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IUCAA

No. 54 / April 2003

A Quarterly Bulletin of the Inter-University Centre for Astronomy and Astrophysics (An Autonomous Institution of the University Grants Commission)

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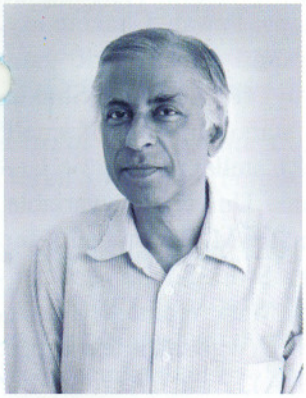
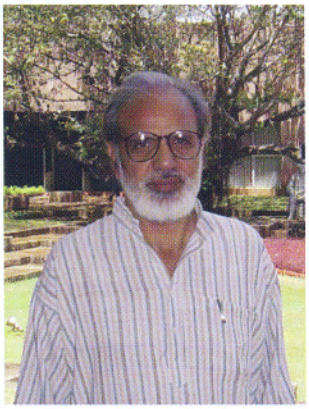
Changes of Leadership at IUCAA



Professor N. Mukunda



Professor Naresh K. Dadhich

The Chairman, University Grants Commission, in his capacity as the President of the Council of IUCAA, has nominated Professor N. Mukunda, the Chairman of the Governing Board of IUCAA in place of Professor R.P. Bambah, whose second term as Chairman ends on June 18, 2003. We welcome Professor Mukunda to this new assignment and look forward to his guidance and counsel in the years to come. We are very grateful to Professor Bambah for shouldering this responsibility and standing behind IUCAA on all occasions whenever his support was needed.

I am happy to inform you that the President of the Council has also appointed Professor Naresh K. Dadhich, the Director of IUCAA after my retirement on July 18, 2003. Professor Dadhich will be the Director designate till this date and will assume full charge as the Director from July 19, 2003. He has my best wishes and I urge all members of the extended IUCAA family to extend to him their warm support and affection as they have shown to me.

J.V. Narlikar
Director

Congratulations

... to **J. V. Narlikar** on being the recipient of the Yashwantrao Chavan National Award 2002 of the Yashwant Chavan Pratishthan, Mumbai

... to **T. Padmanabhan** on being awarded the Homi Bhabha Fellowship for 2003-.

... to **Tarun Souradeep** on being the joint recipient of the N.S. Satyamurthy Memorial Award 2001 of the Indian Physics Association, Mumbai.

Contents...

Introductory School on Astronomy and Astrophysics

An Introductory School on Astronomy and Astrophysics was held in Siliguri College, during November 16-20, 2002. The school was sponsored by IUCAA, Siliguri College and IUCAA Reference Centre of North Bengal University. The aim of the School was to present selected introductory courses on Astronomy and Astrophysics, specially designed for college teachers, research scholars and university students. The topics covered were : (1) Observational Astronomy, (2) Astrophysical Processes, (3) Relativity and Gravitation, (4) Cosmology and (5) Astroparticle Physics. The lecturers were N.K. Dadhich, A. Kembhavi, S. Mukherjee, S. Bharadwaj, D.V. Ahluwalia, S.K. Ghosal, B.C. Paul, K.K. Nandi and S. Karanjai. Although the lectures were mostly on topical issues, the presentation was introductory in nature, keeping in view the general background of the participants. Apart from lectures, there were seminars and discussion sessions, all of which had active and enthusiastic response from the participants. About 25 college teachers and 45 students from the neighbouring universities and colleges participated in the school. The school generated considerable interest among the students and the academic programmes, co-ordinated by S. Mukherjee and A. Kembhavi, were considered equally useful to the teacher participants, as confirmed by their feed-back.

Workshop on Field Theoretic Aspects of Gravity (FTAG-III)

The third IUCAA Workshop on Field Theoretic Aspects of Gravity (FTAG-III) was organized by IUCAA Reference Centre, Department of Physics, Cochin University of Science and Technology, during January 23- 29, 2003. This workshop was cosponsored by IUCAA, IMSc, Chennai and CUSAT, Kochi. There were about 25 active workers including doctoral and post- doctoral fellows and faculty members from all over India. Following the tradition of FTAG, each talk was of 90 minutes duration and the speaker himself/ herself chaired the session. The topics discussed included: quantum gravity, quantum cosmology, quantum field theory in curved space time, black holes, noncommutative geometry, string theory, extended objects in general relativity, dark energy, pre-big bang cosmology, etc. The venue of the workshop (Santhigiri Ashram, Edathala, Aluva), where all the participants stayed was a beautiful place, ideal forsuch small gathering. This resulted in lively discussions outside the lecture hall. N.K.Dadhich (IUCAA) and V.C.Kuriakose (CUSAT) were the coordinators of the workshop

