आईआईए न्यूज़लेटर

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In this issue...

INTERNATIONAL YEAR OF ASTRONOMY 2009

IIA's Galileoscope

अजय सक्सेना, डीन (अत्यंत बाईं ओर) श्री टी.एन.धीरेश कुमार, प्रधानाचार्य, मडिवाला हाई स्कूल (अत्यंत दाईं ओर) को आईआईए गैलिलियोस्कोप सौंपते हुए। (बाएं से दाएं) हरीश भट्ट (डीन शैक्षणिक), गायत्री जे.एस. तथा बाशारथ जहां बेगम (सरकारी हाई स्कूल, मडिवाला के विज्ञान शिक्षिका तथा उप प्रधानाचार्य)

At the extreme left is Ajay Saxena (Dean, Engineering, IIA) handing over the IIA Galileoscope to T.N.Dheeresh Kumar (extreme right), Principal, Madivaala Government High School. Also seen are (left to right) Harish Bhatt (Dean Academic, IIA), Gayatri J.S. and Basharath Jahan Begum (science teacher and Deputy Principal respectively, of Government High School, Madivaala).

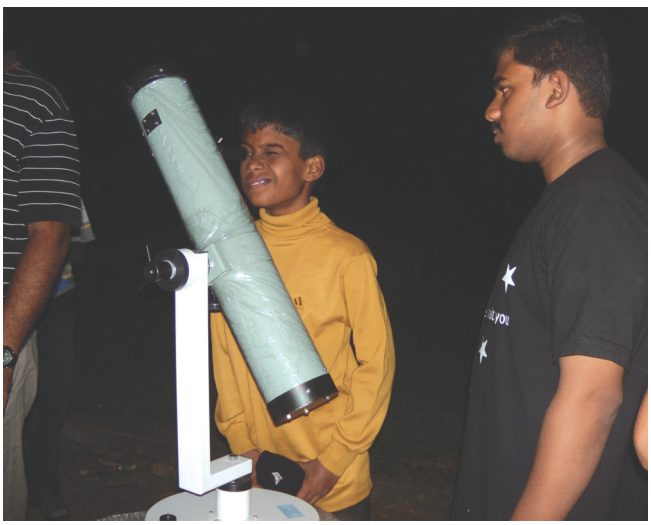
IIA's Galileoscope that was designed as part of the International Year of Astronomy activities has now become available, with about 220 telescopes already shipped to destinations country-wide.

Given IIA's expertise in telescope-making, designing a sturdy, easy-to-handle and low-cost telescope was seen as an important goal of IIA's *Astronomy for All* programme, whose aim is to spread the excitement of viewing objects of the night sky as widely as possible. The design efforts of the Photonics division resulted in a prototype Newtonian reflecting telescope with a 100mm-diameter Aluminium-coated mirror as the aperture, and a standard 10x eye-piece. The telescope was designed to have a sturdy circular base, and an Alt-Azimuth mount, with dual-axis manual fine movement. The light-weight tube was designed to house the Newtonian optics, and have a simple gun-sight arrangement for ease of pointing. The telescope was mass-produced by Lensel Optics Pvt. Ltd., Pune. It is intended for basic night-sky viewing

आईआईए में संयोजित तथा परीक्षित 250 टेलीस्कोपों का प्रथम बैच। पृष्ठभूमि में टेलीस्कोप का संवेष्ठन देखा जा सकता है।

The first batch of mass-produced 250 telescopes assembled and tested at IIA. The packaging of the telescopes is visible in the background.

and may be requested from IIA by both institutions and individuals.It is shipped to sites outside Bangalore with secure protective packaging.



लालभाग उद्यान, बेंगलूर में गैलिलियन रात्रि सार्वजनिक व्योम-वीक्षण कार्यक्रम के दौरान आईआईए के गैलिलियोस्कोप का प्रयोग करते हुए एक विद्यार्थी। बेंगलूर खगोलीय सोसाइटी से विश्व कीर्ति इस दृश्य का अवलोकन करते हुए।

A school boy trying out IIA's Galileoscope at the Galilean Night public sky-watching programme at Bangalore's Lalbagh gardens. Viswa Keerthy from Bangalore Astronomical Society looks on.

One Galileoscope was presented by IIA to the Government High School, Madivaala, with which IIA initiated an extension programme in February, 2008. On the occasion of Mahatma Gandhi's Birthday, Harish Bhatt (Dean-Academic), Ajay Saxena (Dean-Engineering and head of Photonics Division), Sabyasachi Chatterjee (Chair, IYA09 committee) and D.Thyagaraja from IIA participated in a ceremony to hand over the Galileoscope to the school.

At the gathering of the students and teachers of the school, Harish Bhatt and Sabyasachi Chatterjee explained the significance of Galileo Galilei's work 400 years ago, and emphasised the importance of experiments in science. Ajay Saxena handed over the Galileoscope to the school, which was received by the Principal, Shri T.N.Dheeresh Kumar.

The use of IIA's Galileoscope was demonstrated at the *Galilean Nights* programme, which was an IYA event consisting of public sky-watching programmes world-wide, during 22-24 October, 2009. The public viewed the Moon and Jupiter through the telescope. The Galileoscope has been provided to a variety of interested parties that includes schools, colleges, science associations, amateur astronomers, students and other individuals.

The detailed specifications of the telescope are listed in the instruction manual, which is available on the IIA website. The telescope may be requested using an on-line order form, also on the website.

अंतर्राष्ट्रीय खगोलीय वर्ष के क्रियाकलापों के अंश के रूप में अभिकल्पित आईआईए गैलिलियोस्कोप अब उपलब्ध हैं तथा देशभर में विभिन्न गंतव्य स्थानों को 220 टेलीस्कोप भेजे जा चुके हैं।

आईआईए के टेलीस्कोप निर्माण दक्षता के मद्देनज़र आईआईए के *सभी के लिए खगोल विज्ञान* कार्यक्रम के तहत टिकाऊ, प्रयोग में सुविधाजनक तथा किफ़ायती टेलीस्कोप का अभिकल्पन एक महत्वपूर्ण लक्ष्य प्राप्ति है, जिसका उद्देश्य रात्रि व्योम में पिंडों के वीक्षण के कौतुहल को विस्तृत

करना है। फोटेनिक्स प्रभाग के अभिकल्पन प्रयासों के परिणामस्वरूप द्वारक के रूप में 100 mm व्यास ऐलुमिनियम विलेपित दर्पण तथा मानक 10x नेत्रिका सहित प्रारूप न्यूटोनियन परावर्तन टेलीस्कोप का विकास किया गया। इस टेलीस्कोप के अभिकल्पन में ठोस वृत्ताकार बेस तथा द्वि-अक्ष हस्तचालित संचलन सहित उद्दिगंशक विद्यमान हैं। हल्के ट्यूब का अभिकल्पन न्यूटोनियन प्रकाशिकी तथा बिंदुकरण सुगमता के लिए सरल गन-साइट व्यवस्था को आवासित करने के लिए किया गया है। लेंसल ऑप्टिक्स प्राइवेट लिमिटेड, पुणे द्वारा इस टेलीस्कोप का बड़ी संख्या में उत्पादन किया गया। इसका मूलभूत प्रयोग रात्रि व्योम वीक्षण के लिए होता है। भिन्न संस्थान एवं इच्छुक व्यक्ति आईआईए से इसे प्राप्त कर सकते हैं। बेंगलूर से बाह्य स्थानों को इसे सुरक्षित रक्षात्मक संवेष्ठन द्वारा भेजा जा रहा है।

फरवरी 2008 में आईआईए द्वारा प्रवर्तित विस्तार कार्यक्रम के अधीन सरकारी हाई स्कूल, मडिवाला को आईआईए द्वारा एक गैलिलियोस्कोप भेंट स्वरूप प्रदान किया गया। गांधी जयंती के शुभ अवसर पर उक्त स्कूल में आयोजित समारोह में आईआईए की ओर से हरीश भट्ट (डीन-शैक्षणिक), अजय सक्सेना (डीन -अभियांत्रिकी तथा फोटेनिक्स प्रभागाध्यक्ष) तथा सव्यसाची चैटर्जी (आईवईए 09 समिति, अध्यक्ष) उपस्थित थे। हरीश भट्ट तथा सव्यसाची चैटर्जी ने चार सौ वर्ष पूर्व गैलिलियो गैलिली के कार्य के महत्ता पर प्रकाश डालते हुए विज्ञान के प्रयोगों के महत्व पर बल दिया। तदुपरांत अजय सक्सेना ने प्रधानाचार्य श्री टी.एन.धीरेश कुमार को यह गैलिलियोस्कोप सौंपा।

