

### NARAYAN CHANDRA RANA

On August 22, 1996, IUCAA suffered a grievous loss when Narayan Chandra Rana, who was a core faculty member, passed away at the young age of 42. He had been surviving on a pacemaker for over a decade and a half, but in the end such mechanical aids proved inadequate to cope with the vagaries of a progressively weakening and erratic heart.

Perhaps "surviving" is not the right word to describe the dynamic personality of Rana. His small stature and outwardly sedate demeanour hid a highly motivated and restless human being. I discovered this, right from the times when Rana joined me as a Ph.D. student more than sixteen years ago, when we were both at the Tata Institute of Fundamental Research (TIFR), Bombay.

Because of these qualities, the boy from a rustic background in the Midnapur district of West Bengal, became a high achiever at school, had an illustrious career at the Presidency College, Calcutta and came through the stringent selection test for a research scholar at the TIFR with flying colours. Even there, he was the first recipient of the Geeta Udgaonkar Award for the best Ph.D. thesis and later became the INSA Young Scientist Medallist. His research interests covered interstellar grains, primordial nucleosynthesis, and later, the chemical evolution of galaxies and aspects of celestial mechanics.

Rana joined the IUCAA in 1991 and it was here that his many interests began to flower. Put in charge of IUCAA's science popularisation programmes, he took these responsibilities very seriously. His coordination of the National Science Day at IUCAA was very imaginative and would be hard to emulate. He mixed with school children freely and enthused them to participate in the quiz and the various competitions on that day. Likewise, he took up the lion's share of organizing the school students' summer programme and the second-Saturday lecture demonstrations in the Chandrasekhar Auditorium.

He developed rapport with amateur astronomers all over the country and was primarily responsible for catalysing the creation of the Confederation of Indian Amateur Astronomers.

His conduct of workshops for making sky-globes, telescopes and even collapsible planetaria drew enthusiastic response. His marathon effort to mobilise an army of amateurs to take part in his experiment of measuring the width of the shadow region at the time of the Total Solar Eclipse of October 24, 1995, in order to determine the solar photospheric radius, will be well remembered by the many who participated in the venture or watched it from the sidelines.

But it was as a teacher that Rana excelled in his interaction with the students, in motivating them, in firing their imagination. His bachelor household would always be like a "Gurukul" with visiting or residing disciples. Asked to lecture on a topic, Rana would soon work himself up into the excited state of an ayatollah, far exceeding the allotted time. Inevitably, he would be exhausted afterwards, but this did not stop him from repeating the exercise again and again.



Inevitably also, Rana's strong personality led to conflicts with colleagues and others who were uncomfortable with his exuberant modus operandi. As his heart became weaker, his medical advisers also tried to put brakes on his activities; but to no avail.

Rana will be surely missed at IUCAA but will be fondly remembered for all his contributions. That his impact went well beyond the sphere of IUCAA activities became evident from the fact that we have been inundated by letters from scientists, students, amateur astronomers and laypersons as well as institutions and organizations condoling his untimely demise. **It is not possible for us at IUCAA to individually acknowledge all the messages of sympathy and tributes received here: we do record our appreciation to all the senders for sharing their grief with us. We are forwarding the condolence messages to Rana's mother Smt. Nakfuri Rana and his brother Mr. Sujan K. Rana at their native village Sauri.**