Workshop on Astronomy with Small Telescopes

A workshop on Astronomy with Small telescopes was conducted at IUCAA during January 6-10, 2003. There were, in all, 40 participants at the workshop : 16 M.Sc. students, 16 university/college teachers, and 8 Ph.D students/PDFs/others, mostly from outside Pune. This list also includes two M.Sc. students from the University of Mauritius. The workshop began with a brief welcome address by J. V. Narlikar, Director, IUCAA. A coherent set of lectures, delivered during the workshop include detection of light and detectors (photometer and CCDs) by A. N Ramaprakash (IUCAA), elements of photometry and error analysis by A. K. Kembhavi (IUCAA), elements of spectroscopy with applications for small telescopes by Ranjan Gupta (IUCAA), astronomical image processing by Pawan Chakraborty (IUCAA), observing strategy and photometric data reduction by Sudhanshu Barway (Ravishankar Shukla University), interacting binary stars and role of small telescopes by N. M. Ashok (PRL), stellar activity in late type binaries by P. V. Rao (Osmania University), variable stars and observational projects for M. Sc. students by S. K. Pandey (Ravishankar Shukla University), quantitative teaching projects by Mark Whittle (IUCAA Visiting Faculty), transient phenomena with small telescopes by Arvind Paranjpye (IUCAA), and Automated Photoelectric Telescope (APT) by Umesh Dodia (Bhavnagar University). These lectures were planned to be supplemented with observations and demonstrations using the small telescopes (with 10"-16" aperture) available at IUCAA, but sky conditions during the period of the workshop turned out be unfavourable. Some demonstrations using SSP3 photometer and CCD were conducted by Arvind Paranjpye and Sudhanshu Barway during the first two nights. The workshop ended with closing remarks by N. K. Dadhich, Chairman, Workshops Committee, IUCAA, with the hope that such workshops will be organized by IUCAA in future too in order that the excitement of Observational Astronomy with small telescopes can be initiated/promoted/sustained in the universities and colleges in our country, specially for the M.Sc. students. S. K. Pandey, Ravishankar Shukla University, Raipur, was the official coordinator of the workshop, but fair share of credit for making it successful goes to Arvind Paranjpye, Sudhanshu Barway, V. Chellathurai and his automated team at IUCAA.

Colloquium

06.01.2003 Mark Whittle on *Black Holes in Galaxy Nuclei: Recent Developments*; and 30.01.2003 J. V. Narlikar on *Facts and Speculations in Cosmology.*

National Science Day Celebrations at IUCAA 2003

The Science Day celebrations at IUCAA, in addition to the regular programmes of competitions for the school students and open day for public, IUCAA also organized a special series of lectures during February 24 - 27, 2003, in different colleges in Pune as indicated below:

The Story of Gravity - Sanjeev Dhurandhar [Garware College], February 24.

Ganitachi Vividha Rangi Rupe - J. V. Narlikar [Modern College], February 25.

Relativity for Every One - N. K. Dadhich [Fergusson College], February 26

Akashganga : Our Galaxy - R. Srianand [Fergusson College], February 26.

History of Time Keeping - H. K. Jassal [S. N. D. T.], February 26.

Cosmic Saga in the Cosmic Background Radiation - Tarun Souradeep [Fergusson College], February 27.

Programme for the School Students:

The programme for the school students consisted of quiz, essay and drawing competitions and lecture demonstrations. Five students each from 80 schools were invited to participate in the various competitions. This programme, conducted on February 28, began with Jayant Narlikar giving a brief introduction on the importance of celebrating the National Science Day. He also reminded the students that the 28th of February was being celebrated as National Science Day all over India because, on this day, in the year 1928, the "Raman Effect" was discovered, for which Professor C. V. Raman was subsequently awarded the Physics Nobel Prize.

Essay and Drawing competitions along with Quiz elimination round were held from 9:30 a.m. to 10:30 a.m. During this period, the teachers accompanying the students took a science quiz, prepared by T. Padmanabhan. This quiz had questions of varying degrees of difficulty. The best entry was from Sujata A. Deshpande of Abhinav Vidyalaya English Medium School.

Jayant Narlikar gave a lecture in English and Marathi on "Playing with Mathematics" covering some mathematical games.

After the lunch break, final quiz competition was conducted to the top 5 teams selected after the elimination round. This competition was held on stage in front of an audience. The programme ended with Jayant Narlikar giving away the prizes to the winners in all the events. [The names of winners of various events are given on page 9].

Sky show :

On the same evening, a public sky show was organized. About 1000 people visited the science park, which was the venue of the sky show, to look through telescopes. Six telescopes made by amateur astronomers were used for showing Jupiter and Saturn. Images of these planets were projected on a big screen for which a web cam was attached to IUCAA's 14 inch telescope.

The Open Day:

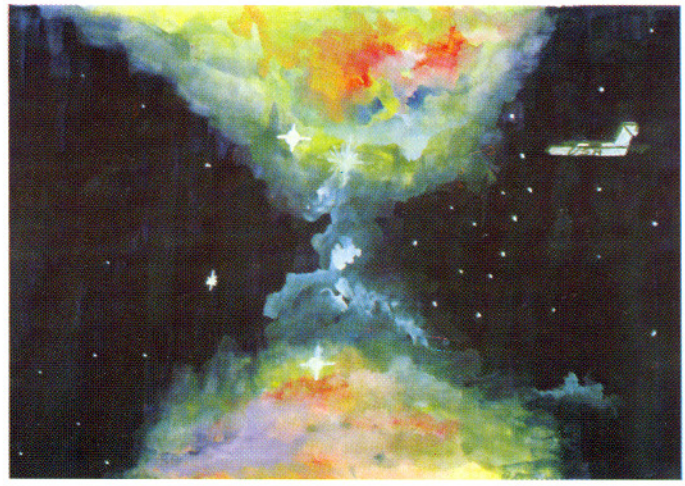
IUCAA's gates were thrown open to the public on Sunday, March 1 at 1:30 p.m. In the lobby between Bhaskara 2 and 3, Amit Dhurandhar, Aniruddha Kembhavi, Krishanu Saha and Puneet Shenoy (students of engineering college) demonstrated the Maze Solving Robot, that they built (which won a prize in the Techfest organized by Indian Institute of Technology, Mumbai).

