

# Resume of Tirthankar Roy Choudhury

January 31, 2023

## Personal Information

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- **Nationality:** Indian
- **Present Position:** Professor 'H'  
National Centre for Radio Astrophysics  
Tata Institute of Fundamental Research, Pune, India
- **Area of Research:** Theoretical Cosmology & Astrophysics
- **Specialization Areas:** Reionization  
Intergalactic medium  
Neutral hydrogen at high redshifts  
Dark energy

## Educational Qualifications

Degree	University	Year	Subjects	Grades
B.Sc.	Visva Bharati, Santiniketan, India	1996	Physics (Hons), Mathematics, Chemistry	81.1%
M.Sc.	Visva Bharati, Santiniketan, India	1998	Physics	82.0%
Ph.D	University of Pune, Pune, India	2005 submitted in 2003	Thesis Title: <i>Physics of Structure Formation in the Universe</i> ; Supervisor: T. Padmanabhan	

## Research Experience

Position	Place	Period
Research Fellow	Inter-University Centre for Astronomy and Astrophysics, Pune, India	Aug 1998 - Oct 2003
Post-doctoral Fellow	SISSA/International School for Advanced Studies, Trieste, Italy	Nov 2003 - Dec 2005
Visiting Scientist	Centre for Theoretical Studies, Indian Institute of Technology, Kharagpur, India	Jan 2006 - Oct 2006
Post-doctoral Fellow	Institute of Astronomy, University of Cambridge, Cambridge, UK	Nov 2006 - Aug 2008
Reader 'F'	Harish-Chandra Research Institute, Allahabad, India	Sep 2008 - Mar 2012
Reader 'F'	National Centre for Radio Astrophysics, TIFR, Pune, India	Mar 2012 - Jan 2017
Associate Professor 'G'	National Centre for Radio Astrophysics, TIFR, Pune, India	Jan 2017 - Jul 2022
Professor 'H'	National Centre for Radio Astrophysics, TIFR, Pune, India	Jul 2022 - present

## Awards and Academic Distinctions

- Peraiah Foundation award for achievements in Theoretical Astrophysics, 2019.
- Hari Om Ashram Prerit Dr. Vikram Sarabhai Research Award, 2017.
- Regular Associate of the Abdus Salam International Centre for Theoretical Physics, Trieste, Italy, 2017-2022 and 2010-2015.
- Late Deblina Choudhari Award of Indian Physics Association for best oral presentation by a research scholar, 1999.
- CSIR-UGC (India) National Eligibility Test, 1998: Qualified for Junior Research Fellowship and Lectureship
- Graduate Aptitude Test in Engineering, Government of India, 1998: 99.87 percentile (all-India rank 2nd)
- Masters in Science, 1998: Ranked 2nd in Physics in the University

- Bachelor of Science, 1996: Ranked 1st in Physics in the University
- High school leaving examination, 1993: Ranked 1st in the board
- School leaving examination, 1991: Ranked 2nd in the board

## Agency Funded Research Projects

- **PI: Research grant under the Indo-South African Flagship Programme in Astronomy** jointly funded by the Department of Science and Technology, Government of India and National Research Foundation, South Africa, 2016.
- **Co-PI: Indo-US Science & Technology Forum (IUSSTF) Award** for supporting an Indo-US Joint R & D Network Joint Centre on “Fundamental Tests of Cosmology with Planck Measurements of the Cosmic Microwave Background”, 2015.
- **PI: Fast Track Young Scientist Project** funded by Department of Science and Technology, Government of India, 2006 (could not take it up because Tirthankar moved to Cambridge).

## Teaching Experience

Tirthankar has taught a number of courses, both basic (e.g., Quantum Mechanics, Mathematical Methods in Physics, Introductory Astrophysics) and advanced (e.g., General Theory of Relativity, Cosmology), in the following programmes:

- Graduate School for Ph.D students at Harish-Chandra Research Institute, Allahabad,
- IUCAA-NCRA Graduate School for Ph.D students, NCRA-TIFR, Pune,
- M.Sc course at the Department of Physics, Pune University and
- M.Sc course at the Fergusson College, Pune.

