Curriculum Vitae
Dr. SOMNATH DUTTA, PhD

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Somnath's Orcid Id — Personal Website — Linkedin

PERSONAL DETAILS

Permanent Address: Saluni, Jhantipahari, Chhatna, Bankura, West Bengal, India – 722137
Date of Birth: 30 April 1988
Languages: English, Bengali, Hindi

EDUCATION & BACKGROUND

Indian Centre for Space Physics, Kolkata, India — Aug, 2026 – Present
Visiting Faculty

Tata Institute of Fundamental Research, Mumbai, India — Apr, 2026 – June, 2026
Visiting Researcher

Academia Sinica Institute of Astronomy and Astrophysics, Taiwan — Jul 2023 – Feb, 2026
Support Scientist

Academia Sinica Institute of Astronomy and Astrophysics, Taiwan — Apr 2019 – Jun 2023
Post doctoral fellow

Indian Institute of Science Education and Research, Tirupati, India — Nov 2018 – Mar 2019
Post doctoral fellow

S N Bose National Centre for Basic Sciences, Kolkata, India — Aug 2017 – Jul 2018
Extended Senior Research fellow

S N Bose National Centre for Basic Sciences, Kolkata, India — Aug 2012 – July 2017
PhD Student
(Thesis title: Multiwavelength Studies of Galactic HII Regions, Supervisor: Dr. Soumen Mondal; defence in October, 2018)

The University of Burdwan, Burdwan, West Bengal, India — 2009 – 2011
Master in Physics (1st Class)

The University of Burdwan, Burdwan, West Bengal, India — 2005 – 2008
Bachelor in Physics (1st Class)

LANGUAGE & SKILLS

- **Computer Languages:** Python, C, Fortran
- **Machine Learning and Data Science**
- **Developed Software:** peakmoment; Tutorial on Basic Python and Machine Learning: python-tutorial; AI_ML-tutorial
- **Softwares:** CASA, CARTA, IRAF, TOPCAT, DS9
- **Other Languages:** HTML, Bash Scripting

RESEARCH INTERESTS

Star-Planet Formation, Outflows, Jets, Planet Formation, Star cluster formation, Variable stars, astronomical Instrumentation.

KEY PROJECTS

- **Infrared Survey of Protostellar Objects:** Ongoing survey (Spectroscopic and Photometric) of a statistically significant large sample of protostars to achieve accretion to ejection correlation using 3.6m Devasthal Telescope, India.
- **Millimeter/submillimeter (220-360 GHz):** An Atacama Large Millimeter/submillimeter Array (ALMA) project focused on studying dense core, young protostellar jets, and planet formation.
- **Multiwavelength (submillimeter, Radio, Infrared):** Aims to study star formation and the time-series variability of protostars.
- **The BURSTT project (400-800 MHz):** An instrumentation project aimed at detecting and localizing fast radio bursts.

INSTRUMENTATION EXPERIENCE

I have hands-on experience in the extensive observations, development, deployment, and scientific utilization of multi-wavelength astronomical instrumentation:

Infrared/Optical Observations

- Conducted photometric and spectroscopic observations using instruments on Indian national facilities (2m Himalayan Chandra Telescope, 3.6m and 1.3m Devasthal Telescope, and 1.2m Mt. Abu Infrared Telescopes).
- Skilled in observing planning, remote and on-site operation of optical CCDs and NIR detectors, and custom data reduction pipelines using IRAF and Python-based tools.

Millimeter/Submillimeter Observations

- Extensive use of ALMA (Atacama Large Millimeter/submillimeter Array), JCMT (James Clerk Maxwell Telescope), SMA (Submillimeter Array) instruments for high-resolution imaging and spectroscopy in the continuum and molecular lines.
- Proficient in CASA, CARTA for calibration, analysis, and imaging.

JWST/MIRI and ALMA Data Handling

- Developing custom Python pipelines for processing JWST MIRI (James Webb Space Telescope – Mid-Infrared Instrument) spectral cubes, including continuum fitting, moment map generation, and line identification.
- Experience in handling large survey datasets and integrating ALMA-JWST products for multi-scale physical analysis.

Radio (low-frequency and submillimeter) Instrumentation

- **Bustling Universe Radio Survey Telescope in Taiwan (BURSTT):** Led the installation and commissioning of one outrigger station of BURSTT for Fast Radio Burst (FRB) localization using Very Long Baseline Interferometry (VLBI).
- **Implementing a VLBI-Based Localization Algorithm for Fast Radio Bursts:** Code Design and Performance.
- Served for 6 semesters on the Time Allocation Committee (TAC) and Technical Association of the JCMT submillimeter telescope.

OBSERVATIONAL EXPERTISE / PROPOSALS

Experienced in multi-wavelength observations through participation in 18+ observing proposals as PI, Co-PI, Co-I, and Delegee across leading international and Indian national observatories: Details Link to all proposals: https://somastro.github.io/proposal.html

Telescope	Proposal Summary
DOT – 3.6-m Devasthal Optical Telescope (ARIES, India)	2 proposal: Science Project PI
HCT – 2.0-m Himalayan Chandra Telescope (IIA, India)	Multiple observing runs: 20+ nights; PI
DFOT – 1.3-m Devasthal Fast Optical Telescope (ARIES, India)	Multiple proposals: PI
ST – 1.04-m Sampurnanand Telescope (ARIES, India)	Multiple proposals: PI
Mt. Abu IR Telescope – 1.2-m IR Telescope (PRL, India)	Multiple proposals: Co-PI
ALMA – Atacama Large Millimeter/submillimeter Array	8 proposals: 1 PI, 6 Co-I, 1 Delegatee
JCMT – James Clerk Maxwell Telescope	6 proposals: 1 PI, 5 Co-PI
SMA – Submillimeter Array	2 proposals: 1 PI, 1 Co-PI

SELECTED TALKS AT CONFERENCES, SEMINARS

- @Seminar on "Unveiling the Nature of Protostellar Jets and Outflows" at Tata Institute of Fundamental Research (TIFR), Mumbai, India, June 2026
- @Talk on "Jets from Low-mass Protostars" at "Lunch Talk" Academia Sinica Institute of Astronomy and Astrophysics, Taipei, Taiwan, January 2026
- @Talk in "Fast Radio Bursts in the Local Universe", National Cheng Kung University (NCKU), Tainan, Taiwan, 2025
- @Talk in "Localization of fast radio bursts in Taiwan 2024", National Ilan University, Yilan City, Yilan County, Taiwan
- @Talk presentation in "XXXV Meeting of Astronomical Society of India" Bangalore, India, 31 Jan -04 February, 2024.
- @Talk in "Star Formation Studies in India" from Jan 8-11, 2024 at SNBNCBS, Kolkata, India.
- @Talk in the East-Asian ALMA Science Workshop 2023, New Taipei City, Taiwan, February 14-17, 2023
- @Talk in the institute Seminar at National Centre for Radio Astrophysics (NCRA)-Tata Institute of Fundamental Research (NCRA-TIFR), Pune, India, September 30, 2022.
- @Talk in the institute seminar of Physical Research Laboratory, Ahmedabad, India, February 20-26, 2022
- @Talk in the "Origin Workshop- ISM, Star and Cluster Formation", January, 10-12, 2022, Salt Lake City, Utah, USA (Online)
- @Talk in the "East-Asian ALMA Science Workshop 2022", Online Meeting, January 18-21, 2022
- @Talk in the "239th American Astronomical Society Meeting", January, 2022, selected for Talk, (the meeting was cancelled due to covid-19).
- @Talk in the "JCMT-Transient program 2021", KAVLI, China, July 21-23, 2021 (Online)
- @Talk in the "East-Asian ALMA Science Workshop 2021", KASI, Daejeon, Korea, February 17-19, 2021
- @Talk in the "2020 ASROC Annual Meeting" in ASIAA, Taipei city, Taiwan, September 3-4, 2020