Jayant Narlikar

## Classification of Stars

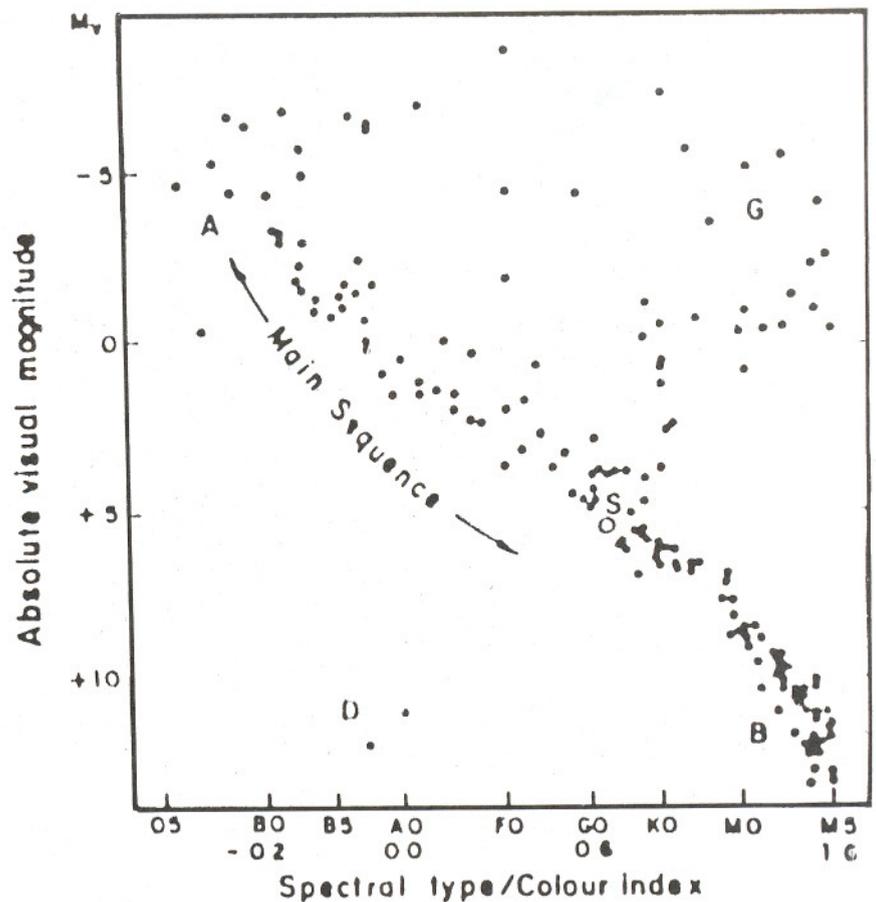
While the early decades of the twentieth century saw a dramatic rise in man's perception of the large scale structure of the universe, the steady but sure rise in his understanding of the physics of stars was no less important.

An important step was taken in this direction when two astronomers independently thought of plotting the stars on a graph, whose horizontal axis denoted their surface colours, ranging from blue to red, while the vertical axis denoted their luminosities. Such a diagram was first introduced by E. Hertzsprung in 1911 followed by H.N. Russell in 1913. Commonly known as the Hertzsprung Russell Diagram or simply the H-R Diagram, this graph plays a key role in the classification of stars and hence in the understanding of their internal structure and evolution.

The discovery of the black body radiation, and its quantum mechanical explanation by Max Planck at the turn of the century had set the relationship between colour of radiation, its wavelength and its temperature. A key astrophysical input to the problem of stellar structure came from the work of Meghnad Saha around 1919 when he showed how the state of ionisation of the atoms in stellar atmospheres is related to the ambient temperature in a thermodynamic equilibrium. Known as *Saha's Ionisation Equation*, this work provided the theoretical input towards determining the surface temperature of a star from its spectroscopy.

Thus, it followed that a blue star would have a higher surface temperature than a red star and hence in the H-R diagram it would lie to the left end whereas the red stars would lie to the right. Likewise the more luminous stars would lie in the upper part of the diagram compared to the less luminous ones. In the adjoining figure we see the so called *Main Sequence* stars distributed on the diagonal band from lower right to the upper left. Above the main sequence to the right lie the *Red Giants* while to the left below it lie the *White Dwarfs*. It was a challenge to the astrophysicists to explain why these stars are found distributed in this way.

Thus, the problem for the theoreticians was well posed: given the surface properties of a star like its temperature, luminosity and radius, find the details of its internal structure. The breakthrough in this direction came soon enough and will be described in the next parsecstone.



