

# Astronomy in Indian Universities



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# University Astronomy

## Growth of A&A in India

### -History; ancient & modern Astronomy

1. An account by Prof J C Bhattacharya
2. Book(1995) by Rajesh Kochhar & J V Narlikar
3. Book by Prof M N Vahia et al

### -Astronomy in University: a bit of history

# Astronomy in the Universities

- **Presidency College, Kolkata (1817)** with several renowned teachers & researchers (**A K Raychaudhury, 1923-2005**); a premier research centre on GTR & Cosmology .  
**Now Presidency University (2010)**
- **Calcutta University (1857):**  
*(Sir C.V. Raman, M N Saha (Ionization theory and its application in spectral classification), Saha also suggested for UV observation and going out of the atmosphere. Other People included N.R. Sen, N.K. Chatterjee, Small Observatory at Presidency College and St. Xavier's College too*
- **Allahabad University (1887) :**  
M.N. Saha joined in 1925, developed laboratory astrophysics and theoretical group including P.L. Bhatnagar, A.C. Banerjee, H.K. Sen, D.S. Kothari, and R.C. Majumdar.
- **BHU, Varanasi (1916):**  
GTR and Cosmology group led by **V.V. Narlikar**  
**P.C. Vaidya.**
- **Nizamiah Observatory (1901) and Osmania University (1917):**  
(Bhaskaran, Akbar Ali., **M.K.V. Bappu, K D Abhyankar & many more**)
- **Delhi University (1922) : Physics & Astrophysics**  
**(D S Kothari ,Head 1934-61)**

# University Astronomy

## (a) Teaching

Mostly as a part of M Sc in Physics, except for Osmania University; it has full fledged M Sc course in Astronomy

**M Sc(Physics)-** elective paper :one/two course per semester covering Sun & solar system, Stellar, Galactic and Extragalactic, General Relativity & Cosmology

**Practicals / Lab courses :** Binary star , proper motion, Pulsars, Quasar, Saturn, Hubble's Law, P-L Relation, Star cluster and HR diagram, Sky & Telescope, Simulated Lab CLEA, Virtual Lab

**Observational exercises:** Using departmental facilities or data from other sources

# University Astronomy

## (b) Research activities

- Theoretical including modeling, Simulations etc
- Observational including archives

## (c) Public outreach

- popular talks
- sky gazing using small optical telescope

# Growth of A&A in University;

## **IUCAA's mandate :**

*nucleation and strengthening of teaching & research activities in A&A in Indian Universities.*

## *IUCAA Facilities :*

- *Library*
- *Computing*
- *Observing & Instrumentation*
- *Participation in collaborative research*
- *Support for national/international observing program*
- *Data Archives, Virtual Observatory etc*

**Skill development**  
**for researchers**  
**IUCAA sponsored workshops**

**Teaching enhancement**  
**for teachers**  
**Refresher Course in A&A**

# IUCAA's role .....

- Visiting associate program
  - IUCAA Resource Centre(IRC)(06)
  - INAAD(04)
  - University Centres(03 :Nanded, Tezpur, Kozhikode)
- plus**
- **New observing facilities around the globe including India, both ground based as well as space borne**
  - **Multiwavelength approach to Astronomy research**
  - **New technology telescopes & instrumentation**
  - **Advancement of computer technology**
  - **Virtual Observatory, data bases, software developments**

# Astronomy ..

- Opportunities for participatory research initiatives requiring international collaboration
- New Mega Projects such as LIGO, TMT, SKI etc became driving force for the possibility of involving students and faculty members from the University sector too.

➔ All these are collectively responsible for the growth of A&A in Indian Universities.

# Associateship Program

Total No. ~150 – from all over the country ([List](#))

## Expectations from associates

- Use available facilities of IUCAA
- Interact with faculty members of IUCAA
- Evolve plan for introducing teaching course in respective departments, if not available
- Observing facilities e.g. small optical telescopes along with SSP3 class photometer, CCD camera (DST-FIST)
- Introduce observational exercises using small telescopes, laboratory astrophysics, simulations to supplement theory courses
- Research projects to funding agencies for infrastructure development at the place of work

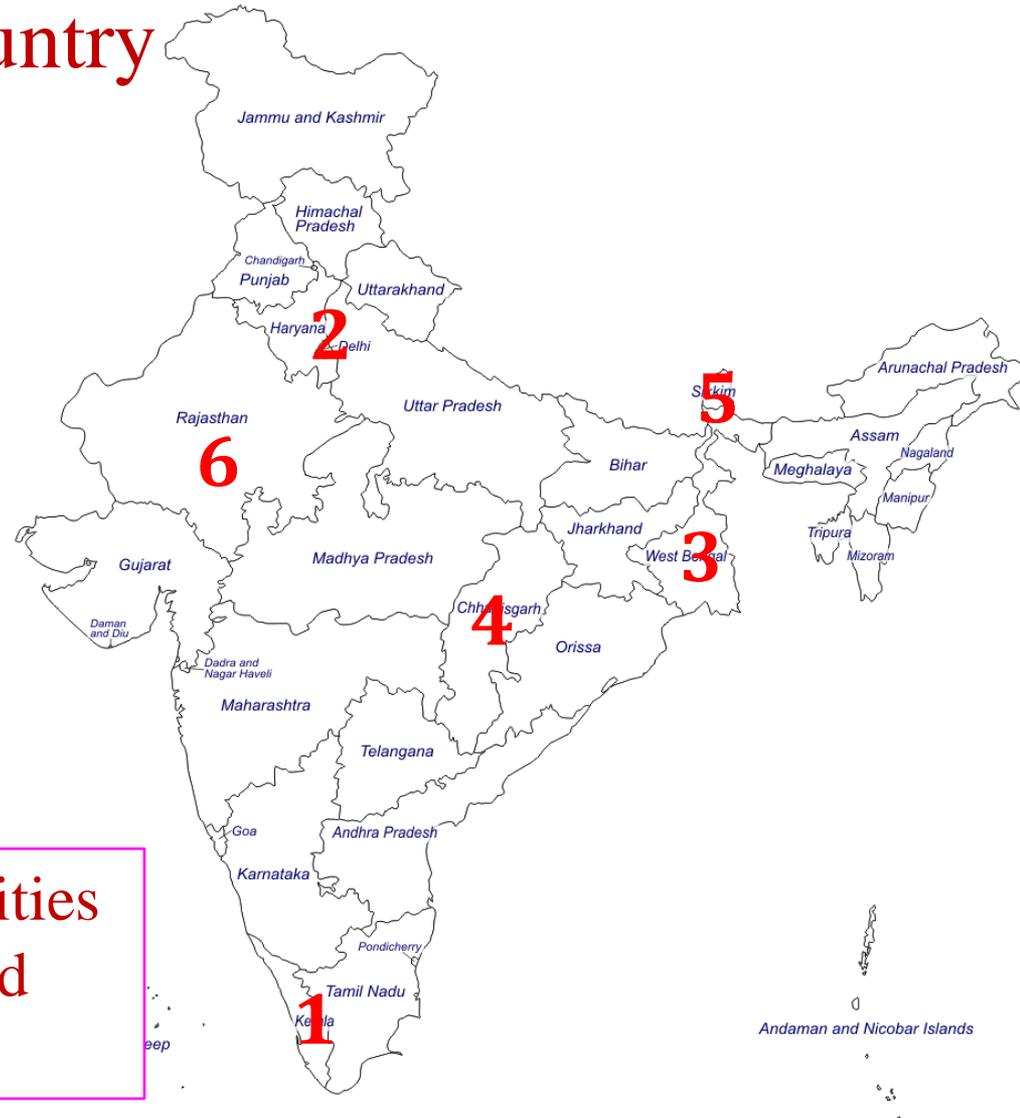
# IUCAA's role ....