- @Poster in the "Science with the Submillimeter Array: Present and Future", ASIAA, Taipei city, Taiwan, November 4-5, 2019
- @Talk in the International conference "INTERNATIONAL ASTRONOMY CONFERENCE Stars: from collapse to collapse" in Russia , Nizhnij Arkhyz, Karachai-Cherkessian Republic, Special Astrophysical Observatory, 2016 October 3 - 7.
- @Talk Presentation of a paper on my research work in "Star and Planet Formation: Insights and Intricacies", IIST, Thiruvananthapuram, 5 - 7 December 2016
- @attended Workshop on "Tools and trends in high resolution optical spectroscopy", Kashmir University, Srinagar, 9th may, 2016

ACADEMIC SOCIETY AND CONTRIBUTIONS

- Member of "JCMT Time Allocation Committee (TAC)", 2021 – 2024 (Six Semester)
- Life member of Astronomical Society Of India: Membership number L2444
- Thesis defense committee: Two Master students' Thesis (2021, 2023)
- Journal Reviewer: Nature Astronomy, The Astrophysical Journal Supplement Series (ApJS), The Astrophysical Journal Letters (ApJL), Monthly Notice of Royal Astronomical Society (MNRAS), Astronomy & Astrophysics (A&A)
- Telescope Proposal Reviewer: ALMA observations proposals, JCMT observations proposals (JCMT TAC member), 3.6 m DOT (India)

ACHIEVEMENTS AND AWARDS

- @ Employment as Support scientist for data processing and instrument calibration, 2023 to 2026
- @ Post Doc Fellowship at ASIAA, Taiwan, April 2019 – June, 2023
- @ Post Doc Fellowship at IISER-Tirupati, India, 2018-2019
- @ Awarded eSRF, SRF and JRF Fellowships from DST (India) at S. N. Bose Centre, Kolkata 2017-2018

TEACHING EXPERIENCE

- **2023 to 2026 (2.5 years):** at Academia Sinica Institute of Astronomy and Astrophysics, Taipei, Taiwan
  Courses: Application of Machine Learning to Astrophysics (Voluntary teaching to young researchers)
- **2021 and 2022 (2 years):** at Academia Sinica Institute of Astronomy and Astrophysics, Taipei, Taiwan
  Courses: Supervised two summer project students in 2021 and 2022 in my own star-planet formation research projects. I was principal supervisor in both the projects.
  Project I (2021): Exploring the Mass Accretion Process in Low-mass Protostellar Systems (supervisors: Somnath Dutta, Chin-Fei Lee)
  Project II (2022): Formation of star cluster in the filamentary structure (supervisors: Somnath Dutta, Chin-Fei Lee)
- **2018-2019 (4 Months):** at Indian Institute of Science Education and Research (IISER)-Tirupati, India
  Courses: Laboratory for BS students (Official Teaching duty as part of Postdoc contract)
- **2017 (August 1-3):** Invited for teaching astronomical data analysis at Ionospheric and Earthquake Research Centre (IERC), under Indian Centre for Space Physics (ICSP), Sitapur, Midnapur, West Bengal, India,

- **2011-2012:** Worked as guest lecturer at Department of Physics at Bidhan Chandra College Asansol, West Bengal, India.
  Courses taught: Heat & Thermodynamics; Wave & Optics; Laboratory

OTHER POSITIONS HELD

- Guest lecturer at Department of Physics at Bidhan Chandra College Asansol, West Bengal, India 2011-2012.
- Visiting scholar, November, 2017 to January, 2018 at Graduate Institute of Astronomy, National Central University, Taiwan.

PUBLICATIONS

Ongoing: "Unveiling the Shock-Excited Molecular Environment in the Orion Protostars: A infrared spectroscopic survey of protostar", by Dutta Somnath et al. 2026, to be submitted.

Total 44 refereed papers in International Journals: 12 first authors (3 single author) + 32 Coauthors
Link to first author paper in NASA-ADS: https://ui.adsabs.harvard.edu/user/libraries/a1GehtF0RBG0bngTSGyq9A
Link to All published papers in NASA-ADS: https://ui.adsabs.harvard.edu/user/libraries/ygRfnm8eR0awYAGfcFK9UA

First Author Only Publication

[12] **Dutta S**, "A Monopolar Jet from Protostar HOPS 10: Evidence for Asymmetric Magnetized Launching", 2026, AJ, 171, 211. doi:10.3847/1538-3881/ae4486, Impact Factor: 5.1; Scopus: Q1

[11] **Dutta S**, Lee C-F, Hirano N, Johnstone D, Kim K-T, Kuan Y-J, Di Francesco J, Tatematsu K, Juvela M, Lee CW, Traficante A, Huei-Ru Chen V, Ranjan Samal M, Eden D, Sahu D, Hsu S-Y, Liu T, Liu S-Y, "ALMASOP: Inner-Envelope Structures of Protostars Driving Nascent Jets", 2026, ApJ, 996, 92. doi:10.3847/1538-4357/ae1d77, Impact Factor: 5.4; Scopus: Q1

[10] **Dutta S**, "Jets in Low-Mass Protostars", (2025), Univ, 11, pp. 333. (REVIEW ARTICLE), Impact Factor: 2.5 ; Scopus: Q2

[9] **Dutta S**, "Molecular Jets from an Evolved Protostar: Insights from JWST-ALMA Synergy", (2025), ApJ, 991, pp. 45. Impact Factor: 5.4; Scopus: Q1

[8] **Dutta S**, Lee C-F, Johnstone D, Lee J-E, Hirano N, Di Francesco J, Moraghan A, Liu T, Sahu D, Liu S-Y, Tatematsu K, Goldsmith PF, Lee CW, Li S, Eden D, Juvela M, Bronfman L, Hsu S-Y, Kim K-T, Kwon W, Sanhueza P, Liu X, López-Vázquez JA, Luo Q, Yi H-W, "ALMA Survey of Orion Planck Galactic Cold Clumps (ALMASOP): Molecular Jets and Episodic Accretion in Protostars", (2024), AJ, 167, pp. 72. Impact Factor: 5.1; Scopus: Q1

[7] **Dutta S**, Lee C-F, Hirano N, Liu T, Johnstone D, Liu S-Y, Tatematsu K, Goldsmith PF, Sahu D, Evans NJ, Sanhueza P, Kwon W, Qin S-L, Samal MR, Zhang Q, Kim K-T, Shang H, Lee CW, Moraghan A, Jhan K-S, Li S, Lee J-E, Traficante A, Juvela M, Bronfman L, Eden D, Soam A, He J, Liu H-li, Kuan Y-J, Pelkonen V-M, Luo Q, Yi H-W, Hsu S-Y, "ALMA Survey of Orion Planck Galactic Cold Clumps (ALMASOP): Evidence for a Molecular Jet Launched at an Unprecedented Early Phase of Protostellar Evolution", (2022), ApJ, 931, pp. 130., Impact Factor: 5.4; Scopus: Q1