The H-R diagram. The end B of the main sequence has cooler and redder stars while the stars at end A are hotter and bluer. The Sun is at S. The part marked G is occupied by red giants and the part D by white dwarfs.

**Workshop on  
Astronomical Image  
Processing and the Internet  
at University of Kerala  
Thiruvananthapuram  
(December 20-24, 1996)**

A workshop on **Astronomical Image Processing and the Internet** will be held at the University of Kerala, Thiruvananthapuram, during December 20-24, 1996. Image processing, data bases and computer networking will be discussed with special reference to astronomy. Also, e-mail and other facilities of computer communication will be discussed, emphasizing practical matters which will help in implementing these facilities in the universities. Interested persons may contact **S.R. Prabhakaran Nayar** at the address : Department of Physics, University of Kerala, Kariavattom, Thiruvananthapuram 695 581, Kerala.

**Discussion Meeting on  
Big Bang and Alternative  
Cosmologies : A Critical  
Appraisal  
at JNCASR, Bangalore  
(January 6-9, 1997)**

A discussion meeting on **Big Bang and Alternative Cosmologies : A Critical Appraisal** will be held at the Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), Bangalore, under the joint sponsorship of IUCAA, JNCASR, Mehta Research Institute (Allahabad) and Indian Institute of Technology (Kanpur). Participation is by invitation only. Interested persons may contact **J.V. Narlikar** at IUCAA.

**Workshop on  
Introductory General  
Relativity  
and Applications  
at Tezpur University,  
Assam  
(January 27-29, 1997)**

A workshop on **Introductory General Relativity and Applications** will be held at Tezpur University, during January 27-29, 1997. Participation is restricted to local persons. Those interested should contact **A.K. Borkakati** at the address: Department of Mathematical Sciences, Tezpur University, Tezpur 784 001, Assam.

**Workshop on  
Astrophysical Spectroscopy  
at Sri Krishnadevaraya University,  
Anantapur  
(February 12-14, 1997)**

A workshop on **Astrophysical Spectroscopy**, sponsored by IUCAA, will be held at Sri Krishnadevaraya University, Anantapur, during February 12-14, 1997. The topics that will be covered in the workshop are: Astrophysical spectroscopic instrumentation, Stellar spectra, Emission lines and its diagnostics, Abundance determinations, Ultraviolet spectroscopy, Spectroscopy of solar corona, Spectra of the Sun and planets, and General topics related to astrophysical spectroscopy. Those interested to participate in this workshop should contact **R. Ramakrishna Reddy**, on or before November 15, 1996, at the address : Department of Physics, Sri Krishnadevaraya University, Anantapur 515 003, Andhra Pradesh.

**Refresher Course in  
Astronomy and Astrophysics  
for College and University Teachers  
at IUCAA  
(May 14 - June 3, 1997)**

IUCAA will conduct a **Refresher Course in Astronomy and Astrophysics** for teachers in universities and colleges to initiate and strengthen teaching of A & A in their regular teaching programmes. The topics will include :

- (i) Basic Physics for Astrophysics,
- (ii) Stellar Structure and Evolution,
- (iii) Extra-galactic Astronomy, and
- (iv) Astronomical Experiments.

The number of participants for the course will be 30. Interested persons should apply on plain paper, giving their curriculum vitae, their interest in A & A, teaching and research. Applications should be supported by their Head of the Departments and it should reach the **Coordinator, Core Programmes, IUCAA**, by **January 20, 1997**. The candidates will be informed of their selection for the course by **March 15, 1997**.

**Minischool on  
General Relativity and Cosmology  
at Lucknow University  
(February 1997, the exact date is to be finalised)**

A regional mini-school on **General Relativity and Cosmology** will be held at the University of Lucknow during February 1997. Participation to the school will be restricted to about thirty five outstation participants. Those interested in attending the school may please contact **Sunil Datta**, Department of Mathematics and Astronomy, Lucknow University, Lucknow 226 007, Uttar Pradesh. A copy of the application must also be sent to **Varun Sahni** at IUCAA.

