

Fazlu RAHMAN

DESIGNATION: Postdoctoral Research Associate
AFFILIATION: Mitchell Institute for Fundamental Physics and Astronomy
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EDUCATION & RESEARCH EXPERIENCE

FEB 2024 TO JULY 2024	Research Fellow Raman Research Institute (RRI) , Bangalore, India Supervisor: Prof. Tarun Souradeep, RRI Bangalore
JAN 2018 TO JAN 2024	PhD in Astrophysics Indian Institute of Astrophysics (IIA) , Bangalore, India Supervisor: Prof. Pravabati Chingangbam, IIA Bangalore Thesis Title: <i>Investigations of Statistical Properties of Galactic Foreground Components and the CMB</i>
NOV 2022 TO DEC 2022	Visiting Fellow Korea Institute of Advanced Study (KIAS) , Seoul, South Korea <i>Visit to the Cosmology group led by Prof. Changbom Park (KIAS)</i>
AUG 2022 TO OCT 2022	Visiting Fellow Institute of Theoretical Astrophysics, University of Oslo , Oslo, Norway <i>Visit to the CMB analysis group led by Prof. Hans Kristian Eriksen (ITA) to work on BeyondPlanck and Cosmoglobe collaborations</i>
JUNE 2015 TO JUNE 2017	Master of Science in PHYSICS Cochin University of Science and Technology (CUSAT) , Cochin, India Supervisors: Prof. M Sabir (Retd. CUSAT, deceased) & Prof. Patrick Das Gupta (Delhi University) Thesis Title: <i>Creation of SuperMassive Kerr Blackholes from the Gravitational Collapse of BECs of Ultra-light Scalars</i> SGPA:8.7/10

RESEARCH INTERESTS

Cosmic Microwave Background (CMB) and Early Universe Physics – CMB Mapmaking & Component Separation – Statistics of Galactic Foregrounds – Galactic Magnetic Field – Mathematics of Random Fields and Geometric & Topological Tools to Characterize Them

PUBLICATIONS

Published

- F. Rahman**, P. Chingangbam, K. Huffenberger, T. Ghosh, D. Pogosyan, T. Souradeep and C. Park, *Understanding the non-Gaussian nature of Galactic foreground emissions towards small scales* [arXiv:2606.22596 [astro-ph.CO]]
- I. Abril-Cabezas, S. Adachi, P. Ade, et al. (including **F. Rahman**) *The Simons Observatory: forecasted constraints on primordial gravitational waves with the expanded array of Small Aperture Telescopes* [arXiv:2512.15833 [astro-ph.CO]]
- M. Bashir, Nidharssan S, P. Chingangbam, **F. Rahman**, P. Goyal, S. Appleby and C. Park, *Local patch analysis of ACT DR6 convergence map using morphological statistics* [arXiv:2503.17849 [astro-ph.CO]]
- P. Chingangbam and **F. Rahman**, *Minkowski Functionals for composite smooth random fields*, accepted for publication in Physical Review D [arXiv:2311.12571 [astro-ph.CO]]
- A. L. Chanu, P. Chingangbam, **F. Rahman**, R. K. B. Singh and P. Kharb, *Analysis of the structural complexity of Crab nebula observed at radio and infrared frequencies using a multifractal approach*, J. Phys. Complex.

2024 5 015005 [arXiv:2206.04717 [astro-ph.GA]]

