

**B3-XI**

**National Centre for  
Radio Astrophysics  
(NCRA)**





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### **National Centre for Radio Astrophysics**

1. Name of the Department :

National Centre for Radio Astrophysics (NCRA)

2. Year of establishment :

1994

3. Is the Department part of a School/Faculty of the university?

It is a TIFR Centre and comes under the Physics Subject board.

4. Names of programmes offered (UG, PG, M.Phil., Ph.D., Integrated Masters; Integrated Ph.D., D.Sc., D.Litt., etc.)

1. Ph.D.

2. Integrated M.Sc.-Ph.D.

Students may avail of an M.Phil. degree as an early exit option provided they have finished a specified set of requirements. However, there is no separate M.Phil. programme.

5. Interdisciplinary programmes and departments involved

NCRA does not have a formal interdisciplinary programme. However, Radio Astronomy is an inherently interdisciplinary programme, involving physics, astronomy, signal processing, instrumentation etc. Several of the Ph.D. research topics are highly interdisciplinary.

6. Courses in collaboration with other universities, industries, foreign institutions, etc.

Graduate school courses are done in collaboration with the Inter University Centre for Astronomy and Astrophysics for the Ph.D. degree. Courses for the Integrated Ph.D. programme are done in collaboration with Pune University, as well as IISER Pune. NCRA faculty also teach courses at Pune University Physics department (as part of the Pune University M.Sc. programme), as well as at IISER

Pune.

7. Details of programmes discontinued, if any, with reasons

There are no such programmes.

8. Examination System: Annual/Semester/Trimester/Choice Based Credit System

Students of the NCRA are offered a programme based on a mixture of compulsory Core Courses and a choice of topics on which they can do project work. During each semester students are evaluated by a Continuous Evaluation process consisting of one or more of Assignments/ Quizzes/ Mid-semester Examination/ End-semester Examination/ Class Presentations/ Term Papers.

9. Participation of the department in the courses offered by other departments

NCRA does not currently participate in courses offered by other departments of the TIFR Deemed University.

10. Number of faculty positions:

	Faculty Designation with DAE Grade	Abbreviation (Item 11)	Number
1.	Distinguished Professor (J)	Distinguished Professor (J)	0
2.	Senior Professor (I)	Sr. Professor (I)	3
3.	Professor (H)	—	2
4.	Associate Professor (G)	Assoc. Professor (G)	5
5.	Reader (F)	—	7
6.	Reader (E)		1
7.	Fellow (E)		0
		Total	18

11. Faculty profile with name, qualification, designation, area of specialization, experience and research under guidance

Name	Deg*	Designation	Specialisation	Exp <sup>†</sup>	Stu <sup>‡</sup>
S. K. Ghosh	Ph.D	Sr. Professor (I)	The Interstellar Medium, Infra-red Astronomy	37	0
Y. Gupta	Ph.D.	Sr. Professor (I)	Pulsars, the interstellar medium and	25.6	2

			Instrumentation		
J. N. Chengalur	Ph.D	Sr. Professor (I)	Extragalactic astronomy, the interstellar medium	19.9	4
D. J. Saikia	Ph.D	Professor (H)	Extragalactic astronomy, AGN , nearby galaxies	27.4	2
P. K. Manoharan	Ph.D	Professor (H)	Solar activity, the interplanetary medium	21.5	1
N. G. Kantharia	Ph.D.	As. Professor (G)	Galactic and extragalactic radio sources, emission models and mechanisms	17.7	0
D. Mitra	Ph.D.	As. Professor (G)	Pulsars, pulsar emission mechanisms, the interstellar medium Physics of interdisciplinary nature	12.3	1
Ch. Ishwara-Chandra	Ph.D	As. Professor (G)	Radio Galaxies and Quasars	14.0	0
N. Kanekar	Ph.D	As. Professor (G)	Fundamental constant evolution, the interstellar medium, high redshift galaxies	6.7	1
B. C. Joshi	Ph.D	As. Professor (G)	Pulsars, polarimetry, instrumentation, software	13.4	3
D. Oberoi	Ph.D.	Reader (F)	Solar Physics, Interplanetary Scintillations, Interferometry	4.3	1
Y. Wadadekar	Ph.D	Reader (F)	Galaxy formation and evolution, radio properties of AGN, high redshift radio galaxies, machine learning	8.6	0
D. V. Lal	Ph.D	Reader(F)	Extragalactic radio and X-ray astronomy	4.3	0
S. Roy	Ph.D	Reader (F)	The galactic centre, the interstellar medium,	8.2	1

			supernova remnants		
P. Chandra	Ph.D	Reader (F)	Supernovae, gamma ray bursts, massive stars	3.3	0
T. Roy Choudhury	Ph.D.	Reader (F)	Reionization, the intergalactic medium, dark energy	7.8	3
S. K. Sirothia	Ph.D.	Reader(F)	Extragalactic radio astronomy, instrumentation	3	0
J. Roy	Ph.D.	Reader(E)	Pulsars, transient radio sources, instrumentation	2	0

\* Highest degree obtained

† Years of Experience as a regular Faculty Member (TIFR and elsewhere)

‡ Ph.D. students guided within the last 4 years (including those joined and those graduated)

12. List of senior Visiting Fellows, adjunct faculty, emeritus professors

We have no senior visiting fellows/adjunct faculty/emergitus Professors. However we are hosting Dr. Sushan Konar and Dr. R. Kale who hold the DST WOS fellowship and the DST INSPIRE faculty fellowship respectively.

13. Percentage of classes taken by temporary faculty – programme-wise information

A total of 56 classes were taught as part of the Ph.D. program over the last four years. Of these three were taught by temporary faculty. No classes in other programs were taught by temporary faculty.

14. Programme-wise Student Teacher Ratio

We currently have 20 students in the Ph.D and Integrated Ph.D. programs combined. We have a total of 18 faculty members all of whom are involved in both programs. The student teacher ratio is hence 20:18, i.e.  $\sim 1.1$ .

15. Number of academic support staff (technical) and administrative staff:

Scientific and Technical Staff	Administrative and auxiliary Staff
143	89

16. Research thrust areas as recognized by major funding agencies

The focus area at NCRA is radio astronomy. The specialties include:

- Solar astronomy
- Stars and star forming regions, pulsars, extra-galactic astronomy
- Interstellar medium, galaxies, galaxy evolution,
- Transients, active galactic nuclei,
- Cosmology, theoretical astrophysics
- Radio astronomy-related instrumentation

17. Number of faculty with ongoing projects from a) national b) international funding agencies and c) Total grants received. Give the names of the funding agencies, project title and grants received project-wise.

	Agency	Title	Project cost (in Rs. Lakhs)	Duration	Faculty
1	DST	Swarnajayanti Fellowship	57	5 years	Nissim Kanekar
2	DST	Neutron Stars Glitch Physics	24	3 years	Sushan Konar
3	DST	Inspire faculty Award	55	5 years	Ruta Kale
4	SERB	Pulsar monitoring observations programme	21	3 years	B C Joshi
5	DST	Swarnajayanti Fellowship	75	5years	Poonam Chandra

## 18. Inter-institutional collaborative projects and associated grants received

NCRA is the lead Indian institution for the Square Kilometer Array Mega Project, which is a large international collaboration to build the next generation Radio Telescope. For the ongoing pre-construction phase of the SKA, NCRA is leading a multi-national consortium for the Monitoring and Control (Telescope Manager) work, as well as participating in other packages like signal transport, signal processing etc. The total funding for this project for the next 3 years is about INR 36 crore.

## 19. Departmental projects funded by DST-FIST; UGC-SAP/CAS, DPE; DBT, ICSSR, AICTE, etc.; total grants received.

	Agency	Title	Project cost (in Rs.Lakhs)	Duration	Faculty
1	DAE	XII Plan Project – Radio Astrophysics at NCRA	10,100	5 years	All NCRA faculty

NCRA has two major projects funded by the DAE, these are focused on Capacity building in Radio Astronomy, and Upgrades to the Giant Meterwave Radio Telescope. The total funding in the 12th 5-year plan for these two projects is about Rs. 100 crore.

