Halogen Chemistry in Volcanic Plumes (Invited)

Christof Weber, Helmut Lammer, Ildar F. Shaikhislamov, Nikolai Erkaev, Joshua M. Chadney, Maxim L. Khodachenko, Jean-Mathias Grießmeier, Helmut O. Rucker, Christian Vocks, Wolfgang Macher, et al.

Geophysical Research Abstracts
Vol. 19, EGU2017-5061, 2017
EGU General Assembly 2017

How Expanded Ionospheres of Hot Jupiters Can Prevent Escape of Radio Emission Generated by the Cyclotron Maser Instability

Christof Weber (1), Helmut Lammer (1), Ildar F. Shaikhislamov (2), Nikolai Erkaev (3,4), Joshua M. Chadney (5,6), Maxim L. Khodachenko (1), Jean-Mathias Grießmeier (7), Helmut O. Rucker (8), Christian Vocks (9), Wolfgang Macher (1), Petra Odert (1), and Kristina G. Kislyakova (1)

(1) Space Research Institute, Graz, Graz, Austria (christof.weber@oeaw.ac.at), (2) Institute of Laser Physics SB RAS, Novosibirsk, Russia , (3) Institute of Computational Modelling SB RAS, Krasnoyarsk 660036, Russia , (4) Siberian Federal University, Krasnoyarsk 660041, Russia, (5) Department of Physics and Astronomy, University of Southampton, Southampton SO17 1BJ, UK, (6) Department of Physics, Imperial College London, Prince Consort Road, London SW7 2BW, UK, (7) LPC2E - Université d'Orlèans/CNRS, France and Station de Radioastronomie de Nancay, Observatoire de Paris,PSL Research University, CNRS/INSU, USR 704 - Univ. Orleans, OSUC, route de Souesmes, 18330 Nancay, France, (8) Comm. Astron. OAW, Graz, Austria, (9) Leibniz-Inst. f. Astrophys. Potsdam, Germany

We present a study of the plasma conditions in the atmospheres of the Hot Jupiters HD 209458b and HD 189733b and for an HD 209458b-like planet at orbit locations between 0.2–1 AU around a Sun-like star. We discuss how these conditions influence the radio emission we expect from their planetary magnetospheres. We find that the environmental conditions for the cyclotron maser instability (CMI), the process which is responsible for the generation of radio waves at magnetic planets in the solar system, most likely will not operate at Hot Jupiters. The reason for that is that hydrodynamically expanding atmospheres possess extended ionospheres whose plasma densities within the magnetosphere are so large that the plasma frequency is much higher than the cyclotron frequency, which contradicts the necessary condition for the production of radio emission and prevents the escape of radio waves from close-in extrasolar planets at distances $<$0.05 AU from a Sun-like host star. The upper atmosphere structure of Hot Jupiters around stars similar to the Sun changes between 0.2 and 0.5 AU from the hydrodynamic to a hydrostatic regime and this results in conditions similar to solar system planets with a region of depleted plasma between the exobase and the magnetopause where the plasma frequency can be lower than the cyclotron frequency. In such an environment a beam of highly energetic electrons accelerated along the field lines towards the planet can produce radio emission. However, even if the CMI could operate the extended ionospheres of Hot Jupiters are too dense to let the radio emission escape from the planets. We also investigate the possible radio emission of the Hot Jupiter Tau Bootis b by placing it at different orbital distances from the host star, i.e. 0.1 and 0.2 AU. In particular we check if the atmosphere of Tau Bootis b at 0.046 AU is in the hydrostatic or in the hydrodynamic regime. If it is in the hydrodynamic regime it's ionosphere is extended and will constitute an obstacle for possibly generated radio waves or the generation via the Cyclotron Maser Instability (CMI) might even be prevented completely. Furthermore we investigate at which orbital location the atmosphere undergoes the transformation from hydrodynamic to hydrostatic, i.e. the transformation to more favourable conditions for the CMI.