22-24 अक्तूबर 2009 के दौरान आईवईए गतिविधि के रूप में विश्वभर में आयोजित सार्वजनिक व्योम वीक्षण कार्यक्रम के तहत आईआईए गैलिलियोस्कोप के प्रयोग का निदर्शन प्रस्तुत किया गया। उक्त कार्यक्रम में सम्मिलित लोगों ने टेलीस्कोप द्वारा चंद्र तथा बृहस्पति ग्रहों का वीक्षण किया। उक्त गैलिलियोस्कोप भिन्न इच्छुक पार्टियों को उपलब्ध कराया गया है जिसमें विद्यालय, महाविद्यालय, विज्ञान संघ, शौकिया खगोलविद, छात्र तथा अन्य व्यक्ति सम्मिलित हैं।

विस्तृत विनिर्देशन अनुदेश मार्गदर्शिका में सूचीबद्ध है जो आईआईए के वेबसाइट पर उपलब्ध है। इस टेलीस्कोप को वेबसाइट पर उपलब्ध ऑन लाइन आदेश प्रपत्र द्वारा मंगवाया जा सकता है।

Physics and Astrophysics of Dust II

Twenty-five participants from multi-disciplinary backgrounds gathered in the first week of September, to bring their diverse insights to deliberations on the *Physics and Astrophysics of Dust* in an international workshop held in the picturesque surroundings of the Vainu Bappu Observatory. The workshop which was the second in the series, was held during the 2-5th September, 2009.

Cosmic dust is an important component of the Universe, playing a key role in astrophysical, physical and biological processes. Dust is also vital without which stars and galaxies would have evolved in a different way and planets and life would not have come into existence. It plays a vital role in governing many processes which are of physical, chemical and biological origin. The aim of the workshop was to discuss the new results related to cosmic dust and to attempt to reach a comprehensive understanding of the phenomena associated with dust. The workshop attracted about 25 researchers from both India and abroad, who are engaged in multiple disciplines that included observations, theoretical modelling, computation and laboratory astrophysics. About twelve participants were from IIA.

The workshop began with a welcome note by C. Muthumariappan and opening remarks by S. Chatterjee. The scientific sessions covered dust in different astrophysical environments, extinction, emission and polarization as probes of dust, dust formation, evolution and Chemistry, laboratory experiments on dust, dust modeling and computation methods. In addition to the scientific sessions, there were also tutorial sessions, the workshop schedule was designed to facilitate extensive discussions and foster new collaborations. The

atmosphere was most conducive for mutual interactions among participants both within and outside of the sessions. In the final session of the workshop, a summary of the scientific presentations was given by Ashoke Sen, Assam University, Silchar. This was followed by a lively debate lead by U.J.Sofia, American University, Washington, USA. Outstanding problems on cosmic dust were intensely debated upon, which included dust composition, graphite and PAHs and the ISM spectral features, ISM grain size distribution, etc. It was felt that specific thrust needed to be given to laboratory astrophysics, dust destruction and surface chemistry. A consensus emerged among all the participants to conduct such a workshop in the country every two years to discuss these problems. Ravinder Banyal proposed the vote of thanks. A picnic to Yelagiri Hills and Krishnagiri dam was organized at the end of the workshop.

Sabyasachi Chatterjee and C. Muthumariappan were the co-ordinators of the workshop.

- C. Muthumariappan

National Meeting on Giant Telescopes

About forty scientists from all over the country met at IIA on the 10 October, 2009 to discuss India's partnership in a giant segmented-mirror telescope consortium, and concluded that India should propose to participate in the Thirty-Meter Telescope Project which is planned to be built on Mauna Kea in Hawaii by an international collaboration of several institutions from North America and Japan. The participating institutes in the IIA meeting included ISAC, Bangalore University, IUCAA, ARIES, TIFR, Utkal University, Assam University, Calcutta University, University of Delhi, Mahatma Gandhi University and IIT-Allahabad.

Several international consortia are planning to build telescopes with mirrors that are over twenty metres in size, in order to make the next leap in searching the depths of the cosmos. These telescopes will achieve their ultra-large sizes by being made of mirror segments put together rather than a single giant mirror. Located in the best astronomical sites on our planet, they will operate in the visible and infra-red region of the electromagnetic spectrum, and will be used to investigate a range of intriguing questions from Kuiper-belt objects to dark energy.

The Indian astronomical community has been debating the idea of participating in one of these consortia as a partner, and IIA hosted a meeting in September last year to deliberate on this topic. Subsequently scientists from several institutes got together to investigate the scientific benefits to the community from India's partnership in such a project, the feasibility of Indian participation, and the evaluation criteria for selection of an observatory from among the several international consortia. National working groups were formed to report on various aspects of the idea, including human resources development and possible participation of Indian industries. The October meeting at IIA, which had sessions chaired by Ram Sagar (Director, ARIES) and Ajit Kembhavi (Director, IUCAA), deliberated on the Detailed Project Report that emerged from these efforts, which is planned to be submitted to the Department of Science and Technology for consideration. Several presentations were made on the scientific, technical, industrial and human aspects. The Thirty-Meter Telescope project was seen as the most advantageous, considering the synergy with the astrophysics facilities in India, the potential technical contributions that the Indian community could make to the project and the impact on India's future in astrophysics research. The Thirty Meter Telescope which is well into the early construction phase, is expected to be commissioned around 2018. The participation in what will be be one of the world's most advanced astronomical observatories, is expected to bridge the gap in access to state-of-the-art international facilities for the Indian astrophysics community.

- B. Eswar Reddy

The Bar in the LMC

The off-centered stellar bar is one of the most striking features of the Large Magellanic Cloud (LMC). On the other hand, this is one of the least studied and understood features of the LMC. Subramaniam (2003) studied the relative distance within the LMC bar using red clump (RC) stars and found that the bar is warped and also found structures in the bar. Zhao & Evans (2000) proposed that this off-centered bar is an unvirialized structure slightly misaligned with, and offset from, the plane of the LMC disk. The small displacement and misalignment are consequences of recent tidal interactions with the Small Magellanic Cloud (SMC) and the Galaxy. Many considered this as a possible reason for microlensing events observed towards the LMC.

In this study, the authors map the vertical structure (derived from the relative magnitude variation) in the inner LMC using the recently published OGLE III catalogue (Udalski et al 2008). Reddening corrected mean magnitude of RC distribution (I_0) is assumed to reflect the variation in distance along the line of sight, such that, regions with brighter peak magnitudes are assumed to be located closer. The high resolution map (64.5 x 64.5 sq.pc), presented in this study is expected to bring out any difference in location, since the bar and the disk are sampled.

After correcting the mean I mag for interstellar extinction, I_0 for each region is estimated. The difference in I_0 between

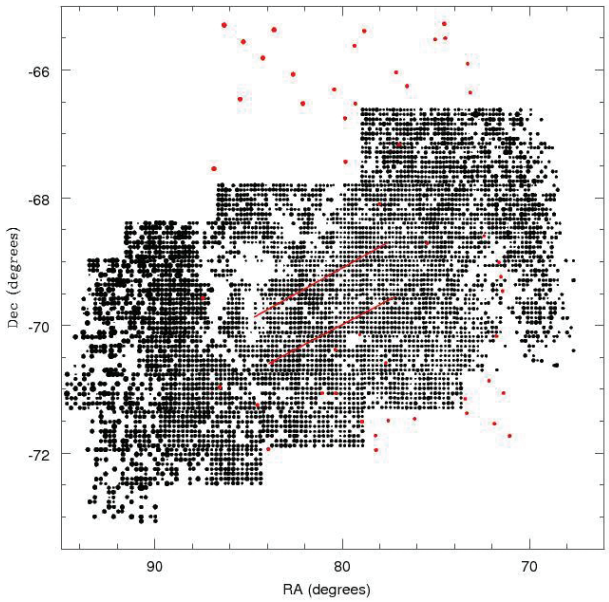


Figure 1: Reddening corrected mean magnitude (I_0) of red clump stars estimated from OGLE III data. The sizes of dots are scaled such that the bigger points are brighter and smaller points are fainter. The approximate location of the bar is also shown. The red points correspond to data taken from Olsen & Salyk (2002).