The project on capacity building for Radio Astronomy includes components on Upgrades of computational facilities, Upgrades for the Ooty Radio Telescope, Upgrades of SIRCFacilities User Community Development, Enhancement to the TGSS Computational Facility, Radio Astronomy From Space, Upgrade of Civil and Related Infrastructure, The expanded GMRT and the NCRA Technology Park.

The upgrade of the GMRT includes components on New Technology Front- End & Signal Transport for GMRT, Upgradation of back-ends for the GMRT, Improvements to GMRT Operations, Upgrades to GMRT data archive, Controlling Radio Frequency Interference at the GMRT, the Next Generation Servo System, Improvements to Mechanical Systems, and Additions & Improvements to Electrical Systems.



In addition NCRA is the nodal Indian agency for the international Square Kilometer Array project. This is one of the mega projects funded by DAE and DST. The budget for this project is INR 36 crore for 3 years.

20. Research facility / centre with National and International recognition.

NCRA designed, built and operates the Giant Meterwave Radio Telescope (GMRT) which is one of the most sensitive radio telescopes in the world. It is located at a site about 80 km north of Pune, and consists of 30 fully steerable gigantic parabolic dishes each of 45m diameter. The array is spread over distances of up to 25 km, with all antennas connected to the central electronics building via optical fibre links. The number and configuration of the dishes was optimized to meet the principal astrophysical objectives which require sensitivity at high angular resolution as well as ability to image radio emission from diffuse extended regions. The multiplication or correlation of radio signals from all the 435 possible pairs of antennas or interferometers enables radio images of celestial objects to be synthesized with a resolution equivalent to that obtainable with a single gigantic dish 25 kilometre in diameter. The array currently operates in 5 frequency bands centered at 153, 233, 325, 610 and 1420 MHz. All these feeds provide dual polarization outputs. In some configurations, dual-frequency observations are also possible.

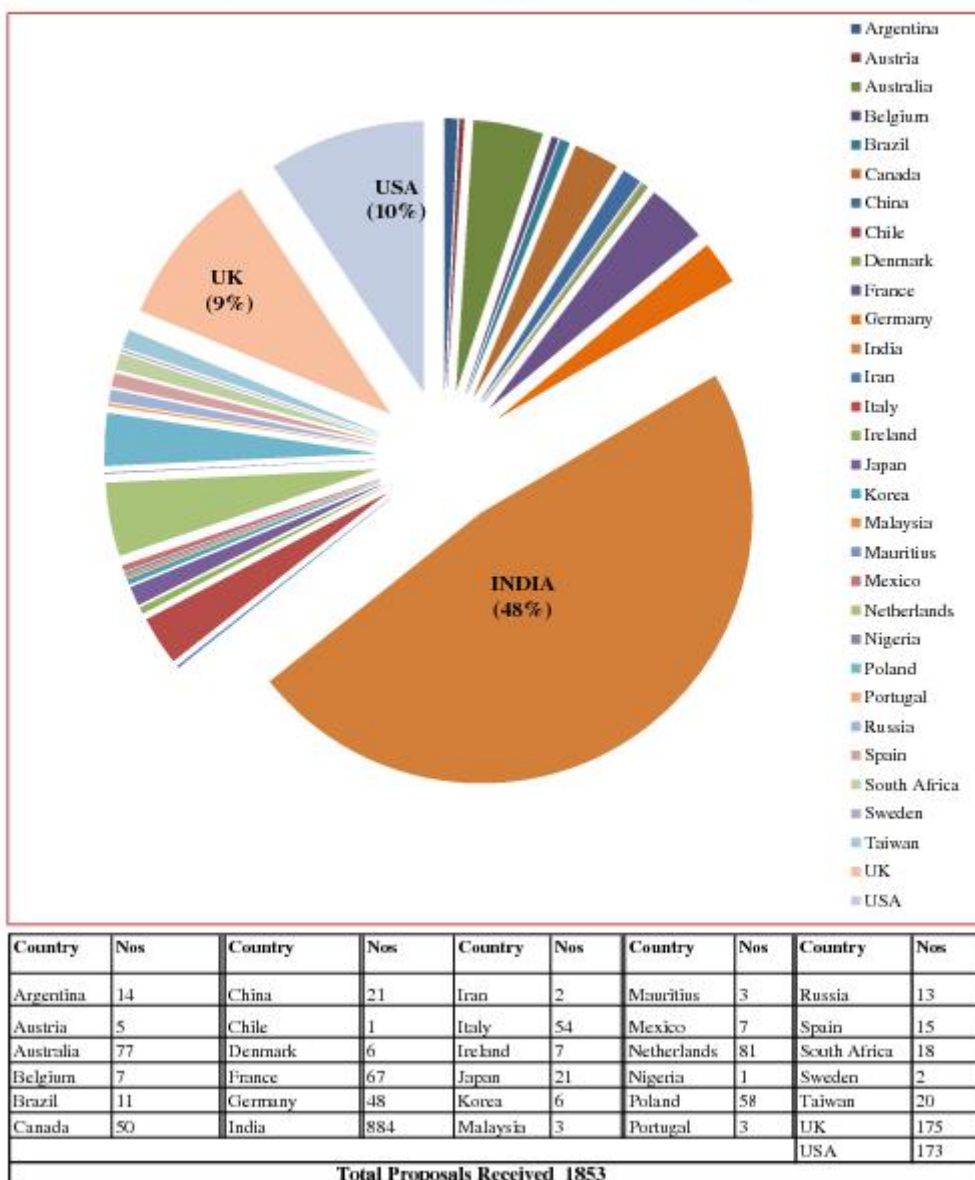
GMRT is a completely indigenous project and is one of the most challenging experimental programmes in basic sciences undertaken by Indian scientists and engineers. The GMRT was dedicated to the nation in 2001 by Shri Ratan Tata and is operated as a national facility with the allocation of observing time with the GMRT is done by an independent Time Allocation Committee, currently chaired by Prof. K. Subramanian from IUCAA. The Time Allocation Committee receives proposals from astronomers from across the world and allocates time based on international peer review, independent of the home institute of the proposer. At the moment about 50% of the time at the GMRT is allocated to proposals from Indian PIs and the remaining to proposals from foreign PIs. The over subscription rate (i.e. the ratio of total observing time requested to the total time available for allocation) at GMRT is around a factor of 2. The GMRT is one of the few national facilities which attracts a significant number of proposals from the international community. The statistics of time distribution at the GMRT (as a function of the

country of origin of the PI) is given below.

In addition the NCRA also operates the Ooty Radio Telescope, which remains one of the most sensitive low frequency single dish telescopes in the world.

