Contribution ID: **56** Type: **not specified**

Mapping the exo-Neptunian landscape. A ridge between the desert and savanna

Monday 7 July 2025 15:00 (15 minutes)

Atmospheric and dynamical processes are thought to play a major role in shaping the distribution of close-in exoplanets. A striking feature of such distribution is the Neptunian desert, a dearth of Neptunes on the shortest-period orbits. We aimed to define the boundaries of the Neptunian desert and study its transition into the savanna, a moderately populated region at larger orbital distances. To do so, we built a sample of planets and candidates based on the Kepler DR25 catalogue and weighed it according to the transit and detection probabilities. We then used the corrected distribution to study occurrences across the period and period-radius spaces. We delimited the Neptunian desert as the close-in region of the period-radius space with no planets at a 3σ level, and identified an overdensity of planets separating the Neptunian desert from the savanna (3.2 days ⪅ Porb ⪅ 5.7 days), which we propose to call the Neptunian ridge. The period range of the ridge matches that of the well-known hot Jupiter pileup (≈3–5 days), which suggests that similar evolutionary processes might act on both populations. Our revised landscape supports a previous hypothesis that a fraction of Neptunes were brought to the edge of the desert (i.e. the newly identified ridge) through high-eccentricity tidal migration (HEM) late in their life, surviving the evaporation that eroded Neptunes having arrived earlier in the desert. The ridge thus appears as a true physical feature illustrating the interplay between photoevaporation and HEM, providing further evidence of their role in shaping the distribution of close-in Neptunes.

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Session Classification: Formation and evolution of planetary systems