
Characterizing cloudy atmospheres with space photometry at optical wavelengths.

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Abstract

The presence of clouds in exoplanets’ atmospheres seems ubiquitous. Hints for hazy atmospheres have been found from the hottest hot Jupiters to the colder super-Earth. High precision photometry at optical wavelengths, as was provided by CoRoT and Kepler allows the detection and characterization of those cloudy atmospheres.

The properties of those clouds is expected to change with the equilibrium temperature of the planet. When observing cooler planets, the dayside should progressively be covered by a thick cloud layer. We expect a large number of planets to be partially cloudy, as observed in Kepler-7b by Demory et al. .

Plato, following the pioneering work of CoRoT and Kepler, will provide a broad census of cloudy exoplanets. From the secondary eclipses and the full phase curves of exoplanets, it will derive both the mean albedo of the planets and its variation with longitude. Understanding those numerous observations requires a good comprehension of the interactions between the thermal structure, the chemical composition and the atmospheric dynamics of those planets.

I will show how three-dimensional global circulation models are necessary to provide constraints on the composition and repartition of clouds in irradiated exoplanets. Such models will be needed to understand the transition from cloudless to cloudy atmosphere that will be probed with the Plato data.

Atmospheric models based on the knowledge gained through observations and detailed dynamical models are crucial to understand the evolution of these planets. I will present our new, non-grey, analytical radiative model. This publicly available model provides good estimates of the thermal structure of irradiated atmospheres over a large range of irradiation flux and gravity. This model can be very handfull to rapidly estimate the thermal flux leaking into the Plato observations or to provide a reasonable boundary condition when modeling the internal structure and evolution of giant planets.

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