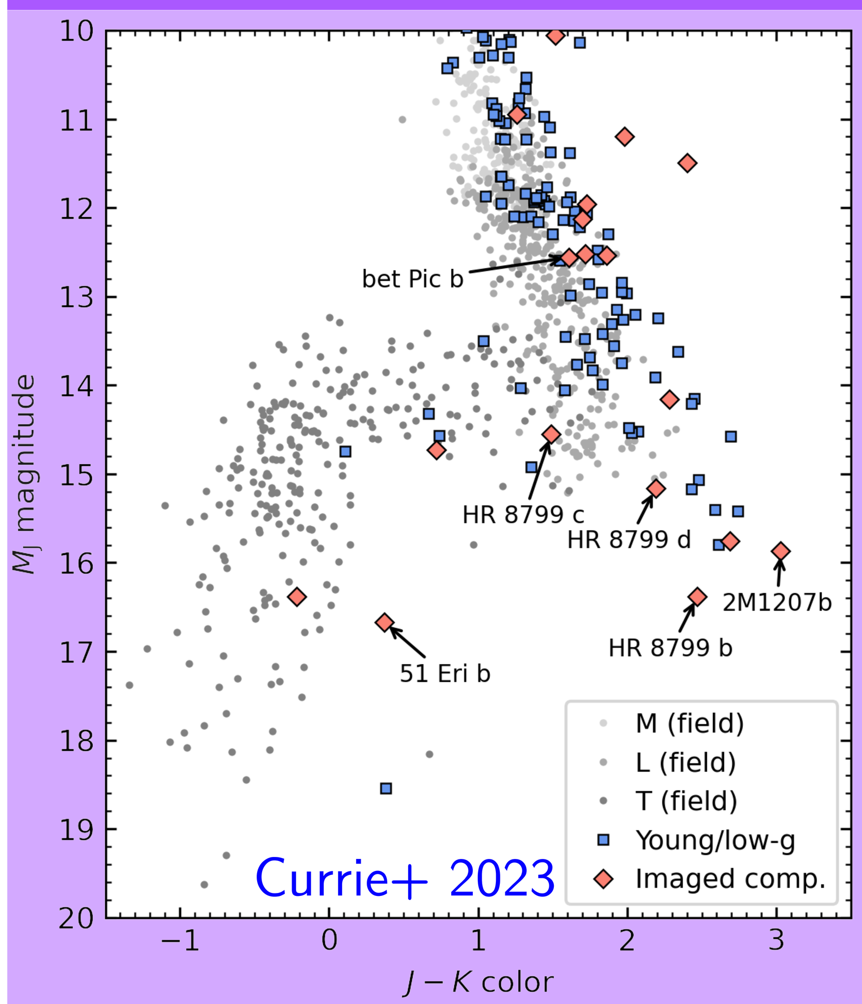
Microphysical Cloud Modeling of Substellar Atmospheres: Preliminary Findings

