

## Tidal Decay and Stable Roche-Lobe Overflow of Short-Period Gaseous Exoplanets

Brian Jackson<sup>1</sup>, Emily Jensen<sup>1</sup>, Sarah Peacock<sup>2</sup>, Phil Arras<sup>3</sup>, Kaloyan Penev<sup>4</sup>

<sup>1</sup> Boise State University, Dept. of Physics, 1910 University Drive, Boise ID 83725 USA

<sup>2</sup> Lunar and Planetary Laboratory, University of Arizona, 1629 E University Blvd, Tucson, AZ 85721-0092

<sup>3</sup> Department of Astronomy, University of Virginia, Charlottesville, VA 22904-4325, USA

<sup>4</sup> Department of Astrophysical Sciences, Princeton University, NJ 08544, USA

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Many gaseous exoplanets in short-period orbits are on the verge or are in the process of Roche-lobe overflow (RLO). Moreover, orbital stability analysis shows tides can drive many hot Jupiters to spiral inevitably toward their host stars. Thus, the coupled processes of orbital evolution and RLO likely shape the observed distribution of close-in exoplanets and may even be responsible for producing some of the short-period rocky planets. However, the exact outcome for an overflowing planet depends on its internal response to mass loss, and the accompanying orbital evolution can act to enhance or inhibit RLO. In this study, we apply the fully-featured and robust Modules for Experiments in Stellar Astrophysics (MESA) suite to model RLO of short-period gaseous planets. We show that, although the detailed evolution may depend on several properties of the planetary system, it is largely determined by the core mass of the overflowing gas giant. In particular, we find that the orbital expansion that accompanies RLO often stops and reverses at a specific maximum period that depends on the core mass. We suggest that RLO may often strand the remnant of a gas giant near this orbital period, which provides an observational prediction that can corroborate the hypothesis that short-period gas giants undergo RLO. We conduct a preliminary comparison of this prediction to the observed population of small, short-period planets and find some planets in orbits that may be consistent with this picture. To the extent that we can establish some short-period planets are indeed the remnants of gas giants, that population can elucidate the properties of gas giant cores, the properties of which remain largely unconstrained.

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Contact: [bjackson@boisestate.edu](mailto:bjackson@boisestate.edu)