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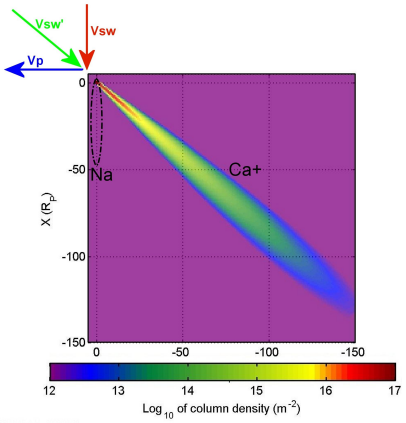
Neutral and ionized tails of close-in rocky exoplanets: detectability of planetary magnetic fields

Alessandro Mura (1), Peter Wurz (2), Helmut Lammer (3) Jean Schneider (4), Jean-Mathias Grießmeier(5), Maxim Khodachenko(3)

(1) IFSI, INAF, Roma, Italy (alessandro.mura@ifsi-roma.inaf.it), (2) UniBe, Bern, Switzerland, (3) OEAW, Graz, Austria, (4) LUTH, Observatoire de Paris, CNRS, France (5) Netherlands Institute for Radio Astronomy, The Netherlands

Abstract

We investigate the interaction of stellar wind plasma with the exosphere and possibly with the planetary magnetospheric environment of close-in rocky exoplanets. In particular, we focus on the "super-Earth" CoRoT-7b. Based on the present knowledge of this planet and drawing on the analogy to solar system planets, we use numerical models to simulate exospheric and magnetospheric distributions of different particle populations, among which are neutral sodium and ionised calcium and magnesium. We find that, for most species, the atmospheric loss rate in such an extreme environment can be very high, so that a neutral and an ionised tail of escaping particles will form. Depending on the planetary composition we postulate the presence of a Mercury-like sodium tail, and of an extended magnetospheric distribution of ionised calcium or magnesium. A parameter study is also performed, tuning basic planetary quantities such as radius, mass, temperature and distance. In this way, we calculate exospheric quantities for a larger ensemble of possible exoplanets. The feasibility of observation of such tails is also evaluated.



Simulated Na and Ca^+ column densities in the *xy* plane, integrated along the *z* direction. The arrows indicate the velocity of the planet/reference frame (V_p), the velocity of the stellar wind in the inertial reference frame (V_{sw}) and in the non-inertial planetary reference frame (V_{sw}'). The Sodium tail is the narrow and short feature on the left (dashed line).