March)*
* Sabyasachi Chatterjee: *How Thick is our Galaxy? Surendra Nath College, Kolkata (5 March)*
* Sabyasachi Chatterjee: *Jyotirbignaner uttanraner nana adhyay (Landmarks in Astronomy, in Bengali) Jogachha Higher Secondary School, Jogachha, Howrah (5 March)*
* Sabyasachi Chatterjee: *Landmarks in Astronomy, Vidyasagar College, Kolkata (6 March)*

* Sabyasachi Chatterjee: *How Thick is our Galaxy*, Dum-dum Motijheel College, Kolkata (6 March)
* Prajval Shastri: *ಅಂತರ ರಾಷ್ಟ್ರೀಯ ಖಗೋಳ ವಿಜ್ಞಾನ ವರ್ಷ IYA09 in Kannada*, Karnataka Education Festival, Bidar (6 March)
* Sabyasachi Chatterjee: *Astronomy since Galileo*, Assam Vijnan Sabha, Guwahati (7 March)
* Siraj Hasan: *Understanding the Secrets of the Sun*, Indian Institute of Chemical Technology, Hyderabad (9 March)
* Sabyasachi Chatterjee: *How Thick is our Galaxy*, Indian Association of Physics Teachers, NMKRV College, Bangalore (14 March)
* Tushar Prabhu: *Effects of Atmosphere on Astronomical Observations*, University of Calicut, Calicut (19 March)
* K B Ramesh: *Living with an Active Star*, Jayaraj Annapakiam College for Women, Periyakulam, Theni district, Tamilnadu (23 March)
* Palahalli Vishwanath: *Galileo: The Scientist and the Man*, University of Guwahati, Guwahati (26 March)
* Tushar Prabhu: *Astronomy at High Altitudes*, Government Degree College, Leh (30 March)
* Tushar Prabhu: *Our Cosmic Environment*, Lamdon Higher Secondary School, Leh (31 March)
* Tushar Prabhu: *Our Cosmic Environment*, Moravian Mission High School, Leh (31 March)
* C. Sivaram: *Big Bang and the Large Hadron Collider*, Science & Technology Club, Dr. Ambedkar Institute of Technology, Bangalore (11 April)
* Sabyasachi Chatterjee: *Universalizing the Universe*, Andhra Pradesh Jam Vignana Vedike, Hyderabad (12 April)
* Sabyasachi Chatterjee: *Landmarks in Astronomy* (in Hindi, Khagol Vigyan ke Padchinh), All India Peoples' Science Network regional workshop, Bhopal (14 April)
* Sabyasachi Chatterjee: *How Thick is our Galaxy?*, Physics Department , Barkatulla Khan University, Bhopal (15 April)
* Dipankar Banerjee: *Our Nearest Star: The Sun and the total Solar Eclipse the Sun*, Bose Institute, Kolkata (15 April)
* Sabyasachi Chatterjee: *How Thick is our Galaxy?*, Jamia Milia University, Delhi (17 April)
* Dipankar Banerjee: *Our Voyage to the Sun*, Al Ameen School, Midnapoore, West Bengal (17 April)
*Chinnathambi Muthumariappan: *Multi-wavelength Astronomy*, VBO, Kavalur (21 April)

INTERNATIONAL YEAR OF ASTRONOMY 2009 IAU

An Evening with Stars

What do astronomy enthusiasts do when skies cloud up? They are not deterred...They sit down and dialogue about the Moon, Venus, Orion, history and other things...

On the 30th April, about 30 members of the public had gathered after dusk at IIA for a sky-watching programme organised in collaboration with the Bangalore Astronomical Society, an amateur astronomy group committed to bringing the excitement of discovering the universe to the public. Among those gathered were both veterans and freshers to astronomy. When it was clear that the skies would not clear, the 'Evening with Stars' converted itself into an animated discussion on planets the scientific method and astrology. Naveen Nanjudappa of the BAS led them through making simple beginnings with astronomy as a hobby and yet experience the excitement of scientific exploration.