Video films on astronomy and physics were screened in Bhaskara 3 lecture hall and thirty minutes talks were given to the general audience in Chandrasekhar auditorium. Joydeep Bagchi talked on "Cosmic Rays: The Mystery of Most Energetic Particles in the Universe", A. N. Ramaprakash on "Jets and Superluminal Motion" and Harivindar Kaur Jassal gave a talk on "History of Time" in Hindi.

Madhav Khare, an amateur aeromodeler gave two talks and demonstrations on aeromodeling.

In the Science Park, teachers and students of the Range Hill School performed a typical folk dance-drama (Gondhal) entitled Khagol Vidnanacha Gondhal.

The Science Day celebrations ended with a public talk by T. Padmanabhan on "Nobel Prize in Physics 2002", that was well attended by the public.



The First Prize-winning Drawing in the Competition

Highlights of the Science Day and Open Day at IUCAA

1 Reception committee

2 Lost in the maze.

3 Lighter side of "Science Day"

4 But the robot solves it.

5 Members of "Weight watcher's association" about to check their weight on the Moon.

6 The winners with their teachers and Director.

Resource Summary - 23: Interstellar Dust and Extinction

Ranjan Gupta and Deepak Vaidya

Evidence of Matter Between Stars

A view of the sky on a clear night reveals dark regions in the Milky Way. Photographs of rich star fields show dark patches in the regions where the light from stars is heavily extinguished. Figure 1 shows a photograph of the Milky Way in Saggitarius, in which the dark patches are clearly seen. Sir William Herschel in 1789, in his visual survey of stars had noted these patches as 'holes' in the sky. However, not until the early 20th century, astronomers discovered that the holes or the dark patches in the sky were actually the huge clouds of dust that obscure the light of the stars behind them. This obscuring or dimming process is called interstellar extinction. Evidence that, these dark patches are in fact produced by dust is obtained from the spectra of stars within or behind the clouds. The absorption and/or scattering of light by solid particles does not show the narrow absorption features characteristics of free atoms and molecules. On the other hand, the effect of weakening or extinguishing of light by a dust grain is found to be varying smoothly with the wavelength. A major effort was then initiated to characterize the wavelength dependent interstellar extinction, so that astronomical observations can be corrected for the obscuring effects of dust. The obscuration was found to be greater at shorter blue wavelengths, as a result, the light reaching us from distant obscured stars is 'reddened'. A similar reddening effect occurs in the earth's atmosphere as the Sun rises and sets; the reddening effect is most prominent in the evening when sunlight has to travel a long distance through the atmosphere and the setting Sun appears red. It was also found that in the visible, the extinction varies with wavelength λ, approximately as λ^{-1} and this immediately identifies the obscuring material as small solid particles, having dimensions approximately of the optical wavelength.

The identification of the extinction with small interstellar dust grains was accepted in the 1930s through the works of Trumpler and Stebbins, Huffer and Whitford. Extinction refers to the sum of absorption and scattering and is generally determined by comparing observations of reddened and unreddened stars assumed to have identical intrinsic energy distributions. See for example, Figure 2, which shows how two stars having same spectral types, but one undergoing high extinction and other with almost no extinction .

Observed Interstellar Extinction and Dust Properties

The extinction of starlight has been measured from the long infrared to the short ultraviolet wavelengths. The observed interstellar extinction curve takes the same general form in many lines of sight; though there are regional variations particularly in blue and ultraviolet regions of the spectrum. The interstellar extinction curve is a plot of $E(\lambda - V)/E(B - V)$ versus λ^{-1}; where $B(\lambda = 0.44\mu m)$ and $V(\lambda = 0.55\mu m)$ are reference wavelengths. The curve is almost linear in the visible from 1 to $2\mu m^{-1}$ with a change in the slope near $2.2\mu m^{-1}$. The most prominent characteristic of the observed extinction is a broad peak in the mid ultraviolet centered at $4.6\mu m^{-1}$, i.e. at '2175 Å '. The curve goes to minimum around $6\mu m^{-1}$ before a steep rise into the far ultraviolet ($\lambda^{-1} \sim 6\mu m^{-1}$). An important parameter characterizing the interstellar extinction is the ratio '$R_v = A_v/E(B - V)$ ' of the optical total to selective extinction. R_v can be determined by extrapolating the near infrared (NIR) extinction to infinite wavelength. The 'mean' extinction law of Savage and Mathis (1979) gives $R_v = 3.1$ and it is commonly used to correct observations for the presence of dust. However, there are regions in the sky where R_v is higher, $4 < R_v < 6$, e.g., Ophiuchus or Taurus molecular clouds. There are strong infrared extinction features peaking at $9.7\mu m$ and $18.0\mu m$, which are almost certainly due to amorphous silicates. Besides these strong features, there are many weak diffuse features, known as 'diffuse interstellar bands' or DIBs. Approximately 300 such features have been identified, the strongest DIB is at 4430 Å . It is also found that most stars show linear polarization and it is well correlated with the extinction, i.e., the amount of polarization is greatest for stars which are the most reddened. The interstellar grains can produce polarizations only if they

are non spherical. The grains must also be aligned; the alignment is probably caused by an interstellar magnetic field.