### Courses taught in the last five years (January 2018 – December 2022):

1. *Electrodynamics & Radiative Processes* (~ 15 lectures), IUCAA-NCRA Graduate School, Pune, India, August – October 2022.
2. *General Relativity & Cosmology* (~ 30 lectures), Fergusson College M.Sc. (Elective), Pune, India, February – May 2022.
3. *Quantum Mechanics* (~ 15 lectures), IUCAA-NCRA Graduate School, Pune, India, October – December 2021.
4. *General Relativity & Cosmology* (~ 25 lectures), Fergusson College M.Sc. (Elective), Pune, India, February – May 2021.
5. *Cosmology & Structure Formation* (~ 20 lectures), IUCAA-NCRA Graduate School, Pune, India, February – April 2021.
6. *Quantum Mechanics* (~ 15 lectures), IUCAA-NCRA Graduate School, Pune, India, October – December 2020.
7. *General Relativity & Cosmology* (~ 20 lectures), Fergusson College M.Sc. (Elective), Pune, India, February – May 2020.

8. *Astronomy & Astrophysics* (~ 35 lectures), SP Pune University M.Sc. (Elective), Pune, India, July – December 2019.
9. *General Relativity & Cosmology* (~ 20 lectures), Fergusson College M.Sc. (Elective), Pune, India, February – May 2019.
10. *Astronomy & Astrophysics* (~ 20 lectures), SP Pune University M.Sc. (Elective), Pune, India, July – September 2018.
11. *Cosmology & Structure Formation* (~ 20 lectures), IUCAA-NCRA Graduate School, Pune, India, January – February 2018.

In addition, Tirthankar has given various lecture courses on more advanced topics related to his research work at different workshops and schools.

## Supervision and Training of Researchers

### Ph. D. Thesis:

- Anirban Chakraborty (NCRA-TIFR, Pune), 2022-present.
- Divesh Jain (NCRA-TIFR, Pune), 2021-present.
- Barun Maity (NCRA-TIFR, Pune), 2020-present.
- Atrideb Chatterjee (NCRA-TIFR, Pune), 2017-2022.
- Prakash Gaikwad (NCRA-TIFR, Pune), 2014-2017.
- Raghunath Ghara (NCRA-TIFR, Pune), 2012-2016.
- Sourav Mitra (HRI, Allahabad), 2010-2013.

### Ph.D. Thesis (informal association, did a significant fraction of their thesis with Tirthankar):

- Bhaskar Arya (IUCAA, Pune, Supervisor: A. Paranjape), 2020-present.
- Arpan Kar (HRI, Allahabad, Supervisor: B. Mukhopadhyay), 2016-2021.
- Hamsa Padmanabhan (IUCAA, Pune, Supervisor: R. Srianand), 2013-2015.
- Suman Majumdar (IIT, Kharagpur, Supervisor: Somnath Bharadwaj), 2007-2012.
- Kanan Datta (IIT, Kharagpur, Supervisor: Somnath Bharadwaj), 2005-2008.
- Simona Gallerani (SISSA, Trieste, Supervisor: Andrea Ferrara), 2003-2005.

### Mentoring at the post-doctoral level:

- Akanksha Kapahtia (NCRA-TIFR, Pune), 2020-present.
- Suman Chatterjee (NCRA-TIFR, Pune), 2020-present.
- Sourabh Paul (NCRA-TIFR, Pune), 2017-2018.
- Kanhaiya Pandey (NCRA-TIFR, Pune), 2013-2016.
- Kanan Datta (NCRA-TIFR, Pune), 2013-2014.
- Tapomoy Guha Sarkar (HRI, Allahabad), 2011-2012.

### Other long-term student projects:

- **M.Sc. Thesis:** Ankur Barsode (BITS, Pilani), 2021.
- **M.Sc. Final Year Project:** Shivaramakrishna Reddy (SP Pune University, Pune), 2019.
- **M.Sc. Final Year Project:** Chandra Shekhar Saraf (SP Pune University, Pune), 2018.
- **MS Final Year Project:** Mihir Kulkarni (IISER, Pune), 2014-2015.
- **M.Sc. Final Year Project:** Prateek Gupta (SP Pune University, Pune), 2014.
- **M.Sc. Thesis:** Prakash Gaikwad (NCRA-TIFR, Pune), 2014.
- **M.Sc. Thesis:** J.N.H.S. Aditya (NCRA-TIFR, Pune), 2013.
- **Bachelor Internship:** Vaibhav Sharma (IIIT, Allahabad), 2011.
- **M.Sc. Thesis:** Abhinav Agrawal (BITS, Pilani), 2011.

