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Ionisation of gas-giant type exoplanetary atmospheres under stellar radiation

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Abstract

Characterising extra-solar planetary atmospheres is the new frontier in exoplanetary research. Future space-based missions will provide consistent and stable measurements of star systems with known transiting exoplanets. These missions, that are currently at selection stage, are ESA's Exoplanet Characterisation Observatory (EChO) and NASA's Fast INfrared Exoplanet Spectroscopy Survey Explorer (FINESSE). Once up and running, they will deliver high stability, long duration observations in the visible to mid-infrared. In the meantime, modelling studies of the atmospheres of extra-solar planets, such as the one undertaken in this work, will be useful to help plan the observational process and provide insight into the data analysis and interpretation, after the missions are launched.

The purpose of this work is to study the influence of differing stellar radiation profiles on the composition and structure of an ionosphere around a typical gas-giant planet. Particular interest is focused upon M and K-type dwarf stars. Typical XUV spectra for the different star types are constructed by combining data from various satellites. Unobserved parts of the spectrum are filled using a combination of extrapolation and results from a correlation study of the solar spectrum. The constructed spectra are then used to calculate ion densities, produced through photo-ionisation, in a H_2/H/He atmosphere, considering the neutral atmosphere as a constant background. Preliminary results show that in planets irradiated by K-type stars, photo-ionisation production rates are remarkably similar to those in planets orbiting Sun-like stars. The case of atmospheres subjected to radiation from flaring M-stars is altogether more interesting: an extension of the production rate peak towards lower altitudes is predicted.