M. Ryleigh Davis

Planetary Science Ph.D. Candidate

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Summary

I am a Planetary Science Ph.D. candidate at Caltech interested in studying the composition of icy satellites throughout the solar system, and the surface processes which affect them. I use ground- and space-based telescope spectroscopy, ranging from UV through mid-infrared wavelengths, to explore these worlds.

Education

Ph.D. **California Institute of Technology**, Planetary Science — Sept 2020 to Jan 2026

M.Sc. **California Institute of Technology**, Planetary Science — May 2022

M.Sc. **Northern Arizona University**, Applied Physics — Aug 2018 to May 2020

- Thesis: Low Energy Electron Sputtering of Water Ice

B.Sc. **University of Arizona**, Astronomy & Physics — Aug 2013 to May 2017

Work & Research Positions

Graduate Student Researcher, Caltech - Division of Geological and Planetary Sciences — CA, USA
Aug 2020 to current

- Worked with Dr. Mike Brown using ground- and space-based telescope spectroscopy to study the compostion of icy satellites throught the solar system.

Senior Associate Consultant, Clarity Insights: Data Analytics Consulting — IL, USA
July 2017 to Aug 2018
1 year 1 month

- Lead developer for a team developing a platform for distributed computations and data analytics on the cloud (via pySpark and AWS) for a major financial institution.
- Worked with the Data Science team to implement relevant machine learning and predictive algorithms within the data analytics tool.

Telescope Operator, Univeristy of Arizona - Steward Observatory — AZ, USA
Jan 2014 to May 2017
3 years 5 months

- Operated Kuiper 1.5m and Bok 2.3m telescopes for research data acquisition
- Trained and certified new observers (Bok 2.2m/B&C Spec, Bok 2.2m/90Prime, Kuiper 1.55m/Mont4k, Ray White 21")
- Assisted Mountain Operations with Instrument changes, system testing, cleaning of mirrors and filters and other telescope maintenance projects as a summer intern.

NASA Space Grant, Univeristy of Arizona, Research Intern — AZ, USA
Aug 2015 to May 2016
1 year

- Worked with Dr. Caitlin Griffith to observe and reduce Kuiper 1.55m telescope data to examine and characterize the atmospheres of hot Jupiter exoplanets

Selected Awards

- **Caltech Center for Comparative Planetary Evolution (3CPE) Graduate Fellow**; (2021-current)
- **Alexander F. H. Goetz Fellowship**; Caltech (2020-2021)
- **Grad College/GSG Academic Scholarship Award**, Northern Arizona University Graduate College (2019)
- **Undergraduate Research Achievement**; University of Arizona Department of Astronomy (2017)
- **Best Poster**; BECUR Conference (2016)
- **Arizona Excellence Award**; University of Arizona (2013-2017)

