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

No. 27 July 1996

IUCAA is looking for a young physicist and a young radio astronomer...

The Inter-University Centre for Astronomy and Astrophysics is setting up an optical-near-infrared observational facility with a 1.5 - 2 m size telescope. In order to carry out development of various instruments for the observations, the *Instrumentation Laboratory* of the Centre is looking for a **YOUNG PHYSICIST**, for the position of **Scientist C**, with a Ph.D. in any branch of experimental physics and having an aptitude for instrumentation. The selected candidate would be placed in the scale **3000-100-3500-125-4500**, with the usual allowances applicable to central government employees stationed at Pune.

Further, as the Giant Metrewave Radio Telescope of the National Radio Astrophysics is nearing completion, IUCAA is also looking for a **YOUNG RADIO ASTRONOMER** in the same grade with a Ph.D. in radio astronomy, to help initiate any joint projects with the NCRA.

Please apply to the *Director*, IUCAA, with biodata and a list of at least three referees. The applicants should ask these referees to send their confidential recommendations directly to the Director.

*Principal Investigators of the Indo-US Exchange Programme in Astronomy and Astrophysics, **Giovanni Fazio** (Harvard Smithsonian Centre for Astrophysics) and **Jayant Narlikar** (IUCAA) with **Francine Berkovitz** (Smithsonian Institution) and **Shiv Shankar Mukherjee** (Minister of Press, Information and Culture, Embassy of India in the USA) at the Smithsonian Headquarters in Washington DC. (Photograph taken on April 9, 1996 by Rajan Devadas)*

DST Contact Programme for Students in Astronomy and Astrophysics

An introductory astronomy and astrophysics course, sponsored by the Department of Science and Technology (DST), Government of Inida, was organised under the DST contact programme for students at IUCAA during June 17-21, 1996. Lectures and demonstration sessions were delivered by N.K. Dadhich, M. Vivekanand, J.V. Narlikar, S.N. Tandon, A.N. Ramaprakash, Ranjan Gupta, Somak Raychaudhury, N.C. Rana, Shiv Sethi and Arvind Paranjpye. Night sky observation was possible only on June 21, as all other evenings were cloudy. A total of 13 students preselected by the DST on all India basis, attended the workshop. A trip to the GMRT site was organised on June 20 and Parveen Farooqui of DST accompanied the participants. Ranjan Gupta was the coordinator of this programme.

Participants of the ***DST Contact Programme for Students in Astronomy and Astrophysics***

Seminars

3.4.96 K. Harikrishna on *Dynamical systems and surfaces of sections*; 8.5.96 P. Roy on *The Dirac seesaw for the neutrino mass*; 20.6.96 K.K. Nandi on *Induced quantum fluctuations in the spherically symmetric spacetime*; and 28.6.96 V.H. Kulkarni on *Dusty plasma dynamics.*

Colloquium

27.5.96 Manoj Banerjee on *Nucleon in nuclear matter*.

Extramural Talk

25.6.96 R. Ramachandran on *Comprehensive Test Ban Treaty (CTBT)*

Mini-Workshop on Inhomogeneous Cosmological Models

at North Bengal University
(November 14-18, 1996)

A mini-workshop on Inhomogeneous Cosmological Models will be held at the North Bengal University, Siliguri during November 14-18, 1996. The workshop is intended for intense discussion between active research workers in this area. The workshop will be coordinated by **S. Mukherjee** of Department of Physics, North Bengal University, Darjeeling 734 430, West Bengal and **N. Dadhich** of IUCAA. Further information about participation could be had from the coordinators.

The Beginning of Theoretical Cosmology

Cosmology deals with the large scale structure and evolution of the universe. Over several centuries, philosophers and religious thinkers had spent considerable intellectua' efforts on this topic. But these were largely speculative exercises. Modern science got into the act in the early part of this century. If the discovery by Hubble (Parsecstone 14) may be called the beginning of *observational* cosmology, the papers by Albert Einstein and W. de Sitter, twelve years earlier, marked the beginning of *theoretical* cosmology.

