EPSC Abstracts
Vol. 12, EPSC2018-1233, 2018
European Planetary Science Congress 2018

Ground-based observations of hot exoplanet upper atmospheres

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Abstract

Transiting exoplanets are among the best suitable targets for atmospheric studies, particularly with transmission spectroscopy. This technique studies the light filtered through the atmosphere of an exoplanet, as it passes in front of its star. These observations have experienced a rapid development in the last few years, allowing us to precisely probe the low part of atmospheres. Despite these progresses, we are still unable to understand the link between the low and the upper part of atmospheres, with the latter undergoing evaporation.

Transit observations from the ground with stabilised high-resolution spectrograph, such as HARPS, have key roles to play in this context. Indeed, while taking care of multiple challenges linked to the stellar lines variability (Rossiter-McLaughlin effect, center-to-limb variation, activity), studies of sodium lines (via the Fraunhofer D doublet) deliver innovative measurements of atmospheres. The measured sodium absorptions in the atmospheres of several hot Jupiters have revealed new informations about their thermospheres. The thermosphere is a very specific region of intermediate altitudes (very low pressure), where most of the stellar irradiation is absorbed by atoms and molecules, resulting in an upper atmospheric heating. This mechanism potentially lead to an hydrodynamical expansion of the atmosphere that may trigger the exoplanet evaporation. The classical sodium probe in now join with a few other probes (such as Helium) increasing the possibilities to measure this part of the upper atmosphere. Henceforth, observations at high-resolution, particularly in the optical and infrared domain (e.g. with ESPRESSO, CARMENES, etc.), are a valuable and important resource in order to understand exoplanets atmospheres.