Publications

- **Davis, M.R.**, Belyakov, M., Brown, M.E, and Wong, I. (2025). "Triton's Wake: Neptune's Destroyed Inner Moons Reveal Icy Satellite Interior Compositions". (in prep for submission to Science).
- Belyakov, M., **Davis, M.R.**, Wong, I., Batygin, K., and Brown, M.E. (2025). "Nereid as a Regular Satellite of Neptune". (in prep for submission to Science).
- Brown, M.E, Belyakov, M., Chandra, S., **Davis, M.R.**, McDowell, M., Pandya, A., Trinh, K., and Trumbo, S.K. (2025). "Such stuff as moons are made on: Deuterated water and the formation of the satellites od Uranus". PNAS (submitted).
- Brown, M.E, Trumbo, S.K., Belyakov, M., **Davis, M.R.**, and Pandya, A. (2025). "Deuterated water on the satellites of Saturn". The Planetary Science Journal (submitted).
- Brown, M.E, Trumbo, S.K., Belyakov, M., **Davis, M.R.**, and Pandya, A. (2025). "A JWST study of CO_2 on the satellites of Saturn". The Planetary Science Journal (in press).
- Belyakov, M. et al. (inc. **Davis, M.R.**) (2025). "Palomar and Apache Point Spectrophotometry of Interstellar Comet 3I/ATLAS", Research Notes of the AAS, 9, 194.
- **Davis, M.R.**, Trumbo, S.K., Brown, M.E, and Belyakov, M. (2025). "Spectroscopic Mapping of Callisto with HST/STIS and Implications for its Surface Composition". The Planetary Science Journal, 6, 161.
- Belyakov, M., **Davis, M.R.**, Milby, Z., Wong, I., and Brown, M.E. (2024). "JWST Spectrophotometry of the Small Satellites of Uranus and Neptune". The Planetary Science Journal, 5(5), 119.
- **Davis, M.R.** and Brown, M.E. (2024). "Pwyll and Manannán Craters as a Laboratory for Constraining Irradiation Timescales on Europa". The Planetary Science Journal, 5, 107.
- **Davis, M.R.**, Brown, M.E., & Trumbo, S.K. (2023). "The Spatial Distribution of the Unidentified 2.07 µm Absorption Feature on Europa and Implications for its Origin". The Planetary Science Journal, 4(8), 148.
- Kunimoto, M., Vanderburg, A., Huang, C.X., **Davis, M.R.**, et al. (2023). "TOI-4010: A System of Three Large Short-period Planets with a Massive Long-period Companion". The Astronomical Journal, 166(1), 7.
- Trumbo, S.K., **Davis, M.R.**, Cassese, B., and Brown, M. E. (2022). "Spectroscopic Mapping of Io's Surface with HST/STIS: SO2 Frost, Sulfur Allotropes, and Large-scale Compositional Patterns", The Planetary Science Journal, 3(12), 272.
- **Davis, M.R.**, Meier, R.M., Cooper, J.F., and Loeffler, M.J. (2021). "The contribution of electrons to the sputter-produced O2 exosphere on Europa". The Astrophysical Journal Letters, 908(2), L53.
- **Fitzpatrick (Davis), M.R.** (2020). "Low Energy Electron Sputtering of Water Ice" (M.Sc. Thesis, Northern Arizona University).
- Zellem, R.T., Griffith, C.A., Pearson, K.A., Turner, J.D., Henry, G.W., Williamson, M.H., **Fitzpatrick (Davis), M.R.**, Teske, J.K., and Biddle, L.I. (2015). "XO-2b: A hot jupiter with a variable host star that potentially affects its measured transit depth", The Astrophysical Journal, 810(1), 11.

Grants and Observing Programs

PI Programs:

- Tracing the Origin of Hydrated Minerals on the Small Satellites of Uranus and Neptune (PI); Palomar/NGPS (2025B); 5 nights
- Constraining the Composition and Thermal Histories of Silicate Minerals on Callisto (PI); JWST/MIRI Cycle 3 GO (2024-2025); 15.96 hrs
- Reconstructing the Histories of the Ice Giant Systems through Small Satellite Observations (Co-PI); JWST/NIRSpec Cycle 3 GO (2024-2025); 26.71 hrs
- Photometric U and B Band Observations of Bright Transiting Exoplanets to Constrain their Atmospheric Compositions (Undergraduate PI); Kuiper/Mont4K & Bok/90Prime (2014-2017); 37 nights

Co-I Programs:

- The Aftermath of a Transient Deposition Event on Europa; JWST/NIRSpec Cycle 3 DDT (2024); 13.2 hrs
- The Saturnian satellites as a laboratory for CO2 in the outer solar system; JWST/NIRSpec Cycle 2 GO (2023-2024); 21.2 hrs
- Complete NIRSpec coverage of Europa's surface: CO2, salt hydrates, and the potential for unexpected discovery;

JWST/NIRSpec Cycle 2 GO (2023-2024); 21.2 hrs

- Titan's Tropospheric Methane Abundance Across the Seasons; NASA Solar System Workings (2019-2022)
- A Global Map of Titan's Tropospheric Methane Abundance Near Northern Solstice; Keck II/NIRSPEC (2017-2019); 10 half nights