**Statistics of GMRT Proposals and Distribution of users from around the world**

**PI - Countrywise distribution of proposals Cycle 1 to Cycle 29**

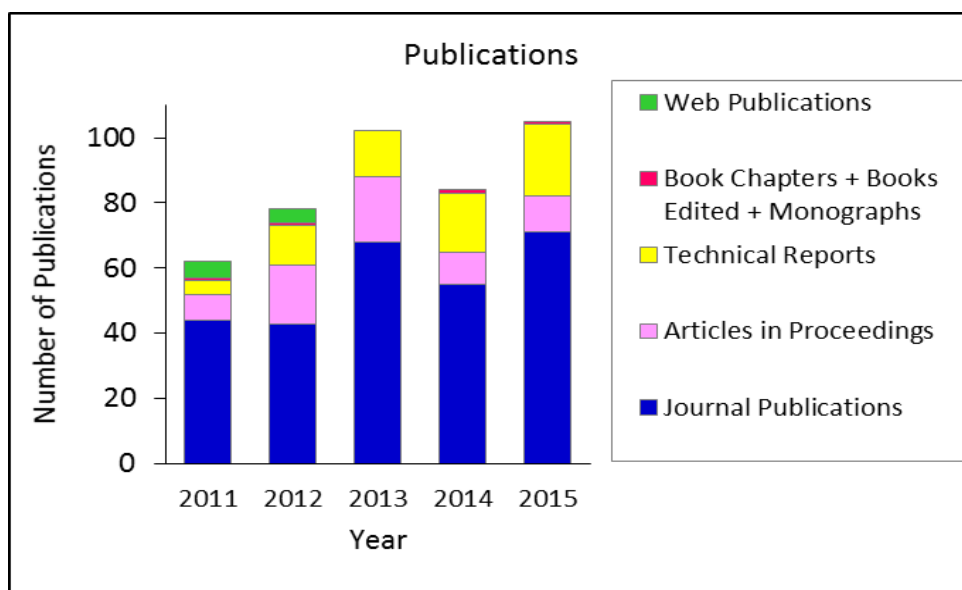


21. Special research laboratories sponsored by / created by industry or corporate bodies

NA

22. Publications:

NCRA	Journal Publications	Articles in Proceedings	Technical Reports	Web Publications	Book Chapters	Books Edited	Monographs
2010-11	44	08	4	5	1	-	-
2011-12	43	18	12	4	1	-	-
2012-13	68	20	14	-	-	-	-
2013-14	55	10	18	-	1	-	-
2014-15	71	11	22	-	-	1	-
<b>Total</b>	<b>281</b>	<b>67</b>	<b>70</b>	<b>9</b>	<b>3</b>	<b>1</b>	



\* Citation Index – range / average

- Total number of citations- 22685 (Source-Astrophysical Data System)
- Number of citations per faculty- 1260

\* h-index

- Range- 8-32

23. Details of patents and income generated

Patent Name	Patent holder	Date of filing	Current status
Preloaded Parabolic Dish Antenna and the Method of Making it	G.Swarup	29-06-07	Granted

Income generated is NIL

24. Areas of consultancy and income generated

None

25. Faculty selected nationally / internationally to visit other laboratories / institutions / Industries in India and abroad

All NCRA faculty have made several visits to both national and international institutes, industries etc. A partial list of visits is given below.

**National Visits:**

	Name of Faculty Member	National Visits	Place of visit	Year of Visit
1	B C Joshi	1)ASI 28th, Meeting, 2)National Seminar On Aerospace and Related Mechanisms 3)ASI 31st, Meeting, 4)Aditya science meeting 5)ASI 32nd Meeting	1)Raipur 2)Thiruvananthapuram  3)Thiruvananthapuram 4)Bangalore  5)Bangalore	1)2010 2)2010  3)2013 4)2013  5)2014
2	Chengalur, J. N.	1)ARIES, 2)Radio Astronomy, Astronomy Olympiad Camp, HBCSE	1)Nainital 2)Mumbai	1)2012 2)2014
3	Choudhury, Tirthankar Roy	1)HRI 2)Indian Institute of Science	1)Allahabad 2)Bangalore	2012

	Name of Faculty Member	National Visits	Place of visit	Year of Visit
4	Dutta, Prasun	1) Indian Inst.of Technology 2)IISER	1) Kharagpur 2)Mohali	2011
5	Ghosh S.K	1)S N Bose National Centre for Basic Sciences 2)ARIES, 3)Astronomical Society of India	1) Kolkatta  2)Nainital 3)Raipur	1)2010  2)2010 3)2011
6	Gupta Yashwant	1)Indian Inst.of Technology 2) ASI,30th Meeting 3)IISER 4)INSPIRE Sc.Camp, NIST 5) IISER 6)2014 IEEE HPC Conference 7)102nd Indian Science Congress meeting. 8)RRI	1)Mumbai  2)Thiruvananthapuram 3) Trivandrum 4)Orissa,  5)Mohali 6)Goa  7)Mumbai  8)Bangalore	1)2010  2)2012 3)2013 4)2014  5)2014 6)2014  7)2015  8)2015
7	Ishwara-Chandra C. H	Cotton College State University, Guwahati,	Assam	2015
8	Kanekar Nissim	1)Indian Conference on Cosmology and Galaxy Formation, IISER 2)Indian Institute of Sciences 3)RRI 4)IISER 5)IIA 6)RRI	1)Mohali  2)Bangalore  3)Bangalore 4)Mohali 5)Bangalore 6)Bangalore	1)2011  2)2012  3)2013 4)2014 5)2014 6)2014
9	Manoharan, P.K	Physical Research Laboratory	1)Ahmedabad	2014
10	Roy, J	1)Saha Institute of Nuclear Physics 2)S N Bose National Centre for	Kolkata	2012

	Name of Faculty Member	National Visits	Place of visit	Year of Visit
		Basic Science		
11	Saikia D.J.	1)Raman Research Institute 2) Indian Inst.. of Technology	1)Bangalore 2)Triruvananthapuram	1)2010, 2011 2)2011

**International Visits:**

	Name of Faculty Member	Date of visit	Details of meetings/Conferences	Place of visit
1	Gopal Krishna	09/05/2011 - 23/05/2011	Collaborative research work in MPIfR, Bonn & IAP, Paris	MPIfR, Bonn
2	D J Saikia	01/05/2011 - 31/07/2011	ELVA, Socorro, New Mexico, USA	Socorro, New Mexico, US
3	Yogesh Wadakekar	28/06/2011 - 30/06/2011	Representative of M & C Lead Institution	Manchester, UK
4	Nissim Kanekar	27/06/2011 - 30/06/2011	speaker	Santiago, Chile
5	N G Kantharia	12/07/2011 - 17/07/2011	Contibuted presentation	Boston, USA
6	Nissim Kanekar	03/07/2011 - 08/07/2011	invited speaker	Ringberg, Germany
7	Yogesh Wadakekar	04/07/2011 - 08/07/2011	M & C Breakout meeting	Banff, Canada
8	Yogesh Wadakekar	26/07/2011 - 29/07/2011	invited speaker in Asia Pacific Regional IAU meeting	Chiang Mai, Thailand
9	Yashwant Gupta	17/07/2011 - 23/07/2011	participating in the review panel meet for MeerKAT	Capetown, South Africa
10	Yashwant Gupta	13/08/2011 - 20/08/2011	invited talk(URSI General Assembly)	Istanbul, Turkey
11	P K Manoharan	28/06/2011 - 07/07/2011	invited talk	Melbourne, Australia
12	P K Manoharan	08/08/2011 - 12/08/2011	invited talk	Taipei
13	B C Joshi	13/08/2011 - 20/08/2011	paper presentation and participation (URSI General Assembly 2011)	Istanbul, Turkey

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14	S K Sirothia	13/08/2011 - 20/08/2011	invited talk (URSI General Assembly, 2011)	Istanbul, Turkey
15	J N Chengalur	05/09/2011 - 14/09/2011	collaboration work at ANU	Australia
16	Prof. Yashwant Gupta	17/10/2011 - 21/10/2011	Visit to UK for PrepSKA WP2 meeting at Manchester	UK
17	Janusz Gil	23/10/2011 - 26/10/2011	invited to work in Zielona Gora, Poland	Poland
18	Ishwara Chandra C H	01/11/2011 - 04/12/2011	Collaborative work at Univ. of Birmigham, UK	UK
19	P K Manoharan	21/10/2011 - 28/10/2011	Living with Star (LWS) meeting at NSA-GSFC)	USA
20	Yashwant Gupta	29/01/2012 - 04/02/2012	Visit to UK for PrepSKA WP2 meeting at Manchester	UK
21	Yashwant Gupta	13/02/2012 - 16/02/2012	Concept of Design Review Meeting at Manchester	UK
23	Swarna K Ghosh	17/03/2012 - 22/03/2012	collaborative work at Russia under DST-RFBR programme	Russia
24	Nissim Kanekar	21/02/2012 - 11/04/2012	Observation with Kast Telescope of Lick Observatory, California , Collaboration research with Dr. Jeff Weagg at Santiago, Chile	California, USA & Santiago, Chile
25	P K Manoharan	09/04/2012 - 07/05/2012	collaborative work on Indo-US project on Solar Eruptive Phenomena at NASA, USA	NASA, USA
26	Yashwant Gupta	24/04/2012 - 27/04/2012	invited talk at Univ. of Zielona Gora, Poland	Univ. of Zielona Gora, Poland
27	Gopal Krishna	20/05/2012 - 04/06/2012	Scientific collaboration at IAP, France	IAP, France
28	Gopal Krishna	05/07/2012 - 19/07/2012	collaborative work at Princeton New Jersey, USA	USA
29	P K Manoharan	13/05/2012 - 14/05/2012	AOGS council meeting at Singapore	Singapore
30	B C Joshi	18/06/2012 - 20/06/2012	RISC meeting in Puschino, Moscow	Moscow, Russia
31	Dharam Vir Lal	20/08/2012 - 31/08/2012	Oral presentation in IAU meeting in Beijing, China	Beijing, China
32	Yogesh Wadakekar	04/08/2012 - 14/08/2012	International Olympiad in Astronomy and Astrophysics in Rio de Janeriro, Brazil	Brazil