## Astrophotography : Five Tasks

In Astroproject 15, we saw how to make a Hand Operated Mount for Astrophotography. In this article, we shall discuss five astrophotography tasks.

The main difference between the normal photography and astronomical photography is the duration of the exposure. In the former, exposures are seldom more than half a second. Whereas in astronomical photography, the exposures are almost always more than a minute. For astronomical photography, therefore, our primary requirements are - (i) a camera with a facility to keep the shutter open as long as we want (this is indicated by mark 'B' on the shutter speed setting on all such cameras); and (ii) a sturdy tripod or a mount for the camera so that it will not shake during the entire duration of the exposure. To begin with, you may use any kind of film available in the market. But, as said in the last issue, use a colour negative film, so that you can get it developed quickly. Just check the expiry date of the film.

**Task 1 : Finding the 'safe exposure'** - Mount the camera on its stand and point it to some prominent group of stars, close to the celestial sphere (e.g. Orion, Gemini, Leo, etc.) and start with 30 second exposure, that is, leave the shutter open for 30 seconds. Recentre the camera and take 1, 2, 4, 8, 16, and 32 minutes exposures. When you get the film developed you will find that up to a certain exposure, the stars on the negative will appear as dark dots. After that you will see short streaks. I call the maximum duration of exposure for which the stars still appear as 'dots' a safe exposure. This depends on the lens of the camera.

**Task 2 : Motions of the planet** - Knowledge acquired from the Task 1 can now be used for recording the motions of the planets on the celestial sphere. Take a series of safe exposure photographs of a planet on different dates. When all the photographs are put together you can see the changing positions of the planet. As an extension to this task you can take up a project to study the retrograde motions of planets.

**Task 3 : Circumpolar and Equatorial trail** - As described above, if we expose a film for longer duration, star trails will appear on the negative. Now, point the camera towards the north pole and take one and two hour long exposures and repeat it in the direction of the celestial equator. For the former set of exposures, you will see curved trails centered on the north pole and a long straight one on the later ones. Can you guess what this demonstrates?

**Task 4 : Meteor** - On the negatives of the Task 3 you might find some streaks cutting the star trails. These could be due to a meteor, a passing aircraft or a satellite. Meteor photography, especially during a meteor shower, is a very important activity. When a comet passes by the Sun it goes through a violent activity. Its parts break loose. This debris in the form of dust and small stony chunks follow almost the same path as that of the comet, rather like a swarm behind the comet. When the Earth passes close to the path of the comet some debris enters the Earth's atmosphere and burn as meteor. Since large number of meteors are seen during this period, it is called a meteor shower. The direction from which the meteor appears to originate is called the *radiant of the shower*; it is the direction of the orbit of the parent comet.

In all the above four tasks, we have not used the hand operated mount for tracking, described in Astroproject 15. You may repeat Tasks 2 and 4 with the tracking mount but giving much longer

exposure than the 'safe exposure'. By giving longer exposure we can record even fainter object. For task 2, try a set of exposures (longer than your safe exposure) in the direction of planets Uranus and Neptune. Even though you cannot see them, you can record them on the celluloid.

**Task 5 : Comet Photography** - As said before, a comet goes through a lot of violent changes as it passes by the Sun. Sometimes a comet may also break. The shape of its tail changes due to its interaction with the solar wind. An astronomer would like to follow these activities as closely as possible. You might catch such an event, that others might have failed to (because of bad weather!). And a good quality photograph of your's might just be the missing link.

So, give astrophotography a try. It is not only fun but also gives us some scientific information. If you have a problem or need more information, please do write to me at IUCAA. My reply will be faster if you send me the proof of your efforts. Send me a picture of star trails and I will send you the meteor shower dates. Send me a picture of your hand operated mount and I will send you the location of Uranus, Neptune and comet Hale-Bopp. A good photograph might find its way into one of the future issues of Khagol.