[6] **Dutta S**, Lee C-F, Johnstone D, Liu T, Hirano N, Liu S-Y, Lee J-E, Shang H, Tatematsu K, Kim K-T, Sahu D, Sanhueza P, di Francesco J, Jhan K-S, Lee CW, Kwon W, Li S, Bronfman L, Liu H-L, Traficante A, Kuan Y-J, Hsu S-Y, Moraghan A, Liu C-F, Eden D, Soam A, Luo Q, (Almasop Team), "ALMA Survey of Orion Planck Galactic Cold Clumps (ALMASOP):

Detection of a Dense SiO Jet in the Evolved Protostellar Phase", (2022), ApJ, 925, pp. 11., Impact Factor: 5.4; Scopus: Q1

[5] **Dutta S**, Lee C-F, Liu T, Hirano N, Liu S-Y, Tatematsu K, Kim K-T, Shang H, Sahu D, Kim G, Moraghan A, Jhan K-S, Hsu S-Y, Evans NJ, Johnstone D, Ward-Thompson D, Kuan Y-J, Lee CW, Lee J-E, Traficante A, Juvela M, Vastel C, Zhang Q, Sanhueza P, Soam A, Kwon W, Bronfman L, Eden D, Goldsmith PF, He J, Wu Y, Pelkonen V-M, Qin S-L, Li S, Li D, "ALMA Survey of Orion Planck Galactic Cold Clumps (ALMASOP). II. Survey Overview: A First Look at 1.3 mm Continuum Maps and Molecular Outflows", (2020), ApJS, 251, pp. 20., Impact Factor: 8.5; Scopus: Q1

[4] **Dutta S**, Mondal S, Joshi S, Das R, "Optical photometric variable stars towards Cygnus OB7", (2019), MNRAS, 487, pp. 1765-1776., Impact Factor: 5.2; Scopus: Q1

[3] **Dutta S**, Mondal S, Samal MR, Jose J, "The Planck Cold Clump G108.37-01.06: A Site of Complex Interplay between H II Regions, Young Clusters, and Filaments", (2018), ApJ, 864, pp. 154., Impact Factor: 5.4; Scopus: Q1

[2] **Dutta S**, Mondal S, Joshi S, Jose J, Das R, Ghosh S, "Optical photometric variable stars towards the Galactic H II region NGC 2282", (2018), MNRAS, 476, pp. 2813-2824., Impact Factor: 5.2; Scopus: Q1

[1] **Dutta S**, Mondal S, Jose J, Das RK, Samal MR, Ghosh S, "The young cluster NGC 2282: a multiwavelength perspective", (2015), MNRAS, 454, pp. 3597-3612., Impact Factor: 5.2; Scopus: Q1

Co-Author Publication

[32] Tatematsu K., Nishimura A., Ogawa H., Sakai N., Sakai T., Tokuda K., Hasegawa Y., including **Dutta S.** et al., "Observations of DNC and DCO+ toward the $\int$-shaped Filament and Starless Cores in the Orion Molecular Clouds", 2026, ApJS, 284, 21. doi:10.3847/1538-4365/ae5637, Impact Factor: 8.5; Scopus: Q1

[31] Hsu S-Y, Lee C-F, Johnstone D, Liu S-Y, Liu T, Bronfman L, Chen H-RV, **Dutta S**, Eden DJ, Hirano N, Juvela M, Kim K-T, Kuan Y-J, Kwon W, Lee CW, Lee J-E, Li S, Lin S-J, Liu C-F, Liu X, López-Vázquez JA, Luo Q, Rawlings MG, Sahu D, Sanhueza P, Shang H, Tatematsu K, Yang Y-L, "ALMASOP. A Rotating Feature Rich in Complex Organic Molecules in a Protostellar Core", (2025), ApJ, 989, pp. 56., Impact Factor: 5.4; Scopus: Q1

[30] Ghosh S, Mondal S, **Dutta S**, Kumbhakar R, Das R, Joshi S, Lata S, "Dynamic Photometric Variability in Three Young Brown Dwarfs in Taurus: Detection of Optical Flares with TESS Data", (2025), ApJ, 981, pp. 75., Impact Factor: 5.4; Scopus: Q1

[29] Mookerjea B, Maheswar G, Acharyya K, Baug T, Datta P, Jose J, Ojha DK, Pandian JD, Roy N, Samal M, Sharma S, Soam A, Vig S, Das A, Dewangan L, **Dutta S**, Eswariah C, Majumdar L, Mallick KK, Mondal S, Ninan JP, Panwar N, Pathak A, Rastogi S, Sahu D, Tej A, Veena VS, "Research on the interstellar medium and star formation in the Galaxy: An Indian perspective", (2025), JApA, 46, pp. 3. Impact Factor: 1.5; Scopus: Q3

[28] Liu C-F, Shang H, Johnstone D, Ai T-H, Lee TM, Krasnopolsky R, Hirano N, **Dutta S**, Hsu S-Y, López-Vázquez JA, Liu S-Y, Liu T, Tatematsu K, Zhang Q, Rawlings MG, Eden D, Ren Z, Sanhueza P, Kwon W, Lee CW, Kuan Y-J, Bandopadhyay S, Väisälä MS, Lee C-F, Das I, "ALMA Survey of Orion Planck Galactic Cold Clumps (ALMASOP): Nested Morphological and Kinematic Structures of Outflows Revealed in SiO and CO Emission", (2025), ApJ, 979, pp. 17., Impact Factor: 5.4; Scopus: Q1

[27] López-Vázquez JA, Lee C-F, Shang H, Cabrit S, Krasnopolsky R, Codella C, Liu C-F, Podio L, **Dutta S**, Murphy A, Wiseman J, "Multiple Components of the Outflow in the Protostellar System HH 212: Outer Outflow Shell, Rotating Wind, Shocked Wind, and Jet", (2024), ApJ, 977, pp. 126. Impact Factor: 5.4; Scopus: Q1

[26] Hsu S-Y, Lee C-F, Liu S-Y, Johnstone D, Liu T, Takahashi S, Bronfman L, Chen H-RV, **Dutta S**, Eden DJ, Evans NJ, Hirano N, Juvela M, Kuan Y-J, Kwon W, Lee CW, Lee J-E,

Li S, Liu C-F, Liu X, Luo Q, Qin S-L, Sahu D, Sanhueza P, Shang H, Tatematsu K, Yang Y-L, "ALMASOP. The Localized and Chemically Rich Features near the Bases of the Protostellar Jet in HOPS 87", (2024), ApJ, 976, pp. 29. Impact Factor: 5.4; Scopus: Q1

[25] Liu X, Liu T, Shen Z, Qin S-L, Luo Q, Gong Y, Cheng Y, Henkel C, Gu Q, Zhu F, Zhang T, Zhao R, Wu Y, Li B, Li J, Zhao Z, Wang J, Zhong W, Liu Q, Xia B, Fu L, Yan Z, Zhang C, Wang L, Ye Q, Yang A, Xu F, Zhang C, **Dutta S**, Li S, Liu M, Yang D, Li C, Chen L, "The First Ka-band (26.1–35 GHz) Blind Line Survey toward Orion KL", (2024), ApJS, 271, pp. 3. Impact Factor: 8.5; Scopus: Q1

[24] Rawat V, Samal MR, Walker DL, Ojha DK, Tej A, Zavagno A, Zhang CP, Elia D, **Dutta S**, Jose J, Eswaraiah C, Sharma E, "The Giant Molecular Cloud G148.24+00.41: gas properties, kinematics, and cluster formation at the nexus of filamentary flows", (2024), MNRAS, 528, pp. 2199-2219. Impact Factor: 5.2; Scopus: Q1