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33	Divya Oberoi	13/08/2012 - 17/08/2012	ASIA OCEANIA GEOSCIENCE Society-American Geophysical Union Joint Assembly 2012	Singapore
34	Gopal Krishna	05/08/2012 - 11/08/2012	Indo-South Africa Workshop	Capetown, South Africa
35	Sandeep Sirothia	05/08/2012 - 11/08/2012	Indo-South Africa Workshop	Capetown, South Africa
36	Yashwant Gupta	05/08/2012 - 11/08/2012	Indo-South Africa Workshop	Capetown, South Africa
37	Yashwant Gupta	12/08/2012 - 18/08/2012	CASPER 2012	Greenbank, USA
38	B C Joshi	19/08/2012 - 29/08/2012	28 General Assembly of IAU & Pulsar Symposium at Beijing	Beijing, China
39	Yashwant Gupta	23/09/2012 - 27/09/2012	RADIO 2012 at Mauritius	Mauritius
40	B C Joshi	19/08/2012 - 29/08/2012	28 General Assembly of IAU & Pulsar Symposium at Beijing	Beijing, China
41	Yogesh Wadadekar	22/09/2012 - 20/10/2012	Collaborative visit to SAAO, Cape Town	Cape Town, South Africa
42	Divya Oberoi	03/10/2012 - 05/10/2012	talk and collaborative work at MIT HAYSTACK Observatory	USA
44	P K Manoharan	21/01/2013 - 26/01/2013	Course teaching lecturer in intl space weather winter school at National Central University, Taiwan	Taiwan
45	Yashwant Gupta	27/01/2013 - 01/02/2013	Participation in SKA Board Meeting in Manchester, UK	UK
46	J N Chengalur	04/02/2013 - 16/02/2013	Collaboration work with Australian National Univ., Australia	Australia
47	Dipanjan Mitra	26/04/2013 - 03/07/2013	Collaborative work in Univ. of Zeilona Gora, Poland	Poland
48	Yashwant Gupta	14/04/2013 - 27/04/2013	SKA related meeting in UK and Modern Radio Universe Conference in Bonn	UK & Germany
49	Tirthankar Roy Choudhury	01/05/2013 - 12/06/2013	Academic collaboration with ICTP, TRIESTE, Italy	Italy
50	Poonam Chandra	14/04/2013 - 18/04/2013	GRB conference in Nashville	USA
51	Ishwara Chandra	01/04/2013 - 28/04/2013	visit to IAS, Paris and MRU2013 Bonn	France & Germany



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52	Divya Oberoi	22/06/2013 - 28/06/2013	Meeting of ASIA OCEANIA Geophysical Society	Australia
53	Divya Oberoi	04/05/2013 - 04/06/2013	Visiting MIT-HAYSTACK Observatory	USA
54	Nissim Kanekar	22/04/2013 - 26/04/2013	Meeting on The Modern Radio Universe	Germany
55	P K Manoharan	13/05/2013 - 12/06/2013	Visit to Goddard Space Flight Centre, NASA,	USA
56	P K Manoharan	24/06/2013 - 29/06/2013	To attend workshop on New Eyes Looking at Solar Activity	Prague, Czech Republic
57	N G Kantharia	03/06/2013 - 08/06/2013	Collaborative work at CFA, Boston	USA
58	B C Joshi	18/06/2013 - 22/06/2013	RADIO ASTRON INTERNATIONAL SCIENCE Meeting	Moscow, Russia
59	Yogesh Wadadekar	18/06/2013 - 22/06/2013	RADIO ASTRON INTERNATIONAL SCIENCE Meeting	Moscow, Russia
60	Yashwant Gupta	24/06/2013 - 28/06/2013	Approval for participation in SKA interfaces workshop meeting in UK	UK
61	Yashwant Gupta	02/07/2013 - 07/07/2013	Participation in MeerKAT review panel meeting in Capetown	South Africa
62	Nissim Kanekar	08/07/2013 - 12/07/2013	Meeting on Varying Fundamental Constants, Italy	Italy
63	Yashwant Gupta	23/07/2013 - 26/07/2013	Participation in SKA Board Meeting in UK	UK
64	Tirthankar Roy Choudhury	10/09/2013 - 21/09/2013	To participate in the conference on LYMAN-ALPHA as an Cosmological Tool om Stockholm Univ., Sweden, collaborative work at IOA, Cambridge	Sweden & UK
65	Yashwant Gupta	07/10/2013 - 11/10/2013	SKA Engineering meeting at Manchester, UK	UK
66	Yogesh Wadadekar	07/10/2013 - 11/10/2013	SKA Engineering meeting at Manchester, UK	UK
67	Jayaram N Chengalur	03/11/2013 - 08/11/2013	Conference on The Universe @GER's Wavelength at Groningen. Netherlands	Netherlands
68	Nissim Kanekar	04/11/2013 - 08/11/2013	Conference on The Universe @GER's Wavelength at Groningen. Netherlands	Netherlands

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69	Nissim Kanekar	21/11/2013 - 28/11/2013	1 day workshop on ELVA CH <sub>3</sub> OH data on fundamental constants at Amsterdam and collaborative research at DARK Cosmology Centre, Copenhagen	The Netherlands & Denmark
70	Yashwant Gupta	10/03/2014 - 13/03/2014	Participation in SKA Board Meeting in Manchester, UK	UK
71	Yashwant Gupta	07/04/2014 - 12/04/2014	Participation in SKA Telescope Manager group meeting at Jodrell Bank Observatory, UK	UK
72	Yashwant Gupta	16/06/2014 - 19/06/2014	Participation in SKA SEAC Meetin in UK	UK
73	Nissim Kanekar	15/07/2014 - 10/08/2014	Observation with Australia Telescope Compact Array at Narrabri, Australia and collaborative work with ICRAR, Perth, Australia	Australia
74	B C Joshi	02/08/2014 - 10/08/2014	COSPAR meeting and Radio Astron intl steering committee meeting	Moscow, Russia
76	Dharam Vir Lal	09/07/2014 - 11/07/2014	workshop on X-ray view of Galaxy Ecosystems (9-11 July 2014) at Boston, USA	Boston, USA
77	Dharam Vir Lal	21/08/2014 - 22/08/2014	APRIM 2014 (12th Asia - Pacific Regional IAU meeting at Daejeon, Korea	Korea
78	P K Manoharan	28/07/2014 - 01/08/2014	Asia Oceania Feosciences Society 11th Annual Meeting (AOGS) Sapporo, Hokkaido, Japan	Japan
79	Poonam Chandra	21/07/2014 - 25/07/2014	BinaMics & MiMes meeting at Paris	France
80	Divya Oberoi	16/08/2014 - 23/08/2014	URSI General Assembly of Scientific Symposium at Beijing	China
81	Ishwara Chandra	03/11/2014 - 29/11/2014	Collaboration work with Argentina Institute of Radio La-Plata, Argentina	Argentina
82	Yashwant Gupta	28/09/2014 - 06/10/2014	Participation in SKA Engineering Meeting and Consortia Meeting in Perth	Australia

