

Madelyn (Hoying) MacRobbie
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Assistant Professor, Michigan Technological University Department of Mechanical and Aerospace Engineering

EDUCATION

Massachusetts Institute of Technology and Harvard Medical School, 2020-present

Ph.D. in Medical Engineering and Medical Physics, AeroAstro track, with a certificate in Bioastronautics; NSF Graduate Research Fellow; Zonta International Amelia Earhart Fellow

- Research in MGH's Human Performance Lab with Dr. Aleksandra Stankovic and Wellman Imaging Center with Dr. Guillermo Tearney; aerospace physiology.

M.S. in Aeronautical and Astronautical Engineering; space analog systems design with Dr. Dava Newman

Duquesne University, 2016-2020

B.S. in Biomedical Engineering and B.A. in Physics, Math minor, Honors Fellow

- Duquesne Swim Team: NCAA D1, Atlantic 10 Conference Champions, 2018-2019
- 2020 NCAA Woman of the Year nominee, Atlantic 10 Conference

WORK EXPERIENCE

Moon and Mars Med-SurgBay Design, University of Arizona-Biosphere 2, 2024-present

- Design, build, and test of a medical-surgical bay for Moon and Mars habitats; implemented in the Biosphere 2 SAM analog facility alongside leading flight surgeons and exploration physicians.

Teaching Assistant, MIT and Harvard Medical School, Spring 2021 - Spring 2025

- MIT HST.928 Healthcare Ventures
- Harvard HST.020 Musculoskeletal Pathophysiology (volunteer)
- MIT 16.89 Space Systems Engineering, undergraduate and graduate design capstone course:
 - Rapid development of a refueling experiment; launched on New Shepherd Aug 2021.
- MIT 16.S688 Planetary Surface Technology Development

Central Intelligence Agency Intern, CIA Headquarters, Summer 2018-2022

- Top Secret/SCI security clearance with a full-scope polygraph.
- 2018: Directorate of Analysis. 2019-2021: Directorate of Science and Technology. 2022: Directorate of Operations. Exceptional Performance Award.

Space Crop Production Intern, NASA Kennedy Space Center, Summer 2022

- With Dr. Ralph Fritsche and Dr. Grace Douglas. Developed integrated research roadmaps across directorates and collaborated to establish working groups on astronaut health topics.

Solid State Laser Materials Intern, NASA Langley Research Center, Spring 2018

- Remote Sensing Branch, with Dr. Brian M. Walsh. Performed experiments in luminescence spectroscopy of crystals doped with elements in the lanthanide series.

OPERATIONAL EXPERIENCE

Harvard ICM Medical Student Intern, Massachusetts General Hospital, Feb.-May 2025

- Clinical rotations in emergency, intensive care, cardiac intensive care, and infectious disease floors.
- Pathways rotation with internal medicine residents, in which an unsolved medical case was investigated in detail and new treatment directions proposed over a two-week period.
- MIT Catalyst program completion, in which a novel medical solution is designed and developed to meet needs identified during time in clinic.

Payload Operator, MIT [To the Moon to Stay](#), Mar.-Apr. 2025

- Mission onboard Intuitive Machines Nova-C lander, deployed on Lunar Outpost MAPP rover.

Pale Red Dot Commander, MIT, May 2023

- Designed and led a Mars analog mission for 11 crew members, with over 25 non-analog researchers. First known test of a distributed Mars mission architecture.

Project MADMEN Commander, Mars Desert Research Station, Jan. 2024

- Commander of a crew of 6 analog members on a search-for-life Mars analog mission involving geology, microbiology, and food production research.

PEER-REVIEWED PUBLICATIONS

MacRobbie M et al. (2025). Analogs as a Research Platform: Systems-Based Optimization Approach to Facility Selection. *Analog Astronaut Research Journal*.

MacRobbie M et al. (2025). Space-Based Solar Power: Implications for Operational Robustness in Lunar EVAs and Exploration Architectures. *Aerotecnica Missili & Spazio*.

MacRobbie M et al. (2025). Evaluating Risk for Astronaut Involvement in In-Space Manufacturing: Analog Field Testing and Future Planetary Surface Procedures. *Wilderness and Environmental Medicine*.

MacRobbie M et al. (2025). Evaluating Fluid-Driven Probe Contact in Altered Gravity Environments. *MDPI Biosensors*.

MacRobbie M et al. (2025). Evaluating the Impact of Mission Architecture on Crew Dynamics in Space Exploration. In review, *npj Microgravity*.

MacRobbie M et al. (2025). Quantifying the Gravity Dependence of the Tight Junction Barrier Function in Intestinal and Respiratory Epithelium. In preparation.

McCallin R, **Hoying M**, et al. (2020). Project ALIEN. *Duquesne University Collection*.

Hoying M (2019). Radiation shielding: the astronomical problem of protecting astronauts on Mars. *DU Quark*.

CONFERENCE PROCEEDINGS

MacRobbie M et al. (2025). Measuring the Microgravity Response in Epithelial Tissue Barrier Function: A Path to Flight. *AIAA Aviation Forum and ASCEND 2025*.

MacRobbie C, **MacRobbie M**, et al. (2025). Architecture for a Flexible, Scalable, and Sustainable Lunar Infrastructure. *AIAA Aviation Forum and ASCEND 2025*.

MacRobbie M and MacRobbie, C. (2025). Analogs as a Research Platform: Quantitative Facility and Experiment Selection Framework. *IEEE Aerospace Conference Proceedings*.

Mckinney, L, et al. (2025). MARTEMIS: Mars Architecture Research using Taguchi Experiments on the Moon with International Solidarity. *IEEE Aerospace Conference Proceedings*.