regions is a measure of the relative distances such that ~ 0.1 mag in δ I corresponds to 2.3 Kpc in distance. The estimated high resolution map of the LMC is shown in figure 1.The absence of any definite feature correlated to the location of the optical bar in the plot is striking. This suggests that the bar is not located in front or back of the disk, at least in the tracer adopted. Thus, the bar is likely to be very much part of the LMC disk. This result also suggests that the RC population in the disk and the bar are very similar. In order to compare the location of the disk studied by Olsen & Salyk (2002), the authors have shown their locations in red, and the size of the dots follow the same convention. Another striking feature is the brightening of the RC stars towards the eastern end of the bar. The average I_0 values in the bar region range between 18.12 to 18.18 mag (east to west), similar to the adjoining disk. There is significant variation in the average value of I_0, along the bar as well as in the adjoining disk. The bar and the disk are found to be coplanar within 0.02 mag. The authors conclude that the LMC bar is very much part of the disk, located in the plane of the disk and it is not a separate component within 0.02 mag. They identify warps or variation in RC population with increase in radial distance. *The results will appear in the Astrophysical Journal Letters (Subramaniam & Subramanian 2009)*

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- Annapurni Subramaniam

Formation of Filaments and Prestellar Cores

Star formation, undoubtedly, is one of the fundamental problems of contemporary astrophysics. The enterprise of this brief article is to discuss some of the recent advances in the numerical theory of low mass star-formation, the initial conditions for which are supplied by detailed observations of young star-forming regions in the interstellar medium (ISM). In this context, the author attempts to contrast the emerging picture of dynamical star-formation, an essential feature of which is its independence of turbulent initial conditions, with the older paradigm of quasi-static core-contraction model; in particular the author would like to discuss his work on the cloud-collision model as an adumbration of the former.

What necessitates a new model ? The classical theory of star-formation based on the collapsing core model suggested by Larson (1969), Penston (1969) and Shu (1977) was simple, where the prestellar core modeled as a truncated Bonnor-Ebert sphere that when perturbed, underwent a rapid, self-similar collapse that terminated in a single, dense central core. The model, however, has been criticised chiefly for its failure to reconcile the observed multiplicity of stellar systems and for ascribing novelty to the central collapsing region that progressively becomes denser, so essentially only the central region of the cloud is collapsing (e.g. Disney 1976, Whitworth et al. 1996). On the contrary, modern day observations aided by powerful instrumentation, have shown that stars form in molecular clouds, the largest of which called the giant molecular clouds (GMCs), have a spatial extent ranging from a few parsecs to a few tens of parsecs with unevenly distributed matter in their interior. GMCs often appear filamentary which has prompted some workers to even suggest fractal GMC models (e.g. Elmegreen 1997). Interestingly, several star-forming regions appear to be located in such filaments which have been a subject of interest for nearly 3 decades and since, a number of individual regions have been observed, for instance the cloud NGC1333 (e.g. Loren 1976), Perseus (e.g. Hatchell et al. 2005), the Pipe nebula (e.g. Rathborne et al. 2009); only to name a few, of course the Orion and Taurus molecular clouds are the best known laboratories to study low-mass star formation and span voluminous literature, that cannot be included here for shortage of space. The GMC interiors are far from being quiescent and velocity dispersions of the order of several km s^{-1} inferred from spectral emission lines, have been reported in a number of surveys (e.g. Larson 1981, Elmegreen 2007); and in fact, the evidence for turbulence is another crucial factor that encourages the dynamical theory of star-formation. Interstellar shocks are believed to inject turbulence in the ISM, stellar feed-back for instance sweep-up massive shells that may become gravitationally unstable and fragment to produce clumps and filamentary structure (e.g. Dale, Clarke & Bonnell 2007). Another scenario,

on which the author has been working on and shall discuss below, is that of fragmenting gas slabs that could form out of an energetic collision between turbulent flows or smaller molecular clouds within GMCs; strong shocks being radiative, it is reasonable to approximate the slab as roughly isothermal. Congenital pressure-density fluctuations renders such slabs dynamically unstable and often leads to runaway growth of various instabilities. This is an attractive proposition that has been investigated by numerous authors (e.g. Whitworth et al. 1994, Semadeni et al. 2007, and references therein), and promises to explain the formation of dense structure and clumps.

The cloud-collision model and fragmenting gas slabs: The response of confined gas slabs to dynamical instabilities has been the subject of active research in the theory of numerical star-formation. Collision between clouds, head-on or off-centre, produces a gas slab that could be either confined by shocks or ram-pressure depending on the precollision velocities of either clouds. The post-shock gas slab accretes matter from individual clouds and it is this slab in whose stability, we are interested. The distinction between the two genre of

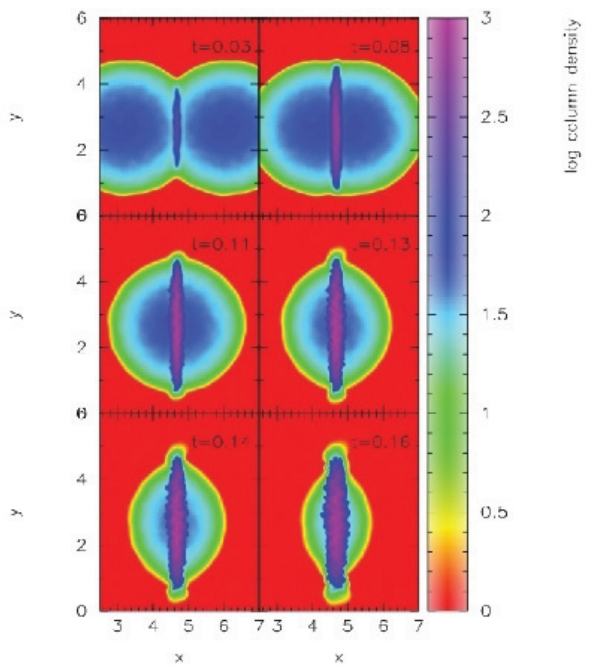

Figure 1: A time sequence of column density plots showing the head-on collision between two identical clouds and the subsequent formation of the shock-compressed gas slab in the plane of collision. Of particular interest is the bending mode (called the thin shell instability in text above) of this slab appears to play a major role in its dynamical evolution.

confined slabs becomes crucial as it appears, slabs in either cases evolve in radically different ways. Although the author has explored the effects of varying the impact parameter, the author here, restricts himself only to the case of high-velocity, head-on cloud-collision. Analytic work in the past usually assumed pressure-free cold gas slabs, and that which admitted external pressure, (incorrectly) simplified the treatment by approximating shock boundary conditions as pressure confinement. Shock being a discontinuity cannot simply be treated as uniform, external ram-pressure. More importantly, turbulence within a shocked gas slab cannot be neglected and below, the author only briefly reports the findings of his recent work to reinforce the point. Though, he may strike a cautionary note as his treatment of the gas thermodynamics was simplified in favour of maintaining purity in the final dynamical analysis. The post-collision gas was allowed to heat adiabatically while that downstream, was allowed to cool to its precollision temperature. The excursions in the temperature-density space were controlled by a piecewise baratropic equation of state. The shocked slab seems to be dominated by a complex interplay of various dynamical instabilities including the Kelvin-Helmholtz (KH), Thin shell instability (TSI), and at times, the Rayleigh-Taylor (RT) instability. While the KH instability is a manifestation of shearing interaction between fluid layers, the RT is a result of pressure imbalance between fluids having a density contrast. The TSI belongs to a different category which in the interest of brevity, may be classified as the bending mode of the gas slab and appears to profoundly influence the dynamical evolution of the shocked slab. The reader is referred to Figure 1 which shows a time sequence of the colliding clouds in a particular simulation.

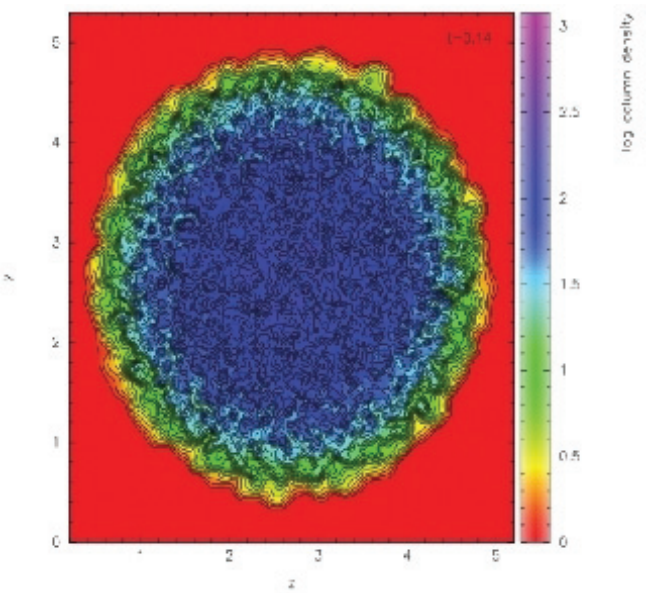

Figure 2: A column density plot of the shocked slab, as seen face-on, soon after its formation. The slab, under the influence of hydrodynamic instabilities (see text), develops structure that can be identified with the aid of density contours overlaid on the picture.

