Sidhant Kumar Suar

sidhant.suar.24@ucl.ac.uk
github.com/Sidvibn
sidvibn.github.io

Education

PhD University of Virginia 2025 - 2030
Astronomy & Astrophysics
Thesis: ...
Advisor: *Prof. Zhi-Yun Li*

MSc University College London 2024 - 2025
Astronomy & Astrophysics
Thesis: *Energetic Events in Astrophysical Sources and Neutrino Emission*
Advisor: *Prof. Kinwah Wu*

Honours BSc University of Toronto 2019 - 2023
Physics and Astronomy Specialist, Mathematics Minor
Graduated with High Distinction

Research Interests

Planetary and Stellar Dynamics, Formation and Evolution; Astrophysical Fluid Dynamics; High-Energy Astrophysics

Publications

Suar, S. K. & Millholland, S. C. "Planetary Obliquity Excitation Through Pre-Main Sequence Stellar Evolution", 2024, AAS Journals, *in review.*

Research Experience

Energetic Events in Astrophysical Sources and Neutrino Emission
University College London September 2024 - Present
Supervisor: Prof. Kinwah Wu

- Modeled the leptonic and hadronic spectral origin of the *Fermi* bubbles using `naima` and `aafragpy`.
- Currently building a lepto-hadronic model to explain the dynamics and evolution of galactic-scale bubbles and their associated AGN outflow events.

Excitation of Planetary Obliquities through Star-Planet Interactions
Massachusetts Institute of Technology November 2023 - November 2024
Supervisor: Prof. Sarah C. Millholland

- Used a spin-axis Hamiltonian to track the secular evolution of planetary obliquities (planet's spin-axis tilt) due to star-planet interactions.
- Found good agreement with N-Body integrations and added additional effects like protoplanetary disk potentials, tides, and planet-planet perturbations using the N-body integrator.
- Showed that close-in planets could be tipped permanently to large obliquities.

Dynamics of the Atmospheres of Ultra-Hot Jupiters
Imperial College London August 2023 - August 2024
Supervisor: Prof. James E Owen

- Used `Athena++` to show that an initially hydrostatic hot Jupiter atmosphere would lead to noise on the order of actual wind speeds in a typical hot Jupiter atmosphere, thus potentially obscuring any interesting phenomena.
- Initialized a well-balanced hydrostatic isentropic hot Jupiter atmosphere using `Python` and implemented a well-balancing algorithm in `Athena++` to track the evolution of the initialized atmosphere due to day-night temperature variations and rotation of hot Jupiters.
- Showed that the dynamics of the well-balanced atmosphere led to no noise over time, therefore removing any potential issues while distinguishing between wind patterns and unwanted noise. Additionally, a Message Passing Interface (MPI) algorithm was implemented to run the simulations faster on larger computational domains.

Listening to Gas Giant Planets
University of Toronto May 2023 - August 2023
Supervisor: Dr. Janosz Dewberry

- Analytically derived a system of partial differential equations (PDEs) using Eulerian and Lagrangian perturbations applied to a simple planetary model for a non-rotating gas giant planet.
- Calculated the internal oscillation modes of the gas giant by numerically solving the system of PDEs using pseudo-spectral methods and compared them to the oscillation modes calculated for a rotating gas giant.
- Implemented a time-dependent perturbative force in `REBOUNDx` and then used power spectral densities (PSDs) to look at the difference in the accelerations of the satellite Juno due to the normal mode oscillations of Jupiter in the rotating and non-rotating planetary models.

Probing the Formation and Evolution of White Dwarf Debris Disks
University of Toronto July 2022 - April 2023
Supervisor: Prof. Yanqin Wu

- Implemented a Keplerian white dwarf debris disk in `Athena++` based on different theoretical models with varying density profiles, initial eccentricities, and semi-major axis, and time-dependent mass (dust+debris) injection rates.
- Wrote a code in `Python` to track the evolution of its orbital elements and other important physical parameters like angular momentum, energy, and mass over time, thus comparing its final state to the current observations.

Electronic States Coupled to Complex Magnetic Orders
University of Toronto July 2022 - April 2023
Supervisor: Prof. Arun Paramekanti

- Used the Bogoliubov-de Gennes (BDG) Hamiltonian to numerically predict the presence of Majorana bound states (MBSs) in an s-type superconductor coupled to an anti-ferromagnetic skyrmion texture with a triangular lattice, thus reproducing results from current literature.

Characterization and Performance Testing of RFoF Units for the CHORD Telescope Array
University of Toronto May 2022 - July 2022
Supervisor: Prof. Keith Vanderlinde

- Tested and debugged the prototype units of radio frequency (RF) transmitters and receivers, thus measuring quantities like attenuation, gain compression, impedance, and signal-to-noise ratio (SNR) to show that optical fibers were more efficient at signal transmission when compared to their counterparts, the coaxial cables.

Awards and Honours

CITA Summer Undergraduate Research Fellowship
University of Toronto April 2023
Awarded for conducting summer research at the Canadian Institute for Theoretical Astrophysics (CITA).

Walter John Helm Scholarship in Astronomy and Astrophysics
University of Toronto December 2022
Awarded to the top third-year physics and astronomy undergraduate student.

Innis College Alumni Association Scholarship
University of Toronto October 2022
Awarded for high academic achievement during my undergraduate studies.

Natalia Krasnopolskaia Summer Undergraduate Research Fellowship
University of Toronto May 2022
Awarded for conducting summer research under the Department of Physics.

Dean's List Scholar
University of Toronto June 2021 - June 2023
Awarded for high academic achievement during my undergraduate studies.

University of Toronto Scholar
University of Toronto October 2019
Awarded to freshmen entering with high academic performance during their high school.

International Award for Young People (Bronze)
The Duke of Edinburgh's Award International Association March 2019
Awarded for community leadership during high school.

Presentations

Talk: **Sidhant Kumar Suar**, Dr. Kinwah Wu, Dr. Ellis R. Owen, (July 2025). *Galactic Scale Bubbles in Galaxies - Beyond the Standard Leptonic Scenario.* National Astronomy Meeting, Durham University

Poster: **Sidhant Kumar Suar**, Dr. Janosz Dewberry, (August 2023). *Listen-*

ing to Gas Giant Planets.
CITA Research Fair, University of Toronto

Poster: **Sidhant Kumar Suar**, Dr. Keith Vanderlinde, (October 2022). *Characterization and Performance Testing of RFoF Units for the CHORD Telescope Array.*
Undergraduate Research Fair, University of Toronto

Conferences and Workshops

National Astronomy Meeting
Durham University July 2025

Canadian Astroparticle Physics Summer School (invited)
Queen's University May 2022

- Selected to attend a summer school on astroparticle physics focused on the detection and phenomenology of probable dark matter candidates.

Outreach

AstroTours
University of Toronto 2022-2023

- Volunteered in this program to demonstrate upper-level astrophysics topics to high school students.

Volunteer Mentor
Center of Integrated and Sustainable Development 2019-Present

- Working towards women's empowerment, skill development, health, and hygiene. It has led to their economic growth and quality of life to ensure a sustainable ecosystem for rural entrepreneurship.

Volunteer Mentor
Kalinga Institute of Social Sciences 2017-Present

- Contributing to the underprivileged indigenous students' academic learning and mental health.

Programming Skills

Languages & Packages: Python, C++, Fortran, Athena++, aafragpy, naima, GYRE, REBOUND, REBOUNDx, TensorFlow, Keras, Wolfram Mathematica, HTML, CSS, LaTeX

Operating Systems: Windows, Linux (High-performance computing), macOS