



**Annual Report
of the
Inter-University Centre for Astronomy and Astrophysics**
An Autonomous Institution of the University Grants Commission

(April 1, 1991 – March 31, 1992)

Edited by
Pramila A. Malegaonkar

Cover (Front & Inside) : Panorama of Akashganga, IUCAA's Housing Colony



Design + Print : FRANKEL'S

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The Council and the Governing Body

The Council

President	Manmohan Singh (till June 21, 1991) Chairman, University Grants Commission	U. Baxi (till December 31, 1991) Vice-Chancellor, University of Delhi
	G. Ram Reddy (from September 9, 1991) Chairman, University Grants Commission	R.N. Basu (from January 1, 1992) Vice-Chancellor, Calcutta University
Vice-President	S.K. Khanna Vice-Chairman, University Grants Commission (Acting President, June 22 –September 8, 1991)	M.N. Faruqui (from January 1, 1992) Vice-Chancellor, Aligarh Muslim University
Members	P. Rama Rao Secretary to the Government of India, Department of Science & Technology	M.I. Savadatti (from January 1, 1992) Vice-Chancellor, Mangalore University
	U.R. Rao Secretary to the Government of India, Department of Space	K.N. Chatterjee Vice-Chancellor, North Bengal University
	S.K. Joshi Director General, Council of Scientific and Industrial Research	Dilavarsingh D. Jadeja Vice-Chancellor, Sardar Patel University
	Y.N. Chaturvedi Secretary, University Grants Commission	H.K. Manmohan Singh Vice-Chancellor, Punjabi University
	S.C. Gupte Vice-Chancellor, University of Poona	M. Lakshmanan Vice-Chancellor, Madurai Kamaraj University
	G. Swarup Director, NCRA, Pune	K.D. Abhyankar Emeritus Professor, Osmania University
	M. Bhattacharya (till December 31, 1991) Vice-Chancellor, University of Burdwan	A. Banerjee Department of Physics, Jadavpur University
	T. Navaneeth Rao (till December 31, 1991) Vice-Chancellor, Osmania University	N. Mukunda (till December 31, 1991) Indian Institute of Science, Bangalore
		H.S. Mani (from January 1, 1992) Mehta Research Institute of Mathematics and Mathematical Physics, Allahabad
		Archana Sharma (till December 31, 1991) Department of Botany, Calcutta University and Member, UGC
		Jafar Nizam (from January 1, 1992) Ex-Vice-Chancellor, Kakatiya University, Warangal and Member, UGC
		P.M. Mathews Department of Theoretical Physics, University of Madras
		R.K. Thakur Department of Physics, Ravishankar University

S.K. Trehan
Centre for Advanced Study in Mathematics,
Panjab University

Member Secretary J.V. Narlikar
Director, IUCAA

The Governing Body

Chairman Manmohan Singh (till June 21, 1991)
G. Ram Reddy (from September 9, 1991)

Vice-Chairman S.K. Khanna

Members Y.N. Chaturvedi
S.C. Gupta
G. Swarup
K.D. Abhyankar
U. Baxi (till December 31, 1991)
M. Bhattacharya (till December 31, 1991)
N. Mukunda (till December 31, 1991)
T. Navaneeth Rao (till December 31, 1991)
Archana Sharma (till December 31, 1991)
R.N. Basu (from January 1, 1992)
M.N. Faruqui (from January 1, 1992)
H.S. Mani (from January 1, 1992)
Jafar Nizam (from January 1, 1992)
M.I. Savadatti (from January 1, 1992)

Member Secretary J.V. Narlikar

Honorary Fellows

1. R. Hanbury Brown
Andover, England
2. S. Chandrasekhar
University of Chicago, USA
3. W.A. Fowler
California Institute of Technology, USA
4. A. Hewish
University of Cambridge, England
5. Sir Fred Hoyle
Bournemouth, England
6. D.S. Kothari
New Delhi
7. Yash Pal
New Delhi
8. A.K. Raychaudhuri
Calcutta
9. A. Salam
International Centre for Theoretical Physics,
Trieste, Italy
10. P.C. Vaidya
Ahmedabad

Visiting Members of IUCAA

Visiting Professors

Professor Abhay Ashtekar
Syracuse University, USA

Professor C.V. Vishveshwara
Raman Research Institute, Bangalore

Senior Associates

S.M. Alladin
Centre for Advanced Study in Astronomy,
Osmania University, Hyderabad

S.M.R. Ansari
Department of Physics,
Aligarh Muslim University, Aligarh

S. Banerjee
Department of Physics,
University of Burdwan, Burdwan

K.B. Bhatnagar
Zakir Hussain College, Delhi

H.L. Duorah
Department of Physics,
Gauhati University, Gauhati

A.N. Maheshwari
Cochin University of Science and Technology,
Kochi

S. Mukherjee
Department of Physics,
North Bengal University, Siliguri

B.K. Pal
Department of Physics,
Himachal Pradesh University,
Shimla

N. Panchapakesan
Department of Physics,
University of Delhi

L.K. Patel
Department of Mathematics,
Gujarat University, Ahmedabad

S.G. Tagare
School of Mathematics and CIS,
University of Hyderabad

V.R. Venugopal
School of Physics,
Madurai Kamaraj University, Madurai

S.D. Verma
Department of Physics and Space Science,
Gujarat University, Ahmedabad

Associates

G.M. Ballabh,
Department of Astronomy,
Osmania University, Hyderabad

Suresh Chandra
Department of Physics,
University of Gorakhpur, Gorakhpur

B.N. Dwivedi
Department of Physics,
Banaras Hindu University, Varanasi

K.N. Iyer
Department of Physics,
Saurashtra University, Rajkot

Pushpa Khare
Department of Physics,
Utkal University, Bhubaneswar

S. Mahajan
Department of Physics,
St. Stephens College, Delhi

Man Mohan
Department of Physics,
K.M. College, University of Delhi

Udit Narain
Department of Physics,
Meerut College, Meerut

S.K. Pandey
Department of Physics,
Ravishankar University, Raipur

R. Ramakrishna Reddy
Department of Physics,
Sri Krishnadevaraya University,
Anantpur

L.M. Saha
Department of Physics,
Zakir Hussain College, Delhi

A.K. Sapre
Department of Physics,
Ravishankar University, Raipur

P.P. Saxena
Department of Mathematics and Astronomy,
Lucknow University, Lucknow

T. Singh
Department of Applied Mathematics,
Institute of Technology,
Banaras Hindu University, Varanasi

D.C. Srivastava
Department of Physics,
University of Gorakhpur, Gorakhpur

S.K. Srivastava
Department of Mathematics,
North Eastern Hill University, Shillong

R.S. Tikekar
Department of Mathematics,
Sardar Patel University, Vallabh Vidyanagar

Post-Doctoral Fellows

G.C. Anupama
P. Das Gupta
C. Debiprasad
A.K. Kshirsagar
B.S. Sathyaprakash

Research Scholars

Debiprosad Duari
Tarun Ghosh
Kanti Jotania
Sucheta Koshti
Roopesh Ojha
Sagar Pandit
Manojit Roy
Ashutosh Sharma

Project Appointees

A. Shanti (C-DAC Project)
A. Sohoni (DST Project)

Visitors

J. Maharana (March 30-April 4),
Institute of Physics, Bhubaneswar

P.K. Kaw (April 22-23),
Institute of Plasma Research, Ahmedabad

Venkateswarulu (April 22-26),
Andhra University, Waltair

K. Indulekha (May 1-23),
Mahatma Gandhi University, Kottayam

D. Banhatti (May 1-June 30),
Madurai Kamaraj University, Madurai

M. Krishan (May 10-June 10),
Bangalore

S. Mukherjee (May 11-June 11),
North Bengal University, Darjeeling

S.D. Verma (May 14-June 16),
Gujarat University, Ahmedabad

G.M. Ballabh (May 15-June 11),
Osmania University, Hyderabad

A. Dolke (May 17-20),
Kutuhall, Nagpur

A.S. Khadakkar (May 17-20),
Kutuhall, Nagpur

A. Deo (May 17-20),
Kutuhall, Nagpur

P. Khare (May 20-June 22),
Utkal University, Bhubaneswar

S. Chandra (May 20-July 14),
University of Gorakhpur, Gorakhpur

M. Sharma (May 20-July 14),
University of Gorakhpur, Gorakhpur

L.K. Patel (May 21-June 14),
Gujarat University, Ahmedabad

T.K. Dey (May 21-June 22),
University of Burdwan, Burdwan

D. Bhattacharya (May 21-June 22),
University of Burdwan, Burdwan

S. Banerjee (May 21-June 23),
University of Burdwan, Burdwan

Ramesh Tikekar (May 27-June 15),
Sardar Patel University, Vallabh Vidyanagar

R. Gaunekar (May 31-June 21),
Goa University, Goa

S. Mahajan (June 2-16),
St. Stephen's College, Delhi

S. Iyer (June 2-July 12),
Indian Institute of Technology, Bombay

B. Bapat (June 2-July 12),
IIT, Bombay

S. Ghosh (June 2-July 12),
Indian Institute of Technology, Delhi

R. Ramasubramaniam (June 2-July 12),
Indian Institute of Technology, Madras

A. Mahabal (June 2-July 12),
Nagpur University, Nagpur

Gopakumar (June 2-July 12),
Cochin Univ. of Science & Technology, Cochin

J. Jacob (June 2-July 18),
Indian Institute of Technology, Madras

K. Roy (June 2-July 12),
Jadavpur University, Jadavpur

C. V. Vishveshwara (June 3-23),
Raman Research Institute, Bangalore

H.L. Duorah (June 10-July 13),
Gauhati University, Guwahati

V.B. Johri (June 16-30),
Indian Institute of Technology, Madras

K.S.V.S. Narasimhan (June 16-30), Madras

S.R. Das (June 18-July 13),
Franklin and Marshall College, USA

K.B. Bhatnagar (June 18-July 4),
Zakir Hussain College, Delhi

L.M. Saha (June 18-July 5),
Zakir Hussain College, Delhi

P.J. Lavakare (June 19-22),
Department of Science & Technology, New Delhi

J.K. Sharma (June 19-22),
Department of Science & Technology, New Delhi

J.C. Bhattacharya (June 19-23),
Indian Institute of Astrophysics, Bangalore

Kameshwar Rao (June 19-23),
Indian Institute of Astrophysics, Bangalore

P.V. Kulkarni (June 19-22),
Physical Research Laboratory, Ahmedabad

R. Cowsik (June 20-22),
Tata Institute of Fundamental Research, Bombay

N. Krishnan (June 20-22),
Tata Institute of Fundamental Research, Bombay

G.C. Kilambi (June 20-22),
Osmania University, Hyderabad

Prasad (June 20-24),
Department of Science & Technology, New Delhi

Ashok Kumar (June 20-24),
Department of Science & Technology, New Delhi

Venkatkrishnan (June 20-22),
Indian Institute of Astrophysics, Bangalore

M.D. Tiwari (June 20-22),
University Grants Commission, New Delhi

M.S. Tewari (June 20-23),
Doctor Harisingh Gaur Vishwavidyalaya, Sagar

M.B.K. Sharma (June 20-23),
Osmania University, Hyderabad

A. Bhatnagar (June 20-23),
Udaipur Solar Observatory, Udaipur

J.N. Desai (June 20-23),
Physical Research Laboratory, Ahmedabad

P. Vivekananda Rao (June 20-22),
Osmania University, Hyderabad

C. Raghavender Rao (June 20-22),
Osmania University, Hyderabad

K.S.B. Manian (June 20-22),
Physical Research Laboratory, Ahmedabad

U.C. Joshi (June 20-22),
Physical Research Laboratory, Ahmedabad

B.G. Anandrao (June 20-22),
Physical Research Laboratory, Ahmedabad

M.K. Das (June 20-24),
Shri Venkateswara College, New Delhi

B.V. Sreekantan (June 21-23),
Tata Institute of Fundamental Research, Bombay

T. Padmanabhan (June 21-23),
Tata Institute of Fundamental Research, Bombay

V.R. Venugopal (June 21-23),
Madurai Kamaraj University, Madurai

S.M. Alladin (June 24-July 13),
Osmania University, Hyderabad

P.S. Desikan (June 25-30),
National Airports Authority, Ahmedabad

D.K. Ojha (June 25-July 20),
Uttar Pradesh State Observatory, Nainital

S.K. Pandey (June 29-July 22),
Ravishankar University, Raipur

P. Monger (July 2-10),
McMaster University, Ontario, Canada

R. Pudritz (July 5-10),
McMaster University, Ontario, Canada

Umashankar Mitra (July 8-11),
Kendriya Vidyalaya, Sarna, M.P.

S.R. Valluri (July 8-August 6),
The University of Western Ontario, Canada

P.C. Vaidya (July 11-13),
Gujarat University, Ahmedabad

J. Sulentic (July 13-17),
The University of Alabama, Alabama, USA

U. Yagnik (July 13-20),
Indian Institute of Technology, Bombay

Vijay Mohan (July 16-August 2),
Uttar Pradesh Solar Observatory, Nainital

G.C. Anupama (July 20-29),
Indian Institute of Astrophysics, Bangalore

S.K. Datta (July 20-28),
Institute of Radiophysics & Electronics, Calcutta

Kalyanakrishnan (July 20-27),
Raman Research Institute, Bangalore

Ramsagar (July 20-29),
Indian Institute of Astrophysics, Bangalore

P. Monger (July 21-26),
McMaster University, Ontario, Canada

R. Pudritz (July 21-22),
McMaster University, Ontario, Canada

J. Sulentic (July 21-26),
The University of Alabama, Alabama, USA

A. Ambastha (July 21-24),
Udaipur Solar Observatory, Udaipur

M.P. Bora (July 21-28),
University of Delhi, Delhi

U.C. Joshi (July 21-26),
Physical Research Laboratory, Ahmedabad

B. Lokanadham (July 21-27),
Osmania University, Hyderabad

S. Mohanty (July 21-27),
Utkal University, Bhubaneswar

S.Sreedhar Rao (July 21-27),
Osmania University, Hyderabad

P. Vivekananda Rao (July 21-27),
Osmania University, Hyderabad

P. Seema (July 21-28),
Physical Research Laboratory, Ahmedabad

R. Swaminathan (July 21-27),
Osmania University, Hyderabad

A. Narayan (July 21-27),
Gujarat University, Ahmedabad

P.N. Bhat (July 22-25),
Tata Institute of Fundamental Research, Bombay

K.P. Singh (July 22-25),
Tata Institute of Fundamental Research, Bombay

Ratan Bisht (August 2-December 31),
Tata Institute of Fundamental Research, Bombay

Geetha Jayaram (August 9-23),
Osmania University, Hyderabad

S. Iyer (September 7-14),
Physical Research Laboratory, Ahmedabad

K. Ratnatunga (September 8-27),
Inst. of Fundamental Studies, Sri Lanka.

N.V.G. Sarma (September 11-20),
Raman Research Institute, Bangalore

V. Radhakrishnan (September 15-18),
Raman Research Institute, Bangalore

G.R. Burbidge (September 16-24),
Univ. of California, San Diego

P.P. Saxena (September 16-October 7),
University of Lucknow, Lucknow

B.R. Iyer (September 22-29),
Raman Research Institute, Bangalore

V.B. Bhatia (September 30-October 7),
University of Delhi, Delhi

R. Ramakrishna Reddy (October 5-21),
Sri Krishnadevaraya University, Anantapur

Titus K. Mathew (October 6-December 1),
Cochin Univ. Of Sc. & Technology, Cochin

P. Khare (October 7-21),
Utkal University, Bhubaneswar

A.W. Wolfendale (October 9),
University of Durham, Durham, U.K.