- **IUCAA Resource Centres (IRCs)**: reaching out to Universities for strengthening teaching & research in A&A
- **Functioning Since 1998-99**
- **A&A Library, Networking, Data Centre, and 6" Newtonian Portable telescope (IYA-2009)**

# IRCs

## Six IRCs across the country

1. Cochin
2. Delhi
3. Kolkata
4. Raipur
5. Siliguri
6. Udaipur



IRCs → Promoting A&A activities  
in near by colleges, Schools and  
other forums

# IRCs Data Centre

- ❖ NAS Server
- ❖ Two NIS Servers
- ❖ 8 PCs
- ❖ Printer
- ❖ Scanner
- ❖ LCD Projector

Loaded with most of the astronomical softwares

Very useful computational facilities for :

M.Sc. and M.Phil Students - Practicals, Projects, Programing

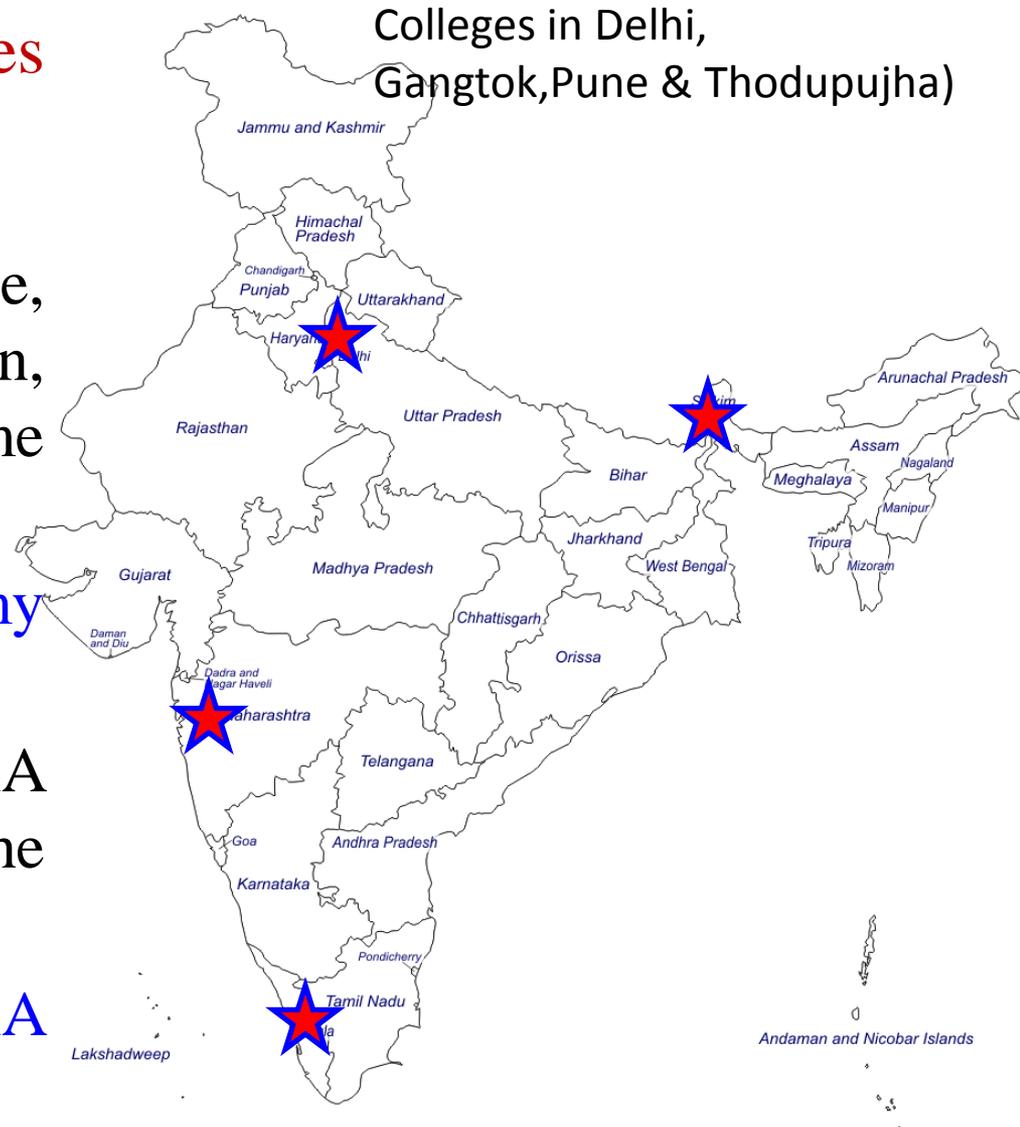
Research Scholars and Faculties

Short Term Visitors (INSPIRE)

# The IUCAA Node for Astronomy and Astrophysics Development (INAAD)

A focused program for Colleges  
to

1. provide technical knowledge, resource people, coordination, financial support and some basic resources.
2. maintain a vibrant astronomy teaching program.
3. organize regular IUCAA sponsored workshops in the host college.  
-Involvement of IUCAA associates.