Conference Talks

- **Davis, M.R.**, Belyakov, M., Wong, I., and Brown, M.E. (Jun 2025) "JWST Spectroscopy of the Small Inner Satellites and Rings of Uranus and Neptune", OPAG Meeting 2025 #6008 (Tucson, AZ)
- **Davis, M.R.** and Brown, M.E. (Jan. 2025) "Exploring the Composition of Callisto's Dark Material with JWST MIRI MRS", JWST Solar System Science Workshop (Meudon, France)
- Belyakov, M., **Davis, M.R.** and Brown, M.E. (Jan. 2025) "JWST results on the small moons of the ice giants", JWST Solar System Science Workshop (Meudon, France)
- **Davis, M.R.**, Trumbo, S.K., and Brown, M.E. (Dec 2024) "Spectroscopic Mapping of Callisto's Surface with HST/STIS", AGU Fall Meeting P32A-06 (Washington D.C.)
- Brown, M.E., Chandra, S., Trumbo, S.K., and **Davis, M.R.** (Dec 2024). "JWST measurement of the D/H ratio of water ice on the surfaces of the mid-sized Saturnian satellites and the implications for the formation of the Saturnian system", AGU Fall Meeting P32A-07 (Washington D.C).
- **Davis, M.R.** and Brown, M.E. (Dec 2023). "Pwyll and Manannán Craters as a Laboratory for Constraining Irradiation Timescales on Europa", AGU Fall Meeting P43B-04 (San Francisco, CA).
- Brown, M.E., Trumbo, S.K., and **Davis, M.R.** (Dec 2023). "JWST Observations of the Icy Saturnian Satellites: A Laboratory for CO2 and Organics in the Outer Solar System", AGU Fall Meeting P32B-05 (San Francisco, CA).
- **Davis, M.R.** and Brown, M.E. (Oct 2023). "Pwyll Crater as a Laboratory for Understanding Irradiation Timescales on Europa", Workshop on the Origins and Habitability of the Galilean Satellites (Marseille, France)
- **Davis, M.R.** and Brown, M.E. (Oct 2022). "A Critical Analysis of the 2.07 µm Absorption Feature on Europa", DPS Meeting #54 (London, Canada).
- Carmack, R., **Davis, M.R.**, and Loeffler, M.J. (Oct 2022). "Sputtering of O2 from Icy Satellites via Electron Irradiation", DPS Meeting #54 (London, Canada).
- Trumbo, S.K., **Davis, M.R.**, and Brown, M.E. (Oct 2022). "Volcanic Sulfur Products and Large-scale Compositional Patterns on Io from HST/STIS", DPS Meeting #54 (London, Canada).
- **Fitzpatrick, M.R.** and Griffith, C.A. (Jan 2020). "New Reduction Techniques for Echelle Spectroscopy of Extended Objects: Creating a Global Map of Titan's Tropospheric Methane Humidity", AAS Meeting #235 (Honolulu, HI).
- **Fitzpatrick, M. R.** and Loeffler, M. J. (Dec 2019). "The Sputtering Yield of Electron Irradiated Water Ice and Its Dependence on Temperature", AGU Fall Meeting (San Francisco, CA).
- **Fitzpatrick, M. R.** and Loeffler, M. J. (Sept 2019). "Composition of the Sputtered Flux in Electron Irradiated Ices", Flagstaff Astronomy Symposium (Flagstaff, AZ).
- **Fitzpatrick, M.R.** and Griffith, C.A. (Feb 2019). "Mapping the Surface Methane Humidity on Titan", Women in Space Conference (Phoenix, AZ)
- Carmen, A., Calahan, J., ..., **Fitzpatrick, M.R.**, et al. (Jan 2017). "Active Galactic Videos: A YouTube Channel for Astronomy Education and Outreach", AAS Meeting #229.
- **Fitzpatrick, M.R.**, Martins-Filho, W., Griffith, C.A., Pearson, K., Zellem, R.T., and AzGOE (Oct. 2016). "A Study of the Effects of Underlying Assumptions in the Reduction of Multi-Object Photometry of Transiting Exoplanets", DPS Meeting #48 (Pasadena, CA).
- McGraw, A.M., Austin, C., Noyes, M., ..., **Fitzpatrick, M.R.** (Jan 2016). "Promoting undergraduate involvement through the University of Arizona Astronomy Club", AAS Meeting #227 (Kissimmee, FL).
- Fitzpatrick, M.R., Watson, Z., Zellem, R.T., Pearson, K., Griffith, C.A., and AzGOE (Jan 2015). "High-precision ground-based observations of transiting exoplanets to detect their magnetic fields and undiscovered companions", AAS Meeting #225 (Seattle, WA).