In his times, Isaac Newton had also grappled with the problem of modelling the universe with his law of gravitation. In Newton's model, the universe was an infinite homogeneous and isotropic distribution of matter which remained in static equilibrium because each particle of matter was equally attracted to the rest in all directions and so stayed put in its place. Newton discoverd, however, that this equilibrium was highly unstable and the universe would undergo gravitational collapse towards any local excess of matter density.

In 1917, Einstein tried a similar model (static, homogeneous and isotropic) within the framework of his newly proposed general theory of relativity. He discovered that to ensure a static model he had to postulate an additional "cosmological" term in his equations. This term represented a cosmic force of repulsion between any two particles that varied in direct proportion to the distance between them. By countering gravity it made the universe static but also required that it has a positive curvature. That is, the space of the Einstein universe is the three dimensional boundary of a four dimensional hypersphere.

The Einstein universe thus had a finite volume with no boundary: imagine it as the two dimensional analogue of the surface of an ordinary sphere. Einstein thought that this model was a unique cosmological solution of his equations. He also hoped that this model would underscore the basic philosophy of general relativity that the spacetime geometry and matter distribution are uniquely related in this way. This expectation was, however, vitiated by the work of de Sitter that followed shortly after in which, he proposed a model universe which was empty and expanding! That such solutions were also possible from his theory came as something of a shock to Einstein.

As at that time the expansion of the universe was not known, the general expectation was that the actual model would indeed conform to the Einstein version. During 1922-24 Alexander Friedmann from Russia worked out a whole range of expanding models in which the universe was non-empty. Again physicists and astronomers, Einstein included, ignored these models and later similar work by Abbe'Lemaitre and H.P. Robertson during 1927-28.

But after the discovery of Hubble's law, the situation changed and the Friedmann models became the pillars on which the cosmological theory came to rest. Einstein himself recognized this fact and saw that since the simplest Friedmann models did not require the cosmological term, it was unnecessary. He went a step further and denounced the term as the "greatest blunder" in his life. Other cosmologists, however, have not thought so as will be clear in the future parsecstones of this series.

Hand Operated Mount for Astrophotography

We perceive the general motion of celestial bodies from east to west because of the rotation of the Earth on its axis from west to east. Therefore to follow a particular object in the sky, astronomer have designed a mount for a telescope in which one of the two axes, used for pointing a telescope, is made parallel to the axis of the earth. Such type of mounts are called equatorial mounts. This axis which is naturally aligned with the north and south celestial poles is referred to as polar axis. The advantage of this type of mounts is, by rotating the polar axis from east to west, one rotation per day* the telescope can be continuously kept pointing towards any celestial objects, excluding of course the solar system object.

Such mounts are made in mechanical workshops, for the mount should not only have a precise clock drive to rotate the polar axis, but there should also be made a provision to move the telescope quickly from one object to the other and to make small changes in the speed of the clock when ever required. Refraction of the light due the atmosphere causes the image of the star (or the other celestial body) shift.

However, if one is planning to take photographs of short duration, (of the order of 15 minutes) and the field of the camera (that is area of the sky covered) is quite large (of the order of a few tens of degrees) than on can build a very low cost hand operated drive for taking astrophotographs. First of this kind of mount was devised by G. Y. Haig. Haig was from Scotland and thus the mount is often called Scotch mount. Many different variations of this type of mount have been made since then and are described in literature.

The basic technique is that to use two wooden planks joined with a hinge and mounted such a way that the axis of the hinge is aligned with the axis of the earth. A bolt of suitable pitch 'P' (the distance between the adjacent thread on the bolt) is attached to one of the planks at such a distance 'X' from the axis of the hinge, that when the bolt is rotated at a certain speed 'T' (normally one rotation per minute) it pushes the planks from each other with the angular change corresponding to the rotation of the earth. The formula is

$$X = 228.5 \times S \times T$$

We are presenting a similar mount here which you can make it quite easily if you are a handy man yourself and improve upon the design. Or can get it fabricated from a carpenter.