Udit Narain (October 11-November 9),
Meerut College, Meerut

A. Mahabal (October 16-November 2),
Nagpur University, Nagpur

Ramesh Tikekar (October 17-November 3),
Sardar Patel University, Vallabh Vidyanagar

S.K. Gupta (October 19-26),
Uttar Pradesh State Observatory, Nainital

U. Khanal (October 19-November 28),
Tribhuvan University, Nepal

T.C. Phukan (October 19-27),
Gauhati University, Gauhati

D.K. Chakraborty (October 19-26),
Ravishankar University, Raipur

K. Mehta (October 20-26),
Physical Research Laboratory, Ahmedabad

D.B. Vaidya (October 20-26),
Physical Research Laboratory, Ahmedabad

B.A. Kagali (October 20-26),
Bangalore University, Bangalore

M.L. Kurtadikar (October 20-26),
JES College, Jalna

M.N. Anandram (October 20-26),
Bangalore University, Bangalore

B.N. Ashoka (October 20-25),
Indian Space Research Organisation, Bangalore

N.M. Ashok (October 20-26),
Physical Research Laboratory, Ahmedabad

C.H. Kumar (October 20-26),
Osmania University, Hyderabad

Ramsagar (October 20-25),
Indian Institute of Astrophysics, Bangalore

H.L. Duorah (October 21-November 5),
Gauhati University, Guwahati

T.P. Singh (October 27-30),
Tata Institute of Fundamental Research, Bombay

Prasenjit Saha (October 30-November 2),
CITA, Toronto, Canada

S. Chakravarti (November 20-24),
California State Polytechnic University, Pomona,
California, USA

D.K. Ojha (November 22-29),
Uttar Pradesh State Observatory, Nainital

P.C. Vaidya (November 24-28),
Gujarat University, Ahmedabad

D.C. Srivastava (November 24-29),
University of Gorakhpur, Gorakhpur

Pankaj Joshi (November 25-28),
Tata Institute of Fundamental Research, Bombay

I.H. Dwivedi (November 25-28),
Agra University, Agra

L.K. Patel (December 1-March 31),
Gujarat University, Ahmedabad

N.M. Ashok (December 2- 4),
Physical Research Laboratory, Ahmedabad

U.C. Joshi (December 3- 4),
Physical Research Laboratory, Ahmedabad

J.N. Desai (December 3- 4),
Physical Research Laboratory, Ahmedabad

S.R. Kulkarni (December 4-31),
California Institute of Technology, California, USA

Cecilia Iwaniszewska (December 5-10),
Nicholas Copernicus University, Torun, Poland

Peter L.M. Heydemann (December 6),
U.S. Embassy, New Delhi

S.G. Tagare (December 8-30),
Univ. of Hyderabad, Hyderabad

V.R. Venugopal (December 8-29),
Madurai Kamaraj University, Madurai

Ludmila Kiseleva (December 18-June 16),
Russian State Pedagogical Univ., Russia

S. Mukherjee (December 19-January 5),
North Bengal University

R. Brandenberger (December 19-25),
Brown University, Providence, Rhode Island,
USA

S. Habib (December 19-25),
Los Alamos Scientific Lab, Gainesville, USA

H. Kandrup (December 19-January 6),
University of Florida, Florida, USA

A. Coley (December 19-20),
Dalhousie University, Halifax, Canada

A. Beesham (December 20-24),
University of Zululand, Natal, South Africa

S.D. Verma (December 21-January 5),
Gujarat University, Ahmedabad

S.M.R. Ansari (December 21-January 5),
Aligarh Muslim University, Aligarh

A. Ashtekar (December 24-January 5),
Syracuse University, Syracuse, USA

K. Indulekha (December 24-January 4),
Mahatma Gandhi University, Kottayam

R. Kulkarni (December 25-January 9),
Raman Research Institute, Bangalore

B.K. Pal (December 27-February 11),
Himachal Pradesh University, Shimla

A.K. Raychaudhuri (December 27-30),
Presidency College, Calcutta

G. Ram Reddy (December 29),
University Grants Commission, Delhi

Sethumadhava Rao (December 29),
University Grants Commission, Delhi

S.K. Srivastava (January 5-February 2),
North-Eastern Hill University, Shillong

Frank Verheest (January 12-14),
Rijksuniversiteit Gent, Ghent, Belgium

Aliev Alikram (January 14-27),
Shemakha Astrophysical Observatory, Mamedalieva,
Azerbaijan

Probir Roy (January 20-21),
Tata Institute of Fundamental Research, Bombay

M. Vivekananda (January 20-25),
Raman Research Institute, Bangalore

P. Eggleton (January 25-February 22),
Institute of Astronomy, Cambridge, UK

P.M. Bhargava (January 27),
Centre for Cellular and Molecular Biology, Hyderabad

J. Anosova (January 31-July 31),
St. Petersburg State University, Russia

K.H. Mariwalla (February 3-7),
Institute of Mathematical Sciences, Madras

S. Basu (February 6-15),
Tata Institute of Fundamental Research, Bombay

T. Padmanabhan (February 10-12),
Tata Institute of Fundamental Research, Bombay

Charles Townes (February 13),
Univ. of California, Berkeley, USA

S.K. Pandey (February 19-March 3),
Ravishankar University, Raipur

B.K. Pal (February 26-March 9),
Himachal Pradesh University, Shimla

R.G. Mukhopadhyay (February 26-27),
Indira Gandhi National Centre for the Arts, New
Delhi

Charanjit Singh Aulakh (March 3- 5),
Institute of Physics, Bhubaneswar

Avinash Sharma (March 6-12),
Kurukshetra University, Kurukshetra

N.C. Mathur (March 10-12),
Indian Institute of Technology, Kanpur

V.L. Chopra (March 10-11),
Indian Council of Agricultural Research, Delhi

B.K. Pal (March 15-18),
Himachal Pradesh University, Shimla

Christopher Tout (March 18-April 2),
Institute of Astronomy, Cambridge, UK

B. Sinha (March 25-27),
Variable Energy Cyclotron Centre, Calcutta

S. Basu (March 28-30),
Tata Institute of Fundamental Research, Bombay

Director's Report

1991--92 is (hopefully!) the last year when IUCAA functioned from temporary premises. The move to the institutional buildings will take place during 1992--93. I take this opportunity to thank all my colleagues (academic, scientific and administrative) for bearing cheerfully with all the inconvenience and giving their best to the various programmes of IUCAA.

Fig. 1 : Geographical Distribution of IUCAA's Academic Activities

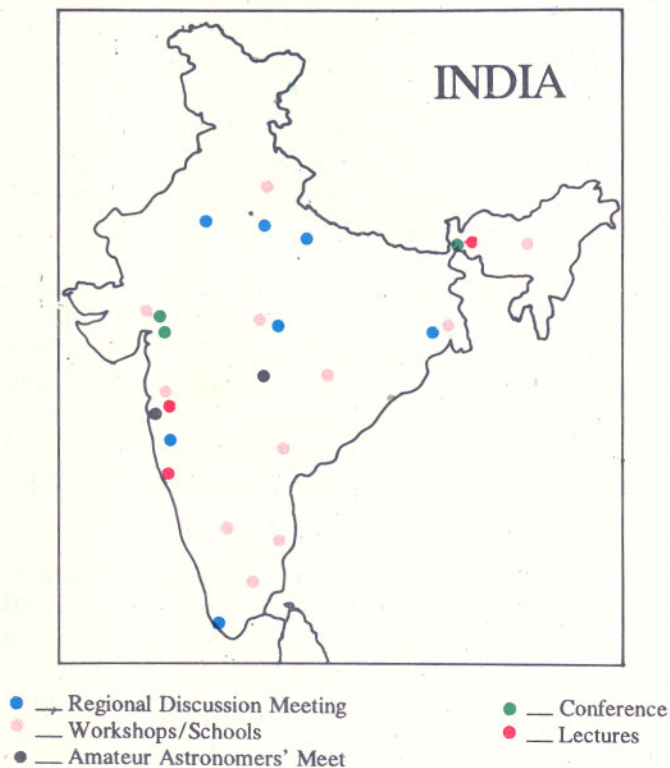
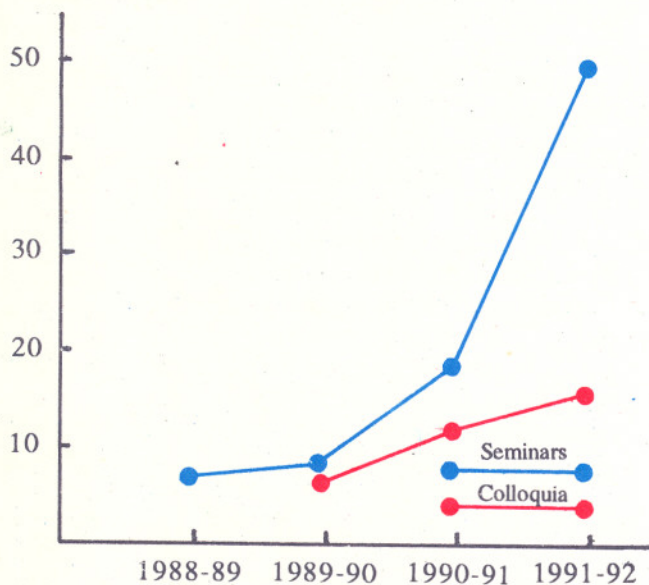
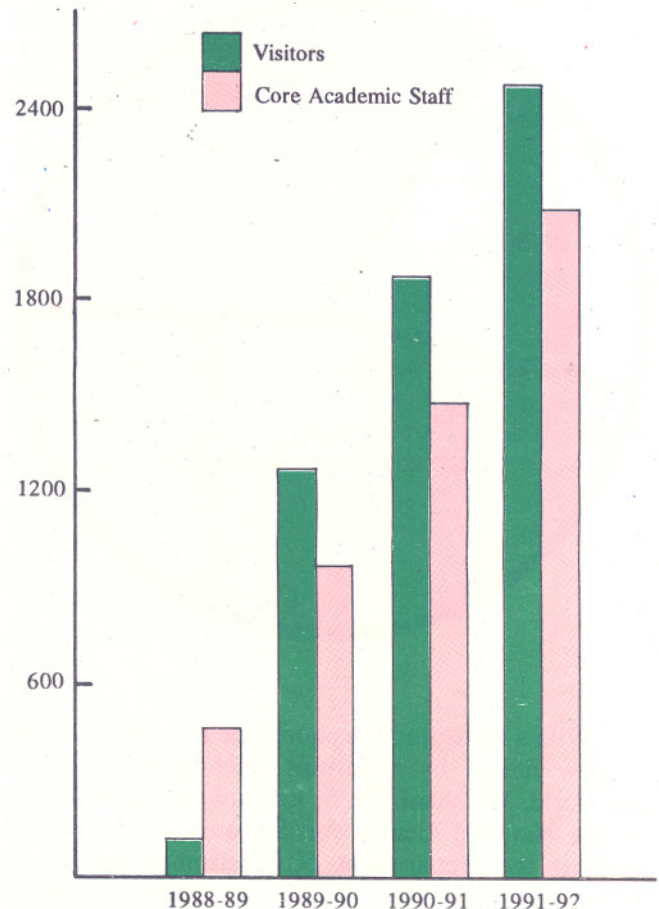


Fig. 2 : Seminar Activities



Figures 1-3 illustrate the growth in IUCAA's academic programmes and their nationwide impact. The users of IUCAA from universities and colleges have been steadily growing in numbers. We are still

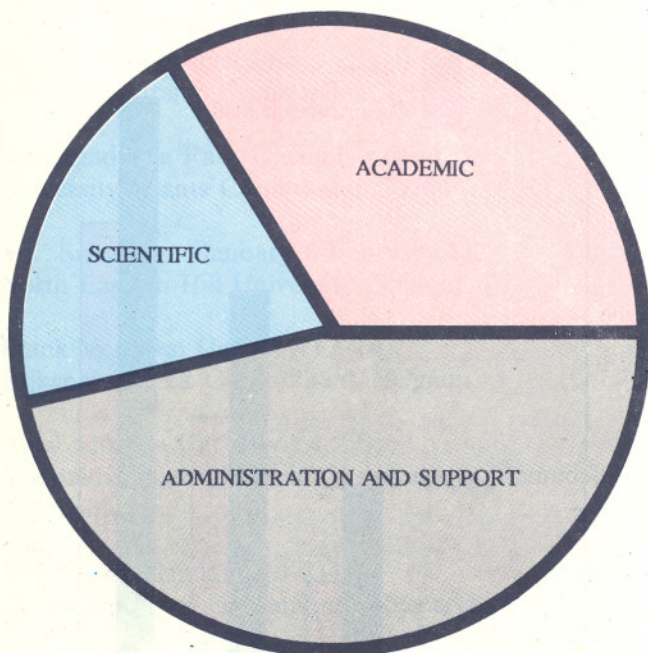
Fig. 3 : Visitor man-days in comparison with core academic staff man-days



some way from our aim to have the visitor rectangle' in Figure 3 rise to three times the size of the core rectangle'. With the completion of our buildings we hope that this goal will be attained quickly.

Figure 4 shows the relative numbers of the academic, scientific and infrastructural members of IUCAA. Automation, one person--many duties, self reliance in work culture and innovations are called for to keep the third sector small in comparison with the first two.

Fig. 4 : Membership Composition



With a dedicated telephone line to Bombay IUCAA is now linked by electronic mail with the rest of the world. We thank Dr. S. Ramani and his colleagues at the National Centre for Software Technology as well as the Department of Electronics for help in setting up this facility. We also thank the Department of Science and Technology for giving us a project grant for setting up the Astronomical Data Centre as a national facility.

For the information on the augmentation of the existing facilities and details of IUCAA's various academic programmes including inhouse research, see the various sections of this Annual Report. The IUCAA Symbol shown on the opening page was designed by Professor Kirti Trivedi of the Industrial Design Centre of the Indian Institute of Technology, Bombay. It depicts the networking--interacting character of the inter-university centre (IUC) as well as the unending nature of the cosmic puzzle encountered in astronomy and astrophysics (A & A).

The construction of the 500 seater IUCAA

auditorium has begun and it should be completed during 1992-93. This will enable us to host major conferences, symposia and public lectures on the campus starting with the VI Asian Pacific Regional Meeting of the International Astronomical Union scheduled for August 16-20, 1993. The auditorium will be an asset to the many science-popularisation programmes we have on the drawing board.

This year's Foundation Day Lecture was delivered by Professor Amal Kumar Raychaudhuri who is an Honorary Fellow of IUCAA. The text of his lecture is printed in this Annual Report. It is a pleasure to welcome four distinguished friends as Honorary Fellows. Besides Professor Raychaudhuri, this year we have added to our rolls Professor Yash Pal (to whom we owe the genesis of IUCAA), Professor P.C. Vaidya (the doyen of Indian relativists) and Professor R. Hanbury Brown (an eminent astronomer with warm links with India).

Through this report, as on various other occasions, I appeal to the Vice-Chancellors and Heads of Colleges to look upon IUCAA as a field station of their institutions, and permit their faculty members and students to use IUCAA facilities as if they are on duty. Its inter-university character (the IUC' of IUCAA) can flourish only if the users look upon the centre as their own.

Last, but not the least, we thank Chairman Professor Ram Reddy, his colleagues and the staff at the University Grants Commission for guidance and assistance whenever we needed it.