[23] Rawat V, Samal MR, Eswaraiah C, Wang J-W, Elia D, Panigrahy S, Zavagno A, Yadav RK, Walker DL, Jose J, Ojha DK, Zhang CP, **Dutta S**, "Understanding the relative importance of magnetic field, gravity, and turbulence in star formation at the hub of the giant molecular cloud G148.24+00.41", (2024), MNRAS, 528, pp. 1460-1475. Impact Factor: 5.2; Scopus: Q1

[22] Hirano N, Sahu D, Liu S-Y, Liu T, Tatematsu K, **Dutta S**, Li S, Lee C-F, Li PS, Hsu S-Y, Lin S-J, Johnstone D, Bronfman L, Chen H-RV, Eden DJ, Kuan Y-J, Kwon W, Lee CW, Liu H-L, Rawlings MG, Ristorcelli I, Traficante A, "ALMA Survey of Orion Planck Galactic Cold Clumps (ALMASOP): Discovery of an Extremely Dense and Compact Object Embedded in the Prestellar Core G208.68-19.92-N2", (2024), ApJ, 961, pp. 123. Impact Factor: 5.4; Scopus: Q1

[21] Hsu S-Y, Liu S-Y, Johnstone D, Liu T, Bronfman L, Chen H-RV, **Dutta S**, Eden DJ, Evans NJ, Hirano N, Juvela M, Kuan Y-J, Kwon W, Lee C-F, Lee CW, Lee J-E, Li S, Liu C-F, Liu X, Luo Q, Qin S-L, Rawlings MG, Sahu D, Sanhueza P, Shang H, Tatematsu K, Yang Y-L, "ALMA Survey of Orion Planck Galactic Cold Clumps (ALMASOP): The Warm-envelope Origin of Hot Corinos", (2023), ApJ, 956, pp. 120. Impact Factor: 5.4; Scopus: Q1

[20] Luo Q-yi, Liu T, Lee AT, Offner SSR, di Francesco J, Johnstone D, Juvela M, Goldsmith PF, Qin S-L, Mai X, Liu X-chuan, Sanhueza P, Xu F-W, Tatematsu K, **Dutta S**, Chen H-RV, Li S, Yang A, Liu S-Y, Lee C-F, Hirano N, Lee CW, Sahu D, Shang H, Hsu S-Y, Bronfman L, Kwon W, Rawlings MG, Eden D, Lu X, Gu Q-lao, Ren Z, Ward-Thompson D, Shen Z-Q, "ALMA Survey of Orion Planck Galactic Cold Clumps (ALMASOP): A Forming Quadruple System with Continuum "Ribbons" and Intricate Outflows", (2023), ApJL, 952, pp. L2. Impact Factor: 11.1; Scopus: Q1

[19] Sahu D, Liu S-Y, Johnstone D, Liu T, Evans NJ, Hirano N, Tatematsu K, Di Francesco J, Lee C-F, Kim K-T, **Dutta S**, Hsu S-Y, Li S, Luo Q-Y, Sanhueza P, Shang H, Traficante A, Juvela M, Lee CW, Eden DJ, Goldsmith PF, Bronfman L, Kwon W, Lee J-E, Kuan Y-J, Ristorcelli I, "ALMA Survey of Orion Planck Galactic Cold Clumps (ALMASOP): Density Structure of Centrally Concentrated Prestellar Cores from Multiscale Observations", (2023), ApJ, 945, pp. 156. Impact Factor: 5.4; Scopus: Q1

[18] Liu X, Liu T, Shen Z, Qin S-L, Luo Q, Cheng Y, Gu Q, Zhang T, Zhu F-Y, Liu S-Y, Lu X, Zhao R, Zhong W, Wu Y, Li J, Zhao Z, Wang J, Liu Q, Xia B, Li B, Fu L, Yan Z, Zhang C, Wang L, Ye Q, Tatematsu K, Liu H, Shang H, Xu F, Lee C-F, Zhang C, **Dutta S**, "A Q-band Line Survey toward Orion KL Using the Tianma Radio Telescope", (2022), ApJS, 263, pp. 13. Impact Factor: 8.5; Scopus: Q1

[17] Luo Q-yi, Liu T, Tatematsu K, Liu S-Y, Li PS, di Francesco J, Johnstone D, Goldsmith PF, **Dutta S**, Hirano N, Lee C-F, Li D, Kim K-T, Won Lee C, Lee J-E, Liu X-chuan, Juvela M, He J, Qin S-L, Liu H-L, Eden D, Kwon W, Sahu D, Li S, Xu F-W, Zhang S-ju, Hsu S-Y, Bronfman L, Sanhueza P, Pelkonen V-M, Zhou J-wen, Liu R, Gu Q-lao, Wu Y-fang,

Mai X-feng, Falgarone E, Shen Z-Q, "ALMA Survey of Orion Planck Galactic Cold Clumps (ALMASOP): How Do Dense Core Properties Affect the Multiplicity of Protostars?", (2022), ApJ, 931, pp. 158. Impact Factor: 5.4; Scopus: Q1

[16] Jhan K-S, Lee C-F, Johnstone D, Liu T, Liu S-Y, Hirano N, Tatematsu K, **Dutta S**, Moraghan A, Shang H, Lee J-E, Li S, Liu C-F, Hsu S-Y, Kwon W, Sahu D, Liu X-C, Kim K-T, Luo Q, Qin S-L, Sanhueza P, Bronfman L, Qizhou Z, Eden D, Traficante A, Lee CW, Almasop Team, "ALMA Survey of Orion Planck Galactic Cold Clumps (ALMASOP): Deriving Inclination Angle and Velocity of the Protostellar Jets from Their SiO Knots", (2022), ApJL, 931, pp. L5. Impact Factor: 11.1; Scopus: Q1

[15] Tatematsu K, Yeh Y-T, Hirano N, Liu S-Y, Liu T, **Dutta S**, Sahu D, Evans NJ, Juvela M, Yi H-W, Lee J-E, Sanhueza P, Li S, Eden D, Kim G, Lee C-F, Wu Y, Kim K-T, Tóth LV, Choi M, Kang M, Thompson MA, Fuller GA, Li D, Wang K, Sakai T, Kandori R, Hsu S-Y, Chiong C-C, "Almasop" Collaboration, "Nobeyama Survey of Inward Motions toward Cores in Orion Identified by SCUBA-2", (2022), ApJ, 931, pp. 33. Impact Factor: 5.4; Scopus: Q1

[14] Qin S-L, Liu T, Liu X, Goldsmith PF, Li D, Zhang Q, Liu H-L, Wu Y, Bronfman L, Juvela M, Lee CW, Garay G, Zhang Y, He J, Hsu S-Y, Shen Z-Q, Lee J-E, Wang K, Tang N, Tang M, Zhang C, Yue Y, Xue Q, Li S, Peng Y, **Dutta S**, Ge J, Xu F, Chen L-F, Baug T, Dewangan L, Tej A, "ATOMS: ALMA Three-millimeter Observations of Massive Star-forming regions - VIII. A search for hot cores by using C2H5CN, CH3OCHO, and CH3OH lines", (2022), MNRAS, 511, pp. 3463-3476. Impact Factor: 5.2; Scopus: Q1