The Integrated M.Tech.-Ph.D Programme

The first batch of six students of the Integrated M.Tech.-Ph.D. programme in Astronomical Instrumentation (run jointly with the University of Calcutta) arrived in March to attend part of their second semester courses in the Bangalore campus. The material was a combination of theoretical concepts and topics related to instrumentation, and was tuned to suit the diverse backgrounds on the one hand and the challenges of modern astronomical instrumentation on the other. They were exposed to the fundamental issues of astronomical optics and image degradation.They also obtained hands-on experience by handling amateur level telescopes, while participating in the sky watch programme at the Lalbagh as part of the 100 hours of Astronomy event.

Summer School at VBO

Twenty three students of physics or engineering from all over the country participated in a summer school amidst the picturesque surroundings of the Vainu Bappu Observatory during 15-22 May, 2009. The students heard lectures that covered Solar, Galactic and extra-Galactic astrophysics and astronomical instrumentation. A special feature was the presence of S. Balakrishnan, Professor of Pondicherry University. He spoke to the students on the connection between astronomy and geology. Tutorials on data reduction techiniques were conducted by IIA PhD students Bharat Kumar Yerra, S. Ramya and P. Ramya. S. Pukalenthi organised night-sky watching with the 6inch refractor. M.J. Rosario organised an observation session with the 15inch telescope. P. Anbazhagan took the participants on a recreational trip to the scenic Bhima waterfalls area one afternoon. The school gave the participants an opportunity to get a flavour of observational research in astronomy, and to have a dialogue on the possibilities of persuing astronomy and instrumentation research as a career. Eleven of the participants went on to do projects at IIA's Bangalore campus.

- C. Muthumariappan, Co-ordinator

Eclipse! सूर्य ग्रहण!

The Total Solar Eclipse of July 22, 2009

Astronomy enthusiasts world-wide excitedly look forward to viewing the longest total solar eclipse of the century on the 22nd July, 2009. The eclipse will be visible in India, Bhutan, Myanmar and China, and the longest duration of totality, which is 6min 39sec, will be seen about 100km south of the Bonin Islands in the ocean southeast of Japan, and will be surpassed only in the eclipse of the year 2132. The longest totality ever recorded was on the 20th June 1955 over the Philippines when totality lasted for 7 mins 28secs.

The path of totality of the eclipse (see map in the next page) extends from coastal Gujarat in the Indian subcontinent, to northern Bangladesh, eastern Nepal, Bhutan, the northern tip of Myanmar and central China, into the Pacific Ocean. The partial eclipse will be visible from a much wider region, as also from all over India. Some Indian cities that are in the path of totality are Bhavnagar, Surat, Ujjain, Indore, Bhopal, Sagar, Jabalpur, Varanasi, Gaya, Patna, Bhagalpur, Jalpaigudi, Guwahati and Dibrugarh.

Like the 1999 eclipse, this eclipse too will take place when monsoon just gets vigorous in India. The other dampener is that it will occur just after sunrise. The maximum width of the path of totality is about 250 km. The closer one is to the central line of the path of totality the longer is its duration. Most solar eclipse expeditions in India are planned to the eastern parts where the likelihood of rain and cloud cover are relatively lower. Patna and Varanasi in India and Shanghai in China are among the popular destinations for eclipse viewing.

While the actual physical diameters of the Sun and the Moon are vastly different, their angular diameters, i.e., the angle that their edges subtend at the eye for an observer on the Earth happen to be very similar. This coincidence is the reason for a grand spectacle which occurs whenever the Earth, the Moon and the Sun get aligned. Since the orbits of the Earth and Moon do not lie in the same plane, (inclination of the Moon's orbit is about 5°), a solar eclipse does not occur on every New Moon day. In a century, there are a total of 238 solar eclipses. The maximum number of solar eclipses in a year is five whereas the minimum number is two. Bangalore has had no luck with total solar eclipses since 1700; it witnessed an annular solar eclipse on 25th July, 1748 and shall witness another on 22nd June, 2085. The eclipse of the 22nd July, 2009 will be partial in Bangalore, with an obscuration of about 66%.