Jayant Narlikar

Jayant Narlikar

Calendar of Events

April 5	Astronomical Data Centre initiated
June 5	Canteen Facility started functioning
June 6 - July 12	First IUCAA Vacation Students Programme
June 21-22	IUCAA hosted Group monitoring workshop on DST funded projects in A & A
June 24-27	Mini-workshop on gravitation and gravitational radiation, HNB Garhwal University, Srinagar
June 25	Council and Governing Body Meetings, at the premises of the University Grants Commission New Delhi
July 1	The second batch of Senior Associates and Associates join IUCAA
July 21-26	Image Processing Workshop at IUCAA
September 16-17	Scientific Advisory Committee (SAC) Meeting at IUCAA
October 21-25	Mini-workshop on Automated Photoelectric Telescopes (APTs) at IUCAA
November 16	Regional Discussion Meeting for the Universities of Western India, at the M.L. Sukhadia University, Udaipur
December 2-7	Mini-workshop on Photoelectric Photometry of Variable Stars, at the Gauhati University, Gauhati
December 10-11	XVI th Meeting of the Indian Association for General Relativity and Gravitation (IAGRG), at the Sardar Patel University, Vallabh Vidyanagar
December 13-18	International Conference on Gravitation and Cosmology (ICGC-91), at the Physical Research Laboratory, Ahmedabad
December 23-27	Mini-workshop on Quasars-Continuum and Line Radiation, at the Ravishankar University, Raipur
December 29	Visit by the Chairman, UGC; IUCAA Foundation Day Lecture
January 4-5	All India Amateur Astronomers' Meet at Gandhi Ashram, Sevagram

January 18	Regional Discussion Meeting for Universities of Southern India, at the University of Kerala, Trivandrum
January 28-February 1	Mini-workshop on Early Universe at the Jadavpur University, Calcutta
January 29	Work begins on the phase III (Auditorium) of IUCAA campus
February 10-14	Young Astronomers' Meet at IUCAA-NCRA campus
February 15	Regional Discussion Meeting for Northern region, at the Aligarh Muslim University
February 24-28	Workshop on Experimental Techniques in Space Science and Astronomy, at the Gujarat University
March 2-6	Mini-workshop on Plasma Astrophysics, at the Indian Institute of Astrophysics, Bangalore
March 14-16	Mini-school on Introductory Astronomy, at the Indian Institute of Technology campus, Madras

Colloquia

- J. Maharana : Wormholes and the cosmological constant, April 1.
- P.K. Kaw : An observed non-linear effect in radiative plasmas, April 22.
- A. Gore : Statistical dimension of ecological issues, April 29.
- C.V. Vishveshwara : Of bees, bubbles and black holes, June 17.
- P.C. Vaidya : A model universe with a conical singularity, July 12.
- S. Ramani : Computer networking for research institutions, July 15.
- Aditi Pant : Indian expeditions to Antarctica : A personal experience, July 29.
- S. Rangarajan : Indian satellite programme, August 19.
- A. Ashtekar : Quantum gravity : old problems and new hopes, January 3.
- Frank Veerhest : Beam-Plasma processes in the heliosphere, January 13.
- Probir Roy : Gravitino mass and cosmology, January 20.
- P.M. Bhargava : Origin of the first living cell, January 27.
- P.V. Panat : 1991 Nobel prize in Physics : P. De Gennes, February 24.
- V.L. Chopra : Conventional and modern methods of improving crop varieties, March 11.
- Bikash Sinha : Quark gluon plasma -- A new state of matter : Terrestrial and cosmological, March 26.

Seminars

- R. Venkateswarulu : Some anisotropic cosmological models in certain alternative theories of gravitation, April 25.
- K. Indulekha : A slow collapse model for galaxies and the possibility of magnetic braking in elliptical galaxies, May 15.
- V. Chellathurai : Effective mass of stationary spacetimes, May 16.
- C.V. Vishveshwara : Frenet-Serret formalism, symmetries, rotation and all that, June 12 and 14.
- Ralph Pudritz : Hydromagnetic disk winds in young stellar objects and AGN, July 5.
- Jack Sulentic : Mysteries of compact groups, July 16.
- Jack Sulentic : Line profiles in active galactic nuclei, July 17.
- V. Radhakrishnan : Of wind and water -- About sailboats, September 16.
- N.V.G. Sarma : Millimetre and sub-millimetre receivers for radio-astronomy, September 19.
- G.R. Burbidge : BL Lac objects, September 19.
- Kavan U. Ratnatunga : Statistical analysis of star catalogs using maximum likelihood estimation, September 24.
- B.R. Iyer : Problems and techniques in gravitational radiation theory followed by a series of talks centered on the topics : STF techniques for multipole expansions and Generation problems for gravitational radiation, September 23--27.
- A.W. Wolfendale : Cosmic rays of the highest energies, October 9.
- S.N. Tandon : Active Optics, October 15.
- A.K. Kembhavi : Quasar X-ray spectra and relativistic beaming, October 18.
- Udit Narain : Mechanisms of chromospheric and coronal heating, October 24.
- Tarun Ghosh : Field theory on a cone, November 1.
- C. Iwaniszewska : Dawn of spectroscopy, December 6.
- S.R. Kulkarni : Pulsar timing - Introductory discussion, December 7.
- S.R. Kulkarni : Young pulsars, December 19.
- S.R. Kulkarni : Millisecond and binary pulsars, December 20.
- S.R. Kulkarni : Globular cluster pulsars, December 21.
- S.R. Kulkarni : Pulsar as probes and sources of gravitational waves, December 23.
- Salman Habib : LAGEOS -- A satellite experiment to measure the Lense Thirring effect, December 23.
- Robert Brandenberger : A non-singular universe; Cosmic strings, textures and structure formation, December 24.
- V.R. Venugopal : Recent revelations on the crab nebula, December 24.
- Henry Kandrup : Non-violent relaxation, January 2.
- Aliiev Alikram : Physical processes near cosmic strings, January 22.
- Peter Eggleton : Some aspects of evolution of binary stars (Pedagogical Lecture Series), January 31, February 7, February 14, February 20.
- Peter Eggleton : A small step in a giant problem, February 3.
- K.H. Mariwala : Universe as a black hole, February 5.
- Charles Townes : High resolution spatial interferometry of stars, February 13.
- Ludmila Kiseleva : Dynamics of small galaxy groups and hidden mass problems, February 18.
- Joanna Anosova : Dynamical evolution of triple star and galaxy systems, February 19.
- Peter Eggleton : Triple stars, low-mass X-ray binaries and other related topics, February 21.
- Anand Karandikar : Intellectual property rights, February 25.

Charan Aulakh : Syncyclons : Evidence for extra dimensions?, March 4.

Mukul Kumar : On heating of the solar corona, March 13.

Christopher A. Tout : Magnetic dynamo viscosity and spin-down of protostars, March 23.

Christopher A. Tout : Determining the low-mass IMF, March 30.

In addition, there were IUCAA-NCRA 'Informal Discussion Group' meetings, organized on alternate thursdays where members of IUCAA and the National Centre for Radio Astrophysics presented two informal half-hour reviews of important developments in A & A as reported in journals, preprints or e-mail.

Academic Activities

(I) Research

Gravitational Wave Data Analysis

Data analysis of coalescing binary signals : Since the advent of laser interferometric gravitational wave detectors, coalescing binaries have become the most promising candidates for the detection of gravitational waves. Signals from coalescing binaries will most probably not stand above the broad band noise of the detector. Their detection is possible by the use of special data analysis techniques like matched filtering which takes advantage of the fact that the waveform can be fairly well predicted. Although the waveform of the coalescing binary signal is known, the parameters of the signal are not known a priori and the signal needs to be correlated with several filters which are copies of the coalescing binary waveform for various values of the parameters. B.S. Sathyaprakash and S.V. Dhurandhar have proposed an algorithm for choosing a lattice set of filters by the criterion that every signal of a certain minimal strength is picked by at least one filter of the set. The waveform is characterized by three parameters : the time of arrival, the mass parameter and the phase of the signal. It is shown that it is enough to have just two filters corresponding to the phase of the signal. This leads to enormous saving in computer time making online data analysis possible with present computing speeds. For the range of mass parameter considered, however one has to construct a reasonably dense set of filters so that no signals are missed out while at the same time the number of computations are kept within the limit imposed by the available computing speed. The analysis has been carried out for white noise. (If the power spectral density of the noise remains constant as a function of frequency the noise is called white'.) A numerical experiment has been carried out on the 256 node parallel processing machine at C-DAC where a speed of 85 Mflops was obtained. Efforts are on the way to increase this speed to about 120 Mflops which is in the range for online data-analysis. In a restricted sense, we have shown that the computing power decides the distance to which we can see and hence the number of detectable events.

B.S. Sathyaprakash and S.V. Dhurandhar have further refined the analysis to include coloured noise present in the data from various modes of recycling especially that from standard recycling. For coloured noise the power spectral density of the noise is not constant but is a function of the frequency.

In this case, the distance between the filters is actually increased since the correlation function does not possess a sharp peak at its maximum due to the higher frequencies of the signal being chopped off.

K. Jotania, S. Wagh and S.V. Dhurandhar have studied the signal-to-noise ratios with the post-Newtonian terms being included in the wave form. It is shown that the signal-to-noise ratios are reduced. This is mainly because the orbit of the binary decays faster due to larger radiation reaction effects leading to a shorter duration of the detected signal.

The problem of estimating the parameters of the coalescing binary is being looked into. It is found that the covariance matrix can be viewed as a metric on the space of parameters and this is useful in gaining insight into the problem where an error in one parameter introduces errors in other parameters.

Optimal orientation problem : S.V. Dhurandhar and his coworkers have carried out some preliminary calculations on the optimal orientation which basically involves using the antenna patterns of several detectors to maximise the detection probability by optimally orienting the detectors. They assume coloured Gaussian noise in the detectors but with different amplitudes. The computation will involve maximising a certain integral representing the detection probability. The first computation will be carried out for two laser interferometric detectors and will apply to the case of the planned LIGO detectors.

Gravitational wave generation problems : Gravitational radiation from supernovae is being studied by Patrick Das Gupta. There is observational evidence for the existence of supernova associated with very fast pulsar, suggesting that the supernova explosion is highly asymmetric. The problem of obtaining lower bounds to the gravitational wave amplitude from such sources is being studied.

Patrick Das Gupta and S.R. Valluri are looking into the production of thermal gravitons from the core of a pre-supernova star. According to the preliminary results, the energy flux is appreciable but the gravitons have very high frequency to be of interest as far as direct detection is concerned.

Extragalactic Astronomy and Cosmology

The universe as we see it today is a boundless collection of galaxies distributed in clusters and superclusters, all of it bathed in a uniform background of radiation. While the observers concentrate in charting out the structural details of the universe

connection formulation. Further, it is shown that the spacetime metric can be reconstructed from the spin connection and the scalar field.

Wormhole physics : For the purpose of computing topology changing amplitudes, it is imperative to study the 'instanton' type solutions to classical Euclidean gravity. These 'wormhole' solutions were first obtained in gravity theories coupled to antisymmetric tensor fields. It was further shown that such solutions are fairly generic to matter coupled with gravity. S. Mukherjee (Senior Associate, IUCAA), B.C. Paul, Naresh Dadhich and A. Kshirsagar have obtained analytic forms of instanton solutions for an interacting scalar field coupled to gravity, by developing a general technique. They further compute on-shell the scalar field potential which drives these solutions and also evaluate the finite actions in a closed form. This method encompasses all previously known solutions.

Cylindrically symmetric models : At the present state of evolution the universe is spherically symmetric and matter-energy distribution in it is overall isotropic and homogeneous. But in its early stages of evolution, it could not have had such a smoothed out picture. Close to the big-bang singularity, neither the assumption of spherical symmetry nor of isotropy would be valid. With the view to construct a model with less restrictive symmetry than spherical, L.K. Patel (Senior Associate, IUCAA) and N. Dadhich have investigated cylindrically symmetric universe filled with viscous fluid having heat and radiation flow.

At the big-bang, matter is in highly compact form and hot, and hence it may have very exotic attributes. They have obtained a number of models with viscosity, heat and radiation flow. It is well known that the behaviour of the big-bang singularity is described by the Kasner empty spacetime which has the oscillatory character (contraction in two directions and expansion in the third and so on). The remarkable feature of their models is that all of them have the Kasnerian time evolution and more interestingly some of them have the Kasner model as their matter-free limit. These models may therefore be applicable for description of the universe very close to the big-bang singularity.

2 + 1 dimensional gravity : Einstein gravity in 2 + 1 dimensions is devoid of any intrinsic dynamics owing to the fact that the Ricci and the Riemann tensors have the same number of independent components. Gravity outside a source manifests itself as global topology with conserved quantities being related to topological invariants. In particular, the space around a point mass in 2 + 1 dimensions has a conical geometry. T.S. Ghosh and V. Sahni

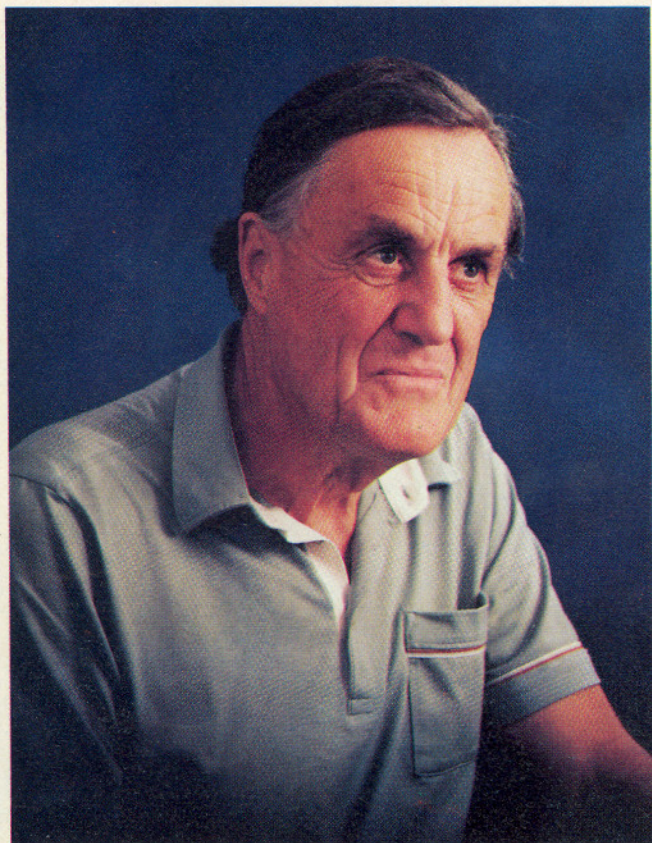
have investigated such configurations and found that this topological nontriviality affects the zero point fluctuations of any quantum field residing on the spacetime leading to vacuum polarisation and a non zero expectation value of the energy momentum tensor. The resulting semi-classical Einstein equations have a well defined Newtonian limit, in marked contrast to the classical case. The extension of the above to non-static spacetime with a cosmological constant show interesting results like the presence of a non zero vacuum flux, an inversion of particle statistics, etc. in addition to the vacuum polarisation caused by the conical nature of the spacetime geometry.

Chemical evolution of galaxies

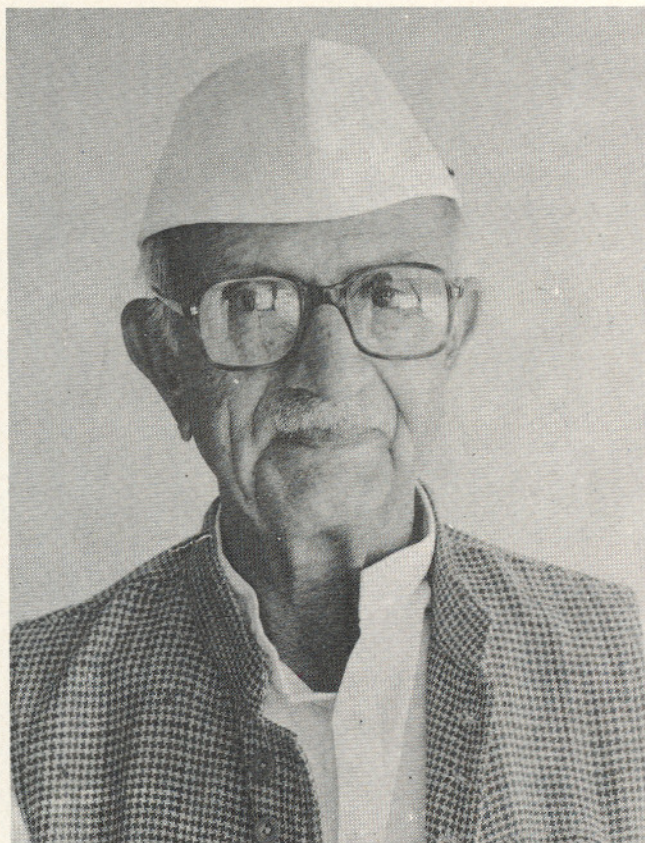
It is known that in the standard hot big bang model of the Universe, elements heavier than helium were synthesized in minuscule amounts (less than one part in billion) compared to their observed values in stars and galaxies at the present epoch. It means that most of the elements heavier than boron were to be synthesized in stars or some other astrophysical sources. Stars are continually born from interstellar gas, synthesize helium and all the other important heavy elements in the central region of the stars, and a good many of them eventually throw away a lot of newly processed heavy elements back to the interstellar medium by catastrophic processes, such as novae and supernovae, or even by quiet processes, such as stellar winds. In this way, the interstellar medium is continually enriched with the heavy elements at the expense of hydrogen as well as the total gas content, leaving behind dead remnants, such as white dwarfs, neutron stars and black holes, and of course, an ever-growing population of long-lived low mass stars. The chemical evolution of galaxies comprises the study of all these aspects including the galactocentric distribution of abundances of elements in stars, ionized hydrogen regions, supernova remnants, the distribution of white dwarf and pulsar populations, occurrence rates of supernovae, cooling rates of white dwarfs and neutron stars, variation of spectral colors, the variation in the rates of star formation etc.