Material required for the basic mount

1. Wooden planks - 150 X 350 X 15 mm : two nos.
2. Bolt (20 TPI quarter inch, 2 inch long) : one no.
3. Bolts (20 TPI quarter inch, 4 inch long) : two nos.
4. Door hinge 4 inch long : one no.
5. Required screws and nuts.
6. Epoxy glue, such as Araldite or M seal

Making the mount

Join the planks with the hinge. Drill a quarter inch hole on one of the plank exactly 29 cm from the hinge center. Now nut the 2 inch 20 TPI bolt half way. Insert this bolt in the hole till the nut touches the plank and tap lightly with a hammer. Impression of the nut will be left on the plank. Take the nut out and scoop out the wood over this area so that the nut can be slide inside this cavity. Now put the nut inside this and glue it, taking care that the glue doesn't touch the inside threads of the nut. When you thread the bolt through the nut, it will control the separation between the two planks. On the two ends of the bottom plank put two more additional nuts and bolts to control the inclination of the planks. As shown in the figure, the planks should be inclined to the horizon by angle equal to the latitude of the place. Make the length of the board aligned east west the axis of the hinge parallel to the axis of the earth. If you rotate this bolt at one rotation per minute, it will compensate for the rotation of the earth. Now make a suitable fixture for mounting the camera.

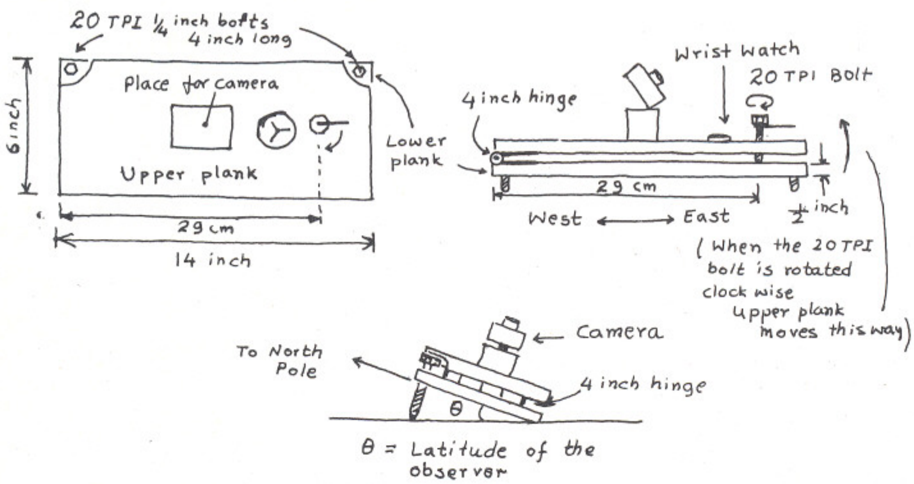
It is now a simple matter to take your first astrophotograph. Find a dark enough place. Put the drive and the mount on firm table or ground. Aligned it east west north south. Put the camera shutter speed on 'B', so that the shutter will remain open as long as you keep the shutter release liver or the button pressed. Keep the aperture full open. Place your analog wrist watch with seconds arm next to the 20 TPI bolt. Load the camera and direct it to some prominent constellation. Open the shutter and rotate the bolt as the seconds arm move. Take a few shorts of 5, 10 and 15 minutes of durations each and get the film developed. Most likely the film processing lab owner or the technician working there in will not make any prints saying that the negative has only some dots. But insist on prints and examine those. If you have done everything correctly you will have a fine photographic star map for yourself.

The information given above is necessary and sufficient to make this kind of mount. However, if you have a problem or doubt, please do write to us.