	<b>Name of Faculty Member</b>	<b>Date of visit</b>	<b>Details of meetings/Conferences</b>	<b>Place of visit</b>
83	Jayaram N Chengalur	10/09/2014 - 20/09/2014	Collaborative work at SAO, Russia	Russia
84	Divya Oberoi	15/09/2014 - 17/10/2014	Collaboration work with MIT Haystack Observatory	USA
85	Yashwant Gupta	15/10/2014 - 17/10/2014	SKA Board Meeting in Guiyang, China	China
86	Tirthankar Roy Choudhury	13/11/2014 - 22/11/2014	Research & Collaboration with Institute of Astronomy, Univ of Cambridge, UK	UK
87	Tirthankar Roy Choudhury	30/11/2014 - 10/12/2014	Invited speaker on SKA 2014 in South Africa	South Africa
88	Jayaram N Chengalur	03/11/2014 - 06/11/2014	Invited speaker - conference on Periphery of Disk Galaxies at Sydney	Australia
89	Yashwant Gupta	01/12/2014 - 04/12/2014	SKA Board + SKA Members meeting in Manchester	UK
90	Jayaram N Chengalur	10/12/2014 - 11/12/2014	To attend the meeting of the SKA Science Review Panel at Jodrell Bank Observatory, UK	UK
91	Yogesh Wadadekar	07/01/2015 - 09/01/2015	SKA TM Design Review Meeting in UK	UK
92	Yashwant Gupta	07/01/2015 - 09/01/2015	SKA TM Design Review Meeting in UK	UK
93	Yashwant Gupta	03/03/2015 - 05/03/2015	SKA Board + SKA Members meeting in Manchester	UK
94	Nissim Kanekar	05/04/2015 - 22/05/2015	To carry out observations with the Arecibo and Greek Bank Telescope and collaboration work with University of California	USA
95	Yashwant Gupta	09/04/2015 - 10/04/2015	SKA Consortium Leads Meet in Jodrell Bank Observatory, UK	UK
96	Tirthankar Roy Choudhury	06/05/2015 - 10/06/2015	Advanced workshop of cosmological structures from Reionization to Galaxies at ICTP, Trieste, Italy	Italy
97	Poonam Chandra	31/05/2015 - 05/06/2015	McCray Symposium 2015 at Univ. of Bern, Switzerland	Switzerland
98	P K Manoharan	02/08/2015 - 07/08/2015	Asia Oceania Geosciences Society 12th Annual Meeting (AOGS 2015)	Singapore

	<b>Name of Faculty Member</b>	<b>Date of visit</b>	<b>Details of meetings/Conferences</b>	<b>Place of visit</b>
99	B C Joshi	14/06/2015 - 18/06/2015	Radio ASTRON INTERNATIONAL Steering Committee meeting	Bonn, Germany
100	Yogesh Wadadekar	01/07/2015 - 25/07/2015	Conference on SKA Pathfinders Radio Continuum Surveys 2015 at South Africa and collaboration work with SAAO, South Africa	South Africa
101	Jayaram N Chengalur	25/06/2015 - 01/07/2015	Colloquium speaker and external examiner of Thesis defence at Groningen Univ., The Netherland	The Netherlands
102	Dharam Vir Lal	01/07/2015 - 03/07/2015	invited talk on SPACS 2015	South Africa
103	Yashwant Gupta	14/07/2015 - 15/07/2015	SKA Consortium Leads Meet in Edinburg, UK	UK
104	Yashwant Gupta	22/07/2015 - 23/07/2015	SKA Board Meeting in South Africa	South Africa
105	Nissim Kanekar	06/06/2015 - 19/06/2015	The trip to receive Delta Lectureship award from the National Central University of Taiwan	Taiwan
106	Poonam Chandra	24/08/2015 - 27/08/2015	Indian Scientists in the SKA Key Science Workshop	Sweden
107	Bhal Chandra Joshi	24/08/2015 - 27/08/2015	Indian Scientists in the SKA Key Science Workshop	Sweden
108	Dharam Vir Lal	24/08/2015 - 27/08/2015	Indian Scientists in the SKA Key Science Workshop	Sweden
109	Divya Oberoi	24/08/2015 - 27/08/2015	Indian Scientists in the SKA Key Science Workshop	Sweden
110	Tirthankar Roy Choudhury	24/08/2015 - 27/08/2015	Indian Scientists in the SKA Key Science Workshop	Sweden
111	Divya Oberoi	17/08/2015 - 21/08/2015	Collaborative work in curtain Univ., Perth, Australia	Australia
112	Ishwara Chandra	19/10/2015 - 31/10/2015	Poster presentation and collaboration work at Bologna, Italy	Italy
113	P K Manoharan	05/10/2015 - 16/10/2015	Coimbra Solar Physics Meeting at Univ. of Coimbra, Portugal	Portugal
114	Yashwant Gupta	14/10/2015 - 16/10/2015	SKA ITO negotiations meet	Italy
115	Yashwant Gupta	08/11/2015 - 12/11/2015	SKA Engineering meeting and Consortia meetings in Canada	Canada

	Name of Faculty Member	Date of visit	Details of meetings/Conferences	Place of visit
116	Yashwant Gupta	19/11/2015 - 20/11/2015	SKA Board Meeting at Manchester, UK	UK
117	Jayaram N Chengalur	02/11/2015 - 06/11/2015	Conference on SKA in Seoul and collaboration work with Korean Astronomy	S Korea
118	Nissim Kanekar	02/11/2015 - 06/11/2015	Conference on SKA in Seoul and collaboration work with Korean Astronomy	S Korea
119	Yashwant Gupta	02/12/2015 - 08/12/2015	Conference on Science at Low Frequencies II at New Mexico and visit to Univ. of California, Berkeley or interactions with CASPER group	USA
120	Jayaram N Chengalur	02/12/2015 - 05/12/2015	Conference on Science at Low Frequencies II at New Mexico	USA

26. Faculty serving in

**(a) National Committees**

	Name of the Faculty Member	Name of the Committee	Role in the Committee	Term of Service
1	S.K.Ghosh	Indian Academy of Science	Fellow	2006-
		Governing Council and Governing Board of Aryabhata Research Institute of Observational Sciences (ARIES),	Member	
		The National Academy of Sciences	Fellow	2010-
		Governing Council of the Western Regional Instrumentation Centre	Member	2009-
		Governing Council and Governing Board of Inter-University Centre for Astronomy and Astrophysics (IUCAA)	Member	2010-
		Scientific Management Board of the India-based Neutrino Observatory (INO) since	Member	2013-
		National Committee of International Astronomical Union	Member	2008-2011
2	J. N. Chengalur	National Committee of the Indian Astronomical Union (IAU)	Member	2012 -
		AIRIES Science Advisory Committee	Member	2012-

	Name of the Faculty Member	Name of the Committee	Role in the Committee	Term of Service
		Indian Academy of Sciences	Fellow	
		National academy of Sciences of India	Fellow	
3	Y.Gupta	TMT-India Software Work Packages Monitoring Committee	Chair	March 2015 -
		Physics Sectional Committee of the Indian Academy of Sciences	Member	2014-15
		The Indian Academy of Sciences	Fellow	2008
		National Academy of Sciences of India	Fellow	2007
		Scientific Advisory Committee, IUCAA, Pune	Member	2009-2013
4	Choudhury, Roy T	Science Working Groups for SKA-India.	Overall coordinator	2014
5	Ishwara Chandra C.H.	1)Executive Council, Astronomical Society of India 2) SOC: Workshop on exploration of Radio Universe, Gorakhpur, Univ 3)SOC:ASI	1)Councilor 2) Member 3)Member	1)2013 – 2016 2) Feb 2010 3)2011
7	D.J.Saikia	National Academy of Sciences India	Fellow	
8	Manoharan PK	Scientific Steering Committee, CAWSES – India, Phase II Programme	Member	2014 -

