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The fluid equilibrium tide in stars and giant planets

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Abstract

Many extrasolar planets orbit very close to their parent star, so that they experience strong tidal interactions; by converting mechanical energy into heat, these tides contribute to the dynamical evolution of such systems. This motivates us to acquire a deeper understanding of the processes that cause tidal dissipation, which depend both on the structure and the physical properties of the considered body.

Here we examine the equilibrium tide, i.e. the hydrostatic adjustment to the tidal potential, in a rotating fluid planet or star. We first present the equations governing the problem, and show how to rigorously separate the equilibrium tide from the dynamical tide, which is due to the excited eigenmodes. We discuss in particular how the quality factor Q is linked whith the turbulent viscosity of the convection zone. Finally we show how the results may be implemented to describe the dynamical evolution of the system.

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