Lastly, some tips : *Keep the aperture of the lens one stop less than full open. Avoid taking photographs during a moonlit night, it will fog your film, and if you must, then give shorter exposure, and Always take two extra exposures slightly longer and slightly shorter than what you thought you might give.*



**Comet Hyakutake** : This photograph of comet Hyakutake was taken by Suhas Gurjar, on March 27, 1996. He used Kodak Gold film - 400 ASA. He used 28 mm lens at f/2. Notice the curved star trails and long tail of the comet.

### Errata : Astroproject 15

Equation on page 4, column 2 should be  $X=228.5 \times P \times T$  and on page 5, col.2 line 7 read 'every 15 seconds' instead of 'every 15 minutes'.

## Second Zel'dovich Meeting on Large Scale Structure and Cosmology at IUCAA (December 16-21, 1996)

An advanced international workshop on **Large Scale Structure and Cosmology** will be held at IUCAA during December 16 - 21, 1996. The workshop will deal with structure formation in the universe, focussing on recent developments. Topics covered include: Large Scale Structure and the Cosmic Microwave Background, Clusters of Galaxies, Dark Matter Candidates, Dynamical and Statistical Aspects of Gravitational Clustering, etc. The workshop is open to researchers working in advanced areas of Cosmology with emphasis on structure formation. Varun Sahni and Sergei Shandarin are the coordinators of this workshop. Interested persons may contact **V. Sahni** at IUCAA.

### Seminar on Astronomy and Astrophysics

A one day seminar on Astronomy and Astrophysics for college and university teachers affiliated to the University of Bombay was organised on August 31, 1996. The main theme of the seminar was to highlight research activities in astronomy and astrophysics and the support extended by IUCAA. This seminar was chaired by A.A. Rangwala from University of Bombay and was inaugurated by K.P. Singh from TIFR, Mumbai. A.K. Kembhavi and N.K. Dadhich, both from IUCAA, introduced the recent trends in astrophysics. There were lively discussions with the participants for more than one hour. Thirty seven teachers, 34 research scholars, M.Sc. and B.Sc. students participated in this seminar.

### IUCAA Swimming Pool

The construction of the IUCAA Swimming Pool was completed in August this year. It was inaugurated on the 15th of August, our fiftieth independence day, by **Mr. M.P. Wagh**, President (Operations), of the Larsen & Toubro Ltd., who had handsomely donated funds towards the pool. At 11:30 a.m. on August 15, Mr. Wagh cut the ribbon and officially opened the pool. This was followed by the children of the IUCAA Housing Colony jumping into the pool.



*Mr. M.P. Wagh inaugurating the IUCAA Swimming Pool*



*Children enjoying in the pool*

The IUCAA pool is open to all official visitors to IUCAA in addition to the IUCAA members. We urge our associates/visitors from universities to enthusiastically use this new facility.

## Welcome to...

**Sukanta Bose, Sayan Kar and Ranjeev Misra**, who have joined as post-doctoral fellows. Bose's research interests are quantum gravity and quantum field theory in curved spacetime; Kar's research interests are general relativity and strings in curved spacetime; and Misra's research interests are galactic black hole and radiative mechanisms,

**S.K. Banerjee**, who has joined as a project scientist. His research interest is cosmology, and

**Archana Pai, T.K. Ramkumar and Niranjana B. Sambhus**, who have joined as research scholars.

## Seminars

held during July - September 1996

2.7.96 K. Narayan on *Blackhole with global monopole charge*; 2.7.96 V. Korchagin on *Nonlinear interaction of global modes in protostellar disks*; 10.7.96 Sumati Surya on *Analysis of the theta sectors of quantum gravity*; 18.7.96 Ron Holo on *A flair redshift survey in the direction of the motion of the local group*; 24.7.96 R. Mukund on *Effective Lagrangian in external fields*; 9.8.96 Dipak Munshi on *Certain aspects of the formation and evolution of large scale structure in the universe*; 13.8.96 Jasjeet Singh Bagla on *Gravitational clustering in an expanding universe*; and 28.8.96 K.P. Singh on *X-ray astrophysics in the 21st century*.