# Teaching & Research activities in Colleges/Universities

A partial list ....

1. **SRTMU, Nanded**
2. **Central University, Tezpur**
3. **St. Thomas College, Kozhencherry**
4. **Osmania University, Hyderabad**
5. **Pt Ravishankar Shukla University, Raipur**
6. **University of Delhi**
7. **Cochin University of Science & technology(CUSAT), Kochi**
8. **University of Calcutta, Kolkata**
9. **Assam University, Silchar**
10. **MG University, Kottayam**
11. **Gorakhpur University**
12. **Udaipur University**
13. **Pune University**
14. **University of Srinagar**
15. **Jadhapur University**
16. **University of Calicut**
17. **North Begal University, Siliguri, and the list is growing with time.**

# (1) Facilities at SRTMU, Nanded

## 16" State-of-the-Art Fully Automated Astronomical Observatory

with moderate observing facilities for imparting first-hand observing and data analysis training to the M. Sc. and M. Phil students

- 16" ACF Schmidt Cassegrainin MEADE Telescope
- STX-ME CCD
- 3.5m fully steerable motor driven fiber dome

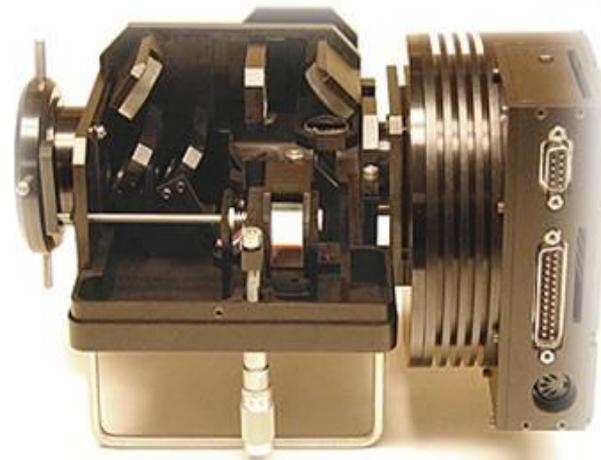


# Facilities Developed....

## 16" Optical Telescope

### Specifications

- Aperture 16" Schmidt-Cassegrain
- Advanced Coma Free
- Smart Mount
- Computer controlled



16" Telescope + SBIG SG Spectrograph + ST-10XME CCD

DST-FIST 2012

# Research area

- Dust and ISM in early type galaxies
- Properties of dust in extragalactic

Environment

Using optical broad-band & H-alpha  
Observations and multiwavelength (UV, X-ray,  
Near-IR, far-IR) data from the archives

# Workshop

## *Astronomy with Small Telescopes*

- SRTMU conducted a four day workshop on “**Astronomy with Small Telescopes**” during December 8-11, 2015 in collaboration with IUCAA, Pune
- A total of 150 participants participated actively in the workshop.
- Prof. Jayant Narlikar, Prof. S. K. Pandey, Prof. N M Ashok, Dr. Yogesh Wadadekar, Dr Padmakar Parihar, Dr Kaustubh Waghmare acted as the resource persons

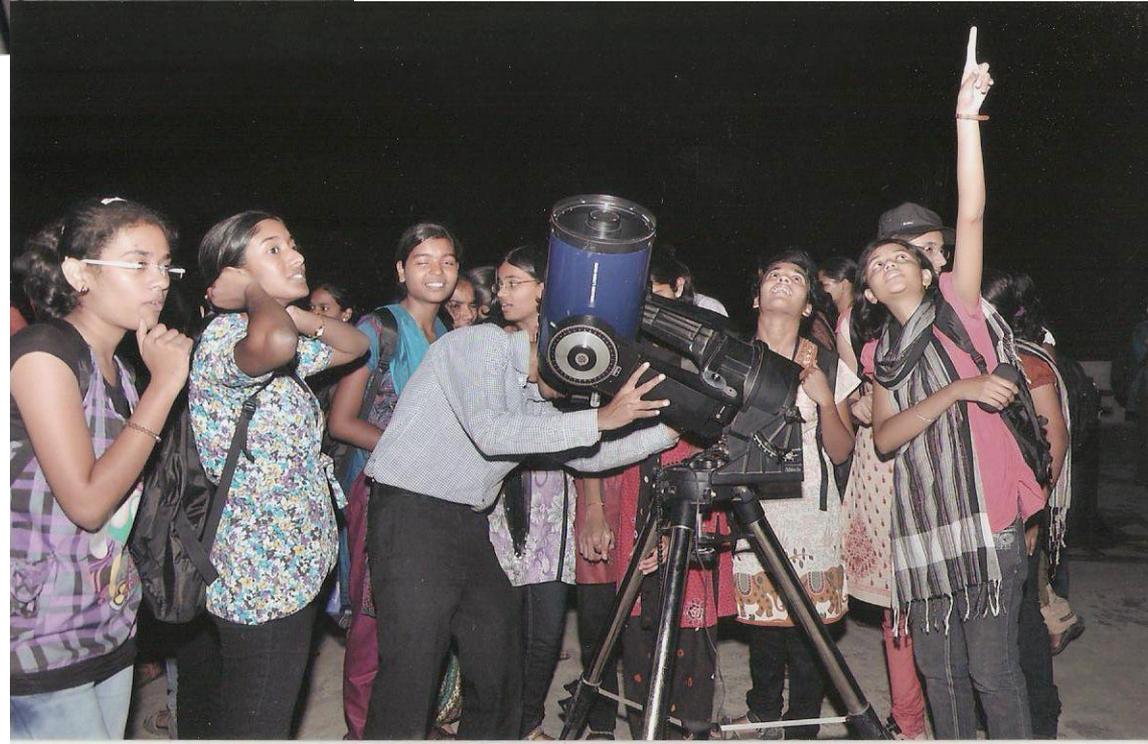


# Public Lecture by Hon'ble Padma Vibhushan Prof. Jayant Narlikar

SRTMU, Nanded organized a public lecture of Padma Vibhushan Prof. Jayant Narlikar on the topic “*Vishwat Aapan Ektech Aahot Ka? (Are We Alone in the Universe?)*” on Tuesday December 8, 2015.