Over the past seven years, Narayan Chandra Rana has worked extensively in this field, and a summary of the work can be presented as follows: an empirical law of star formation has been proposed which consistently reproduced various observational data; a mass function of stars in the solar neighbourhood was derived with due consideration of the existence of multiple stellar components which eliminated the need for evoking dark matter in the solar neighbourhood; an age-metallicity relation for iron is derived from a combination of the existing

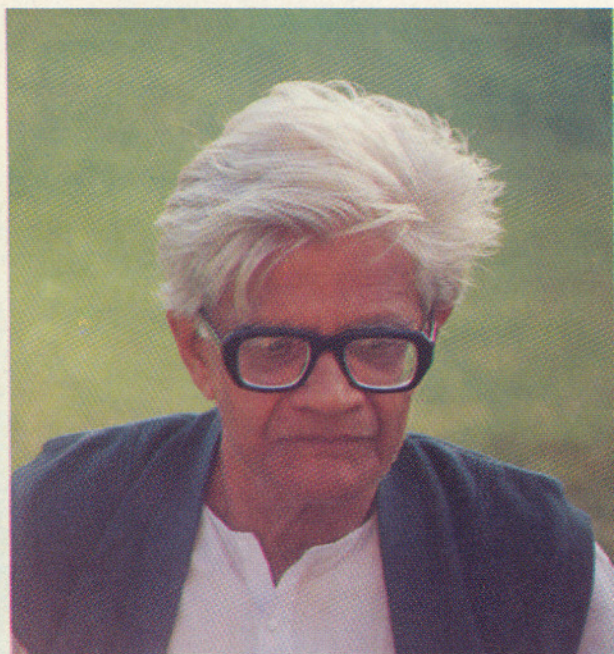
Honorary Fellows



R. Hanbury Brown



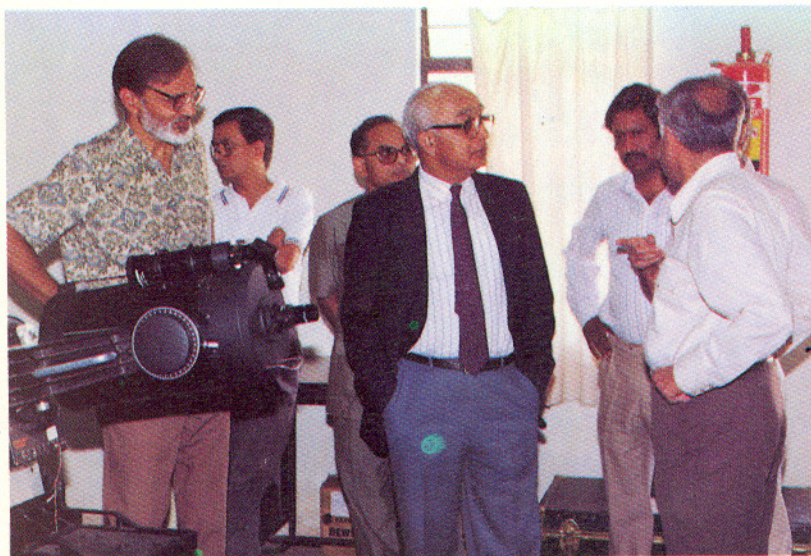
P. C. Vaidya



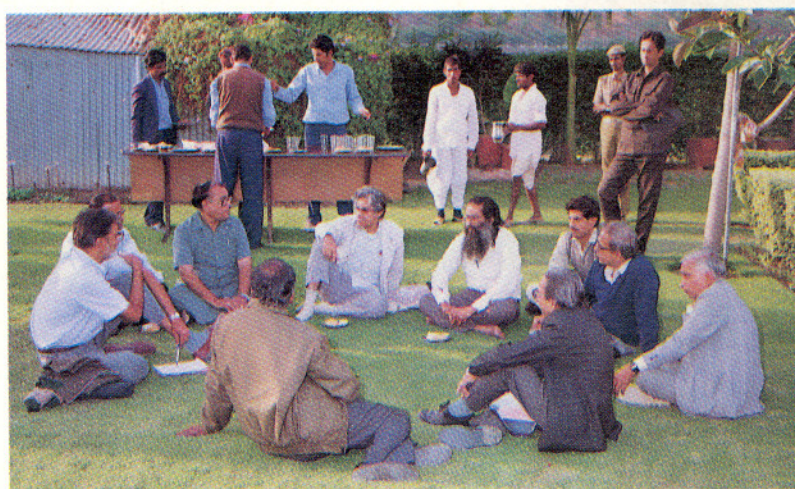
A. K. Raychaudhuri



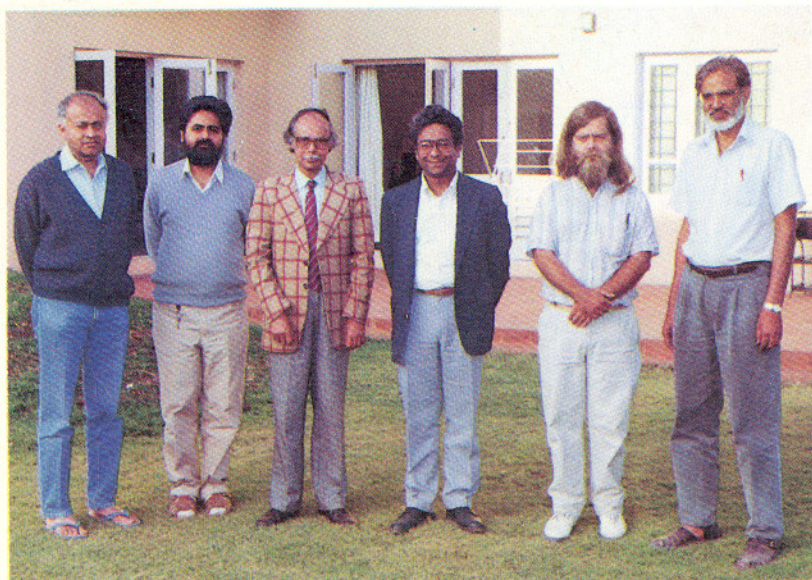
Yash Pal



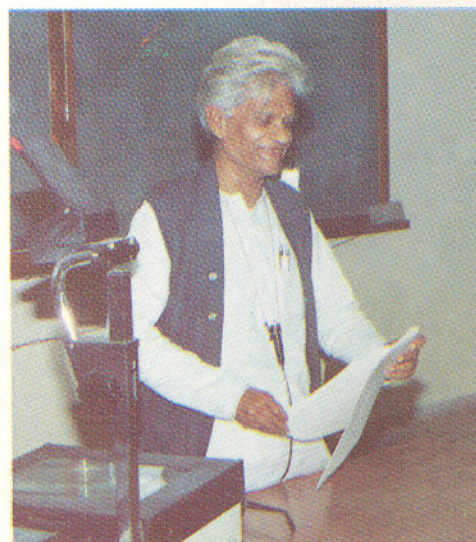
G. Ram Reddy,
Chairman UGC Visiting IUCAA



Western India Regional
Discussion Meeting, Udaipur



Visitors S. Mukherjee, A. Ashtekar and H. Kandrup.
with members of the IUCAA Faculty.



Foundation Day Lecture
by A. K. Raychaudhuri

Scientific Advisory
Committee Meeting



National Science Day
Prize Distribution



IUCAA Automated Photoelectric
Telescope being assembled



Charles Townes at IUCAA

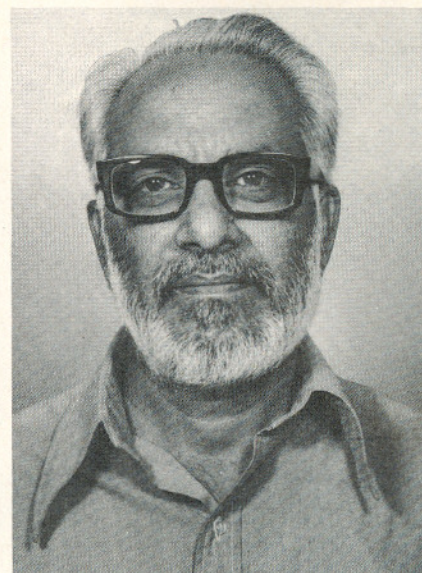
The Scientific Advisory Committee



Russell Cannon



N. Kameshwar Rao



N. V. G. Sarma



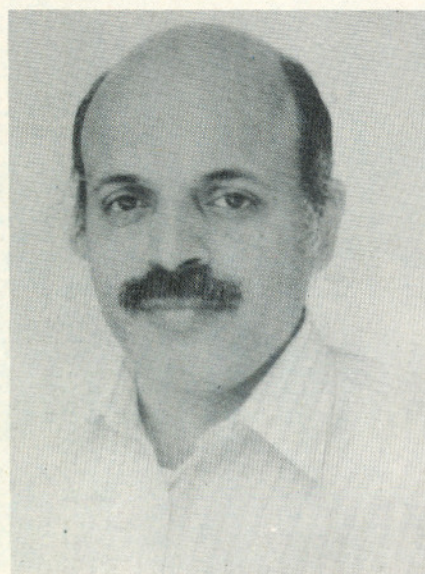
R. K. Thakur



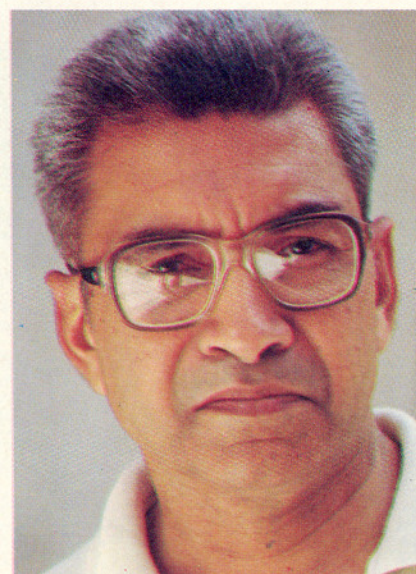
J. R. Bond



K. D. Abhyankar



R. Ramachandran



N. C. Mathur



B. V. Sreekantan

data on the history of star formation and the frequency distribution of stellar metallicity; and a consistent model of chemical evolution without invoking any infall or radial inflow of matter in the disc has been proposed. Some of these works also led to two Ph.D. theses (one by David Wilkinson at the University of Durham, and the other by Sarbani Basu at TIFR, Bombay, the latter being under preparation). The present plans are to investigate further the evolution and distribution of other elements in the galaxy, simulation of actual processes of star formation, the kinematics of the disc-halo connection, evolution of heavy elements in the distant quasars through the spectroscopic studies of their so-called heavy element systems, and so on.

Primordial nucleosynthesis

During the first fifteen minutes or so of the supposed event of the hot big bang, the primeval Universe had a very very hot soup of nuclear and leptonic matter, the environment of which was conducive of producing about a quarter of the nucleonic matter in the form of ^4He and a tiny fraction of it in the form of ^2H , ^3He , ^6Li , ^7Li , and ^9Be . The above process is generally christened as the primordial nucleosynthesis and the abundances of nucleonic matter at the end of the above process is called the primordial abundances of the light elements. There are well-developed numerical codes to handle such studies with firm predictions about the primordial nucleosynthesis. In order to make a suitable comparison of these predictions with the observed abundances, one has to very carefully subtract all the possible contributions due to later astrophysical processes of stellar nucleosynthesis, cosmic ray spallations, etc. from the results of the present day observations. It is not very clear whether the standard hot big bang model can really account for the observational estimates of the primordial abundances of all the above mentioned light elements in a very consistent way. To some extent, it seems that ^4He and $^2\text{H} + ^3\text{He}$ are overproduced in the model big bang than their observational counterparts could allow for.

This problem was independently posed by N.C. Rana and other people about a decade ago in the form of an inconsistency in the required values of a certain key parameter, namely the baryon-to-photon ratio, in order to satisfy all the available observational constraints. The issue has been debated time and again with more and more improved confidence in both the observational data reduction and the various model parameters involved in the calculations of the big bang nucleosynthesis. The situation has further been complicated by the possibility of the first order

phase transition from quark-gluon plasma to hadrons in the early Universe, which is supposed to have taken place just before the era of primordial nucleosynthesis. Along with others, N.C. Rana has suggested possible cures to such inconsistencies, for example by allowing a slight overabundance of neutrinos over antineutrinos, or dumping the dark matter in the form of strange nuggets, or even questioning the claim that the phase transition is of the first-order. In the meantime, Wagoner's numerical code for big bang nucleosynthesis has been independently updated by N.C. Rana and Lawrence Kawano. However, the corrections due to energy loss during the e^+e^- pair annihilations leading to heating of neutrinos has still been neglected by Kawano, an effect which reduces the primordial mass fraction of helium by about 0.003.

History of astronomy and preparation of ephemerides

An effort is being made to incorporate the post-Newtonian order of corrections to the N-body code of Aarseth, and reproduce the ephemerides of the solar system with an accuracy close to that of DE202 of JPL, Caltech. This has led towards self-reliance in the preparation of the Indian ephemerides. A Lagrangian approach to the equation of motion of N-bodies is to be adopted in order to define the barycenter of the solar system in a proper way. Much work is also needed to bring the lunar ephemeris to the desired accuracy, simply because at present the French version differs from the American and the Russian versions. A book on the historical dating and locations of the paths of the total solar eclipses over the Indian subcontinent is lacking, which is under consideration by N.C. Rana.

Possible reforms of the existing Indian Panchang systems are on the way to evolve a national panchang system to be used uniformly across the length and breadth of the country. N.C. Rana has probed certain astrological conventions to determine their possible dating or antiquity. To cite an example, an otherwise odd enough ecliptic longitude assigned to the so-called exaltation of Mars can be interpreted as due to its location at orbital perihelion and this gives us a date of about 1200 BC for adopting this particular convention.

Periodic, stochastic and secular variations of the length of day (LOD)

The length of the earth's period of rotation is subject to daily, monthly, annual and long period variations due to tidal effects, motion of the winds, seasonal currents in the oceans, global heating of

gravitational waves - generation and detection, experimental tests of general relativity and cosmology. IUCAA was a cosponsor of the meeting.

Other Meetings

SAC-IUCAA Meeting : The second meeting of the Scientific Advisory Committee was held at IUCAA during September 16-17 and was attended by Geoffrey Burbidge, V. Radhakrishnan and N.V.G. Sarma. IUCAA academic members described their present research and developmental activities and future programmes at open sessions with SAC members. The SAC appreciated the overall growth in IUCAA activities and offered critical constructive comments on the areas where improvements can be made.

DST Group Monitoring Meeting : A Group Monitoring Workshop of the Department of Science and Technology funded projects in A & A was hosted by IUCAA during June 21-22, attended by about 30 scientists including Principal Investigators of the projects, experts, and Programme Advisory Committee members. Govind Swarup spoke on Radio Astronomy with GMRT and highlighted the exciting areas of research in A & A.

IUCAA Internal Meeting : As a new tradition the academic members of IUCAA meet in a quiet retreat to have intense discussion of their research activity. This year the Internal Meeting was held at Mahabaleshwar on March 20-22.

(III) Vacation Students Programme (VSP)

The first Vacation Students Programme of six weeks duration started on June 3 and concluded on July 12. Under the supervision of the IUCAA faculty, selected 9 students presented seminars on specific topics such as conical metrics, gravitational lensing, gravitational waves, non-linear and Lorentz invariant version of Newtonian gravitation, pointing of a telescope, some properties of black holes, source counts of quasars, star formation in the interstellar medium and study of CCD characteristics and photometry.

