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and re-enacted the forward integration with the regular satellites around the ice giant. The final orbital elements of the satellites with respect to the ice planet were used to restart the integration for the next planetary encounter. If we assume that Uranus is the ice planet that had encounters with a gas giant, we considered the satellites Miranda, Ariel, Umbriel, Titania and Oberon with their present orbits. For Neptune we introduced Triton with an orbit with a 15% larger than the actual semi-major axis to account for the tidal decay from the LHB to present time. We also assume that Triton was captured through binary disruption (Agnor and Hamilton 2006, Nogueira et al. 2011) and its orbit was circularized by tides during the 500 million years before the LHB.

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THE MOST COMMON HABITABLE PLANETS ATMOSPHERIC CHARACTERIZATION OF THE SUBGROUP OF FAST ROTATORS

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The current search for habitable planets has focused on Earth-like conditions of mass, volatile content and orbit. However, rocky planets following eccentric orbits, and drier than the Earth, may be a more common phenomenon in the Universe. For the subgroup of fast rotators, it is suggested that their atmospheric thermal capacitance, subjected to the radiative forcing of their parent stars, may provide researchers in the near future with a simple method for the determination of a robust lower limit of atmospheric thickness. This technique, together with the spectroscopic analysis of resolved planets from their stars, both allowed by planned space and ground-based observatories with thermal infrared capabilities, would enable us with a better understanding of the habitability of this class of planets. The technique works better for shorter orbital periods, but since the tidal-lock radius of M dwarfs encompasses their Habitable Zone (HZ), the optimum targets would be planets around K dwarf stars. The atmospheric thermal capacitance could also expand the range of HZs for shorter orbits, particularly for planets around M dwarf stars, since the higher frequency of the periodic radiative forcing dampens the surface temperature variation considerably.

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SPIN-ORBIT RESONANCES IN SUPER-EARTH SYSTEMS CLOSE TO MEAN-MOTION COMMENSURABILITIES

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There is a great deal of planets in close-in orbits and low mass on order of magnitude less than 10 Earth mass. Valencia et al. (2006) call them Super-Earths. Recently, several efforts have been done in order to understand the dynamics of rotation of these planets, including spin-orbit resonance and spin tidal evolution (Rodríguez et al. (2012), Callegari and Rodríguez (2013)). In the referred papers, it is considered a single planet whose motion around the star is governed by the rules of the two-body problem. However, many Super-Earths are present in systems where other terrestrial or giant planets are present, and that problem must be checked. In this work we study the dynamical effects of mean-motion commensurabilities on rigid body rotation and spin-orbit resonances. Emphasis is given in the cases of the multi-planetary systems Kepler-11, KOI-55 and KOI-961, where the mean motions of several pairs of planets are commensurable. In some cases we have observed that the period associated to a particular commensurability is close to the period of the free libration of the rotation of one of the super-Earths. Thus, we investigate the role of the mean motion resonance on the synchronous rotation. Depending on the initial conditions inside the synchronous domain, the stable librations induced by the torque of the central star on the figure of the planet can lead to instabilities on its rotation which are not expected in such regular regions of rotational phase space. This phenomenon has been observed in the cases of Kepler-11 b (disturbed by Kepler-11 c), KOI-55 b (disturbed by KOI-55 c), KOI-961c (disturbed by KOI-961b and KOI-961d).

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