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Hot-Jupiter ionospheres irradiated by low-mass stars

J. Chadney (1), M. Galand (2), Y. Unruh (2), T. Koskinen (3) and J. Sanz-Forcada (4)
(1) Department of Physics, Imperial College London, UK (joshua.chadney10@imperial.ac.uk), (2) Department of Physics, Imperial College London, UK, (3) Lunar and Planetary Laboratory, University of Arizona, USA, (4) Departamento de Astrofisica, Centro de Astrobiologia (CSIC-INTA), Madrid, Spain

Abstract

We present a modelling study of the upper atmospheres of extra-solar planets, focussing on the influence of different stellar radiation spectra on the composition and structure of the ionosphere around a gas-giant planet. In particular, we concentrate on hot-Jupiter planets orbiting low mass stars, of K and M type. Compared to a solar type star, the XUV radiation of these stars is extremely variable and they have a much higher XUV-to-bolometric-flux ratio than similarly aged solar type stars – greatly affecting the planetary ionospheres they irradiate. In this work, XUV spectra for the different stars selected are constructed using a combination of spectral data from various space telescopes, as well as coronal models of the stars. Ion production rates and densities are then calculated for a given H_2/H/He background atmosphere, taking into account ionisation through both primary and secondary processes. Additionally, the effect of orbital separation on ionospheric composition is examined. Results show that in atmospheres subjected to radiation from active M-dwarf stars, ion production is boosted in the lower ionosphere, which is also the region most affected by secondary ionisation processes.