Anirban ROY

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PERSONAL DATA

The Center for Cosmology and Particle Physics
New York University,
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E-mail: ar8816@nyu.edu
Phone: (+1) 607-262-1190
Citizenship: Indian
Date of Birth: March 17, 1993

PRESENT POSITION

OCT, 2023 - PRESENT

Postdoctoral fellow
The Center for Cosmology and Particle Physics
New York University, NY, USA
Mentor: Anthony Pullen

Guest Researcher
Center for Computational Astrophysics (CCA)
Flatiron Institute, New York

PROFESSIONAL EXPERIENCE

OCT, 2019 - SEP, 2023

Research Associate
Cornell Center for Astrophysics and Planetary Science
Cornell University, Ithaca, USA
Mentor: Nicholas Battaglia

EDUCATION

OCT, 2015 - SEP, 2019

PhD cum laude in Astrophysics
SISSA/ ISAS- International School for Advanced Studies, Trieste
Title: Probing patchy reionization via CMB, LSS, and their cross-correlations
Supervisors: Carlo Baccigalupi, Andrea Lapi, and David Spergel
Award date: Sep 19, 2019

SEP, 2013 - JUL, 2015

Master Degree in Physics (M.Sc.)
University of Burdwan, Burdwan, India
Master thesis: Secondary anisotropies in Cosmic Microwave Background
Supervisor: Sarbeswar Chaudhuri

AUG, 2010 - JUL, 2013

Bachelor Degree in Physics (B.Sc.)
Asutosh College, Kolkata, India

WORK EXPERIENCE

MAY, 2018 - AUG, 2018

Visiting Student
University of Cambridge, UK
Project Title: The study of reionization induced B-mode signal
Collaborators: Girish Kulkarni, Daan Meerburg, Anthony Challinor, and Martin Haehnelt

JAN, 2014 - MAY, 2015 | *Project Student*
Presidency University, India
Project Title: Modelling Sunyaev Zeldovich effect in active galaxies
Supervisor: Suchetana Chatterjee

RESEARCH INTEREST

Interface of Astrophysics and Cosmology: multi-line intensity mapping, redshifted 21-cm signal, star formation history in high redshift galaxies.

Cosmic Microwave Background (CMB): secondary anisotropies in CMB by lensing, reionization and Sunyaev-Zeldovich effect, imprints of non-Gaussianity in CMB, cross-correlation studies with multiple tracers.

RESEARCH PAPERS

Total citation: 3633 (Inspire-HEP) and 2576 (Google scholar)

In preparation

20) "Synergy between multi-line intensity mapping and 21 cm observations"
Anirban Roy, Anthony Pullen, et al.

19) "Estimators for the analysis of multi-line intensity mapping"
Anirban Roy, Kailai Wang, et al.

Published

18) "The Modeling Landscape of Extragalactic CO in CMB Surveys"
Yogesh Mehta, **Anirban Roy**, Simon Foreman, Alexander van Engelen, and Nick Battaglia, submited to APJ
[arXiv:2506.16028]

17) "The Simons Observatory: science goals and forecasts for the enhanced Large Aperture Telescope"
M. Abitbol et al., (including **Anirban Roy**)
[arXiv:2503.00636]

16) "Semi-Empirical Approach to [CII] Line Intensity Mapping"
Anirban Roy and Andrea Lapi, JCAP01(2025), 01, 010
[arXiv:2407.19007]

15) "A Measurement of CO(3–2) Line Emission from eBOSS Galaxies at $z \sim 0.5$ using Planck Data"
Anirban Roy, Nick Battaglia, and Anthony Pullen, submitted to PRL
[arXiv:2406.07861]

14) Cross-correlation Techniques to Mitigate the Interloper Contamination for Line Intensity Mapping Experiments
Anirban Roy and Nicholas Battaglia, ApJ (2024), 969, 2
[arXiv:2312.08471]

13) LIMpy: A Semi-analytic Approach to Simulating Multi-line Intensity Maps at Millimetre Wavelengths
Anirban Roy, Dariannette Valentín-Martínez, Kailai Wang, Nicholas Battaglia, Alexander van Engelen, APJ 957 (2023) 2, 87
[arXiv:2304.06748]

12) "Probing Circumgalactic medium from the CMB polarization statistical anisotropy"
Anirban Roy, Vera Gluscevic, Alexander Van Engelen, and Nicholas Battaglia, APJ (2023), 951, 1
[arXiv:2201.05076]

11) "CCAT-prime Collaboration: Science Goals and Forecasts with Prime-Cam on the Fred Young Submillimeter Telescope"
Aravena et al. (including **Anirban Roy**), APJ Supplement Series (2022), 264, 1
[arXiv:2008.12619]

10) "Constraining reionization with the first measurement of the cross-correlation between the CMB optical-depth fluctuations and the Compton y-map"