The interaction between dust and the interstellar radiation field also produces the diffuse galactic emission in the IR. This is due to the absorption of starlight by grains that is transferred to thermal energy and re-radiated by the grains. The full extent of this thermal radiation output of the Galaxy became available only after the IRAS (Infrared Astronomical Satellite) observations in 1984. Later, the FIR results have been obtained by the Far-Infrared Absolute Spectrometer (FIRAS) and the Diffuse Background Experiment (DIRBE) of the COBE (Cosmic Background Explorer) in 1994. The IRAS discovered the cirrus clouds in the passbands at $60\mu m$ and $100\mu m$ and this emission turned out to be a widespread component of the interstellar matter accounting for a dominant fraction of the diffuse IR emission of the Galaxy.

Grain Models

The problem of evaluating the expected wavelength dependence of extinction for a given grain model of dust is essentially that of evaluating the extinction efficiency factor Q_{ext}, which is defined as the ratio of the extinction cross section $C_{ext}(\lambda)$ to the geometrical cross section C_g ($= \pi a^2$) for a spherical grain of radius 'a'. The extinction efficiency is a function of two quantities, (i) a dimensionless size parameter $X = 2\pi a/\lambda$, and (ii) a composition parameter, i.e., the complex refractive index of the grain material, $m = n - ik$. Q_{ext} may in principle be calculated for any assumed grain model and compared with the observational data. However, the problem is to solve Maxwell's equations for electromagnetic waves for appropriate boundary conditions at the grain surface. Exact solutions for Maxwell's equations are available only for a few cases; viz. homogeneous spheres, cylinders and spheroids. Figure 3 shows plots of Q_{ext} versus X for spheres with refractive index $1.7 - 0.0i$ and $1.33 - 0.0i$. For a constant grain radius 'a', these plots are equivalent to extinction curves expressed as $A(\lambda)$ versus (λ^{-1}). Figure 4 is same as Figure 3 except that the refractive indices are absorbing: $m = 1.7 - 0.1i$ and $1.33 - 0.1i$. These refractive indices correspond to silicates and ices. The nature of the grains responsible for the observed extinction is investigated using the model calculations for candidate materials with known optical properties (e.g., silicates, graphite, ices) and an assumed grain size distribution. The results are then compared with the observations. In principle, the observed visible-infrared extinction curve, i.e., $0.5 - 2.5\mu m^{-1}$, may be explained by a single material with optical properties and grain sizes comparable to the wavelength of visible light. However, the observed extinction in the UV and the far UV region requires multicomponent models. A three-component model suggested by Greenberg (1978) consists of (i) 'large' about 0.2μ grains which contribute to the visible-infrared extinction (ii) 'small' grains (about 0.005μ) of carbonaceous material like graphite, to explain '2175' feature and (iii) still very small grains, (0.002μ in size) to account for the far UV extinction. Using silicate and graphite grains with a power law size distribution and the grain size range of $0.005\mu - 0.250\mu$, Mathis et.al. 1977 (MRN model) obtained excellent fit to the observed average extinction curve. In addition to reproducing the observed extinction curve, a grain model must be consistent with the abundance constraints. The MRN model fails to meet the abundance constraints. i.e., it requires about 300 carbon atoms (normalized to 10^6 H atoms), in the form of graphite, to fit the observed extinction, compared to about 100 atoms available in the dust phase of the interstellar medium. Similarly, all other models with solid grains fail to meet the abundance requirements. Hence, models with porous, fluffy and composite grains have been proposed (see e.g., Mathis 1996). Since there is no exact theory to treat the scattering and absorption of light by irregular and inhomogeneous particles (i.e., porous, fluffy composite) approximate methods are required. Currently, two methods, viz. effective medium approximation (EMA) (e.g., Mathis 1996) and Discrete Dipole Approximation (DDA) (e.g., Draine 1988, Wolff et.al. 1994) are used to calculate extinction efficiencies for porous and composite particles.

Since spherical grains cannot explain the observed polarization that accompanies interstellar extinction, the models are required to incorporate non-spherical (e.g., cylindrical, spheroidal, etc.) grains.

In Figure 5, we show the interstellar extinction

curve evaluated using the spheroidal porous silicate and graphite grains. The model curve is also compared with the observed interstellar extinction curve (Savage and Mathis 1979). Interstellar grains are also suggested to be composites or aggregates of small particles glued together. Recently, the composite grain model (Figure 6) consisting of a host spheroid with inclusions is used to ease the abundance constraints (see e.g., Mathis 1996, Vaidya etal 2001).

