EPSC Abstracts
Vol. 5, EPSC2010-236, 2010
European Planetary Science Congress 2010

The magnetopause position in the case of an expanding ionosphere

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Abstract

The magnetosphere of a planet provides protection against the planetary environment. Its size and location determine how well the planet is shielded against the stellar wind, stellar Coronal Mass Ejections, or stellar and galactic cosmic rays. The question of magnetospheric shielding is particularly relevant for close-in extrasolar planets, where the magnetosphere can be strongly compressed by the enhanced stellar wind. The size of the magnetosphere and the position of the magnetopause are determined by the pressure equilibrium between the pressure exerted by the stellar wind and the pressure contributions from within the magnetosphere (see e.g. [1]). The standoff distance R_S is defined as the planetocentric distance of the magnetopause along the line connecting the planet and the star where the pressure equilibrium is satisfied. In the case of a magnetized planet, the magnetospheric pressure is usually dominated by the contribution caused by the planetary magnetic field. Here, we discuss the case of a non-magnetized or weakly magnetized planet, where the magnetospheric pressure is provided by a strongly expanding planetary ionosphere. Such ionospheres are expected for close-in exoplanets where strong stellar heating leads to intense photoinonization, but may also be of relevance for the early terrestrial evolution during the Hadean epoch. Both analytical and numerical results from a hybrid simulation [2] are shown and compared.

References

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[2] Johansson, E. P. G., Bagdonat, T., and Motschmann, U.: Consequences of expanding exoplanetary atmospheres for magnetospheres, Astron. Astrophys., 496, pp. 869–877, 2009.