(IV) Publications

a) Journals and Proceedings

C. Debiprasad (1992) Observation of IO associated phenomena with the MP Ae focal reducer and tunable etalon at the Calar Alto 2.2 m telescope (with K. Jockers and N. Thomas), Calar Alto Kolloquium, MPI fuer Astronomie, Heidelberg, 11 und 12 Marz 3.

D. Duari, P. DasGupta and J.V. Narlikar (1992) Statistical tests of peaks and periodicities in the observed redshift distribution of quasi-stellar objects, *Astrophys. J.*, 384, 35

S. Koshti, N. Dadhich and A. Kshirsagar (1991) On constraints of pure-connection formulation of general relativity for non-zero cosmological constants, *Class. Quant. Grav.*, 8, L61

J.V. Narlikar (1991) Does a possible laboratory observation of a frequency anisotropy result from a non-zero photon mass m ? (with J.-C. Pecker and J.-P. Vigiér), *Phys. Lett. A*, 154, 203

--- (1991) Some consequences of a spatially varying cosmological constant in a spherically symmetric distribution of matter (with J.-C. Pecker and J.-P. Vigiér), *J. Astrophys. Astron.*, 12, 7

--- (1991) The role of quantum phenomena in our understanding of the universe, *Mem. S. A. It.*, 62, 519

--- (1991) On doing cosmology with a large optical telescope, in *Proceedings of the National Large Telescope Workshop : Scientific requirements and requirement of site held at IIA, Bangalore, October 1989* ed. M. Parthasarathy (Government of India, Ministry of Science and Technology, Department of Science and Technology, New Delhi), 6

--- (1991) Sixty years of cosmology, in *Glimpses of Science in India*, ed. U.S. Srivastava (Malhotra Pub. House, New Delhi), 409

--- (1991) Inflation for Astronomers (with T. Padmanabhan), in *Annu. Rev. Astron. Astrophys.*, 29 ed. by G. Burbidge (Annual Reviews Inc., Palo Alto), 325

N.C. Rana (1991) Effect of neutrino heating in the early universe on neutrino decoupling temperatures and nucleosynthesis (with B. Mitra), *Phys. Rev. D* 44, 393

--- (1991) Chemical evolution of the galaxy in *Annu. Rev. Astron. Astrophys.*, 29 ed. by G. Burbidge, (Annual Reviews Inc. Palo Alto), 129

(1991) G-dwarf problem and gas-metallicity relations (with S. Basu) in- *Proceedings of Elba Workshop on Chemical and dynamical evolution of galaxies*, eds. F. Ferrini, J. Franco & F. Matteucci (Giardini-Editore, Pisa-Lugano), 603

V. Sahni (1991) The Adhesion Model : Some Results

in two and three dimensions, in Texas/ESO-CERN Symposium on Relativistic Astrophysics, Cosmology and Fundamental Physics, Annals of the New York Academy of Sciences, Vol. 647, p. 749

--- (1992) Loitering universe (with Hume Feldman and Albert Stebbins), *Astrophys. J.*, 385, 1

B.S. Sathyaprakash and S.V. Dhurandhar (1991) Choice of filters for the detection of coalescing binaries, *Phys. Rev. D.* 44, 3819

B.S. Sathyaprakash, S.M. Wagh and S.V. Dhurandhar (1991) Signal analysis of gravitational radiation from a coalescing binary, in *Advanced Computing, Proceedings C-DAC August 1988 - July 1991*, ed. by V.P. Bhatkar et al (Tata McGraw Hill, New Delhi), 400

Non-Technical and Popular Articles

J.V. Narlikar (1991) आंतर विद्यापीठ खगोल व खगोल भौतिकी केंद्र (IUCAA), *Yojana*, June, 4

--- (1991) On resistance to new ideas in astronomy, *Cruz del Sur XXIst IAU General Assembly*, Buenos Aires No. 3, July 24, 3

--- (1991) Indian science and the university system, *Bulletin of Sciences*, July-September, 15

--- (1991) वैज्ञानिक चौकटीतून फलज्योतिषाचे मूल्यांकन (Assessment of astrology within the scientific framework), *Milun Saryajani*, August, 17

--- (1991) कोपर्निकसचे गाव - टोरून (Torun-the town of Copernicus), *Maharashtra Times*, September 22

--- (1991) वैज्ञानिक दृष्टिकोन से फलित ज्योतिष का मूल्यांकन (An evaluation of astrology from the scientific standpoint, Translator Durga Ghatge), *Deshabandhu*, Diwali issue, 17

--- (1991) अंतराळातील जॅकपॉट (Jackpot in space : a science fiction story), *Kistrim*, Diwali Number, November

--- (1991) व्हायरस (Virus [a science fiction story]), *Raviwar Sakal : Deepavali Visheshank*, November

--- (1991) माझे वसंतमामा (My Uncle Vasant), *Maharashtra Times*, December 8

--- (1991) Microscopic achievement -- Science, *Times of India*, December 29

--- (1992) Set higher norms for science journalism, *Times of India*, January 11

--- (1992) Science journalism in India and 'abroad, *Maer's MIT Pune Journal*, February, 9

b) Books

J.V. Narlikar (1991) *Yashopahar* (The gift of the yakshas) (Translated in Hindi by Sunita Paranjape), *Bharatiya Gyanapeetha Prakashan*

--- (1991) *Vishvayan* (The Cosmic Spaceship) (Translated in Kannada by G.T. Narayana Rao)

--- (1991) *Astrofisica, Un'enciclopedia EDO d'orientamento*, Editoriale Jaca Book spa, Milano (Translated into Italian by Giovanni Ferraro)

--- (1991) The message from Aristarchus, *Clarion Books*, New Delhi

c) Book Review

J.V. Narlikar (1991) *An introduction to topology of differential geometry for physicists*, by Sunil Mukhi and N. Mukunda, for Wiley Eastern Ltd. Publishers, New Delhi

--- (1991) *Chandra : A biography of S. Chandrasekhar*, by Kameshwar Wali (Viking, Penguin India) and *Truth and beauty : Aesthetics and motivations in science-*, by S. Chandrasekhar (Viking, Penguin India) as Anatomy of genius, in *Indian Express*, Sunday Magazine, October 20

--- (1992) *Stephen Hawking : A Life in Science*, by Michael White and John Gribbin (Viking, Penguin India), in *Weekend Observer*, March 14

(V) Pedagogical Activities

a) Ph.D. Thesis

Sucheta Koshti : *Applications of the Ashtekar variables in classical relativity*, University of Poona (Supervisor : N.K. Dadhich)

b) Teaching

• NCRA-IUCAA Graduate School

P. DasGupta Quantum & Statistical Mechanics 18 lectures

S.V. Dhurandhar	Introductory analysis, Topology, Complex analysis, Green's functions, Fourier transforms, Differentiable manifolds, Tensor calculus	42 lectures
D. Duari	Tutorial Session	
T.S. Ghosh	Tutorial Session on Cosmology	
A.K. Kembhavi	Astrophysics	40 lectures
A. Kshirsagar	Statistical Mechanics	15 lectures
N.C.Rana	Stellar evolution and Interstellar medium	20 lectures
V.Sahni	Cosmology	15 lectures
S.N. Tandon	Techniques of Astronomy	

• **M.Sc. (Physics) University of Poona**

N.K. Dadhich	General Relativity (Astrophysics II Course)	15 lectures
D. Duari	Tutorial Session (Astrophysics I Course)	
A.K. Kembhavi	Astrophysics	40 lectures
N.C. Rana	Core course in Classical Mechanics (1 st Semester)	40 lectures
V. Sahni	Cosmology	15 lectures
S.N. Tandon	Laboratory course on Astrophysics	

• **Project supervision**

P. DasGupta	Bhas Bapat (VSP), <i>Cosmic strings & conical metrics</i>	
S.V. Dhurandhar	Namrata Gyndiah (B.Sc., Fergusson College, Pune) <i>Black holes</i> Dhiren Mehta (MCA), <i>FFTs of long data sets</i> Sangita Pitre (M.Sc.), <i>Gravitational wave detection</i> Kaushik Ray (VSP), <i>Bar detectors for gravitational waves</i>	
A.K. Kembhavi	Mrinalini Puranik (B.Sc. Garware College) <i>H.R. Diagram</i> Madhavi Dinakaran (M.Sc.) <i>Pulsars</i>	
J.V. Narlikar	Rajiv H. Pande (M.Sc.), <i>Structures in the universe</i> Manjiri Suryavanshi (M.Sc.) <i>Newtonian cosmology</i>	

N.C. Rana	Rajashree Gaunekar (Goa), <i>Development of a photometer for measuring magnetic field strengths in sunspots and the effect of limb darkening of the Sun</i> Umashankar Mitra (Headmaster, kendriya Vidyalaya Sarna, M.P.), <i>Development of a spectrometer</i> K.S. Gopinath (M.Sc.), <i>Some aspects of the large scale structure of the universe</i> Amit Gardi (B.Sc., Fergusson College, Pune), <i>Fractals and the large scale structure of the universe</i> Bhas Bapat (VSP), <i>Cosmic strings & conical metrics</i>	
V. Sahni		

• **UGC sponsored lectures on 'Advanced Institutes in Gravitation Theory'**

S.V. Dhurandhar Gravitational radiation (3 lectures)
at the Department of Physics, Cochin University of Science & Technology, December 21-January 3

(VI) **Seminars and Invited Talks**

a) **Technical Talks**

G.C. Anupama
CCDs in astronomy, IIT, Madras, March 14-16
Astronomical spectroscopy, IIT, Madras, March 14-16

N.K. Dadhich
Rotating blackholes in magnetic field, Relativity and Cosmology Research Centre, Jadavpur University, April 15
Spinorial variables in general relativity, Relativity and Cosmology Research Centre, Jadavpur University, April 16
Some physical properties of blackholes, North Bengal University, Siliguri, April 18
Gravitation : From modern standpoint, Mahatma Gandhi College, Trivandrum, January 18
Gravitational waves; Black holes in Astrophysics; Gravitation as a gauge theory, Centre for Development of Physics Education, University of Rajasthan, Jaipur, March 9-11

P. DasGupta
Squeezed light, Quantum Non-demolition and all that, Mini-workshop on gravitation and gravitational radiation, HNB Garhwal University, Srinagar, June 24
Quantum techniques in the detection of gravitational

waves, XVIth IAGRG Conference, Sardar Patel University, Vallabh Vidyanagar, December 10-11
Gravitons from the core of a pre-supernova star-, PRL, Ahmedabad, December 13
Some observational consequences of an accelerating universe, PRL, Ahmedabad, December 13-18
Evolution of quasars and radio galaxies, Mini-workshop on Early Universe, Jadavpur University, Calcutta, January 28
Astrophysical gravitational waves, Institute of Physics, Bhubaneswar, February 10
Gravity in superfluids and superconductors, Institute of Physics, Bhubaneswar, February 12

S.V. Dhurandhar

Gravitational wave detection, HNB Garhwal University, Srinagar, June 25
The inverse problem in gravitational wave detection, Mini-workshop on gravitation and gravitational radiation, HNB Garhwal University, Srinagar, June 26
The Indian effort in gravitational wave detection, University of Western Australia, Perth, Australia, October 1
Matched filtering techniques in gravitational wave data analysis, University of Western Australia, Perth, Australia, October 8
The inverse problem in gravitational wave detection, Australian National University, Canberra, Australia, October 9
The inverse problem and optimal orientation for gravitational wave detectors, University of Adelaide, Adelaide, Australia, October 11
Choice of filters for the detection of coalescing binaries, University of Western Australia, Perth, Australia, October 15
Gravitational wave data analysis of coalescing binaries, International Conference on Gravitation and Cosmology (ICGC), PRL, Ahmedabad, December 15
Search for gravitational waves, TIFR, Bombay, January 15
Filtering the coalescing binary signal, TIFR, Bombay, January 16
The inverse problem in gravitational wave detection, TIFR, Bombay, January 17
Search for gravitational waves, University of Poona, February 8

D. Duari

Are quasar redshifts periodic?, Astronomy and Instrumentation Seminar, NCRA, Pune, October
Are quasar redshifts periodic?, XVIth IAGRG Conference, Sardar Patel University, Vallabh Vidyanagar, December 10
Quasar redshifts - some interesting results, Mini-workshop on Quasar continuum and

radiation, Ravishankar University, Raipur, December 23-27

Redshift distribution of quasars, Mini-workshop 'on Early universe, Jadavpur University, Calcutta, January 28

Quasi stellar objects, Young Astronomers' Meet, February 10-13

T.S. Ghosh

Origin of density fluctuations from inflation, Mini-workshop on Early universe, Jadavpur University, Calcutta, January 28
Quantum effects near a point mass in 2 + 1 Dimensional gravity, ICGC 91, PRL, Ahmedabad
Primordial density perturbations, Young Astronomers' Meet, February 10

R. Gupta

Fabry-Perot spectroscopy in astronomy, Harvard-Smithsonian Centre for Astrophysics, Cambridge, USA, July 3
Fabry-Perot spectroscopy in astronomy, York University, Toronto, Canada, July 10
APT's for Indian universities, 103rd annual meeting of the ASP, University of Wyoming, Wyoming, USA, June 23
IUCAA's Automated Photoelectric Telescope, IUCAA Miniworkshop on Automated Photoelectric Telescopes, October 22
Automated photoelectric telescopes, Jyotirvidya Parisanstha, Pune, October 27
High resolution spectroscopy in astronomy, JES College, Jalna, January 28
Low and medium resolution spectroscopy, Workshop on Experimental Techniques in Space Sciences and Astronomy, Gujarat University, Ahmedabad, February 24
Automated photoelectric telescopes for Indian universities, Bangalore University, Bangalore, March 11
Fabry-Perot spectroscopy in astronomy, Indian Institute of Astrophysics, Bangalore, March 12
Astronomical Instrumentation; Astronomical Photometry, IUCAA Minischool on Introductory Astronomy, IIT, Madras, March 14, 15

K. Jotania

Pulsar search through gravitational radiation, Mini-workshop on gravitation and gravitational radiation, HNB Garhwal University, Srinagar, June
Gravitational wave detectors, Young Astronomers' Meet, February 12

A.K. Kembhavi

Quasars (3 lectures), Astronomy Department, Osmania University, Hyderabad, May 5, 6

