Sayantan Auddy

CONTACT INFORMATION

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RESEARCH INTERESTS

- Planet/Star formation, Protoplanetary disks, Magneto-rotational Instability
- Magnetohydrodynamics simulations and Computational Astrophysics
- Artificial Intelligence and its application in Exoplanet characterization
- Convolutional Neural Networks (CNN)

CURRENT APPOINTMENT

Assistant Research Scientist, Johns Hopkins University, **June 2022**

PREVIOUS APPOINTMENT

- Postdoctoral Research Associate, Iowa State University, **Nov 2020 - Jun 2022**
- Academia Sinica Fellow, Institute of Astronomy and Astrophysics, Academia Sinica, **Jan-Oct 2020**
- Postdoctoral Fellow, Institute of Astronomy and Astrophysics**,** Academia Sinica, **Nov 2018 - Jan 2020**

EDUCATION

Ph.D., Physics, University of Western Ontario, **August 2018**

- Thesis: "From Large-Scale Molecular Clouds to Filaments and Cores: Unveiling the role of the Magnetic Field in Star Formation"
- Adviser: Prof Shantanu Basu

Visiting Fellow, Harvard–Smithsonian Center for Astrophysics, **May - November, 2017**

- Adviser: Dr. Philip Myers

MSc Astronomy, University of Western Ontario, **September 2014**

- Thesis: "A Study of Substellar Mass Limit for Brown Dwarfs"
- Adviser: Prof Shantanu Basu

MSc Physics, Indian Institute of Technology (Madras, India), **April 2013**

- Thesis: "Inflation and Cosmological Perturbation Theory"
- Adviser: Prof L Sriramkumar

RECOGNITIONS

- Academia Sinica Fellow at **ASIAA, 2020**
- Honourable Mention of Oral presentation in **Taiwan Physical Society annual meeting, 2020**
- Lillian Margaret & Walter David Jackson Scholarship in Physics, **UWO, 2017**
- Visiting Fellow, Harvard–Smithsonian Center for Astrophysics, **May - November, 2017**
- Best Poster Award in National conference for the Electron Collision Process in Atomic and Molecular Physics, **Ahmedabad, India, March 2013**.
- 3rd Prize in a contributed talk "Cosmic Topology", **IUCCA, India, 2012**
- IIT Merit Scholarship - at Indian Institute of Technology, **2011-2013**

INVITED TALKS

- "Star formation in different environments 2020" **Invited talk** in ICISE, **Quy Nhon, Vitenam Aug 2020.** (Postponed to 2022)
- "'Data Analytics for Basic and Applied Sciences" . **Invited talk** at School of Basic and Applied Sciences (SoBAS), Adamas University**, India, June 2021**.
- "From Large Scale Molecular Clouds to Filaments and Cores" **Invited talk** at the **NTHU colloquium, Taiwan, September 2020**.
- "Column Density PDFs as an Indirect Tracer of Magnetic fields in Star-Forming Molecular Clouds", **Invited talk** at the **NAOJ, Mitaka, Japan, November 2019**.
- "Star Formation: Simulation and Observation of Molecular Clouds ". **Invited talk** at "Winter School on Astronomy", **Hyderabad, India, February 2019**.

- "The role of magnetic fields in star formation". **Invited talk** at the **Taiwanese Theoretical Astrophysics Workshop, Taipei, September 25, 2018**
- "Evolution of Brown Dwarf" **Invited talk** at the CPSX research forum at Western, **London, Canada, November 2014**.

CONTRIBUTED TALKS

- "Using Machine Learning to infer planet mass from observed gap in protoplanetary disks" (Virtual), **AAS Meeting, June 2020**
- "Using ML to constrain planet mass from gap profiles in PPDs", **Taiwan Physical Society, February 2020**
- "Using deep neural networks to constraint the mass of a planet from gap profiles in protoplanetary disks", **NAOJ Science Workshop, Mitaka, Japan, November 2019**
- "Column Density PDFs as an Indirect Tracer of Magnetic fields in Star-Forming Molecular Clouds", Contributed talk at the **Zooming in on Star Formation, Nafplio, Greece, June 2019**.
- "The effect of magnetic fields and ambipolar diffusion on the column density PDFs in molecular clouds". Contributed talk at the **Magnetic Field vs Turbulence conference, Taiwan, February 2018**
- "The role of magnetic fields on the column density PDFs in molecular clouds". Talk at the **Star Formation Lunch, CEA SACLAY Paris, France, January 2018**
- "The role of strong magnetic fields in molecular clouds and star formation". Talk at the **Max Planck Institute for Extraterrestrial Physics, Germany, January 2018**
- "The effect of magnetic fields on the column density probability distribution function in molecular clouds". Talk at **CITA, University of Toronto, Canada, November 2017**
- "Column Density PDFs of Molecular Clouds". Talk at the Star Formation Journal Club at **Centre for Astrophysics**, **Harvard, Cambridge, United States, October 2017**
- "A Magnetic Ribbon Model for Star-Forming Filaments". Contributed talk at "Winter School on Astronomy", **Hyderabad, India, February 2017**.
- "Analytic Model for The Substellar Mass Limit and Brown Dwarf evolution". Contributed talk at "Astronomy At Taj", **Agra, India, February 2016**.
- "Analytic derivation of sub-stellar mass limit for non-zero degeneracy parameter." Contributed talk at Canadian Association of Physicists, **Sudbury, Canada, June 2014**.
- "Cosmic Topology". Contributed Talk at IUCAA Summer School in Astronomy and Astrophysics, **Pune, India, June 2012**.