Soon after its formation, the KH instability and the TSI appear on the surface of the gas slab and produce rich structure of various shapes and sizes; filaments and isolated clumps, see Figure. 2 shows a projection of the shock front with density contours overlaid on its surface. Turbulent motion induced by the TSI seems to produce, and shear apart, clumps on a timescale much shorter than the sound-crossing time and only the most massive clumps survive disruption. The gas within the slab interiors being highly turbulent, interaction between turbulent

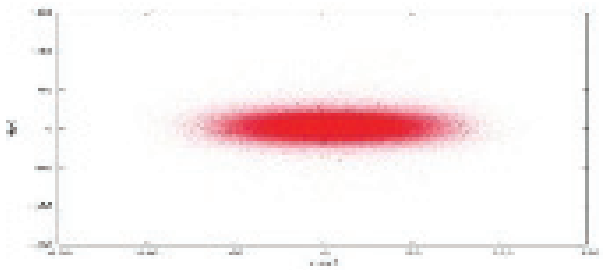

Figure 3: The positions of gas particles in the plane (x-y coordinate axes) of collision at a later instant, when the slab has collapsed laterally and formed an elongated filament, after dissipating internal energy via shocking, accelerated by the thin shell instability.

elements driven by fluid instabilities, dissipates mechanical energy. These instabilities grow rapidly and produce structure on the slab surface, most of which, is quickly destroyed because of tidal disruption and apparently suppresses the gravitational instability. Findings such as from the current work, lend credence to the idea of prestellar cores simply being density enhancements in the diffuse ISM, the densest cores eventually collapse to form stars. It has generally been found that such slabs eventually collapse and form a thin long filament, aligned with the collision axis, see Figure 3. Stars may then form in this filament, a situation quite analogous to the integral filament in the Orion molecular cloud. The author believes, that work of the type discussed here might be able to explain the existence of filamentary regions that have clumps but no sites actively forming stars, in fact some of these clumps that seem to be in dynamical equilibrium are known to oscillate radially, the B68 for instance. *(This work has been published in the Journal Astronomy & Astrophysics (Anathpindika 2009, a & b)*

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- Sumedh Vinayak Anathpindika

H. S. Nataraj under the supervision of Prof. B. P. Das, submitted his thesis titled ***Electric Dipole Moment of the Electron and its implications for Matter-Antimatter Asymmetry in the Universe*** to the Mangalore University on 24 September 2009.

Filling the Black Hole Mass Gap?

The few globular clusters that have been found to harbour a black hole in their middles, appear to fit the well-established but intriguing relationship between the mass of central black holes in galaxies and the velocity dispersion of their stars, and current data also suggest that the globular clusters extend to lower masses the correlation between the mass of these central black holes and the luminosity of the galaxies.

Black holes are clearly ubiquitous in the universe. The Milky Way appears to contain at least ten million black holes that are several times as massive as our sun ("stellar-mass" black holes), and this is expected to be true for most galaxies. At the other extreme, black holes that are a million times the mass of our Sun or more ("supermassive" black holes), are now known to exist at the centres of all reasonably-sized galaxies. On the occasions when matter is driven to the close neighbourhood of these black holes, it is pulled in by the gravity of the black holes, producing enormous radiative power in the process, resulting in an "active" galaxy. The logical bridge between the stellar-mass black holes and supermassive black holes, viz., black holes of "intermediate" mass, i.e., a few hundred to thousand times the mass of our Sun, are relatively sparse. The search for such black holes has been on using different methods but with only a few actual discoveries.

It has been well-established over the last decade that there is a very intriguing relationship between the mass of the supermassive black holes and the mass and stellar velocity dispersion of the galaxies that house them, whether active or otherwise (see Figure 1) - the now-famous "$M_\bullet - \sigma$" relationship (e.g., Ferrarese & Meritt 2000). An obvious question that follows is "To what mass limit does this relationship extend at the low mass end?"

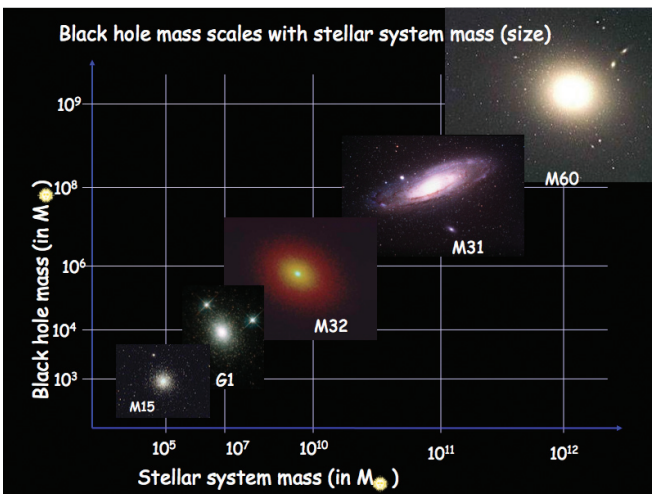

Figure 1. A pictorial representation of the correlation between the mass of the central supermassive black holes in stellar systems and the luminous mass of their bulges.

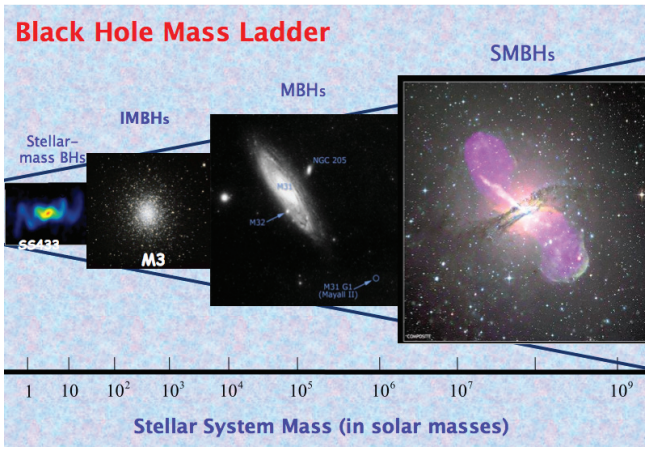

Figure 2. The central black holes that globular clusters may house, could provide the bridge between stellar-mass black holes and supermassive black holes.

Extrapolating the $M_\bullet - \sigma$ correlation down to lower masses suggests that the intermediate-mass black holes can be found in stellar systems that have velocity dispersions of < 30 km/sec. This is the typical value for small stellar systems such as globular clusters and dwarf galaxies. Globular clusters are gravitationally bound spherical collections of stars commonly seen in large numbers in the halos of galaxies, and they contain some of the oldest stars in the galaxy. It would follow that globular clusters could house central black holes that provide the bridge between the stellar-mass black holes and super massive black holes (see Figure 2).

The authors revisited the question how the measured central black hole masses in globular clusters behave w.r.t. the velocity dispersion of their stars. Using the data to date, they find that they are consistent with the $M_\bullet - \sigma$ relationship for galaxies (see Figure 3). They find that the points corresponding to different types of stellar systems occupy distinct regions, suggesting that black hole masses of about 10,000 times the mass of our sun represent the *Slowest* limit for the central supermassive black holes of galaxies. Masses of the central black holes that are below this limit correspond to the globular cluster domain. They recall that globular clusters G1 and ω Centauri are believed to be tidally stripped dwarf galaxies and not "genuine" globular clusters. The consistency of globular clusters with the $M_\bullet - \sigma$ relationship implies consistency with the theoretical predictions such as that of Begelman & Nath (2005), but not with those that predict a steepening of the relationship at the low-mass end from heirarchical black hole growth models (e.g., Granato et al. 2004).

The authors use the extended $M_\bullet - \sigma$ relationship to estimate the black hole masses in the globular clusters in which candidate central black holes have been predicted (e.g., Drukier & Bailyn 2003).They use these estimated masses to extend the $M_{\text{black hole}}$ luminosity plot to lower black hole masses. Here again, the measured and estimated central black hole masses of globular clusters taken together are consistent with the extrapolation of

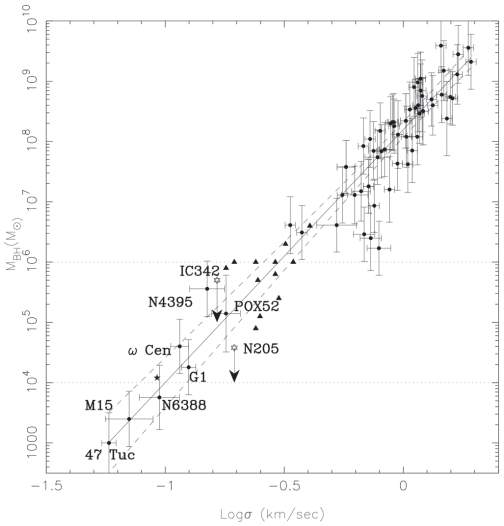

Figure 3. Central black holes of globular clusters are consistent with the extrapolation of the $M_\bullet - \sigma$ relationship for galaxies to the low mass regime. Globular clusters and dwarf galaxies are labelled. The triangles represent low-luminosity active galaxies. The linear regression is represented by the solid line.

