Contribution ID: **68** Type: **not specified**

The Orbital Eccentricity-Radius Relation for Planets Orbiting M Dwarfs

Friday 11 July 2025 15:30 (15 minutes)

The orbital eccentricities of exoplanets quantify their current dynamical states and encode information about the predominant processes in their dynamical histories (e.g., the role of giant impacts vs. photoevaporation and core-powered mass loss in sculpting a system's dynamical state). Recent studies have demonstrated a relationship between orbital eccentricity and planet radius, showing modestly elevated eccentricities for large planets and planets in the radius gap, for planets orbiting Sun-like stars. We investigate the eccentricity—radius distribution for planets orbiting M dwarfs, the smallest and most common planet host. We find that large M dwarf planets exhibit elevated eccentricities, similar to FGK-dwarf planets. However, we find a lack of evidence for elevated eccentricities in the radius gap for multi-transit systems. We discuss implications for predominant atmospheric loss mechanisms; namely, supporting evidence for the predominance of photoevaporation as a dynamical sculpting mechanism in M dwarf planets vs. giant impacts in FGK dwarf planets. Furthermore, we situate these findings within an emerging framework of planetary galactic context, as recent work suggests that a planetary system's galactic birthplace, location, and orbit may be intertwined with its current dynamical properties.

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Session Classification: Stability and dynamics of planetary systems