

Khagol

Inter-University Centre for Astronomy and Astrophysics
An Autonomous Institution of the UGC



No. 4

THE IUCAA BULLETIN

October 1990

To Our Readers

For the schools and workshops organised under the auspices of IUCAA we invite participation through announcements in *Khagol*. Please apply to the coordinator of the event and wait for his communication confirming your participation. Often, when there is shortage of time, the confirmation will come telegraphically and should be treated as official. For example, we were sorry to learn that a research student could not attend our mini school on Cosmic Strings because his university did not consider our telegraphic confirmation as official. We hope that the concerned university authorities will come to look upon IUCAA as a field station and facilitate active participation in its activities by their staff and students.

We would like research students to make use of their contingency grant for attending schools and workshops organised by IUCAA. The same applies to the faculty members who have their own research grants. In future we shall ask you to apply on a specific proforma which will solicit all the relevant information.

IUCAA Schools/Workshops

A Mini School on Infrared Astrophysics will be conducted by Professor K. Shivanandan from Naval Research Laboratory, Washington, USA at Madurai Kamaraj University during January 1-5, 1991 (Revised Dates). Interested persons should apply to Professor V.R. Venugopal, School of Physics, Madurai Kamaraj University, Palkalai Nagar, Madurai 625 021, giving a brief account of their interest in the topic.

IUCAA's Construction Programme

The Phase II of IUCAA's buildings was launched on August 24 amidst the festivities of Ganesh Chaturthi. It will include the faculty and administrative block, the lecture halls, laboratories, the library, the canteen, the hostel block and the guest flats. A number of large trees which would have come in the way of the proposed buildings were transplanted to the adjoining plot where IUCAA's housing is nearing completion. Phase II is expected to be ready in early 1992.



Honorary Fellows of IUCAA

We welcome Professor D.S. Kothari as the sixth Honorary Fellow of IUCAA. The other Honorary Fellows are:

Professor S. Chandrasekhar
Professor W.A. Fowler
Professor A. Hewish
Professor F. Hoyle
Professor A. Salam

IUCAA Lecture Notes

Abhay Ashtekar : Non-Perturbative Canonical Gravity

The notes are based on the lectures given by the author at IUCAA during July-August 1989. Interested persons may write for a copy of the notes to In-Charge, Visitor Programme, IUCAA.

Observing at IUCAA

We have acquired a Celestron 14" and Ultima 8" - telescopes for star gazing, teaching and instrument testing. When the rainy season is finally over we hope to begin these activities.

CONGRATULATIONS!!

To: *Dr. G.S.D. Babu, Dr. Jagdev Singh and Mr. Wahabuddin* on successful solar observations at the Antarctica.

POST-DOCTORAL POSITIONS

IUCAA invites applications for post-doctoral fellowships in astronomy and astrophysics. The duration of a fellowship is flexible within the range of one to five years, with the possibility of conversion to a tenured position. As a newly set up institution, IUCAA offers challenging opportunities to experts in theory, observation as well as in astronomical instrumentation. IUCAA will be especially looking for observers and experimentalists willing to contribute to its programmes including the establishment of an astronomical instrumentation centre equipped with the most modern facilities. Candidates should apply to **Professor J.V. Narlikar, Director, IUCAA, Post Bag 4, Ganeshkhind, Pune 411 007, India**, with curriculum vitae and list of publications. They should also arrange to send three confidential references. All relevant material should reach IUCAA by 10 December 1990. Candidates will be informed of the results of their application by 30 January 1991. The fellowship will normally commence in the second half of 1991.

AMATEUR ASTRONOMERS' MEET

Astronomy is perhaps the only science in which amateurs play an important role and have contributed to many discoveries. The professionals and amateurs can be truly complementary to each other. With the same spirit, the IUCAA and Jyotirvidya Parisanstha (JVP), Pune have come together to organise the Amateur Astronomers' Meet at a national level for the first time on January 12-13, 1991. The aim of the Meet is to propagate astronomy amongst people at large and to bring together various amateur groups so as to induce them to take up scientifically useful observational programmes. The professional astronomers are expected to suggest a number of survey kind of projects which can be taken up by the various amateur groups.

