Himanshu Tiwari

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RESEARCH INTERESTS

Cosmic-Dawn and Epoch of Reionization, 21-cm Cosmology, Fast Radio Bursts (FRBs), Exoplanets

RESEARCH EXPERIENCE

Radio Interferometric observations, Imaging, Large-volume simulations, Big Data & Machine Learning, Bayesian Statistics, Visualisation Tools.

MWA, *Murchison Widefield Array*

Using First-hand MWA observational data for my ongoing PhD projects.
Pipeline developed — **Lunar Occultation, Closure phase analysis**

HPC, *High-Performance Computing*

Used various HPC clusters in various stages of the research projects. Some of them are **Garrawarla:** Pawsey Supercomputing Centre, **Shakti:** Indian Institute of Technology Kharagpur (IITKGP), **HPC (cosmology group):** Indian Institute of Technology Indore (IITI).

MACHINE LEARNING, *Artifical Neural Network (ANN)*

Used Machine Learning (Artificial Neural Networks) to emulate the **21-cm signal statistics** and **Bayesian Inference** to constrain the astrophysical model parameters of the Epoch of Reionization.
Pipeline developed: **EmuPBk**- ANN based statistical signal emulator of Epoch of Reionization.

EDUCATION

PH.D. RADIO ASTRONOMY 2021 – present

Curtin Institute of Radio Astronomy, Curtin University, Australia

Thesis Title: Radio Inteferometric Tools of study the early Universe.
Supervisors: Prof. Cathryn Trott, Dr. Nithyanandan Thyagarajan, Dr. Benjamin McKinley, A/Prof. Randall Wayth.

M.SC. ASTRONOMY 2018 – 2020

Indian Institute of Technology Indore, India

Thesis Title: Developing Statistical Inference Tools for Future Observations of the Cosmic Dawn and the Epoch of Reionization. ***Link***
Supervisor: A/Prof. Suman Majumadar

B.SC. 2013 – 2016

Kumaon University, Nainital, India

Bachelor of Science with Physics, Mathematics and Chemistry major.

ADDITIONAL AFFILIATIONS

CSIRO, *Australia Telescope National Facility (ATFN)* 2022 – present

ATFN graduate research student at Commonwealth Scientific and Industrial Research Organisation (CSIRO)

ICRAR, *PhD research scholar* 2021 – present

PhD research scholar at Curtin Node of International Centre for Radio Astronomy Research (ICRAR)

PUBLICATIONS

COSMIC DAWN & EPOCH OF REIONISATION (CD-EoR)

1. ***21cm Epoch of Reionisation Power Spectrum with Closure Phase using the Murchison Widefield Array.***
Himanshu Tiwari, *Nithyanandan Thyagarajan, Cathryn M. Trott, Benjamin McKinley, {**accepted PASA: arXiv**}*

2. ***Measuring the global 21-cm signal with the MWA-II:*** *improved characterisation of lunar-reflected radio frequency interference.*
Himanshu Tiwari,*Benjamin McKinley, Cathryn M. Trott, Nithyanandan Thyagarajan {**published PASA: DOI**}*

3. ***Improving constraints on the reionisation parameters using 21-cm Bispectrum.***
Himanshu Tiwari, *Abinash Kumar Shaw, Suman Majumdar, Mohd. Kamran, Madhurima Choudhury {**published Jcap:DOI**}*

FAST RADIO BURSTS (FRBs)

1. ***Modelling the energy distribution in CHIME/FRB Catalog-1*** *Siddhartha Bhattacharya, Somnath Bharadwaj,* ***Himanshu Tiwari****, Suman Majumdar {**published MNRAS:DOI**}*

2. ***A maximum likelihood estimate of the parameters of the FRB population*** *Siddhartha Bhattacharya,* ***Himanshu Tiwari****, Somnath Bharadwaj, Suman Majumdar {**published MNRAS:DOI**}*

CONFERENCE PAPERS

1. ***Interpreting multi-wavelength observations from next-generation telescopes using ANN-based emulators:****Interpreting CII line intensity map power spectrum using via ANN-based emulators.*
S. Dutta, S. Majumdar, C. Murmu and ***H. Tiwari*** *{**DOI**}*

WORK UNDER REVIEW OR PROGRESS

1. ***Interpreting multi-wavelength observations from next-generation telescopes using ANN-based emulators:****Interpreting CII line intensity map power spectrum using via ANN-based emulators.*
S. Dutta, S. Majumdar, C. Murmu and ***H. Tiwari*** *{**Near Submission**}*

TECHNICAL SKILLS

- **Operating System**
  Linux, Mac, Windows

- **Programming Language**
  C, Python, HTML, shell, slurm

- **Software tools**
  CASA, CARTA, WSCLEAN, MWA-related tools, Blender (Scientific Visualization), Vim, Visual Studio, Office, PyCharm, Version Control, Github

- **DEVELOPMENT LINKS**

  Closure phase analysis: Radio Interferometric closure phase (bispectrum phase) to study EoR-pipeline.

  Lunar Occultation to estimate the global 21-cm spectrum using radio interferometry-pipeline.

