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Sayan Saha

Curriculum Vitae

Research Interests

Observational and computational astrophysics with a focus on weak gravitational lensing. Particular emphasis on end-to-end image processing pipelines for weak lensing galaxy surveys — including PSF characterisation and modelling, and shear measurement systematics. Neural-network-based shape measurement techniques, galaxy cluster dynamics from multiple probes, and Bayesian inference methods for cosmology and CMB data analysis.

Current Position

Oct 2024 – Present **Postdoctoral Research Associate**, *Northeastern University, Boston, MA*
Working on the NASA balloon-borne imaging telescope SuperBIT. Leading the development of the weak-lensing shape-measurement pipeline.

Education

Aug 2019 – Sep 2024 **PhD in Physics**, *Indian Institute of Science Education and Research (IISER), Pune, India*
Thesis: *Novel Bayesian Inferences from the Cosmic Microwave Background*
Advisor: Prof. Tarun Souradeep.

2017 – 2019 **M.Sc. in Physics**, *IISER, Pune, India*

2014 – 2017 **B.Sc. in Physics**, *Ramakrishna Mission Residential College, Narendrapur (University of Calcutta), India*

Visiting Positions

Sep 2023 – Sep 2024 **Visiting Researcher**, *Raman Research Institute, Bengaluru, India*
Host: Prof. Tarun Souradeep.

Sep 2022 – Aug 2023 **Swiss Government Excellence Fellow**, *Université de Genève, Switzerland*
Host: Prof. Julien Carron.

Publications

Submitted & In Preparation

2026 **S. Saha**, M. Amit et al., *Lensing in the Blue IV: First Weak Lensing Convergence Maps from the Stratosphere*, in preparation.

2026 A. Field , **S. Saha**,et al., *ShearNet: Neural-Network-Based Shear Estimation for Balloon-Borne and Space-Based Weak Lensing Surveys*, in preparation.

2026 P. Voyer et al., *Multi-sensor fusion for fine-guidance and milliarcsecond-level attitude estimation of balloon-borne telescope*, arXiv:2607.28816 [astro-ph.IM]. SPIE Astronomical Telescopes + Instrumentation 2026.

2026 G. Cerini, **S. Saha** et al., *Lensing-Reconstructed Dark Matter–Intracluster Medium Coherence as a Probe of Cluster Dynamical State: Application to HSTFF, RELICS, and CLASH Clusters*, arXiv:2607.01389 [astro-ph.CO]. Submitted to ApJ.

2026 **S. Saha**, J. McCleary et al., *Lensing in the Blue III: Weak Lensing Shape Catalogs of 30 Merging Galaxy Clusters*, arXiv:2603.18376 [astro-ph.CO]. Submitted to ApJ.

Peer-Reviewed

2024 **S. Saha**, L. Legrand, and J. Carron, *Cluster profiles from beyond-the-QE CMB lensing mass maps*, JCAP 01 (2024) 024, arXiv:2307.11711.

2021 **S. Saha**, S. Shaikh, S. Mukherjee, T. Souradeep, and B. D. Wandelt, *Bayesian estimation of our local motion from the Planck-2018 CMB temperature map*, JCAP 10 (2021) 072, arXiv:2106.07666.

Research Experience

Postdoctoral Research Developing the end-to-end image processing and weak-lensing pipeline for SuperBIT, NASA's balloon-borne telescope. Key components include accurate PSF modelling, galaxy shape measurement, shear calibration, construction of realistic image simulations, and pipeline validation.

Doctoral Research I Studied weak gravitational lensing of the CMB by galaxy clusters at small angular scales. Implemented a Maximum-a-Posteriori (MAP) estimator for cluster mass measurement targeting CMB-S4–like experiments, extending the `clusterlens` module of LensIt (J. Carron). Developed flat-sky simulations of CMB patches lensed by galaxy cluster potentials.

Doctoral Research II Investigated signatures of statistical isotropy violation in the CMB arising from the motion of the observer's rest frame. Estimated the local-motion velocity at high significance using a Bayesian framework with Hamiltonian Monte Carlo sampling.

Master's Research Analysed high-energy cosmic-ray air-shower data using machine learning and deep learning techniques. Developed a Monte Carlo pipeline to simulate air showers for different primary species.

Experiments & Collaborations

SuperBIT Lead developer of the weak-lensing shape-measurement pipeline for the SuperBIT balloon-borne telescope.

LSST DESC Junior Member

CMB-S4 Member of the Cluster Working Group; contributing to forecasts of galaxy cluster mass detection.

CMB-Bharat Web Coordinator for the proposed Indian CMB space mission.

Awards & Fellowships

2022 – 2023 Swiss Government Excellence Scholarship (Research), ESKAS No. 2022.0316, hosted by the Université de Genève (CHF 23,540 stipend + CHF 600 travel allowance).

2023 Grant from the Société académique de Genève (SACAD, 2000 CHF) to attend *Future Science with CMB × LSS*, YITP Kyoto.

2023 Infosys Foundation Travel Award and Fellowship (50,000 INR) to attend *Future Cosmology*, IESC Cargèse.

2019 Institute PhD Fellowship, IISER Pune (MHRD).

2017 – 2019 Institute M.Sc. Fellowship, IISER Pune (MHRD).

2017 State Topper, National Graduate Physics Examination (top 1% of 774 candidates), Indian Association of Physics Teachers.

2014 – 2017 DST-INSPIRE Scholarship, Ministry of Human Resource Development, Government of India.

Talks & Presentations

Invited Talks

Apr 2026 *Mapping Dark Matter from the Stratosphere* (seminar). CCAPP Seminar, Ohio State University, Apr 21.

Apr 2026 *Inferences from the CMB & Balloons* (seminar). CMB Lunch Talk, Lawrence Berkeley National Laboratory, Apr 17.