[13] Hsu S-Y, Liu S-Y, Liu T, Sahu D, Lee C-F, Tatematsu K, Kim K-T, Hirano N, Yang Y-L, Johnstone D, Liu H, Juvela M, Bronfman L, Chen H-RV, **Dutta S**, Eden DJ, Jhan K-S, Kuan Y-J, Lee CW, Lee J-E, Li S, Liu C-F, Qin S-L, Sanhueza P, Shang H, Soam A, Traficante A, Zhou J, "ALMA Survey of Orion Planck Galactic Cold Clumps (ALMASOP): A Hot Corino Survey toward Protostellar Cores in the Orion Cloud", (2022), ApJ, 927, pp. 218. Impact Factor: 5.4; Scopus: Q1

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PREVIOUS RESEARCH SUMMARY

[**] Multiwavelength Studies of Star–Planet Formation with Submillimeter, Infrared, and Optical Instruments

Stars and planets originate within cold ($\sim$ 10 K), dense ($\sim 10^4$ cm^{-3}) molecular cloud cores (Lada & Lada 2003; Bergin & Tafalla 2007). Under appropriate conditions (e.g., Jeans instability), some cores collapse to form protostars. During accretion, jets and molecular outflows are launched from the disk–envelope system, while a circumstellar disk emerges as the site where dust grows and planets begin to form. As protostars evolve, their luminosity increases and the surrounding envelope dissipates, eventually producing a main-sequence star with a planetary system. Understanding these early physical conditions and evolutionary pathways requires coordinated multiwavelength observations—optical, infrared, submillimeter, and radio—each probing distinct components of the protostar–disk–envelope system.

(ii) Optical/Infrared Observations (Space & Ground-Based): Optical (0.5–0.8 μm), near-IR (1–2.5 μm), and mid/far-IR (3–500 μm) wavelengths probe progressively younger and more embedded protostars. I use these regimes to study stellar variability, disk/envelope heating, and warm dust/gas emission and planet forming conditions. Recent work includes combining ALMA submillimeter data with JWST infrared imaging to characterize protostellar jets (Dutta et al. 2025a). As PI, I have conducted 50+ nights of optical/IR observations through more than 10 proposals at Indian 1–4 m telescopes with 2m Himalayan Chandra Telescope (IIA, India), 1.3-m Devasthal Fast Optical Telescope (ARIES, India), 1.04-meter Sampurnanand Telescope(ARIES, India), 3.6m Devasthal Optical Telescope (ARIES, India) (proposal list: https://somastro.github.io/proposal.html). I developed scientific ideas, coordinated proposal preparation, carried out on-site observations, performed real-time data checks, reduced the raw data, and analyzed both photometric and spectroscopic datasets. Highlights from my first-author studies include:

- Dutta et al. (2018b, 2019) provide a broad, statistically significant census of optical photometric variability among protostars in young clusters (e.g. NGC 2282, Cyg OB7), revealing several of variable candidates across a wide mass range, and exploring how rotation, disk presence and accretion/disc-related variability contribute to observed light-curve properties.
- Dutta et al. (2015, 2018a) demonstrate that combining optical and infrared observations in photometric and spectroscopic mode—both new data and along with archival surveys—provides a broad, multiwavelength view of young clusters by simultaneously tracing their stellar content, circumstellar disks, accretion activity, extinction structure, and evolutionary stages. Such a multi-band approach allows the identification of young objects across a wide mass range, reconstruction of cluster age and star-formation history, and characterization of how disks and variability evolve during early cluster development.

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(i) Submillimeter Observations: I work extensively with submillimeter facilities, primarily Atacama Large Millimeter/submillimeter Array (ALMA) and James Clerk Maxwell Telescope (JCMT), including writing several successful PI-led proposals (listed at: https://somastro.

github.io/proposal.html). The 210–375 GHz (1.4–0.8 mm) regime is crucial for tracing dust emission and molecular lines in cold protostellar environments. I have also developed Python-based data-reduction pipelines for bulk data observations (e.g., ALMASOP survey; Dutta et al. 2020). My research uses submillimeter data to probe jet/outflows, disk/envelope structures, their kinematics, chemistry, and dust evolution. We have analyzed outflows and jets (e.g., with SiO, CO, H_2CO), cold disks/envelopes (e.g., with N_2D^+, $C^{18}O$, CH_3OH, other complex molecules), and continuum emission, enabling constraints on early star-formation conditions, accretion histories, and early dust growth. Key publications include Dutta et al. 2020, 2022a, 2022b, 2024, 2025a, 2025b, 2025c). Highlights from my first-author studies include:

- Discovery of a dense molecular jet from an evolved Class I protostar (HOPS-315) with moderately high mass-loss rate (Dutta et al. 2022a).
- Identification of one of the youngest molecular jets, likely just after the First Core stage (Dutta et al. 2022b).
- One of the largest molecular jet surveys with SiO and CO (21 sources), showing systematic trends of jet velocity, mass-loss rate, and episodic accretion with intrinsic protostellar properties (Dutta et al. 2024).
- Discovery of stratified layers in outflow/jets comparing submillimeter from Atacama Large Millimeter/submillimeter Array (ALMA) and infrared from James Webb Space Telescope (JWST) data (Dutta, 2025a).
- Establishing the evolutionary stages of the youngest stars from astrochemical analyses (Dutta et al. 2026).

Technical Experience: I have served on the James Clerk Maxwell Telescope (JCMT) Time Allocation Committee (TAC) for six semesters (2021–2024), reviewing proposals and evaluating observational feasibility.

References: [1] Dutta S. et al., 2025c, Accepted for publication in ApJ, arXiv:2511.05829. [2] Dutta S., 2025b, Univ, 11, 333. [3] Dutta S., 2025a, ApJ, 991, 45. [3] Dutta et al. 2024, AJ 167, 72. [4] Dutta et al. 2022b, ApJ 931, 130. [5] Dutta et al. 2022a, ApJ 925, 11. [6] Dutta et al. 2020, ApJS 251, 20.

[**] Software Development and Application of Machine Learning in Young Star Cluster Identification and Emerging Planet Detection in the Disk

I am actively developing new software for raw data reduction and analysis across different telescopes. Most recently, I published a streamlined tool – "peakmoment" – for analyzing raw JWST data, which extracts spectra directly from calibrated exposures and creates moment maps for each emission line. The package is publicly released and documented on Zenodo (https://zenodo.org/records/16623946; DOI: 10.5281/zenodo.16623946), the results related to this code has been published in Dutta (2025, ApJ, 991, 45).

In astronomical surveys, distinguishing young stars from other celestial objects such as main-sequence field stars, galaxies or quasars relies on analyzing their observed photometric and spectroscopic properties. Protostars typically exhibit morphology and characteristic spectral energy distributions (SEDs) that differ from field stars or non-stellar sources. Machine learning (ML) techniques—such as Random Forests, Support Vector Machines, and Deep Neural Networks—are trained on labeled datasets to automatically classify objects based on features like color indices, brightness profiles, and spectral features. These models can efficiently separate protostars from field stars (background or foreground), galaxies or artifacts across large-scale survey data.

For emerging planet detection, particularly within protoplanetary or circumstellar disks, machine learning helps identify subtle disk substructures—such as gaps, rings, or asymmetries—seen in high-resolution submillimeter data from ALMA or near-infrared images from JWST. These features often indicate the gravitational influence of forming planets. ML algorithms enhance sensitivity by learning complex signal patterns and distinguishing genuine planetary signatures from noise or stellar variability.

References: [1] Dutta S., 2025, ApJ, 991, 45; https://zenodo.org/records/16623946; DOI: 10.5281/zenodo.16623946. [2] The basic algorithms and implementations of ML, which I have developed, are available on my GitHub page: https://github.com/somastro/AI_ML-tutorial. A manuscript describing these methods of detection and results is currently under preparation.

