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The Interior and Surface Environment of Corot-7b

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The discovery of extrasolar planets - planets that orbit stars other than our sun - has always been fascinating. Mean- while more than 400 so–called exoplanets have been detected. These discoveries provide us with the opportunity to gain a better understanding of our own solar system. However, most of the detected exoplanets so far are relatively large (beyond 10 MEarth) and can be regarded as gaseous planets, which allow comparisons with the gas giants in our solar system. Scientists have always seeked after smaller and rocky planets, which could be compared to Earth or other earth–like bodies.

The COROT mission discovered an object, Corot-7b, with a radius of only 1.68 REarth corresponding to a mass of 4.8 $\pm$ 0.8 MEarth. This first low-mass exoplanet – a so-called 'Super-Earth' – can be considered to be solid. Corot-7b orbits its primary at a very close distance and is therefore tidally locked in an 1:1 spin-orbit resonance. This implies a very inhomogeneous energy input from the star into the planet. Since the dayside is constantly exposed to the star, there is a strong temperature gradient towards the nightside. The high temperatures on the dayside could cause the evaporation of volatiles, which gives rise to the formation of an atmosphere.

We introduce a three dimensional thermal convection model by solving the pertaining dimensionless hydrodynamical equations, derived from the conservation of mass, momentum and energy. With the code we compute the temperature field T (r, θ, φ), by employing a combination of a spectral and a finite difference method. We are especially looking at the formation of partially molten regions due to the inhomogeneous energy input onto the surface. The temperature of the surface and subsurface regions is enormously important for the composition of the atmosphere fed from volatiles, which escaped from the planet. The atmosphere is the only part of this exoplanet which can be observed with remote sensing methods. Henceforth, understanding the conditions for the formation of an atmosphere (i.e. surface temperature map) is an important step forward in understanding extrasolar planets.