MAYUKH BAGCHI

PhD Candidate in Astronomy & Instrumentation

Department of Physics, Engineering Physics and Astronomy
Queen's University, Kingston, ON, Canada

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RESEARCH INTERESTS

High-frequency radio astronomy instrumentation • Very Long Baseline Interferometry (VLBI) • Black hole imaging • Millimeter/submillimeter detector development and Readout • Balloon-borne telescopes

EDUCATION

Ph.D. in Astronomy and Instrumentation *Sept 2023 – Present*
Queen's University, Kingston, ON, Canada
Advisor: Prof. Laura Fissel
Current GPA: 3.65
Coursework: General Relativity, Electrodynamics
Research Focus: Design and development of the Balloon-borne VLBI Experiment (BVEX)

M.Sc. in Astronomy and Instrumentation *Sept 2021 – Sept 2023*
Queen's University, Kingston, ON, Canada
GPA: 3.7
Thesis: Advances in Microwave and Sub-mm Astronomical Instrumentation and Analysis
Coursework: Stellar Structure, Radio Astronomy, Statistics, Interstellar Medium

B.Tech. in Electrical and Electronics Engineering *May 2016 – July 2020*
SRM Institute of Science and Technology, Chennai, India
CGPA: 9.23/10.0
*Relevant Coursework:*Engineering Physics, Power Electronics, Microcontrollers, Control Systems, Digital Signal Processing

RESEARCH EXPERIENCE

Graduate Research

Balloon-borne VLBI Experiment (BVEx) *Queen's University*
Jan 2022 – Present
Principal Investigator, NRAO/HSA Proposal VLBA/25A-342 (12 hours approved) for simultenous radio observation with BVEX

- Leading development of a novel 22 GHz balloon-borne radio telescope for VLBI observations
- Designing backend and signal processing chains for high-altitude operation
- Implementing VLBI-compatible data acquisition and storage systems for balloon-borne platforms
- Developing position-tracking hardware and an ultra-stable OCXO-based timing chain to meet the timing requirements of a mobile VLBI station

CCAT-prime MKID Readout Development *Queen's University*
2021 – 2023

- Performed atmospheric characterization simulations for optimal detector performance at 5600m altitude
- Analyzed simulated detector response characteristics for the Prime-Cam instrument to improve the tone-tracking firmware

Star Formation and Magnetic Field Studies *Queen's University*
2021 – 2023

- Analyzed polarimetry data from JCMT and Planck telescopes to trace magnetic field alignment
- Applied stacking analysis techniques to improve signal-to-noise ratio in core-scale magnetic field studies
- Correlated 70 μm luminous sources with polarized intensity signals to understand field-formation relationships

Undergraduate Research

Dark Matter Detection Research *Purdue University(remote)*
Nov 2020 – June 2021
Supervisor: Prof. Rafael Lang

- Developed theoretical models for direct detection of dark matter interactions using accelerometer arrays
- Implemented data acquisition and analysis pipelines for the "Windchime" project
- Performed Monte Carlo simulations of expected dark matter signals

Superconducting Cyclotron Instrumentation *Variable Energy Cyclotron Centre*
Apr 2019 – Jul 2019

- Designed a 20kV, 15mA inflector power supply using switched-mode schemes
- Built and characterized a charged particle detector for nuclear property studies
- Gained experience with ECR ion sources

Multi-particle System Dynamics *Saha Institute of Nuclear Physics*
Apr 2018 – Jul 2018

- Studied statistical mechanics of multi-particle systems using VPython simulations
- Investigated lattice structures and packing efficiency in crystalline materials, including analysis of cadmium sulphide crystal structures using scanning tunneling electron microscopy (STEM)

TEACHING EXPERIENCE

Head Teaching Assistant – APSC 102: Engineering Physics Lab *Queen's University*
Fall 2021, Fall 2022, Fall 2023 – Grading

- Supervised and coordinated a team of teaching assistants
- Developed rubrics and grading standards for first-year undergraduate laboratory reports

- Mentored undergraduate engineering students in experimental physics techniques

Teaching Assistant – Multiple Courses *Queen's University*

- ASTR 102: Astronomy (Fall 2023) – Led discussion sections and graded assignments
- PHY 250: Electronics Lab (Winter 2022, 2024, 2025) – Designed experiments and supervised labs
- Undergraduate Thermodynamics (Winter 2022) – Conducted tutorials and office hours

