The extreme physical properties of the CoRoT-7b super-Earth

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Over the past five years alone, the search for exoplanets has seen much advancement. New planets, including "Super-Earths" have been discovered (Grasset et al., 2009; Rivera et al., 2005; Lovis et al., 2009; Bouchy et al., 2009) and characterized based on our current and ever-growing understanding of planetary atmospheres and internal structures. We envision that such discoveries would eventually allow us to map the possibility of life-sustaining planets in other solar systems. Thus investigation of properties pertaining to rocky planets situated within the habitable zone of their stars, in particular, continues to be a forefront in exoplanet research.

By comparing with known parameters of Earth, Earth-like planets and the largest icy satellites of the Jovian planets, it is possible to model the surface properties and internal structure of these extrasolar planets to obtain mas-radius curves (Sotin et al., 2007; Fortney et al., 2007; Seager et al., 2007; Valencia et al., 2007a; Grasset et al., 2009). Here we have outlined a discussion of the key findings that characterize the rocky super-Earth, CoRoT-7b, with radius of about 1.58 ± 0.01 times and mass is 6.9 ± 1.2 times that of Earth's (Leger et al., 2011), latter having been obtained from averaging results of radial velocity data (Bruntt et al., 2010; Hatzes et al., 2010; Boisse et al., 2011; Ferraz-Mello et al., 2011).

We propose that being so close to its host star (0.0171 AU), the planet's orbital rotation and spin are most likely tidally phase-locked (Bruntt et al. 2010). This indicates large fluxes of high frequency radiation and particle velocities directed at the dayside, implying lack of thermalization and volatile entities in the atmosphere. As a result, using currently established models and equations of state, it has been shown that the surface composition, pressures, temperatures are drastically different between the day and night side ("extreme"). We have evaluated such extreme parameters within constraints of two-dimensional modeling in the paper.

Here we show the computed surface temperature profile for a thin-atmosphere model of our exoplanet (Fig. 4 Leger el al., 2011). We find that within the constraints imposed by models and its parameters, the atmosphere must be made of rocky vapors subject to extremely low pressures. We thereby also present the equivalent distribution for the atmospheric pressure for the same zenith angle range (Fig. 7 Legal et al., 2011). The drastic dayside temperatures allow the molten silicate rocks to cause formation of a "lava ocean" on this side only. These extreme properties are likely to extend to similar other extrasolar entities, such as the Kepler-10b; thus marking the beginning of a new era of studies dedicated to "lava-ocean planets".

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