Toshiya Namikawa, **Anirban Roy**, Blake Sherwin, Nicholas Battaglia, and David Spergel, PRD, (2021) 6, 104, 063514
[arXiv:2102.00975]

9) "The correlation of high-redshift galaxies with the thermal Sunyaev-Zel'dovich effect traces reionization"
Eric J. Baxter, Lewis Weinberger, Martin Haehnelt, Vid Irsic, Girish Kulkarni, Shivam Pandey, **Anirban Roy**, MNRAS (2021), 501, 4, 6215
[arXiv:2006.09742]

8) "Revised estimates of CMB *B*-mode polarization induced by patchy reionization"
Anirban Roy, Girish Kulkarni, P. Daniel Meerburg, Anthony Challinor, Carlo Baccigalupi, Andrea Lapi, Martin G. Haehnelt, JCAP (2021), 01, 003
[arXiv:2004.02927]

7) "CMB-S4: Forecasting Constraints on Primordial Gravitational Waves"
Kevork Abazajian et al., including **Anirban Roy**, APJ 926 (2022) 1, 54
[arXiv:2008.12619]

6) "Detectability of the $\tau - 21\,cm$ cross-correlation:a tomographic probe of patchy reionization"
Anirban Roy, Andrea Lapi, David Spergel, Carlo Baccigalupi, JCAP (2020), 3, 62
[arXiv:1904.02637]

5) "Cosmology with low-redshift observations: No signal for new physics"'
Koushik Dutta, **Anirban Roy**, Ruchika, Anjan A. Sen, M.M. Sheikh-Jabbari, PRD (2019), 100, 103501
[arXiv:1808.06623]

4) "The Simons Observatory: Science goals and forecasts"
Peter Ade et al., (including **Anirban Roy**), JCAP(2019), 56
[arXiv:1808.07445]

3) "Beyond ΛCDM with Low and High Redshift Data: Implications for Dark Energy"
Koushik Dutta, **Anirban Roy**, Ruchika, Anjan A. Sen, M.M. Sheikh-Jabbari, GRG (2020), 52, 15
[arXiv:1908.07267]

2) "CMB-S4 Science Case, Reference Design, and Project Plan",
Kevork Abazajian et al. (including **Anirban Roy**), 2019
[arXiv:1907.04473]

1) "Observing Patchy Reionization With Future CMB Polarization Experiments",
Anirban Roy, Andrea Lapi, David Spergel, Carlo Baccigalupi, JCAP (2018), 5, 014
[arXiv:1801.02393]

White paper/ Proceedings

4) "Snowmass 2021 CMB-S4 white paper", Kevork Abazajian, et al.
[arXiv:2203.08024]

3) "CMB-S4 Decadal Survey APC White Paper"
Kevork Abazajian et al.
[arXiv:1908.01062], Bull.Am.Astron.Soc. 51 (2019) no.7, 209

2) "The Simons Observatory: Astro2020 Decadal Project Whitepaper"
Simons Observatory Collaboration
[arXiv:1907.08284], Bull.Am.Astron.Soc. 51 (2019) 147

1) "Unique Probes of Reionization with the CMB: From the First Stars to Fundamental Physics"
Alvarez et al. (including **Anirban Roy**)
Bulletin of the American Astronomical Society, Vol. 51, Issue 3, 482 (2019)

Academic Services

Reviewer for astronomical journals such as MNRAS, A&A, PRL.
Developed **public software packages** to analyze astronomical datasets.
Involved in **Prison Teaching Program** at Cornell University.
Evaluated sixty applications for graduate admissions in 2021 and 2022 at Cornell University.

Awards/ Honors

February 2023	Seal of Excellence awarded for the Marie Curie Fellowship proposal.
Jul, 2022 - lifetime	Life Member, Indian Astronomical Society
Nov, 2015-Oct, 2019	PhD Fellowship in Astrophysics Division, SISSA, Italy
Oct, 2015-Nov, 2015	Postgraduate Fellowship in Astrophysics Division, SISSA, Italy
March, 2015	1st Prize in Poster Presentation in West Bengal Science and Technology Congress , Burdwan, India

Collaboration

Fred Young Submillimeter Telescope (FYST): Intensity mapping and galaxy cluster working group
Simons Observatory: SZ and Cluster working group
CMB S4: Maps to other statistics working group
CMB Bharat (An India based space CMB mission): Reionization and lensing working group

Computer skills

Programming Languages	Python (advanced), C (working knowledge), MATLAB, Fortran (basic knowledge)
Developed packages	LIMpy (line intensity mapping in python), and SECpy (code for CMB secondary observables)
Scientific Packages	CLASS, Monte Python, CosmoMC, CAMB, HEALPY, emcee, Lenspix, Quicklens, LensIt, CMB4CAST, Cosmolopy, 21cmFAST, 21cmSense, Picola, and Pylians
Simulation	Worked on Sherwood simulation suite, IllustrisTNG, and UniverseMachine
OS & Others	Windows, Linux, Mac, and LaTeX

Students supervised

[* co-author/significant contribution in published papers.]
Chujian Wang (New York University): "Probing the redshift evolution of galaxies using line intensity mapping."
Kailai Wang* (Cornell University): "Development of analysis tools for line intensity mapping."
Ariel Marxena Baksh (Cornell University): "Noise simulations for line intensity mapping observations."
Dariannette Valentin* (Arizona State University): "Modeling [CII] & CO line emissions during the epoch of reionization."