Some tips, tricks and traps

Use a colour negative film, so that you can get it developed in 'one hour labs'. Glue a small metallic rod to the turning bolt to help you follow the seconds arm. Strap a wrist watch to the board and use a dim torch covered with the red cellophane tape to read time. Instead of continuously moving the bolt, rotate it by 90 degrees every 15 minutes. While rotating the bolt, hold a black paper cover in front of the camera lens. So in case you disturb the setup you can abort the exposure. Just in case you missed the time or turn, don't start where you left, keep covering the lens and move the bolt to the position where it should be. Glue a piece of metal to the lower plank just where the bolt rests over it. It will protect the wood.

* *In fact almost nearly one rotation per day - look into some elementary book on astronomy.*



Sketch of the mount

Introductory Summer School on Astronomy and Astrophysics

An Introductory Summer School on Astronomy and Astrophysics (A & A), funded by the Department of Science and Technology, Government of India, and hosted by IUCAA and NCRA, was held at IUCAA during May 20 - June 8, 1996. This was seventh in the series of summer schools, the venue for which alternates between Pune and Bangalore. In this summer school, 26 students of physics and engineering from all over the country, took part.

There were 50 lectures of various topics in A & A, which were delivered by leading scientists from different A & A centres in the country. In addition, the students also took part in individual projects under the supervision of academic members of IUCAA and NCRA. Observations through an optical telescope, a visit to the GMRT site and computer image processing demonstrations were also some of the activities arranged during the school. The school provided adequate exposure to A & A and emphasized the thrust areas in the field. S. Sridhar from IUCAA and D.J. Saikia from NCRA were the coordinators of this school.

Welcome to the IUCAA family

IUCAA is happy to announce the selection of the **seventh** batch of its Associates and Senior Associates, who are selected for a tenure of *three years,* beginning July 1, 1996.

Associates

I. Bardoloi
Handique Girls' College, Guwahati

S.P. Bhatnagar
Bhavnagar University

S. Chakrabarty *
Kalyani University

M.K. Gokhroo
Government College, Ajmer

P. Das Gupta *
Delhi University

T. Subba Rao
S.V. University P.G. Centre, Kurnool

S.V. Vaishampayan
North Maharashtra University, Jalgaon

C. Venugopal
Mahatma Gandhi University, Kottayam

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

Senior Associates

Z. Ahsan
Aligarh Muslim University

M.N. Anandaram *
Bangalore University

A. Banerjee *
Jadavpur University

S. Banerji *
Burdwan University

D.K. Chakraborty *
Pt. Ravishankar Shukla University, Raipur

S. Chandra *
Indira Gandhi National Open University, New Delhi

S. Chatterjee
New Alipore College, Calcutta

M.K. Das *
Sri Venkateswara College, New Delhi

A.D. Gangal *
University of Pune

V.B. Johri
Lucknow University

K.N. Joshipura
Sardar Patel University, Vallabh Vidyanagar

B.A. Kagali *
Bangalore University

P. Khare *
Utkal University, Bhubaneswar

S.P. Khare
Ch. Charan Singh University, Meerut

V.C. Kuriakose
Cochin University of Science and Technology

D. Lohiya
Delhi University

S. Mukherjee *
North Bengal University, Darjeeling

L.K. Pande
Jawaharlal Nehru University, New Delhi

S.K. Pandey *
Pt. Ravi Shankar Shukla University, Raipur

L.K. Patel *
Gujarat University, Ahmedabad

S.S. Prasad *
U.N.P.G. College, Padrauna

L.M. Saha *
Zakir Husain College, New Delhi

L.P. Singh
Utkal University, Bhubaneswar

R.S. Tikekar *
Sardar Patel University, Vallabh Vidyanagar

Talks during Visits Abroad

S.V. Dhurandhar : *A two step hierarchial strategy for detecting gravitational waves from coalescing binaries*, Stefan-Banach International Mathematical Centre, Warsaw, Poland, March 25; *Gravitational waves from coalescing binaries - An overview,* Albert Einstein Institute, Potsdam, Germany, April 30; *Data analysis aspects of gravitational wave signals from coalescing binaries,* Meudon Observatory, Paris, France, May 30; and *Hierarchical detection strategy for gravitational wave signals from coalescing binaries,* at the VIRGO meeting, LAPP, Annecy, France, June 13.