Apr 2026 *Mapping Dark Matter from the Stratosphere* (seminar). KIPAC Tea Talk, Stanford University, Apr 14.

Apr 2026 *Mapping Dark Matter from the Stratosphere* (seminar). Dark-Sector Meeting, Jet Propulsion Laboratory, NASA, Apr 9.

Apr 2026 *Mapping Dark Matter from the Stratosphere* (seminar). Cosmology Journal Club, Caltech, Apr 7.

Contributed Talks & Posters

July 2026 *First Ever Weak-Lensing Studies From a Balloon (SuperBIT)* (Firetalk & poster). LSST DESC Collaboration Meeting, Boston University.

July 2026 *First Ever Weak-Lensing Studies From a Balloon (SuperBIT)* (Firetalk & poster). Roman workshop, Caltech/IPAC.

Jun 2025 *Weak Lensing with SuperBIT: Shape Measurement and Mass Mapping of Galaxy Clusters* (Firetalk & poster). mm Universe 2025, University of Chicago.

Jul 2024 *Novel Bayesian Inferences from the Cosmic Microwave Background* (talk). Relativistic Effects and Novel Observables in Cosmology, Université de Genève.

Nov 2023 *Exploring Cutting-Edge Statistical Methods for Parameter Inference in Present and Future CMB Surveys* (talk). Neighbourhood Cosmology Meeting, Raman Research Institute, Bengaluru.

May 2023 *Extracting Cluster Information from Small-Scale CMB* (talk). Third EuCAPT Annual Symposium, CERN, Geneva.

Apr 2023 *Dark Matter Halos under the Spotlight of CMB-Lensing* (talk). Future Cosmology, IESC Cargèse.

Apr 2023 *Dark Matter Halos under the Spotlight of CMB-Lensing* (talk & poster). Future Science with CMB × LSS, YITP Kyoto.

Jan 2023 *Inferring Our Local Motion from Small-Scale CMB* (talk). Cosmoglobe Winter Workshop, University of Oslo.

Schools & Workshops

Jan 2022 Physics of the Early Universe, International Centre for Theoretical Sciences (ICTS), Bengaluru.

Aug 2021 Data Analysis in Cosmology and Astroparticle Physics, Indian Statistical Institute, Kolkata.

Jun 2021 Summer School in Statistics for Astronomers, Penn State University.

Mar 2019 Pune–Mumbai Collider Meet, IISER Pune.

Computational Skills

Languages Python, Fortran 90, Shell scripting.

Scientific Tools GalSim, ngmix, SExtractor, PSFEx, PIFF, astropy, plancklens, CAMB, HEALPix/healpy.

Machine Learning PyTorch, JAX, TensorFlow, scikit-learn.

Statistical Methods MCMC sampling (Metropolis–Hastings, Hamiltonian Monte Carlo)

Infrastructure Git, HPC/SLURM, Linux, LaTeX.

Open-Source Software Contribution
`superbit-lensing` – Shear measurement pipeline for the SuperBIT telescope.
`SMPy` – Contributed to Convergence map reconstruction from shear measurements.
`ShearNet` – Neural-network-based galaxy shape measurement.
`CosmoHMC` – Hamiltonian Monte Carlo sampler for field-level inference.
`LensIt` – Contributed to MAP reconstruction of CMB-lensing potential.

Mentoring

2025 – Present: Mentor to Adam Field (undergraduate, Worcester Polytechnic Institute), working on neural-network-based shear estimation (ShearNet).

Jun – Jul 2026: Mentor to Karuna Tarafdar and Adam Aoua through the NSF-funded Young Scholars Program (YSP) at Northeastern University.

Jun – Jul 2025: Mentor to Leila Ohashi and Marcus Michaud through the NSF-funded Young Scholars Program (YSP) at Northeastern University.

2024 – 2025: Co-mentor to Maya Amit (Northeastern Co-op program); currently a graduate student at NYU.

Teaching

Fall 2019: Teaching Assistant, *Electricity & Magnetism* (PHY201), IISER Pune.

Spring 2020: Teaching Assistant, *Nuclear & Particle Physics* (PHY422), IISER Pune.

Fall 2020: Teaching Assistant, *Group Theory in Physics* (PHY356), IISER Pune.

Outreach

IISF 2024: Represented RRI at the India International Science Festival; team received the Best Conceptual Pavilion Award.

NCSC 2023: Served as a judge for the National Children's Science Congress 2023 (Regional level) in Bengaluru.

RRI Schools: Delivered a talk as a part of the outreach program for school children organised by Raman Research Institute (RRI), Talk - **The Universe in your pocket** [slides].

Service

CMB-Bharat: One of the lead organiser of the Monthly Cosmology Seminar Series for CMB-Bharat, an Indian cosmology consortium (YouTube).

Journal Clubs: Organised the Astrophysics, Cosmology & Particle Physics Journal Club at IISER Pune (2019–2020). Regular participant in the Cosmology Journal Club (Université de Genève) and Very Sirius Meeting (RRI).

Additional Information

Languages: English (fluent), Bengali (native), Hindi (fluent).

References

Postdoc advisor: Prof Jacqueline McCleary, Northeastern University, Boston, USA
Email: j.mccleary@northeastern.edu

PhD Supervisor: Prof Tarun Souradeep, Raman Research Institute, Bengaluru, India,
Email: tarun@rri.res.in

Collaborator: William C. Jones, Princeton University, New Jersey, USA, Email: wcjones@princeton.edu

Collaborator: Prof Julien Carron, University of Geneva, Switzerland, Email: julien.carron@unige.ch

Collaborator: Prof Benjamin D. Wandelt, Institut d'Astrophysique de Paris, France, Email: bwandelt@iap.fr