Conference/Workshop/School/ Visit

June 2025	Institut d'Astrophysique Spatiale, France
June 2025	University of Bonn and Cologne, Germany
June 2024	Line Intensity mapping workshop, University of Illinois Urbana-Champaign, USA
June 2023	CCAT collaboration meeting, Cornell University, USA
April 2023	Present and Future of Line-Intensity Mapping, Max Planck Institute for Astrophysics, Germany
April 2023	Academic visit to Heidelberg University and Stockholm University
September 2022	Academic visit, Cambridge University.
April 2022	CCAT-p collaboration meeting, (online).
April 2021	CCAT-p collaboration meeting, (online).
June 2020	Simons observatory collaboration meeting, (online).
April 2020	CCAT-p collaboration meeting, (online).
January 2020	Academic visit, New York University, Abu Dhabi.
June 2019	"Quantum to Cosmos", Tubitak Tusside, Gebze, Turkey.
March 2019	Academic visit, NASA Jet Propulsion Laboratory, Pasadena, USA.
June 2018	CMB S4 Collaboration Meeting, Fermilab, Chicago, USA.
August 2018	Academic visit and CMB S4 collaboration meeting, Princeton University, Princeton, USA.
June 2018	Simons Observatory Collaboration Meeting, University of Pennsylvania, Philadelphia, USA.
March 2018	Academic Visit, Center for Computational Astrophysics, New York, USA.
October 2017	Post Planck Cosmology-Enigma, Challenges and Visions, IUCAA, Pune, India.
September 2017	Astro-Trieste conference, SISSA, Trieste, Italy.
July 2017	Probing the space-time fabric: from concepts to phenomenology, SISSA, Trieste, Italy.
January 2017	III Saha Theory Workshop: Aspects of Early Universe Cosmology, SINP, Kolkata, India.
December 2016	Academic Visit, Tata Institute of Fundamental Research, Mumbai, India.
June 2016	Summer School in Cosmology, ICTP, Trieste, Italy.
November 2014	"Observational Aspects of Astrophysics and Cosmology", Visva Bharati University, Shantiniketan, India.

FEBRUARY 2013 Workshop on Solar Physics, Vivekananda University, Belur, India.
DECEMBER 2012 Workshop on "Virtual Observatory In Astrophysics", University of Calcutta, Kolkata, India.

TALKS

INVITED "Review talk on Modelling LIM Signals",
IFPU (Trieste), June, 2025

INVITED "How Well Can Cosmologists Do Astrophysics Using Line Intensity Mapping Observations?",
University of Bonn, June, 2025

CONTRIBUTED "Optimal Techniques for Analyzing Line Intensity Mapping Data",
LIM2025, Laboratoire d'Annecy de Physique Théorique (LAPTh), June, 2025

INVITED "How Well Can Cosmologists Do Astrophysics Using Line Intensity Mapping Observations?",
University of Pennsylvania, February, 2025

CONTRIBUTED "Cross-Correlation Techniques for Mitigating Interloper Contamination",
LIM2024, University of Illinois, June, 2024

INVITED "Multi-line Intensity Mapping: A Bridge Between Astrophysics and Cosmology",
New York University, New York, February, 2024

INVITED "Exploring the Universe: From the First Billion Years to the Present Day",
IIT Tirupati, India, September, 2023

INVITED "Simulating multi-line intensity maps",
Indian Statistical Institute (ISI), Kolkata, India, January 11, 2023

CONTRIBUTED "Cosmology with cosmic microwave background and multi-line intensity mapping",
AlbaNova University Center, Stockholm University, Sweden, June 2, 2023

INVITED "Probing reionization and CGM with tSZ and cross-correlations",
CCA, Flatiron Institute, USA, June 2, 2022

INVITED "Electrons and baryons in the Universe: from first billion years to the present day",
remote presentation, IISER Kolkata, India, April 20, 2022

CONTRIBUTED "Towards the optimal statistics for LIM estimators",
remote presentation, CCAT-prime collaboration meeting, April 5, 2022

INVITED "Cosmology with the first light in the Universe: from first billion years to the present day",
Istanbul University (remote presentation), Turkey, February 28, 2022