The programme of the Meet will consist of review talks by the experts, paper and poster presentations by the participants and the exploration of the Pune sky with the help of IUCAA's Celestron 14" and Ultima 8" telescopes on the night of January 12, 1991.

All those interested in attending the Meet should apply immediately and in any case not later than October 31, 1990 to Dr. P.R. Tupe, Secretary, JVP, Tilak Smarak Mandir, Sadashiv Peth, Pune 411 030 giving a brief description of their work as amateur astronomers. Owing to logistic and other constraints, the total number of participants will be restricted to 150 and the participation will be by invitation only. Those who respond to this announcement will hear back from Dr. Tupe by November 20, 1990 about their participation. A small number of travel grants will be available for long distance participants.

As a part of the organisation of this Meet, we would also like to make a comprehensive **Directory of Amateurs Groups** in the country for ours as well as others' use in future. We would thus appeal to all the amateur astronomers individually or in groups to send their postal addresses to Dr. Tupe on the address given above.

OTHER SCIENTIFIC MEETINGS

ICGC 91

Sequel to the International Conference on Gravitation and Cosmology (ICGC 87) held at Goa in 1987, ICGC 91 will be held at Ahmedabad during December 13-18, 1991. Participation is by invitation and further details can be had from Professor A.R. Prasanna, PRL, Ahmedabad 380 009.

21st IAU General Assembly

July 23 - August 1, 1991, Buenos Aires, Argentina

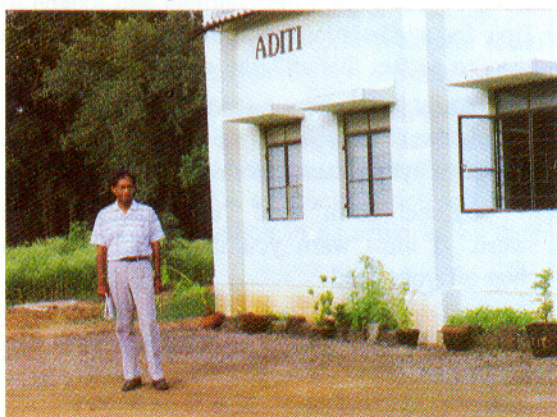
Details are given in IAU Information Bulletin 64, June 1990 and can be had from IAU General Assembly, LOC, Sarmiento 1562, 4F, 1042 Buenos Aires, Argentina.

Academic Events At IUCAA

Mini-School on the Theory of Cosmic Grains

During 1 - 4 August, 1990, Professor N.Chandra Wickramasinghe from the University of Wales, Cardiff, UK, delivered a set of four thought provoking lectures.

In his first two lectures, Chandra explained the nature of obscuration of starlight produced by the interstellar medium, which ought to contain dust particles of micron to sub-micron size. In order to find out the chemical composition of these interstellar dust grains, one has to study, the optical properties of the grains, namely the absorption, scattering and polarisation. Chandra described the results of the Mie theory applied to spherical dust grains and his own later work on cylindrical grains.



Arguing from the general composition of the interstellar medium, Chandra stressed the limited interstellar resources of carbon, oxygen, silicon, magnesium and iron to form interstellar dust grains. The most probable constituents of the interstellar dust grains turn out to be ice, silicates, graphite and organic molecules.

Detailed study of the law of interstellar extinction shows a pronounced peak in the ultraviolet at about 2170 Å. For a long time, this peak was believed to be due to small spherical graphite grains. But there are difficulties in understanding the need for spherical grains of a particular size.

In his last two lectures, Chandra focused on the problems of fitting the extinction curves in the far ultraviolet and of some specific absorption

features in the infrared. He showed how desperate attempts for explaining the absorption/emission peaks in terms of the conventional models of the dust grains made up of ice-coated, siliceous material could not be successful. Inclusion of biotic material in the composition of these grains such as the E. Coli bacterium, and aromatic molecules not only improves the fit to the observational data on the extinction profiles but also the flat wavelength dependence of the degree of polarisation in the infrared bands.