FUTURE RESEARCH PLAN WITH THE INSTRUMENTS AT INDIAN CENTRE FOR SPACE PHYSICS (ICSP)

My long-term research goal is to understand the formation and early evolution of stars and planetary systems through multi-wavelength observations that combine optical, infrared, and millimeter data. While much of my previous work has utilized facilities such as ALMA, JWST, JCMT, the 3.6-m Devasthal Optical Telescope (DOT), and the Himalayan Chandra Telescope (HCT), I view the observational facilities at ICSP as an excellent opportunity to develop a complementary optical time-domain research program while continuing investigations of young stellar objects and star-forming regions.

One of my primary objectives at ICSP will be to establish a systematic observational program using the 0.61-m VASISTHA telescope for **photometric monitoring of young stellar objects**, embedded clusters, and nearby star-forming regions. High-cadence optical observations can reveal stellar variability associated with accretion, stellar rotation, magnetic activity, eclipses, and circumstellar disk evolution. Such observations provide essential diagnostics of the physical processes governing the earliest stages of stellar evolution and naturally complement infrared and millimeter observations obtained from facilities such as ALMA and JWST.

Building upon ICSP's successful work in **exoplanet** transit monitoring and variable-star studies, I also plan to extend the existing time-domain program toward young stellar populations. Long-term monitoring of open clusters and nearby star-forming regions can identify pulsating stars, eclipsing binaries, rotational variables, and pre-main-sequence variables, enabling investigations of stellar evolution across a wide range of ages. Combining ICSP observations with Gaia astrometry and public photometric surveys such as TESS and LSST (Rubin Observatory) will significantly enhance the scientific return of these programs.

Another important direction will be the **spectroscopic** characterization of young stars and protostellar outflows. My previous experience in near-infrared spectroscopy has involved studying molecular hydrogen emission, accretion signatures, and shock-excited gas in embedded protostars. Optical imaging and spectroscopy available at ICSP can be effectively used to investigate Herbig-Haro objects, jets, outflows, H II regions, and emission-line stars, providing complementary constraints on the interaction between young stars and their surrounding environments.

I also intend to contribute to the development of observational capabilities at ICSP through **instrument characterization, detector calibration, data reduction pipelines, and automated photometric analysis**. My experience with observations from multiple international facilities has provided extensive expertise in CCD image processing, spectroscopy, observational planning, and multi-wavelength data analysis. I hope to work closely with students and collaborators in developing efficient observing strategies and modern data-analysis tools that maximize the scientific productivity of ICSP's telescopes.

Finally, I aim to establish collaborative programs linking ICSP observations with major international observatories and archival surveys. By combining optical observations obtained at ICSP with infrared and radio data from facilities such as JWST, Gaia, 2MASS, WISE, VISTA and ALMA, we can address fundamental questions concerning stellar variability, disk evolution, star formation, and the early evolution of planetary systems. Such multi-wavelength investigations will strengthen ICSP's observational astronomy program while providing valuable research opportunities and training for students and young researchers.

Overall, my objective is to build a research program that combines ICSP's growing strengths in optical time-domain astronomy with my expertise in star and planet formation, spectroscopy, and multi-wavelength astrophysics, thereby expanding the scientific impact and international visibility of the institute.

FUTURE COMPLEMENTARY RESEARCH DIRECTIONS

[**] Formation and Evolution of Star–Planet Systems: A Multiwavelength Perspective

Overview and Motivation: I study the physical mechanisms that shape the earliest phases of star and planet formation, with a particular focus on the interplay between accretion, jet ejection, and disk evolution. My long-term vision is to build a synergistic research program that enriches global efforts to understand how stars and planets are born. This program will bridge internationally leading telescope observatories, enabling coordinated, multi-wavelength investigations of protostellar environments.

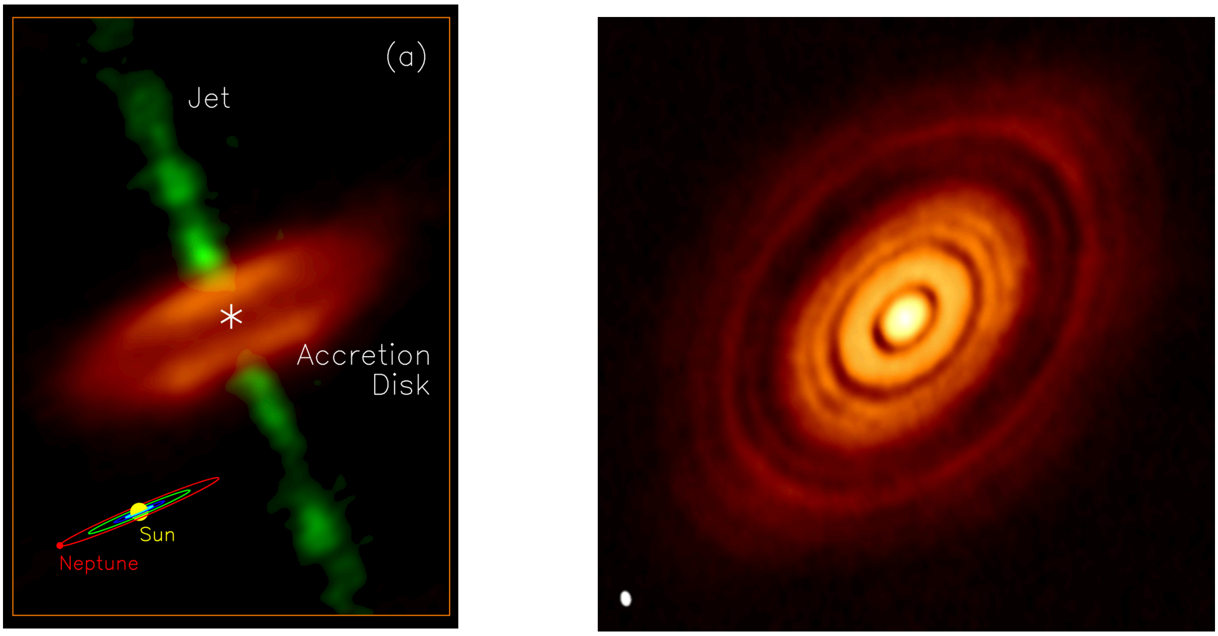
In the next few years, I plan to lead multi-wavelength studies of protostellar jets, outflows, and disks using facilities such as JWST (James Webb Space Telescope), Indian National Facility Optical/Infrared telescopes and ALMA (Atacama Large Millimeter/submillimeter Array).

Statement of Problem to be Addressed:

The formation of stars and planets involves interconnected physical and chemical processes unfolding over vast spatial and temporal scales. Despite major progress, fundamental questions persist: (i) what drives the launching of jets and outflows during the earliest protostellar stages, (ii) how these processes alter the chemical landscape of planet-forming disks, and (iii) what broad framework governs the formation and evolution of protostars and their planetary systems. These gaps hinder the development of unified models of stellar and planetary formation. This project proposes a multi-scale, multi-wavelength approach to connect accretion dynamics, jet launching mechanisms, and disk chemistry, with the goal of clarifying the sequence of ejection processes and their impact on stellar growth and planet-forming environments.