## Professional and Organizational Experience

### Organizing meetings, workshops etc (selected list):

- Co-organized a three-day workshop on “NSM Astrophysics GPU Bootcamp” in collaboration with the National Supercomputing Mission (NSM), NVIDIA and OpenACC, Online (May 2022).
- Co-organized a four-day workshop on High Performance Computing for Astronomy and Astrophysics in collaboration with IIT Kharagpur and the National Supercomputing Mission (NSM), Online (September 2021).
- Chair, Local Organizing Committee and Member, Scientific Organizing Committee of the conference “The Metre Wavelength Sky - II: Celebrating the 90th year of Govind Swarup and the 1st year of the upgraded GMRT” at National Centre for Radio Astrophysics, Pune, India (March 2019).
- Co-organized a Conference on Aspects of Gravity and Cosmology at Inter-University Centre for Astronomy and Astrophysics, Pune, India (March 2017).
- Co-organized a school and workshop on “Large Scale Structures: From Galaxies to the Cosmic Web” at Inter-University Centre for Astronomy and Astrophysics, Pune, India (February 2016)
- Co-organized a school and workshop on “Cosmology with the HI 21-cm Line” at Raman Research Institute, Bangalore, India (June 2015)
- Member, Scientific Organizing Committee of a conference on “Celebrating the Centenary Year of General Relativity (IAGRG 2015)” at Raman Research Institute, India (March 2015)
- Co-organized a workshop on “Galaxies & Cosmology” at National Centre for Radio Astrophysics, Pune, India (July 2014).
- Co-chair of the “Workshop on Cosmology (Theory & Observation)” at the “27<sup>th</sup> Meeting of the Indian Association for General Relativity and Gravitation (IAGRG-27)”, Garhwal University, Srinagar, India (March 2013).
- Co-organized the 26th Meeting of the Indian Association for General Relativity and Gravitation (IAGRG) at Harish-Chandra Research Institute, Allahabad, India (January 2011).
- Co-organized the “Summer School on Gravitation & Cosmology” at Harish-Chandra Research Institute, Allahabad, India (May 2010).
- Co-organized an international meeting on “Cosmological Reionization” at Harish-Chandra Research Institute, Allahabad, India (February 2010).

### Activities related to the Square Kilometre Array (SKA) mega-project:

- Member of the International Science Working Group on Cosmology for the Square Kilometre Array (2013–present)
- Member of the International Science Working Group on Epoch of Reionization and Cosmic Dawn for the Square Kilometre Array (2015–present)
- The overall coordinator of the Science Working Groups for the Square Kilometre Array in India (2014–present), and the Chair of the Science Sub-committee of the SKA-India Consortium (2016–present).
- Organized several workshops and meetings as part of the SKA-India initiative (2014 onwards).
- Guest Editor, Journal of Astrophysics and Astronomy Special Issue on “Science with the Square Kilometre Array: An Indian Perspective”.

- Member of (i) the Events Organizing Committee and (ii) the Scientific Organizing Committee, International Conference on SKA 2016: Science for the SKA generation, Goa, India (November 2016).
- Member (Indian representative), SKA (International) Communications Steering Committee.
- Member (Indian representative), SKA (International) Communications And Outreach Network.
- Coordinated the SKA-India participation in Vigyan Samagam: First Mega Science Exhibition in India during 2019-2020.

**Membership of professional associations:**

- Member of the International Astronomical Union (IAU).
- Member of the Astronomical Society of India (ASI).
- Member of the Indian Radio Science Society (InRaSS).
- Member of the Editorial Board of the Journal of Astronomy & Astrophysics (co-published by Indian Academy of Sciences and Astronomical Society of India), January 2021 – present.
- Refereeing for various international journals.

**Administrative duties (selected list):**

- Member of the coordination committee for preparing the question paper of the all-India Joint Entrance Screening Test (JEST) for Ph.D students (2011, 2020, 2021).
- Member of the Computer Committee in Harish-Chandra Research Institute, Allahabad (2009–2012) and National Centre for Radio Astrophysics (2012–present).
- Member of the Academic Affairs Committee in National Centre for Radio Astrophysics, Pune (2012–present).
- Member of the Graduate Studies & Admission (JEST) Committee in Harish-Chandra Research Institute, Allahabad (2009–2011).
- Chair of the Library Committee in National Centre for Radio Astrophysics, Pune (2012–2022).
- Member of the Women's Cell at National Centre for Radio Astrophysics, Pune (2014–2020).