Viewing the Eclipsed Sun

The gripping effect the serene beauty of the corona which is the plasma atmosphere of the Sun, has on the viewer cannot be put down in words. A minute or so before the 'second contact', the moment the Moon's disc just about covers the Sun's disc and totality begins, one can look for shadow bands on the ground. These are a result of passage of the sunlight through the irregularities in the Earth's atmosphere. As the totality is about to commence the sky gets dark enough that the planets Venus and Mercury and a number of bright stars may be seen. After the totality is over and the Moon's disc moves further eastwards, the Sun's rays shine through the valleys on its western limb giving the effect of a diamond ring, which is a magnificent sight. Just before the second contact, while the Moon is about to cover the Sun, the last rays leak through the uneven eastern limb of the Moon and produce a bead-like effect, the "Bailey's beads", which can be seen again just after the third contact. The shape of the corona depends on the phase of the solar cycle. Currently the Sun is passing through its deepest minimum in nearly a hundred years, with very few sunspots on its disc. Solar physicists therefore predict a somewhat symmetrical corona.

City	Second contact IST	Third contact IST	Sun Altitude
Surat	06h 21m	06h 24m	02°
Bhopal	06h 22m	06h 25m	07°
Patna	06h 25m	06h 28m	15°
Jalpaigudi	06h 26m	06h 30m	19°

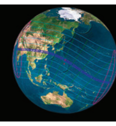
Directly viewing total and partial eclipses of the Sun with the naked eye can be dangerous to the eyes, just as directly observing the Sun under normal circumstances is dangerous. Eclipses should be safely viewed using proper filters that can be obtained from planetaria or other science popularisation organisations. The only safe time when the sun may be viewed directly is when the eclipse is total, i.e., between second and third contact. Between the first and second contact as also during the third and the fourth contact, i.e., once the diamond ring appears, the eclipse is partial, and a filter is a must. A pin hole camera may also be used to project the image of the Sun onto a screen. Alternatively, the Sun's reflection in muddy water may be viewed.

The next solar eclipse in India is an annular one, on the 15th January 2010. The Moon will fail to completely cover the disc of the Sun, and the corona will not be visible because the annulus of the sun's disc will simply outshine it. The event will still be of interest and has a great educational value in its own right. The path of the eclipse will pass around Kanya Kumari and Adam's Bridge in Southern India. The next time the path of totality will pass over India on the 20th March 2034, so, the opportunity of the 22nd July should not be missed!

- R C Kapoor

Eclipse!

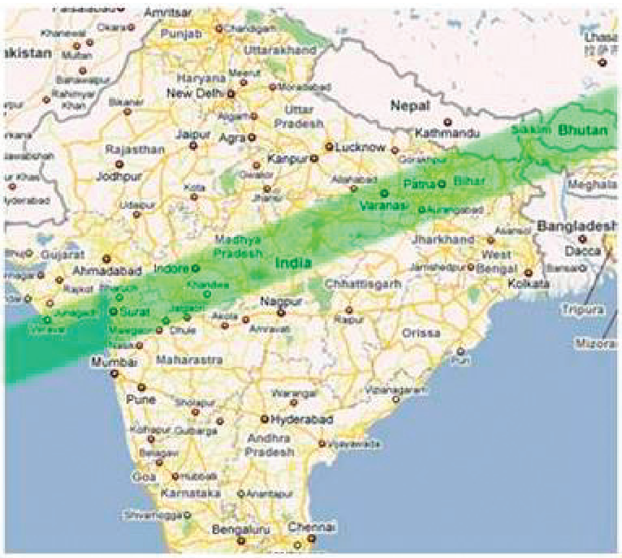
सूर्य ग्रहण!