6. **F. Rahman**, P. Chingangbam and T. Ghosh, *Statistical properties of Galactic synchrotron temperature and polarization maps – a multi-frequency comparison*, JCAP 01(2024) 036 [arXiv:2212.06076 [astro-ph.CO]]
7. J. R. Eskilt, K. Lee, D. J. Watts et al. (including **F. Rahman**) COSMOGLOBE: *Towards end-to-end CMB cosmological parameter estimation without likelihood approximations*, A&A 678, A169 (2023) [arXiv:2306.15511 [astro-ph.CO]]
8. J. R. Eskilt, D. J. Watts, R. Aurlien, A. Basyrov et al. (including **F. Rahman**) COSMOGLOBE DR1 RESULTS. II. *Constraints on isotropic cosmic birefringence from reprocessed WMAP and Planck LFI data*, A&A 679, A144 (2023) [arXiv:2305.02268 [astro-ph.CO]]
9. D. J. Watts, A. Basyrov, J. R. Eskilt, M. Galloway, L. T. Hergt, D. Herman, H. T. Ihle, S. Paradiso, **F. Rahman** et al. COSMOGLOBE DR1 RESULTS. I. *Improved Wilkinson Microwave Anisotropy Probe maps through Bayesian end-to-end analysis*, A&A 679, A143 (2023) [arXiv:2303.08095 [astro-ph.CO]]
10. M. Brilenkov, K. S. F. Fornazier, L. T. Hergt, G. A. Hoerning, A. Marins, T. Murokoshi, **F. Rahman** et al. *BeyondPlanck IV. On end-to-end simulations in CMB analysis – Bayesian versus frequentist statistics*, A&A, 675, (2023) A4 [arXiv:2209.04437 [astro-ph.CO]]
11. **F. Rahman**, P. Chingangbam and T. Ghosh, *The nature of non-Gaussianity and statistical isotropy of the 408 MHz Haslam synchrotron map*, JCAP 07 (2021) 026 [arXiv:2104.00419v2 [astro-ph.CO]].
12. **F. Rahman** and P.D. Gupta, *Creation of Supermassive Kerr Black Holes from the Gravitational Collapse of the Rotating BECs of Ultra-light Scalars*, Ecology of the New; Matter, Mind and Body Vol 1, Anthology of Research Papers, ISBN: 978-93-528188-8-4 [Conference Proceeding]
13. P.D. Gupta and **Fazlu Rahman**, *Aspects of Black Hole Physics and Formation of Super-massive Black Holes from Ultra-light Dark Bosons*, The Physical Universe, eds. S. M. Wagh, S. D. Maharaj & G. Chon (2018, Published by Central India Research Institute, Nagpur, India) [arXiv:1801.02559v3 [gr-qc]] [Conference Proceeding]

In preparation

1. **F. Rahman** & K. Huffenberger, *Galactic Dust Filament Characterization using IRAS, Planck and AKARI surveys*

COLLABORATION & MEMBERSHIPS

- Simons Observatory (SO)
- PanEx Galactic Science Collaboration
- Cosmoglobe
- CMB-Bharat Consortium
- Square Kilometer Array (SKA) - India Cosmology Consortium

PRESENTATIONS

Talks

- Contributed Talk on *Characterizing Dust Filaments using Planck, IRAS and AKARI* at the 247th American Astronomical Society (AAS) Meeting, Phoenix Arizona, Jan 2026
- Invited Talk on *Kurtosis non-Gaussianity of Galactic Foreground Emission*, Kavli Institute for Cosmology, University of Cambridge, UK, Aug 2025.
- Contributed Talk on *Towards Understanding non-Gaussianity of Galactic Emissions* at the American Physical Society (APS) Meeting, Anaheim, California, March 2025
- Dissertation Talk on *Morphological Characterization of CMB and Galactic Foreground Emissions* at American Astronomical Society (AAS) Meeting at National Harbor, MD, January 2025.
- Invited Talk on *Morphological Characterization of Galactic Foreground Emissions* at Astrophysical Relativity Seminar, ICTS Bangalore, June 2024
- Invited Talk on *Morphological Characterization of Galactic Foreground Emissions* at SKA-India CD/EoR Bi-Weekly Discussion Meeting (Online), April 2024