R. Gulati : *Synthesis of stellar spectral features for stellar populations,* Institute for Astronomy and Astrophysics, University of Kiel, Germany; *Classification of stellar spectra using Artificial Neural Networks,* Center for EUV Astrophysics, Berkeley; and *Employing an artificial brain to spectral classification,* Keele University, Stafforshire, UK (April 18 - June 17).

J.V. Narlikar : *The quasi-steady state cosmology : Achievements and challenges*, Department of Physics, University of Pittsburgh, USA, April 4; *An alternative to big bang cosmology*, Department of Physics and Astronomy, University of Maryland, USA, April 8; *The variable mass hypothesis*, International Conference on Modern Mathematical Models of Time and Their Applications to Physics and Cosmology, University of Arizona, Tucson, April 12; *An alternative to big bang cosmology*, University of Wyoming, USA, April 17; *Crisis in cosmology : Big bang and alterntives*, University of California, San Diego, USA, April 23; and *The big bang cosmology : Problems and alternatives*, Stanford University, Stanford, USA, April 26.

T. Padmanabhan : *Understanding nonlinear gravitational clustering,* Fermilab, Chicago, USA, April 30; and *Power transfer in nonlinear gravitational clustering,* Department of Astronomy, California Institute of Technology, Pasadena, USA, May 21.

IUCAA Preprints

Listed below are the IUCAA preprints released during April - June 1996. These can be obtained from the Librarian, IUCAA.

L. Sriramkumar and **T. Padmanabhan** *Does a non-zero tunnelling probability imply particle production in time independent classical electromagnetic backgrounds?,* IUCAA-14/96; **H.P. Singh, R.K. Gulati** and **M.K. Das** *Visualising theory to support astronomy teaching*, IUCAA-15/96; **N. Dadhich** *Isothermal spherical perfect fluid model: Uniqueness and conformal mapping*, IUCAA-16/96; **N. Dadhich** *A conformal mapping and isothermal perfect fluid model*, IUCAA-17/96; **K. Srinivasan, L. Sriramkumar** and **T. Padmanabhan** *`Thermal' ambience and fluctuations in classical field theory*, IUCAA-18/96; R. Sachs, **J.V. Narlikar** and F. Hoyle *The quasi-steady state cosmology : Analytical solutions of field equations and their relationship to observations*, IUCAA-19/96; **J.S. Bagla** and **T. Padmanabhan** *Critical index and fixed point in the transfer of power in nonlinear gravitational clustering*, IUCAA-20/96; **J.S. Bagla** *Observational constraints on Ω and H_0*, IUCAA-21/96; D.K. Sahu, **S.K. Pandey**, **D.K. Chakraborty**, **A.K. Kembhavi** and Vijay Mohan *Nuclear dust and outer shells in the elliptical galaxy NGC 7562*, IUCAA-22/96; **B.K. Datta** and R. Datta *Einstein field equations in spinor formalism: A Clifford algebra approach*, IUCAA-23/96; **A. Goyal** and S. Dutta *Constraining the right handed interactions from Pion condensate matter*, IUCAA-24/96; **A.N. Petrov** and **J.V. Narlikar** *The energy distribution for a spherically symmetric isolated system in general relativity*, IUCAA-25/96; S. Bharadwaj, **D. Munshi** and T. Souradeep *Skewness in the cosmic microwave background anisotropy from inflationary gravity wave background*, IUCAA-26/96 and **A. Goyal** and D. Chandra *Late formation of quark stars and their possible survival*, IUCAA-27/96; **D. Munshi** and **T. Padmanabhan** *Modelling the evolution of correlation functions in gravitational clustering,* IUCAA-28/96 and **A.N. Petrov** *Asymptotically flat spacetimes at spatial infinity: II. Gauge invariance of the integrals of motion in the field approach*, IUCAA-29/96.

