february 22nd, 2025

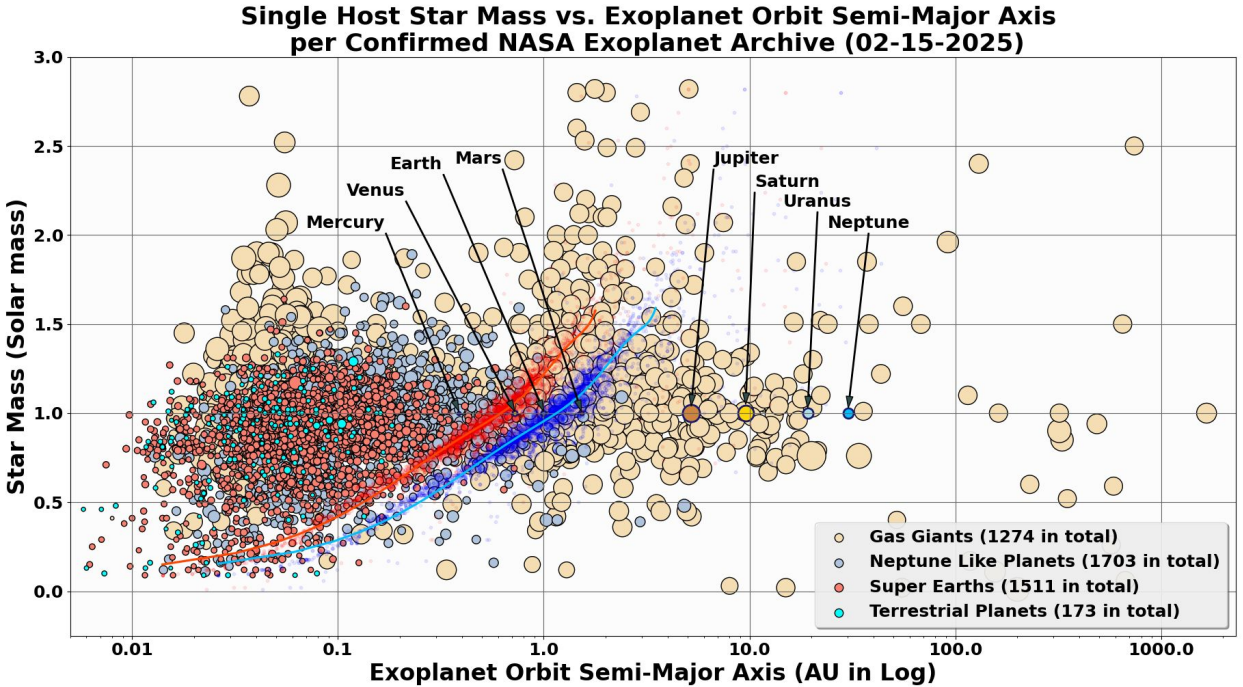
exoplanet classification

past weeks

- focused on the short paper
- star mass vs exoplanet orbit graphs per planetary system class

short paper

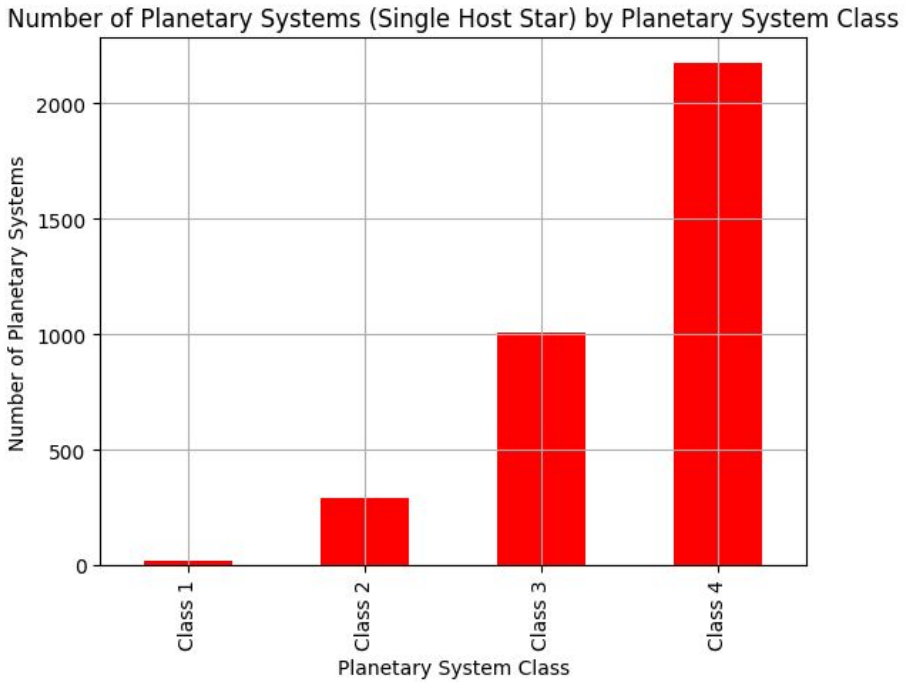
- worked with Dr. Jiang on the short paper: *Revisiting Seager's 2013 Habitability Diagram with 2025 Data*