## Selected Invited Talks

### Talks at International Meetings / Institutions Outside India:

- Modelling the high-redshift universe at large scales  
Invited Colloquium  
Thüringer Landessternwarte, Tautenburg, Germany, November 2022 (Online).
- **Invited Talk:** High-redshift universe with redshifted 21 cm line  
Sixteenth Marcell Grossmann Meeting (MG16), Parallel Session CM1: Cosmic Backgrounds from radio to far-IR  
Organized by ICRA (Rome, Italy), ICRANet (Pescara, Italy) and the associated ICRANet centers including Yerevan, Armenia; Minsk, Belarus; Rio de Janeiro, Brazil; USTC, China; Isfahan, Iran; Stanford University and the University of Arizona, USA, July 2021 (Online).
- **Invited Talk:** First stars with the SKA and its pathfinders  
Indo-French CEFIPRA Astronomy Meeting: Galactic and Extragalactic universe in the era of new generation radio(SKA and pathfinders)/infrared/optical(MSE) facilities  
Indian Institute of Astrophysics, Bangalore, India, March 2021 (Online).
- **Invited Talk:** Cosmology and high-redshift universe with the redshifted 21 cm line  
XXIV DAE-BRNS High Energy Physics Symposium  
National Institute of Science Education and Research, Odisha, India, December 2020 (Online).
- Photon number conserving semi-numerical models of reionization  
Invited Seminar  
International Centre for Theoretical Physics, Trieste, Italy, June 2020 (Online).
- **Invited Talk:** Analytical and semi-numerical models of reionization  
International Conference and School on Observing The First Billion Years of the Universe Using Next Generation Telescopes  
Indian Institute of Technology, Indore, India, January 2020.
- **Invited Plenary Talk:** Cosmology with the First Stars  
International Conference on Gravitation & Cosmology (ICGC)  
Indian Institute of Science Education and Research, Mohali, India, December 2019.
- **Invited Talk:** Gravitational Waves and the “Final Frontier” of Cosmology  
Workshop on The Future of Gravitational-Wave Astronomy  
International Centre for Theoretical Sciences, Tata Institute of Fundamental Research, Bangalore, India, August 2019.
- Challenges in modelling the reionization physics  
Invited Colloquium  
Kapteyn Astronomical Institute, The University of Groningen, The Netherlands, June 2019
- **Invited Talk:** Cosmology and high-redshift universe with the Square Kilometre Array  
International Workshop on Cosmology – The Next Decade  
International Centre for Theoretical Sciences, Tata Institute of Fundamental Research, Bangalore, January 2019.
- **Invited Talk:** Probing the First Stars with Upcoming Facilities  
Conference on Shedding Light on the Dark Universe with Extremely Large Telescopes  
International Centre for Theoretical Physics, Trieste, Italy, July 2018.
- Modelling Cosmic Reionization  
Invited Seminar  
Kapteyn Astronomical Institute, The University of Groningen, The Netherlands, April 2018.



- **Invited Review:** Observational Constraints on Cosmological Reionization  
Workshop on The Reionization History of the Universe  
Center for Interdisciplinary Research, ZiF, Bielefeld University, Germany, March 2018.
- **Invited Talk:** Reionization constraints from Planck and upcoming probes  
International Workshop on Post-Planck Cosmology: Enigma, Challenges and Visions  
Inter-University Centre for Astronomy and Astrophysics, Pune, India, October 2017.
- **Invited Talk:** Reionization constraints post Planck-15  
Conference on CMB Spectral Distortions from Cosmic Baryon Evolution  
Raman Research Institute, Bangalore, India, July 2016.
- **Invited Talk:** 21cm signature of the first sources in the Universe  
Workshop on Cosmology with Next Generation Radio Surveys  
International Centre for Theoretical Physics, Trieste, Italy, June 2016.
- **Invited Talk:** Constraining Reionization: Do the observations prefer a small  $\tau_{\text{el}}$ ?  
Workshop on Cosmic Reionization  
Munich Institute for Astro- and Particle Physics (MIAPP), Garching, Germany, April 2016.
- **Invited Talk:** 21-cm Signature of the First Sources in the Universe  
Physics of Cosmic Dawn and Reionization in the SKA Era  
Sexten Center for Astrophysics (CfA), Sesto, Italy, January 2016.
- **Invited Talk:** Probing the Universe with Cosmic Neutral Hydrogen  
Advances in Astroparticle Physics and Cosmology (AAPCOS)  
Saha Institute of Nuclear Physics, Kolkata, India, October 2015.
- **Invited Talk:** Observational Constraints on Cosmological Reionization  
Advanced Workshop on Cosmological Structures from Reionization to Galaxies: Combining efforts from analytical and numerical methods  
Abdus Salam International Centre for Theoretical Physics, Trieste, Italy, May 2015.
- **Invited Review:** Cosmology and astrophysics using neutral hydrogen distribution  
SKA-SA 2014 Postgraduate Bursary Conference  
Stellenbosch Institute for Advanced Study, Stellenbosch, South Africa, December 2014.
- **Invited Talk:** Effect of Complex Reionization Histories on Cosmological Parameters  
Astronomical Surveys Symposium  
Tata Institute of Fundamental Research, Mumbai, India, December 2012.
- **Invited Review:** Constraining Reionization with Present/Future Facilities  
39th COSPAR Scientific Assembly  
Mysore, India, July 2012.
- **Invited Talk:** Constraining Reionization and First Stars  
Indo-UK Meeting on Confronting particle-cosmology with Planck and LHC  
Inter-University Centre for Astronomy and Astrophysics, Pune, India, August 2011.
- Reionization: Detectability of various aspects with current and future experiments  
Astrophysics Seminar  
Imperial College, London, UK, February 2008.
- **Invited Talk:** Observational Constraints on Reionization History  
HI Survival through Cosmic Times  
Abbazia di Spineto, Sarteano, Italy, June 2007.
- Observational constraints on dark ages and cosmic reionization  
Oxford Astrophysics Theoretical Astrophysics “Brown Bag” Seminars  
Oxford, UK, May 2007.