# Sky Watch Program



# (2) Central University, Tezpur

## Teaching

Specialization courses in Astrophysics for MSc III, IV, Int. MSc IX, X semesters.

The Department has acquired a 14" Celestron for conducting MSc Practicals and Outreach activities.

The University also has an active Astronomy Club.



### **Cosmic Dust & Interstellar medium**

- Study of **dust in the ISM** of nearby galaxies with the use of observational data from multi-wavelength observatories.
- Study of **Circumstellar Dust** properties and its modeling.
- Study of **interstellar Polycyclic Aromatic Hydrocarbons** in the ISM.
- Study of the **ionized ISM** through observations of OVI.
- Light scattering through indigenous experiments.

### **AGN and long term variability**

- Flux-resolved spectral analysis of Mrk 335 and Ark 564

### **Dynamics of Galaxies**

- Study of the evolutionary track of galaxies and how they evolve over time primarily due to stellar activity and secular processes.

# Tezpur

## Workshop & Meetings

We have been conducting several workshops, meetings and conferences that have been fully / partially supported by IUCAA.

We have also been organizing workshops at nearby institutes in the North-East Don Bosco University, Guwahati, JB College, Jorhat, RG University, Itanagar, etc.



# (3) Research Activities @ St. Thomas College, Kozhencherry

- Workshops/Meetings

- INAAD Kerala Radio Astronomy Meeting
  - Radio Astronomy Meeting, Host: Macfast, Thiruvalla, February 24 - 28, 2013.
  - Radio Astronomy Meeting II, Host: St. Thomas College, Kozhencherry, May 8 - 10, 2013.
- Prospects of Astronomy - Today and Tomorrow, Host: Macfast, Thiruvalla, August 12, 2013.
- Workshop on Research in Astronomy : Opportunities and Challenges, Host: Macfast, Thiruvalla, August 12-14, 2013.
- Workshop on Variability of Astronomical Sources, Host: Macfast, Thiruvalla, January 22-24, 2014.
- IUSSTF Joint Center Meetings, Host: Macfast, Thiruvalla, January 20 - 24, 2014.

# Collaborations

1. On going Indo - South African Bilateral project on Multi-wavelength Astronomy with Virtual Observatory [VOSALT] - [2011-] with faculty exchange programs where South African Large Telescope related research is done. Faculty have also visited other major institutions in South Africa like the African Institute of Mathematical Sciences (AIMS) and a student have been to postdoctoral position in this institute based on the research done at St. Thomas College.
2. On going Indo - US Bilateral project, IUSSTF Joint Center – Center for Astronomical Object and Feature Characterization and Classification (ClassACT)[2012- ]. Research student and faculty exchange program in which students and faculty have visited US institutions like Caltech, Boston etc under this project. The research done here have been implemented in the CRTS telescope and data analysis pipelines installed in Arizona, USA.
3. Research collaboration and faculty exchange programs with Cardiff University in Gravitational wave astronomy.
4. Research collaboration and faculty exchange programs with University of Boston, USA in Machine learning.

1. **Founding Member Institution of the Indian Consortium for the International Mega Square Kilometer Array (SKA) Project (MOU signed on Feb 16th 2015). This is going to be the largest radio Telescope in the 2020s jointly being built by 11 nations. India is one of them mostly contributing in kind - technology and human resource. Being a founding member has the advantage that a representative from St. Thomas college will be on the executive board of the SKA- India Consortium and will get dedicated observation time on the telescope for scientific research.**
2. **Nodal centre in the state for all Inter University Center for Astronomy & Astrophysics (IUCAA) programs. St. Thomas college became the first college in the country to have Internet and email connectivity (from 1996) through ERNET and have hosted several dozens of outreach programs in the state under this collaboration.**
3. **We have research collaborations with Tata Institute of Fundamental Research (TIFR) and are partners in promoting Radio Astronomy research programs in the state through various workshops. The college has hosted three of these workshops in the past two years.**
4. **Indo-UK Bilateral project on X-ray Binaries in collaboration with the University of Southampton, UK. Research student, Savithri H. Ezhikode, will be visiting the University of Southampton starting from May 8, 2015.**

# Some more details .....

Actively involved in several committees

- International Conference on Bio-inspired Computing
- Astrostatistics and Astroinformatics Portal (ASAIP)
- International Virtual Observatory Alliance (IVOA)
- Knowledge Discovery in Databases (kdd)
- Virtual Observatory - India (vo-i)

International research collaborations with US, Italy, UK and South Africa

- Ninan Sajeeth Philip visited California University of Technology from May 18th - June 13th, 2014 under the INDO-US Bilateral project of which Ninan Sajeeth Philip is a Principal Investigator (PI).
- Arun Kumar A and Sheelu Abraham visited California University of Technology from May 31st - July 1st, 2013 under the INDO-US Bilateral project of which Ninan Sajeeth Philip is a Principal Investigator (PI).
- The college is a research partner for the Indo-South Africa bilateral project for Virtual Observatory at south African Large Telescope (SALT) and Ninan Sajeeth Philip, the PI of the project visited Observatory, Cape Town, South Africa from July 20 - August 8, 2013 and gave a talk at the African Institute of Mathematical Sciences (AIMS) in Cape Town.
- As a part of UGC/UKIERI Thematic Partnerships Savithri H. Ezhikode visited the University of Southampton, UK from 08 May to 02 July, 2015 and from 02 April to 14 May, 2016.

# (4) Osmania University, Hyderabad

## Teaching

- The Department offers two year/4 semester course at Masters level in Astronomy and Astrophysics
- Covers a broad range from Basics of Astronomy, Stellar structure and evolution, celestial mechanics, Radio astronomy, binary stars, advance astrophysics, astronomical techniques and few other papers dealt with mathematics and physics
- Lab sessions include programming, IRAF, stellar spectroscopy, photometry, numerical analysis along with electronics
- In the final semester of course, students carry out a project under the faculty. Students present their project in a seminar and is being evaluated by a internal and an external member.
- Student have library session, where they have to ready a topic of his/her own choice.
- On weekends, they have to present a seminar

# Research & Public Outreach ....

**Research specializations** : study of binary systems eg. Contact binaries, Algols, RR Lyare, X-ray binaries along with, Sun, Galaxies, Meteors showers

- Optical data is collected from various ground based observatories, like VBO, JCBT, HCT with IIA, IGO with IUCAA, from ARIES telescopes, India and BOAO with Korea Astronomy Space Science (KASI), South Korea

## **Public Outreach activities**

Faculty of the department go to various schools/colleges, delivers a popular lecture in astronomy and encourages them for Science

On few occasions like Science day, Department of astronomy shows various exhibits to school students and is open for public for a duration of one week.