PUBLICATIONS AND CONFERENCES

Peer-Reviewed Publications

1. **Bagchi, M.**, et al. (2019). "Wireless Charging Scheme for Medium Power Range Application System." *International Journal of Power Electronics and Drive Systems*, 11(4), pp. 1979-1986. DOI: 10.11591/ijpeds.v11.i4.pp1979-1986

Conference Presentations

1. **Bagchi, M.** (2024). "An RFSoC-Based Backend and Timing Reference System for Balloon-Borne VLBI Experiment." Oral presentation at CASCA Annual Meeting, Toronto, ON
2. **Bagchi, M.** (2023). "BVEX: Balloon-borne VLBI EXperiment." Oral presentation at CASCA Annual Meeting, Penticton, BC
3. **Bagchi, M.** (2023). "Technical Challenges in Balloon-borne VLBI." Oral presentation at Scientific Ballooning Technologies Workshop, Minneapolis, MN
4. **Bagchi, M.** (2022). "Balloon-borne VLBI Experiment: Design and Development." Poster presentation at CASCA Annual Meeting, Waterloo, ON. *Runner-up for Best Student Poster Award*

Workshops & Professional Development

- **20th NRAO Synthesis Imaging Workshop** *2024*
  Socorro, NM – Radio interferometry imaging, data calibration, RFI flagging, VLBA data reduction
- **CASPER Workshop** *2022*
  Cagliari, Italy – Week-long workshop on FPGAs in radio astronomy (INAF/CASPER)
- **CSA STRATOS Campaign** *2023*
  Timmins, ON – Flew BVEXTracker position tracking sensor on CNES gondola
- **Haystack Observatory Collaboration Visit** *2022,2025*
  Westford, MA – BVEX project collaboration and system testing

TECHNICAL SKILLS

Programming Languages: Python (advanced), MATLAB (proficient), C/C++ (advanced), VHDL
Astronomical Software: CASA, AIPS, Astropy, DS9, Sched
Data Analysis: NumPy, SciPy, Pandas, Matplotlib, Machine Learning (scikit-learn)
Hardware & Instrumentation: Xilinx Vivado, FPGA programming, RF circuit design, Microcontrollers
Other Tools: Git/GitHub, LaTeX, Adobe Creative Suite, Linux/Unix systems

OBSERVING EXPERIENCE

Radio Telescopes: Experience with observing using K-band radio telescope and VLBI data reduction and analysis
Submillimeter Telescopes: Analysis of JCMT polarimetry data
Space Telescopes: Experience analyzing Planck satellite dust emission maps

AWARDS AND HONORS

Harold M. Cave Travel Scholarship *2023*
Department of Physics, Engineering Physics and Astronomy, Queen's University

CASCA Student Committee Poster Award *2022*
Runner-up for Best Student Poster Presentation

Merit-Based Scholarships *2016-2019*
SRM Institute of Science and Technology

First Prize for Physics Project *2017*
Department of Physics and Nanotechnology, SRM IST

PROFESSIONAL SERVICE & OUTREACH

Science Communication

- YouTube Channel: Creating astronomy and science education content (@mayukh_bagchi)
- Queen's Observatory: Volunteer for public open house events (2021-present)
- Science Rendezvous: Volunteer science communicator, Canada's largest science festival

ASTROPHILIA – Founder and Organizer *Feb 2018 – July 2021*
SRM Institute of Science and Technology

- Established university-affiliated astrophysics and cosmology club
- Organized lecture workshops and guest seminars by international experts
- Coordinated outreach activities to promote astronomy education

Teaching and Mentorship

- Sivananda Ashram NGO, Chennai: Volunteer teacher for Science, English, and Mathematics

SELECTED ENGINEERING PROJECTS

Solareon Racing Team – Electronics Lead *Oct 2017 – Jul 2018*

- Developed wireless CAN protocol for solar electric racing car
- Won "Most Innovative Design Award" at SUVC 2018
- Gained hands-on experience building solar-powered vehicles from scratch

Additional Projects:

- H-Bridge inverter for wireless power transfer applications
- Smart IoT-enabled dustbin using machine learning and image processing
- Swarm robotics system for autonomous surveillance
- Voice-controlled IoT smart home devices

PROFESSIONAL DEVELOPMENT

Winter Internship – CESC Limited Thermal Power Plant *Dec 2017 – Feb 2018*

- Gained practical experience in power plant operations
- Studied Automatic Load Frequency Control (ALFC) and Automatic Voltage Regulator (AVR) systems

LANGUAGES

English (fluent), Hindi (native), Bengali (native)