

**WELCOME**  
to the  
IUCAA Family

IUCAA is happy to announce the selection of the **sixth** batch of its Associates and Senior Associates, who are selected for a tenure of *three years*, beginning July 1, 1995.

### Associates

**G. Ambika**  
Maharaja's College, Cochin

**R.V. Saraykar**  
Nagpur University, Nagpur

**S. Sreedhar Rao**  
Osmania University, Hyderabad

**N. Banerjee**  
Jadavpur University, Calcutta

**A.K. Sharma**  
Shivaji University, Kolhapur

**G. Yellaiah**  
Kakatiya University, Warangal

**S. Chakraborty**  
Jadavpur University, Calcutta

**Harinder Pal Singh**  
Sri Venkateshwara College,  
New Delhi

### Senior Associates

**Pradip K. Bhuyan**  
Dibrugarh University,  
Dibrugarh

**V.H. Kulkarni**  
Bombay University, Bombay

**S.N. Paul**  
Serampore Girls' College,  
Hooghly

**B.K. Datta**  
Tripura University, Agartala

**B. Lokanadham**  
Osmania University, Hyderabad

**R.P. Saxena**  
Delhi University, Delhi

**D.P. Datta**  
NERIST, Nirjuli,  
Arunachal Pradesh\*

**G.P. Malik**  
Jawaharlal Nehru University,  
New Delhi

**D.B. Vaidya**  
Gujarat College, Ahmedabad\*

**A.K. Goyal**  
Hans Raj College, Delhi\*

**S.R. Prabhakaran Nayar,**  
Kerala University,  
Thiruvananthapuram\*

**P. Vivekananda Rao**  
Osmania University, Hyderabad

\*Appointments of these third batch of Associates and Senior Associates are extended for three years.

## Workshop on Effective Way of Teaching Science

A workshop on Effective Way of Teaching Science for the high school science teachers of Pune was conducted in two batches, each comprising 70 to 75 science teachers during May 2-5, 1995. Samar Bagchi from Calcutta agreed to take this responsibility, and his novel and simple experiments simply



enchanted all the participants. Portions of his demonstrations have been video-taped and descriptive cards for about 40 experiments are in the process of being made available to anyone (school science teacher) interested in them.

### *Parsecstones in Astronomy -11*

*J.V. Narlikar*

#### **Astronomical Spectroscopy**

The discovery of helium described in the previous parsecstone was a major step in a quiet but significant revolution that was taking place in astronomy in the nineteenth century, a revolution that was to lead to major advances in physics in the early years of the twentieth century. This astronomical revolution was in spectroscopy and some important developments in it were as follows.

1814-15 J. von Fraunhofer measured the relative positions of darkness in the solar spectrum.

1822 John Herschel discovered the bright spectra of volatilized metallic salts and suggested in the following year that such lines might be used to detect these elements.

1849 J. Foucault pointed out the exact correspondence between the bright and dark lines.

1850 George Stokes showed that atoms which emit bright emission lines when hot, absorb lines of the same wavelength when in cold vapour form. Thus, he explained that the dark Fraunhofer lines represent absorption by metallic vapours.

1860 The first spectroscopic examination of stars began.

1867 Angelo Secchi classified stars in four classes according to their spectra.

1900 Around this time E. Pickering introduced the Harvard spectral classes O, B, A, F, G, K, M, R, N,... that are now commonly used.



### 3rd Refresher Course in A & A for College and University Teachers

The third Refresher Course in Astronomy and Astrophysics for College and University Teachers was held at IUCAA during May 8 - 26, 1995. Thirty four participants joined the programme and there were about 50 lectures following a structured syllabus covering broadly the thrust areas of research in astronomy and astrophysics including the basics. Emphasis was also given for instrumentation and about half a dozen photometers were made by the participants. Due to cloudy skies, the observational programmes suffered. But on the whole, it was a successful venture.



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### Summer Programme for School Students

IUCAA's Summer Programme for the School Students was conducted for the third year during April 17 - May 26, 1995. About 120 students, from about 60 schools, have each done a week-long



project under the supervision of IUCAA's academic members, including the graduate students. Like the yesteryears, there was tremendous enthusiasm among the students, who were from the eighth to tenth standards, coming from both the English and Marathi medium schools. At least 25 telescopes were made by the students, apart from a large number of theoretical projects.



## Measuring Wavelength of Light

In the previous projects, we have discussed various measurements involving use of light from heavenly bodies. In this project, we consider the measurement of the wavelength of light - a fundamental property of light.