Chandra also addressed the question of how the biotic material could possibly grow in the interstellar environments, given the destroying agents such as the stellar ultraviolet radiation, energetic cosmic ray particles, etc. In spite of all odds, he reasoned for the possible cometary sites of nutrient resources, where bacteria can multiply at super-astronomical rates and spread across the galactic and even the extragalactic distances within one Hubble time. Regarding the spontaneous emergence of life on Earth by purely chemical processes, Chandra estimated an extremely low probability - one part in $10^{-40,000}$. Thus, he argued, the universe as per the big bang cosmology is unable to account for the origin of life in the limited time scale.

Superstrings as theory of spacetime

Superstring theory has been one of the most fascinating ideas in quantum field theory and mathematical physics, for the past six years. In a special IUCAA Colloquium on 17 August, 1990, Professor Harry Lam from McGill University, Montreal, Canada, spoke on **Superstring theory as theory of spacetime?** He expressed the view point that it is a theory of spacetime itself as well as all the matter that lives on it. It provides, in four spacetime dimensions, a truly unified theory of electroweak, strong and gravitational interactions and brings closer to home, the long cherished dream of unification. In explaining these ideas, Harry exposed the audience to many simple notions from the mathematics of self dual lattices. He concluded his colloquium with remarks on the present status of the theory and the outstanding problems to be solved before superstrings can be called a 'theory of everything (TOE)'.

Mini-School on Cosmic Strings

In the first week of August, Professor Tanmay Vachaspati from Tufts University, delivered a set of four lectures on the theme of cosmic strings. He started his discussion with the ideas like symmetry breaking and phase transitions in a field theory, using a real self-interacting scalar field theory. He showed that the formation of domain walls, and topological defects in general, is quite generic to self interacting field theories. He demonstrated that such effects are stable and persist in the context of finite temperature, thereby becoming quite relevant to the phase transition in the early universe.

He then moved onto the topic of strings as topological defects. They are formed in the context of a complex scalar field whose finite temperature Lagrangian exhibits a global $U(1)$ gauge invariance and whose potential has the form of the bottom of a wine bottle or a Mexican hat. The solution to the equation of motion known to this date is in a non-closed form, with limiting cases known analytically. Symmetry considerations dictate that the solution corresponds either to an infinite string or a closed loop. A computer simulation of the string network was also described. He further showed how bounds on some physical parameters of axions could be set by the lifetimes of red giant stars and the mean density of the universe.

Tanmay discussed various phenomena like intercommuting of strings, gravitational radiation from strings and the rocket effect, collapse of a string loop and formation of blackholes etc. The gravitational effects due to the presence of a cosmic string in the universe are largely because of the conical spacetime structure in its vicinity. Lensing effect and formation of double images of a star is one such. The conical metric can also be used for candidate explanations of anisotropy in the microwave background and sheet like large scale structures in the universe.

In his last lecture, Tanmay discussed a few speculative ideas about the origin of primordial galactic magnetic fields, as seed fields for the operation of a galactic dynamo.

THE SWORD OF TIPU SULTAN

No claim is made for the historical accuracy or authenticity of the following anecdote about Tipu Sultan, the eighteenth century ruler of the state of Mysore in South India :

A stranger whose fame had preceded him presented himself before Tipu for royal recognition of his talents.

"What are your achievements?" asked Tipu.

"Sire, I will give you an actual demonstration of what I can do." At the visitor's bidding Tipu asked his staff to erect a four-metre tall wall with a hole one centimetre in diameter going right through it at a height of three metres. The stranger then asked for a bowl of uncooked rice.

Standing five metres away from the wall in front of the hole he then systematically threw the rice grains right through the hole.

"Bravo" called the courtiers and looked to Tipu for appreciation. "Sire, I practised for ten years to perfect this art", the man added.

"Bring my silver sword" ordered the Sultan. It was brought in a silver tray. The stranger's eyes gleamed at this reward.

"Kneel down" said Tipu picking up the sword. "I must warn you that I am going to chop off your head."

The visitor collapsed in a shock and begged to know in what way he had offended the king.

"You wasted ten years of your precious life towards this useless fine tuning. You do not deserve to live", Tipu said.

We are glad that today's funding agencies are less demanding of fundamental research.

How To Communicate With IUCAA?

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