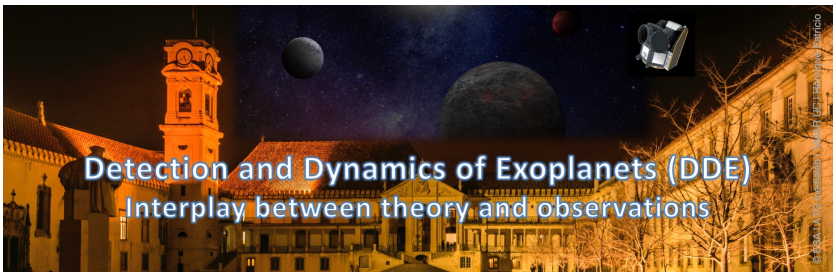

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Evidence that Planets in the Radius Gap Do Not Resemble Their Neighbors

Friday, July 11, 2025 2:45 PM (15 minutes)

Planets in compact multi-transiting systems tend to exhibit self-similarity with their neighbors, a phenomenon commonly called “peas-in-a-pod”. Previous studies have identified that this self-similarity appears independently among super-Earths and sub-Neptunes orbiting the same star. In this study, we investigate whether the peas-in-a-pod phenomenon holds for planets in the radius gap between these two categories (located at ˜1.8 R⊕). Employing the Kepler sample of planets in multi-transiting systems, we calculate the radius ratios between radius gap planets and their neighbors. We find that in systems in possession of a radius gap planet, there is a statistically significant deficit of planet pairs with radius ratios near unity. We find that neighbors to radius gap planets actually exhibit reverse size-ordering (that is, a larger inner planet is followed by an outer smaller planet) more often than they exhibit self-similarity. We go on to compare whether the period ratios between neighboring planets also differ, and find that radius gap planets are likelier to reside in mean motion resonance with neighbors, compared to non-gap planets (particularly in the 3:2 configuration). We explore the possibility that systems with a radius gap planet may be modified by a process other than photoevaporation or core-powered mass loss. The appearance in tandem of unusual size-ordering of gap planets in multi-planet systems, together with unusual spacing, furnishes potential supporting evidence in favor of giant impacts sculpting the radius distribution to some degree.

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