You would be aware that the wavelength of light is very small on the length scale which we experience with unaided senses. Therefore, in order to be able to measure the wavelength, some trick must be used to achieve a large multiplying factor (it would be clear from the following discussion). In a laboratory, interference / diffraction phenomena are used to estimate the wavelength. Whereas such experiments use special equipment, in this project we describe a simple implementation of diffraction for estimating the wavelength.

**Diffraction from a grating:** When a parallel beam of light falls on a grating (say, a set of parallel wires kept periodically, i.e., the separation of any two neighbouring wires is the same) placed normal to the light, the outgoing light not only travels along the original direction but it also gets bent (diffracted) in other directions given by,

$$\theta = k \lambda / D \quad \dots(1)$$

where  $\theta$  is the angle (in radians) between the original beam and the outgoing beam ( $\theta \ll 1$ ),  $D$  is the separation between two neighbouring wires of the grating,  $\lambda$  is the wavelength of the light, and  $k$  is an integer, here  $k = 0$  represents the direction of the original beam, and if +ve values of  $k$  represent left hand side then -ve values of the  $k$  would represent the right hand side, and any two neighbouring beams have an angular separation of  $\lambda / D$  radians. From the above equation one can see that a measurement of length  $D$  would lead to an estimate of length  $\lambda$ . The interesting point is that,  $D$  can be much larger than  $\lambda$ , because our eye, being an optical

instrument, can make an estimate of small angles, thus, the problem of measuring a small length has been transferred to the problem of measuring a small angle.

A thin nylon cloth with fine weaving would make a useful grating; although it has two crossed sets of threads, the diffraction effect remains the same in its basic essentials. If you stretch it, hold it at a distance of few cm. from the eye, and look at a far away lamp you would see multiple images of the lamp (Fig. 1). The central image is bright and appears to be in the same direction as the lamp, whereas the other images are fainter and are placed in a two dimensional array. The separation between any two rows of the images, in the vicinity of the central image, is given by Eq. (1). In order to use this equation, the separation between two neighbouring rows needs to be estimated. In case you are looking at an incandescent lamp, you could observe it from a distance of about 5 m. and judge the separation between the rows as a fraction of the length of the filament. Thus, if the length of the filament is  $l$ , the separation of the rows appears a fraction  $r$  of  $l$ , and if the distance to the filament is  $d$ , we can write the angle of separation between the neighbouring rows as,

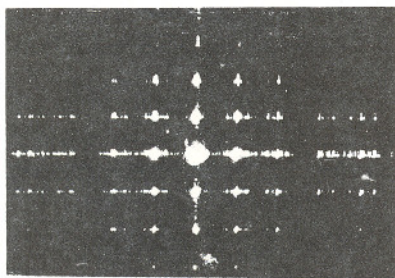
$$\theta_s = (l \times r) / d = \lambda / D \text{ radians}$$

$$\text{or } \lambda = D \cdot \theta_s \text{ cm; } D \text{ is in cm.}$$

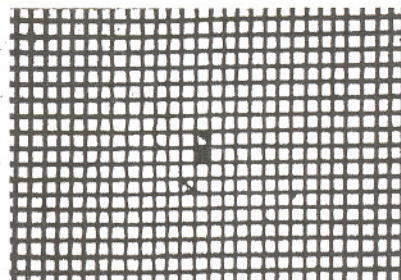
The spacing between the threads of the cloth,  $D$ , can be measured by counting the number of threads over a length of about 1cm.

In case you are looking at an incandescent lamp, the measurement corresponds to yellow-green light, because the human eye is most sensitive to these wavelengths. The measurement can be repeated with coloured glass filters kept on the cloth (grating) to estimate the wavelengths for other colours.





(a)



(b)

**Fig. 1.** The distribution of multiple images is shown (a) along with a sketch of the cloth (b). Notice the decrease in the brightness of the images away from the centre. The images are aligned on lines parallel to the threads of the cloth, and the extra blurred dots are due to the irregularities in the spacing of the threads. In case the source is a thin filament each of the images would have shape of the filament. (Reproduced from *Optical Physics*, by Lipson & Lipson, Cambridge University Press, Cambridge, 1981)

## Seminars

held during April - June 1995

4.4.95 **Soma Mukherjee** on *A Statistical Study of the Magnetic Field Decay in Single Radio Pulsars*, 26.4.95 **Sunu Engineer** on *Evolution of Spherical Density Perturbations*, 26.4.95 **Tarun Deep Saini** on *Charged Particle in Curved Spacetime*, 26.4.95 **K. Srinivasan** on *Some Observational Aspects of the Quasi-Steady State Model* and 26.4.95 **Yogesh Wadadekar** on *Interaction in Elliptical Galaxies*.