Workshops for school children : they participate in an experiment and listen to lectures given by professionals .

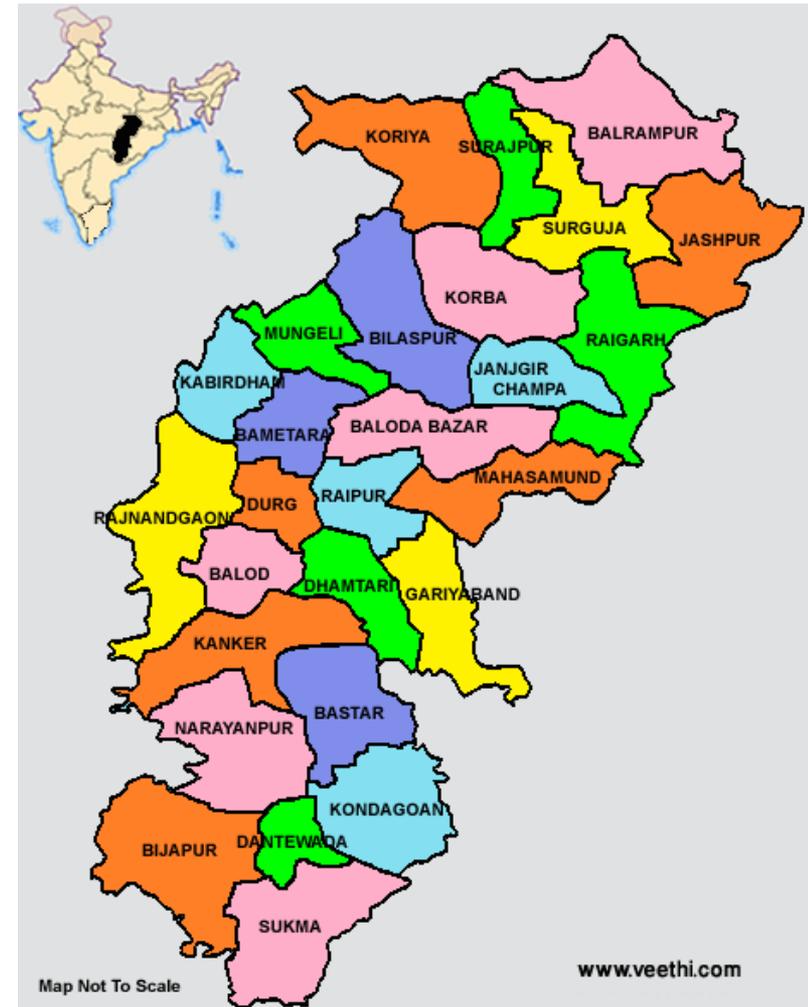
Foundation course in Astronomy : during summer vacation for 15 days, where almost 40-50 participants are enrolled.

# (5) Astronomy and Astrophysics

at

Pt. Ravishankar Shukla University Raipur, C. G.

Pt. R.S. University is among few Indian Universities, and the only one in the erstwhile state of M. P., and in the new state of Chhattisgarh where teaching and research in A&A are carried out in the Physics Department.



## Astronomy and Astrophysics in courses offered

Name of the course	Intake	Course Duration
Post Graduate : M. Sc.	40	4 Semester
Research M. Phil. Ph. D.	10 (As per UGC norms)	1year 4 years
CBCS (Choice Based Credit System)	10	2 Semester

# *Research activities -*

(1) Multiwavelength surface photometry of early-type galaxies :

# Dust and multiphase ISM in early-type galaxies.

# Galaxies from deep survey fields.

(2) Teaching and Research using small telescope.

(3) Study of Supernovae.

(4) Study of Chemically Peculiar Stars.

(5) Theoretical investigation and modeling of Galaxies.