२१वीं सदी का दीर्घतम पूर्णता का सूर्य ग्रहण

दिसंबर 20, 2007 को अपनी 62वीं जनरल एसेम्बली में संयुक्त राष्ट्र ने वर्ष 1609 में गैलिलियो गैलिली द्वारा दूरदर्शी के प्रथम खगोलीय प्रयोग के अनुष्ठान के लिहाज़ से वर्ष 2009 को अंतर्राष्ट्रीय खगोल वर्ष (अ.ख.व. 2009) घोषित किया। अ ख व 2009 वैश्विक सहयोग के शांतिपूर्ण उद्देश्य को प्रक्षेपित करेगा-हमारे ब्रह्माण्डीय उद्गम की खोज एवं हमारी सम्मिलित बपौती, जो विश्व के सभी नागरिकों को जोड़ती है । अ ख व 2009 की संकल्पना है सर्वजन को अन्वेषण का आनन्द, दिन व रात के आकाश दर्शन से उन्हें विश्व में अपनी स्थिति को जान सकने में सहायता तथा एक केन्द्रीय विषयवस्तु - ब्रह्माण्ड आपके स्वयं के अन्वेषण के लिए ह्व के तहत उनमें, विशेष रूप से युवाओं में खगोल व विज्ञान में दिलचस्पी जगाना । इस विषय में कार्यकलाप स्थानीय एवं वैश्विक स्तर पर हो रहे हैं ।

यह सुखद आश्चर्य का विषय है कि इस सदी में दीर्घतम पूर्णता का सूर्य ग्रहण भी इसी वर्ष में होने जा रहा है। यह 22 जुलाई 2009 के दिन दक्षिण-पूर्व एशिया एवं पश्चिमी प्रशान्त महासागर में देखा जा सकेगा । हमारे लिए दिलचस्पी की बात यह है कि इसकी पूर्णता का पथ भारत के ऊपर से भी गुज़रेगा। तथापि यह ग्रहण उस समय होने जा रहा है जब देश में मानसून अपने पूरे जमाल पर होगा । दूसरी दिक्कत इसकी पूर्णता के समय को लेकर है क्योंकि इस दिन सूर्योदय के तुरंत बाद ही पूर्ण ग्रहण होगा। अतएव दृष्टिरेखा की सीध में आकाश में घने बादलों के जमे होने की आशा है। यद्यपि संस्थान के वैज्ञानिकों का दल चीन का रुख करेगा जहाँ पूर्ण ग्रहण सूर्योदय के काफ़ी बाद देखा जा सकेगा, भारत में इस घटना में फिर भी सर्वजन की दिलचस्पी जागेगी। पूर्णता का पथ भारत, भूटान एवं चीन से हो कर गुज़रता है जहाँ बादल वर्ष के इस समय मौज़ूद हुआ करते हैं । फिर भी पूर्व की ओर बढ़ते जाने से हालात कुछ बेहतर होने की संभावना है। ऐसे में पूर्णता का काल भी बढ़ता है। इस दृष्टि से शंघाई शहर सबसे अच्छा मौका देता है जहाँ पूर्णता 5 मिनट 56 सेकंड तक रहेगी ।



पूर्णता का पथ **Path of Totality**

22 जुलाई 2009 का ग्रहण इस सदी में दीर्घतम पूर्णता काल का ग्रहण है - वर्ष 1991 से 2132 तक के भीतर सबसे अधिक। जून 11, 2132 का ग्रहण ही इससे अधिक पूर्णता काल का होगा। इस वर्ष के ग्रहण का पूर्णता काल जापान के दक्षिण पूर्व में बोनिन द्वीप में 6 मिनट 39 सेकंड तक का होगा। ग्रहण का परिमाण (सूर्य के चंद्रमा द्वारा आच्छादन का अंश) है 1.0799। पूर्णता पथ की अधिकतम चौड़ाई है 250 कि.मी. । सूर्य ग्रहण का पूर्णता का काल अधिक से अधिक 7 मिनट 31 सेकंड हो सकता है। अब तक ज्ञात सर्वाधिक पूर्णताकाल 20 जून 1955 के ग्रहण के समय था जो फिलीपीन्स में 7 मिनट28 सेकंड तक देखा जा सका। पूर्णतापथ की केन्द्र रेखा के जितने निकट हम रहेंगे इसका काल उतना ही अधिक मिलेगा।

भारतीय उपमहाद्वीप में इस सूर्य ग्रहण की पूर्णता का पथ गुजरात समुद्र तट से आरंभ हो कर उत्तर भारत से गुज़र कर उत्तरी बंगला देश, भूटान, म्यॉमार के उत्तरी छोर, केन्द्रीय चीन से होकर प्रशान्त महासागर में पहुँचेगा। आंशिक सूर्य ग्रहण समूचे भारत से देखा जा सकेगा। देश के जिन प्रमुख शहरों से पूर्ण ग्रहण की छाया गुज़रेगी वे हैं:- इंदौर, भोपाल, सागर, जबलपुर, वाराणसी, इलाहाबाद के निकट से, गया, पटना, भागलपुर, जलपाईगुड़ी, गुवाहाटी तथा डिब्रूगढ़ आदि । कुछ शहरों के लिए ग्रहण परिस्थितियाँ इस प्रकार हैं :

