Stephen J. M. McKay

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Research Interests

I study dusty star-forming galaxies (DSFGs), the most rapidly star-forming galaxies in the Universe. Using state-of-the-art telescopes such as the Atacama Large Millimeter/submillimeter Array (ALMA) and the James Webb Space Telescope (JWST), I investigate the stellar and dust properties and morphologies of these galaxies to understand their role in high-redshift galaxy evolution.

I currently work with Amy Barger at the University of Wisconsin–Madison and have published three first-author papers in the course of my PhD.

Keywords: *Submillimeter galaxies, high-redshift galaxies, dust-obscured star formation, radio interferometry*

Education

2021–present	**Ph.D. in Physics**, University of Wisconsin–Madison GPA: 3.87 Advisor: Prof. Amy Barger, Dept. of Astronomy
2021–2023	**M.A. in Physics**, University of Wisconsin–Madison GPA: 3.90
2017–2021	**B.S. in Physics and Mathematics**, Wheaton College (IL) GPA: 3.99 (graduated *summa cum laude*) Honors Thesis: "Implementation of Angular Momentum Transport by an Accretion Disk in MESA" Advisor: Dr. A. J. Poelarends

Awards & Honors

2024	Graduate Research Fellowship, Wisconsin Space Grant Consortium
2024	ALMA Ambassador Fellow, National Radio Astronomy Observatory
2022	Best Teaching Assistant Spring 2022, Dept. of Physics, UW–Madison
2020	Barry M. Goldwater Scholarship
2020	Induction into Sigma Pi Sigma Honors Society
2020	Joseph Spradley Outstanding Physics Award, Dept. of Physics, Wheaton College
2020	Senior Scholarship, Wheaton College Alumni Association
2019 & 2020	Physics Merit Scholarship, Wheaton College
2017	National Merit Scholarship

Research Projects

2025–present	The Complete Spectroscopic Redshift Distribution of DSFGs Advisor: Prof. Amy Barger, UW–Madison Analyzed ALMA spectral line scans of >50 DSFGs to identify millimeter emission lines and redshifts. Used these literature redshifts to determine the full redshift distribution of submillimeter-bright DSFGs to $\gtrsim$90% completeness. Fit photometric redshifts to test the effectiveness of various photo-z methods for DSFGs. First-author paper in preparation.

2024–2025 Stellar Properties and Morphologies of JWST-selected DSFGs
Advisor: Prof. Amy Barger, UW–Madison
Constructed a unique sample of JWST/NIRCam color-selected DSFGs in order to compare the properties of faint submillimeter sources to those of brighter DSFGs. Fit spectral energy distributions and surface brightness profiles of the sample to understand their stellar populations and merger histories. First-author paper published (McKay et al. 2025, ApJ, 988, 135).

2023–2024 SCUBA-2 and ALMA Selections of Faint DSFGs in A2744
Advisor: Prof. Amy Barger, UW–Madison
Compared selection of DSFGs using ALMA 1.2 mm observations with a red color selection using JWST NIRCam data with SCUBA-2 850 μm observations. First-author paper published (McKay et al. 2024, ApJ, 962, 128).

2022–2023 Dust Properties of DSFGs in GOODS-S
Advisor: Prof. Amy Barger, UW–Madison
Used multiwavelength ALMA observations along with SCUBA-2 450 and 850 μm data to study the dust temperatures and spectral emissivity indices of 57 DSFGs by fitting models to their spectral energy distributions. First-author paper published (McKay et al. 2023, ApJ, 951, 48).

2020–2021 Implementing Accretion Disk Angular Momentum Transport into MESA
Advisor: Dr. A. J. Poelarends, Wheaton College
Senior Honors Thesis project using the Modules for Experiments in Stellar Astrophysics (MESA) code to simulate how an accretion disk around an accreting star regulates the angular momentum transfer and rotation speed of the star.

2019 Emission and Current Distribution of a Laboratory Plasma Arcade
Advisor: Dr. Darren Craig, Wheaton College
Ran trials of pulsed plasma array, operated CCD imaging, and analyzed extent of current distribution. Presented results at SPS Physics Congress 2019.

Refereed Publications

1. **McKay, S. J.**; Barger, A. J; Cowie, L. L.; & Nicandro Rosenthal, M. J. (2025). "The Physical Properties and Morphologies of Faint Dusty Star-forming Galaxies Identified with JWST." ApJ, 988, 135.
2. Nicandro Rosenthal, M. J.; Barger, A. J; Cowie, L. L.; Jones, L. H.; **McKay, S. J.**; & Taylor, A. J. (2025). "Spectroscopic Confirmation of a Massive Protocluster with Two Substructures at $z \simeq 3.1$." ApJ, 979, 247.
3. **McKay, S. J.**; Barger, A. J; & Cowie, L. L. (2024). "Comparing SCUBA-2 and ALMA Selections of Faint Dusty Star-forming Galaxies in A2744." ApJ, 962, 128.
4. **McKay, S. J.**; Barger, A. J; Cowie, L. L.; Bauer, F. E.; & Nicandro Rosenthal, M. J. (2023). "Dust Properties of 870 μm-selected Galaxies in GOODS-S." ApJ, 951, 48.