Figure 1: Photograph of the Milky Way in Saggitarius

In this article, we have provided information on the observed properties of the interstellar dust and have discussed dust grain models which explain the observed extinction. MRN model, with silicate and graphite as constituent materials and the grain sizes in the range 0.005μ - 0.300μ, is the most successful so far in reproducing the essential features of the extinction curve over the entire spectral range available. However, the MRN model is not consistent with the abundance constraints. Composite grain models with silicates, carbonaceous material like graphite, polycyclic aromatic hydrocarbons (PAHs) as constituent materials, may explain all the observed extinction features as well as be consistent

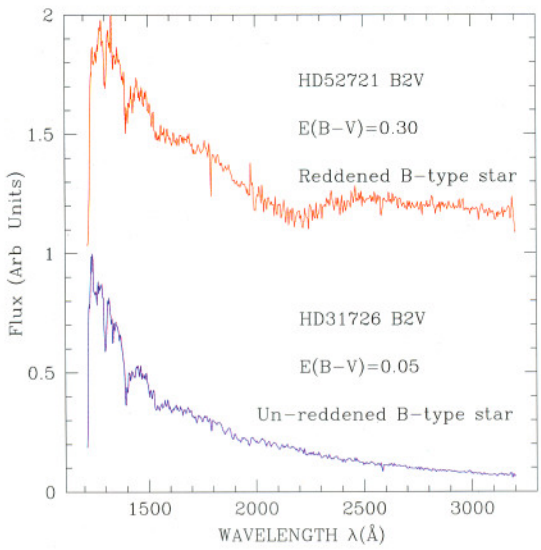


Figure 2: Reddened and unreddened spectra in UV from IUE

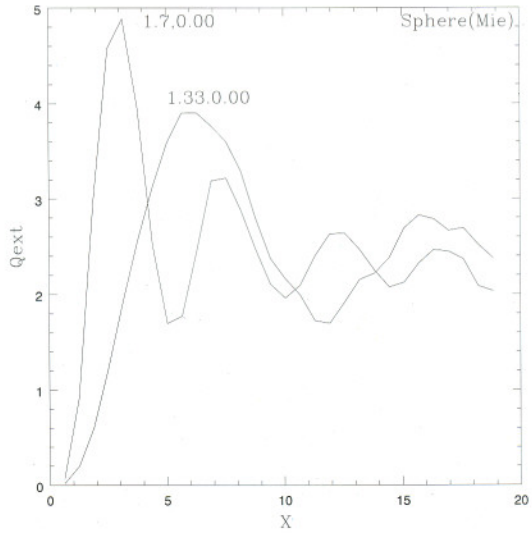


Figure 3: Extinction curves for spherical non-absorbing grains using Mie Theory.

with the abundance constraints.

References

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Bohren and Huffman, 1998, Absorption and Scattering of Light by Small Particles, J. Wiley, USA.
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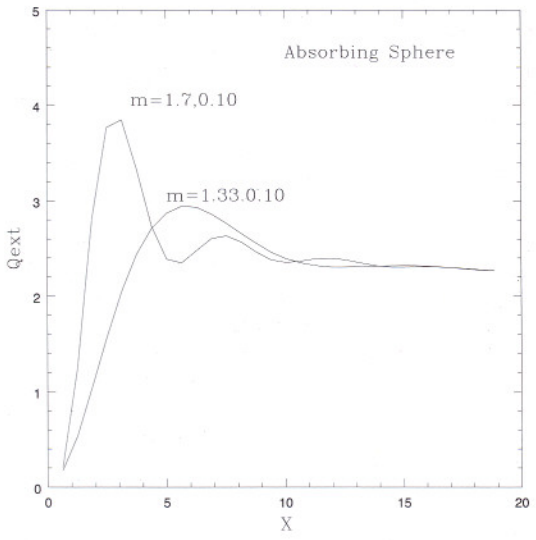

Figure 4: Extinction curves for spherical absorbing grains using Mie Theory.

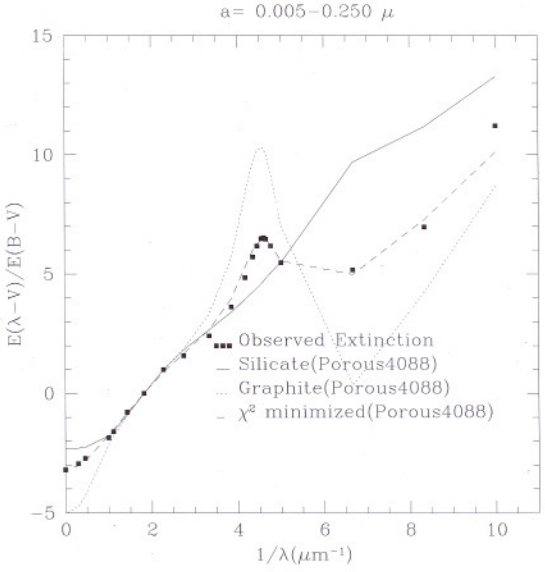

Figure 5: The observed interstellar extinction curve is shown with square dots. Also shown is the χ^2 minimized curve of best fit with a combined model of silicate and graphite porous grain models (Vaidya and Gupta, 1999).