सूर्य ग्रहण परिस्थितियाँ

नगर	द्वितीय सम्पर्क	तृतीय सम्पर्क	क्षितिज से सूर्य की ऊँचाई
सूरत	06h 21min.	06h 24min.	02 डिग्री
भोपाल	06h 22min.	06 25min.	07 डिग्री
पटना	06h 25min.	06h 28min.	15 डिग्री
जलपाईगुड़ी	06h 26min.	06h 30min.	19 डिग्री

पूर्ण सूर्य ग्रहण साधारण घटना नहीं। पूर्णता के समय देखे जाने वाले सूर्य किरीट की छवि का वर्णन शब्दों में नहीं किया जा सकता। कुछ कारणों से यह दुर्लभ एवं अप्रत्याशित है। इसीलिए प्रागैतिहासिक काल से मानव मन को यह भय एवं दुश्चिन्ता से ग्रसता रहा है। वैज्ञानिकों के लिए इसका अपना महत्व है। संस्थान एवं इसकी पूर्ववर्ती वेधशालाओं या वैज्ञानिकों द्वारा भारत से देखे गये पिछले 150 वर्ष के ग्रहणों से अनेक वैज्ञानिक उपलब्धियाँ हुई हैं । 1868 के ग्रहण से ही सौर भौतिकी का भारत में जन्म हुआ जब पहली बार स्पेक्ट्रोस्कोप का प्रयोग हुआ। सौर वर्णक्रम में एक नयी रेखा की पहचान हुई जो अब तक ज्ञात तत्वों से अलग किसी नये तत्व के कारण उत्पन्न मानी गयी। इस तत्व को नाम दिया गया हीलियम, जो लगभग 25 वर्ष बाद ही पृथ्वी पर खोजा जा सका । ब्रह्माण्ड के अनेक रहस्यों को उजागर करने में सूर्य के अध्ययन ने आधारभूत भूमिका अदा की है ।

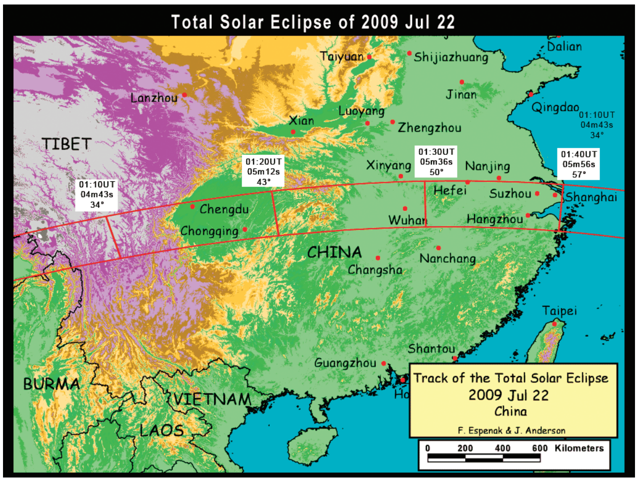
रमेश कपूर

Eclipse! सूर्य ग्रहण!

IIA's Eclipse Expedition

IIA's plans to use the eclipse to investigate the possibility that magnetohydrodynamic waves drive the heating of the solar corona. Imaging and spectroscopy of the solar corona in the green and red emission lines are planned using equipment that will be set-up at a camp in Anji, a small hilly area near Hangzhou, China.