POSTERS

- "Magnetic Ribbons: A minimum hypothesis model for filaments", at Star Formation in Different Environment , **Quy Nhon, Vietnam, July 2016**.
- "An Analytic Brown Dwarf Model", at CASCA, **Hamilton, Canada, May 2015**.
- "An Analytic Brown Dwarf Model including a non-zero degeneracy parameter." at Circumstellar Disks and Planet Formation Conference, **Ann Arbor, United States, November 2014**.
- "Scattering of Electrons in a Hollow cylindrical Potential." National conference for the Electron collision Process in Atomic and Molecular Physics, **Ahmedabad, India, March 2013**.

AWARDED OBSERVING PROPOSAL

- **Principal Investigator :** "Testing the "Core Field Structure" method against dust polarization observation of H- MM1" at James Clerk Maxwell Telescope (**JCMT**) —**2019**
- **Co-Investigator** : "Using Hourglass Field Morphologies to Directly Estimate Magnetic Field Strengths" at Atacama Large Millimeter Array (**ALMA), —2019**
- **Co-Investigator** : "Magnetic field measurement in the nucleus of a prestellar core" at Atacama Large Millimeter Array (**ALMA), —2019**

EXPERIENCE

- Summer school in Statistics for Astronomers XI in R computing language, **Penn State, United States, June 1-5, 2015.**
- KROME computational School. Attended the workshop in KROME software package for Astrochemistry, **Copenhagen, Denmark, July 20-24, 2015.**

SOFTWARE SKILLS

Computer Programming:

- Machine Learning: Supervised and Unsupervised learning, Multilayer Perceptron (MLP), Convolutional Neural Network (CNN), Bayesian Deep Learning, Generative Adversarial Network (GAN), Decision tree, NLP, SVM, Random forest, K-means Clustering, Regression (linear, non-linear logistic).
- Statistical Data Analysis: Maximum Likelihood Estimation (MLE), Bayesian Inference, Hypothesis Testing, PCA, Model comparison, MCMC.
- Computer Programming: Python (TensorFlow, TensorFlowProbability, Keras, Scikit-Learn,Pandas, Numpy, Scipy, OpenCV, PyMC3, Beautiful Soup, Requests, Hyperopt)
- Data Visualization: Matplotlib, Seaborn
- Supercomputer/Cluster computing: Stampede2 (USA), SHARCNET (Canada), TAIWANIA2 (Taiwan), TIARA(Taiwan)
- Numerical codes: FARGO3D, Athena++, Basu MHD code

TEACHING EXPERIENCE

- I developed and delivered a python workshop on optimization using maximum likelihood estimation at the Winter School in **Hyderabad, India 2017**
- Teaching Assistant at University Of Western Ontario, **2013 - 2018**

  Courses: Quantum Mechanics (3rd year undergraduate), Classical Mechanics,
  Physics for Engineering students (Electricity and Magnetism), Sport Physics
  Classical Mechanics (3rd year undergraduate), Stellar Astrophysics (4th year undergraduate)
  First year Physics Lab
- Physics Instructor for Beat Your Course (BYC), **Fall 2016**

PUBLIC OUTREACH

- Public Talk at Astronomy on Tap, **Taiwan, August 2019**
- I was one of the key organizers for the "Winter school on Astronomy and Workshop on Star Formation" for consecutive years **2019, 2017 and 2016 in India**
- "Looking into the Future", Invited Talk at the Symposium of Ancient and Modern Science, Organized by Rotary Club and Divine Life, **India, 2017**
- Volunteered for Public Nights at The Hume Cronyn Memorial Observatory, UWO. Assisted the public in astronomical observations at Western, London, **Canada 2015**
- Popular talk to a general audience on "The Universe as we see it" at Kolkata, **India 2012**

VOLUNTEER ACTIVITY

- Volunteered for Canadian Association for Girls In Science (CAGIS) in conducting one-hour event of physics experiments for children of a younger age group, London, **Canada 2015**
- Volunteer, Rotary International, India, **2012 - current**