- Quasars* (3 lectures), DST Summer School, Indian Institute of Science, Bangalore, June 17, 18, 19
- X-ray beaming in quasars*, Laboratory for Astrophysics and Space Research, Boulder, USA, November 2
- Soft X-ray excess in quasars*, University of Ohio, USA, November 11
- Quasar X-ray spectra*, Massachusetts Institute of Technology, Cambridge, USA, November 16
- X-ray beaming in quasars*, California Institute of Technology, USA, November 24
- Quasar X-ray spectra*, University of California, Santa Cruz, USA, November 26
- Quasar* (4 lectures), IUCAA Mini-School on Quasars, Ravishankar University, Raipur, December 23, 24
- Pulsars* (3 lectures), Physics Department, Osmania University, Hyderabad, January 21
- Radiative Processes* (2 lectures), IUCAA/IIA Mini-School on Plasma Astrophysics, Bangalore, March 3, 4
- 1) *Our Universe*: 2) *X-ray Astronomy*, IUCAA Minischool on Introductory Astronomy, IIT, Madras, March 14, 15
- S. Koshti**
- Pure-connection formulation of general relativity*, Mini-workshop on gravitation and gravitational radiation, HNB Garhwal University, Srinagar, June
- Einstein-Klein-Gordon theory in pure spin connection formulation*, ICGC 1991, PRL, Ahmedabad
- A. Kshirsagar**
- Pure connection formulation of GR*, oral presentation in the section on classical general relativity at the Sixth Marcel Grossman meeting on general relativity, Kyoto, Japan, June 23-29
- GR without metric*
- Jet Propulsion Laboratory, Pasadena, CA, USA, July 2
 - University of North Carolina, Chapel Hill, NC, USA, July 22
 - Tufts University, Bedford, MA, USA, August 19
 - l'Universite de Montreal, Montreal, Canada, August 26
 - University of Colorado, Boulder Co., USA, September 10
 - University of Delhi, February 7
- J.V. Narlikar**
- Some historic misconceptions in Astronomy*, University of Burdwan, Burdwan, April 18.
- Peaks and periodicities in the redshift distributions*, University of California at San Diego, USA, May 14
- Some posers to the Big Bang Cosmology*, Physics Research Conference -- California Institute of Technology (Caltech), Pasadena, USA, May 16
- Redshift periodicities : Are they significant?*, Kellogg Seminar, Caltech, Pasadena, USA, May 17
- Some posers to the Big Bang Cosmology*, University of British Columbia, Department of Astronomy and Physics, Vancouver, Canada, May 23
- Some problems with Big Bang Cosmology*, CITA, Toronto, Canada, May 27
- Some posers to the Big Bang Cosmology*, Department of Physics, Syracuse University, Syracuse, USA, May 29
- Some problems with Big Bang Cosmology*, E.O. Hulbert Centre for Space Research, Space Science Division, Naval Research Laboratory, Washington, DC, USA, May 31
- Tests of periodicity in the redshift distribution*, University of Maryland, USA, May 31
- Gravity as a physical interaction*, Mini-workshop on gravitation and gravitational radiation, HNB Garhwal University, Garhwal, Srinagar, June 24
- Microwave background radiation : An alternative view*, IAU General Assembly, Buenos Aires, July 29
- Peaks and periodicities in the redshift distribution of quasars* Uniwersytet Warszawski, Instytut Fizyki Teoretycznej, Warszawa, August 15
- Reference frames in cosmology*, GIREP, Torun, August 19
- Challenges in Astronomy and Astrophysics*, Suresh Chand Memorial Lecture, IIT, Delhi, September 12
- Successes and shortcomings of Big Bang cosmology*, Symposium of the Indian Academy of Science meeting, Pune, November 9
- New challenges in astronomy*, CSIR Foundation Day Lecture, NCL, Pune, September 26
- Recent advances in observational astronomy*, Institution of Electrical Engineers, Bombay, September 28
- Mystery of redshift periodicities*, Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore, November 16
- New challenges in astronomy and astrophysics*, Udaipur Solar Observatory, November 17
- Big bang cosmology : Strengths, weaknesses and alternatives*, University of Delhi, November 18
- Big bang cosmology : Strengths, weaknesses and alternatives*, Jadavpur University, Calcutta, November 23
- Gravity as a physical interaction*, Second Vaidya-Raychaudhuri Endowment Award Lecture, XVI IAGRG Conference, Sardar Patel University, Vallabh Vidyanagar, December 11
- Big bang cosmology -- A critical review and some*

alternatives, ICGC Conference, Physical Research Laboratory, Ahmedabad, December 13

Periodicities in the distribution of redshifts, Physics Department, Utkal University, January 13

Big bang cosmology -- Strengths, weaknesses and alternatives, Institute of Physics, Bhubaneswar, January 13

Facts inferences and beliefs in cosmology, Silver Jubilee Lecture of the Indian Institute of Advanced Studies, Shimla, Department of Physics, University of Poona, February 3

Search for extra-terrestrial intelligence-SETI, Plenary Lecture of the National symposium on recent trends in molecular and medical biophysics, University of Poona, February 7

Some unsolved problems on the physics-astronomy frontier, Kurukshetra University, February 14

Cosmology, A series of three lectures in the 6th Course on "An integrated approach to knowledge and information", National Institute of Advanced Studies, Bangalore, February 17, 18 & 19

A. Paranjpye

Some observational techniques in optical astronomy, Jyotirvidya Parisanstha, Pune, October 20

Astronomical telescopes : optics and mounts, Jyotirvidya Parisanstha, Pune, October 21

Celestial sphere, Gauhati University, Gauhati

Astronomical telescopes, Gauhati University, Gauhati

Some observational projects for small telescopes, Gauhati University, Gauhati

Photoelectric photometric and CCD observations for amateur astronomers, 2nd All India Amateur Astronomers' Meet, Sevagram

Celestial sphere and astronomical telescopes, Mini-School on Introductory Astronomy, Indian Institute of Technology, Madras, March 14-16

N.C. Rana

Chemical evolution of the galaxy (3 lectures) under the TPSC lectureship at Satyen Bose National Centre for Basic Sciences, Calcutta, November 25-30

Nuclear Astrophysics with Radiation Ion Beams, VECC, Calcutta, November 27

Basic Astronomy (6 lectures), Jyotirvidya Parisanstha, Pune, September to December

Practical Astronomy with small telescopes (3 lectures), Workshop on Photoelectric Photometry of Variable Stars, Gauhati, December 2-5

Early universe, Physical Society of Gauhati University, Gauhati, December 5

Primordial nucleosynthesis, Physics Colloquium at The Institute of Physics, Bhubaneswar, September 30

Evolution of iron in the solar system, The Institute of Physics, Bhubaneswar, October 1

Energy generation in stars, 2nd National Meet of A & A, Wardha, Sevagram, January 4

V. Sahni

The adhesion model and the large scale structure of the universe, NCRA, Pune, May

The stochastic gravity wave background, HNB Garhwal University, Srinagar, June 24-27

The large scale structure of the universe, TIFR, Bombay, October

The large scale structure of the universe, XVIth IAGRG Conference, Sardar Patel University, Vallabh Vidyanagar, December 10-11

The large scale structure of the universe -- theory confronts observation, ICGC, PRL, Ahmedabad, December 19

The inflationary paradigm, Mini-workshop on the Early Universe, Jadavpur University, Calcutta, January 28-February 1

The large scale structure of the universe (2 lectures), University of Delhi, March 27-31

B.S. Sathyaprakash

The coalescing binary signal, Mini-workshop on Gravitation and Gravitational Radiation, HNB Garhwal University, Srinagar, June 24-27

Gravitational Waves, UPSO, Nainital, July 5

b) Popular Talks

P. DasGupta

Cosmic Intrigues, Jyotirvidya Parisanstha, April

D. Duari

Are quasar redshifts periodic?, Rotaract Club of Poona Midtown, October 27

A.K. Kembhavi

Quasars, Physics Department, University of Poona, April

Gravity, Mathematics Department, Fergusson College, Pune, April

Measuring distances in astronomy, Jyotirvidya Parisanstha, Pune, January

A.K. Kshirsagar

Three lectures on String Theory, Folk-talk Club, Physics Department, University of Poona, April-May 1991

कण-विज्ञान (Particle Physics), Pune Vidyan Adhyapak Sangh, January 19

J.V. Narlikar

Inter-University Centre for Astronomy and Astrophysics -- A new experiment in the University sector, Association of Indians in

alternatives, ICGC Conference, Physical Research Laboratory, Ahmedabad, December 13

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b) Popular Talks

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Are quasar redshifts periodic?, Rotaract Club of Poona Midtown, October 27

A.K. Kembhavi

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Measuring distances in astronomy, Jyotirvidya Parisanstha, Pune, January

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कण-विज्ञान (Particle Physics), Pune Vidnyan Adhyapak Sangh, January 19

J.V. Narlikar

Inter-University Centre for Astronomy and Astrophysics -- A new experiment in the University sector, Association of Indians in

America and Association of Scientists of Indian origin in America, Rockville, MD, June 2

अंतराळातील सुरस आणि चमत्कारिक गोष्टी (Interesting and strange stories from the cosmos) Sneh-Seva at the Tilak Smarak Mandir, Pune, August 31

रुढी, अंधश्रद्धा आणि वैज्ञानिक दृष्टिकोन (Traditions, superstitions and the scientific outlook) Anawat, Bombay September 7

खगोलशास्त्रापर एक नजरिया (A review of astronomy) A series of three lectures under the auspices of the M.P. Uchcha Shiksha Anudan Ayog, Bhopal, September 30 and October 1

Space in the microworld and cosmology Symposium on Space at the Max Mueller Bhavan, Bombay, October 6

खगोल विज्ञानातील नव्या दिशा (New directions in astronomy) A series of two lectures at the P.B. Kakani Nagar Vachanalaya, Malegaon, October 12

Cosmology Lecture to the participants at the school at the National Insurance Academy, Pune, October 24

खगोलशास्त्रातील सुरस आणि चमत्कारिक गोष्टी (Interesting and strange stories from the cosmos) Marathwada Vidnyan Vikas Manch -- Bal Vidnyan Sammelan, Verul, October 30

Scientific temper in the twenty first century: Dangers of the widening gap between the 'haves' and 'have nots', Indira Gandhi Memorial Conference on The challenges of the twenty-first century", New Delhi, November 19

शिक्षणाची बदलती क्षितिजे (The changing horizons in education) Lecture at the Principal Nanasaheb Naralkar Birth Centenary Symposium, Naralkar Institute, Pune, November 30

Science journalism in India and abroad, Dr. Jagzap Memorial Lecture at Department of Communication and Journalism, University of Poona, Ranade Institute, Pune, December 7

New challenges in astronomy and astrophysics, Vikram Sarabhai Community Centre, Ahmedabad, December 15

खगोलशास्त्र आणि वैज्ञानिक दृष्टिकोन (Astronomy and the scientific outlook) XXVIth Akhil Bharatiya Marathi Vigyan Sammelan, Gadhinglaj, December 28

Nature of the universe, State Committee on Science, Technology and Environment, Government of Kerala at Senate Hall, University of Kerala, January 18

सामाजिक स्थित्यंतरात विज्ञान-तंत्रज्ञानाचा वाटा (The role of science and technology in bringing about social changes) Presidential address, Rashtriya Samajik Parishad, Pune, January 29

२१ व्या शतकात विज्ञान अध्यापकांकडून अपेक्षा (The expectations from science teachers in the 21st century) Pune Zilla Mukhyadhyapak Sangh, at Sadhana Vidyalaya, Hadapsar, Pune, February 1

Black holes, Kendriya Vidyalaya, Ganeshkhind, Pune, February 3

Dadasaheb Aaltekar Memorial Lecture Series, Kanya Shala, Karad, February 8, 9

शिक्षणात उत्कृष्टतेची कदर (Appreciation of excellence in education) Tilak College of Education, Pune, February 27

विश्वाची उत्पत्ती कशी झाली? (How was the universe created?) Ayurved College, Hadapsar, Pune, February 29

(VII) Collaborative Programmes and Participation in Scientific Meetings

a) Collaborative Programmes

Dr. S.R. Valluri of University of Western Ontario, Canada and P. DasGupta are collaborating on a research work concerning high frequency gravitational radiation from the core of collapsing stars.

IUCAA's strong interaction with the University of Wales, Cardiff continues as intensively as before. There is frequent exchange of ideas and problems and ways of solving problems in gravitational wave data analysis. B. Schutz, who heads the Cardiff group, is a global coordinator for gravitational wave data analysis. The group at IUCAA is working jointly on the parameter estimation of the coalescing binary signal involving more than one detector. At the ICGC the group at IUCAA had detailed discussions with B. Schutz on their ongoing programmes.

A joint proposal by S.V. Dhurandhar on the Indian side and D.G. Blair on the Australian side has been submitted to the DITACH in Australia and DST in India. This is a proposal to fund visits of Indian and Australian scientists to each others institutions in Australia and India to carry out work in the computer modelling of seismic isolators and the light field in laser cavities. Preliminary work has already started in this direction.

IUCAA's on-going programme of 'Numerical computation on gravitational waves' continues with C-DAC. Parallel computing programmes have been written which give a speed of 85 Mflops on the 256 transputers machine at C-DAC. This programme simulates the detection of coalescing binary signal from the data stream of a gravitational wave detector. Parallelisation seems to be a cheap way for supercomputing. A 4-transputer board has been installed by C-DAC at IUCAA for speeding up work. In future IUCAA hopes to use this facility for many other problems in gravitational wave data-analysis.

A new project on 'Gravitational wave data analysis and software development' has been submitted to

DST by S.V. Dhurandhar and B.S. Sathyaprakash.

The project involves three major problems of current interest: (i) data analysis of coalescing binary signals, (ii) the optimal orientation problem of detectors, and (iii) data analysis of pulsar signals.

A research training programme on Automated Telescopes has been submitted to DST by Ranjan Gupta.

A Tandem Fabry-Perot spectrometer for the study of stellar absorption spectra at high S/N ratio ~ 100 and high spectral resolution ~ 1.0 has been submitted to DST by Ranjan Gupta.

A programme has begun on studying the quasi-normal modes of black holes by the complex plane WKB model with S.K. Srivastava, Department of Mathematics, NEHU, Shillong.

Steps to start a programme are on way with D.C. Srivastava of Gorakhpur University on gravitational wave data analysis problems.

b) Participation in Scientific Meetings

G.C. Anupama

IUCAA mini-school on Introductory Astronomy, Indian Institute of Technology, Madras, March 14--16

N. Bawdekar

'SLIM' : IUCAA library software package -- oral presentation, at the Advanced course on Library Networking, National Centre for Software Technology, Bombay, January 22-24

N. Dadhich

XVI IAGRG, Sardar Patel University, Vallabh Vidyanagar, December 10--11

ICGC 91, Physical Research Laboratory, Ahmedabad, December 13--18

Workshop on TOKTEN and NRIs participation in R&D programmes organised by CSIR, at National Physical Laboratory, New Delhi, January 14--16

P. DasGupta

Mini-workshop on gravitation and gravitational radiation, HNB Garhwal University, Srinagar, June 24--28

XVI IAGRG, Sardar Patel University, Vallabh Vidyanagar, December 10--11

ICGC 91, Physical Research Laboratory, Ahmedabad, December 13--18

Mini-workshop on The Early Universe, Jadavpur University, Jadavpur, Calcutta, January 28--February 1

S.V. Dhurandhar

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D. Duari

ICGC 91, Physical Research Laboratory, Ahmedabad, December 13--18

IUCAA mini-workshop on Quasar Continuum and line radiation, Ravishankar University, Raipur, December 23--27

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Workshop on Galaxy Formation, TIFR, Bombay, October 7

R. Gupta

'Robotic Telescopes in the 1990s', 103rd Annual Meeting of the Astronomical Society of the Pacific, University of Wyoming, Wyoming, USA, June 22--24

IUCAA mini-workshop on Automated Photoelectric Telescopes, October 21--25

79th Indian Science Congress, Vadodra, January 3--8
Experimental techniques in Space Sciences & Astronomy, Gujarat University, Ahmedabad, February 24--28

IUCAA mini-school on Introductory Astronomy, Indian Institute of Technology, Madras, March 14--16

K. Jotania

Mini-workshop on gravitation and gravitational radiation, HNB Garhwal University, Srinagar, June 24--28

XVI IAGRG, Sardar Patel University, Vallabh Vidyanagar, December 10--11

ICGC 91, Physical Research Laboratory, Ahmedabad, December 13--18

Advance Institute on Gravitation Theory, Department of Physics, Cochin University, December

21-January 3

S. Koshti

Mini-workshop on gravitation and gravitational radiation, HNB Garhwal University, Srinagar, June 24--28

XVI IAGRG, Sardar Patel University, Vallabh Vidyanagar, December 10--11

ICGC 91, Physical Research Laboratory, Ahmedabad, December 13--18

J.V. Narlikar

Mini-workshop on gravitation and gravitational radiation, HNB Garhwal University, Srinagar, June 24--28

21st General Assembly at Buenos Aires, July 22--August 1

GIREP Conference in Torun, Poland, August 19-24

XVI IAGRG, Sardar Patel University, Vallabh Vidyanagar, December 10--11

ICGC 91, Physical Research Laboratory, Ahmedabad, December 13--18

A. Paranjpye

IUCAA mini-workshop on Image Processing, July 21--26

IUCAA mini-workshop on Automated Photoelectric Telescopes, October 21--25

Mini-workshop on Photometric Photometry, December 2--7

Amateur Astronomers' meet, Sevagram, January 3--5
Experimental techniques in Space Sciences & Astronomy, Gujarat University, Ahmedabad, February 24--28

IUCAA mini-school on Introductory Astronomy, Indian Institute of Technology, Madras, March 14--16

R. Radhakrishnan

Advanced course on Library Networking, National Centre for Software Technology, Bombay, January 22-24

Course on Common Communication Format 'CCF', Department of Library Science, University of Poona, March 24-27

N.C. Rana

National Seminar in Physics with Radioactive Ion Beams, VECC, Calcutta

IUCAA mini-workshop on Automated Photoelectric Telescopes, October 21--25

Mini-workshop on Photometric Photometry, December 2--7

Amateur Astronomers' meet, Sevagram, January 3--5

V. Sahni

Mini-workshop on The Early Universe, Jadavpur University, Jadavpur, Calcutta, January

28--February 1

Mini-workshop on gravitation and gravitational radiation, HNB Garhwal University, Srinagar, June 24--28

XVI IAGRG, Sardar Patel University, Vallabh Vidyanagar, December 10--11

ICGC 91, Physical Research Laboratory, Ahmedabad, December 13--18

Visitors Program, University of Delhi, March 27-28

B.S. Sathyaprakash

Mini-workshop on gravitation and gravitational radiation, HNB Garhwal University, Srinagar, June 24--28

XVI IAGRG, Sardar Patel University, Vallabh Vidyanagar, December 10--11

ICGC 91, Physical Research Laboratory, Ahmedabad, December 13--18

S.N. Tandon

IUCAA mini-workshop on Automated Photoelectric Telescopes, October 21--25

Photoelectric Photometry of Variable Stars, Gauhati University, December 2--7

Experimental techniques in Space Sciences & Astronomy, Gujarat University, Ahmedabad, February 24--28

The Third Foundation Day Lecture (December 29, 1991) by Professor A.K. Raychaudhuri

Coordination of research and teaching in our education system

I feel greatly honoured to deliver the third IUCAA foundation day lecture and thank you all, especially Professor Jayant Narlikar for giving me this privilege. It gives me an opportunity to say a few words on a topic which had been close to my heart for a long time -- the coordination of research and teaching in our academic system. I believe this was also one of the motivations in the foundation of IUCAA and I am happy to note its efforts in that direction. Excuse me for telling you a little about my personal career -- that will perhaps explain my interest in the subject and offer an apology for me to think that I have an expertise in talking on it.