## Visit Abroad

**Jayant Narlikar** visited five countries from May 6 to June 8, 1995, starting with the Institute for Advanced Studies in Basic Sciences in Zanjan, Iran, and the Technical University of Sharif in Tehran. From there he went to Spain at the invitation of the BBV Foundation to deliver lectures in Madrid and the Canary Islands. The latter included the Instituto d Astrofísica d Canarias and the telescopes on La Palma.

After Spain, he attended the 80th Birthday celebrations for Fred Hoyle at the Institute of Astronomy, Cambridge followed by a visit to the Theoretical Astrophysics Center at Copenhagen, where he delivered a colloquium and explored avenues of collaboration between TAC and IUCAA. His last stop was at Bern, the Institute of Theoretical Physics, where he delivered a lecture.

## Colloquium

held at IUCAA...

24.4.95 **Palash Pal** on *Do Neutrinos have Mass?*

## IUCAA Preprints

Listed below are the IUCAA preprints released during April - June 1995. These can be obtained from the Librarian, IUCAA.

**K. Jotania, S.R. Valluri and S.V. Dhurandhar** *Study of the gravitational wave form from pulsars*, IUCAA-10/95; **B. Nath and C. Masashi** *Dwarf galaxies and the origin of intrastellar medium*, IUCAA-11/95; **B. Nath and C. Masashi** *Dwarf galaxies and the origin of intracluster medium*, IUCAA-12/95, **A.L. Melott, B.S. Sathyaprakash and V. Sahni** *Evolution of the potential cosmological gravitational clustering*, IUCAA-13/95; **V. Sahni and P. Coles** *Approximational methods for gravitational clustering*, IUCAA-14/95; **L. Sriramkumar** *Limits on the validity of the semiclassical theory*, IUCAA-15/95; **M. Seriu** *Spectral representation of the spacetime structure - the distance between universe with different topologies*, IUCAA-16/95; **L.K. Patel, N. Dadhich and A. Beesham** *String-dust distributions with the Kerr-NUT symmetry*, IUCAA-17/95 and **L.K. Patel and N. Dadhich** *Class of stationary rotating string cosmological models*, IUCAA-18/95.



Workshop on  
**Space Dynamics  
and Celestial Mechanics**

at B.R.A. Bihar University, Muzaffarpur  
(September 18 - 22, 1995)

A Workshop on Space Dynamics and Celestial Mechanics is scheduled to be conducted at the B.R.A. Bihar University, Muzaffarpur, during **September 18 - 22, 1995**, sponsored by IUCAA. Topics include celestial mechanics of three-bodies, a few bodies and N-bodies with due reference to non-linear dynamics, chaotic behaviour of certain satellites of Saturn, the formation and sustenance of the Oort Cloud system. Desirous college and university teachers and senior graduate students may apply to **Bhola Ishwar**, Department of Mathematics, B.R.A. Bihar University, Muzaffarpur, Bihar 842 001, with complete bio-data and the relevance of this workshop to their interest, *before July 31, 1995*.

**Pre Total Solar Eclipse  
Training Programme**  
at IUCAA

(September 25 - 28, 1995)

A Pre Total Solar Eclipse Training Programme is scheduled to be arranged at IUCAA during **September 25 - 28, 1995**. The training will include photography for designated programmes, handling the electronic network of photo-detectors for delineating the umbral boundaries, manual time keeping for events, weather recording, shadow band recording, etc. Mostly, experienced amateur astronomers, college and university students and teachers, and motivated high school teachers and students may apply to the **Coordinator, Core Programmes, IUCAA**, *before August 10, 1995*, giving their bio-data with expertise and background and indicating their choices.

Workshop on  
**Computer Image Processing**  
at Pt. Ravishankar Shukla University, Raipur  
(September 25-29, 1995)

A Workshop on Computer Image Processing is scheduled to be conducted at Pt. Ravishankar Shukla University, Raipur, during **September 25-29, 1995**, sponsored by IUCAA. Interested persons may write to **S.K. Pandey**, School of Studies in Physics, Pt. Ravishankar Shukla University, Raipur 492 010, Madhya Pradesh, with complete bio-data and the relevance of this workshop to their interest, *before August 5, 1995*.