- **Invited Talk:** Dark ages and cosmic reionization  
RAS National Astronomy Meeting 2007  
Centre for Astrophysics, University of Central Lancashire, Preston, UK, April 2007.
- **Invited Talk:** Reionization of the Universe  
Cosmology Winter School and Reionization Workshop  
Theoretical Institute for Advanced Research in Astrophysics, Taiwan, February 2006.

#### Talks at National Meetings / Institutions in India:

- **Invited Plenary Talk:** Studying the First Stars using Neutral Hydrogen  
*Second Chennai Symposium on Gravitation and Cosmology*  
Centre for Strings, Gravitation and Cosmology, IIT Madras, India, February 2022 (Online).
- **Invited Talk:** Probing the Universe using Neutral Hydrogen  
Tribute to Prof. Thanu Padmanabhan, Commemorative Webinar Series  
Kerala State Council for Science, Technology and Environment, Kerala, India, September 2021 (Online).
- First Stars in the Universe  
Invited Webinar  
Indian Institute of Science Education and Research, Thiruvananthapuram, India, September 2020 (Online).
- The Final Frontier of Observational Cosmology: The First Stars in the Universe  
Invited Webinar  
BITS Pilani, K K Birla Goa Campus, India, August 2020 (Online).
- Recent advancements in theoretical modelling of reionization  
Colloquium  
Aryabhata Research Institute of Observational Sciences, Nainital, India, March 2020 (Online)
- Theoretical models of reionization  
Colloquium  
Inter-University Centre for Astronomy and Astrophysics, Pune, India, March 2020.
- **Invited Talk:** Understanding the Nature of Dark Matter using Cosmological Observations  
Workshop on Gravity at Different Length Scales  
Indian Association for the Cultivation of Science, Kolkata, February 2019.
- **Invited Plenary Talk:** Epoch of reionization: probing cosmology and the first stars  
37th Scientific Meeting of the Astronomical Society of India (ASI)  
Christ (Deemed to be University), Bengaluru, February 2019.
- Probing the high-redshift universe using neutral hydrogen  
Invited Colloquium  
Department of Astronomy & Astrophysics, Tata Institute of Fundamental Research, Mumbai, January 2019.
- Cosmic Neutral Hydrogen as a probe of the first stars in the Universe  
Institute Colloquium  
International Centre for Theoretical Sciences, Tata Institute of Fundamental Research, Bangalore, November 2017.
- **Invited Talk:** Studying Dark Matter Using High-redshift Observations  
29th Meeting of the Indian Association of General Relativity and Gravitation (IAGRG)  
Indian Institute of Technology, Guwahati, India, May 2017.
- Cosmic Neutral Hydrogen: Probing the First Stars in the Universe  
Institute Colloquium  
Saha Institute of Nuclear Physics, Kolkata, India, March 2016.

