Resume of Tirthankar Roy Choudhury

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Personal Information

- **Name:** Tirthankar Roy Choudhury
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- **Date of birth:** 26 September, 1974
- **Place of birth:** Jhargram, West-Bengal, India
- **Nationality:** Indian
- **Present Position:** Reader-F at the 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: *Physics of Structure Formation in the Universe*; 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/ Project Consultant	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 - present

Awards and Academic Distinctions

- Recipient of the first *Peraiah Foundation award* for achievements in Theoretical Astrophysics, July 2019.
- Regular Associate of the Abdus Salam International Centre for Theoretical Physics, Trieste, Italy for the period 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 courses (e.g., Quantum Mechanics, Mathematical Methods in Physics, Introductory Astrophysics) and advanced (e.g., General Theory of Relativity, Cosmology), in the Graduate school at Harish-Chandra Research Institute (Allahabad), IUCAA-NCRA Graduate School (Pune), M.Sc course at the Pune University and B.Sc course at Fergussion College, Pune. In addition, he 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:

- Atrideb Chatterjee (NCRA-TIFR, Pune), 2017-present.
- 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 work with me):

- Arpan Kar (HRI, Allahabad, Supervisor: B. Mukhopadhyay), 2016-present.
- 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.

Other long-term student projects:

- **MS Final Year Project:** Mihir Kulkarni (IISER, Pune), 2014-2015.
- **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.

Mentoring at the post-doctoral level:

- Sourabh Paul
- Kanhaiya Pandey
- Kanan Datta
- Tapomoy Guha Sarkar

Professional and Organizational Experience

Organizing meetings, workshops etc (selected list):

- 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^{th} 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).

SKA-related activities:

- 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).

Membership of professional associations:

- Member of the International Astronomical Union (IAU).
- Member of the Astronomical Society of India (ASI).

Administrative duties:

- Member of the coordination committee for preparing the question paper of the all-India Joint Entrance Screening Test (JEST) for Ph.D students (2011).
- 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 (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 (2012–present).
- Member of the Women's Cell at National Centre for Radio Astrophysics (September 2014 - present).
- Chair of the Recreation Club Committee of National Centre for Radio Astrophysics (December 2013 - present).

Others:

- Refereeing scientific articles in journals Monthly Notices of the Royal Astronomical Society, Astronomy & Astrophysics, Classical & Quantum Gravity

Statement of Research: Past and Present

My research interests lie in various aspects of theoretical astrophysics and cosmology, in particular, reionization, intergalactic medium, neutral hydrogen at high redshifts and dark energy.

My main science achievements are listed below:

Reionization:

- 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. (*Collaborators: Andrea Ferrara*).
- Obtained non-parametric constraints on reionization history by comparing the semi-analytical model with observations through advanced (MCMC-based) statistical techniques (*Collaborators: Andrea Ferrara, Sourav Mitra*).
- Developed hybrid simulations to model the reionization history and constrain it using the evolution in space density of the Lyman-α emitters (*Collaborators: Martin Haehnelt, Ewald Puchwein, James Bolton*).
- Constrained the evolution of the escape fraction of ionizing photons using different observations (*Collaborators: Sourav Mitra, Andrea Ferrara, Vikram Khaire, R. Srianand*).
- Constrained the value of the primordial magnetic field using reionization observations (*Collaborators: Kanhaiya Pandey, Shiv Sethi, Andrea Ferrara*).

Intergalactic Medium:

- Developed a semi-analytical model for Lyman-α forest based on the lognormal distribution of the baryons and used it to constrain properties of the intergalactic medium (*Collaborators: T. Padmanabhan, R. Srianand*).
- Used the dark gap statistics in the quasar absorption spectra to constrain the neutral hydrogen fraction at $z \sim 6$ (*Collaborators: Simona Gallerani, Andrea Ferrara*).

21 cm Signal from Reionization and Cosmic Dawn:

- 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 (*Collaborators: Aseem Paranjape*).
- 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 (*Collaborators: Martin Haehnelt, John Regan*).
- Developed a one-dimensional radiative transfer code to model the 21 cm signal from reionization and cosmic dawn (*Collaborators: 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 (*Collaborators: Somnath Bharadwaj, Kanan Datta, Suman Majumdar*).
- Studied the line of sight effects on the 21 cm signal from reionization and cosmic dawn (*Collaborators: Somnath Bharadwaj, Raghunath Ghara, Kanan Datta, Suman Majumdar*).
- Developed improved analytical models for calculating the growth of ionized bubbles during reionization (*Collaborators: Aseem Paranjape*).

Others:

- Developed models of neutral hydrogen distribution within galaxies / haloes and compared with different data sets, e.g., damped Lyman-α systems, 21 cm intensity mapping experiments, 21 cm galaxy surveys (*Collaborators: 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 (*Collaborators: T. Padmanabhan, Anjan Sen, N. Chandrachani Devi*).

Current Interests:

- Studying the prospects of detecting the first stars in the Universe through their 21 cm pattern using telescopes like the SKA (*Collaborators: Raghunath Ghara, Kanan Datta*).
- Developing advanced simulations and strategies for detecting the ionized regions high-redshift quasars using the SKA and its pathfinders like the upgraded GMRT (*Collaborators: Kanan Datta, Suman Majumdar*).
- Developing concordant models of the 21 cm signal from reionization using high dynamic range simulations (*Collaborators: Girish Kulkarni, Martin Haehnelt, Ewald Puchwein*).
- Studying constraints on reionization scenarios driven by quasars (*Collaborators: Andrea Ferrara, Sourav Mitra*).
- Studying methods for constraining the thermal history of the intergalactic medium using Lyman-α forest simulations (*Collaborators: Hamsa Padmanabhan, R. Srianand, Prakash Gaikwad*).
- Studying constraints on the ionizing background at $z \sim 0.2$ using Lyman-α forest simulations and comparing with HST-COS data (*Collaborators: Prakash Gaikwad, R. Srianand, Vikram Khaire*).
- Developing improved semi-numerical models of 21 cm signal, addressing the issue of apparent non-conservation of photons (*Collaborators: Aseem Paranjape*).