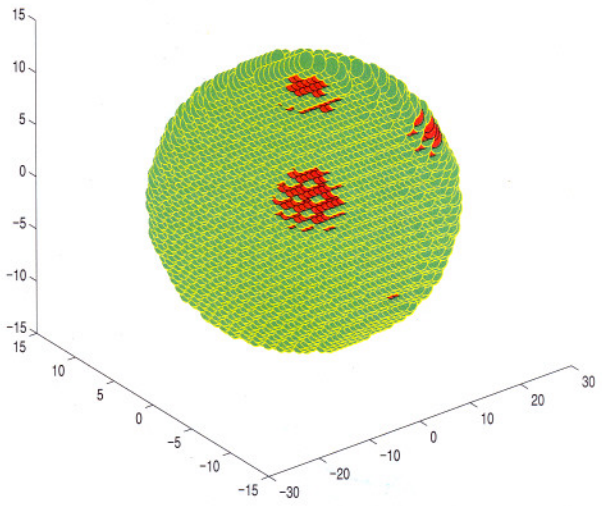

Figure 6: A typical Non-spherical Composite grain with number of dipoles N=14440. The inclusions are embedded in the host spheroid such that only the ones placed at outer periphery are seen.

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IUCAA Science Day Competitions - Prize Winners

Drawing Competition

1st Prize
Abhishek K. Patil [Balshikshan Mandir]

2nd Prize
Sayalee B. Chaudhary [Renuka Swaroop High School]

3rd Prize
Pooja Suresh Laygude [Narayan Rao Sanas Vidyalaya]

Essay Competition (Marathi)

1st Prize
Milind Shethe [Saraswati Madyamik Vidyalaya]

2nd Prize
Bhagyashree Thakur [Mahilashram High School]

Honorable Mention

Sayalee Subhash Jagtap [Renuka Swaroop High School]
Sarang Bawiskar [M. S. S. High School]
Minakshi Vaishampayan [Ahilyadevi High School]
Smita Ramchandra Pol [Narayanrao Sanas Vidyalaya]

Essay Competition (English)

1st Prize
No prize was awarded

2nd Prize
Omkar Sathe [S.P.M. English School]

Honorable Mention

Tanvee Sharad Shevade [Symbiosis Secondary School]
Abhisek Dang [Jnana Prabodhini Navanagar, Nigdi]
Shristi Shridhar [Army Public School]

Quiz Competition

1st Prize

Dr. Kalmadi Shamrao High School
Aditya Kanitkar
Omkar Wagh
Aditya Chandorkar

2nd Prize

D. E. S. Secondary School
Sarang Kulkarni
Pushkar Pandit
Akshya Navgire

3rd Prize

Bhartiya Vidya Bhavan Sulochana Natu Vidya Mandir
Aneesh Hemant Gokhale
Nakul Nitin Gote
Siddharth Laxmidhar Pati

The Rolling Trophy was not awarded to any school this year.

Public Lectures

IUCAA has started a new activity of Popular Lectures for general public, on topics related to astronomy and astrophysics. Though there is no fixed periodicity for these lectures, it is proposed to organize, on an average, one lecture every month.

October 25, 2002 *Searches for Extraterrestrial Life,* J. V. Narlikar, [IUCAA]

November 12, 2002 *Astronomy and Society,* W. C. Saslaw, [Institute of Astronomy, Cambridge, UK]

December 27, 2002 *When the Universe was Young*, Mark Whittle, [University of Virginia, USA]

January 14, 2003 *The Story of Our Calendar,* T. Padmanabhan, [IUCAA]

March 28, 2003 *(W)MAP - ing the Universe,* Kandaswamy Subramanian, [IUCAA]

Seminars

07.01.2003 David John Vikas Rosario on *The Interaction between Radio Jets and the ISM in Seyfert Galaxies*; 08.01.2003 Jogesh Babu on *Statistical and Computational Challenges for the Virtual Obsevatory*; 09.01.2003 J. Maharana on *Symmetries of Axion-Dilaton String Cosmology*; 10.01.2003 Gargi Shaw on *Molecular Hydrogen in Photo-Dissociation Region*; 16.01.2003 Bruno Guiderdoni on *Modelling Hierarchical Galaxy Formation with the Hybrid Approach: The GalICS Project*; 23.01.2003 Hasi Ray on *Positron and Positronium Physics*; and 20.03.2003 A. N. Ramaprakash on *Cambridge Infrared Panoramic Survey Spectrograph.*

Workshop on Cosmology and the High Redshift Universe

Participants of the Workshop on Cosmoslogy and the High redshift Universe ↑↓

As a part of the scientific collaborative programme between IUCAA and Institute for Astronomy (IFA) Hawaii, a four day workshop on "Cosmology and High Redshift Universe" was held during February 8-11, 2002. This collaborative programme was funded by Watumull Foundation, Honolulu, Hawaii. There were about 40 participants from all over India attending the workshop. The speakers included Brent Tully, Bob Joseph, Harald Ebelling and Iztvan Szapudi (IFA), J. Bagchi, A.K. Kembhavi, J.V. Narlikar, T. Padmanabhan, Tarun Souradeep, R. Srinand, Tirthankar Roy Choudhury, Jatush Sheth and R.G. Vishwakarma (IUCAA), J. Chengalur (NCRA) and U.C. Joshi (PRL). A wide range of topics in modern day cosmology were covered. The coordinators of the workshop were Ajit Kembhavi and R. Srianand from IUCAA.