planetary system classes - recap

- create simple planetary system classes based on member planets:
  - **class 1**: at least one Terrestrial + at least one Neptune-Like or Gas-Giant
  - **class 2**: at least one Super-Earth + at least one Neptune-Like or Gas-Giant
  - **class 3**: only Terrestrial or Super-Earth
  - **class 4**: only Neptune-Like or Gas-Giant

planetary systems per class (single host star)

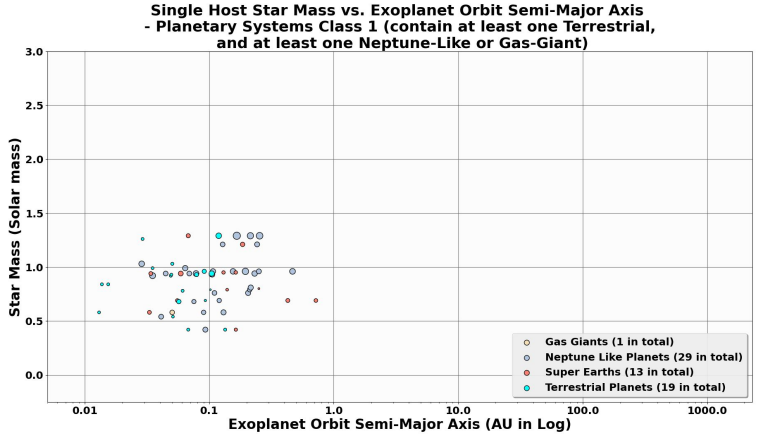


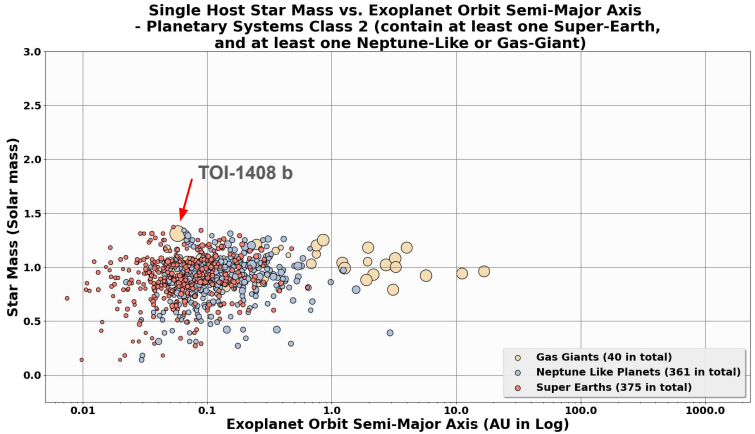
Notes:

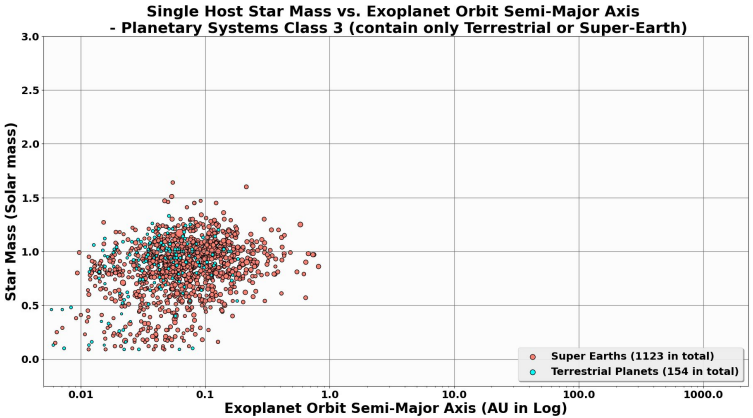
- class 1 and class 2 planetary systems are relatively rare.
- class 4 planetary systems are dominant.