Science Background and Relevance to Previous Work in the Field:

- **Protostellar jet:** Protostellar jets and outflows are among the most conspicuous manifestations of star formation. An example of the protostellar jet is shown in Figure 1a. They are believed to remove excess angular momentum, facilitate disk evolution, and trace ongoing accretion processes (Shu et al., 1995; Konigl & Pudritz, 2000). Despite decades of theoretical work, the observational distinction of jet-launching processes between X-wind (launching radius fraction of AU to a few AU) and disk-wind (a few AU to a few tens of AU) models remains inconclusive. High-resolution submillimeter wavelength ALMA observations have begun to reveal rotational signatures in jets (Lee et al., 2017), allowing to measure the jet launching zones (Figure 1a), and exclusive details of disk structures (Figure 1b). Infrared high-sensitive observations with JWST provide exclusive details of the shock excited jet-launching zones (Figure 2). Systematic studies linking these submillimeter and infrared observations of outflow/jet are scarce. Protostellar jets are often observed as episodic or clumpy in nature (Figure 1a), which are believed to be the consequence of episodic accretion onto the protostars. Episodic accretion—manifested as FUor and EXor outbursts—has emerged as a key process in low-mass star formation (Hartmann & Kenyon, 1996; Audard et al., 2014). These bursts could influence disk chemistry, alter temperature profiles, and may affect planet formation pathways (Cieza et al., 2018, Dutta et al. 2024). However, the frequency, duration, and physical triggers of such events remain poorly constrained. A systematic study of these processes with submillimeter ALMA and infrared JWST will be crucial to constrain the jet launching zone, angular momentum removal, ejection mechanisms, and their influence on the disk chemistry and initial condition of planet formation.



(a) (b)

Figure 1: (a) ALMA observations of the protostellar system HH 212 with accretion disk, episodic jet. A schematic of the solar system is shown for comparison (credit: Lee et al. 2017, Nature Astronomy, 1, 152). (b) 1.3mm ALMA continuum images of HL Tau protoplanetary disk (credit: ALMA Partnership et al. 2015, ApJ 808, L3).

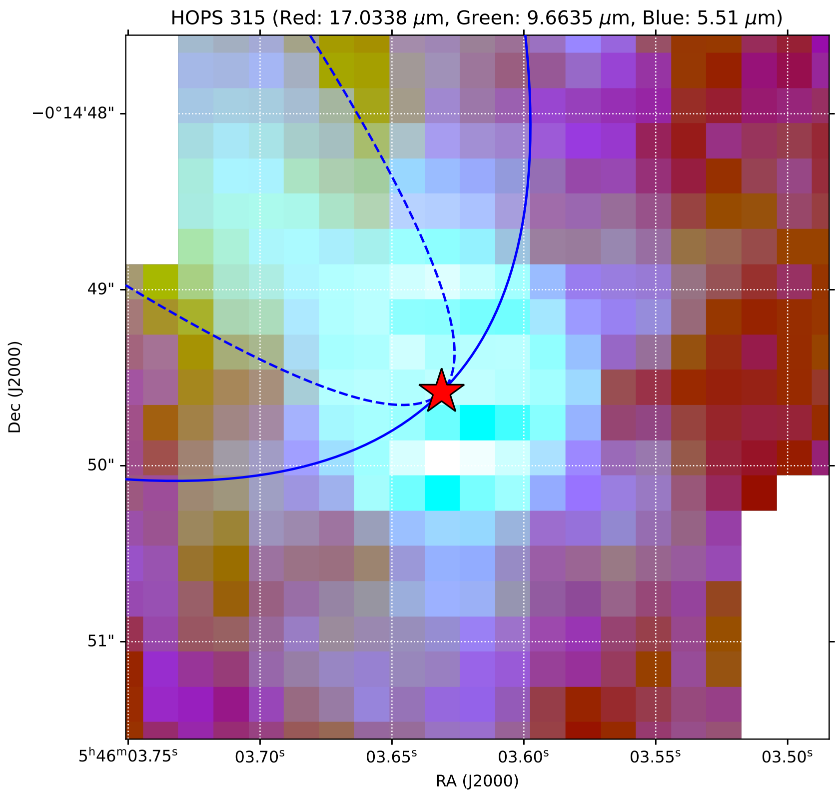


Figure 2: JWST observation of the protostellar system HOPS-315. Background colors show JWST mid-infrared emission, while the solid and dotted parabolas indicate the wide-angle outflow and narrow jet, respectively, detected in ALMA observations (Credit: Dutta 2025a, b).

- **Disk and Envelope:** ALMA and JWST have revealed rich organic chemistry in protoplanetary disks, providing critical insights into the physical and chemical environments where planets form (Jørgensen et al., 2022). Figure 1b illustrates the continuum of chemically rich disk traced in complex organic molecules (COMs), which are believed to form on icy grain mantles and be released into the gas phase during episodic accretion bursts. Despite these advances, the causal connections between episodic accretion, jet/outflow activity, and the resulting chemical evolution of the disk remain poorly constrained. My prior work (Dutta et al., 2020, 2022a, 2022b, 2024, 2025a) on jet and outflow morphology, episodic ejection and accretion, and photometric variability in young stellar objects (Dutta et al. 2018a, Dutta et al. 2019) provides a strong foundation for an integrated approach that connects protostellar accretion, outflow dynamics, disk chemistry, and early planet formation. A combined study of infrared JWST and submillimeter ALMA will be important to extensively study this scenario.
- **Global Star Formation Scenario:** Comparison across multiple wavelengths, particularly infrared and millimeter, provides a unique window into the overall morphology and physical conditions of the star-planet forming region. For example, as shown in Figure 3a from Dutta 2025a, b, the comparison between infrared observations from JWST and submillimeter data from ALMA reveals stratified layers within protostellar outflows and jets. Figure 3b suggests a potential correlation between accretion and ejection rates; however, this relationship is strongly influenced by inconsistencies in the observational data. A systematic infrared spectroscopy with JWST survey could help establish a more reliable and consistent correlation between accretion and ejection phenomena during the early stages of protostellar evolution and planet formation.

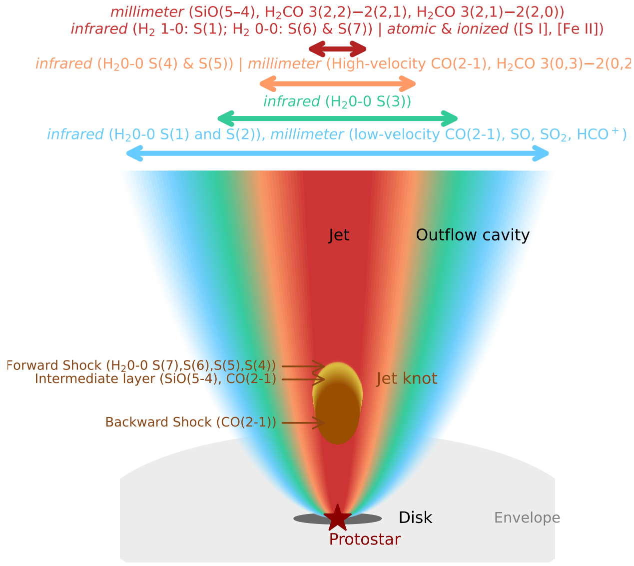
I possess strong technical and software capabilities that are integral to multi-wavelength studies of protostellar accretion, disk chemistry, and jet/outflow dynamics. I routinely write new proposals to Indian national telescope facilities and international telescopes for observations. I extensively use archive data from those telescopes. I am proficient in data reduction and analysis using IRAF/CASA/CARTA for ALMA data, JWST pipeline tools and Python-based photometric/spectroscopic processing for ground-based optical and infrared observations. I employ advanced tools such as Astropy, SciPy, NumPy for time-series analysis, variability classification, and spectral diagnostics. I also have been working on astrochemical/disk modeling codes and visualization platforms such as CASA viewer, DS9, CARTA, enabling me to handle complex, multi-instrument datasets with precision and scientific insight.