## Facilities at Raipur



Prof. Ratna Kumar Thakur Memorial Observatory

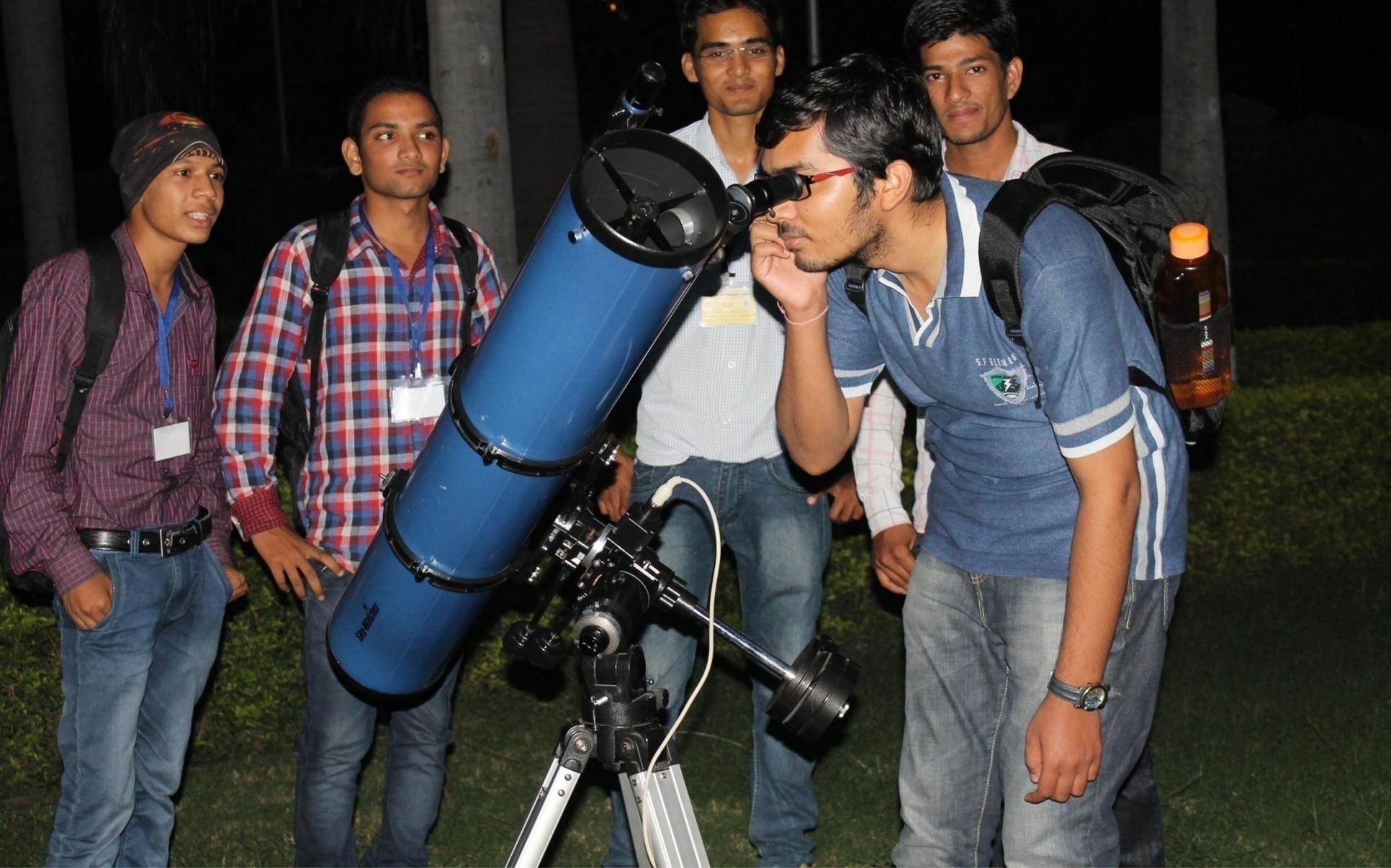
8 inch



14 inch



Procured through DST – FIST Project (2003-2008)



6 inch portable telescope provided by IUCAA

# Mobile Planetarium



Ready for Recent Advances in Technology

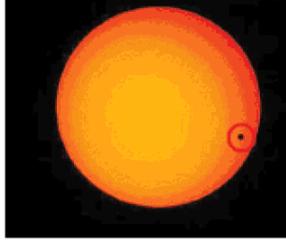
Center for Mega Projects  
in  
Multi-wavelength Astronomy



9 May 2016 : Transit of Mercury

# बुध ने लगाया सूरज को नजर का 'टीका'

बुध पारगमन देखने लोगों ने दिखाई दिलचस्पी



कुछ ऐसा दिखता है बुध पारगमन। बुध ग्रह (लाल धरे में)।



» टेलीस्कोप से देखी अद्भुत खगोलीय घटना

**रायपुर (निा)।** सोमवार की शाम बेहद खास थी। दस साल बाद ऐसी अद्भुत खगोलीय घटना हो रही थी, जिसका गवाह बनने हर कोई बेकरार था। रायपुरवासियों ने शाम बुध पारगमन (ट्रांजिट ऑफ मर्करी) देखा। इस मौके पर रविशंकर तिवि में फिजिक्स डिपार्टमेंट की ओर से टेलीस्कोप की व्यवस्था की गई थी। तिवि के लगभग 370 स्टूडेंट्स ने टेलीस्कोप से बुध को देखने का आनंद लिया। टेलीस्कोप पर ढलते नारंगी रंग के सूरज पर बुध काले तिल के रूप नजर आया। मानों वह सूरज को नजर का 'टीका' लगा रहा हो। इसके बाद यह घटना नवंबर 2019 में दिखाई देगी। सोमवार को बुध पारगमन 4:40 मिनट से सूर्यास्त तक दिखाई दिया।

**क्यों होता बुध पारगमन**

बुध पारगमन एक खगोलीय घटना है। सौरमंडल में सूर्य और पृथ्वी के बीच बुध और शुक चक्कर लगाते हैं। इनमें जब बुध या शुक में से कोई ग्रह पृथ्वी और सूर्य के बीच आ जाते हैं तो वह पारगमन कहलाता है। अभी बुध सूर्य और पृथ्वी के बीच आया है। इससे पहले यह नजारा 2006 में दिखाई दिया था।



सूर्य पर बुध का पारगमन देखते रविशंकर के स्टूडेंट्स।

फोटो : नईदुनिया

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टेलीस्कोप से देखने पर सूर्य के ऊपर एक काला सा छिदु धीरे-धीरे चलता नजर आया। हर पांच मिनट में इसकी स्थिति बदलती दिखेगी। किसी भी खगोलीय घटना का इसान के जीवन पर कोई असर नहीं होता है। बस इसे देखने के यत्न एहतियात बरतनी चाहिए।

- नंदकुमार चक्रवर्ती, सहायक प्राध्यापकभौतिक संकाय रविशंकर

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बुध पारगमन पर सूर्य पहले सांभेद सा नजर आया इसके बाद थोड़ा सा पीला दिखाई दिया फिर जब सूर्य पुरा अस्त होने के करीब पर आया तो लाल रंग का हो गया।

- प्रियालक्ष्मी साहू, स्टूडेंट

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दूरबीन से भी सीधे सूर्य की ओर नहीं देख सकते। इसे आंखों को नुकसान पहुंच सकता है। इससे आंखों का रेटिना जल सकता है। इसे दूरबीन पर सोलर फिल्टर लगाकर इसे देखा गया।

- नेहा खजूर, स्टूडेंट

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बुध पारगमन को टेलीस्कोप से देखने पर सूरत पर एक तिल के निशान की तरह नजर आया। इस खगोलीय घटना को देखना पहला एक्वीरियंस था जिसे मैंने और सब लोगों ने खूब इन्जॉय किया।

- मित्रेशा साहू, स्टूडेंट

# (6) Department of Physics and Astrophysics Delhi University

- Teaching : Two courses in Astronomy and Astrophysics
- Two courses in General Relativity and Cosmology (*includes Gravitational waves and Relativistic Stars also*)
- One course in Observational Astronomy

# Observational Facility



## Dimensions:

Total Height 3.25 metres 10'6"

