S. Maitrey

Curriculum Vitae

Research Interests

Planet formation, protoplanetary disk modeling, astrochemistry.

Employment

2025 – Present **Graduate Student Researcher**, *The Kavli Institute for Astronomy and Astrophysics at Peking University*, Beijing, China.
Supervisor: Prof. Ruobing Dong

2024 – 2026 **Project Fellow**, *Exoplanets and Planetary Formation Group, School of Earth and Planetary Sciences, National Institute of Science Education and Research (NISER)*, Bhubaneswar.
Supervisor: Dr. Liton Majumdar

Education

2026 – 2030 **Doctor of Philosophy (Astrophysics)**, *Department of Astrophysics, School of Physics, Peking University*, Beijing, China.
Supervisor: Prof. Ruobing Dong

2019 – 2024 **Integrated Master of Science (Physics)**, *School of Physical Sciences, National Institute of Science Education and Research (NISER)*, Bhubaneswar.
Thesis title: *Tracing the evolution of gas and dust at planetary formation scales using the Atacama Large Millimeter/submillimeter Array (ALMA).*
Supervisor: Dr. Liton Majumdar

Publications

Lead Author Publications

2025 **Maitrey, S.**, Majumdar, L., Manilal, V., Srivastava, B., Rayalacheruvu, P., Willacy, K., and Herbst, E. Role of diffusive and nondiffusive grain-surface processes in cold cores: Insights from the PEGASIS three-phase astrochemical model. *Astronomy & Astrophysics (A&A)* 699, A332 (July 2025), A332. DOI: 10.1051/0004-6361/202554717. arXiv: 2504.18138 [astro-ph.GA].

Co-author Publications

2026 Kashyap, P., Majumdar, L., Bergin, E. A., Blake, G. A., Willacy, K., Guilloteau, S., Dutrey, A., Liu, S.-Y., Henning, T., Goldsmith, P. F., Lis, D. C., **Maitrey, S.**, Turner, N., Sahai, R., Lee, C.-F., and Saito, M. Unveiling the Chemical Complexity and C/O Ratio of the HD 163296 Protoplanetary Disk: Constraints from Multiline ALMA Observations of Organics, Nitriles, and Sulfur-bearing and Deuterated Molecules.

The Astrophysical Journal Supplement Series (ApJS) 282.2, 47 (Feb. 2026), p. 47. DOI: 10.3847/1538-4365/ae278e. arXiv: 2511.10882 [astro-ph.EP].

2025 Rayalacheruvu, P., Majumdar, L., Rocha, W. R. M., Ressler, M. E., Giri, P. R., **Maitrey, S.**, Willacy, K., Lis, D. C., Chen, Y., and Klaassen, P. D. Expanding the Ice Inventory of NGC 1333 IRAS 2A with INDRA Using JWST Observations: Tracing Organic Refractories and Beyond. *The Astrophysical Journal Supplement Series (ApJS)* 281.2, 51 (Dec. 2025), p. 51. DOI: 10.3847/1538-4365/ae112f. arXiv: 2506.15358 [astro-ph.GA].

Projects

2025 – Present **Studying planet-disk interactions using hydrodynamics models**.
Supervisor: Prof. Ruobing Dong (The Kavli Institute for Astronomy and Astrophysics, Peking University, Beijing, China.)

2023 – Present **Constraining the disk gas mass through well-established chemical tracers to constrain giant planet formation**.
Development of an exhaustive radiative transfer and self-consistent gas-grain thermochemical code to study planet-forming regions and commenting on material available for the genesis of giant planets in later stages of planet formation.
Supervisor: Dr. Liton Majumdar (School of Earth and Planetary Sciences, NISER).

2025 **Exploring effects of cosmic-ray ionization in protoplanetary disks**.
Implemented various prescriptions to model cosmic-ray ionization attenuation for the disk HD163296 to fit ALMA observations and explored how different modes of ionization (X-ray, short-lived radionuclides, Lyman-Alpha and cosmic-rays) can influence the disk chemistry. This work is currently under preparation.
Supervisor: Dr. Liton Majumdar (School of Earth and Planetary Sciences, NISER).

2024 **Development of a novel pipeline to explore and constrain ice inventory from JWST observations**.
Planned and designed the initial stages of the algorithm to constrain ice column densities from JWST observational data. This work is currently under review at *The Astrophysical Journal Supplement Series (ApJS)*.
Supervisor: Dr. Liton Majumdar (School of Earth and Planetary Sciences, NISER).

2022 – 2024 **Development of a three-phase gas-grain astrochemical code with state-of-the-art chemistry.**.
Lead developer of a comprehensive three-phase gas-grain astrochemical model with isotope and spin-state chemistry designed to study chemical evolution in planet-forming regions, from molecular clouds and protostars to protoplanetary disks. This work has been accepted at Astronomy & Astrophysics (A&A).
Supervisor: Dr. Liton Majumdar (School of Earth and Planetary Sciences, NISER).