Methodology and Timeline: ALMA and JWST will be utilized to obtain these observations by delivering high-resolution, multi-wavelength diagnostics of jets, outflows, disks, and warm molecular chemistry. ALMA and JWST datasets will be mined for jet kinematics, outflow structures, and infrared tracers of accretion and shocks. ALMA will target CO, SiO, H_2CO and related molecules to map cold gas structures, whereas JWST will probe organic species, H_2 emission, and dust features associated with outburst-driven heating.

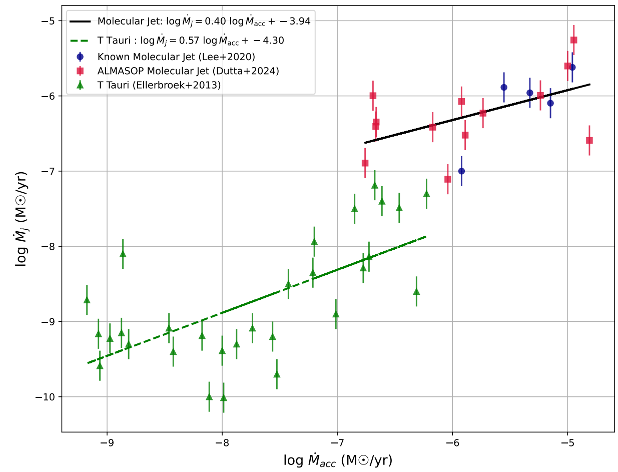
Together, the new observations, and archival ALMA and JWST form an integrated observational framework. In the first one/two years, a sample of Class 0/I protostars in regions such as Perseus, Orion, and Serpens will be assembled, combining archival datasets with newly acquired Indian telescope monitoring. All data streams will be analyzed jointly using radiative-transfer modeling and chemical diagnostics to quantify how episodic accretion influences jet launching, mass-loss efficiency, disk evolution, and chemical enrichment.

This coordinated, multi-facility strategy will yield a comprehensive observational and theoretical picture of early stellar growth and planet formation conditions. Results will be published through peer-reviewed publications, international conference presentations.

References: Shu et al. 1995, ApJL, 455, L155; Konigl & Pudritz 2000, PPIV, 759; Hartmann & Kenyon 1996, ARA&A, 34, 207; Audard et al. 2014, PPVI, 387; Cieza et al. 2018, MNRAS, 474, 4347; Jorgensen et al. 2022, Nature, 606, 272; Lee et al. 2017, ApJ, 843, 27; Dutta et al.



(a)



(b)

Figure 3: (a) Schematic diagram showing the detection ranges of various molecular, atomic and ionic species in outflow–jet–shocks comparing infrared and molecular lines, adapted from Dutta (2025a, b). (b) Observed jet mass-loss rate versus accretion rate for protostellar jet sources, adapted from Dutta 2025b. Tentative linear correlations are shown.

2018, MNRAS, 476, 2813; Dutta et al. 2019, MNRAS, 487, 1765; Dutta et al. 2020, ApJS, 251, 20; Dutta et al. 2022a, ApJ, 925, 11; Dutta et al. 2022b, ApJ, 931, 130; Dutta et al. 2024, AJ, 167, 72; Dutta 2025a, ApJ, 991, 45; Dutta 2025b, Universe, Volume 11, Issue 10, id.333.

STATEMENT OF TEACHING PHILOSOPHY AND PRACTICE

I believe that the primary goal of teaching is to inspire curiosity, develop scientific reasoning, and empower students to become independent learners. Physics and astronomy provide unique opportunities to help students understand the natural world while cultivating quantitative reasoning, problem-solving skills, and critical thinking. My teaching philosophy is centered on creating an inclusive, student-focused learning environment where every student feels encouraged to participate, ask questions, and develop confidence in their abilities.

My approach begins with building strong conceptual understanding before introducing mathematical formalism. Students often find physics challenging because they focus on equations without first developing physical intuition. I therefore emphasize real-world examples, demonstrations, visualizations, and guided problem-solving to connect abstract concepts with observable phenomena. Drawing upon my research in observational astrophysics, I incorporate examples from the James Webb Space Telescope (JWST), the Atacama Large Millimeter/submillimeter Array (ALMA), and other modern observatories to demonstrate how the principles of mechanics, electromagnetism, optics, quantum mechanics, and thermodynamics are applied to answer fundamental questions about the Universe.

I believe students learn most effectively through active engagement. Rather than relying solely on traditional lectures, I encourage classroom discussions, collaborative problem-solving, think-pair-share activities, inquiry-based learning, and computational exercises. Frequent formative assessments, conceptual questions, and timely feedback help students identify misconceptions and strengthen their understanding. I also integrate computational methods, data visualization, and Python-based scientific analysis whenever appropriate, enabling students to develop skills that are increasingly valuable in modern scientific research and industry.

A central aspect of my teaching philosophy is a commitment to inclusive excellence. I recognize that students enter physics courses with diverse educational backgrounds, experiences, and levels of preparation. My goal is to create a welcoming and supportive classroom where every student feels respected, valued, and encouraged to participate. I use multiple teaching approaches—including visual explanations, worked examples, collaborative learning, and accessible office hours—to accommodate different learning styles. By fostering a classroom culture where questions are welcomed and mistakes are viewed as opportunities for growth, I strive to ensure that all students have equitable opportunities to succeed and develop confidence in their scientific abilities.

I am enthusiastic about teaching both foundational and advanced undergraduate physics courses. I would be delighted to teach introductory and algebra- or calculus-based physics, mechanics, electricity and magnetism, thermodynamics and statistical physics, quantum mechanics, atomic and molecular physics, optics, modern physics, astronomy, and laboratory courses. With my background in electronics, I am also well prepared to teach electronics and instrumentation laboratories, emphasizing hands-on experimental design, measurement techniques, uncertainty analysis, and scientific communication.

My research expertise in observational astrophysics allows me to enrich undergraduate education through specialized topics in astronomy and instrumentation. I would welcome opportunities to teach observational astronomy and astronomical techniques, introducing students to telescope instrumentation, detector technologies, observational strategies, calibration procedures, and modern data reduction methods. Using publicly available observational datasets, students can gain practical experience in astronomical imaging, spectroscopy, computational analysis, and scientific interpretation. I also enjoy introducing topics such as stellar evolution, the interstellar medium, star and planet formation, and exoplanetary systems, allowing students to appreciate how fundamental physics underpins contemporary astronomical discoveries.

Beyond the classroom, I view mentoring as an essential component of undergraduate education. I encourage students to participate in independent studies, computational projects, and undergraduate research experiences that develop scientific writing, programming, data analysis, and presentation skills. My experience working within international scientific collaborations has reinforced the importance of teamwork, communication, and interdisciplinary problem-solving. I hope to involve undergraduate students in authentic research projects using publicly available astronomical data, providing them with opportunities to experience the excitement of scientific discovery while developing transferable analytical and computational skills.

At this institute, I would strive to create a supportive, intellectually stimulating, and inclusive learning environment where students are challenged to think critically, communicate effectively, and appreciate the beauty and relevance of physics and astronomy. Through engaging classroom instruction, hands-on laboratory experiences, computational training, active mentorship, and research-integrated teaching, I hope to inspire students from all backgrounds to become confident learners, informed citizens, and future scientists.

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