**(b) International Committees:**

	Name of the Faculty Member	Name of the Committee	Role in the Committee	Term of Service
1	Y Gupta	SKA Telescope Manager Consortium	Leader	Oct 2013 -
		Steering Board of CASPER, University of California, Berkeley	Member	2010-
		Review panel of the Mid-Scale Innovations Program (MSIP) of the National Science Foundation (NSF), USA	Member	2014-15
		Indian representative on the Board of the international Square Kilometre Array Organisation,	Member	2011-
2	J N Chengalur	SKA Science Working Group	Member	2011-

		SKA Science Review Panel	Member	2014
3	Choudhury, Roy T	International Science Working Group on Cosmology for the SKA	Member	2014-
4	B C Joshi	Panel on Education, COSPAR	Member	2008-
		RadioAstron International Science Committee	Member	2011-
5	D.V.Lal	Square Kilometre Array (SKA), Continuum-Surveys Science Working Group	Member	2015-
6	Manoharan, P.K.	IAU Division E Commission 49 Interplanetary Plasma & Heliosphere	Vice President	2013-
		International Space Weather Initiatives (ISWI) Programme in India.	National Coordinator	2011-
		Solar and Terrestrial Sciences Section, Asia-Oceania Geosciences Society	President	2012
7	D. Oberoi	International SKA Solar-Heliospheric-Ionospheric Science Working Group	Co-chair	2015-
		MWA Solar Heliospheric and Ionospheric Coordination committee	Vice Chair	2014-2015
8.	P.Chandra	SKA International transient Science Working Group	Member	2015

### Scientific Organising Committees of International Meetings

	Name of the Faculty Member	Name of the Committee	Role in the Committee	Term of Service
1	Gupta, Y	1)SOC: Meeting, Tempe2014: Early Science Results from Low-frequency Radio Telescopes 2)SOC:Low Frequency Radio Astronomy" in the XXXth General Assembly of URSI, Istanbul, Turkey	Member	1)December, 8-10 2014 2)August 13-20, 2011

	Name of the Faculty Member	Name of the Committee	Role in the Committee	Term of Service
2	Kanekar N	1)SOC: The Universe at Ger's (wave)-length, Kapteyn Institut, Groningen, The Netherlands;	Member	1) November 2013
3	Saikia, D.J	1)SOC: 25th Texas Symposium on Relativistic Astrophysics, Heidelberg 2)SOC:An international conference on Diffuse Relativistic Plasma, RRI, Bengaluru 3) SOC: Special Session on 'Cosmic Evolution of Groups and Clusters', Beijing General Assembly of the International Astronomical Union	Member	1)December 6-10, 2010 2)March 1-4, 2011 2) 2012
4	P.Chandra	1)SOC: TMT Science Forum, Kyoto, Japan 2) SOC for IAU 296, Supernovae and their environments, Raichak, Kolkata	1) Member 2) Member	1) 24-26 May 2016 2) Jan 2013

**(c) Editorial Boards:**

	Name of the Faculty Member	Name of the Journal	Impact Factor	Term of Service
1	S. K. Ghosh	Journal of Astronomy and Astrophysics	0.711	2010-
2	D. J. Saikia	Bulletin of the Astronomical Society of India	0.89	2010-2014
3	P. K. Manoharan	Solar and Terrestrial Sciences Section of Geosciences Letters, official journal of the Asia Oceania Geosciences Society (AOGS).	2.0	2011-
		Journal of Space Weather and Space Climate.	2.588	2011-



27. Faculty recharging strategies (UGC, ASC, Refresher / orientation programs, workshops, training programs and similar programs).

As all TIFR faculty members regularly participate in national and international research-oriented symposia, conferences, workshops and schools, often as the organizers or principal lecturers, they are always in touch with the state of the art in their areas of expertise. Therefore, no separate recharging/refresher programmes are needed, nor are any conducted. In fact, TIFR faculty are in great demand as lecturers in such programmes in other institutions, both inside and outside India.

28. Student projects

- percentage of students who have done in-house projects including inter-departmental projects

100% of our students do their Ph.D. projects in house or in collaboration with other research institutes.

- percentage of students doing projects in collaboration with other universities / industry / institute

Almost all TIFR faculty and laboratories have collaborations with scientists in India and abroad. Students of these faculty members and laboratories participate in these projects. Thus the percentage of students involved in such projects may be 95% or more.

29. Awards / recognitions received at the national and international level

**Faculty Members:**

**(a) National Awards**

	Year	Name of the Awardee	Name of the Award
1	1)2006 2)2010	S K Ghosh	1) Fellow of Indian Academy of Science 2) Fellow of The National Academy of Sciences

2	1)2007 2)2007 3)2008	Yashwant Gupta	1) S S Bhatnagar award 2) Fellow of The National Academy of Sciences 3) Fellow of Indian Academy of Sciences
3	2008	Nissim Kanekar	Vainu Bappu Gold Medal
4	1)2008 2)2009 3) 2011 4)2009	Jayaram Chengalur	1) DAE-SRC outstanding research investigator award 2) Hari Om Ashram Prerit Vikram Sarabhai award 3) Fellow of Indian Academy of Science 4) Fellow of The National Academy of Sciences
5	2012	Jayanta Roy	Bharat Jyoti Award
6	2013	Nissim Kanekar	Swarna Jayanti Fellowship
7	2011	D J Saikia	Fellow of The National Academy of Sciences
8	1)2006 2)2016	Poonam Chandra	1) INSA Young Scientist Award 2) Swarna Jayanti Fellowship

**(b) International Awards**

	Year	Name of the Awardee	Name of the Award
	2002	D. V. Lal	URSI Young Scientist Award
	2010	Poonam Chandra	IUPAP Young Astrophysicist Award
	2014	Nissim Kanekar	Delta Lectureship Award, National Central University of Taiwan

**Students, Postdocs**

• **National Awards**

	Year	Name of the Awardee	Name of the Award
	2016	A.J.Nayana	Best oral presentation in the NSSS2016, Astronomy and Astrophysics parallel session.

• **International Awards**

	Year	Name of the Awardee	Name of the Award
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	2011	Vishal Kumar Gajjar	URSI Young Scientist Award
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30. Seminars/Conferences/Workshops organized and the source of funding (national / international) with details of outstanding participants, if any.

	Year	Name	Funding Agency	Faculty members
1	2015	Astronomical Society of India Meeting	All meetings have been funded via registration fees and out of the NCRA budget.	J N Chengalur & Ishwara Chandra C.H.
2	2015	SKA Face-to-Face All-Hands Meeting of the Telescope Manager Consortium		Y.Gupta
3	2015	SKA India Steering Committee		Y.Gupta
4	2015	First meeting of SKA India Consortium (SKAIC)		Y.Gupta
5	2014	Workshop on Galaxies and Cosmology		J N Chengalur and Tirthankar R. Choudhury
6	2013	Scientific Discussion on Advanced Solar Physics		P K Manoharan
7	2013	SKA Telescope Manager Consortium Meeting		Y.Gupta
8	2013	Square Kilometer Array (SKA) meeting		Y.Gupta
9	2013	SKA Project Stage 1 – Kick Off meeting of the Telescope Manager Consortium		Y.Gupta
10	2013	The Metrewavelength Sky: Celebrating 50 years of Radio Astronomy at TIFR and 10 years of GMRT		J N Chengalur
11	2011	CASPER Workshop		Y.Gupta
12	2011	SOLAR RADIO Workshop		P K Manoharan
13	2013	International Space Weather Winter School		Taiwan National Univ

31. Code of ethics for research followed by the departments

NCRA follows the TIFR Guidelines on Academic Ethics (see Annexure B2-B).

## 32. Student profile programme-wise:

Numbers are summed over 2011 – 2015 batches.

