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Observational constraints on the composition of exoplanets

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Abstract

In 2002, an extrasolar atmosphere was detected through measurements of Na absorption from the planet HD 209458b. Subsequent photometry of exoplanets sampled the atmospheres' temperatures at different phases in the planets' orbits. It was realized that two forms of exoplanetary spectra can be measured. The primary eclipse provides a transmission spectra of the exoplanet's limb as the planet passes in front of the star. The secondary eclipse measures the emission of mainly the planet's dayside atmosphere from the planet plus star's emission minus the emission of star alone, when it eclipses the planet. Yet, only in the past 3 years, have infrared transmission and emission spectroscopy revealed the presence of the primary carbon and oxygen species (CH_4, CO_2, CO, and H_2O). Efforts to constrain the abundances of these molecules are hindered by degenerate effects of the temperature and composition in the emission spectra. Transmission spectra, while less sensitive to the atmospheric temperatures, are difficult to interpret because the composition derived depends delicately on the assumed radius. This talk will discuss the correlations in the degenerate solutions that result from the radiative transfer analyses of both emission and transmission spectroscopy. The physical implications of these correlations are assessed in order to determine the temperature and composition structure of extrasolar planets, and their significance with respect to the exoplanet's chemistry and dynamics.