

Anuroop Dasgupta

PhD Scholar in Astrophysics

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Summary

Doctoral candidate in Astrophysics specializing in planet formation and the evolution of protoplanetary disks, with a strong background in multi-wavelength observations, high-resolution imaging, and interferometry. My work integrates data from ALMA, VLT/ERIS, VLTI/GRAVITY, and CHARA to investigate the physical and structural properties of disks across evolutionary stages. I develop and implement instrument-adaptable data reduction pipelines and apply advanced statistical techniques, including Bayesian modeling, to extract and interpret key signatures of disk dynamics, fragmentation, and early planet formation. My research spans from large-scale disk surveys to sub-au scale studies of inner disk regions, contributing to a comprehensive understanding of planetary system assembly.

Education

PhD in Astrophysics

2024 (March)–Present

Universidad Diego Portales, Santiago, Chile

Research on the structure and evolution of protoplanetary systems from infrared and millimeter observations.

Supervisor: Dr. Lucas Cieza

ESO Studentship (2025–2027), European Southern Observatory, Santiago, Chile — working under the supervision of Dr. Aaron Labdon on high-angular-resolution interferometric studies of young stellar objects.

M.Sc. in Physics

2021–2023 (September)

Presidency University, Kolkata, India

Specialized in astrophysics and cosmology.

B.Sc. in Physics (Hons.)

2018–2021 (September)

Presidency University, Kolkata, India

Focused on foundational concepts in physics and astrophysics.

Research Interests

My research is broadly focused on understanding the formation and early evolution of planetary systems through the study of protoplanetary disks. I specialize in combining multi-wavelength observations and high-resolution techniques to explore the physical, chemical, and structural properties of disks at various stages of evolution.

A central aspect of my work involves analyzing the population-level characteristics of protoplanetary disks to constrain the processes that govern their evolution and dispersal. In the ODISEA survey, I investigated the size distributions of disks in the Ophiuchus star-forming region using ALMA Band 8, focusing on the effects of stellar multiplicity and evolutionary stage on disk truncation and morphology.

In parallel, I am actively involved in high-contrast imaging studies to identify and characterize young substellar companions and their associated circumstellar structures. My work with ERIS/VLT led to the discovery of a new faint companion candidate in the FU Ori-type system V960 Mon, supported by a dedicated pipeline I developed for optimal PSF subtraction and photometric extraction in the L' band.

I am currently expanding into the inner disk regime using near-infrared interferometry with VLTI/GRAVITY and CHARA/MIRCX-MYSTIC. This work focuses on resolving sub-au-scale disk structures around Her-

big stars to search for signatures of ongoing planet formation, binarity, and gas accretion processes. These observations are coupled with spectroscopic diagnostics (e.g., CO, Br γ) and mid-infrared follow-up (e.g., VISIR, X-Shooter) to build a comprehensive picture of the inner disk environment.

Recently, I have developed a strong interest in understanding the formation and distribution of **crystalline silicates** in outbursting systems such as FUors. These episodic accretion events can heat disk surfaces to temperatures sufficient for silicate crystallization, offering a unique window into dust processing and mineralogy during early stages of planet formation. My current work combines mid-infrared spectroscopy (e.g., with VISIR) and radiative transfer modeling to identify and interpret the 10 μ m silicate feature in FUor disks, probing the thermal history and dynamical environment during and after outbursts.

While my primary focus is now fully centered on the planet formation problem, my earlier research included studies on radial metallicity gradients in dwarf galaxies using MaNGA data, and theoretical modeling of high-energy shocks and the thermal history of the intergalactic medium. This diverse background has equipped me with a robust foundation in both data-driven and theoretical approaches, enhancing my ability to tackle complex, multi-scale problems in disk evolution and planet formation.

Projects and Research Experience

Crystalline Silicate Analysis in FUor Disks (VISIR)

2025–Present

ESO Chile, Universidad Diego Portales

Conducting a detailed mid-infrared spectral analysis of FU Orionis-type objects, using archival VLT/VISIR data. The project focuses on identifying and characterizing crystalline silicate emission features through continuum subtraction, Gaussian profile fitting, and comparison with laboratory spectra. Quantitative estimates of the crystalline fraction provide insights into the thermal history, grain processing, and possible outburst-driven radial mixing in these disks. This work contributes to understanding planet formation environments in highly dynamic accretion systems. – (*Manuscript in preparation*)

Inner Disk Structures Around Herbig Stars: A Statistical Approach

2025–Present

ESO Chile, Universidad Diego Portales, CHARA/MIRCX–VLTI/GRAVITY collaboration

Analyzing high-resolution interferometric data of Herbig stars using GRAVITY and MIRCX-MYSTIC. The project aims to investigate inner disk morphology, binarity, and planet formation indicators such as Br γ and CO emission. Initial phase includes photometric calibration using GRAVITY acquisition camera in dual-field mode. This multi-institute collaboration involves leading experts in high-angular resolution techniques. – (*In collaboration with A. Labdon*)