Selected Seminars & Colloquia

- **JPL**, Icy Worlds Collaboration and Exchange (ICE) Seminar, Apr. 10, 2025
- **Europa Clipper Team**, Composition Working Group Science Talk, Jan. 23, 2024
- **Caltech**, DIX Planetary Science Seminar, Jun. 7, 2022 - May 9, 2023 - Jun. 4, 2024 - Apr. 15, 2025

Teaching Positions

Graduate Teaching Assistant, California Institute of Technology — AZ, USA
Oct 2021 to Dec 2023

- Teaching Assistant for Ge 108: Applications of Physics to the Earth Sciences (3 terms)

Graduate Teaching Assistant, Northern Arizona University — AZ, USA
Aug 2018 to May 2020

- Instructor for Introductory Electricity and Magnetism laboratory class (4 semesters).
- Teaching Assistant and Grading for Indigenous Astronomy (2 semesters).

Student Educator and Video Producer, Steward Observatory Education Group — AZ, USA
Aug 2015 to May 2017
1 year 9 months

- Communicated with and educated the public on Astronomy and science related topics via production of YouTube videos on the Active Galactic Videos channel.
- Aided in curriculum development, filming, and video editing for an Introductory Astronomy online course (hosted on Coursera) with Professor Chris Impey.

Special Projects Assistant for Education & Public Outreach, National Optical Astronomy Observatory (NOAO) — AZ, USA
Aug 2014 to Oct 2015
1 year 2 months

- Developed Astronomy and STEM related education curriculum and outreach activities for the National Optical Astronomy Observatory, coordinated and ran large and small public events, managed the Globe at Night citizen science campaign, and ran teacher training's and workshops on Astronomy and Space Education.
- Co-ran a training session for Astronomers interested in outreach and education at the 2016 AAS Winter Meeting.

Engineering & Robotics Instructor, Engineering for Kids Summer Camp — AZ, USA
May to Aug 2014
3 months

- Taught a science, engineering, and robotics related curriculum to summer camp students including a Lego Robotics class for students aged 3-7 and an Engineering Basics and Design course for students aged 8-14.

Science Communication & Outreach

- **University of Arizona College of Science Career Center**; Panelist for Earth, Physical, & Space Science Graduate Student Panel (March 19, 2025)
- **Caltech GPS Buddy Program**; Mentor (2021-2026)
- **Caltech GPS Division Planetary Science Option Ombuds Person** (2021-2022)
- **Caltech Women Mentoring Women**; Mentor (2021-2022)
- **Skype a Scientist**; Scientist Partner (2020-current)
- **Letters to a Pre-Scientist**; Scientist/STEM Professional (2022-2024)
- **Society of Women in Space Exploration (SWISE)**; NAU chapter co-founder & Vice President (2018-2020)
- **Middle School Science Mentor**; Sinagua Middle School (Flagstaff, AZ) (2019-2020)
- **Flagstaff Community Star Party**; Public lecture (2019)
- **University of Arizona Astronomy Club**; President & Outreach Coordinator (2013-2017)