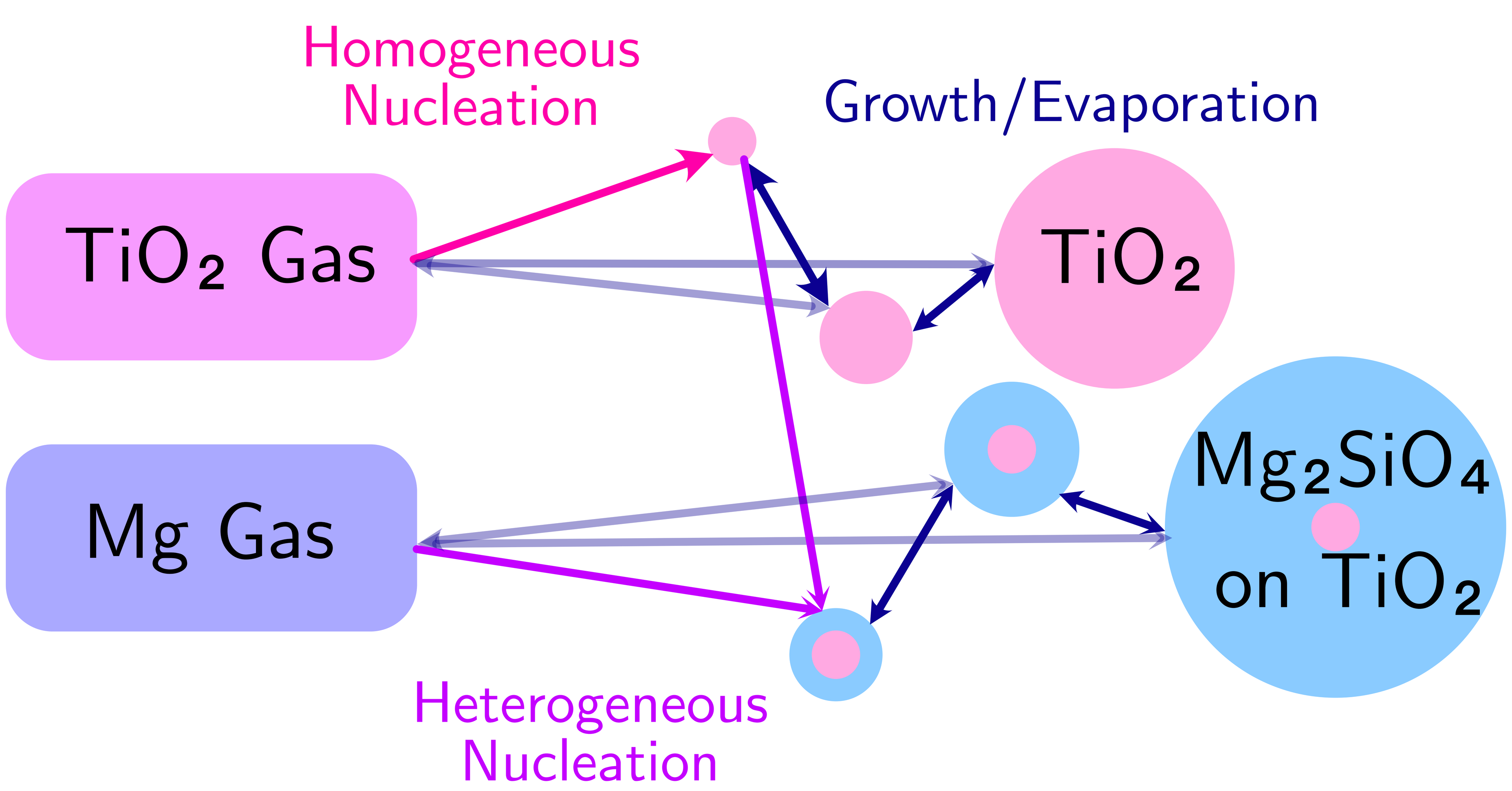
Wolf Cukier, Diana Powell
University of Chicago