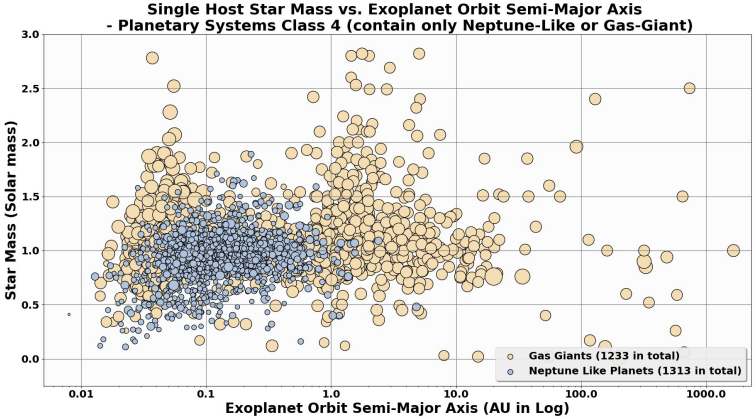
st_system_class	count
Class 1	18
Class 2	288
Class 3	1005
Class 4	2175

star mass v.s. exoplanet orbit radius per planetary class

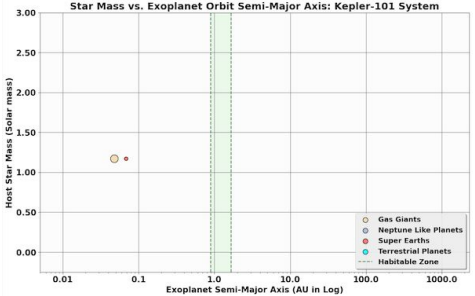


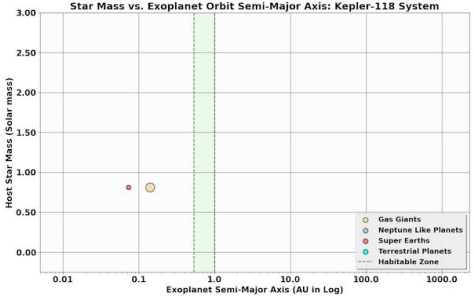


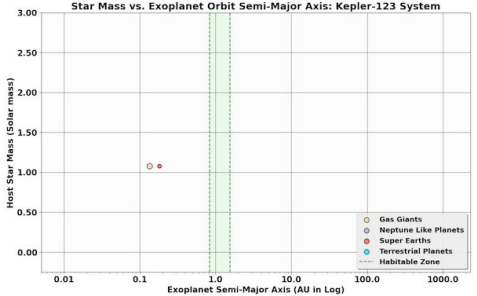


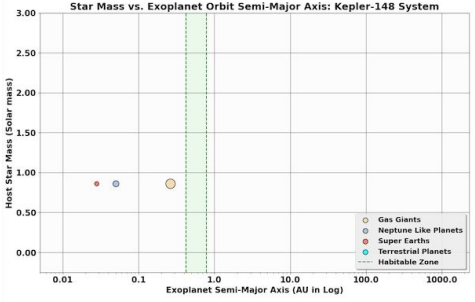


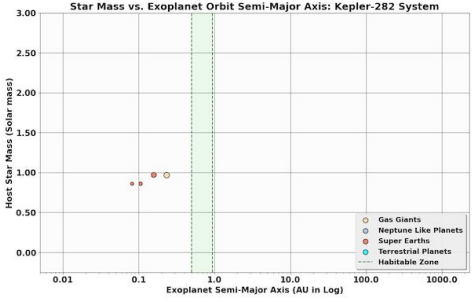
class 2 planetary systems with near-star Gas-Giant (pl_orbsmax <= 0.3)

