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The importance of magnetospheric protection of Hot Jupiters against ion loss caused by CMEs

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Due to the close location of Hot Jupiters to their host stars, these gas giants are embedded in dense plasma fluxes caused by stellar winds and Coronal Mass Ejections (CMEs), which can ionize and strongly erode their upper atmospheres. Here we investigate the atmospheric erosion due to CMEs on short-periodic gas giants orbiting close to a star. To study the effect of encountering CMEs produced in the magnetospheres and atmospheres of Hot Jupiters we model the possible interaction of the dense CME plasma with the exoplanet HD209458b, which orbits a 4.0 to 4.5 Gyr old Sun-like star at a distance of about 0.045 AU. Because the upper atmospheres of Hot Jupiters experience hydrodynamic blow-off, we apply a numerical hydrodynamic model for the calculation of the upper atmospheric density and the hydrogen wind of HD209458b as a function of planetocentric distance. Based on thousands of solar CME observations obtained by the LASCO instrument on board of SoHO we infer an average CME velocity of about 490 km/s as well as minimum and maximum values of CME plasma densities at 0.045 AU. Taking into account the similarity of HD209458b's host star to our Sun we use for the study of the ion production and loss rate of atomic hydrogen ions the CME plasma parameters obtained from the SoHO observations and apply a numerical test particle model. The obtained results may be considered as an indication that Hot Jupiters close to their host stars should have intrinsic magnetic moments in the order of at least about 0.1 that of Jupiter's, which are strong enough to balance the dense CME plasma flow at planetocentric distances where their atmospheres can not be strongly eroded. The atmospheres of Hot Jupiters with weaker magnetic moments should be highly eroded, may shrink to their core sizes, or may even not survive the interaction of their atmospheres with the dense CME plasma flux.