Wall Height 1.5 metres 5'0"

Diameter 3.5 metres 11'6"

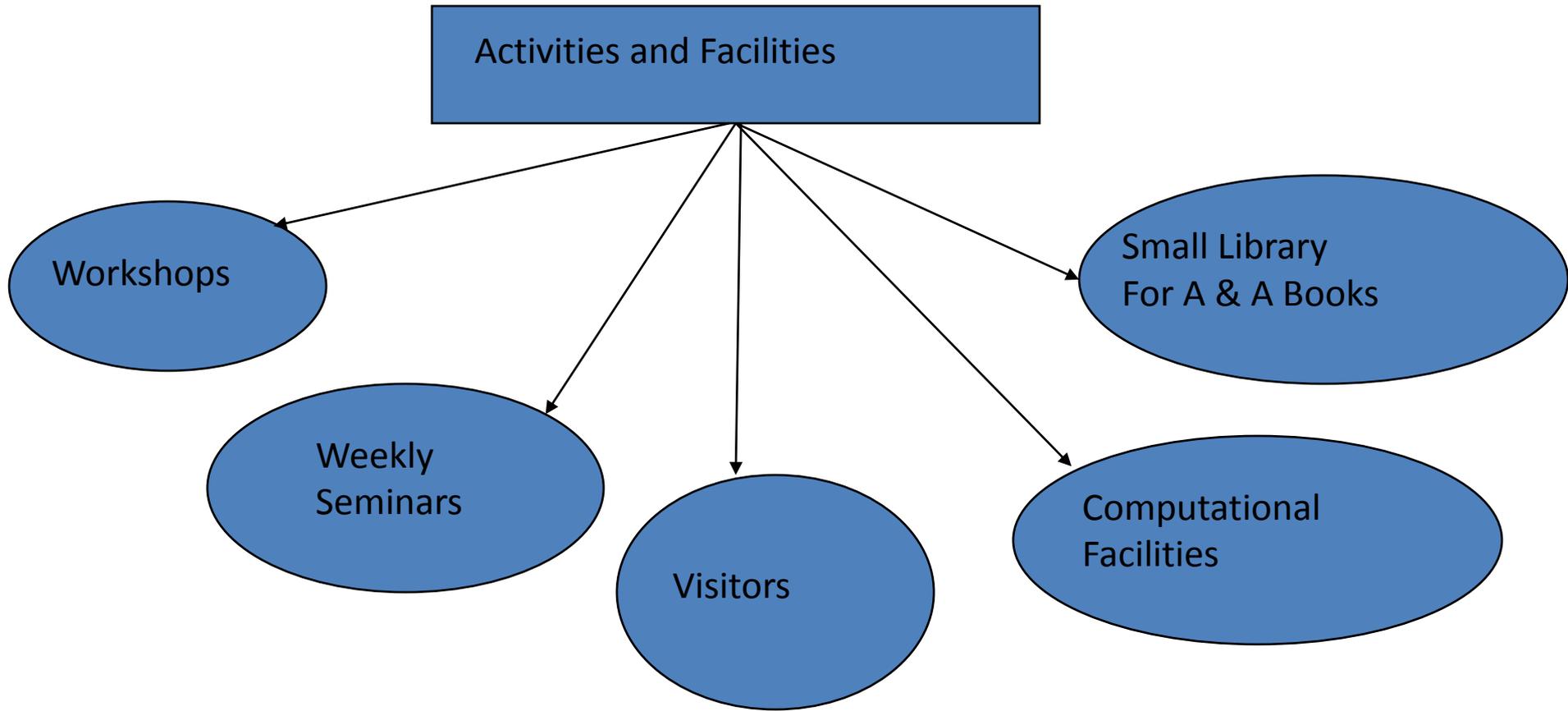
Aperture Width 1 metre 3'3"

Open past zenith 400mm 1'3"

Wind speed 144/225 kph

Equipped with Photometer and CCD Camera

Aim: Development of trained manpower in Observational Astronomy



**Users:**

B.Sc. , MSc. Students for projects/dissertation

PhD. Students and Faculty for Research

Visitors for Academic Discussions and References

**(7) Cochin University of Science & technology(CUSAT),  
Kochi**

**Teaching programme at M.Sc. Level**

Two elective courses : Elementary Astronomy

Gravitation and Cosmology

Astronomical project works

**Research programme**

The thrust area of research : Black Hole Physics, Gravitational waves, Dark Energy problems in Cosmology

**Seminars, Conferences, Workshops, Schools**

Organize seminars, workshops, schools in Astronomy related topics at the department as well at different colleges and universities in Kerala.

## Public outreach programmes

summer programme for school children (Since 2006) : small telescope making, sky watching and talks on elementary Astronomy.

Visit to schools and colleges especially in villages (since 2009) : talk on Elementary Astronomy, making small telescopes and sky watching using a 6" telescope provided by IUCAA.

**Astronomical Society of Kerala** : Some active members of the Astronomy Community in Kerala formed an organisation named Astronomical Society of Kerala (ASK) to conduct public out-reach programmes among college and school students interested in Astronomy and related areas. The first one in this series was organised by Dr. R. Tharanath on August 5, 2017 at the Department of Physics, Aquinas College, Edakochi, Kerala. The following persons: V C Kuriakose, NinanSajeeth Philip, Joe Jacob, Minu Joy, Nijo Varghese and R. Tharanath led the programme. There were about 90 students from different colleges in Kochi, Kerala .

