From tidal migration to exomoon survival: can close-in giant planets still host satellites?

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Abstract

Exomoons are expected to arise naturally during giant-planet formation, and their existence would provide key constraints on circumplanetary accretion, tidal evolution, and the long-term dynamical history of planetary systems. Yet, despite sustained observational efforts and a few tentative candidates, the exomoon population remains essentially unconstrained [1]. A central unresolved question is therefore not only how to detect exomoons, but also which classes of exoplanets are actually able to retain them over astrophysically relevant timescales. In this context, tidal evolution offers a natural framework to identify the systems in which moons should survive, migrate, or be lost.

This presentation will briefly revisit tidal migration models in which dissipation inside the planet–moon system drives a secular evolution of satellite orbits [2, 3], in some cases leading to instability, escape, or transformation into planet-like bodies known as ploonets [4]. I will then discuss the case of WASP-49Ab as an extreme test of this idea. This compact hot Saturn has recently gained renewed interest because circumplanetary material and satellite-related interpretations have been invoked in connection with its observed properties [5]. Rather than treating this possibility as an isolated peculiarity, I will frame WASP-49Ab within the broader evolutionary problem of exomoon survival under strong tidal forcing. The key question is whether a giant planet so close to its host star can still host a stable moon at all, and, if so, under what orbital conditions. Finally, I will place this discussion in a broader comparative context by contrasting compact hot giants with colder giant planets on wider orbits. While the former may be efficient at destroying or ejecting moons, the latter should offer more extended stable regions and weaker tidal forcing, making them more favourable environments for long-lived satellites and future detection. In that sense, systems such as WASP-49Ab and Kepler-167e can be viewed as complementary laboratories: one probes the tidal limit of satellite survival, while the other may represent a more favourable regime for persistence and eventual detection.

References

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