2024 **Development of an easy-to-use Python wrapper to ODEPACK solvers.**.
Developed a Python wrapper to the `DLSODE` family of ordinary differential equation solvers for stiff systems and problems involving sparse Jacobians from the Fortran library ODEPACK.

2023 **Modeling the interior evolution of rocky exoplanets using Machine Learning.**.
Built a model which can predict the evolution of terrestrial exoplanet interiors using recurrent neural networks (RNN) from the `scikit-learn` library, by using outputs from the `VPLANET` software library as training data.
Supervisors: Dr. Subhankar Mishra (School of Computer Sciences, NISER) and Dr. Liton Majumdar (School of Earth and Planetary Sciences, NISER).

2022 **Probing the circumgalactic medium in cosmic voids through stacking of void galaxies.**.
Construction of a filtering algorithm to remove the wall galaxies from cosmic voids to increase the signal-to-noise ratio in the void galaxy stacking techniques.
Supervisor: Dr. Tuhin Ghosh (School of Physical Sciences, NISER)

2021 **Exploring algorithms for robust ODE solvers through adaptive step-size Runge-Kutta methods.**.
Supervisor: Dr. Subhasish Basak (School of Physical Sciences, NISER, Bhubaneshwar)

2020 – 2022 **Studying the meridional circulation in Sun**.
through finite difference methods for ordinary and partial differential equations.
Supervisor: Dr. Bidya Binay Karak (Department of Physics, IIT-BHU)

2020 **Exploring the bounding interval hierarchy space-partitioning data structure as a ray tracing technique.**.
Supervisor: Dr. Subhankar Mishra (School of Computer Sciences, NISER)

Miscellaneous Experience

Conferences and Workshops

2022 **Selected** for the summer school through the Summer Programme organised by the Indian Institute of Astrophysics (IIA), Bangalore

2023 Attended the **Strange New Worlds: The Exploration of Exoplanets** conference on exoplanetary science at IISER Pune during August 17-19, 2023 at Pune.

2019 Attended RAD@Home Radio Astronomy Workshop at IISER Berhampur, India.

Talks and Posters

2023 **Presented and Won** the $4^{\mathbf{th}}$ **best** poster award for a contributed poster at the **Strange New Worlds: The Exploration of Exoplanets** conference on exoplanetary science at IISER Pune during August 17-19, 2023.

Awards and Achievements

2019 **DISHA (DAE Incentive Scheme for Holistic Science Education and Augmentation)** – 5-year scholarship for undergraduate studies, by Department of Atomic Energy (DAE), Government of India.

2018 **Qualified** for *Technothlon Mains*, organized by IIT Guwahati.

2017 **Recipient** of the **National Talent Search Examination (NTSE) Scholarship** organized by the National Council of Educational Research and Training (NCERT), New Delhi.

2016 **Qualified** for the Indian National Mathematical Olympiad (INMO), conducted for the selection for the International Mathematical Olympiad by the Homi Bhabha Centre for Science Education (HBCSE) and Tata Institute of Fundamental Research (TIFR).

Extra-curricular

2019 – 2024 **As part of the NISER Astronomy Club**:

- Contributed to various astrophotography sessions, especially smartphone astrophotography.
- Conducted online astronomy quizzes through remote interactions.
- Served as one of the principal content editors for the NISER Astronomy Club's biannual magazine ***Kshitij***.
- Served as one of the content writers for the monthly newsletter published by the NISER Astronomy Club.

2021 Participated and **won $2^{\mathbf{nd}}$** prize at the Intra-NISER Table Tennis tournament.

2019 Tutored senior secondary school students of JNV Dhenkanal as a part of AVANTI mentorship program.

2019 **Won the first prize** in the team category, *NISER Quizone Club*.

2017 Notable representation of my school at the CBSE Science Exhibition, for building a "*A Working model of energy efficient highways*", CBSE.

2015-2018 Participated in various high school level quizzes organized by CBSE like the CBSE Cultural Heritage Quizzes over my school tenure.

Skills

Languages Strong reading, writing and speaking competencies for English (**TOEFL Score 108 / 120**) and Hindi.

Programming Python, Fortran, Rust, C, Julia and LaTeX.

Codes/Models `rac-2d` (a thermochemical model for protoplanetary disks), `RADMC-3D` (radiative transfer code), `athena++` (a grid-based code for astrophysical hydrodynamical and magnethydrodynamical simulations), `rebound` (an N-body code to simulate planetary system dynamics), `NAUTILUS` (gas-grain astrochemical code), `Optool` (Tool to create opacities for astrophysical dust), `RADEX` (program to perfrom non-LTE line transfer through escape probability formulation), `RADlite` (a fast 2D/3D raytracer for infrared lines), `LIME` (Line Modeling Engine, a 3-D radiative transfer code for modelling far-IR and sub-mm observations), Meudon PDR (code to study physics and chemistry in diffuse clouds), `healpy`. Contributed to `astropy/astroquery`.

References

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