## Colloquia

held during July - September 1996

12.8.96 K.B. Marathe on *Recent developments in gauge theory*; and 2.9.96 Jihad Touma on *The phase space adventure of Earth and Moon*.

## PEP Talks

held during July - September 1996

2.8.96 S.D. Mohanty on *Some general statistical techniques used in gravitational wave data analysis*; 8.8.96 T. Padmanabhan on *Clever but lazy? Try dimensional analysis*; 29.8.96 Dipak Munshi on *Statistics and dynamics of gravitational clustering*; 5.9.96 S.N. Tandon on *Sub-wavelength microscopy*; 19.9.96 Sukanta Bose on *Hawking radiation and the information-loss paradox*.

## IUCAA Preprints

Listed below are the IUCAA preprints released during July - September 1996. These can be obtained from the Librarian, IUCAA ([library@iucaa.ernet.in](mailto:library@iucaa.ernet.in)).

**G.P. Mallik, Raman K. Jha and V.S. Varma** *Mass spectrum of the temperature dependent Bethe-Salpeter equation for composites of quarks with a Coulomb plus a linear kernel*, IUCAA-30/96; **T. Padmanabhan** *Nonlinear gravitational clustering in expanding universe*, IUCAA-31/96; **D.C. Srivastava** *An overview of exact solutions of Einstein's equations*, IUCAA-32/96; **Shiv K. Sethi** *Radiatively decaying neutrinos and photoionization of the universe at high redshifts*, IUCAA-33/96; **G. Ambika** *Linear scaling relations near onset of chaos for the Josephson junction model*, IUCAA-34/96; **T. Padmanabhan** *Duality and zero-point length of spacetime*, IUCAA-35/96; **R. Srianand** *Radiation induced void in the spectrum of Tol 1038-2712*, IUCAA-36/96; and **R. Srianand and A.K. Kembhavi** *Origin of the spread in the B-K color of quasars*, IUCAA-37/96.

## Talks during Visits Abroad

**S.V. Dhurandhar** : *Gravitational waves : sources and detectors*, at the VIIth Asia-Pacific Regional Meeting of the IAU, Pusan National University, Pusan, South Korea, August 20; *Data analysis techniques for the detection of coalescing binary signals*, University of Tokyo, Tokyo, Japan, August 27; *On the instabilities of optical cavities of laser interferometric gravitational wave detectors*, Institute of Space and Aeronautical Science, Japan, August 29; and *Detecting gravitational waves from coalescing binaries*, Cosmic Ray Research Institute, Tokyo, Japan, August 30.

**J.V. Narlikar** : *An alternative cosmology*, at the VIIth Asian-Pacific Regional Meeting of the IAU, Pusan National University, Pusan, South Korea, August 19.

**Ali Nayeri** : *Statistical mechanics of confined binary systems*, International Centre for Theoretical Physics (ICTP), Trieste, Italy, July 20.

**Varun Sahni** : *Growth of non-Gaussianity during cosmological gravitational clustering*, at the Second International Conference on Astronomy, Cosmoparticle Physics, dedicated to the seventy fifth Anniversary of A.D. Sakharov, Moscow; *Dynamical and statistical aspects of gravitational clustering in the universe*, at the VIIth Asian-Pacific Regional Meeting of the IAU, Pusan National University, Pusan, Korea, August 19; and *Probing large scale structure using percolation and shape statistics*, California Institute of Technology, Los Alamos National Laboratory, CITA, Fermilab (USA).

