The exploration of exoplanets: What can we learn from solar system synergies?

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Abstract

Most of the discovered exoplanets are "exotic" with regard to the Solar system, with characteristics that are very different from our own planets. Still, we can use the experience gained in the study of the solar system planets for trying to understand the physical nature of exoplanets. The properties of their atmospheres are, as in the case of the Solar system, constrained by a few parameters: their mass and radius, the stellar radiation flux (and thus the star's properties and its distance to the planet), the planet's ellipticity, its inclination, its rotation, the presence or absence of a magnetosphere... Under some simple hypotheses (thermochemical equilibrium and absence of migration), it is possible to make simple predictions about the nature of the exoplanet's atmospheric composition, on the basis of the planet's mass and its equilibrium temperature. The study of solar system planets also tells us which other mechanisms may lead to a departure from thermochemical equilibrium, in particular photochemistry and transport-induced quenching. The study of planetary spectra is a good starting point to try to understand the spectra of exoplanets that now become available through transit spectroscopy observations. From the spectral type of the hosting star and its distance to the exoplanet, one can estimate the spectral ranges where reflected/scattered stellar radiation and thermal emission dominate. In the thermal regime, the observation of a given molecule in different bands of different intensities may provide constraints on the vertical thermal profile and the vertical distribution of the molecule.

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