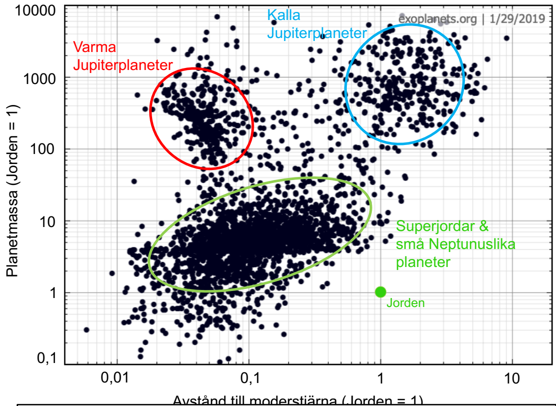
Master's thesis project in Space, Earth and Environment

Formation and Evolution of Super-Earth Exoplanet Systems

Background

NASA's Kepler space telescope has discovered thousands of planets around other stars in our Galaxy – so-called "exoplanets" – by the transit method in which the planet shadows a small portion of the stellar light. A large fraction of these are found in "Systems with Tightly-packed Inner Planets" (STIPs), which typically have several Earth to Super-Earth sized planets in close orbits around their host star. STIPs are very common: perhaps up to about half of all low-mass stars like our Sun may host STIPs! STIPs are very different from our own Solar System and present a great challenge to planet formation theories. A new theory of "Inside-Out Planet Formation" (IOPF) has been proposed by Chatterjee & Tan (2014) (see review by Tan et al. 2016), which involves the planets forming near their current observed locations from "pebble"-rich rings, sequentially from the inside-out. The theory makes several predictions that can be compared to latest observational exoplanet statistical data. More background information on Prof. Tan's research on this topic can be found here: http://cosmicorigins.space/tan



Overview of exoplanet properties: planet mass versus orbital semi-major axis (average distance from the star). Super-Earths and Mini-Neptunes are the most common type of planet found so far. (Figure from C. Persson).

Task description

Precise tasks will be determined depending on the particular interests of the student, however, example aspects include developing simple physical models for planet formation and evolution that relate to super-Earth systems. Statistical analysis of recent exoplanet data with a focus on testing predictions for mass, size and orbital radius relations in the IOPF theory may also be performed.

Required education and potential course requirements

"Interstellar Medium and Star Formation" (RRY041 for Chalmers; ASM480 for Gothenburg Univ.) is recommended for this Master's research project, as it reviews astrophysics relevant to the research. A program of individual reading will also be supervised as part of this thesis. Computational programing skills, e.g., Python, C++, etc., are helpful, but may also be developed as part of this thesis.

Credits: 30 or 60 credits

Starting time

The project can start in January 2020, but earlier contact and preparatory activities are highly encouraged to maximize the chance that the work leads to a refereed publication.

Contact information to supervisor

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