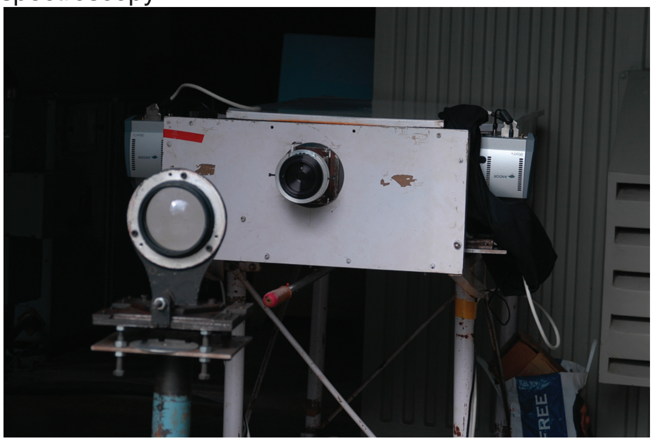
Such studies during total solar eclipses have two major advantages over investigations with space-borne equipment, namely the coronagraphs. Firstly, contribution from scattered light is minimal, about 1000 times less than that in the coronagraphs. Secondly, unlike space-based instrumentation, ground-based equipment is far less constrained in terms of its size and weight, and therefore large collecting areas can be used to obtain a fast imaging rate as well as fine spectral resolution.



Path of the total solar eclipse in China on July 22, 2009

The Sun has a very hot plasma "atmosphere" around it extending to millions of kilometres in space. While the temperature of the Sun is about 5700 degrees at the photospheric level, it rises to a million degrees in the solar corona. This enormous heating effect is as yet not understood. Though several physical processes have been proposed, none of them are able to explain all the physical and dynamical properties of the corona. It has been recognized that magnetic fields play an important role in heating up the plasma in the solar corona, but the exact mechanism is still an open question. Heating driven by magnetohydrodynamic waves is one possibility, and this phenomenon would typically leave oscillatory signatures in intensity and velocity signals observed in the solar corona. Many attempts have been made to detect these oscillations but the results are contradictory.

Imaging of the solar corona has the advantages of providing the information over a two dimensional region, but it is subject to small uncertainties arising from variations in sky transparency. On the other hand, spectroscopy provides data only over a small portion of the solar corona but with spectral purity, and the variations in the sky transparency can be taken into account. Line profiles can also yield information about the temperature and non-thermal structure of the solar corona. IIA's proposed experiments at Anji include both imaging and spectroscopy.



IIA's spectrograph to be set up at Anji, China

Two 40 cm telescopes with effective focal length of 200 cm each, fitted with CCD cameras will be used to image the solar corona. These telesopes will image the corona in the green line (530.3 nanometres) and the red line (637.4 nanometres) respectively, at a rate of one 200 millisecond exposure every second. The 2K x 2K CCDs have a pixel size of 13.5 micron, and will thus cover the solar corona up to 1.5 solar radii where most of the emission occurs.

A 30 cm two-mirror system (coelostat) will be used to direct the sun- and coronal light to a 10 cm objective to form an image of the corona on the slit of the Littrow type spectrograph, fitted with a grating with 600 lines per mm blazed at 2 microns. Two 1K x 1K CCD cameras with pixel size of 13.0 x 13.0 microns will be used to record the spectra at of the solar corona at a frequency of about 5 Hz with an exposure time of 200 ms.

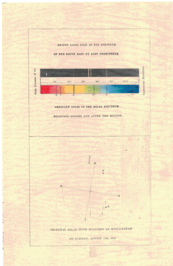
One of the 40cm imaging telescopes

- Jagdev Singh

Eclipse! सूर्य ग्रहण!

From the IIA Archives: Historical Eclipse Expeditions by IIA

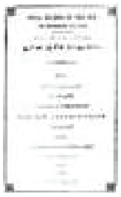
The Madras and Kodaikanal Observatories to which IIA traces its roots, have a long history expeditions to observe solar eclipses, starting with the eclipse of 1868.



Date: *August 18, 1868* **N. R. Pogson, C. Ragoonatha Chary**
Places: *Vanarpati, Masulipatam*

Picture on left: Handpainted solar spectrum of the solar eclipse 1868 showing D3 line

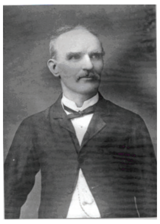
The very first spectroscopic observations of a solar eclipse were made. Hydrogen emission lines were detected in the chromospheres. The observation of a yellow line near the Sodium D line was later attributed to Helium.