Research Talks

2025 "Spectroscopic Redshifts for Faint Dusty Star-forming Galaxies." *2025 Wisconsin Space Conference, University of Wisconsin–Green Bay.* Green Bay, WI.

2025 "A New View of Dusty Star-forming Galaxies with JWST and ALMA." *New Data that Challenge Underlying Assumptions in Early Galaxy Evolution, CHOIR collaboration workshop, Schoodic Institute.* Winter Harbor, ME.

2025 "Revealing Faint Dusty Star-forming Galaxies with JWST and ALMA." *Extragalactic Discussion Group Seminar, University of Hawaii Institute for Astronomy.* Honolulu, HI.

2025 "Revealing Faint Dusty Star-forming Galaxies with JWST and ALMA." *Instituto de Astrofísica, Pontificia Universidad Católica*. Santiago, Chile.

2024 "The Physical Properties of Faint Dusty Star-forming Galaxies in GOODS-S and A2744." *244th Meeting of the American Astronomical Society*. Madison, WI.

Poster Presentations

2024 **McKay, S. J.**, Barger, A. J, & Cowie, L. L. "Identifying Faint Dusty Star-forming Galaxies with JWST NIRCam." ESA/STScI conference: *Science with the Hubble and James Webb Space Telescopes VII: Stars, Gas, and Dust in the Universe*, Porto, PT.

2024 **McKay, S. J.**, Barger, A. J, & Cowie, L. L. "Comparing ALMA and SCUBA-2 Selections of DSFGs in Abell 2744." ALMA Ambassadors Poster Session, National Radio Astronomy Observatory, Charlottesville, VA.

2023 **McKay, S. J.**, Barger, A. J, & Cowie, L. L. "Unveiling the DSFG Population with a Red NIRCam Selection." STScI *First Year of JWST Science* Conference. Space Telescope Science Institute, Baltimore, MD.

2019 **McKay, S. J.**, Craig, D., McMillan, M., Rak, M., & Adams, C. "Emission and Current Density Distribution in an Extended Magnetic Arcade." Society of Physics Students *Physics Congress 2019*. Providence, RI.

Facilitated Conference Sessions

2025 Co-led *"Growing and Destroying Dust"* breakout session at CHOIR collaboration workshop, focused on understanding the existing paradigms and major open questions in dust formation and evolution.

Observing Experience

2025 Keck II 10-m telescope – KCWI – 2 nights integral field unit spectroscopy

2023–2025 Keck II 10-m telescope – DEIMOS – 5 nights multi-object spectroscopy

2023–2025 Keck I 10-m telescope – MOSFIRE – 7 nights multi-object spectroscopy

Teaching Experience

2021–2022 Teaching Assistant, Dept. of Physics, UW–Madison
Course: Physics 103 – Mechanics
6 discussion sections and 3 labs weekly
75 undergraduate students per semester

2019–2021 Observatory Assistant, Wheaton College
Course: Astronomy 305
Operated two deck telescopes and one 24 in dome telescope, 3 hours weekly
45 undergraduate students per semester

Outreach and Volunteering

2024–present	Activities for Community Outreach in STEM (ACORNS), *UW–Madison* Assist in leading planetarium visits, developing and running astronomy/physics demos, and other educational activities for K-12 students from low-income backgrounds through partnerships with local community centers, with the goal of developing ongoing relationships and increasing opportunities for STEM experiences.
2024	ALMA Ambassador, *NRAO*/*UW–Madison* Supported new ALMA users and those interested in interferometry by sharing expertise and facilitating community events. Led proposal preparation workshop at home institution and assisted in proposal review.
2022	PEOPLE Program, *UW–Madison* Helped teach a short-term physics summer class for high-school students from underrepresented minority groups. Led large-scale group demos on electricity and magnetism.

Summer Schools and Workshops

2025	CHOIR conference: New Data that Challenge Underlying Assumptions in Early Galaxy Evolution
2025	Picture an Astronomer Symposium
2024	Code/Astro: A Software Engineering Workshop for Astronomy
2023	IMPRS (Max Planck) Summer School: Galaxy Evolution with JWST
2023	SMA Interferometry School
2022	Penn State Summer School for Statistics for Astronomers XVII
2022	NRAO 18th Synthesis Imaging Workshop

Other Skills

Programming:	Proficient: Python (including `astropy`, `scipy`, `matplotlib`, `casa`, `bagpipes`, `cigale`, `emcee`, `pyBDSF`, `scikit-learn`, and `photutils`) Bash MATLAB Familiar: C/C++ Java FORTRAN (including `MAGPHYS` and `MESA`) Beginner: R Julia
Other software:	`Jupyter`, `CARTA`, `GALFIT`, `GILDAS`, `MAGMA`, `git`
Observing/lab skills:	Optical/near-IR spectroscopy (Keck/MOSFIRE, Keck/DEIMOS, Keck/KCWI) CCD imaging Oscilloscopes Soldering
Languages:	Spanish (limited working proficiency) German (elementary proficiency)