

Aiden Weatherbee

M.Sc. Physics | Spacecraft GNC | Formation Flying | Exoplanet Instrumentation

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RESEARCH PROFILE

Physics and space-engineering researcher leading an end-to-end Mini-X precursor concept for the Large Interferometer for Exoplanets (LIFE). Develops high-fidelity spacecraft dynamics, relative-navigation and formation-control simulations, and robotic hardware-in-the-loop testbeds. Connects millimetre-scale formation-flying performance to optical path difference, tip/tilt residuals, null depth, signal-to-noise ratio, and exoplanet yield.

EDUCATION

Master of Science in Physics

2025–Present

York University, Toronto, Ontario

Thesis: *Derisking the LIFE Mission: End-to-End GNC Verification and Yield Analysis for the Mini-X Precursor.*

Supervisors: Sarah Rugheimer and Michael Bazzocchi.

Bachelor of Engineering in Space Engineering

2019–2025

York University, Toronto, Ontario

RESEARCH EXPERIENCE

Graduate Researcher - ASTROLab and Exoclimateers Research Group

2025–Present

York University, Toronto, Ontario

- Conceived and lead the Mini-X precursor study for a LIFE-like five-spacecraft mid-infrared nulling interferometer at Sun–Earth L2, spanning formation geometry, orbit selection, spacecraft dynamics, GNC, and science-performance interfaces.
- Built and validated a high-fidelity Basilisk simulation with JPL DE440 ephemerides, variable-step truth propagation, gravity-gradient and environmental disturbance models, relative metrology, UKF estimation, attitude control, reaction wheels, pulsed micropropulsion, and formation-control trade studies.
- Quantified the effects of orbit family, chief geometry, formation rotation, viewing angle, and controller choice on closed-loop position error, attitude error, and delta-v; linked the resulting residuals to optical path difference, tip/tilt, null depth, SNR, and detection yield.
- Developing optics-aware minimum-intervention and allocator-aware control methods alongside hardware-in-the-loop robotic testbeds for close-proximity operations.

Researcher - Exoplanet Atmospheres and Astronomy Education

2024–2025

York University, with Sarah Rugheimer and Elaina Hyde

- Developed a Python-based workflow for exoplanet transit photometry using York University's 1-metre Allan I. Carswell Observatory; collected and processed transit, galaxy, variable-star, and nebular observations.
- Created JWST and Hubble image-processing tutorials, scientific visualizations, and instructional videos using Python, Astropy, PixInsight, Siril, and GIMP for use in undergraduate astronomy education.

Research Assistant - Spacecraft Vision and Robotic Capture

2022–2023

York University, in collaboration with MDA

- Developed RGB-D and machine-learning vision algorithms for spacecraft tracking, pose estimation, collision avoidance, and robotic capture in simulated space environments.
- Integrated vision pipelines with NVIDIA Jetson Nano and Raspberry Pi platforms and designed force-sensing concepts for robotic spacecraft gripping applications.

PUBLICATION AND SELECTED PRESENTATIONS

- **Weatherbee, A.**, Rugheimer, S., and Bazzocchi, M. (2026). *Sun–Earth L2 Point Nulling Interferometry Formation Flying Performance Analysis*. AAS/AIAA Astrodynamics Specialist Conference, Whistler, BC, Paper 967.
- **Poster:** *Derisking the LIFE Mission: End-to-End GNC Verification and Yield Analysis for the Mini-X Precursor*. LIFE Conference, Barcelona, 2026.
- **Oral presentation:** Paper 967, AAS/AIAA ASC, Whistler, 2026.

SELECTED ENGINEERING AND LABORATORY EXPERIENCE

Capstone Design Team Member - CSA/MDA Stratos Balloon Payload

2024–2025

York University, RSONar 3 mission

- Worked in a six-person team to design a CMOS imaging payload for measuring stratospheric brightness on the Canadian Space Agency / MDA Stratos balloon mission.
- Coordinated payload requirements and design decisions with Dr. Michael Bazzocchi, CSA, and MDA while working toward flight-relevant engineering standards.

Co-Lead, Mechanical Design Team - ESSENCE CubeSat

2019–2020

York University

- Co-led mechanical design for a 3U CubeSat concept to monitor snow and ice coverage in Northern Canada.
- Performed component selection, SolidWorks CAD, Siemens NX thermal analysis, and preliminary compliance work for CubeSat standards.

TEACHING AND TECHNICAL COMMUNICATION

Teaching Assistant - Undergraduate Physics Courses

2025–Present

Department of Physics and Astronomy, York University

- Delivered lectures for **PHYS 3070 - Planets and Planetary Systems**, including exoplanet transits, observational methods, and Python-based transit analysis.
- Graded coursework for **PHYS 1800 - Engineering Mechanics** and **PHYS 1801 - Electricity, Magnetism, and Optics for Engineers**.
- Independently ran laboratory sections for **PHYS 2221**, **PHYS 2222**, **PHYS 1421**, and **PHYS 1422**, covering electronics, optics, and introductory motion and forces, along with experimental design, uncertainty analysis, data reduction, and technical reporting.

TECHNICAL EXPERTISE

Spacecraft GNC	Formation flying; relative navigation; CR3BP and ER3BP dynamics; UKF estimation; PID, LQR, and LQI control; MRP attitude control; reaction-wheel and microthruster allocation; convex optimization; proximity operations.
Simulation and tools	Basilisk; Python; NumPy; SciPy; Astropy; SPICE; JPL DE440 ephemerides; MATLAB; STK; Git; Linux-based scientific workflows.
Robotics and hardware	Robotic gantry testbeds; hardware-in-the-loop validation; motion capture; RGB-D sensing; spacecraft vision; robotic arm control; star trackers; IMUs; laser metrology; embedded computing.
Engineering and design	SolidWorks; Siemens NX; Fusion 360; Blender; finite-element and thermal analysis; spacecraft mechanical design; payload integration.
Astronomy and data	JWST and Hubble data; exoplanet transit photometry; astronomical image processing; PixInsight; Siril; GIMP; scientific visualization; LIFESimMC science-yield analysis.

AWARDS AND HONORS

York University RAY Research Award	2022, 2023, 2024
Lassonde Undergraduate Research Award (LURA)	2022
York University Dean's List	2020–2021
York University Entrance Scholarship	2019