Unravelling tidal dissipation in gaseous giant planets

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Abstract

Tidal dissipation in planetary and stellar interiors is one of the key mechanisms that drive the evolution of planetary systems, especially for planets orbiting close to their host star. Moreover, tidal dissipation depends on the internal structure and rheology of the involved bodies. In this work, we focus on the tidal response of gaseous giant planets using a simplified bi-layer model consisting of a homogeneous rocky/icy core surrounded by a homogeneous fluid convective envelope. In the cases of Jupiter-like and Saturn-like planets, we compare the frequency-averaged strengths of the viscoelastic dissipation occurring in the central solid region and the damping of inertial waves by turbulent friction occurring in fluid layers as a function of the size and the mass of the core. We find that the two distinct tidal dissipation reservoirs are generally of the same order of magnitude. This demonstrates that tidal dissipation in giant planets must be examined from their centre to their surface. In a near future, we would apply such a method to icy giant and telluric planets.

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