ODISEA Survey – Protoplanetary Disk Analysis

2024–2025

Universidad Diego Portales, Santiago, Chile

Conducted a detailed investigation into the size distribution of protoplanetary disks within the Ophiuchus molecular cloud, utilizing ALMA Band 8 observations. The project focused on understanding the effects of binary systems on the physical properties and evolutionary paths of these disks, contributing to a broader understanding of disk dynamics and planet formation processes. – (*Published in ApJL, doi:10.3847/2041-8213/adb03*)

ERIS High-Contrast Imaging and Pipeline Development for V960 Mon

2024–2025

Universidad Diego Portales, Santiago, Chile

Led the development of a dedicated data reduction pipeline for ERIS (Enhanced Resolution Imager and Spectrograph) to enable high-contrast L' -band imaging of young eruptive stars. This project focused on the FUor object V960 Mon, aiming to identify substellar companions and characterize the immediate circumstellar environment. Our observations led to the detection of a previously unknown, faint point-like source southeast of the central star, suggesting a candidate substellar companion. The pipeline was essential in achieving optimal PSF subtraction and astrometric accuracy. This discovery is now being followed up to assess its co-moving nature and potential formation scenario via gravitational instability. – (*Published in ApJL, doi:10.3847/2041-8213/ade996*)

Bayesian Analysis of 51 Pegasi b

2024 (March–August)

Universidad Diego Portales, Santiago, Chile

Utilized the Emperor code to perform a comprehensive Bayesian analysis of the exoplanet 51 Pegasi b. This involved refining the orbital parameters through the analysis of radial velocity data, incorporating various noise models and priors to improve the precision of mass and orbital characteristics. The work aims to advance the understanding of exoplanetary dynamics and inform future observational strategies.

Radial Gradient Analysis in Dwarf Galaxies

2022–2023

Presidency University, Kolkata, India

Investigated the metallicity gradients in dwarf galaxies using advanced stellar population synthesis models applied to MaNGA (Mapping Nearby Galaxies at Apache Point Observatory) data. This research aimed to elucidate the correlation between stellar and gas-phase metallicity gradients, providing insights into the processes influencing star formation and the chemical evolution of dwarf galaxies. – (*Publication in prep*)

Particle Acceleration by Astrophysical Shocks

2022

IISER Bhopal, India

Analyzed the mechanisms of particle acceleration in high-energy astrophysical shock waves. The research focused on the fluid dynamics involved in shock propagation and its effects on cosmic ray production, contributing to a deeper understanding of energetic phenomena in astrophysical environments.

Thermal Evolution of the Intergalactic Medium after Re-ionization: Effect of Helium Reionization

2020–2021

Presidency University, Kolkata, India

Explored the thermal history of the intergalactic medium (IGM) post-reionization, specifically examining the impact of Helium II reionization on temperature fluctuations. This project established a correlation between observational temperature data and theoretical predictions by introducing additional heating terms to resolve discrepancies linked to adiabatic expansion. The findings contribute to the understanding of the thermal state of the IGM and its implications for cosmic structure formation.

1st Author Publications

- **Dasgupta, A.**, Cieza, L., Labdon, A., et al. *Crystalline Silicates in FUor Disks: Evidence from VISIR Mid-Infrared Spectroscopy*, (In prep)
- **Dasgupta, A.**, Labdon, A., Cieza, L. et al. *Inner Disk Structures Around Herbig Stars: A Statistical Approach*, (In prep)
- **Dasgupta, A.**, Cieza, L. A., Bhowmik, T., et al. *Size Distributions of Protoplanetary Disks in the Ophiuchus Molecular Cloud*, ApJL, 2024, [doi:10.3847/2041-8213/adb03c](https://doi.org/10.3847/2041-8213/adb03c)
- **Dasgupta, A.**, Weber, P., Maio, F. et al. *Characterizing a New Companion Candidate Near V960 Mon: A Closer Look at a Potential Discovery*, ApJL, 2024, [doi:10.3847/2041-8213/ade996](https://doi.org/10.3847/2041-8213/ade996)
- **Dasgupta, A.**, Roy, N., Chatterjee, R., & Samui, S. *Metallicity Gradients in MaNGA Observed Dwarf Galaxies: Assessing the Influence of the External Environment*, 2024 (To be submitted).

Co-Author Publications

- Orcajo, S., Cieza, L. A., Guilera, O. M., Pérez, S., Rannou, F. R., González-Ruilova, C., Batalla-Falcon, G., Bhowmik, T., Chavan, P., Cassasus, S., **Dasgupta, A.**, et al. *The Ophiuchus Disk Survey Employing ALMA (ODISEA): A Unified Evolutionary Sequence of Planet-driven Substructures Explaining the Diversity of Disk Morphologies*, ApJ Letters, 2025, [doi:10.3847/2041-8213/adbd38](https://doi.org/10.3847/2041-8213/adbd38)

Press & Media Coverage

ESO Press Release

July 2025

European Southern Observatory

A dedicated press release was issued by ESO highlighting our ERIS/VLT discovery of a new faint companion candidate in the young eruptive system V960 Mon. The work emphasized the use of high-contrast imaging and adaptive optics to explore early stages of planet formation.