Programme	Applications received #	Selected		Joined		Pass percentage*	
		Male	Female	Male	Female	Male	Female
Ph.D.	13258	53	17	20	03	65	100
Int.M.Sc.-Ph.D.		25	03	04	0	75	--
<b>Total</b>							

## a) Diversity of students

**Geographical**

	Ph.D.		Integrated M.Sc.- Ph.D.		M.Sc.		Total
	Male	Female	Male	Female	Male	Female	
From the state where NCRA is located	4	0	0	0	0	0	4
From other states in India	10	3	3	0	0	0	16
NRI students	0	0	0	0	0	0	0
Foreign students	0	0	0	0	0	0	0
<b>Total</b>	<b>14</b>	<b>3</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>20</b>

## b) Graduate Institution:

	Ph.D.		Integrated M.Sc.- Ph.D.		M.Sc..		Total
	Male	Female	Male	Female	Male	Female	
From Universities	4	1	3	0	0	0	8
From premier science institutions †	3	0	0	0	0	0	3
From premier professional institutions #	7	2	0	0	0	0	9
From others*	0	0	0	0	0	0	0
<b>Total</b>	<b>14</b>	<b>3</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>20</b>

† Science institutions, e.g. CBS, NISER, etc. ,# IITs, NITs, etc.

## 33. How many students have cleared Civil Services and Defense Services examinations, NET, SET, GATE and other competitive examinations? Give details category-wise.

The break up given below is for the twenty students currently at NCRA.

	Examination	No of students who cleared
1.	NET	10
2.	GATE	7

34. Student progression

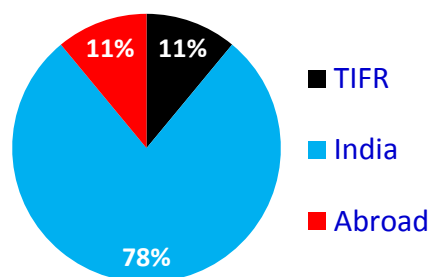
Students joining NCRA for a Ph.D. or Integrated Ph.D. go on to do post-docotoral fellowships at research institutions in India or abroad. So far all students who completed the program have successfully got postdoctoral positions.

35. Diversity of staff

**Number of faculty who are Ph.D.'s**

from TIFR :	2
from other institutions in India :	14
from institutions Abroad:	2
<b>Total No</b>	<b>18</b>

**Faculty Ph.D.s**



36. Number of faculty who were awarded M.Phil., Ph.D., D.Sc. and D.Litt. during the assessment period

The minimum eligibility criteria for selection as a member of the TIFR faculty is a Ph.D. degree. Thus, this number is not relevant.

37. Present details of departmental infrastructural facilities with regard to

a. Library

NCRA Library is user-focused, innovative, and excellently driven. The library is a pioneer in adopting new technology. NCRA Library manages collections both in print and digital formats and ensures access to scholarly resources. The total area of library is approximately 464 Sq metres and available reading area is 139 sq. metres. At a time about 25 users can be seated comfortably in the reading area.

The Library Working Hours are Monday through Friday 09.30-1800 hrs. On weekends and holidays users can issue the library key from the security for library usage. A drop box has been placed near the entry check point, and library members desiring to issue books can drop the library card in the box. The library is enriched with vast collections of books in various disciplines. Summary of the statistics is given below:

<b>Collection</b>	<b>Total as on 01/Jan/16</b>
Books, Theses, CDs	10069
Bound Volumes of Journals	5049
Reports, Pamphlets, Standards	520
Journals (Print, Online)	Print 30 & 25 Online
Databases	IEEE, ScienceDirect, JASTOR

The Library maintains excellent exchange relations with a number of libraries in the vicinity of the campus and city, for its users. The library can also procure soft/hard copies of articles needed by our users from other libraries as well as from international colleagues. The Library offers photocopying service to all its members. The library is a part of the institute-wide network. Library automation has also been carried out to provide efficient services to library users. The Library participates in the consortia with TIFR for accessing APS and IEEE journals. The Library has also carried out the digitization of various old reports, thesis, and manuals to provide direct access to collections.

b. Internet facilities for staff and students

NCRA has multiple internet links to ensure unbroken service at all times. These include direct broad band (32 Mbps) link to the internet, a point to point link to TIFR Mumbai, as well as an NKN link. There is a high speed (10 Gbps back bone) fiber based network that connects all of the buildings of the campus. All students and staff members have individual workstations connected to a high speed 10G backbone LAN. Students can access the LAN not only from their office rooms but also from their hostel rooms.

c. Total number of class rooms and

d. Class rooms with ICT facility:

NCRA has a fully equipped (audio/visual facilities, wireless internet, video link, air-conditioned) 100-seater auditorium as well as a similarly equipped 50-seat lecture hall, and fully equipped rooms for smaller classes.

e. Students' laboratories

The Radio Physics laboratory (RPL) is a joint initiative of the National Centre for Radio Astrophysics (NCRA-TIFR) and Inter-University Centre for Astronomy and Astrophysics (IUCAA). RPL provides a platform for training students in radio astronomy as well as carrying out small radio astronomy projects. A set of simple hands on experiments have been designed using RPL facilities.

f. Research laboratories

NCRA operates two major facilities, the Giant Metrewave Radio Telescope (GMRT) which is operated as a national facility, and attracts users from both the national and international community, and the Ooty Radio Telescope (ORT) which remains one of the most sensitive single dish radio telescopes in the world. NCRA runs several fully equipped laboratories which do development work in several technologies relevant to radio astronomy and which develop the instrumentation used at the GMRT. These laboratories are funded via plan projects. The laboratories include a feed and front end lab, fibre optic lab, analog lab, telemetry lab and a digital back-end lab, a servo lab as well as fully equipped mechanical workshop. The current major project at the GMRT is a major upgrade of the telescope. This upgrade will increase the instantaneous bandwidth by more than an order of magnitude (from the current 32 MHz to 400 MHz) and to provide close to seamless frequency coverage from about 150 MHz to 1420 MHz. This activity is part of one of the major 12<sup>th</sup> plan projects at NCRA which is funded at a level of approximately 60 crores.

38. List of doctoral, post-doctoral students and Research Associates

Doctoral students	Post-doctoral fellows
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1.	J.N.H.S. Aditya	1.	Kanhaiya Lal Pandey
2.	Omkar S. Bait	2.	Yogesh Maan
3.	Avishek K. Basu	3.	Narendra Nath Patra
4.	Apurba Bera	4.	Peter Kamphuis
5.	Atrideb Chatterjee	5.	
6.	Aditya Chowdhury	6.	
7.	Prakash Gaikwad	7.	
8.	Raghunath Ghara	8.	
9.	Sushma Kurapati		
10.	Souvik Manna	JRFs	
11.	Surajit Mondal	1.	Jesu Raja P
12.	Preetish K Mishra	2.	Joshy T.R.
13.	Atul Mohan		
14.	Arun Kumar Naidu		
15.	A.J.Nayana		
16.	Minhajur Rahaman		
17.	Dinesh Raut		
18.	Biny Sebastian		
19.	Rohit Sharma		
20.	Mayuresh Surnis		

39. Number of post graduate students getting financial assistance from the university.

All research scholars at NCRA are provided with financial assistance as per the DAE norms. Currently we have 20 students in the Ph.D. and I-Ph.D. programmes combined.

40. Was any need assessment exercise undertaken before the development of new programme(s)? If so, highlight the methodology.

The curriculum at NCRA is developed in the following systematic way. A subcommittee of experts draws up the proposed curriculum, generally in consultation with the standing Academic Affairs Committee. This curriculum is then discussed in the entire faculty and modified as needed. The next stage is to submit the proposed curriculum to the Subject Board Physics, which then vets it, suggests modifications which are taken on board before ratification.

41. Does the department obtain feedback from



- a. faculty on curriculum as well as teaching-learning-evaluation? If yes, how does the department utilize the feedback?

As described for (41) above, curriculum development is done after obtaining feedback from the entire faculty.

- b. students on staff, curriculum and teaching-learning-evaluation and how does the department utilize the feedback?

Feedback from students is obtained at the end of each semester. All feedback is available to the Centre Director, so that appropriate follow up can be initiated.

- c. alumni and employers on the programmes offered and how does the department utilize the feedback?