Indo-US Workshop on  
**Galaxy Structure and  
Dynamics**

at IUCAA  
(November 23 - December  
7, 1995)

Indo-US Workshop on Galaxy Structure and Dynamics is scheduled to be held at IUCAA, from **November 23 to December 7, 1995**. A series of workshops have been approved under the Indo-US Exchange Programme in Astronomy and Astrophysics and funded by the Smithsonian Institution, USA. This will be the third workshop under the current programme. Six scientists from the USA and about forty scientists from various Indian Universities and Institutions are likely to participate in the workshop. The workshop will have lecture courses, seminars and discussions to make it informative and productive. The purpose of the workshop is to encourage research in emerging areas and to create atmosphere for closer interaction so that new collaborations between Indian and US scientists are developed. Interested persons may send their application along with the bio-data and the relevance of this workshop to their interest to the **Co-ordinator, Core Programmes, IUCAA**, to reach *before August 25, 1995*.

# IUCAA Academic Calendar August 1995 - July 1996

<b>1995</b>			<b>1996</b>		
<b>AUG</b>	<b>21</b>	<b>IUCAA-NCRA Graduate School</b> <i>First Semester begins</i>	<b>JAN</b>	<b>8-12</b>	<b>Workshop on</b> <b>Active Galactic Nuclei,</b> <b>Dense Stellar System &amp;</b> <b>Galactic Environments</b> <i>at IUCAA</i>
<b>SEP</b>	<b>18-22</b>	<b>Workshop on</b> <b>Space Dynamics and</b> <b>Celestial Mechanics</b> <i>at B.R.A. Bihar University,</i> <i>Muzaffarpur</i>		<b>15</b>	<b>IUCAA-NCRA Graduate School</b> <i>Second Semester begins</i>
	<b>25-28</b>	<b>Pre Total Solar Eclipse</b> <b>- Training Programme</b> <i>at IUCAA</i>		<b>*</b>	<b>Workshop on</b> <b>Numerical Simulations in</b> <b>Space and Astrophysical Plasmas</b> <i>at IUCAA</i>
	<b>25-29</b>	<b>Workshop on</b> <b>Computer Image Processing</b> <i>at Pt. Ravishankar Shukla</i> <i>University, Raipur</i>	<b>FEB</b>	<b>13-17</b>	<b>Post Total Solar Eclipse - Feed Back</b> <i>at IUCAA</i>
<b>NOV</b>	<b>Nov 23- Dec 7</b>	<b>Indo-US Workshop on</b> <b>Galaxy Structure and</b> <b>Dynamics</b> <i>at IUCAA</i>		<b>*</b>	<b>Workshop on</b> <b>Nuclear Astrophysics</b> <i>at Kalyani University, Kalyani</i>
<b>DEC</b>	<b>9-12</b>	<b>Workshop on</b> <b>Gravitational Waves</b> <i>at IUCAA</i>		<b>Feb 26 - Mar 1</b>	<b>Workshop on</b> <b>Instrumentation for Small</b> <b>Telescopes and Astronomy</b> <b>Programmes at University Level</b> <i>at Bhavnagar University, Bhavnagar</i>
	<b>13-19</b>	<b>International Conference on</b> <b>Gravitation and Cosmology</b> <b>(ICGC-95)</b> <i>at IUCAA</i>		<b>28</b>	<b>National Science Day</b>
	<b>20-24</b>	<b>Miniworkshop on</b> <b>Gravitational Collapse and</b> <b>Cosmic Censorship</b> <i>at IUCAA</i>	<b>MAR</b>	<b>*</b>	<b>Workshop on</b> <b>Inhomogeneous</b> <b>Cosmological Models</b> <i>at North Bengal University, Siliguri</i>
	<b>Dec 21 - Jan 4</b>	<b>School on</b> <b>Classical General Relativity</b> <i>at Physical Research Laboratory,</i> <i>Ahmedabad</i>	<b>APR</b>	<b>Apr - May end</b>	<b>School Students' Summer</b> <b>Programme</b> <i>at IUCAA</i>
	<b>29</b>	<b>IUCAA-NCRA Graduate School</b> <i>First Semester ends</i>	<b>MAY</b>	<b>*</b>	<b>Introductory Summer School</b> <b>on Astronomy and Astrophysics</b> <i>at IUCAA</i>
	<b>29</b>	<b>Foundation Day</b>		<b>17</b>	<b>IUCAA-NCRA Graduate School</b> <i>Second Semester ends</i>
			<b>JUN</b>	<b>Jun 3 - Jul 12</b>	<b>Vacation Students' Programme</b>
			<b>JUL</b>	<b>*</b>	<b>Selection of Research Scholars</b>