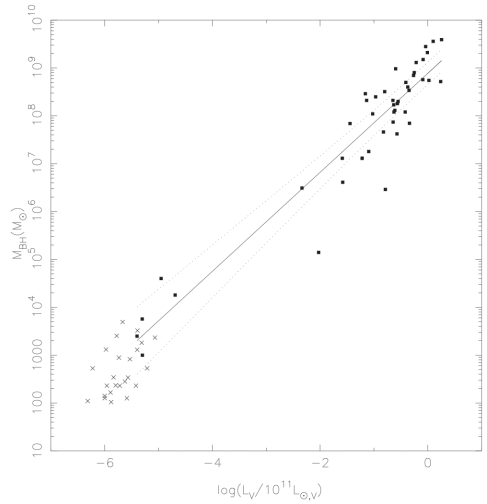

Figure 4. The measured and estimated central black hole masses of globular clusters taken together are consistent with the extrapolation of the $M_{\text{black hole}}$ luminosity relationship for galaxies. The linear regression is represented by the solid line.

the plot for galaxies (Figure 4). The consistency of black hole masses in globular clusters with the extrapolated $M_\bullet - \sigma$ and $M_{\text{black hole}}$ luminosity relationships reinforces the idea that globular clusters harbour inermediate-mass black holes in their centres.Furthermore, if this consistency persists even with increased sample size and reduced measurement uncertainties, it would imply that common mechanisms underlie the parallel growth of black holes and their hosts in both galaxies and globular clusters. *The details of these results will appear in the journal Astrophysics & Space Sciences (Safonova & Shastri 2010).*

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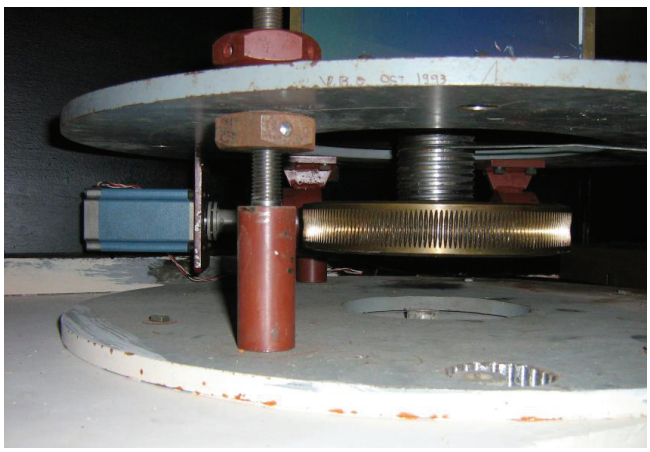
- Margarita Safonova & Prajval Shastri

Micro-Stepping Drive for High-Precision Tracking

A high-precision micro-stepping drive has been introduced into the grating drive system of the 24 inch Solar Tower Tunnel telescope at the Kodaikanal Observatory. Because the micro-stepping reduces the shaft speed for a given input pulse-rate the drive systems then operate smoothly. Thus micro-stepping drives provide stable vibration-free movement even at lower speeds, when compared with the stepper-motors that involve full-step movement.The successful installation of the micro-stepping drive for the grating of the Tunnel telescope has meant that now the grating can be moved line by line quite comfortably with micro-step resolution, greatly enhancing the efficiency and ease of spectroscopic observations. The effects of mid-range instabilities are also reduced.

The drive system consists of a micro-step drive module (MD 808), a stepper motor (KML 063) and a fivechannel digital counter/timer (based on USB4301-9513). The SLO-SYN MD 808 is a bipolar, speed adjustable, two-phase PWM drive which uses power MOSFET devices and can be set to operate a stepper motor in eight-step resolutions from full step to 1/100 microstep with a maximum running speed of 3,000 rpm. To reduce the possibility of electrical noise problems, the control signals are optically isolated from the drive circuit. The drive has under-voltage and transient over-voltage protection and thermal protection. Input frequencies upto 20MHz are accepted. A step resolution as low as 1/100 and 20,000 pulses per revolution can be achieved with the system.



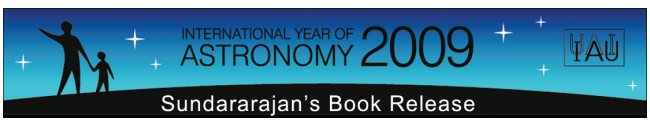
Stepper motor KML 063 being used for positioning the grating at 24 inch Solar Tower Tunnel Telescope at Kodaikanal Observatory.

In order to avoid the instabilities which cause a loss of torque at stepping rates outside the range of natural resonance frequencies, the base speed is selected to be above the motor's resonant frequencies and the acceleration and deceleration are adjusted so that the motor moves through the unstable regions quickly. The USB-4301 is designed with a 9513 counter/timer chip which is software-programmable for event counting, pulse and frequency measurement, alarm comparisons and other output functions. The chip has five independent 16-bit counters, each with an input source, internal count register, load register, hold register, output, and gate. It is a 5-channel, 16-bit counter/timer with event counting, PWM, frequency measurement/division and duty cycle generation. Both Visual Basic, .net framework and Visual C/C++ be used for programming the system, which runs on Microsoft Windows platforms.The system was used for the tracking of the Coelostat which was employed in the recent total solar eclipse experiment of IIA in Anji, China.

This high precision drive system also has other applications such as telescope right-ascension tracking, shutter control of cameras, focusing movements of telescope mirrors and control of filter-wheels.

- N. Sivaraj

The Association of Physics Teachers of Mangalore University organised a week-long series of public lectures on astronomy in different colleges all across the Karnataka coastal districts of Udupi and Dakshina Kannada, in September, on the occasion of the International Year of Astronomy. Amateur astronomer associations of the districts also partnered in the organisation. The inaugural session of this series was in the Poornaprajna College, Udupi, where Chandrashekhar Shetty, physicist and former Registrar of Mangalore University, delivered the key-note address on the significance of Galileo's work, the scientific method and the impact on astronomy and science in general. This was followed by a lecture on *Landmarks in Astronomy* by Sabyasachi Chatterjee and another on *Shining Black Holes and Growing* Galaxies by Prajval Shastri. Following the inaugural event, Sabyasachi Chatterjee and Prajval Shastri gave lectures at colleges in Kalyanpur, Bantwal, Udupi, Mulki and Mangalore.



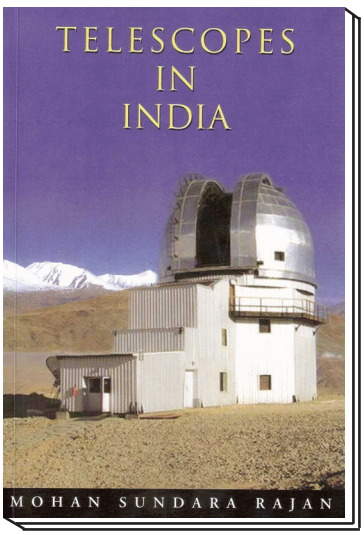
Telescopes in India, a popular science book, written by Mohan Sundara Rajan, was released by Harish Bhatt, Dean of IIA, at a colourful function at the Visvesvaraya Industrial and Technological Museum, Bangalore, on the 9th October 2009.

The book describes telescopes in India ranging from radio to gamma-ray wavelengths for the lay reader, together with some historical background as well as the related exciting scientific discoveries that have been made with them.

The author has dedicated the book to Vainu Bappu, India's pioneering astronomer. Harish Bhatt presented copies

Left to Right: Harish Bhatt, Ram Sagar and Smt Yamuna Bappu at the release of the book Telescopes in India by Mohan Sundara Rajan.

to selected students and principals of schools, as well as to Smt Yamuna Bappu, wife of Vainu Bappu. In his address Harish Bhatt commended the National Book Trust for having brought out the first popular science book in India to mark the International Year of Astronomy. He appreciated the comprehensive coverage of the book, which described not only the technology and the country's progress in optical, radio and space telescopes but also the advanced scientific concepts in a simple manner. Dr Ram Sagar, Director, Aryabhatta Research Institute of Observational Sciences, Nainital, who presided over the function, said the book fulfilled a long-felt wish of the astronomical community of India to have a popular science book on the subject. It had come at a time, when India is about to build Asia's largest optical telescope near Nainital. He urged the amateur astronomers' associations and clubs as well as educational institutions to encourage the effort to reach a wide range of readers for the book.