- **Public Talk:** Square Kilometre Array: Exploring the Universe with the world's largest radio telescope  
Outreach Programme on Different Aspects of Astroparticle Physics and Cosmology  
Saha Institute of Nuclear Physics, Kolkata, India, October 2015.
- **Invited Review:** Observational Constraints on Reionization: Do we need 21 cm experiments?  
National Workshop: Cosmology with the HI 21-cm Line  
Raman Research Institute, Bangalore, India, June 2015.
- **Invited Talk:** Reionization  
Saha Theory Workshop: Cosmology at the Interface  
Saha Institute of Nuclear Physics, Kolkata, India, January 2015.
- Square Kilometre Array: Exploring the Universe with the world's largest radio telescope  
Colloquium  
Centre for Theoretical Physics, Jamia Millia Islamia, New Delhi, India, January 2015.
- Probing the Universe through Neutral Hydrogen  
Physics Colloquium  
Indian Institute of Technology, Kanpur, India, February 2014.
- Probing the Universe through Neutral Hydrogen Distribution  
CTS-Physics Joint Seminar  
Indian Institute of Technology, Kharagpur, India, November 2013.
- Cosmic Reionization: Probing Galaxy Formation and Constraining Cosmological Parameters  
Astrophysics Seminar  
Indian Institute of Science, Bangalore, India, March 2013.
- **Invited Talk:** Observational Constraints on Cosmic Reionization History  
Workshop on Galaxies in Absorption  
Inter-University Centre for Astronomy and Astrophysics, Pune, India, December 2012.
- Probing the Universe through Neutral Hydrogen Distribution  
Theoretical Physics Colloquium  
Tata Institute of Fundamental Research, Mumbai, India, September 2011.
- **Invited Review:** Cosmological Reionization  
29th Scientific Meeting of the Astronomical Society of India (ASI)  
Pt. Ravishankar Shukla University, Raipur, India, February 2011.
- **Invited Talk:** Constraints on reionization physics from CMBR and other observations  
Cosmology Rapid Response Meeting  
International Centre for Theoretical Sciences, Tata Institute of Fundamental Research, Mumbai, India, April 2010.
- **Invited Review:** Cosmological Reionization  
From Black Holes to the Universe: Gravity at Work, 25th Meeting of the Indian Association for General Relativity & Gravitation (IAGRG)  
Saha Institute of Nuclear Physics, Kolkata, India, January 2009.
- **Invited Talk:** Probing the topology of reionization with 21 cm emission in the "photon-starved" scenario  
Cosmological evolution in diffuse baryons: Reionization epoch to the present day  
Orange County, Coorg, India, December 2008.
- **Invited Review:** Reionization of the Universe: Before and After WMAP  
IX Workshop on High Energy Physics Phenomenology (WHEPP-9)  
Institute of Physics, Bhubaneswar, India, January 2006.

**Publications (in reverse chronological order):****Refereed Journals:**

101. Lognormal semi-numerical simulations of the Lyman- $\alpha$  forest: comparison with full hydrodynamic simulations  
B. Arya, **T. Roy Choudhury**, A. Paranjape & P. Gaikwad  
Mon. Not. R. Astron. Soc., in press (2023), arXiv:2206.08013
100. Constraining the reionization and thermal history of the Universe using a semi-numerical photon-conserving code SCRIPT  
B. Maity & **T. Roy Choudhury**  
Mon. Not. R. Astron. Soc., **515**, 617 (2022), arXiv:2204.05268
99. Probing the thermal history during reionization using a semi-numerical photon-conserving code SCRIPT  
B. Maity & **T. Roy Choudhury**  
Mon. Not. R. Astron. Soc., **511**, 2239 (2022), arXiv:2111.11472
98. The impact of black hole feedback on the UV luminosity and stellar mass assembly of high-redshift galaxies  
O. Piana, P. Dayal & **T. Roy Choudhury**  
Mon. Not. R. Astron. Soc., **510**, 5661 (2022), arXiv:2111.03105
97. CosmoReionMC: A package for estimating cosmological and astrophysical parameters using CMB, Lyman- $\alpha$  absorption and global 21 cm data  
A. Chatterjee, **T. Roy Choudhury** & S. Mitra  
Mon. Not. R. Astron. Soc., **507**, 2405 (2021), arXiv:2101.11088
96. A consistent and robust measurement of the thermal state of the IGM at  $2 \leq z \leq 4$  from a large sample of Ly $\alpha$  forest spectra: Evidence for late and rapid HeII reionization  
P. Gaikwad, R. Srianand, M. Haehnelt & **T. Roy Choudhury**  
Mon. Not. R. Astron. Soc., **506**, 4389 (2021), arXiv:2009.00016
95. Multi-wavelength mock galaxy catalogs of the low-redshift Universe  
A. Paranjape, **T. Roy Choudhury** & R. Sheth  
Mon. Not. R. Astron. Soc., **503**, 4147 (2021), arXiv:2101.02717
94. Prospects of constraining reionization model parameters using Minkowski tensors and Betti numbers  
A. Kapahtia, P. Chingangbam, R. Ghara, S. Appleby & **T. Roy Choudhury**  
J. Cosmol. Astropart. Phys., **05**, 26 (2021), arXiv:2101.03962
93. Using artificial neural networks to extract the 21-cm global signal from the EDGES data  
M. Choudhury, A. Chatterjee, A. Datta & **T. Roy Choudhury**  
Mon. Not. R. Astron. Soc., **502**, 2815 (2021), arXiv:2012.00028
92. Studying the Lyman- $\alpha$  optical depth fluctuations at  $z \sim 5.5$  using fast semi-numerical methods  
**T. Roy Choudhury**, A. Paranjape & S. Bosman  
Mon. Not. R. Astron. Soc., **501**, 5782 (2021), arXiv:2003.08958
91. Cosmic microwave background constraints on a physical model of reionization  
**T. Roy Choudhury**, S. Mukherjee & S. Paul  
Mon. Not. R. Astron. Soc., **501**, L7 (2021), arXiv:2007.03705
90. The mass assembly of high-redshift black holes  
O. Piana, P. Dayal, M. Volonteri & **T. Roy Choudhury**  
Mon. Not. R. Astron. Soc., **500**, 2146 (2021), arXiv:2009.13505