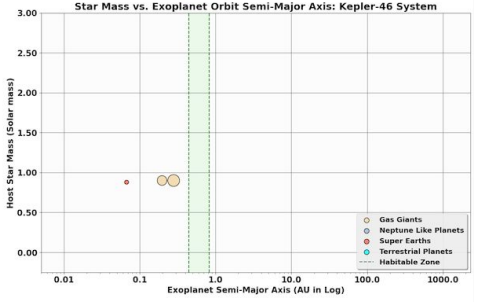


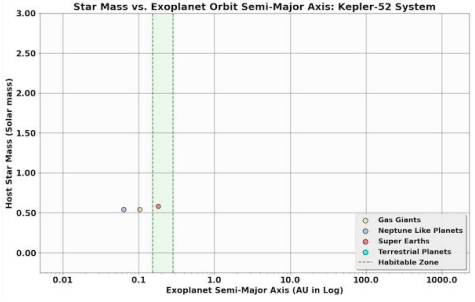


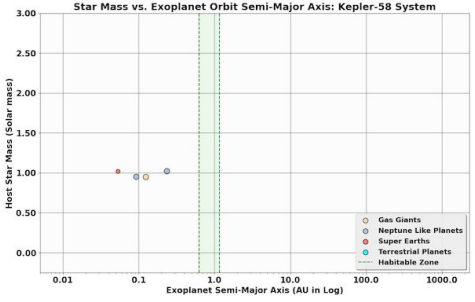


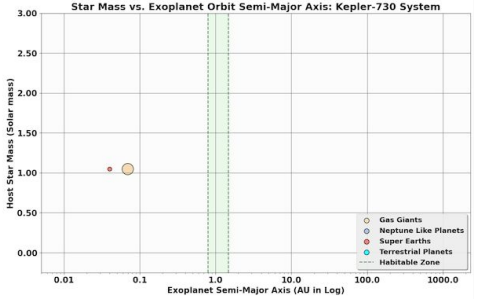




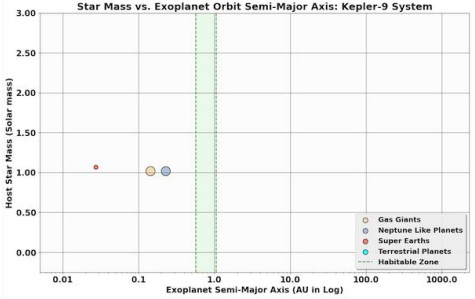


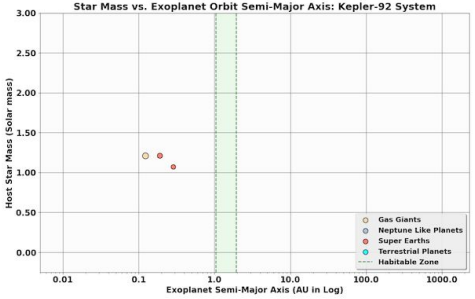


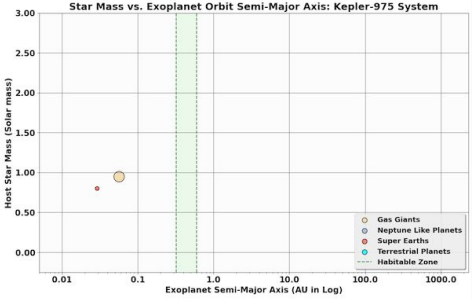


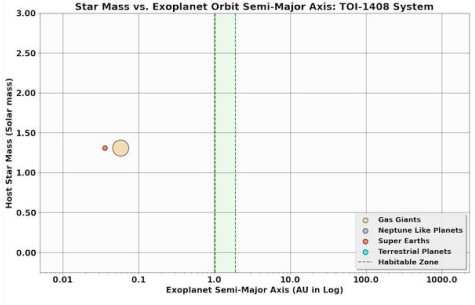


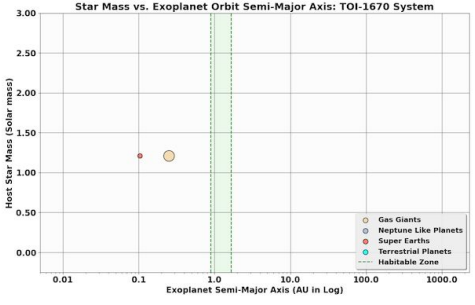
class 2 planetary systems with near-star Gas-Giant