\* **Dates to be finalised.**



## Sino-Indian School on Astronomy

The first Sino-Indian school on Astronomy, organized jointly by IUCAA and the Purple Mountain Observatory (PMO), Nanjing, was held at the Nanjing Normal University during **April 9-21, 1995**. This school was the first in a series to be conducted alternately in China and India, and was funded jointly by the Department of Science and Technology, Government of India and the Chinese Academy of Sciences. The theme of the school was *High Energy Astrophysics*, and the main topics covered included *the evolution of massive stars, supernovae, pulsars and star bursts in galaxies*. There were 5 lecturers from India and 11 from China and 40 participants from various university departments and institutions from all over China. The main lecture courses consisted of 2 or 3 lectures each and there were a number of seminars delivered by senior researchers as well as graduate students. There was a great deal of discussion generated during and after the lectures, as well as in the evenings, and

it was heartening to see that many common astronomical interests exist between the two countries. From discussions at the school, as well as at the Chinese observatories that the Indian lecturers visited on their way home, it became abundantly clear that there was much scope for the establishment of collaborative programmes between the two countries. In a meeting held at the end of the school, the Scientific Organizing Committee proposed that the next school should be held at IUCAA towards the end of 1996, and that the theme of the school will be observations, in the optical and radio bands, of the phenomena covered in the school in Nanjing. The visit to China was very exciting, memorable and scientifically productive, and it is to be hoped that the collaborations between the two countries will be beneficial to astronomy. **A.K. Kembhavi** (IUCAA); **Hong-jun Su** and **Fu-xing Su** (Purple Mountain Observatory, China) were the coordinators of this school.

### Beware of the Laws of Motion!

The following real life incident from Bombay's suburban traffic (where anything can happen) illustrates the consequences of taking the Newtonian laws of motion too seriously.

A novice to Bombay's overcrowded traffic got into a train only to discover too late that it would not stop at his intended destination. A fellow passenger, more knowledgeable about the train system, however, advised him to stand near the door; for the train would surely slow down if not stop as the station approached and he could take a chance and get off the moving train. "Keep running for a while after you jump", the experienced one advised.

Our novice remembered the laws of motion and as the station approached and the train slowed down he jumped and kept running along with the train. However, the train slowed down further and he overtook a couple of compartments with the result that the passengers in the next compartment thought that he was trying to board a moving train. They gave him a 'helping' hand and pulled him up as the train gathered speed!

### Welcome...

to **Devendra Kumar Ojha**, who has joined as post-doctoral fellow. His research interests are in galactic structure, kinematics, dynamics, stellar populations and galaxies.

### and... Farewell

to **G.C. Anupama**, who has joined the Indian Institute of Astrophysics, Bangalore, **Stephen Lau**, who has joined the Institut für Theoretische Physik, Wien and **Masafumi Seriu**, who has joined the Yukawa Institute for Theoretical physics, Kyoto.

Also, to **Debiprosad Duari**, who has got his Ph.D. degree and **Kanti Jotania**, who has submitted the Ph.D. degree thesis.

### Visitors

April - June 1995

**April:** P.S. Naik, T.P. Prabhu, M.A. Ittyachen, Sukumaran Nair, S. Ramani, V.M. Nandakumaran, Ambika Nandakumaran, S.S. Aundhkar, M.L. Kurtadikar, A. Gopakumar, Palash B. Pal, Devendra Kumar Ojha, Sanjay M. Wagh and D.B. Vaidya.

**May:** R. Ramakrishna Reddy, Nazeer Ahammed, Utpal Mukopadhyay, Samar K Bagchi, A.C. Balachandra Swamy, S.G. Tagare, K.S.V.S. Narasimhan, R.K. Varma, Asim K Ray, J.J. Rawal, S.H. Behere, M.K. Das, H.P. Singh, P.C. Vinodkumar, Pankaj Joshi, K.S. Sastry, S. Mukherjee, L.M. Saha, Asit Banerjee, Gopi Garge, L. Radhakrishna, G.K. Johri and S. Banerji.

**June:** Ashok Goyal, Ramesh Tikekar, M.R. Balakrishnan, D.P. Datta, Bhola Ishwar, Sukanto Dutta, S.M. Alladin, Anirudh Pradhan, A. Maheswari and M.N. Anandaram.

### Visitors

Expected

**July:** S. Chakraborty, Jadavpur University; T. Subba Rao, S.V. University; S. Shandarin, University of Kansas; Kalyan Ram, Mehta Research Institute; Marc Van Loo, Singapore University; B. Kagali, Bangalore University, S. Chandra, Gorakhpur University.

**September:** Andrej Krolak, Witold Kondracki, both from Polish Academy of Sciences.

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

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