# Khagol The IUCAA BULLETIN

# April 1990

#### **TO OUR READERS**

The first issue of IUCAA Bulletin sent out in January this year has received favourable responses. We thank our readers for writing back to us or giving verbal comments wherever possible.

To fulfill its role effectively IUCAA has to work on two fronts. Its academic members need to interact with the university community through regional meetings, lectures on campuses, workshops, etc. Secondly, as its centralized facilities grow at Pune IUCAA will encourage their usage by the interested teachers and students from the universities. The Bulletin will give periodic briefings on both fronts.

If you come across the Bulletin in some library or see it with a colleague and wish to receive a copy, please send your name and address for updating our mailing list. Our address is :

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note : to contact some specific person in IUCAA by email, replace the word root by the person's first name.

#### WILLY FOWLER'S UNIVERSE

In a very lively and entertaining talk, Professor Fowler restated the probable age of the universe to be around 11 billion years. It was based on the recent model proposed by him in collaboration with Malaney, requiring an inhomogenous density distribution of nucleons.



Professor William Fowler visited IUCAA from March 23 to 25 and delivered a special colloquium on "The Early Universe".

Notable features of the model are : (i) zero spatial curvature (k = 0) and cosmological constant and (ii) the abundances of relic elements found today are related to the quark gluon phase transition in the early universe. Fowler claimed that it is a minimalistic model in terms of general relativistic simplicity and that it does not require any dark matter candidates like axions, photinos or weakly interacting massive particles (WIMPs) currently popular in the literature. He referred to the standard big bang model as 'obsolete' and argued that 'our universe' arose as a bubble from a finite part of an infinite universe without a beginning and without an end.

#### Visits to IUCAA on duty

In response to letters from the Chairman and the Secretary of the University Grants Commission as well as from the Director, IUCAA, some universities have agreed to treat the leave of absence of their faculty members for visits to IUCAA as on duty. We sincerely hope that other universities will follow suit.

#### THE COMPUTER CENTRE

IUCAA has started developing a network of workstations to serve its computing and image processing requirements. The network at the present consists of a SUN 4 server with 32 Mbytes core memory, disk space of about 2 Gbytes and various peripherals, a SUN 386i workstation, and PC-compatibles using the NFS protocol. Two SPARC stations are expected to arrive soon. The network is expected to expand rapidly in the coming year, as the demand for computers goes up due to increase in the number of academics at IUCAA as well as visitors from the universities. In keeping with emerging trends the world over, it has been decided to base most of the computing at IUCAA on workstations. This permits a flexible approach which can be tailored to needs and resources, taking into account developments in computing technology which now occur over a timescale of several months.

High speed computing which cannot be handled by workstations can at present be done on the NEC mini-super computer of the National Informatics Centre (NIC) at Pune. A terminal at IUCAA is connected to the NIC computer. As the need for such computers grows at IUCAA during the next few years, a suitable mini-super or super computer will be acquired.

IUCAA has a local area network of PCcompatibles of various kinds. This is used to implement the library, accounts and administration software packages, as well as for wordprocessing, drafting and computer courses for students. The computer centre also provides facilities for typesetting, desktop publishing and e-mail.

#### THE IUCAA LIBRARY

The IUCAA Library is being developed as a major collection of the literature on astronomy, astrophysics and related areas. In one year of operation it has acquired about 2500 books and catalogues, and hopes to increase its holdings very substantially in the next 2 years. The astronomical collection is supported by literature from the general areas of physics and mathematics. There are also small numbers of books on other basic sciences, arts, humanities etc. The library is being developed in such a manner that it benefits research workers as well as students and less experienced persons coming to IUCAA for summer school, refresher courses and the like.

IUCAA now subscribes to about a hundred periodicals, many of which arrive by airmail. The idea here is to have an up-to-date collection of scientific journals to which the university astronomical community has an easy access.

A novel feature of the IUCAA Library is that all its functions are computerized. The software, developed ab initio and in situ by M/s Algorhythms in close consultation with IUCAA staff, resides on a network of IBM-PC compatibles. All user services like literature searches, issue of books, reservations etc. are computerized. The computerization also extends to all library management functions like acquisition of books and periodicals, accession and cataloguing, circulation monitoring etc. The software is user-friendly, and has been designed in such a manner that it can be easily installed in various university departments and institutions, on a single PC-AT or a network, at a very reasonable cost.

#### INTERACTION WITH UNIVERSITIES

With a view to initiating a dialogue with the universities and to solicit their cooperation in teaching & research in Astronomy & Astrophysics (A&A) on their campuses IUCAA proposes to have a number of regional discussion meetings with faculty members of the universities.

The first meeting of this kind was held on 31 March 1990 at the Centre for Advanced Technology, Indore, for the Madhya Pradesh region. It was attended by faculty members from Devi Ahilya Vishwa Vidyalaya, Indore; Jiwaji University, Gwalior; Vikram University, Ujjain and two faculty members from IUCAA.