After my university education I began my career in a research institute which had no connection with teaching whatsoever. I spent about twelve years in that institute and that too was divided between an experimental laboratory and a theoretical department. For the last thirty years, I have been teaching in an institution which is a college and not a university. Here research is not encouraged but is just tolerated. What I mean is this -- a teacher will not be penalised for doing research but he is not provided with any research facilities as such. In spite of this rather depressing atmosphere for pursuing research, I had tried to carry on research in an admittedly very modest manner. But I believe that I have in the process realised the importance of the coordination of research and teaching.

I begin with a translation of few lines from Kalidasa -- the famous author of *Avighan-Shakuntalam*. The translation is from *Malavikagnitram* and runs as follows :

If a professor thinks what matters most
Is to have gained an academic post
Where he can earn a living, and then
Neglect research, let controversy rest,
He's but a petty tradesman at the best.

– Tr. John Brough

The above translation is not quite faithful, as 'research' does not occur in the original. But the word controversy is there; in ancient India controversy and debate were the standard methods for the advancement of knowledge, the translator has therefore thought it proper to insert the word 'research'. The exact words in Sanskrit for 'petty

tradesman' are 'Jnanapanyam Vanijang' (a trader whose article of trade is knowledge).

One may argue that being a trader is after all not that bad but what is important is that the disparagement of the teacher relative to a researcher exists even today and has led to a disease in our academic system which I am naming as Gunadasa-Haradatta syndrome after the two relevant characters in Kalidasa's drama.

Gunadasa-Haradatta Syndrome : The researcher thinks that the teacher is one who has taken up an academic career but has failed to prove his worth, and so become a teacher. His knowledge is frozen at the level he learnt in his student days and he remains ignorant of the new knowledge created by later researches. Some of the teachers are however clever in making money by private coaching and writing note-books. On the other hand teachers think that researchers are people who give a show of doing important things but in reality they are parasites of the society and earn a decent living without rendering any service. The teacher finds nothing wrong in earning money by private coaching. He compares it with the work of a medical practitioner -- both render useful service in present social conditions.

You may think that I am giving a picture which is far from truth and there is a large number of men who are both teachers and researchers at the same time. Yes, there was such a group but that breed is fast dying out. You will find that the number of such men above fifty years of age is few and below fifty the number is vanishingly small. Ask any bright promising young man and he will tell you that he will like to have a berth in a research centre in India and failing that he would rather go abroad than join a teaching post in a university.

I do not blame them; I myself was sorry to go over from a research institution to a college. There is a great gulf of difference in the facilities and opportunities of promotion available in a research centre and a university. So with time, more and more the universities will be staffed by men of poor research calibre.

The role of researcher as a teacher : Generally it is assumed that good researchers are assets in a teaching institution. The common idea of a good teacher is one who goes over the entire prescribed syllabus and has good notes giving host of information that the students find useful to secure high credits at the examinations. Judged by this criteria, the eminent researchers under whom I had the good fortune to study were by no means good teachers. Let me

give some specific instances. Professor M.N. Saha was our teacher. Very often he would be outside Calcutta so that he was unable to take his class. Even when in Calcutta, he usually forgot that he had a class, so that when he was reminded, he would come to the class very late and completely unprepared. He would then talk of any topic that came to his mind little caring about continuity and systematic development of the subject. Proceeding in this way at the end of the session one found that he had covered very little of the syllabus. Still I shall call him a good teacher for he did not hesitate to criticise things written in the books and challenge standard ideas. This inculcated amongst some of us the attitude not to take things for granted but to analyse and think on our own. Another eminent researcher was Professor P.C. Mahalanobis. He was in-charge of our thermodynamics, but if anybody attended his class on any day he would find it extremely difficult to decide what was the class about. Was it on pure mathematics or statistics or on the influence of bias in experiments or on how to behave in the laboratory? But out of all this, we did gain something and I would not hesitate to call him a good teacher. Perhaps the above cases of neglect of regular syllabi is not typical. But what is significant is that they gave us something which is not there in books.

How does the teacher without any research background behave? If he is good, he prepares careful notes but he does not go beyond anything written there. If and when a student asks an odd question or points out that there is apparently a contradiction between two books, the teacher is at a loss. He is diffident to say anything on his own and is completely lost when two books differ. Such a teacher can at best dump the student with informations but cannot kindle the fire that will energise the student to push forward. In recent years things have become worse as many of the new recruits lack a clear understanding and knowledge of their subject. I have come to this painful conclusion in course of moderating the question papers of many universities. The question papers contained mistakes which betrayed the ignorance of their setters.

Cooperation amongst universities and research centres : Sometimes there have been suggestions that with the realities of the situation as it stands, it is neither possible nor desirable to have really bright young men in the universities. Rather we should try to have some sort of arrangement whereby men of research take some part in teaching and thus come in contact with the students. But the experience so far is not encouraging. In Calcutta, Saha Institute people at one time took part in Calcutta University

teaching. But the arrangement broke down. And the way in which the breakdown came is perhaps illuminating. Saha Institute people demanded that they must be given official ranking in the university department so that they may have a voice in the university administration. This was not acceptable to the university authorities. Further, the university teachers welcomed the breakdown as it would open the prospects of creation of new posts and promotions. Elsewhere in West Bengal I know of no such cooperation even though the Jadavpur University is situated just on the opposite side of the road of the Indian Association for the Cultivation of Science. You may be surprised to know that sometimes there are hurdles even in using the libraries of the research institutes by university teachers.

A few years earlier a joint system of teaching was introduced by the TIFR and the University of Poona. Considerable planning was done and attempts were made to bring the best boys of the country. Indeed, very high hopes were raised, but I am sorry to find that the arrangement did not survive after a few years. Recently the university centres like the IUCAA are experimenting with a new system by which the university teachers can enjoy some of the facilities of a modern research institute. It will surely give some relief to the existing teachers, but the basic problem of obtaining a steady supply of brilliant young men for teaching posts will not be solved. Rather, any new research centre will attract some of the brightest men of the field and thus remove them from the market from which the universities recruit. In short, I believe I will not be called a pessimist if I entertain little hope for cooperation between research and teaching centres to succeed in a big way.

The future : Let us try to extrapolate the situation to the foreseeable future. Already the developments during the last few decades give a clear indication. Taking for example the distribution of present INSA fellows I have found that about forty percent of them are retired people, ten percent come from universities and IITs and forty five percent are in research institutes, the remaining five percent are outside the country. Of course, of the retired forty percent there is no doubt that the overwhelming majority were in universities. The whole picture simply indicates that research of high quality is practically dead in our universities. So we expect that the research institutes will continue to grow perhaps at an even faster rate. And proceeding to the extreme limit, all the available talents that stay on in India will be there; the universities will be filled with the left out. True, no such separation can in practice be that perfect -- there would be stray sickly sheep

in a flowering research centre and a lonely bright man in a decadent university.

What would be the result of all this? Granting for argument's sake that excellent discoveries and inventions both in theory and application will pour out from the research institutes, will that flow continue? The dying universities will turn out run-of-the-mill graduates who will hardly be of any use for the research institutes. Perhaps there will be an impressive rise in India's stature in the field of scientific research but then an eternal darkness will descend. Are we planning for such a future India?

A suggestion, not a solution : I do not know whether any ready-made solution of our problem exists. However, let us analyse the basic reason for our difficulty. In my opinion, broadly there are two problems -- firstly, our academic institutions have expanded so much that the demand for qualified people exceeds the available supply. This statement may seem absurd when one simply makes a count of the Ph.D.s that are coming out annually. The unfortunate fact is that there is often a mis-match between the qualifications of a Ph.D. and that demanded for a teaching position so that most of these Ph.D.s prove not quite equal to the task. Secondly, for the universities the supply is further drastically reduced by the research institutes offering greater facilities and prospects.

How can then we remedy the situation? We cannot cut down the demand overnight by shutting down some of the research institutes. That would simply be disastrous. Nor can the supply of capable young people be increased magically. The only way in which there will be some alleviation is by a greater utilization of the limited talents, that we have. To be more precise, in our research institutes people are only to do research. I do not understand why they will not be able to bear an additional load of some teaching. Even now elsewhere in the world, unlike in India, the best scientists seem to be in the universities and participate in the teaching. However we have seen that a cooperation between two independent bodies (a university and a research institute) does not work in our country. Although lamentable, this has to be accepted as a fact of life. So what I suggest is that the research institutes should convert themselves into mini universities dealing with only a limited number of subjects. Thus in Calcutta the Saha Institute of Nuclear Physics may take up fullfledged M.Sc. course in Physics; The Indian Association for the Cultivation of Science may take up Physics and Chemistry and so on.

This will not solve the problem of our traditional universities but will bring about a creation of some better Schools.

One thing is important to emphasize. Teaching does provide some incentive to research but this is often overlooked. During my long stretch of teaching I have learnt the benefits of contacts with fresh young students. They are yet to be brain-washed to think only along the beaten track so that they can think often in bizarre manner and ask the teacher odd questions. To be sure most of these questions are sheer nonsense but some of them are quite startling. Such questions force the teachers to think on the very fundamentals of the subject. As a result of this thinking the teacher himself gains in knowledge and may even make some research contributions.

I end with the English translation of a few lines of a Bengali poem which conveys this idea beautifully:

Of all the types of wealth, knowledge is supreme,
No one can snatch it away from you,
And the more you give it to others,
More of it will grow in you.

Awards and Distinctions

S. Koshti

Post-Doctoral Fellowship for the period 1992-94,
by National Board for Higher Mathematics,
Government of India

A. Kshirsagar

Speaker for gravitation, Theoretical Physics Seminar
Circuit (TPSC), year 1992.

J.V. Narlikar

Honorary Degree of Doctor of Science : University
of Burdwan

M.V. Chiplonkar Award : Indian Physics Association
Pune Chapter

Vice-President : International Astronomical Union
Commission No. 47 on cosmology

President : Marathi Vidyan Parishad

Honorary Life Fellowship : The Institution of Engineers
(India), Calcutta

Goyal Prize : Kurukshetra University, Shri Kala Ram
Trust, Department of Chemistry

Dr. V.M. Gogate Award : Sarvajanic Vachanalaya,
Nashik

V. Sahni

Honourable mention in the Annual Gravity Research
Foundation essay competition for the year 1991 for
the essay : *Loitering Cosmological Models*

Facilities

(I) Astronomical Data Centre

An Astronomical Data Centre (ADC) supported by the Department of Science and Technology has been set up at IUCAA. The purpose of the ADC is to obtain and maintain in a conveniently usable form catalogues and databases of relevance to research in astronomy, astrophysics and related areas. Professor KSVS Narsimhan is assisting in identifying the Astronomical Observation Data sources, catalogues, etc.

The ADC at the present has about a hundred and fifty catalogues acquired from other data centres. The collection is being constantly updated, and will soon include archival data bases from various missions along with the software required in the analysis.

At the present time the ADC aims to provide to the user community the following:

1. List of catalogues and data bases available.
2. Particular catalogues on paper, floppy diskettes, cartridges or tapes.
3. Acquisition of catalogues, data bases and software from other centres upon request, when such material is not already available with the ADC.
4. Access to foreign databases through the IUCAA Internet link, when the remote user has a PC-AT and modem.
5. Support for travel and stay where necessary.

(II) Computer Centre

The IUCAA computer network has expanded during the period of this report, and now has 11 workstations including two SUN sparc2s. The available disk space has been increased substantially, and a number of devices including cartridge drives, CD-ROM readers, Exabyte etc. have been added. There is an extensive collection of commercial and non-commercial software available for analysis. Visitors from universities, including those engaged in highly theoretical research are encouraged to use the computing facilities for various purposes, including analytical calculations using symbol manipulation software and text processing.

IUCAA now has a dedicated data link with the National Centre for Software Technology at Bombay, so that it has become a part of the Internet network. The data link allows remote login and file transfer. The E-mail facilities available at IUCAA are being extended to different university departments in India with the help of NCST and the Department of

Electronics.

(III) Library

The IUCAA Library collection and computers are now under one roof, albeit temporary, in the Akashganga complex. With the addition of 1792 books and 474 bound volumes of periodicals, the total collection of the library has now risen to about 6790 volumes. The library subscribes to 165 periodicals. A flow of about 1200 preprints/reprints, 220 bulletins/newsletters, and 25 Annual reports have been recorded in the period of the report. With the setting up of Reprographic section (acquisition of separate Xerox machine and Microfilm Reader Printer) large scale photocopying service is being rendered to the university community. Limited inter-library loan and current awareness service are also being provided. As decided at the XIVth Astronomical Society of India meeting, IUCAA library has undertaken the responsibility of collection, compilation and distribution of lists of astronomy acquisitions at major astronomy libraries in India, to university libraries in the country through a quarterly cumulative list. Usage of IUCAA Library by local students from many subjects has increased and visits of library science students have been arranged. The use of a fully operational library software package has facilitated quick and efficient library operations.

(IV) Instrumentation Laboratory

The instrumentation laboratory is expected to develop, and to provide facilities towards development of instrumentation for observations by IUCAA's academic staff as well as interested scientists from the universities. In order to achieve this aim in stages (of increasing complexity and resources) the laboratory has taken up development of several, relatively less complex instruments. The status of each of these is briefly presented below.

(i) *Automated Photoelectric Telescope* : A small (14-inch aperture) prototype automated telescope, capable of making photoelectric-photometric observations under computer control is being developed. The interested scientists from universities can duplicate this telescope in our laboratory and take it for their own observations. (Some universities have shown keen interest in it.) The mechanical parts of the drive for the telescope are being made, and work is continuing on the interfacing with computer.

(ii) *CCD Camera* : A liquid N₂ cooled CCD camera is being developed for observations. The camera design incorporates electrical flexibility so that

it could be adapted to different CCD devices without requiring any major change. The design of the cards (based on the well tested designs of some observatories) is over and the cards are being made.

(iii) *Tandem Fabry-Perot Spectrometer* : A proposal has been submitted to DST for the development of a Tandem Fabry-Perot spectrometer, which would be capable of measuring the details of the line profiles in stellar spectra at high resolutions of $\sim 10^5$ with a high S/N ratio of ~ 100 . This instrument would be used for observations on the Vainu Bappu 2.3m telescope and other telescopes in the country. The development of this instrument would take about 2 years.

