

# Radio Astronomy Winter School Report

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December 26, 2018

## **Abstract**

This report summarizes my learning and experiences during Radio Astronomy Winter School (RAWSC-2018), jointly organized by Inter University Centre for Astronomy and Astrophysics (IUCAA) and National Centre for Radio Astrophysics of the Tata Institute of Fundamental Research (NCRA-TIFR) Pune.

The duration of this winter school was from 14th December 2018 to 24th December 2018.

## **1 About**

### **1.1 IUCAA**

The Inter-University Centre for Astronomy and Astrophysics (IUCAA), is an autonomous institution set up by the University Grants Commission (UGC) of India to promote the nucleation and growth of active groups in astronomy and astrophysics at Indian universities. IUCAA aims to be a centre of excellence within the university sector for teaching, research and development in astronomy and astrophysics. [1]

IUCAA was established in 1988 at Savitribai Phule Pune University Campus, Pune. [2]

### **1.2 NCRA-TIFR**

The National Centre for Radio Astrophysics (NCRA) is a premier research institution in India in the field of radio astronomy. It is located in the Savitribai Phule Pune University Campus and is a part of the Tata Institute of Fundamental Research, Mumbai, India.

NCRA has an active research program in many areas of astronomy and astrophysics. NCRA operates Giant Meterwave Radio Telescope (GMRT) at Khodad and Ooty Radio Telescope (ORT) at Udhamandalam. [3]

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### 1.3 GMRT

NCRA has set up a unique facility for radio astronomical research using the metre wavelengths range of the radio spectrum, known as the Giant Metrewave Radio Telescope (GMRT). It is located at Khodad, about 80 km north of Pune. GMRT consists of 30 fully steerable gigantic parabolic dishes of 45m diameter, each spread over distances of upto 25 km. GMRT is one of the most challenging experimental programmes in basic sciences undertaken by Indian scientists and engineers. [4]

### 1.4 RAWSC

The Radio Astronomy Winter School for College and University Students 2018 is held at Radio Physics Laboratory (RPL), a joint initiative of NCRA-TIFR and IUCAA. RPL provides facilities for teaching radio physics and radio astronomy techniques using simple hands on radio physics experiments. Its facilities include two radio telescopes equipped with 21 cm radio receivers, which are used to observe Sun, hydrogen gas in our galaxy and other radio sources. The laboratory is also equipped with radio receivers operating at 408 MHz, various test and measurement instruments and interesting laboratory experiments demonstrating fundamental principles of radiophysics.

The participants are introduced to radio astronomy through a series of lectures. The institute's approach is hands-on way of teaching radio astronomy. Participants get ample opportunities to carry out simple radio astronomy experiments, presentation, quiz and learn about operation of radio telescopes. A visit to Giant Metrewave Radio Telescope (GMRT) operated by NCRA is organized during the programme. [5]

## 2 Lectures

Following are the topics on which lectures were delivered during the winter school.

- Radio Astronomy
- Interstellar Medium
- Basics of Radio Emission
- Spherical Coordinate System
- Radio Interferometry
- Error Analysis
- Sun
- Active Galactic Nuclei
- Radio Transients

- Galaxy Clusters
- Pulsars
- High Energy Astrophysics
- General Theory of Relativity
- Large Telescopes
- Raman Effect

### 3 Experiments

Following were the experiments carried out by the participants in groups, during winter school at Radio Physics Laboratory of IUCAA and NCRA.

- Detection and Characterizing H1 Emission from galaxy
- Sun Observations using the 4m telescope - Finding Pointing Offsets and Beam Width of the antenna
- Characterizing Superheterodyne Radio Receiver
- Analyzing Johnson-Nyquist Noise across a resistor at room temperature

### 4 Visit to GMRT

A trip to GMRT was carried out on 15th December 2018. A site visit to C3 antenna was arranged, followed by an introductory lecture on radio interferometry and visit to the control room of GMRT. The trip concluded with a small amateur optical astronomy session during night.

### 5 Presentation

On the last day of the winter school, each group of participants had to give a presentation on any one of the experiments carried out previously during the winter school. Our group (Group 5) had presented on Johnson-Nyquist Noise.

## 6 Quiz

Followed by the presentation, each group of participants had been given one topic among the lectures, based on which a quiz competition was held. Our group was assigned the topic of Interstellar Medium.

It is noteworthy to mention here that **our group (Group 5) was declared winner, considering the performance in both the presentation and quiz.**

## 7 My experiences

RAWSC-2018 is really a good introductory platform for the students having their interests inclined towards astronomy and astrophysics. All the lectures delivered here were a flavour of the topics which are essentially dealt with in the research level of academics. Topics for the experiments were a blend of radio astronomy and the corresponding electronic systems that drive these instruments. Every experiment was preceded by a short introduction to the theory and working principles of the instruments used, by the experiment instructor. We were required to submit group report on the experiments of *Detection and Characterizing H1 Emission from galaxy*[6] and *Analyzing Johnson-Nyquist Noise across a resistor at room temperature*[7]. Visit to GMRT familiarized us to the scale at which these observatories operate. Interaction session with Prof. Jayant Narlikar, an eminent cosmologist, was inspiring. The presentation session helped us truly understand the process of presenting the theory and corresponding experimental observations to the scientific panel, in a formal way. The quiz held at the end of the winter school was intellectually stimulating and rewarding for a student.

RAWSC-2018 had been a wonderful experience in terms of lectures, experiments and group work as a whole.

## 8 Acknowledgements

I would like to thank the following professors of IIT Dharwad for their valuable reference, support and advice for this winter school.

- **Prof. D. Narasimha**, Professor, Department of Physics, IIT Dharwad
- **Prof. Dhiraj V. Patil**, Assistant Professor, Department of Mechanical Engineering, IIT Dharwad

I would also like to thank **Prof. Subhashis Roy**, Coordinator, RAWSC-2018, NCRA-TIFR, for his continuous support and guidance during the winter school.

## References

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