Professor Dadhich briefed the university representatives about the programmes and facilities available at IUCAA, and invited everyone from the universities interested in A&A to make use of them. The following points emerged during the ensuing discussion:

- M.Sc. syllabi are being revised in many universities. This opportunity should be taken to introduce 1 or 2 semester courses in A&A. Laboratory astrophysics experiments, as well as observations using the 3" telescopes which many universities already have, should be made an integral part of the course.
- 2. IUCAA should provide help in developing A&A syllabi for theoretical as well as practical work. IUCAA should arrange short lecture courses by its faculty in departments offering A&A.
- IUCAA should soon start the services of providing lists of recent publications, photocopies of papers etc. to the university community.

Similar meetings will be held at IIT Kanpur during April 20-21, 1990 and at Calcutta University on May 26, 1990.

#### INDORE WORKSHOP ON THE LASER INTERFEROMETRIC DETECTION OF GRAVITATIONAL WAVES

The direct detection of gravitational waves is one of the most challenging problems in experimental physics today. Success in this field will be of considerable significance both for astronomy, where new information about the universe can be obtained and for fundamental physics where various aspects of gravity theories can be checked. Indirect evidence of the existence of gravitational radiation has been provided by observations on the binary pulsar PSR 1913+16 and this gives added impetus to the experimental development in this field.

A workshop on interferometric gravitational wave detectors was held at the Centre for Advanced Technology (CAT), Indore during February 1-3, 1990 to consider the possibility of such an experiment in India. It was attended by twenty-five scientists including three experts, Professor Bernard Schutz, University of Wales, Cardiff; Dr. Brian Meers, University of Glasgow and Dr. Alain Brillet from CNRS, Orsay, Paris. In addition two Russian scientists were present who had been at CAT for another meeting. Professor Schutz began by describing the nature of gravitational waves, the effort being put into their detection and the various astrophysical sources of gravitational waves. Drs. Meers and Brillet described in detail the techniques required in the various aspects of the lasers, laser optics, seismic isolation, etc. The demands on the sensitivity and accuracy of the experiment require the technology to be pushed to its limits in almost all aspects. Professor S.N. Tandon described the TIFR experiment at Gouribidinur on the detection of the fifth force, Mr. A.S. Rajarao gave an account of vacuum technology in the country and Dr. D.D. Bhawalkar reviewed our capabilities in lasers and laser optics.

Feasibility calculations carried out by the experts revealed that a 100 metre detector operating in the narrow band mode may prove scientifically useful for, say, pulsar detection and could have similar sensitivity as the full scale detectors in their initial stages when they would necessarily be operating in the broad band mode. It would be prudent, at first to go for a 100 metre prototype on which experimen-

During the discussion session, it was generally felt that the experiment is technologically very challenging as well as formidable and the consensus was that an expert group should go into the various aspects of the experiment and submit a report on the feasibility of further work in this direction.

The expert group met on 30.3.90 at CAT and had in depth discussions on our capability and expertise for a 100 metre detector. It came to the conclusion that we do have adequate capability. Further work on the experiment can only be undertaken after a firm decision is taken at appropriate levels.

### RESEARCH NEWS

## COBE AND THE MICROWAVE BACK-GROUND

The Cosmic Background Explorer (COBE) Satellite was launched by NASA to make measurements of the spectrum and inhomogeneities of the cosmic microwave background (CMBR). The first findings are now being published in a paper entitled "A preliminary measurement of the CMBR by the COBE satellite" by a team of 21 scientists, Mather et al, in Astrophysical Journal Letters.

The CMBR is widely believed to be the relic of the early hot era in the big bang universe. As such the radiation background should fulfill two predictions : its spectrum should be Planckian and there should be small scale inhomogeneities imprinted on it as records of the formation of discrete structures - galaxies, clusters, etc. which came into existence later.

On the second count the data are being analyzed but the first indications are disappointing - the CMBR is extremely smooth, down to a sensitivity level that should have detected temperature fluctuations of a few parts in a hundred thousand. This negative finding poses a challenge to the theorists.

#### A MATTER OF STATISTICS

We do not know if the following story is true - it is too good to be otherwise.

In the 1950s when Professor and Mrs. Dirac were visiting India, they met Professor S.N. Bose in Calcutta. Having presided over Dirac's lecture, Bose accompanied the Diracs to their hotel. After making sure that both the Diracs were comfortably seated in the back seat of their limousine, Bose got into the front seat. Two of Bose's pupils also wanted to accompany him and they squeezed into the front seat too.

"Couldn't Professor Bose come to the back seat?" asked Mrs. Dirac. "He will be much more comfortable here." Bose, however, politely declined and Dirac offered an explanation in his brief but cogent style :

"It is a matter of statistics, my dear!."

On the first count, however, the above paper presents reassuring results. Contrary to another finding by the Japanese-U.S. rocket experiment (Matsumoto et al, AP.J. 329, 567, 1988) the COBE data are consistent with a Planckian spectrum of temperature 2.735K with error bars of 0.06K. The frequency range covered is 1 to 20  $cm^{-1}$ , i.e., it goes well past the short side of the Planckian peak - a region not accessible to ground based observations.

