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The complete transmission spectrum of an exoplanet from UV to IR

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Abstract

Transmission spectroscopy of transiting planets is one tool to obtain atmospheric spectra of planets outside the solar system. Using four different instruments on the HST – STIS, ACS, NICMOS and WF3 – we combined wide-band and narrow-band spectrophotometry over dozens of HST orbits to piece together the complete transmission spectrum of the hot Jupiter prototype HD 189733b.

These observations paint a very different picture of the atmosphere of this planet than predicted by the models. The transmission spectrum is dominated by Rayleigh scattering over the whole visible and near-infrared range, with narrow sodium and potassium lines, and excess absorption in the UV. This is interpreted as indicating an atmosphere dominated by haze over at least six scale heights, with residual alkali metal absorption above the haze, and possible opacity from photochemical products in the UV.

Altogether the atmosphere of HD 189733b seems to be more dominated by hazes or/and clouds than expected for hot Jupiters, not unlike Solar System planets like Venus or Titan. The only other well-studied case, the planet HD 209458b, has a transparent, absorbing atmosphere, suggesting the existence of at least two families of hot gas giant planet atmospheres.