Motivation



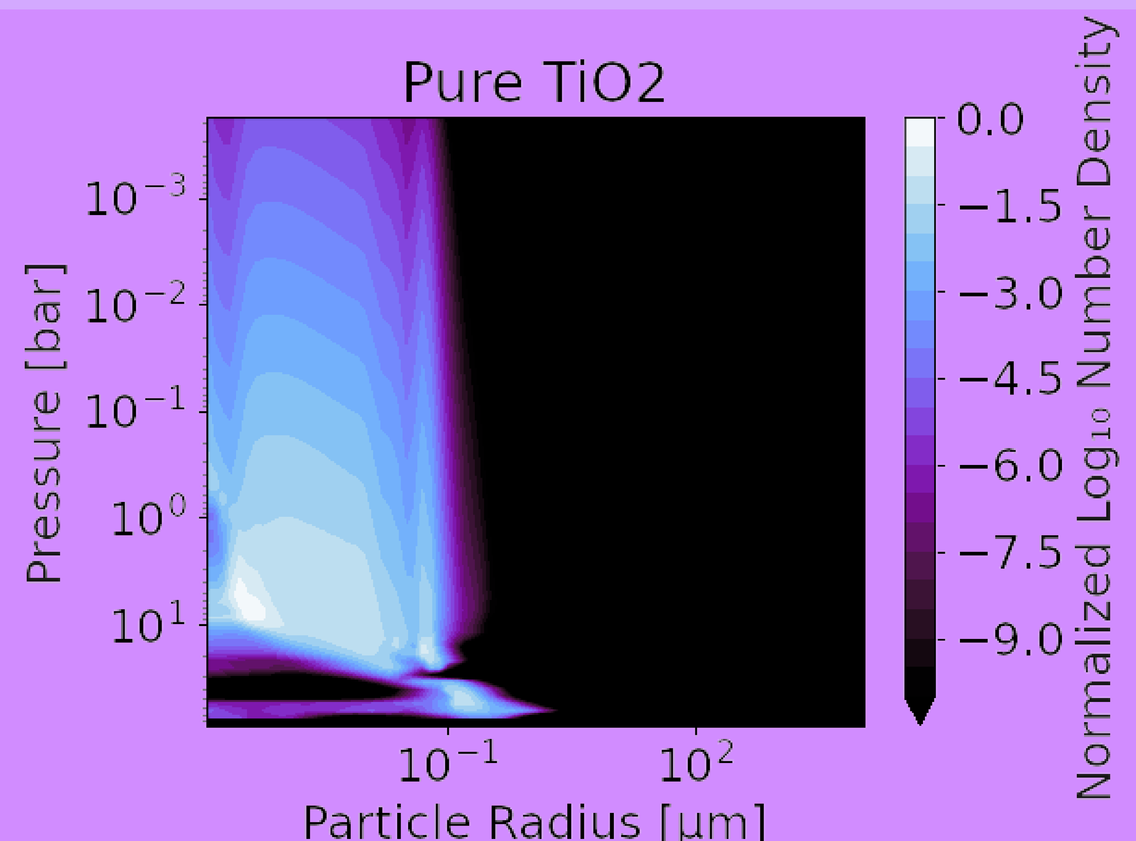
Clouds, being coupled to atmospheric processes, are highly complex and critical to a complete understanding of substellar atmospheres. Clouds are thought to cause color trends in the M-L-T-Y sequence of brown dwarfs and the abnormally red color of directly imaged giant planets. CARMA is a well-validated model that calculates the formation of clouds from first principles through modeling fundamental microphysical processes. It has been used to model clouds on every atmosphered solar system body as well as hot Jupiters, sub-Neptunes and Y-Dwarfs