Date: *December 12, 1871* **N. R. Pogson, C. Ragoonatha Chary**
Place: *Avinashy*

Picture on left: First page of the report prepared by C. Ragoonatha Chary in Tamil

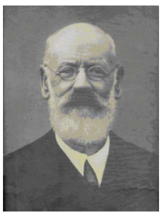
In addition to imaging, spectroscopic and polarimetric measurements were made. Bright lines were seen in the spectrum. What is now termed as the F Corona was first seen.



Date: *June 6, 1872 (Annular Eclipse)* **N. R. Pogson**
Place: *Madras*

Picture on left: N. R. Pogson

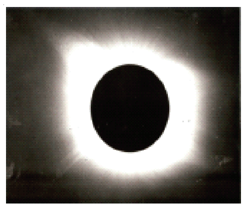
This is the first observation on record of viewing the flash spectrum during an annular eclipse.

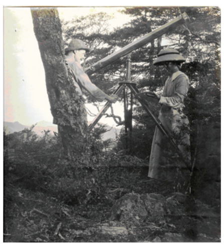


Date: *January 22, 1898* **M. Smith**
Place: *Sahdol*

Picture on left: M. Smith

White light photographs on different scales were obtained





Date: *September 21, 1922* **J. Evershed**
Place: *Wallal, Australia*

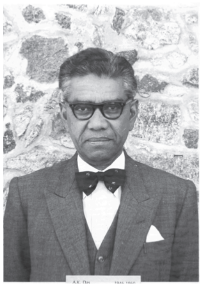
Picture on left: Evershed and his wife at the camp site

Several experiments were planned, including spectroscopy of the East and West limbs of the sun to determine coronal line shifts due to solar rotation, and also to test Einstein's theory of relativity. However, the attempts were foiled by bad weather.

Date: *May 9, 1929* **T. Royds**
Place: *Kamishari, Japan*

Picture on left: T. Royds

The aim here was to study the effect of scattering by the earth's atmosphere on the Fraunhofer lines. No significant difference between the eclipse spectra and full-sunlight spectra were found, in either the centre or the limb.



Date: *February 25, 1952* **A. K. Das**

Place: *Artawi, Iraq*

Although photographic photometry of the flash spectrum and coronal spectrum were planned, the observations were frustrated by bad weather.

Picture on left: A. K. Das

Date: *June 20, 1955* **A. K. Das**

Place: *Hingurakgoda, Ceylon*

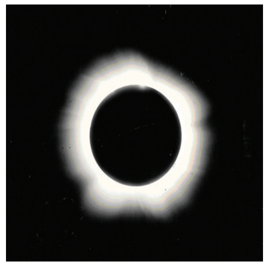
Bad weather prevented any optical observations. However, geomagnetic ionospheric and radio observation were successful.

Date: *March 7, 1970* **M. K. V. Bappu**

Place: *Miahuatlan, Mexico*

Picture on left: M. K. V. Bappu

Direct high resolution photography of the corona and coronal spectroscopy at 30Å/mm covering the spectral region 3300 to 8800Å were done. Cooler gas in the hot corona (of million degrees temperature), was inferred from the presence of Hydrogen, and Helium in the coronal region.

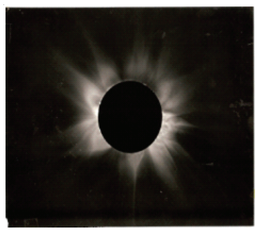


Date: *Feb 16, 1980* **M. K. V. Bappu**

Places: *Jawalgera, Hosur*

Picture on left: Bappu at Jawalgera Camp

The high resolution multislit spectra obtained showed that the solar corona is remarkably quiet and that it corotates with photospheric layers. Detailed information on the temperature the structure of solar corona was obtained. It was found that collisional excitation dominates up to 1.3 solar radii and beyond that radiative excitation dominates.



