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Ohmic inflation of Hot Jupiters

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The inflated radii observed in hundreds of Hot Jupiters (HJs) represents a long-standing open issue, with Ohmic dissipation being one of the most promising mechanisms for a quantitative explanation. In this study, inspired by results from evolutionary models in the last decade, we specifically delve into the inferrance of the amount of electrical currents induced by the atmospheric winds. Using the evolutionary code MESA, we simulate the evolution of irradiated giant planets, spanning the observed range of masses and equilibrium temperatures, a plausible range of core sizes and compositions. We incorporate an internal source of Ohmic dissipation that extends to deep layers of the envelope, accounting for electrical currents proportional to the electrical conductivity, given by thermal ionization of alkali metals and pressure-ionization of hydrogen at deeper layers. We explore how, varying the intensity of currents, we can broadly reproduce the range of observed radii. As a by-product, using classical scaling laws which relate the deep-seated and surface magnetic fields to mass, structure and internal luminosity, we predict that heavy planets are much more likely to have large surface fields of hundreds of G.

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