## Vacation Students' Programme 1996

The VSP-96 was conducted during June 3 - July 12, 1996. Six students, selected from various universities, participated in this programme. There were 21 lectures covering all aspects of Astronomy and Astrophysics. In addition, each student worked on a project during this period. The students were graded based on their performance in the project work and a written test was conducted at the end of the programme. This year, two students were pre-selected for the Research Scholarship starting from August 1997. Sukanya Sinha was the coordinator for this programme.

## Post-Doctoral Positions at IUCAA

The Inter-University Centre for Astronomy and Astrophysics (IUCAA), was set up by the University Grants Commission in December 1988 in the picturesque surroundings of the Pune University Campus. IUCAA is a national autonomous institution and aims at being a centre of excellence within the university sector for teaching, research and development in astronomy and astrophysics.

The Centre at present consists of about 36 academic members, including core faculty, post-docs and graduate students, and is in a growing mode. In addition to in-house activities, IUCAA runs a vigorous visitor programme involving short and long term visits of scientists from India and abroad. The Centre also has 68 associates from universities and colleges who visit periodically.

Applications are invited for post-doctoral fellowships in astronomy and astrophysics. The duration of the fellowship is flexible within a range of one to five years, with the possibility of conversion to a tenured position. *IUCAA offers challenging opportunities to young research workers in theory, observation and instrumentation in A & A and will be especially looking for observers and experimentalists.* Candidates should apply to **The Coordinator, Core Programmes, IUCAA, Post Bag 4, Ganeshkhind, Pune 411007, India, (e-mail : vch@iucaa.ernet.in)** with curriculum vitae and list of publications and arrange for three confidential references to be sent independently. All the relevant material should reach IUCAA by **December 25, 1996**. Candidates will be informed of the result by **February 15, 1997**. The fellowship will normally commence **during 1997**. Accommodation on the campus will be offered to all post-doctoral fellows. For further details, please contact the Coordinator, Core Programmes, IUCAA.

### Facilities at the Centre

- ❖ State-of-the-art computer network, e-mail, tcp/ip, www
- ❖ Instrumentation laboratory
- ❖ Astronomical image processing and data centre
- ❖ Modern library

### Research areas covered

- ❖ Cosmology and large scale structure
- ❖ Galactic and extra galactic astronomy
- ❖ High energy astrophysics
- ❖ Galaxy dynamics
- ❖ Quantum cosmology and quantum gravity
- ❖ General relativity
- ❖ Gravitational waves
- ❖ Observational astronomy
- ❖ Astronomical instrumentation

### Other academic activities

- ❖ Schools and workshops
- ❖ Refresher courses
- ❖ Graduate and post-graduate courses
- ❖ Science popularisation

## IUCAA Publications

### Some Aspects of Gravitation and Cosmology

*Edited by Jayant Narlikar (IUCAA, Pune).*

ISBN : 81-900378-1-1

Price : US \$ 12.00 International, including  
Air-mail postage  
Rs. 120.00 India

This book is a collection of lectures delivered at the Silver Jubilee Conference of the Indian Association for General Relativity and Gravitation held at Pune. Contents include, a foreword by the Editor, Jayant Narlikar, followed by a historical introduction to IAGRG and the growth of GRG in India, by P.C. Vaidya, a critique of big bang cosmology by Fred Hoyle entitled "How successful is the big bang?", "The new gravitational wave antenna system with noncontacting readout at the University of Western Australia" by David Blair, et al., "Numerical relativity of null cones" by Nigel Bishop, "Quasinormal models and the grin of the Cheshire cat" by Nils Anderson, "Spacetime modes and some solutions of the field equations" by Sunil Maharaj, "The search for the most symmetric superstring" by Lars Brink and "Experimental gravitation in India: Progress, challenges and prospects" by C.S. Unnikrishnan.