Visitors

April - June 1996

S.G. Tagare, A. Petrov, K. Boruah, Kiran Shanker, V.M. Nandakumaran, G. Ambika, S. Ramani, M.N. Anandaram, H.P. Singh, M.L. Kurtadikar, S. Mukherjee, J.C. Soni, K. Narayan, G.P. Pimpale, S. Banerji, B.K. Datta, K. Sankara Sastry, S. Sreedhar Rao, Probir Roy, D.B. Vaidya, L.K. Patel, H.S. Wamane, V. Korchagin, S.S. Aundhkar, R. Nityananda, R. Ramakrishna Reddy, Nazeer Ahmed, P. Vivekananda Rao, T.P. Prabhu, Suresh Chandra, R. Datta, G. Srinivasan, R.K. Varma, U.A. Yajnik, R. Mukund, D. Bhattacharya, A. Banerjee, P.C. Vinodkumar, S.K. Pandey, D. Narasimha, Y. Shchekinov, S. Iyer, P. Khare, Sukanta Datta, Mamta, B.B. Walwadkar, K. Dave, S. Vaishampayan, A. Kuldeep, G.G. Asgekar, A. Goyal, M.C. Sabu, Anima Nagar, S.R. Prabhakaran Nayar, K. Revathi, D. Lohiya, D.K. Sahu, P. Agarwal, Sushil Kumar, S.N. Borah, K.K. Nandi, S.S. Prasad, G.K. Johri, R.P. Saxena, H.S. Somal, Budh Ram, D.K. Chakraborty, Kaustav Saikia, N. Banerjee, B. Robbason, V.H. Kulkarni, G.P. Malik, V.K. Dhar, A. Gupta, S.N. Paul, R. Ramachandran, M. Bhagwat, R.K. Jha, Ron Hola, A.K. Borkakati and B.P. Sarmah.

Apart from the above visitors, there were 26 summer school students, 13 students who participated in the DST contact programme and 6 VSP students.

Visitors

Expected

July : D.C. Srivastava, University of Gorakhpur; P.K. Bhuyan, Dibrugarh University; S.P. Agrawal, A.P.S. University; S.M. Chitre, TIFR; N. Mukunda, Centre for Theoretical Studies; J.N. Desai, PRL; S.M. Alladin, Osmania University; Nirupama Raghavan, Nehru Planetarium; P. Chatterjee, Cambridge University and M. Colless, Mt. Stromlo Observatory.

August : N. Babu, University of Kerala

New Genesis

*The following description of **Nucleosynthesis** by **George Gamow** may be of interest to the readers, some four decades after it was stated.*

In the beginning God created radiation and ylem. And ylem was without shape or number, and the nucleons were rushing madly over the face of the deep.

And God said: `Let there be mass two'. And there was mass two. And God saw deuterium, and it was good.

And God said: `Let there be mass three'. And there was mass three. And God saw tritium and tralphium, and they were good. And God continued to call number after number until He came to transuranium elements. But when He looked back on his work, He found that it was not good. In the excitement of counting, He missed calling for mass five and so, naturally, no heavier elements could have been formed.

God was very much disappointed, and wanted first to contract the Universe again, and to start all over from the beginning. But it would be much too simple. Thus, being almightly, God decided to correct his mistake in a most impossible way.

And God said: `Let there be Hoyle'. And there was Hoyle. And God looked at Hoyle... and told him to make heavy elements in any way he pleased.

And Hoyle decided to make heavy elements in stars, and to spread them around by supernovae explosions. But in so doing, he had to obtain the same abundance curve which would have resulted from nucleosynthesis in ylem, if God would not have forgotten to call for mass five.

And so, with the help of God, Hoyle made heavy elements in this way, but it was so complicated that nowadays neither Hoyle, nor God, nor anybody else can figure out exactly how it was done.

Amen.

(from : *My World Line* by G. Gamow, Viking, Penguin)

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

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