The speakers, including Vasudeva Bhatta, Director, VITM, commended the choice of illustrations in the book as well as its reader-friendly presentation and style and lauded the NBT for moderately pricing it. Siraj Hasan in his foreword to the book, says, "The author, an eminent science writer, has made the story accessible to the general reader in a lucid and enjoyable manner." Dr K. Kasturirangan, eminent scientist, has written a special message for the book where he says, "This fascinating book portrays in a succinct and readable way India's best scientific pursuits in recent times. I welcome the book, which marks the International Year of Astronomy".

The release of the book was followed by a lecture by Harish Bhatt on *Our Place in the Universe*, and another by Ram Sagar on *Telescopes.* The lectures triggered a lot of questions, especially by the high school students who formed a large part of the audience.

As part of its IYA09 programmes, IIA hosted a unique interactive, internet-streamed, cross-continental dance performance at its Hosakote campus on the 17th October, 2009, with Bharatanatyam dancer and scientist Sharada Srinivasan performing in IIA, and contemporary dancer Anusha Emrith performing in Cité De L'Espace in Toulouse, France.

This event, titled *Dance of Stars: Nataraja and the Cosmos (Danse e-Toile: Nataraja et le Cosmos)*, featured in the first Toulouse knowledge *Festival La Novela*, which attempted a view of science from an artistic enjoyable perspective.The event was streamed live from both venues for remote audiences. Distant streaming and e-interaction was explored as a means of conveying the metaphors of the cosmos and cosmic order and flux. The streaming was made visible to the two dancers as well, so that each could respond to the other in real time.The webcast used technology to combine images of the two performances so that sometimes the dancers were seen separate, and sometimes merging. It was a synthesis of art, science and advanced technology, produced in collaboration with the French *K.danse Company* led by Jean-Marc Matos and Anne Holst, among whose specialties are internet-streamed dance performances. The entire event was webcast live from both venues through the website of Théâtre Villette, Paris.

Srinivasan used an interpretation of the *Devadideva Varna* of the Pandanallur school and drew from the cosmic aspects of *Nataraja* imagery in the Bharatanatyam tradition, while Emrith performed her interpretation of the cosmos in the contemporary dance style. The concept was inspired by Srinivasan's archaeo-metallurgical work as well. It also built on the archaeo-astronomy research on the *Nataraja* bronze icon which was done in collaboration with the late Nirupama Raghavan, astrophysicist and IIA alumnus, which drew attention to the possibility that the *Nataraja* imagery might have been in part inspired by observations of the Orion constellation and the Crab supernova in the 11th century.

Sharada Srinivasan performing at the Danse e-Toile. The projection of the internet-streamed "e-duet" with the merged images of Srinivasan and Emrith is seen in the background.

The internet-streamed event was preceded by a photo-montage exhibition by Sharada Srinivasan at both the Indian and French venues, elucidating the art-science-dance connections and the archaeometallurgical and archaeoastronomical aspects of the *Chola Nataraja* bronze imagery. Geetha Navale's veena performance was streamed live as a prelude to the dance recital. David Fieffe arranged the combination of Bharatanatyam music interwoven with electronic background music to convey a sense of 'space' and with mridangam inputs from Gurumurthy and veena by Geetha. Rekhesh Mohan and Sanjiv Gorkha were technical co-ordinators of the event from IIA, together with Digvijay Mallah and Rakesh Mannar working on the videographic aspects.

The performance was followed by an on-line discussion between French and Indian scholars and artists. Sharada Srinivasan, science writer and science-historian Balachandra Rao, artist Sultana Hasan from Bangalore, and astronomer Karine Gadre, and digital choreographer Jean-Marc Matos from Toulouse, among others, discussed the art-science interface, the interplay between Bharatanatyam and contemporary dance, the links between astronomy, pre-modern art, architecture and religious beliefs, and the unique artistic idiom that emerges when performances images are streamed.

Projection of the internet-stream of a scene from the Danse e-Toile.

Spurred by the phenomenal success of the *100 Hours of Astronomy* programme that spawned public sky-watching events throughout the world, the IAU declared a second world-wide programme of public sky-watching during 22-24 October, 2009, called *Galilean Nights*. The dates were chosen when the moon as well as jupiter and its planets would be visible fairly high in the sky.

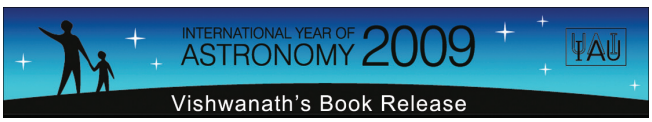
Padmakar Parihar (IIA) showing Jupiter and its moons to the public through the 14" Meade telescope on the first Galilean Night sky-watching programme at IIA.

On the first Galilean Night IIA organised a sky-watching session on the terrace of the IIA building. Many members of the public who had come to the Landmark lecture by T.Jayaraman stayed on for the session and were joined by others as well. Venus, Jupiter and the moon were popular targets through both the 14" and 6" telescope. The use of IIA's Galileoscope was also demonstrated. The sky-watching was conducted in partnership with the Bangalore Astronomical Society (BAS).

The IIA and BAS teams that participated in the public sky-watching programme at Lalbagh gardens on the Galilean Nights.

A member of the public viewing jupiter and its moons through the IIA 14" Meade telescope at Lalbagh gardens. IIA students Vineeth and Sajal Dhara look on.

On the 2nd and 3rd Galilean night, IIA partnered with the BAS to celebrate the beauty of the night sky at the rocky outcrop of Lalbagh gardens. The IIA telescopes were joined by several telescopes belonging to the members of the BAS. Over 700 people queued up to watch Jupiter, its moons and our moon. The occasion, as always, resulted in dialogue between the scientists, the amateur astronomers and the public on a wide variety of topics. The event exemplified in more ways than one, spirit of 'The Universe, Yours to Discover'.

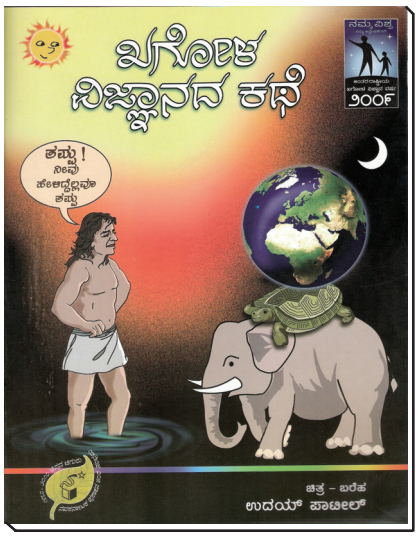


The book ಖಗೋಳ ವಿಜ್ಞಾನದ ಕಥೆ (*The Story of Astronomy*) originally written in English by Uday Patil and translated into Kannada by P.R.Vishwanath was released at a special function in Bangalore on the occasion of the International Year of Astronomy, on the 25th of October, 2009. The book, published by the Navakarnataka Publications Pvt. Ltd., treats the growth of astronomy over centuries in dialogues using cartoons in "comic book" style. This

R.S.Rajaram, P.R.Vishwanath (IIA), B.S.Shylaja, C. V. Vishveshwara, Arvind Gupta, V.S.S. Shastry and H.N. Geetha at the release function to commemorate IYA09.

Kannada translation also contains the hand-drawings by the original author Uday Patil. Several other books were

also released at the function, including one on astronomy by B.S.Shylaja. The function was presided over by C. V. Vishveshwara, who then treated the audience to an interesting lecture on Galileo Galilei.



On the 22nd October, 2009, Professor T. Jayaraman from the Institute of Mathematical Sciences, Chennai and currently at the Tata Institute of Social Sciences, Mumbai gave the fourth in the series of IIA's public lectures on Landmarks in Astronomy. In his lecture titled *From Static Worlds to Evolving Systems: Philosophical Implications of Changes in the Natural World*, Jayaraman brought his experience of twenty years as a particle physicist in an elite research institute researching string theory, and his recent immersion in the social sciences exploring the interface between science and society, to an analysis of the evolution of world-views as influenced by the natural sciences. He covered the historical scientific developments which were important landmarks of the shifts in these world views, including those of Galileo Galilei and Charles Darwin. The importance of the revolution that Galileo ushered in was that it demolished that Aristotelian framework of a physical world built on the image of an ideal social world in which subordination was the natural principle, with a divine power at the helm of a hierarchy which was considered unchangeable. The ideas of Charles Darwin ushered a new paradigm that viewed the universe as a changing rather than static one. Attempting to cut through the complacence that is easy for scientists to slip into, particularly given their alienation driven by the ubiquitous increase in specialisation, he emphasised how scientific developments strongly influenced our world-view, but that primarily it was our social existence on earth that determines our outlook. The lecture was attended by scientists, students, teachers and other members of the public, many of whom also participated in the sky-watching programme later in the evening.