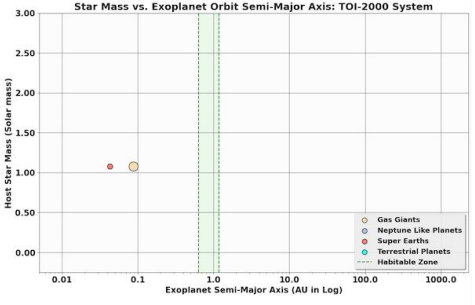


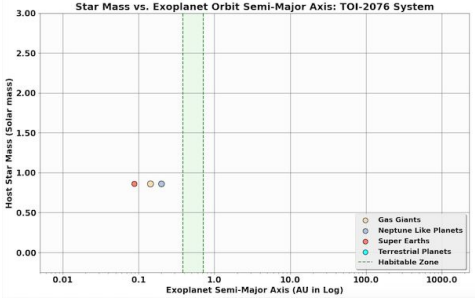


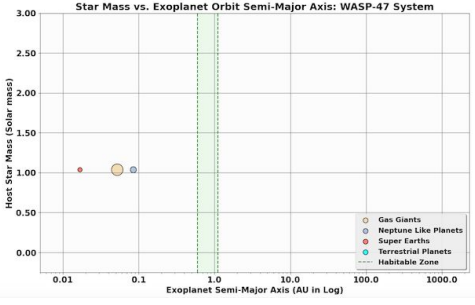


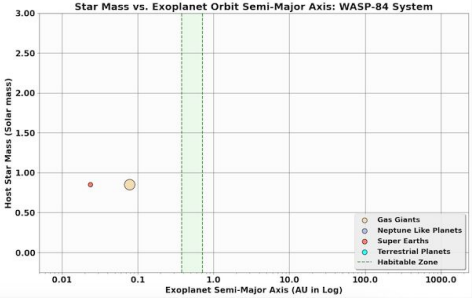




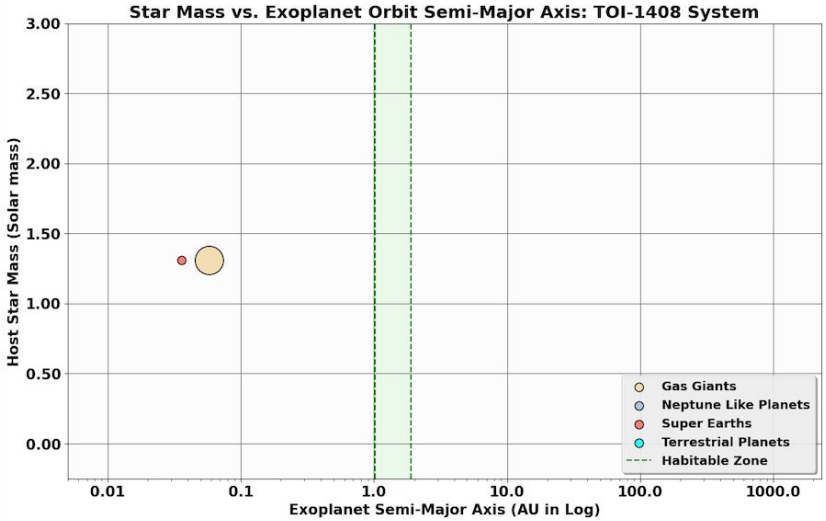








TOI-1408 System



a Super-Earth exists near a Gas-Giant (Hot Jupiter)

- **TOI-1408 b**: a Gas-Giant with 1.69 mass of Jupiter (or 593 mass of Earth), 0.05778 AU from its F star, 4.4 days to complete one orbit, discovered in 2023.
- **TOI-1408 c**: a Super-Earth with 7.6 mass of Earth, 0.03587 AU from its F star, 2.2 days to complete one orbit, discovered in 2024.

relevant publication (25th July 2024): TOI-1408: Discovery and Photodynamical Modeling of a Small Inner Companion to a Hot Jupiter Revealed by TTVs

Data from NASA Exoplanet Archive:

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TOI-1408 c	TOI-1408	1	2	Transit Timing V	2024	Transiting Exopl	0	2.1664	0.0001	-0.0001	0	0.03587	0.00008	-0.00008	0	2.22