IUCAA Preprints

D.V. Ahluwalia, M. Kirchbach and N. Dadhich, *Operational indistinguishability of doubly special relativities from special relativity*, IUCAA-1/2003; Anand S. Sengupta and Sanjeev Dhurandhar, *A faster implementation of the hierarchical search algorithm for detection of gravitational waves from inspiraling comapact binaries*, IUCAA-2/2003; Kumud Pandey, Udit Narain and N.K. Lohani, *On Tripolar magnetic reconnection and coronal heating*, IUCAA-3/2003; Saibal Ray and Sumana Bhadra, *Classical electron model with negative energy density in Einstein-Cartan theory of gravitation*, IUCAA-4/2003; Saibal Ray and Sumana Bhadra, *Energy density in general relativity: a possible role of cosmological constant*, IUCAA-5/2003; Banibrata Mukhopadhyay, Subharthi Ray, Jishnu Dey and Mira Dey, *Origin and interpretation of kilohertz QPOS from strange stars in X-ray binary system: Theoretical hydrodynamical description*, IUCAA-6/2003; M. Sami and T. Padmanabhan, *A viable cosmology with a scalar field coupled to the trace of the stress-tensor*, IUCAA-7/2003; T. Padmanabhan and T. Roy Choudhury, *A theoretician's analysis of the supernova data and the limitations in determining the nature of dark energy*, IUCAA-8/2003; M. Sami, *Cosmological aspects of rolling tachyon*, IUCAA-9/2003; M. Sami, *A note on the cosmological dynamics in finite-range gravity*, IUCAA-10/2003; Amir Hajian and Tarun Souradeep, *Statistical isotropy of CMB and cosmic topology*, IUCAA-11/2003; Pia Mukherjee, Kim Coble, Mark Dragovan, Ken Ganga, John Kovac, Bharat Ratra and Tarun Souradeep, *Galactic foreground constraints from the Python V cosmic microwave background anisotropy data*, IUCAA-12/2003; Parampreet Singh and Banibrata Mukhopadhyay, *Gravitationally induced neutrino asymmetry*, IUCAA-13/2003; Banibrata Mukhopadhyay and Shubhrangshu Ghosh, *Global solution of viscous accretion disk around rotating compact objects: A psudo-general-relativistic study*, IUCAA-14/2003; Naresh Dadhich and Yuri Shtanov, *Brane corresponding to the Nariai bulk*, IUCAA-15/2003; Banibrata Mukhopadhyay, *Unification to the pseudo-general-relativisitc analysis of accretion disks around rotating black holes and neutron stars*, IUCAA-16/2003; Cedric Ledoux, Patrick Petitjean and R. Srianand, *The VLT-UVES survey of molecular hydrogen in high-redshift damped Lyman-α systems*, IUCAA-17/2003; and R. G. Vishwakarma and Parampreet Singh, *Can brane cosmology with a vanishing Λ explain the observations?*, IUCAA-18/2003.

Software Helpdesk
Science College, Nagpur

A software helpdesk has been set up by IUCAA at Science College, Congress Nagar, Nagpur. The Coordinator of this helpdesk is Sushant Ghosh of the Mathematics Department of the College, who is a Visiting Associate of IUCAA.The aim of the helpdesk is to provide important softwares, available free of charge in the public domain, to faculty and students from universities, colleges and other organizations, who wish to make use of the softwares in their academic work.

Softwares for Linux and Windows platforms will be available with the helpdesk, which will aim to maintain the latest versions, and to regularly update the collection. The type-setting softwares LaTeX, PDF/PS viewer, Acroread/ Ghostview, Graphics softwares like PG-PLOT, GNU-PLOT and SM-PLOT, softwares for Mathematical and Numerical computations, a large collection of softwares for Astronomy and many other useful softwares are available.

Persons needing the softwares can send email to S. G. Ghosh at sgghosh@iucaa.ernet.in or sgghosh@yahoo.com, giving details of their requirements and the platform available to them. The softwares will be sent to them on a CD, along with instructions for installation, if these are not included as part of the software package. Ghosh will also make an effort to provide support to clear difficulties, which may arise in the installation or in use of the softwares.

While the public domain softwares will be provided free of charge, it is necessary to levy a charge to cover the cost of the CD, postage and other overheads. For this purpose, users of the facility are requested to send to S.G. Ghosh Rs. 50/- (if the amount is sent by money order) or Rs.70/- (if the amount is sent by cheque). The cheque should be crossed and made in favour of "Inter-University Centre for Astronomy and Astrophysics, Pune" and sent to S. G. Ghosh, Department of Mathematics, Science College, Congress Nagar, Nagpur, 440 012, Maharashtra. He will acknowledge the receipt of the amount, and an official receipt will be sent in due course. Users are requested to correspond with Ghosh regarding the availability of the softwares that they need before sending the money.

This helpdesk is being set up on an experimental basis, and the facilities provided at it will be improved after receiving responses from the users, and they are requested to send suggestions and comments to Ghosh, with a copy to Anjali Chordia at IUCAA (anjali@iucaa.ernet.in). Requests for the softwares should be sent only to S.G. Ghosh.

Visitors Expected

April: Sujan Sengupta, IIA, Bangalore; Kunwar Singh, BHU; Abhishek Srivastava, BHU; Farooq Rehman, Jadavpur Univ.; G. Ambika, Maharaja's College Kochi; Suresh Chandra, SRTM Univ., Nanded; P. Iyamperumal, Tamilnadu Science and Technology Centre, Chennai; S. Soundrarajaperumal, Tamilnadu Science and Technology Centre, Chennai; K. Shanti, Academic Staff College, University of Bombay *and* S.G. Ghosh, SSES Amti's Science College, Nagpur.