INVITED "Cross-correlation studies with future CMB experiments",
Tata Institute of Fundamental Research, India (remote presentation), May 21, 2021

INVITED "Cross-correlation studies as a probe of reionization",
CMB-S4 workshop, University of Chicago, USA (remote presentation), August 11, 2021

CONTRIBUTED "Late-time universe: surprises, tension, and prospects",
IISER Pune, India, January 7, 2020

INVITED "Patchy Reionization and induced B-mode signal",
Conference Speaker, Tor Vergata, Rome, Italy, August 12, 2020

CONTRIBUTED "B-mode signal from patchy reionization",
Conference Speaker, ICTS, Bangalore, India, January 24, 2019

INVITED "Probing the new physics with future CMB experiments",
Seminar Speaker, Jamia Millia Islamia, New Delhi, India, December 20, 2018

CONTRIBUTED "Do we need to worry about patchy reionization?",
Fire slide, Simons Observatory Collaboration meeting, Upenn, USA, June 18, 2018

INVITED "Probing the reionization with Cosmic Microwave Background",
Seminar Speaker (Remote), IIT-Indore, Indore, India, May 14, 2018

INVITED "Precision Cosmology with the baby picture of the Universe",
Seminar speaker, Akdeniz University, Turkey, March 13, 2018

INVITED "Precision Cosmology with the baby picture of the Universe",
Seminar speaker, Istanbul University, Turkey, March 12, 2018

INVITED "Cosmic Reionization: What can future CMB experiments tell us?",
Seminar speaker, SINP, Kolkata, India, October 10, 2017

INVITED "Cosmic Reionization: What can future CMB experiments tell us?",
Seminar speaker, Challenges and Visions, IISER, Kolkata, India, October 13, 2017

CONTRIBUTED "Observing Patchy Reionization with Future CMB Polarization Experiments",
Post-Planck Cosmology-Enigma, Challenges and Visions, IUCAA, Pune, India, October 10, 2017

CONTRIBUTED "Observing Patchy Reionization with CMB S4",
Astro-Trieste Conference, SISSA, Trieste, Italy, September 26, 2017

CONTRIBUTED "Effects of inhomogeneous reionization on CMB anisotropy",
III Saha Theory Workshop: Aspects of Early Universe Cosmology,
Saha Institute of Nuclear Physics, Kolkata, India, January 16, 2017

INVITED "Our Universe: Through The Eyes of A Cosmic Detective",
"Challenges in Modern Cosmology", Seminar Speaker,
University of Dhaka, Dhaka, Bangladesh, January 7, 2016

OUTREACH ACTIVITIES

I am dedicated to promoting science among students and the public, especially in developing countries. I have shared my research at over ten schools and six colleges in India, Bangladesh, Nepal, and the USA. Since 2018, I have annually organized "Women in Science" events in Contai, my hometown, to inspire rural Indian female students to pursue science careers. Notably, I held interview sessions with Professors Cora Dvorkin, David Spergel, and Avi Loeb, garnering positive responses.

ARTICLES FOR PUBLIC

I am enthusiastic about composing articles on Astronomy and research for the general public. Additionally, I am a staunch advocate for promoting science in native languages, particularly in my mother tongue, Bengali. I contribute articles to online magazines in Bengali to further this cause.

3) "Guatemalar Rodrigo", Anirban Roy, Bigyan Barnali Magazine, [link]
2) "Bipulo Tarongo re", Anirban Roy, Bongodorshon, [link]
1) "Gobeshonar Galpokatha", Anirban Roy, Elebele magazine, [link]

LANGUAGES

Bengali (native), English (fluent), Hindi (speaking)

REFERENCES

David Spergel | *Emeritus Professor, Princeton University, USA*
President, Simons Foundation
E-mail: dns@astro.princeton.edu
Homepage: http://www.astro.princeton.edu/~dns

Anthony Pullen | *Professor, The Center for Cosmology and Particle Physics*
New York University, USA
E-mail: anthony.pullen@nyu.edu
Homepage: https://as.nyu.edu/faculty/anthony-pullen.html

Nicholas Battaglia | *Assistant Professor, Astrophysics Division*
Cornell University, USA
E-mail: nb572@cornell.edu
Homepage: https://astro.cornell.edu/nicholas-battaglia

Carlo Baccigalupi | *Full Professor, Department of Astronomy*
SISSA/ ISAS- International School for Advanced Studies, Italy
E-mail: bacci@sissa.it
Homepage: http://www.people.sissa.it/~bacci

Andrea Lapi | *Full Professor, Department of Astronomy*
SISSA/ ISAS- International School for Advanced Studies, Italy
E-mail: lapi@sissa.it
Homepage: https://lapi.jimdofree.com/

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Tata Institute Of Fundamental Research (TIFR), India
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Homepage: http://theory.tifr.res.in/ kulkarni/