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Tidal evolution of close-in exoplanets

A.C.M. Correia (1,2), G. Boué (2), J. Laskar (2) and A. Rodriguez (3).
(1) Departamento de Fisica, I3N, Universidade de Aveiro, Campus de Santiago, 3810-193 Aveiro, Portugal (correia@ua.pt),
(2) ASD, IMCCE-CNRS UMR8028, Observatoire de Paris, UPMC, 77 Av. Denfert-Rochereau, 75014 Paris, France,
(3) Insituto de Astronomia, Geofisica e Ciências Atmosféricas, IAG-USP, Rua do Matão 1226, 05508-090 São Paulo, Brazil.

Abstract

The continuous action of tides modify the rotation of close-in planets together with its orbit until an equilibrium situation is reached. It is often believed that synchronous motion is the most probable outcome of the tidal evolution process, since synchronous rotation is observed for the majority of the satellites in the solar system. However, in the 19th century, Schiaparelli also assumed synchronous motion for the rotations of Mercury and Venus, and was later proven wrong. Rather, for planets in eccentric orbits, synchronous rotation is very unlikely. Based on the well-studied cases in the solar system, we can make some predictions for close-in planets. Here we describe in detail the main tidal effects that modify the secular evolution of the spin and the orbit of a planet. We then apply our knowledge acquired from solar system situations to exoplanet cases. In particular, we will focus on two classes of planets, hot Jupiters (fluid) and super-Earths (rocky with atmosphere).