Currently no such feedback is collected on a formal basis.

42. List the distinguished alumni of the department (maximum 10)

A number of our students have been awarded very prestigious postdoctoral fellowships and later other awards.

	Name of the Alumnus	Reason for Distinction
1.	A. Begum	ASTRON Fellowship
2.	N. Roy	Jansky and Humboldt Fellowship
3.	B. Bhattacharya	Marie Curie Fellowship
4.	N.Kanekar	<ul style="list-style-type: none"> <li>i. Swarna Jayanti Fellowship</li> <li>ii. Ramnajuan Fellowship</li> <li>iii. Max Planck Fellowship</li> <li>iv. Jansky Fellowship</li> <li>v. NOVA Fellowship</li> <li>vi. Bolton Fellowship</li> <li>vii. URSI Young Scientist Award</li> <li>viii. ASTRON Fellowship</li> </ul>

5.	G.Swarup	<ul style="list-style-type: none"> <li>i. Padma Shri</li> <li>ii. S.S. Bhatnagar Award</li> <li>iii. P.C.Mahalanobis Medal,</li> <li>iv. Tskolovosky Medal of USSR</li> <li>v. Meghnad Saha Medal,</li> <li>vi. Third World Academy of Sciences Award in Physics,</li> <li>vii. John Howard Delinger Gold Medal of the International Union of Radio Science,</li> <li>viii. C.V. Raman Medal,</li> <li>ix. Khwarizmi International Award, Iran,</li> <li>x. Dr B. C. Roy National Award by the Medical Council of India and</li> <li>xi. William Herschel Medal of the Royal Astronomical Society in 2005.</li> </ul>
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43. Give details of student enrichment programmes (special lectures / workshops / seminar) involving external experts.

NCRA generally has a weekly seminar/colloquium given by leading experts from the country or abroad. After the colloquium a special session is held to allow the students to interact informally with the colloquium speaker, in the absence of any NCRA faculty. In addition NCRA regularly organizes larger meetings and workshops (See list provided as part of of 3.30).

44. List the teaching methods adopted by the faculty for different programmes.

Besides class room teaching, students often meet with the faculty members one on one in order to clarify doubts. In some courses, assignments include mini research problems, or dealing with practical issues of radio astronomy using data obtained from one of the NCRA facilities.

45. How does the department ensure that programme objectives are constantly met and learning outcomes are monitored?

The course work and progress of students who have not yet registered for a Ph.D. are regularly monitored by a standing 3 member committee of faculty members, the Academic Affairs Committee. The progress of each student who has registered for a Ph.D. is also regularly monitored by a special 3 person faculty committee

which includes the Ph.D. guide. In addition the progress of all of the students is reviewed annually by the NCRA faculty.

46. Highlight the participation of students and faculty in extension activities.

NCRA organizes "Science Day" at the GMRT. The Science Day celebrations comprise a major component of our outreach programmes. Science Day events are usually spread over two days starting 28th of February, in order to cater to the tremendous response from the general public, especially the students from the schools and colleges in the rural and semi-urban areas and districts in the western Maharashtra, especially those near the GMRT observatory. It is perhaps one of the largest Science Day events in rural India, with about a hundred schools, colleges and institutions participating, and over 25000 people visiting the observatory in 2015 during the two-day event.

The programme consists of a grand Science Exhibition, where children from the schools and colleges exhibit their science projects, and prizes are given for the best entries in different age groups. In addition, there are exhibitions illustrating astronomical themes and concepts, exciting results obtained with the GMRT, various subsystems of GMRT and illustrative models. There are also exhibits and live demonstrations from various research institutes and science popularisation groups, as well as teaching institutions such as the University of Pune and various national laboratories. There are also programmes to interact with well-known scientists and engineers and film shows on astronomical topics of current interest. Both students and faculty participate in organizing this program.

In addition to the annual science day program, both students and faculty regularly engage in outreach activities via public lectures, star-gazing events, etc. Some faculty members have also participated in the Exciting Science programme for school children (organized by IISER and NCL) as well as the Chai and Why? program (organized by TIFR and Prithvi theatre

47. Give details of "beyond syllabus scholarly activities" of the department.

NCRA students and faculty regularly publish the outcome of their research in international peer reviewed journals. Additionally faculty regularly participate in

national and international conferences, and give colloquia at other institutions (both in India and abroad), to describe the work that they have been doing. Students also generally present their work at 2-3 national conferences and at least 1 international conference during their tenure.

48. State whether the programme/ department is accredited/ graded by other agencies? If yes, give details.

NCRA, as a part of TIFR, was reviewed by a UGC Review Committee in 2012.

49. Briefly highlight the contributions of the department in generating new knowledge, basic or applied.

NCRA faculty research output is excellent and is documented in the papers published in leading international refereed journals. Faculty members typically publish a total of 40-50 research papers per year. Particularly interesting results are sometimes the subject of press releases issued by NCRA, and generally get wide coverage in the media. Areas in which research at NCRA has made significant impact include studies of Coronal Mass Ejections, weather in the inner heliosphere, discovery of new pulsars, including milli-second pulsars and exotic binary pulsars, discovery of new supernovae remnants, studies of the interstellar medium of our galaxies, dark matter and star formation in nearby dwarf galaxies, Giant Radio Galaxies, physical conditions in the interstellar medium of distant gas rich galaxies, constraints on the variability of fundamental constants, observational constraints on the Epoch of Reionisation, theoretical models of the Epoch of Reionisation. NCRA faculty are also involved in the development of instrumentation, and the Giant Meterwave Radio Telescope built and operated by NCRA remains one of the most sensitive telescopes in the world at most of its frequencies of operation.

50. Detail five major Strengths, Weaknesses, Opportunities and Challenges (SWOC) of the department.

**Strengths**

- a. Excellent, internationally reputed faculty.
- b. Easy access to world class instrumentation in the form of the GMRT which is built and operated by NCRA.

- c. High quality student body, thanks to a rigorous selection process.
- d. High standard of training provided.
- e. Relatively stable funding.

**Weaknesses**

- a. Available hostel space is severely stressed at current levels of student intake.
- b. Faculty strength could be increased.
- c. Low awareness in universities regarding the potential of radio astronomy as a research field.

**Opportunities**

- a. Involvement in cutting edge research with the upgraded GMRT and ORT.
- b. Involvement with and use of the upcoming Mega projects like the SKA.

**Challenges**

- a. Faculty has numerous demands on their time, particularly since NCRA is responsible for operating the GMRT as a national facility.
- b. Identifying and attracting students of the highest caliber who are motivated towards radio astronomy.
- c. Strengthening the postdoctoral program.

**51. Future plans of the department**

NCRA is currently in the midst of upgrading the GMRT. The upgrade has two major components, (1) to increase the maximum instantaneous bandwidth from 32 MHz to 400 MHz and (2) to provide near seamless coverage from about 100 MHz to 1420 MHz. This is a major development, which has been spread over two plan periods and which is now nearing completion. The first phase of the upgrade has already been released for use to the national and international community, and the entire upgrade itself is expected to be completed shortly. This is an end to end upgrade of the GMRT, where all of the major sub-systems, from the feed antennas and low noise amplifiers, the antenna servo system, the fibre optic signal transport, the analog and digital signal processing as well as the telescope control and monitor system have been completely revamped. The upgrade ensure that the GMRT keeps a competitive niche globally for the next several years. Several

research programs tuned around the capacities of the upgraded GMRT are expected to be started over the next year or so.

Similarly the Ooty Radio Telescope is also being upgraded, and the research plans using the upgraded telescope are in an advanced stage of preparation.

NCRA is also participating in the international SKA project. This is a major international project with more than 10 partner countries coming together to build a multi-purpose radio telescope, covering the frequency range from 50 MHz to 20 GHz. It is expected that the SKA will play a major role in answering key questions in modern astrophysics and cosmology. It will be one of a small number of cornerstone observatories across the electromagnetic spectrum that will provide astrophysicists and cosmologists with a transformational view of the Universe.