- Christina Birdie, A.Vagiswari

A Joint Programme with Pondicherry University

IIA and Pondicherry Central University entered into a collaboration on the 28th April, 2009, by launching a joint PhD programme. Siraj Hasan (Director), and Harish Bhatt (Dean-Academic) from IIA, and S. Loganathan (Registrar) and S. Balakrishnan, (Dean, School of Physical, Chemical & Applied Sciences) from Pondicherry University, were signatories to the Memorandum of Understanding signed on the Pondicherry University Campus, under which, the PhD Programme will be jointly administered by the two institutions. Addressing the Pondicherry University community at the signing ceremony, Siraj Hasan said, “We do not have the full range of disciplines which you have in universities. To run an institution, we need good minds and good minds come from universities. Until, we find good students, we will not be able to sustain research”.

Harish Bhatt, Dean (Academic), IIA, speaking at the signing ceremony.

The MoU will be a platform for a variety of academic collaborations, student and faculty exhanges, and joint conferences and workshops.

Left to right are Swapan Saha (IIA), J.A.K Tareen (Vice-Chancellor, Pondicherry University), K. Porsezian (Head of Department of Physics, Pondicherry University), Siraj Hasan (Director, IIA) and S. Loganathan (Registrar, Pondicherry University).

New Appointments

Welcome to Dr. Sivarani Thirupathi, who has joined the academic staff in May 2009. Before joining IIA, she was a Joint Institute for Nuclear Astrophysics Research Associate at Michigan State University, East Lansing, USA (2004-2008) and a Sloan Digital Sky Survey project post-doctoral fellow (2008-2009) at University of Florida, USA. Sivarani's scientific career started at IIA earlier in 2000 when she completed her Ph.D. studying the elemental abundances in evolved stars. Sivarani's current research interests include stellar abundances and galactic chemical evolution, near field cosmology, host star properties of exo-planets and planet formation.

Welcome to Dr. Sumedh Anathpindika, who joined IIA in April 2009 as a post-doctoral fellow. Sumedh completed his doctoral research at the Cardiff University, UK, in November 2008. The subject for his PhD research was numerical/theoretical star formation and, specifically, simulating low mass star formation in cloud-cloud collision and its role in quick decay of turbulence in the interiors of giant molecular clouds. Sumedh's current research involves theoretically exploring various aspects of this problem.

Sumedh was elected to the Royal Astronomical Society, London in 2006, was a member, European Astronomical Society, Switzerland, and The Institute Of Physics, London, in 2006 and 2007, respectively.

The paper "Curvature, Phase-space, Holography and Black Hole Entropy" by C. Sivaram got an honourable mention in the competition of the Gravity Research Foundation, Massachusetts, USA, for the year 2009.

Chandrasekhar Post-Doctoral Fellowships

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 year. The fellowship is for an initial period of two years, extendable to three, with a minimum monthly stipend of Rs.25,000/-, an annual contingency grant of Rs.1,00,000/-, housing and medical benefits, and support for travel to Bangalore. More details are at www.iiap.res.in/postdoc.htm.

Retired

A. J. Raghupathy, who joined the administration division of IIA in 1974, retired on the 30 March, 2009. He served the administration in various capacities, and was the Administrative Officer during 2006-2009.

Ramaiah, who moved to IIA in 1978 from ISRO, served the purchase department in various capacities, and retired as Senior Assistant Administrative Officer (Purchase) on the 31 May, 2009.

C.Nagappan, who served on IIA's support staff since 1986, retired on the 28th February, 2009.

D.Muniappan and R. Venu who served as support staff of IIA since June,1978 and August,1982 respectively, retired on the 31st March, 2009.

A.Annadurai, who joined the Kodaikanal observatory in 1974, served on the technical support staff of IIA and contributed to the Vainu Bappu Telescope and other projects, retired on the 31st May, 2009.

P.Alphonse who worked as IIA support staff since 1977 and contributed to the Vainu Bappu Telescope and other projects, retired on the 31st May, 2009.

Editors: Prajval Shastri and S. P. Rajaguru
Editorial Assistance: Suchitra K.
Photo Credits: T. K. Muralidas, V. S. Shyam

Indian Institute of Astrophysics
II Block, Koramangala, Bangalore 560 034, INDIA
Tel : 91 (80) 2553 0672 Fax : 91 (80) 2553 4043
Voicemail : 91 (80) 2553 9250 E-Mail : newslet@iiap.res.in