Lordos G, **Hoying M**, et al. (2024). Leveraging Economies of Scale and Gains from Specialization for Robust Crewed Mars Architectures. *IEEE Aerospace Conference Proceedings*.

Hoying M et al. (2024). Space-Based Solar Power for Operational Robustness in Lunar EVAs and Exploration Architectures. *Proceedings of the 75th International Astronautical Congress*.

Lordos G, **Hoying M** et al. Reusable Mars Transportation Architecture Modeling for Larger Crewed Missions. *Proceedings of the 75th International Astronautical Congress*.

Mckinney, L, et al. (2024). MARTEMIS: Mars Architecture Research using Taguchi Experiments on the Moon with International Solidarity. *Proceedings of the 75th International Astronautical Congress*.

Hoying M et al. (2023). Pale Red Dot. *NASA RASC-AL Technical Papers*.

Hoying M et al. (2023). Framework for Large-Scale, Low-Cost Mars Analog Missions. *74th International Astronautical Congress*.

Lordos G, **Hoying M**, et al. (2023). Pale Red Dot. *AIAA ASCEND 2023*.

Erkel D et al. (2022). Distributed, Agile, and Redundancy-based Concurrent Engineering (DARCE) for Technology Demonstrator and Cost-Effective Space Missions. *73rd International Astronautical Congress*.

Gentgen C et al. (2022). BART & MARGE: Bipropellant All-in-one ISRU Truck & Mobile Autonomous Reactor Generating Electricity. *AIAA ASCEND 2022*.

Hoying M et al. (2021). Project MADMEN: Proposed Analog Fidelity Comparison to ALIEN Martian Mission. *IEEE Aerospace Conference Proceedings*.

Hoying M, et. al. (2019). Solar Orbital Logistics, Forecasting, and Radiation Module (SOLFARM). *1st International Orbital Debris Conference Papers*.

HONORS AND AWARDS

- Duquesne University Athletics Hall of Fame Inductee, 2026

- National Science Foundation Graduate Research Fellow, 2020-2025
- Zonta International Amelia Earhart Fellow, 2024
- P.E.O. International Scholar, 2025
- MIT Collamore-Rogers Fellowship, 2025
- MIT Surpina and Panos Eurnekian Biotechnology Fund Fellowship, 2024
- 2023 Emerging Space Leader, International Astronautical Federation
- 2024 IEEE Aerospace Track 13 (Systems Engineering, Management, and Cost) Best Paper Award
- 2020 NCAA Woman of the Year nominee, Atlantic 10 Conference
- 2018 and 2019 Atlantic 10 Conference Champion
- Sigma Xi Associate Member, 2020-present
- MIT Media Lab and Zero-G Parabolic Flight Selected Flyer and Experiment, 2024
- Asclepios IV Analog Astronaut (international lunar simulation), 2024
- Duquesne University Department of Engineering Outstanding Student Award, 2020
- Duquesne University Rangos School of Health Sciences Outstanding Student Award, 2020
- Duquesne University Certificate of Excellence in Physics, 2020

INVITED LECTURES AND TALKS

- Epithelial Breakdown in Space and its Impacts on Astronauts. *Wellman Research Seminar, MGH*
- Systems Optimization for Analog Facility Utilization. *EDEN-LUNA Workshop, DLR*
- Sensor Payloads for Space, *Putney Student Travel MIT Summer Camp* (lecture and workshop)
- Mission to Mars: How to Eat, Sleep, and Think Like an Astronaut. *2024 Cambridge Science Festival; 2025 Cambridge Science Festival* (lecture; sold out event)
- Astronaut Lunch & Learn: Insights from the Final Frontier, *2024 Cambridge Science Festival* (panel member alongside retired NASA astronaut Jeffrey Hoffman and others)
- Inventher: Devices and Operations for Space Exploration, *2024 Women in Aerospace and Astronautics Conference*, University of Michigan
- Flexible Analog Mission Design for Operational Risk Management, *2024 Analog Astronaut Conference*, University of Arizona Biosphere 2
- How to Eat, Sleep, and Think Like an Astronaut, *2023 Undergraduate Research Program Guest Lecture*, Duquesne University
- Mission Planning for Mars: How do we keep astronauts safe on another planet? *2023 Science and Engineering Exploration Camp*, University of Michigan
- Aero 200 Culture and Careers Panel Discussion (panel member), *2023 University of Michigan Aero 200*

LEADERSHIP

- Deep Space Food Consortium analog subject matter expert, 2025-present
- ACHIEVED Competition Expert, *Space Generation Advisory Council*, 2025
- Lunar Mill CAN-RGX parabolic flight experiment team advisor, *University of Waterloo*, 2024-present
- Graduate Resident Advisor, *MIT Baker House*, 2022-2025
- DU Infinity and Beyond Founder and Leader, *Duquesne University*, 2017-2020; Advisor, 2025
- MIT Space Resources Workshop Team Lead, *MIT AeroAstro*, 2022-2025
- Growing Beyond Earth Judge, *Fairchild Botanical Gardens and NASA Kennedy Space Center*, 2023
- HST Admissions Committee, *MIT-Harvard Medical School*, 2022-2024
- Medicines Sans Frontieres/Doctors Without Borders Student Chapter President, *Duquesne*, 2019-2020
- ISS Downlink event for Charlestown, MA elementary schools, *Massachusetts General Hospital*, 2024

SELECTED CERTIFICATIONS

- MIT Kaufmann Teaching Certificate, 2025
- FAA Private Pilot certificate, 2020
- FAA UAS Pilot certificate, 2021
- PADI Open Water Scuba and Enriched Air Nitrox certification, 2019
- MIT-Harvard Medical School HST Bioastronautics Certificate, 2025