Link to ADS: ui.adsabs.harvard.edu/#/public-libraries/rAPk8x0TTjaXOHKLMYtvvw
GITHUB LInk : https://github.com/sauddy
Publication List (Google Scholar)

REFERENCES

Dr. Min-Kai Lin
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Academia Sinica, Taipei, Taiwan
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PUBLICATIONS

1st Author refereed Publications

- (15) Magnetic field and density relation in Star forming molecular clouds ", **Sayantan Auddy**, Shantanu Basu, Takahiro Kudoh, **2022** (accepted in ApJL) arXiv:2201.05620
- (14)"Using Bayesian Deep Learning to predict masses of exoplanets", **Sayantan Auddy,** Ramit Dey, Min-Kai, Daniel Carrera, Jacob B Simon **2022** (accepted in ApJ) arXiv:2202.11730
- (13)"DPNNet-2.0 Part I: Finding hidden planets from simulated images of protoplanetary disk gaps", **Sayantan Auddy**, Ramit Dey, Min-kai Lin, et al., **2021**, APJ 920, 3, arXiv:2107.09086
- (12)"A Machine Learning model to infer planet masses from gaps observed in protoplanetary disks", **Sayantan Auddy**, Min-Kai Lin, **2020,** ApJ 900:001 **,** arXiv:2007.13779
- (11)"The Transition from a Lognormal to a Power-Law Column Density Distribution in Molecular Clouds: An Imprint of the Initial Magnetic Field and Turbulence"; **Sayantan Auddy**, Shantanu Basu, Takahiro Kudoh, **2019**, ApJL,881:L15, (arXiv:1907.09783)
- (10)"Magnetic Field Structure of Dense Cores using Spectroscopic Methods"; **Sayantan Auddy**, Philip Myers, Shantanu Basu, et al., **2019**, ApJ 872:207. (arXiv:1901.09537)
- (9)"The Effect of Magnetic Fields and Ambipolar Diffusion on the Column Density Probability Distribution Function in Molecular Clouds"; **Sayantan Auddy**, Shantanu Basu, Takahiro Kudoh, **2017**, MNRAS, 474, 400 (arXiv:1710.05427)
- (8)"A Magnetic Ribbon Model for Star Forming Filaments"; **Sayantan Auddy**, Shantanu Basu, Takahiro Kudoh, **2016**, ApJ 831:46 (6pp). (arXiv:1609.02989)
- (7)"Analytic Models of Brown Dwarfs and Substellar Mass Limit"; **Sayantan Auddy**, Shantanu Basu and S.R. Valluri, **2016**, Advances in Astronomy, Volume 2016 (2016), Article ID 5743272, 15 pages. (arXiv:1607.04338)

Invited Review (refereed)

- (6)"From Molecular Clouds to the IMF: Spatial and Temporal Effects"; Shantanu Basu, **Sayantan Auddy**, **2017**, Memorie della Societa Astronomica Italiana, arXiv:1710.06361

Coauthor refereed publications

- (5)"Magnetic Field Structure in Spheroidal Star-Forming Clouds. II. Estimating Field Structure from Observed Maps"; Philip Myers, Ian W. Stephens, **Sayantan Auddy**, Shantanu Basu, et al. **2020,** ApJ 896:163**,** arXiv:2005.04307
- (4)"Magnetic Field Structure in Spheroidal Star-Forming Clouds"; Philip Myers, Shantanu Basu, and **Sayantan Auddy, 2018** ApJ 868:51(19pp)
- (3)"The MLP Distribution: A Modified Lognormal Power-Law Model for the Stellar Initial Mass Function"; Shantanu Basu, M. Gil and **Sayantan Auddy**, **2015**, MNRAS 449(3) : 2413-2420
- (2)Vacuum Birefringence, the Photon Anomalous Magnetic Moment and the Neutron Star RX J1856.5-3754"; S. R. Valluri, J. W. Mielniczuk, F. Chishtie, D. Lamm, **Sayantan Auddy**, **2017**, MNRAS 472-2398
- (1)"Gravitational Wave Background in the Quasi-Steady State Cosmology"; J V Narlikar, Sanjeev Dhurandhar, R. G. Vishwakarma, S. R. Valluri, **Sayantan Auddy**, **2015**, MNRAS, 451 : 1390-1395

Conference Proceeding

- (1)"Magnetic Ribbons: A Minimum Hypothesis Model for Filaments"; **Sayantan Auddy**, Shantanu Basu, Takahiro Kudoh, **2017**, to appear in proceedings of SFDE conference, eds. D. Johnstone, T. Hoang, F. Nakamura, Q. Nguyen Luong, and J. Tran Tranh Van.

In preparation

- (1)"3D-simulations of PPDs studying MRI and disk winds", **Sayantan Auddy,** Jacob B Simon, **2022** (in prep)
- (2)"A planet Hunter using Artificial Intelligence", Sayantan Auddy et al. 2022 (in prep)