(iv) *Photo-diode Photometer* : A photometer based on photo-diode detector is being developed. The design is such that it could be used on small telescopes, it works on batteries and has a digital display for the output. The basic design allows three configurations: the most compact one has no visual viewing port and a single element diode, the most complex version would have a four element diode detector and a visual viewing port (the four elements are used to find the location of the star in the field). The electrical circuits have been designed and tested, and the mechanical parts are being made. This instrument is expected to be useful for observations at many levels e.g. research on variable stars, and laboratory course for M. Sc. students.

(v) *Experiments for Astronomy Courses* : A set of experiments is being developed which would be suitable for B.Sc. / M.Sc. students and which could be carried out with the 3" refractors made by CSIO Chandigarh several years back and supplied to many colleges and universities through DST/UGC. A complete manual for these experiments is being developed so that the experiments could be implemented by the interested departments.

The instrumentation laboratory has a 14-inch and a 8-inch telescope, which are used for laboratory courses of M. Sc. students and for testing photometers etc. (The 14-inch telescope is being used, part of the time, for observing some variable stars.) An optical bench has been set up for testing the instruments under development, and an electronic laboratory has been established. The resources of these facilities are continuously being upgraded in response to the need of the projects in hand.

The number of personnel connected with the

instrumentation laboratory is small (2 academic and 3 scientific staff) and with the increase in personnel and other resources more projects would be taken up. In parallel, we expect some of the university groups to initiate some projects involving utilisation of the facilities here.

Science Popularization Programmes

(I) Promotion of amateur astronomy in India

It is often lamented, perhaps justifiably, that India simply does not exist in the world map of the real down-to-earth observations by the amateur astronomers, in spite of the phenomenal enthusiasm that was noticed among them during the total solar eclipse of the year 1980 and also during the latest visit of the comet Halley in 1985-86. IUCAA is attempting to act as a catalyst in the activities of the amateur astronomers in the country by way of organizing national meets, providing necessary support to carry out observations and setting guidelines for maintaining log books. Moreover, due to ever-increasing shortage of talented research scholars opting for to do research in astronomy and astrophysics related areas, an action plan is being evolved to promote astronomy in our schools and colleges, through organizing regional schools and workshops, and helping the interested universities in drawing up suitable syllabi at the desired levels.

A recent stock taking has revealed that there exist no less than 400 telescopes of size 6-inch or above in possession of individuals, schools, colleges, universities and small astronomy clubs in the country. Most of them are, however gathering dust for lack of proper guidance and self-motivation. From time to time, various telescope-making workshops alone have produced more than 200 mirrors of the above category. IUCAA is currently planning to conduct small telescope making workshops which will enable each participant to grind his/her 6-inch mirror and make a simple Dobsonian mount. The estimated cost per telescope is about Rs. 1000 only, which is, by any standard, an order of magnitude cheaper than their current market price.

IUCAA has started sending the details of the possible asteroidal occultation of stars and cometary visits to the interested amateurs, which can result in a work of some research value. The initial response has been an encouraging one. We are also hiring a few experts in cometary observations and are planning to build on-line polarimeters and photometers which can be coupled to our acquired C-14. We are also developing graphics softwares to generate a window of the sky with stars up to a certain limiting magnitude, which would be useful as identifying charts for the amateurs for locating faint objects, such as asteroids, comets, and variable stars. Improved techniques for resolving very close binaries is another thrust area that we are trying to embark upon. A. Paranjpye has been enthusiastically assisting in most of these developmental works.

(II) Sky Observation Programmes

Sky observation programmes were conducted for general public, amateur astronomers and students. Celestron 14 telescope was used for viewing purpose on site which was temporarily fixed on the roof of the NCRA building. This instrument will be shifted to the IUCAA institutional buildings in November 1992. The 8-inch telescope has been taken on field trips at other observing locations depending on the requests from the concerned amateur groups. The usage of these instruments since their acquisition has grown significantly.

(III) Amateur Astronomers' Meet

Following the grand success of the amateur astronomers meet held in early 1991, the second such meet organised by Kutuhil, Nagpur was held this year at Sevagram, Wardha (Maharashtra) during January 4-5. The National meet was preceded by a one-day meet at the state level on January 3. N. C. Rana was the Chairman of the National Organising Committee and he also delivered the keynote address. It was decided that the organisers of the Maharashtra Meets would lay emphasis on promoting amateur astronomy in three different regions of Maharashtra keeping in mind the general awareness of these regions. The next year's national meet will be held at Vikram A. Sarabhai Community Science Centre (Ahmedabad), and to be convened by Vatsal Thakkar. The handout entitled "Some observational projects for small telescopes" prepared by N. C. Rana and A. Paranjpye was distributed to participants. It is hoped that these meets will eventually lead to the formation of a National Federation of Amateur Astronomers.

(IV) Young Astronomers' Meet

The first meeting of the young astronomers -- YAM'92, was successfully hosted jointly in the campuses of NCRA and IUCAA between February, 10--13 1992. YAM'92 was designed to be the first realisation of an annual forum where research students working in astronomy, astrophysics and other closely related fields could get together and discuss their fields of research. It was felt that this would help usher in a cohesive environment in A & A activities in India.

This meet was funded by Department of Science and Technology and the organisation was almost entirely carried out by the research scholars of NCRA and IUCAA. The meet saw three days of intensive academic activity, with each of the 24 participants giving a short talk on their field of work. There

were lively open discussion sessions and five invited talks by senior and eminent workers in A & A. YAM'92 ended with a trip to Narayangaon (90 kms. north of Pune) -- the site of the GMRT (Giant Meterwave Radio Telescope) currently under construction.

The heartening success of YAM'92 makes us look forward to the next YAM tentatively planned to be organised in Bangalore.

(V) The National Science Day

The National Science Day (February 28) celebration at IUCAA under the leadership of N. C. Rana went off very well with an overwhelmingly large response from the local schools. There were slide shows, demonstration of on-line computer processed images of the galaxies, a number of scientific magic shows, demonstration of some experiments with laser beams, identification of Venus in the daytime, observation of sun spots and a very lively quiz contest. The Kendriya Vidyalaya, Ganeshkhind bagged the rolling trophy as the first prize, The Hindustan Antibiotics School won the rolling cup as the second prize and The Bishop High School obtained the third prize.

Interaction with Universities and colleges

Regional discussion meetings

A regional discussion meeting for the universities of Western India was held at Mohanlal Sukhadia University, Udaipur on November 17 and was attended by representatives from Gujarat, Sardar Patel, South Gujarat, Saurashtra and host universities. N. Dadhich briefed the participants on the Visitor Programme of IUCAA and S. N. Tandon talked on IUCAA's programme of Automated Photoelectric Telescopes, while A. Bhatnagar spoke on Our Sun. There was enthusiasm amongst university colleagues to introduce an introductory course in astrophysics in their M. Sc. curriculum. They would like IUCAA to help them in framing the course. There was also a view that some selected students during their M. Sc. course should be given specialised training in A and A at IUCAA for 8-10 weeks. Participants visited the Udaipur Solar Observatory situated in the lake.

The regional discussion meeting for the universities of Southern India was held at Kerala University, Trivandrum on January 18, 1992 and was attended by about 40 participants from various universities and colleges. Participants expressed keen interest in the use of various IUCAA programmes and facilities for growth of A & A and a desire to have active interaction with IUCAA.

The seventh and last meeting in the series of regional discussion meetings was held at the Aligarh Muslim University on February 15, 1992 and was attended by 20 participants from various universities and colleges. They were interested in incorporating some introductory courses in A & A in their existing programmes. They suggested that regional introductory schools should be held on basic A & A for students and teachers. A modular syllabus prepared by IUCAA and which has sufficient flexibility in terms of the topics and experiments to be covered, was given to the participants.

IUCAA faculty members visited Jadavpur University, North Bengal University, Gauhati University, North Eastern Hill University and gave lectures, carried discussions with faculty and students on their interaction with IUCAA.

Teaching at the University of Poona

IUCAA faculty members along with the members from the National Centre for Radio Astrophysics have been taking part in the teaching of astrophysics oriented subjects in the M. Sc. Physics course of

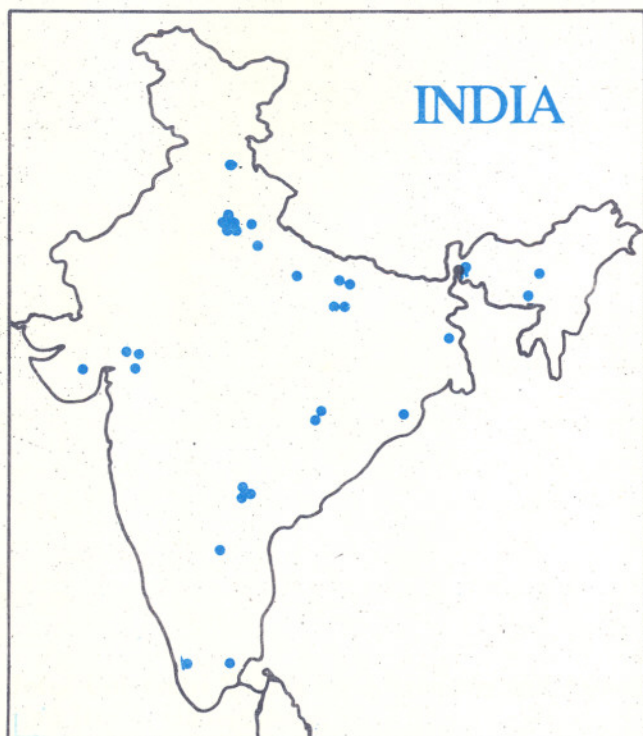
the University of Poona.

IUCAA faculty members helped in the formulation of the syllabi for the eight core courses as well as the courses to be taught to M. Sc. students taking A & A as optional papers for specialisation.

The Associateship Programme at IUCAA

The associateship programme is the backbone of the scheme of interaction between scientists working in the university sector and the academics at IUCAA. A number of senior associateships and associateships are awarded every year by IUCAA for a period of three years. The awardees can spend up to *three* months every year at IUCAA, and during their visits establish collaboration, carry out their research work, set up proposals for research projects, schools and workshops, deliver seminars or short lecture courses and generally participate in various other academic activities. Judging from the work accomplished and the research papers published or prepared for publication, the programme has been quite a success, in spite of the limited infrastructural facilities available during the first two years of operation. It is hoped that as progressively more office space and accommodation become available during the next few months, there will be increasing activity under the associateship programme, both in terms of the number of associates, as well as the frequency of visits. Figure 5 shows the geographical distribution of the associates.

**Fig. 5 : Senior Associates and Associates 1990-92
Geographical Distribution**



The activity that associates pursue at IUCAA include their research interests of long standing, as well as completely new areas initiated by collaboration with the academic staff at IUCAA, other associates as well as visitors from other institutions in India and abroad. Associates are particularly encouraged to participate in astronomical observations and the building of instruments, and the response here has been quite heartening. Theoreticians are also persuaded to extend their horizons by interacting with observers and experimentalists, and are encouraged to become experts in the use of computers as an aid in analytic calculations, preparation of manuscripts and so on.

During 1991-92 there were 13 senior associates and 17 associates at IUCAA. Most of these managed to visit IUCAA for periods of a month or more, while a few had to postpone their visits due to circumstances in their home institutions. In all cases however there has been a sense of involvement in various activities and much fruitful exchange. The programmes carried out by associates at IUCAA are very briefly listed below. It is apparent that the research interests of the associates cover a fairly wide spectrum in the general area of astronomy and astrophysics.

S. M. Alladin studies structural changes caused by the tidal effects in the ejecting as well as ejected stellar systems. The situation is compared with that of head-on collision between galaxies of unequal dimensions.

S. Banerjee has considered the interaction of matter with white holes in the early stages of evolution of the universe and has examined the question of their being converted into black holes by condensation of matter.

K. B. Bhatnagar and L. M. Saha have been investigating perturbed potentials for non-linear stability of liberation points in the restricted three body problem and chaos in dynamical systems.

H. L. Duorah studied stellar structures under slow rotation in general relativity and has worked out a model of the compact star made of self bound matter that can give rise to an ultra fast pulsar.

S. Mukherjee (together with B. Pal, N. Dadhich and A. Kshirsagar) has worked out a model for gravitational instanton with an interacting scalar field in the context of quantum tunneling of the early universe. He has also initiated collaborative work on quantum gravity in the Ashtekar's programme of quantization.

N. Panchapakesan in his brief visits has had discussions with IUCAA faculty on various problems of gravitation theory and cosmology.

L. K. Patel and R. S. Tikekar have obtained a number of exact solutions of Einstein equations for radiating systems and string cosmologies. Patel and N. Dadhich have considered cylindrical viscous fluid models with the Kasnerian time evolution.

S. D. Verma chalked out the academic programme for the organisation of the workshop on "Experimental techniques in space sciences and astronomy" held at Gujarat University, Ahmedabad during February 24-28, 1992. The overall planning of the workshop was done in consultation with the concerned IUCAA faculty.

G. M. Ballabh was engaged in studying the CCD image processing softwares and IRAF for analysing a CCD frame of a galaxy.

Suresh Chandra has attempted to solve magnetohydrostatic equations for solar corona including the effect of gravity and has found two solutions corresponding to two different configurations with different energies.

K. N. Iyer has analysed the data of ionospheric scintillation at 244 MHz recorded at his university. An experiment to study travelling ionospheric disturbances using two dimensional radio interferometry and ionosonde was planned.

Pushpa Khare alongwith N. C. Rana has tried to determine the rate of chemical evolution of galaxies from the red shift distribution of the heavy element absorption systems in the spectra of QSOs. She has also been working on the analysis of high resolution observations of quasar absorption lines and with A. Kembhavi on effect of variation of the shape of the X-ray, continuum of QSOs on its emission line spectra.

Shobhit Mahajan has been working on phase transitions in the early universe with a view to obtain bounds on particle physics parameters.

Udit Narain has been working on heating of solar corona and has planned to study magnetic fields in pulsars.

S. K. Pandey alongwith A. Kembhavi and others has been involved in the CCD observations of galaxies with Vainu Bappu Telescope at Kavalur and UPSO, Nainital.

Administration

In furtherance of automation in office work, substantial areas of accounting and purchasing have been computerised. These include Cash Book, Bank Book, General Ledgers, Trial Balance, Payroll, Provident Fund, MRF Register, Purchase Orders, etc. Relevant reports are also being generated. IUCAA sponsored S.N. Khadilkar and M.S. Sahasrabudhe for a Diploma in Office Automation while R.D. Pardeshi and P. Krishnan for a Certificate Course in Lotus, Wordstar and dBase, in order to enhance their familiarity with automated work-situations. K.M. Abhyankar conducted a course in Electronic Spreadsheets (Lotus 123) for the administrative staff and delivered a series of lectures on 'Secretarial Efficiency' based on her participation in a similar course conducted by the Institute for Training and Management Development, Dehradun.

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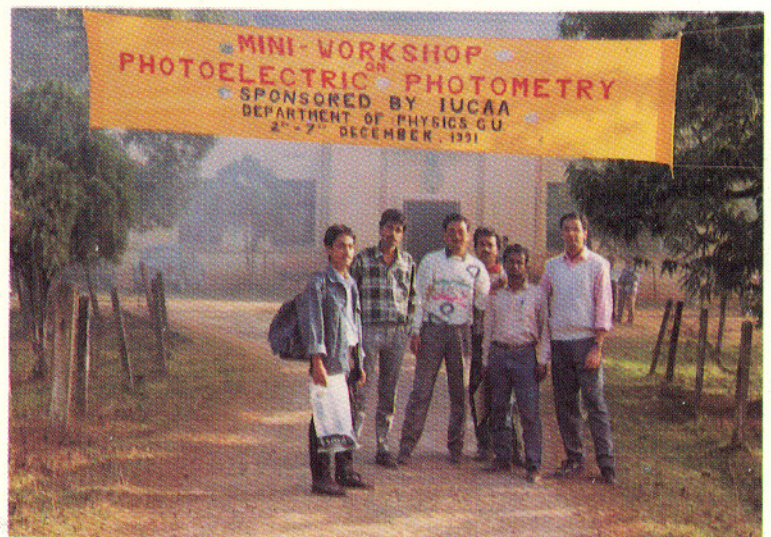
Image Processing at the IUCAA
Computer Centre



A. W. Wolfendale



Associates with IUCAA Faculty



Miniworkshop at Gauhati University