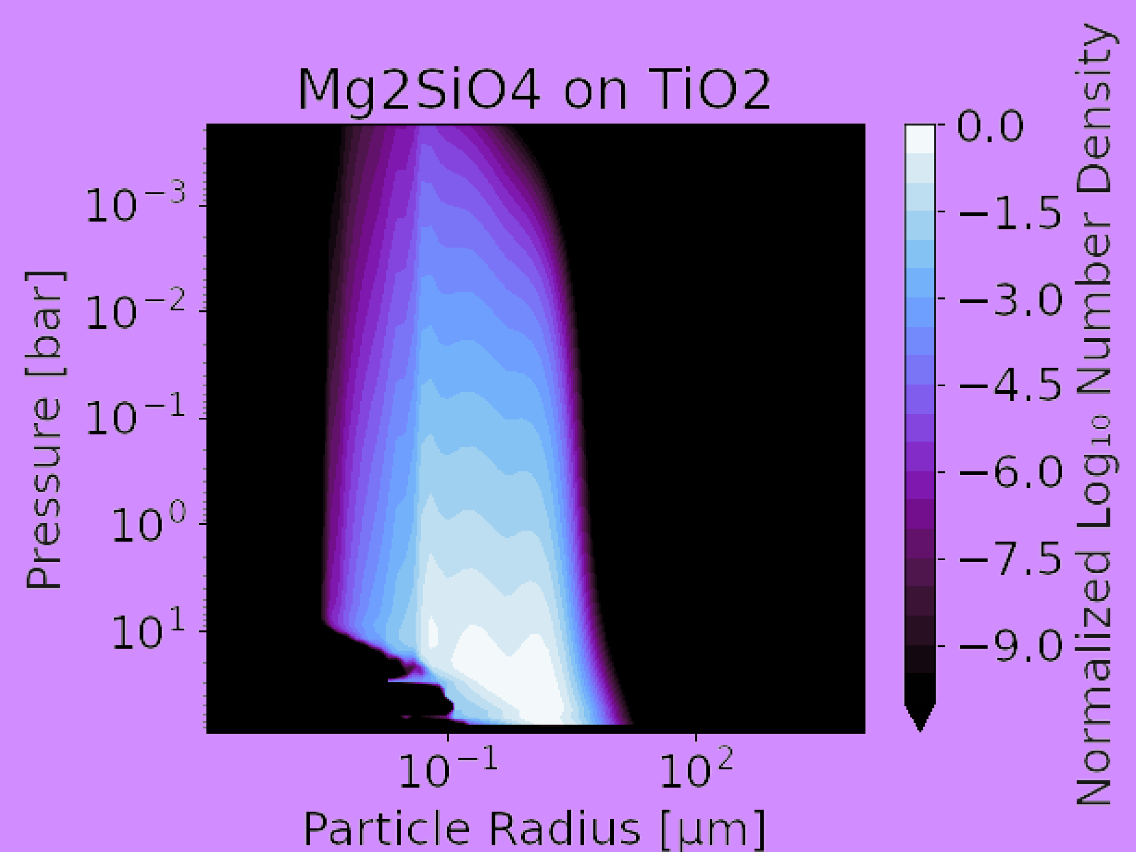
CARMA's Microphysics



*Other species also included

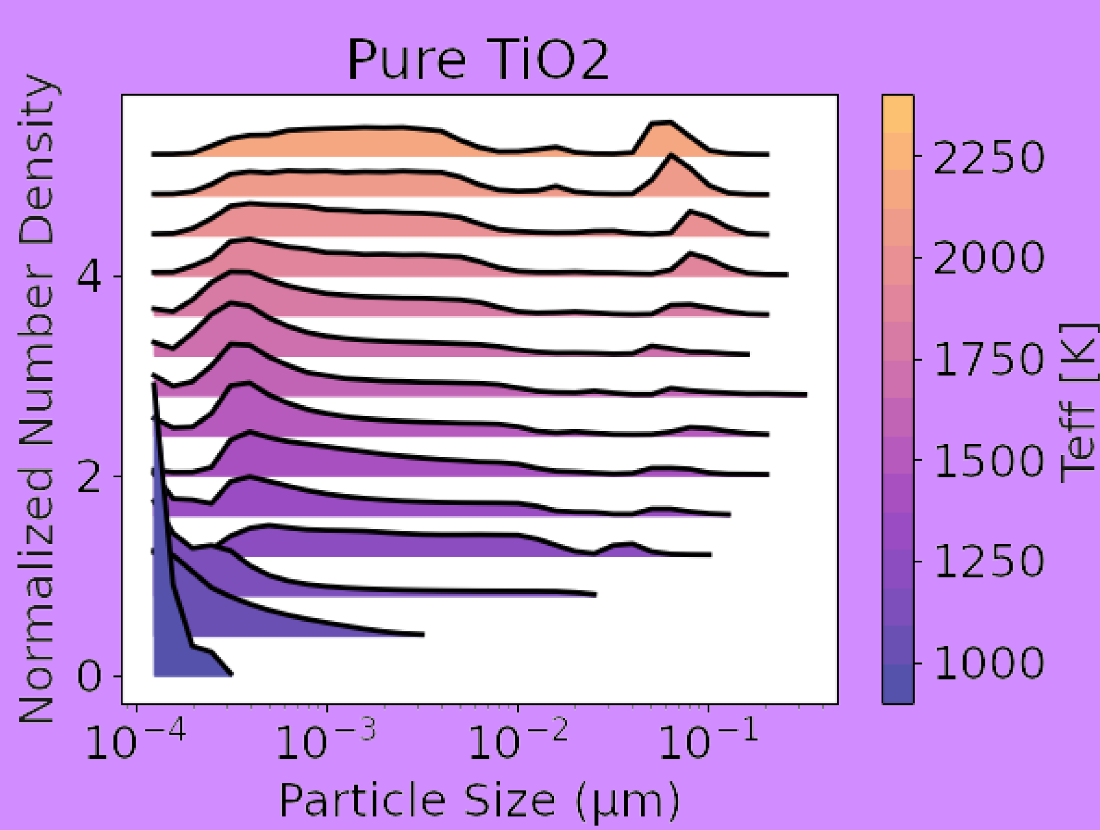
Preliminary Results

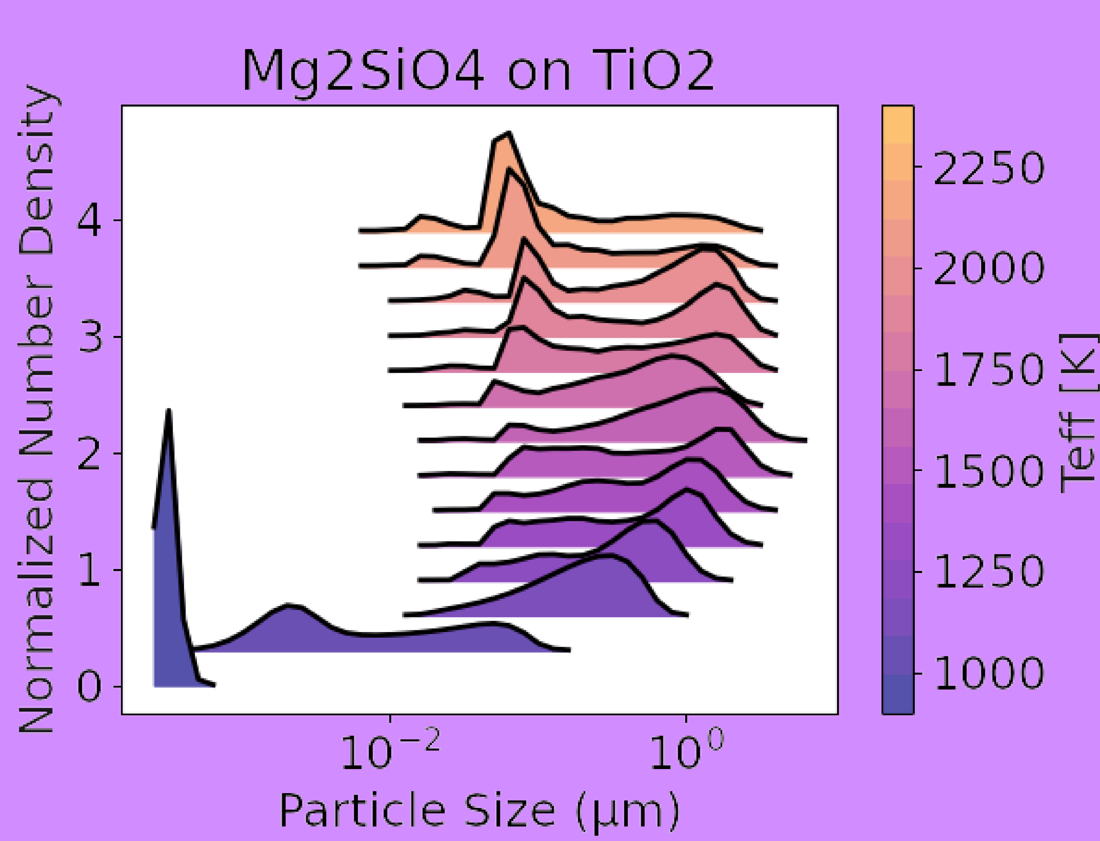




Size Distribution Profiles for
Teff = 1400 K, log g = 3.5, Z = +0.0

- We have calculated a grid of cloud particle size distributions for:
  - Teff in (900K, 1000K, ... 2400 K)
  - log g in (3.5, 4.5, ... 5.5)
  - Metallically in (-0.5, 0.0, +0.5)
- Above ~1000 K Mg_2SiO_4 is dominant
  Below ~1000 K KCl is dominant
  (by total atmosphere cross-section)
- Hotter objects tend to have larger cloud particles. Cooler objects tend to have smaller cloud particles
- Clouds are variable on time scales of a few days





Size Distributions for
log g = 3.5, Z = +0.0, P = 10 mbar

Next Steps

- Release particle size grid to the community
- Compare distributions with log-normal, bimodal, etc.
- Create emission spectra across the grid
- Release `carmapy`: a CARMA python wrapper

Contact + About

Wolf Cukier (He/Him)
1st year Graduate Student

Email: wcukier@uchicago.edu
Website: wolfcukier.com