EAPS Planetary lunch Colloquium Series (PICS)

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Sublimation-Driven Exoplanet Migration

Planets are everywhere! The Kepler spacecraft has found thousands of planets orbiting other stars, and has even detected a Vesta to Ceres-sized dwarf planet orbiting a dead star (white dwarf WD 1145+017) with a 4.5-hour orbital period. This requires that some enigmatic process to have moved WD 1145+017 b into this close orbit from several AU, otherwise it would have been destroyed during the star?s death rattle (i.e., Red Giant phase). In this talk, I describe how sublimative orbital perturbations (SOPs) moved WD 1145+017 b into its observed orbit. I then show how this mechanism explains why debris disks are exclusively found orbiting white dwarfs cooler than 27,000 K.

If a white dwarf planet is scattered inward into an orbit with sufficiently small pericenter, it may get so close to its host white dwarf that its surface material sublimates/vaporizes. The resulting escaping gases a sublimative reaction force that changes the planet?s orbital angular momentum, and thus its orbit. This force will circularize the orbit of a planet with a retrograde spin, leading to an ultra-short period orbit. However, this SOP mechanism strongly constrains the composition and water content of WD 1145+017 b, allowing us to reconstruct the evolutionary history of the WD 1145+017 system.

The strength of SOPs strongly depends on the temperature of the white dwarf. Hot white dwarfs will tend to circularize planets outside of the tidal disruption radius, leaving the planet intact. However, white dwarfs cooler than 27,000 K will exclusively circularize objects inside of the tidal disruption radius, where they crumble into debris disks. Thus, the SOP migration mechanism restricts debris disks to cooler white dwarfs, and predicts that migrated planets may be present orbiting hotter white dwarfs outside the tidal disruption radius.

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