  Fast Radio Burst Estimator: FRBe

  EmuPBK: Artificial Neural Network-based 21-cm signal statistical (Power Spectrum, Bispectrum) emulator and parameter estimation pipeline: Github
  Documentation: Read the Docs

  Visualize Epoch of Reionization: Animation

  Planets 3D-VR Gallery: Gallery

  PYTHON-BASED TOOLS USED
  Astropy, Scipy, Numpy, MPI for general projects, Tensorflow (Keras) for Machine Learning, Emcee & CosmoHammer for Bayesian Inference

LIFE SKILLS

CERTIFIED FIRST AIDER, FIRE WARDEN, *Red-Cross Australia: certificate*

AWARDS AND ACHIEVEMENTS

- Awarded **Curtin International Postgraduate Research Scholarship (CIPRS)**
  net amount AUD$**28,597.00**/annum + AUD$**38,800**/annum Tuition Fee Cover (2021 pro-rata).
- Awarded PhD position at **Curtin Institute of Radio Astronomy (CIRA), Curtin University, Australia**.
- Awarded PhD position at **International Max Planck Research School on Astrophysics (IMPRS), Ludwig Maximilian University of Munich (LMU)**: Rejected, offer
- Master of Science (Astronomy) with **First Class** Degree.
- 96 percentile in IIT-JAM (Joint Admission Test for Masters) examination: score card
- Bachelor of Science Degree with **First Class** Degree.
- Best Talk at Lok Vigyan Kendra (A non-profit science outreach organization): certificate

PRESENTATIONS N' OUTREACH

- Presented my work on MWA-II closure phase upper limits at the **SKA-India Science Group** Biweekly-meeting (14th March 2024).
- Volunteered in **AstroFest-2023** (Australia's Biggest Astronomy Event)
- Volunteered in the **NASA's Moon observation day** 21st Oct. 2023 in Perth (social outreach event).
- Presented in UU Astro Friday at **Uppsala University** (29th Sept, 2023).
- **Nordita** Colloquium at **Stockholm University** (27th Sept, 2023): Talk Link.
- Presented at **Kapteyn Astronomical Institute**, **University of Groningen**, Netherlands (25th Sept, 2023).
- Presented my work at **INAF-IRA**, Italy (22nd Sept, 2023): Talk Link.
- Presented my work at **Scuola Normale Superiore di Pisa**, Italy (18th Sept, 2023)
- Presenting my work on MWA-II lunar occultation at the **6th Global 21-cm conference**: Link
- Presented my work on MWA lunar occultation at the **5th Global 21-cm conference**: Link
- Presented my work on 21-cm bispectrum & ANN emulator-EmuPBk at the **3rd Global 21-cm Workshop, Cambridge, UK (19-22 Oct. 2020) (online event)**: Link
- Participated in **Astronomy Astro-3D outreach** event for Kids in Perth
- Participated in the **NASA Sagan Workshop 2021** on Exoplanets
- Participated in **Indian National Science Day-2020**, demonstrated the model of Sun and National Science Day-2020, developed a **VR tour**: Link my VR tour.
- Participated in **Reaching For The Stars (IAU's 100 Hours of Astronomy Event)**.
- Participated in the **Workshop on 21-cm Cosmology** (19-23 April 2021) organised by **SKA India**: Link
- Participated in the event **SU-UU-IITI (RISU)** CD-EoR meeting (13 Dec. 2020) under **SPARC project**: Link.
- Participated in the **EoR conference SAZERAC** (6-9 July 2020) & gave an online talk: YouTube Link.
- Participated in **Winter School of Observational Astronomy** (29-4th Feb. 2020): certificate
- Participated in the International conference (20-24 Jan. 2020) and School (27-31 Jan. 2020) on **observing the First Billion Years Of The Universe Using Next Generation Telescopes**.
- Participated in the **International Workshop on Recent Advances in Space Science (RASS)**: certificate

ADDITIONAL COURSES

- **SUPER-EARTHS AND LIFE BY HARVARDX:**, *certificate*
- **COMPLETE PYTHON BOOTCAMP:**, *certificate*
- **MODERN DEEP LEARNING IN PYTHON, ANDROID SDK PROGRAMMING, UNITY AR-VR, C-PROGRAMMING FOR BEGINNERS, ETHICAL HACKING WITH KALI LINUX, DAVINCI RESOLVE,**

NON-ACADAMIC JOBS

CURTIN STUDENT RESIDENTIAL ADVISOR, *Unilodge Australia Pvt. Ltd.* 2023-present

EXTRA-CURRICULARS

- Organised Intra-House social sporting events: **Cricket, Chess, Tennis, Mini Music Concert: Bollywood Night** during my stay at **Unilodge**.
- Run two small YouTube channels 1^{st}, 2^{nd}: Interest in **video editing, 3D designing, Film-making, Music & Poetry**.

REFERENCES

- **Prof. Cathryn Trott**
  Curtin Institute of Radio Astronomy (CIRA),
  Curtin University, Bentley, Perth (6102), Western Australia.
  Cathryn.Trott@curtin.edu.au
- **Dr. Benjamin McKinley (Senior Researcher, University Adjunct)**
  Curtin Institute of Radio Astronomy (CIRA),
  Curtin University, Bentley, Perth (6102), Western Australia.
  ben.mckinley@curtin.edu.au
- **Dr. Nithyanandan Thyagarajan (Senior Scientist)**
  Commonwealth Scientific, Industrial and Research Organisation, (CSIRO).
  26 Dick Perry Ave (6151), Kensington, Western Australia.
  nithyanandan.thyagarajan@csiro.au
- **A/Prof. Suman Majumdar (Associate Professor)**
  Department of Astronomy, Astrophysics and Space Engineering (DAASE),
  Indian Institute of Technology, Indore-453552, M.P., India.
  suman.majumdar@iiti.ac.in