- Contributed Talk on *Morphological Statistics of Galactic Synchrotron Emission*, Galactic Science and CMB Foregrounds Conference, Tenerife, Spain, December 2022 (Hybrid).
- Talk on *Morphological Statistics of Galactic Synchrotron Emission*, CMB Group Meeting, Institute of Theoretical Astrophysics (ITA), University of Oslo, October 2022.
- Contributed Talk on *Multi-Frequency Statistics of Galactic Synchrotron Emission*, Cosmoglob Workshop 2022, University of Oslo, May 2022 (Online)
- Contributed Talk on *Multi-Frequency Statistics of Galactic Synchrotron Emission*, ASI 2022, IIT Roorkee, March 2022
- Talk on *Statistical Features of Galactic Synchrotron Emission*, EoR India Telecon, July 2021 (Online)
- Contributed Talk on *The Nature of Non-Gaussianity and Statistical Isotropy of the 408 MHz Haslam Synchrotron Map*, IIA In-house Scientific Meeting, IIA Bangalore, June 2021 (Online)
- Talk on *The Nature of Non-Gaussianity and Statistical Isotropy of the 408 MHz Haslam Synchrotron Map*, KDESci Group Meeting, Korea Institute of Advanced Study (KIAS), Seoul, South Korea, April 2021 (Online)
- Contributed Talk on *The Nature of Non-Gaussianity and Statistical Isotropy of the 408 MHz Haslam Synchrotron Map*, April 2021, Workshop & School on 21-cm Cosmology & Reionization (Online)
- Contributed Talk on *Gaussianity and Statistical Isotropy of Galactic Synchrotron at 408 MHz*, Young Astronomers Meet 2019, Kodaikanal Solar Observatory, Kodaikanal, Tamil Nadu, India, Sept 2019
- Contributed Talk on *Gaussianity and Statistical Isotropy of Galactic Synchrotron at 408 MHz*, July 2019, Workshop on Geometrical and Topological Methods for Cosmological Data Analysis, NISER Bhubaneswar, India, July 2019

Posters

- Poster Presentation on *Understanding the Small-Scale Non-Gaussianity of Galactic Emissions*, Simons Observatory F2F Meeting, University of Toronto, July 2026.
- Poster Presentation on *Dust Filament Characterization using Planck, IRAS and AKARI*, Simons Observatory F2F Meeting, The University of Manchester, UK, July 2025.
- Poster Presentation on *Multi-frequency Statistics of Galactic Synchrotron Emission*, Frontiers in Cosmology Conference, Raman Research Institute, Bangalore, India, Feb 2023
- Poster Presentation on *Gaussianity and Statistical Isotropy of Galactic Synchrotron at 408 MHz*, Dec 2019, B-mode from Space, Max-Planck-Institut für Astrophysik, Munich, Germany, Dec 2019
- Poster Presentation on *Gaussianity and Statistical Isotropy of Galactic Synchrotron at 408 MHz*, XIII Tonale Winter School on Cosmology, Passo del Tonale, Italy, Dec 2019
- Poster Presentation on *Gaussianity and Statistical Isotropy for Galactic Foregrounds Using Planck*, Asia Pacific Winter School and Workshop on Gravitation and Cosmology, YITP, Kyoto University, Japan, Feb 2019

SCIENTIFIC EXPERIENCE

Teaching

MAY 2024	Lecture series on Minkowski Functionals & Tensors, RRI Bangalore
DECEMBER 2023	Trainer, Hands-on Session for the Lectures on Statistical Techniques, Advanced 21-cm Cosmology School, NISER Bhubaneswar
AUGUST 2022	Teaching Assistant, AST9240 GCSN course, Institute of Theoretical Astrophysics, University of Oslo.
JUNE 2021	Trainer, Hands-on Session for Cosmology, IIA Summer School (Online)
JUNE 2021	Teaching Assistant, Numerical and Statistical Techniques Course, IIA Bangalore
JULY 2019	Trainer, Tutorial Session, Workshop on Geometrical and Topological Methods for Cosmological Data Analysis, NISER Bhubaneswar

Mentoring

Current

- Sophia Korte, Graduate Student, Texas A&M University
- Mehjabin A, Master Student, University of Calicut, Kerala, India working on her master's thesis on *CMB Cosmology*