89. Inevitable imprints of patchy reionization on the cosmic microwave background anisotropy  
S. Paul, S. Mukherjee & **T. Roy Choudhury**  
Mon. Not. R. Astron. Soc., **500**, 232 (2021), arXiv:2005.05327
88. Dark matter annihilation in  $\omega$  Centauri: Astrophysical implications derived from the MWA radio data  
A. Kar, B. Mukhopadhyaya, et al, including **T. Roy Choudhury**  
Physics of the Dark Universe, **30**, 100689 (2020), arXiv:2005.11962
87. Three- and two-point spatial correlations of IGM at  $z \sim 2$ : Cloud based analysis using simulations  
S. Maitra, R. Srianand, P. Gaikwad, **T. Roy Choudhury**, et al.  
Mon. Not. R. Astron. Soc., **498**, 6100 (2020), arXiv:2005.05346
86. A hint on the metal-free star formation rate density from 21cm-EDGES data  
A. Chatterjee, P. Dayal, **T. Roy Choudhury** & R. Schneider  
Mon. Not. R. Astron. Soc., **496**, 1445 (2020), arXiv:2003.05911
85. Bayesian approach to constraining the properties of ionized bubbles during reionization  
R. Ghara & **T. Roy Choudhury**  
Mon. Not. R. Astron. Soc., **496**, 739 (2020), arXiv:1909.12317
84. Reionization with galaxies and active galactic nuclei  
P. Dayal, M. Volonteri, **T. Roy Choudhury**, R. Schneider, et al  
Mon. Not. R. Astron. Soc., **495**, 3065 (2020), arXiv:2001.06021
83. Heavy dark matter particle annihilation in dwarf spheroidal galaxies: radio signals at the SKA telescope  
A. Kar, S. Mitra, B. Mukhopadhyaya & **T. Roy Choudhury**  
Phys. Rev. D, **101**, 023015 (2020), arXiv:1905.11426
82. Three- and two-point spatial correlations of intergalactic medium at  $z \sim 2$  using projected quasar triplets  
S. Maitra, R. Srianand, P. Petitjean, H. Rahmani, P. Gaikwad, **T. Roy Choudhury** & C. Pichon  
Mon. Not. R. Astron. Soc., **490**, 3633 (2019), arXiv:1907.02086
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#### Citation Details:

- According to SAO/NASA ADS, publications listed above have more than 4500 citations (including self-citations) as on 31 January, 2023. Corresponding *h*-index is 38.
- There are *three* papers with citations  $\geq 250$ , *five* papers with citation between 100–249 and *twenty* papers with citations between 50-99.