<https://www.eso.org/public/news/eso2513/>

Accepted Telescope Proposals

- **2024, ESO Period 115:** PI, VSIR Observations of FUOri disks: formation and distribution of crystalline material in outbursting disks
- **2024, ESO Period 115:** CoI, Searching for PDS 70 analogues
- **2024, ESO Period 114:** PI, Looking for satellites/circumplanetary disks around DI companions using star-hopping - survey continue
- **2024, Period 114:** CoI, The first survey of (sub)-stellar companions around protostars (part II)

Observatory Projects

Paranal Observatory, ESO

July-2025

Chile

Site visit as part of ESO Studentship activities. Exposure to VLTI operations and ongoing GRAVITY instrument calibration work.

Swope Telescope, Las Campanas Observatory

Oct-2024

Chile

Visited to conduct observations for a multi-filter imaging project aimed at understanding the connection between metallicity and galaxy dynamics.

Skills

- **Programming Languages and Software:** Python, Fortran, Mathematica, L^AT_EX
- **Operating Systems:** Mac, Windows, Linux
- **Analytical Skills:** Numerical differentiation and integration in all methods, ODE, transcendental and algebraic equations, Fourier series and Fourier transforms, Monte Carlo integration, random numbers, etc.
- **Packages used in Astronomy:** CASA, Pandas, Fermitools, IRAF, Astropy, DS9 (SAOImage DS9), TOPCAT, Specutils, etc.
- **Experimental Setups:** Spectrometer, Thermocouple, Platinum Resistance Thermometer, electrical and electronic circuits, etc.

Academic Achievements and Awards

- Selected for the ESO Studentship Programme (2025–2027), European Southern Observatory, Chile.
- Recipient of “Outstanding Paper” presentation award in the the 31st West Bengal State Science & Technology Congress, India (*State Level*) 2024
- Recipient of “Outstanding Paper” presentation award in the the 31st West Bengal State Science & Technology Congress, India, (*Regional Level*) 2024

- Recipient of Paramesh Chandra Bhattacharya Memorial Award, for delivering the best seminar in Physics, Presidency University, Kolkata, January 2023
- Ranked 3rd in MSc third and fourth-semester exams at Presidency University
- Selected for the prestigious MSc program in Physics at Savitribai Phule Pune University, India, through the entrance exam (ranked 14 among around a thousand examinees) – **Did not join**.
- Top 1% in Class 12 and Class 10 State Board Exams (West Bengal), 2018
- Ranked among the **top 1%** in Class 10 State Board exam (West Bengal) and was selected to attend a 3-day workshop, “Young Scientists Meet” at Inspire Internship Science Camp, organized by iLEAD, Kolkata, and sponsored by the Department of Science & Technology, Govt. of India, December 2016.

Conferences and Workshops

SOCHIAS XIX Meeting *Nov-2024*
 Universidad de Tarapacá, Arica, Chile
 Talk on: What is the size distribution of disks in nearby starforming region?

Unveiling the Origin of Brown Dwarfs *Nov-2024*
 European Southern Observatory, Santiago, Chile
 Talk on: First direct observations evidence of Gravitational Instability?

Born in Fire Workshop *Sep-2024*
 Santiago, Chile
 Participated in Panel discussions on eruptive stars and planet formation.

Summer School at Indian Institute of Astrophysics *2022*
 Bangalore, India
 Gained practical experience in astrophysics and cosmology.

Summer Internship at IISER Bhopal *2022*
 Worked as a summer intern fellow on high energy astronomy specially in fluid dynamics and its applications in astrophysics

Presidency University *2019*
 Kolkata, India
 Participated in ‘Presision’, an undergraduate physics symposium organized by students of the Department of Physics, Presidency University. Presented and demonstrated an experiment on Linear Air Track.

Indian Astrobiology Research Centre *2019*
 Kolkata, India
 Attended International Capsule Workshop on Astrobiology

Colloquia and Invited Seminars

Indian Institute of Bombay *September 2025*
 Mumbai, India
 Colloquium on: *Planet Formation accorss different wavelenghts*

Indian Institute of Science Education and Research *October 2025*
 Kolkata, India
 Colloquium on: *Planet Formation accorss different wavelenghts*

Tata Institute of Fundamental Research (TIFR)

Mumbai, India

Colloquium on: *Size Distributions of Protoplanetary Disks in Nearby Starforming Regions*

December 2024

National Centre for Radio Astrophysics (NCRA)

Pune, India

Colloquium on: *Size Distributions of Protoplanetary Disks in Nearby Starforming Regions*

December 2024

References

- **Dr. Lucas Cieza** – Professor, Instituto de Estudios Astrofísicos, Universidad Diego Portales, lucas.cieza@mail.udp.cl
- **Dr. Aaron Labdon** – Staff Astronomer, European Southern Observatory, Santiago, Chile, Aaron.Labdon@eso.org
- **Dr. Alice Zurlo** – Assistant Professor, Instituto de Estudios Astrofísicos, Universidad Diego Portales, alice.zurlo@mail.udp.cl
- **Dr. Ritaban Chatterjee** – Assistant Professor, School of Astrophysics, Presidency University, ritaban.astro@presiuniv.ac.in