Past

- Fahmidha K, Master Student, PSMO College, Kerala, India working on her master's thesis on *Primordial non-Gaussianity using CMB Maps*
- Travis Reed, Undergrad, Texas A& M University working on his undergrad project on *Scattering Transform Applications in Studying Galactic Thermal Dust*
- Boorith A. Y, IISc Bangalore, for the summer internship on *CMB Component Separation using ILC Techniques* (May 2024-January 2025).
- Mentored Nidharssan S, IISER Trivandrum, for his MSc thesis (July 2023 - April 2024).
- Mentored Aniket Nath, NISER Bhubaneswar, for the summer internship on the project titled *Constraining Galactic Magnetic Field Models using Synchrotron Observations* (Summer 2023).
- Mentored Masroor Bashir, IIA Bangalore, for his IIA-PhD coursework project (Summer 2023).
- Mentored Jithu Jose, Department of Physics, Cochin University of Science and Technology, for the project *Application of Euclidean Distance Transform to Gaussian Random Fields in Cosmology*, as a part of the Summer Research Fellowship by Indian Academy of Sciences (June 2020 to February 2021).
- Mentored Yogitha S.N., Department of Physics, Central University of Karnataka, on the topic 'Cosmological Parameter Estimation using Supernova Datasets' for her Summer Research Fellowship by the Indian Academy of Sciences (June to August 2019).

Schools and Workshops Attended

1. AST9240 GCSN Component Separation Course 2021, October 2021, Institute of Theoretical Astrophysics (ITA), University of Oslo, Norway
2. B-mode from Space, Dec 2019, Max-Planck-Institut für Astrophysik, Munich, Germany
3. XIII Tonale Winter School on Cosmology, Dec 2019, Passo del Tonale, Italy
4. SERB Preparatory School on Theoretical Higher Energy Physics, Oct 2019, Tezpur University, Assam, India
5. YITP Asia Pacific Winter School and Workshop on Gravitation and Cosmology, Feb 2019, Kyoto University, Japan
6. Cosmology – The Next Decade, Jan 2019, ICTS Bangalore, India

TECHNICAL SKILLS

Python, Fortran, Mathematica, $\text{\LaTeX}$, bash/shell, git, Healpix

LEADERSHIP ROLES

Current

- Website Committee Chair, Simons Observatory Collaboration
- Organizer, Mitchell Institute Weekly AstroSeminar, Texas A&M University
- Organizer, IIA Cosmology Weekly ArXiv Meet

Past

- Web Coordinator & Webinar Organizer, CMB-Bharat Consortium
- Student Coordinator, IIA Journal Club

- Organizer, IIA Cosmology arXiv meet & Journal Club
- Senior Editor, DOOT e-Magazine, IIA Bangalore

OUTREACH ACTIVITIES

Public Talks

- Talk on *Big Bang Cosmology* at Astronomy on Tap (AoT) Bryan College Station (BCS), Jan 2026
- Invited Webinar on *Cosmology using Cosmic Microwave Background (CMB) Radiation*, December 2024, Kerala Theoretical Physics Initiative (KTPI)
- Talk on *Cosmic Signals from the Big Bang and Beyond*, October 2024, Markaz Garden, Calicut
- Invited Talk on *Tale of the Cosmos*, June 2024, Caliph Life School, Calicut
- Invited Talk on *Research Trends in Astrophysics*, June 2021, WEFI Calicut, India (Online)
- Invited Nobel Prize Talk on *Physics of Black holes*, August 2021, PSMO College Tirurangadi, Kerala, India (Online)
- Three-day Lecture Series on *Big Bang Cosmology* for Undergraduates, April 2020 (Online)
- Astrophyz, Astronomy Seminar Series, October 2019, Markhinzz Bangalore, India
- Invited Talk on *Advent of Multi-messenger Astronomy in the Light of GW170817*, Jan 2018, PSMO College Tirurangadi, India

Other Activities

- Hands-on session for Cosmology Lecture Series at the University of Mysore, conducted by COSMOS-IIA Mysore, August 2023
- Poster Presentation on *Big-Bang Cosmology* at National Science Day 2020, Indian Institute of Astrophysics, Bangalore, India

REFERENCES

Prof. Kevin Huffenberger

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