## Main Research Results

My research interests lie in various aspects of theoretical astrophysics and cosmology, in particular, reionization, intergalactic medium, galaxy formation and dark matter & dark energy. I have made significant contributions in theoretical modelling of reionization, the phase of the early universe when the first stars were born and the hydrogen atoms in the surrounding medium were ionized by the radiation from these stars. My aim has been to use the models, constrained by existing observations, to learn about the physical processes that drove galaxy formation in the young universe.

A selected list of achievements, along with the names of the collaborators (given in parentheses), is as follows:

### Reionization Physics:

- Solved a long-standing problem with the excursion set-based semi-numerical codes for generating the 21 cm signal at high redshifts, namely, the non-conservation of photon number (*Aseem Paranjape*).
- Constrained the reionization history by applying the photon-conserving code SCRIPT on quasar absorption data at  $z \sim 5 - 6$  and CMB data (*Aseem Paranjape, Barun Maity, Suvodip Mukherjee, Sourabh Paul, Sarah Bosman*).
- Developed a self-consistent semi-analytical model of reionization and thermal history of the Universe that is consistent with a variety of data sets. The model incorporates almost all the relevant physics and as a result has numerous other applications too (*Andrea Ferrara*).
- Obtained non-parametric constraints on reionization history by comparing the semi-analytical model with observations through advanced (MCMC-based) statistical techniques (*Andrea Ferrara, Sourav Mitra, Atrideb Chatterjee*).
- Developed hybrid simulations to model the reionization history and constrain it using the evolution in space density of the Lyman- $\alpha$  emitters (*Martin Haehnelt, Ewald Puchwein, James Bolton, Lewis Weinberger, Girish Kulkarni*).
- Constrained the evolution of the escape fraction of ionizing photons using different observations (*Sourav Mitra, Andrea Ferrara, Vikram Khaire, R. Srianand*).
- Constrained the value of the primordial magnetic field using reionization observations (*Kanhaiya Pandey, Shiv Sethi, Andrea Ferrara*).

### 21 cm Signal from Reionization and Cosmic Dawn:

- Constrained the warm dark matter mass and the metal-free star formation rate at  $z \sim 18$  using the EDGES 21 cm global signal (*Atrideb Chatterjee, Pratika Dayal*).
- Developed a semi-numerical code for generating the 21 cm signal at high redshifts, one of the first ones to characterize the effect of non-homogeneous recombinations (*Martin Haehnelt, John Regan*).
- Developed a one-dimensional radiative transfer code to model the 21 cm signal from reionization and cosmic dawn (*Raghunath Ghara, Kanan Datta*).
- Developed a matched-filter based method to detect ionized regions around  $z \sim 6 - 7$  quasars using their redshifted 21 cm signal (*Raghunath Ghara, Somnath Bharadwaj, Kanan Datta, Suman Majumdar*).
- Studied the line of sight effects on the 21 cm signal from reionization and cosmic dawn (*Somnath Bharadwaj, Raghunath Ghara, Kanan Datta, Suman Majumdar*).
- Developed improved analytical models for calculating the growth of ionized bubbles during reionization (*Aseem Paranjape*).

### Intergalactic Medium:

- Obtained constraints on the thermal state of the intergalactic medium using a combination of observational data and high-dynamic range hydrodynamical simulations (*Prakash Gaikwad, R. Srianand, M. Haehnelt*).

- Developed efficient hydrodynamical simulations of the Lyman- $\alpha$  forest and managed to solve the so-claimed “cosmic photon under production crisis” (*Prakash Gaikwad, R. Srianand, Vikram Khaire*).
- Developed a semi-analytical model for Lyman- $\alpha$  forest based on the lognormal distribution of the baryons and used it to constrain properties of the intergalactic medium (*T. Padmanabhan, R. Srianand*).
- Used the dark gap statistics in the quasar absorption spectra to constrain the neutral hydrogen fraction at  $z \sim 6$  (*Simona Gallerani, Andrea Ferrara*).

**Others:**

- Obtained constraints on particle physics models of dark matter using radio observations (*Arpan Kar, Biswarup Mukhopadhyaya, Sourav Mitra, Steven Tingay*).
- Developed models of neutral hydrogen distribution within galaxies / haloes and compared with different data sets, e.g., damped Lyman- $\alpha$  systems, 21 cm intensity mapping experiments, 21 cm galaxy surveys (*Hamsa Padmanabhan, Alexandre Refregier*).
- Worked on models of dark matter and dark energy, and obtained constraints using the SN-Ia data sets. Studied possible constraints with future galaxy cluster surveys (*T. Padmanabhan, Anjan Sen, N. Chandrachani Devi*).