### Training Program :

**Academy of Physics Teachers (APT)** a teachers organisation in Kerala has started a series of workshops aimed at training teachers and students for doing astronomy curricular projects. They are supported by IUCAA and **Kerala State Council for Science Technology and Environment (KSCSTE)** for the conduct of this programme

Three programmes conducted till now:

Workshop on Virtual Observatory projects, July 16-17, 2016, S. H. College, Chalakudy, Kerala- number of teachers participated-30

X-ray Astronomy workshop, 19-20 November, 2016, Providence Women's College, Calicut, Kerala- Number of participating teachers- 15, students-15

Workshop on Introduction to stellar Astrophysics, 26-27 August 2017, C M S College, Kottayam, Kerala- Number of participating teachers-15, Students-30

## **(8) IRC KOLKATA**

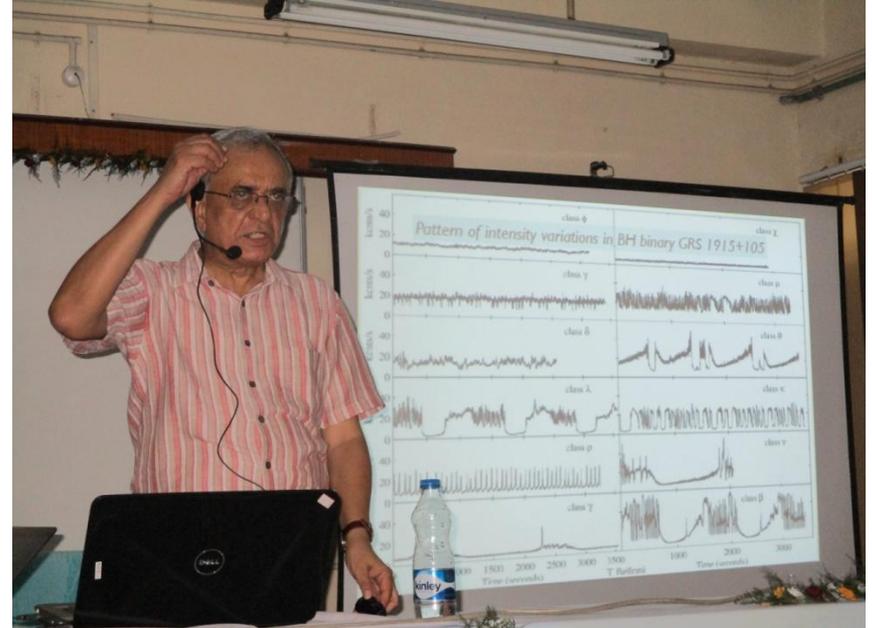
Department of Statistics, Calcutta University

**(Asis Kumar Chattopadhyay and Narayan Banerjee)**

- **Research Areas** : Galaxies, globular clusters, gamma-ray bursts, star formation, large scale simulation, and some theoretical work.
- **Astronomical Project Work for PG students**
- **Astronomical Workshops, Seminars and Meetings**
- **Lectures by the Coordinator of IRC**

# Workshops

- Faculty Development Programme on Pedagogy and Research, RCC Institute of Information and Technology, August 1-5, 2016.
- UGC sponsored Two-day National Seminar on Use of Statistics in the Analysis of Socio-Economic Development: Contemporary issues in India, Departments of Economics and Statistics, Midnapore College, West Bengal, November 7-8, 2016.
- 49<sup>th</sup> ORSI Conference, Birla Institute of Management and Technology, Greater Noida, Plenary Talk, December 12-14, 2016.
- 2<sup>nd</sup> Workshop on Statistical Techniques used in Research, Department of Statistics, University of Burdwan, Feb 21-24, 2017.
- 5<sup>th</sup> IIMA International conference on Advanced Data Analysis, Business Analytics and Intelligence, Key note Address, Indian Institute of Management, Ahmedabad, April 8-9, 2017.
- National Workshop cum Training Programme on Statistical Tools for Research Data Analysis, Department of Agricultural Statistics, Bidhan Chandra Krishi Viswavidyalaya, West Bengal, May 29-June 09, 2017.



# **(9) Astronomy and Astrophysics @ Assam University, Silchar**

Teaching at PG level

- M Sc(Physics) III & IV semesters;  
elective paper in A&A covering  
observational Astronomy, stellar astrophysics, extragalactic  
astrophysics, elements of GTR & Cosmology

Faculty members : 04 (IUCAA associates)

(URL : <http://www.aus.ac.in/physics.html>)

# Research activities

- **Areas of Research**
- Laboratory Astrophysics(Light scattering from Asteroid like regolith surface)
- Observational Astronomy : two broad areas
  - -Solar system-comets, asteroids
  - -star formation and dark clouds
- Archival Data : X-ray Astronomy and QSOs
- Numerical simulation : light scattering by dust particles
- Theoretical astrophysics : GTR, Cosmology( dark energy, inflation, string theory)
- **Research Projects :**
  - Funded by DST, DOS(ISRO), DAE & UGC
  - International : Indo-French, Indo-Japan, Indo-Russia

# (10) MAHATMA GANDHI UNIVERSITY, Kottayam

**EDUCATION** in A&A

MoU with IUCAA

Master of Science in  
Physics with

2 courses in A&A

+

Three month project

Many **ALUMNI** have made  
significant contributions to

Gravitational Wave Physics  
**LIGO**

Dark Matter Map of the  
Universe

**Dark Energy Survey**

Globular Clusters  
**SLUGGS Survey**

Discovered Magnetar

Discovered the most Strontium  
rich star

# MAHATMA GANDHI UNIVERSITY

RESEARCH

Associateship at IUCAA

Cosmology

Optical Astronomy  
(with IUCAA)

X-ray Astronomy  
(with RRI, IUCAA)

Radio Astronomy  
(with RRI)

Stellar Clusters

SCIENCE

DEVELOPMENT

For

Thirty Meter Telescope

Square Kilometer Array

# MAHATMA GANDHI UNIVERSITY

## OUTREACH

Workshops

Project Based  
Workshops

Seminars

Talks

Star Watch

## EXTENSION

All India Radio

Village Libraries

Visual Media

Talks at Schools

Organizations

# University Collaborations with Major Research Institutions

IIA Bengaluru

RRI Bengaluru

IISc Bengaluru

ISRO Bengaluru

TIFR Mumbai

PRL Ahmedabad

ARIES Nainital

## Some Other A&A Groups

- Indian Institute for Space Technology (IIST) Thiruvananthapuram
- Indian Institute for Scientific Education and Research (IISER)  
Kolkata, Pune, Mohali, Bhopal, Thiruvananthapuram, Tirupati
- Indian Institute of Technology (IITs)

# Way ahead ...

- Given the number of Universities (~600) in India, the teaching and/or research facilities are available in a handful of Universities
- Steps needed for the growth of Astronomy in the University; trained man power needed for the new facilities created as well as for the planned facilities e.g TMT, LIGO-India, SKA etc
- Small telescope Astronomy in University needs support for strengthening teaching A&A
- Practice of Multiwavelength Astronomy needs encouragement in Universities; specially for data analysis

Thank You