May: S.P. Bhatnagar, Bhavnagar Univ.; A. Pradhan, Hindu P.G. College, Ghazipur; Sanjay Pandey, L.B.S.P.G. College, U.P.; R. Ramakrishna Reddy, SK Univ.; P.K. Suresh, Univ. of Hyderabad; Asoke Sen, Assam Univ.; Sarbeswar Chaudhuri, Gushkara Mahavidyalaya; G.P. Singh, VR College of Engg., Nagpur; T. Seshadri, Univ. of Delhi; Harikrishan K.P., The Cochin College, Kochi; A.K. Mittal, Univ. Of Delhi; D. Lohia, Univ. of Delhi; R.S. Kaushal, Univ. of Delhi; Usmani, Aligarh Muslim Univ; Axel Brandenburg, NORDITA, Denmark; K.D. Patil, BD College of Engg., Sevagram; Subenoy Chakrabarty, Jadavpur Univ.; S.N. Hasan, Osmania Univ. Hyderabad; A.C. Kumbharkhane, SRTM Univ, Nanded; *and* Suresh Chandra, SRTM Univ., Nanded.

There will be about 40 college and university teachers and students participating in the Refresher Course and the Vacation Students' Programme.

IUCAA Reference Centre (IRC)

IUCAA has four reference centres operational in: (i) Cochin University of Science and Technology, Kochi,
(ii) University of Delhi, (iii) North Bengal University, Darjeeling and (iv) Pt. Ravishankar Shukla University, Raipur.

The term of these four IRCs has been extended to June 30, 2004. It has been decided that two more IRCs will be set up, one at D.D.U. Gorakhpur University and the other at Jadavpur University, Kolkata. The new IRCs are expected to be functional early in the next academic year. Further information about the IRCs is available on the IUCAA web site.

For the Younger Minds - 4

T. Padmanabhan

(1) We are often told that looking directly at the Sun can be harmful to the retina, because the image of the Sun formed on the retina can cause damage. How come stars do not cause similar damage? It is true that stars are much fainter than the Sun but the size of the image formed on the retina is also smaller. The intensity of the light drops as $1/r^2$, where r is the distance to the light source but so does the size of the image formed on the retina. This would mean that the intensity per unit area of the image remains the same whether you are looking at the Sun or the stars. How come we are not blinded by the stars?

Answers to the questions which appeared in Khagol - January 2003

(1) The earliest form of clocks were sun-dials, in which the movement of the shadow was used to measure time. When the first mechanical clocks were constructed, the direction of motion of the hands were taken to be the same as the direction of movement in the sun-dials. It is interesting that, what we now call "clockwise" has its origin in the fact that these developments took place in the northern hemisphere of the Earth.

(2) Let I be the rate of production of heat energy by the source inside the body. In the absence of the shield, this will be matched by the energy radiated away by the surface giving $I = \sigma A T^4$, where A is the surface area, σ is the Stefan's constant and T is the equilibrium temperature. When a thin protecting shield is kept around the body, the above equation applies to the shield and T will be the surface temperature of the *shield*. [We are ignoring the difference in the areas which needs to be taken into account in a more precise calculation]. But the shield will also emit radiation inwards and consequently the surface of the body now absorbs an amount of radiation equal to that radiated into the space. If the temperature of the surface of the body is T_1 then we clearly have $2I = \sigma A T_1^4$. Thus $T_1 = 2^{1/4} T$; the temperature goes up by the factor $2^{1/4}$ due to the shield.

Visitors during January to March 2003

Badri Krishnan, S.K. Pandey, A. Nigavekar, Ved Prakash, P. Prakash, Apoorva Patel, Monika Sinha, Manjiri Bagchi, P.S. Joarder, Ashok Raina, Nagendra Kumar, Himanshu Sikka, Jogesh Babu, K.P. Harikrishnan, J. Maharana, Jishnu Dey, Arun Mangalam, Gary Ferland, Gargi Shaw, Alexei Starobinsky, Michel Yann, Ninan Sajeeth Philip, R. Ramakrishna Reddy, A. Beesham, Bruno Guiderdoni, Rajendra Shelke, Manzoor A. Malik, Rabin Chhetri, Hasi Ray, V.C. Shetty, Maheswar G., S.M. Chitre, Jim Rose, H.P.Singh, N.C. Wickramasinghe, M. Wainright, P. Rajaratnam, C.D. Ravikumar, Tully B., Istuan Szapudi, Harald Ebeling, R.D. Joseph, N. Panchapakesan, N. Mukunda, U.C. Joshi, Moncy John, Daksh Lohiya, T.R. Seshadri, P. Khare, Bhim Prasad Sarmah, D.B. Vaidya, S.A. Shinde, P. Janardhan, R. Price, J. watts, K. Harland, Gholamhosseen Rastegarnasab, Hossein Bakhshi, Alain Omont, Shantanu Rastogi, Anil Kumar Lal, Amit Pathak, Francois Ochsenbein, Fernique Pierre and U.P. Singh.

Apart from these, about 45 participants attended the Workshop on Astronomy with Small Telescopes at IUCAA.

***Khagol* (the Celestial Sphere) is the quarterly bulletin of IUCAA. We welcome your responses at the following address:**

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