The Asiatic Society of Bengal organised a two day national seminar entitled "The International Year of Astronomy: Perspective and Challenges" on the 20th and 21st Novemebr 2009 at Kolkata. The seminar focused on the developments in astronomy at the time of the Copernican revolution on the one hand and the surge towards multi-wavelength astronomy in the present times. S.Chatterjee of IIA gave a lecture on Galileo, Kepler and the IYA. India's efforts in radio astronomy were reviewed by Govind Swarup, of TIFR, while those in space astronomy were coverd by P.C. Agarwal, TIFR. S. M. R. Ansari formerly of the Aligarh Muslim University spoke on the Persian influence on the post-Copernican and pre-20th century Indian astronomy. Debi Prosad Duari of the Birla Planetarium, Kolkata, reviewed the efforts in the search for extra terrestrial life.

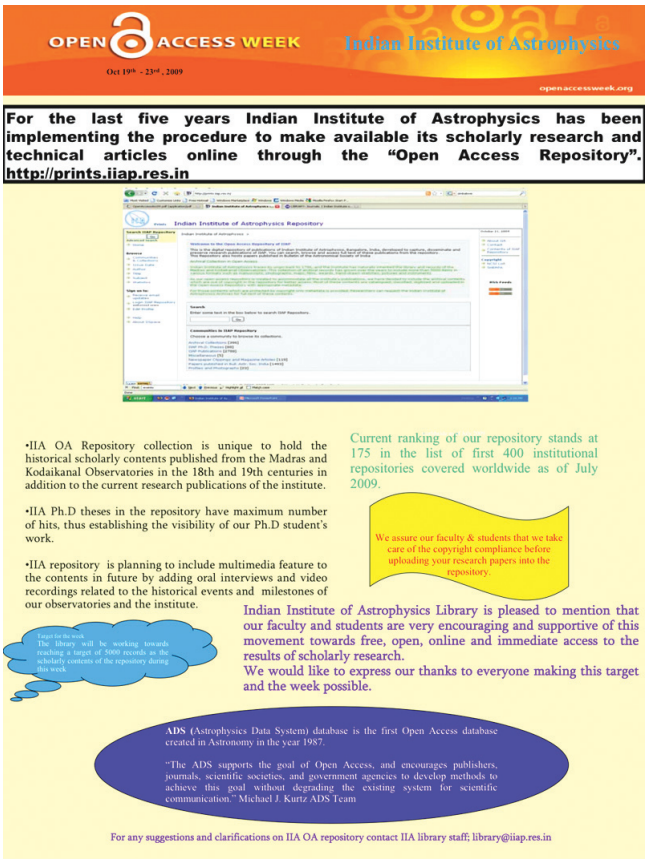
Over 150 children from six different schools in Bangalore visited the Bangalore campus of IIA on the 27th November for a half-day programme on astronomy. This educational event was organized by the youth wing of the Rotary Club Bangalore to motivate and attract high school students towards science. The students listened to a lecture by Ravidner Kumar Banyal on the history and the evolution of optical telescopes and the significant role they have played to advance our understanding of the Universe in the last 400 years. They then heard S. P. Rajaguru talk on the Sun, explaining some of the most interesting and intriguing features of our nearest star. This was followed by a lively question answer session where students came up with sharp and probing questions related to sun spots, black holes, space travel, galaxies, exploding stars and also the possibility of life on other planets.

A series of lectures by IIA scientist to student and public audiences country-wide was initiated in January targetting 100 lectires over the year.

* P. Shastri: *Shining Black Holes &Growing Galaxies*, Poornaprajna College, Udupi, Karnataka (9 Sep)
* S. Chatterjee: *Landmarks in Astronomy*, Poornaprajna College, Udupi, Karnataka (9 Sep)
* P. Shastri: ಕಪ್ಪು ಕುಳಿಗಳು ಮತ್ತು ಗ್ಯಾಲಾಕ್ಸಿಗಳು, *(Black Holes & Galaxies* in Kannada) SVS College, Bantwal, Karnataka (10 Sep)
* S. Chatterjee: *How Thick is Our Galaxy?*, Milagrees College, Kallianpur, Karnataka (10 Sep)
* S. Chatterjee: *Landmarks in Astronomy*, Government Women's First Grade College, Udupi, Karnataka (10 Sep)
* P. Shastri: *Our Enchanting Universe* , St Agnes College Mangalore Amateur Astronomers Association (11 Sep)
* S. Chatterjee: *Landmarks in Astronomy*, Vijaya College, Mulki, Karnataka (11 Sep)
* S. Chatterjee: *Landmarks in Astronomy*, Mahatma Gandhi Memorial College, Udupi, Karnataka (11 Sep)
* C. Sivaram: *Frontiers in Astronomy,* Christ Junior College, Bangalore (11 Sep)
* R. K. Banyal: *अंतरिक्ष की गहराइयाँ* , *(In the Depths of Space* in Hindi) AIPSN All India Training Workshop on Astronomy, Hyderabad (18 Sep)
* S. Chatterjee: *Landmarks in Astronomy*, AIPSN All India Training Workshop on Astronomy, Hyderabad (18 Sep)
* R. K. Banyal: *Our Solar System*, AIPSN All India Training Workshop on Astronomy, Hyderabad (20 Sep)
* P. Shastri: ಅಂತರ ರಾಷ್ಟ್ರೀಯ ಖಗೋಳ ವಿಜ್ಞಾನ ವರ್ಷ, *(InternationalYear of Astronomy* in Kannada) All India Radio ta, Mangalore (6 Oct)
* Harish Bhatt: *Our Place in the Universe*, Visvesvaraya Industrial and Technological Museum, Bangalore (9 Oct)
* Harish Bhatt: *Our Place in the Universe*, Parikrama Foundation, Jayanagar, Bangalore (12 Nov)
* R. K. Banyal: *खगोलविज्ञान तथा ज्योतिष विद्या, (Astronomy & Astrology* in Hindi) Himachal Gyan Vigyan Samiti, Kullu (13 Nov)
* P. R. Vishwanath: ಖಗೋಳದ ಕುತೂಹಲಗಳು, *(The Curiosities of the Cosmos* in Kannada) KRVP School Students' Programme, Mysore (13 Nov); Bangalore (19 Nov)
* S. Chatterjee: *Landmarks in Astronomy,* Karnataka Rajya Vijnana Parishat, Ramnagaram, Karnataka (15 Nov)
* S. Chatterjee: *Landmarks in Astronomy*, Karnataka Rajya Vijnana Parishat, Mandya, Karnataka (15 Nov)
* R. K . Banyal: *Telescope: A Window to Our Universe*, National Institute of Technology (NIT), Hamirpur (16 Nov)
* S. Chatterjee: *Galileo, Kepler and the IYA 2009*, Asiatic Society of Bengal, Kolkata (20 Nov)
* S. P. Rajaguru: *The Sun*, Rotary Club programme for high schools, IIA, (27 Nov)
* R. K. Banyal: *Telescope: Past, Present and Future*, Rotary Club programme for high schools, IIA, Bangalore (27 Nov)
* K. B. Ramesh: *Developments in Solar Physics*, Physics Department, Bangalore University (27 Nov)

Open Access Week at IIA

The IIA library participated in the *Open Accesss Week* celebrated world-wide during October 19-23, 2009, by reaching a target of 5000 scholarly records in its open access repository.



Open Access Week is an annual celebration that has been occurring since 2007, to increase awareness and understanding of the concept of open and public access to scholarly works. The event was pioneered by the Open Access movement which uses internet technology to implement the long-standing scholarly tradition of making fruits of knowledge creation publicly accessible to all curious minds. The belief is that, free of the barriers of payment or other restrictions, such shared learning and unrestricted access enriches education, accelerates research, and unites humanity's common quest for knowledge.

