James Mang

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Research Interests

Characterization of exoplanetary atmospheres, through forward models of clouds. Focusing on the coolest Y Dwarfs as exoplanetary analogs. Astrobiology—the search for biosignatures and constraining the parameters of habitability.

Education

University of Texas at Austin (Austin, TX) PhD **Aug 2021 – May 2026**
Focus: Exoplanetary Atmospheric Cloud Models| **Advisor:** Caroline Morley

University of California, Berkeley (Berkeley, CA) B.A & B.Sc **Aug 2017 – May 2021**
Major: Astrophysics & Chemistry

Research Experience

Caroline Morley Research Group (Austin, TX) – *Graduate Research Assistant* **Aug 2021 – Present**

- Generating water clouds models for the coolest Y Dwarfs that emulate microphysical cloud formation models without the computational expense. Future investigations include cloud formation in atmospheres of substellar objects in chemical disequilibrium and incorporating 3-D effects like rotation and winds.

Imke de Pater Research Group (Berkeley, CA) – *Undergraduate Researcher* **Aug 2019 – May 2021**

- Investigated water clouds in hydrogen/helium dominated atmospheres, as applied to temperate, mid-sized exoplanets utilizing the 1-D Community Aerosol and Radiation Model for Atmospheres (CARMA).
- Developed a cloud model to constrain the typical particle sizes and the vertical extent of water clouds. Homogeneous and heterogeneous nucleation is considered and for cloud condensation nuclei, the efficacy of meteoritic dust, organic photochemical hazes, and potassium chloride clouds is investigated.
- Generated simulated emission and reflected light spectra to inform future observations of Y dwarfs and temperate giant planets by telescopes like JWST as the first step towards constraining the impact of water clouds on smaller and cooler worlds, such as K2-18b and habitable rocky planets.
- First-author on the publication accepted to ApJ and presented at the 237th AAS conference.

NASA Goddard Center for Astrobiology (Greenbelt, MD) – *Research Associate* **June 2020 – Aug 2020**

- Modeled M-Earth atmospheres in transit utilizing the NASA Planetary Spectrum Generator (PSG) as the radiative-transfer suite to create over 26,000 atmospheric profiles for K2-18b.
- Developed a pipeline in preparation for future JWST observations. The pipeline starts from a defined set of parameters to create an atmospheric grid which is then processed by PSG to use as training sets for MARGE and HOMER, our designated retrievals machine learning and nested sampling modules.
- Successfully tested our process by matching previous K2-18b observations and models to inform better constraints on atmospheric parameters.

Dunlap Institute for Astronomy (Toronto, ON) – *Undergraduate Researcher* **May 2019 – Sept 2019**

- Identified long-period TESS planet candidates through a ground-based follow-up survey for further atmospheric study of cooler exoplanets utilizing high-resolution imaging from the MMT observatory.
- Tested and calibrated a 0.5m telescope, including 3 observational nights, which was deployed to New Mexico in September 2019 for a 3-year mission to recover approximately 60 planets.

- Created an automatic, real-time pipeline for nightly observational operations. It operates all desktop applications, prepares observable candidate lists, captures images, performs data reduction, produces light curves, and estimates planetary periods. A publication is in preparation.

Space Sciences Laboratory (Berkeley, CA) – *Experimental Astrophysics Researcher* **Sept 2018 – July 2021**

- Directed the general R&D effort to evaluate over 50 microchannel plates (MCPs) produced using atomic layer deposition (ALD) for future spaceflight and ground-based applications.
- Assisted in laboratory operations including cleanliness, safety, maintenance, and development of new process control equipment, including vacuum test chambers, in a cleanroom environment.
- Led a team of 6 project members to create a fully automated MATLAB pipeline to produce test analysis reports for MCP evaluation, making the process 80% more efficient.

Streitwieser Research Group (Berkeley, CA) – *Computational Chemistry Researcher* **Sept 2017 – Jan 2019**

- Developed the correlation of energies in transition state organic molecules with metals and the effects on electron distribution.
- Used Gaussian, AIMII, and QChem computational chemistry programs to complete calculations.

ULAB (Berkeley, CA) – *Undergraduate Researcher, Astrophysics Division* **Oct 2017 – May 2018**

- At ULAB (Undergraduate Laboratory), the Astrophysics subdivision aims to develop essential programming skills integral to modern astrophysical research.
- The group focused on exoplanet detection through methods of transit and spectroscopy for atmospheric composition through the utilization of python packages.

Teaching/Advising Experience

Astronomy Department (Austin, TX) – Graduate *Teaching Assistant for AST 309R* **Jan 2022 – May 2022**
Office of Undergraduate Research (Berkeley, CA) – *Peer Advisor* **July 2020 – May 2021**
Astronomy Department (Berkeley, CA) – *Reader for Astron C12* **Jan 2020 – May 2021**
College of Chemistry (Berkeley, CA) – *Teacher-Scholar for Chem 1AL* **Aug 2018 – Dec 2018**

Publications

Mang J., Gao P., Hood C.E., Fortney J.J., Batalha N., Yu X., de Pater I. (2022) Microphysics of Water Clouds in the Atmospheres of Y Dwarfs and Temperate Giant Planets. *ApJ* 927, 184

Ziegler C., Tokovinin A., Briceno C., **Mang J.**, Law N., Mann A. (2019) SOAR TESS Survey. I: Sculpting of TESS planetary systems by stellar companions. *AJ* 159, 19

Talks

"Microphysics of Water Clouds in the Atmospheres of Brown Dwarfs and Temperate Giant Planets". *AAS* 237. January 14, 2021

"Modeling M-Earth Atmospheres in Transit". *NASA Goddard URAA Summer Series*. August 8, 2020

"One Hit Wonders: Searching for Single Transit TESS Planets". *University of Toronto, Dunlap Institute*. July 5, 2019

Observation Proposal Involvement

2020 **Collaborator** on Cycle 28 HST Proposal GO-16448 (8 Orbits):
"Confirming a tentative detection of an atmosphere around a potentially rocky planet."

Skills

Data Analysis, Python, LaTeX, Fortran, MATLAB, Microsoft Office Suite