### Ordering Information :

Contact Address : Library, IUCAA  
Post Bag 4, Ganeshkhind,  
Pune 411 007, INDIA

International : Only by Demand Draft  
orders in favour of IUCAA

Inland orders: Within Pune :  
Banker's Cheque  
in favour of IUCAA

Outstation :  
Only by Demand Draft  
payable at Pune  
in favour of IUCAA

### Singularities, Black Holes and Cosmic Censorship

*Edited by Pankaj S. Joshi (TIFR, Bombay).*

ISBN : 81-900378-2-X

*in press*

Please check the forthcoming issues of *Khagol* for more details.

## Visitors

July - September 1996

M. Fischer, S. Mukherjee, D.C. Srivastava, M.N. Satish, P.K. Bhuyan, K. Boruah, G. Konwar, Sumati Surya, S.H. Behere, S.M. Alladin, N. Mukunda, N. Raghavan, P.S. Rajput, J.N. Desai, D.P. Datta, S.M. Chitre, K. Ravindran Asari, Pinaki Chatterjee, C. Correa, S. Pandit, J. Patwardhan, J. Touma, G. Ambika, M.N. Anandaram, Anil Seth, S.N. Chintalapudi, Vijay Mohan, Soma Mukherjee, K. Sinha, M.V. John, N. Philip, M.A. Ittyachen, G. Anene, S.R. Prabhakaran Nayar, S.K. Pandey, D.K. Chakraborty, S. Umopathy, G.P. Pimpale, A.C. Balachandra Swamy, A. Pati, M.K. Das, H.P. Singh, M.L. Kurtadikar, V.H. Kulkarni, P.S. Wamane, Ram Sagar, S.P. Agrawal, A.K. Saxena, P.S. Naik, P. Vivekananda Rao, S. Sreedhar Rao, P.N. Bhat, K.P. Singh, S.K. Ghosh, Bharat Trivedi, Asis Mukherjee, S.S. Aundhkar, R. Andania, V. Pattanayak, D.G. Chaniyara, C.A. Soundale, S. Joshi, N. Vayada, A. Talwar, C.B. Devgun, V.G. Atale, D.K. Soman, R. Ramakrishna Reddy, S.K. Pandey, A.L. Choudhari, I. Sriyastava, M. Bhagwat, K. Jotania, R. Tikékar, R.P. Saxena

## Visitors

Expected

**October :** Arnab Rai Choudhuri, Indian Institute of Science, Bangalore; A.K. Sen, Institute of Radio Physics and Astrophysics, Calcutta; P.V. Subrahmanyam, CASA, Hyderabad; Sibaji Raha, Bose Institute, Calcutta; Anil Kumar Goswami, Radio Astronomy Centre, Guwahati; P. Vivekananda Rao, CASA, Hyderabad; R. Swaminathan, CASA, Hyderabad; D.C. Srivastava, Gorakhpur University; S.S. Prasad, U.N.P.G. College, Deoria; B.K. Datta, ICSC World Laboratory; B. Ishwar, B.B. Ambedkar Bihar University, Muzaffarpur; D. Lohiya, University of Delhi; D. Carter, RGO; B. Mack, RGO; N. Parker, RGO; T. Flinder, RGO.

**November :** K.N. Joshipura, Sardar Patel University, Vallabh Vidyanagar

## Extramural Talk

30.8.96 Tapas Sen on *Light in Space*

## The Age-Old Age Problem

*The following oft-told story might or might not be true:*

Once Eddington ran into Rutherford in the premises of the Cavendish Labs.

"How old is the Universe?" asked Rutherford.

"Not more than two thousand million years old" Eddington replied, thinking that this was a long enough time scale for any physicist.

Rutherford produced a piece of rock from his pocket and said "It would interest you to know that this rock is 3,000 million years old."

The problem posed by Rutherford more than six decades ago has resurfaced in modern cosmology wherein the "best sell" model of the big bang universe with inflation appears to be no more than ten billion years old but we have evidence of stars in globular clusters which may be one and a half times as old as this model universe.

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

IUCAA, Post Bag 4, Ganeshkhind,  
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