The open-access repository of the IIA library has been operational for the last five years. In addition to IIA's modern research papers and Ph.D. theses, it also houses the historical scholarly collections of the 18th and 19th centuries from the Madras Observatory to which IIA traces its roots, in addition to several original and historical documents from the Kodaikanal Observatory. Diligent efforts towards copyright compliance has enabled expanding signficiantly the contents of the repository. A web-based interface to access the repository is now in place and extensively used. Future plans for the repository include the addition of multi-media materials such as oral interviews and video recordings related to the historical milestones of IIA.

IIA's open access repository can be found at *prints.iiap.res.in*. More information on the event is available at *www.openaccessweek.org*.

Hindi Fortnight & Hindi Day 2009

Hindi Fortnight was organized during 1 - 14 Sep 2009. Hindi competitions were organized for IIA staff members in debating, singing, *Antyakshari*, essay writing and translation.

The Hindi Day was celebrated in a befitting manner on 14 Sep 2009. This function was presided by Prof. Harish Chandra Bhatt. In his address, he emphasized the importance of Hindi as a link language in the country. Administrative Officer Dr. P. Kumaresan in his address said that it is the statutory obligation of all the Government employees to do their work in Official Language Hindi. Personnel Officer Mr. A. Narasimha Raju read out the message of Home Minister sent by Ministry of Home Affairs. Later on prizes were distributed to the 27 prize winners of the above said competitions. The function concluded by the vote of thanks by Dr. S.N. Mahesh, Section Officer (Hindi).

- S.N. Mahesh

हिन्दी पखवाड़ा व हिन्दी दिवस समारोह – 2009

01 सितंबर 2009 से 14 सितंबर 2009 के दौरान हिन्दी पखवाड़ा का आयोजन किया गया। आईआईए के कर्मचारियों के लिए हिन्दी में वाव-विवाद, गान, अंत्याक्षरी, निबंध लेखन तथा अनुवाद प्रतियोगिताओं का आयोजन किया गया।

14 सितंबर 2009 को भारतीय ताराभौतिकी संस्थान में हिन्दी दिवस भव्य रूप से मनाया गया। इस समारोह की अध्यक्षता प्रोफेसर हरीश चन्द्र भट्ट, डीन ए ने की। उन्होंने अपने संबोधन में राजभाषा हिन्दी के घटनाक्रम पर प्रकाश डालते हुए राजभाषा हिन्दी के महत्व पर अपने विचार व्यक्त करते हुए कहा कि विविध भाषा-भाषी को एक सूत्र में बांधने के लिए ही संविधान सभा ने सर्वसम्मत हो कर हिन्दी को राजभाषा का सम्मान प्रदान किया। इस अवसर पर संस्थान के राजभाषा कार्यान्वयन समिति के सदस्य डॉ. पी. कुमरेसन, प्रशासनिक अधिकारी ने कहा कि सरकारी कामकाज में हिन्दी का प्रयोग सभी सरकारी अधिकारी एवं कर्मचारियों का नैतिक दायित्व है और कहा कि सरकारी कामकाज सरल, सहज तथा आम बोल चाल की भाषा में निपटाया जाना चाहिए। श्री ए. नरसिंह राजू, कार्मिक अधिकारी ने गृह मंत्रालय द्वारा प्रेषित गृह मंत्री का संदेश प्रस्तुत किया। तदोपरांत विभिन्न प्रतियोगिताओं के 27 विजेताओं को पुरस्कार वितरित किए गए। डॉ. एस.एन. महेश, अनुभाग अधिकारी (हिन्दी) ने आभार प्रदर्शित करते हुए हिन्दी दिवस का समारोह सुखद समापन किया।

- एस. एन. महेश

डॉ. आर.सी. कपूर, प्रोफेसर एच.सी. भट्ट, डॉ. पी. कुमरेसन (बाएं से दाएं)
Dr. R.C. Kapoor, Prof H.C. Bhatt and Dr. P. Kumaresan (L to R)

पुरस्कार वितरण समारोह
Prize Distribution Ceremony

Farewells

IIA wishes all the best to....

...S. Jerald, who served in IIA's carpentry division since the 5th November, 1979, and retired on the 30th September, 2009.

...C. Gurumurthy, who served in IIA's transport division since the 30th March 1983, and retired on the 31st October, 2009.

...Savita Mathur, who was IIA's first Chandra post-doctoral fellow since September 2008, and left IIA in October, 2009, to move on to the High Altitude Observatory, Colorado, USA. Savita, a solar physicist who got her PhD from CEA Saclay, France, worked at IIA on astrophysical problems in helioseismology and asteroseismology. In helioseismology she investigated rotation inversions to understand which specific modes (acoustic or gravity) could improve our knowledge of the rotation profile at different depths in the radiative zone of the sun. She also investigated the correlation between solar flares and the enhancement of high-frequency p modes using data from the Solar Heliospheric Observatory. She also attempted to quantify the uncertainties in the prediction of the gravity mode frequencies due to numerical errors. In asteroseismology, she built a pipeline called A2Z, to determine the global parameters of solar-like oscillations as well as the mass and radius of the star. She used the pipeline in the analysis of a few CoRoT stars (Convection, Rotation and planetary Transits) and also in the analysis of data from Kepler, which is a NASA observatory launched in March 2009 to mainly search for Earth-like planets. These results have appeared or will appear in Solar Physics, Astronomy & Astrophysics and Astrophysical Journal.

...Andrea Borch, who was a post-doctoral fellow at IIA since 6 October 2007 and left IIA in October to now move back to the Astronomisches Rechen-Institut of Heidelberg University in Germany. While at IIA, Andrea investigated the luminosity and spectral evolution of globular clusters using numerical techniques, by taking into account both the stellar evolution and the dynamical evolution of the cluster, which becomes really important for low-mass globular clusters. She used the direct N-body code NBODY6++, which enabled dealing with particles as large as 10,000 or more. The first results from this method are in agreement with observational data and are submitted to the Astronomy and Astrophysics journal.

...Meetu Sethi, who was a visiting faculty at IIA from Bhaskaracharya College of Applied Sciences, University of Delhi, and who left in November to rejoin her college after three years at IIA. Meetu worked with Bhanu Pratap Das and his group on quantum phase transitions involving ultra-cold atoms in optical lattices using the Density Matrix Renormalisation technique. She has worked on the system of bosonic ladders and studied the effect of vertical hopping on the phase transitions. She also worked on the problem of the one-dimensional Bose-Hubbard model in the presence of an external trap and the one-dimensional extended Bose-Hubbard model. Further, she analysed the extended Bose-hubbard model for Bosonic ladders. The research has been published in Physical Review A and B.

New Appointments

IIA Welcomes ...

...Varsha Chitnis, who joined the IIA faculty in September, 2009. Varsha got her PhD from the Tata Institute of Fundamental Research on the topic of *Hard X-ray Studies of X-ray Binaries*. She worked with the very high-gamma ray astronomy group of TIFR before joining IIA, on the Pachmarhi Array of Cerenkov Telescopes, and on the High-Energy Gamma-Ray Telescope which is a collaboration between TIFR and IIA. In the interim she was also visiting scientist at ISRO, and post-doctoral fellow at the Paris University working on the High Energy Stereoscopic System which is a Cerenkov experiment. Her research interests are multi-waveband investigations of active galaxies. She likes to read and listen to music in her spare time.

...P. Kumaresan, who joined IIA as its Administrative Officer. Kumaresan has a Masters in Public Administration, an MBA in Human Resources, and a PhD from IIT-Delhi in organisational behaviour on the topic *Correlates and Predictors of Job Satisfaction: A Study of Teachers in Select Engineering Colleges in India.* He worked in the IIT-Delhi administration since 1991 in various capacities, and served as Senior Assistant Registrar, for the last thirteen years. He was attracted to IIA by the challenge of handling administration in its totality. He enjoys reading in his spare time, including books on administrative rules! He also enjoys teaching and has given guest lectures on organisational behaviour in several institutions.

...Chiranjib Konar, who joined IIA as a post-doctoral fellow. He did his PhD at the NCRA, TIFR, and was then a post-doctoral fellow at IUCAA for two years before joining IIA. His PhD thesis research involved an investigation of active galaxies which produce giant radio-emitting sources and the question of episodic activity of supermassive black holes. His research continues to evolve around giant radio galaxies, their environment and evolution. In his spare time he enjoys reading history, and listening to music, especially *Rabindra Sangeet*.

***Siraj Hasan** has been awarded the J.T.M. Gibson Award for Excellence by Mayo College, Ajmer. The award, instituted to honour Jack Gibson's memory and the impact he had on Mayo College students during his tenure as principal from 1954 to 1969, is awarded to alumni who have, consistent with Jack Gibson's ideals, made a difference to society.*

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 *http://www.iiap.res.in/postdoc.htm*.

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