Unveiling the atmosphere of HD 189733b with ESPRESSO

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Broad-band transmission spectroscopy of exoplanets atmospheres has been performed with great success with space telescopes using spectrophotometry. From ground-based instruments there is a analogue technique, using radial velocities, that has not yet been extensively explored. The often called chromatic Rossiter-McLaughlin (CRM, e.g. Di Gloria+ 2016) can make use of high-resolution spectroscopy observations to derive these broad-band transmission spectra.
We make use of the CRM to retrieve the transmission spectrum of HD 189733b with ESPRESSO. We employ an improved Rossiter-McLaughlin (RM) model which includes the differential rotation and convective blue-shift effects on stellar disk velocity fields to achieve the best RM modeling so far. In particular, as the differential rotation is a function of the latitude, we were able to measure the true obliquity of the planetary orbit due to the extreme precision of the RVs. To retrieve the transmission spectrum we split the wavelength range of ESPRESSO into smaller wavelength bins, and use our RM model to compute the planetary radius. We derive a transmission spectrum with decreasing radii as a function of increasing wavelength, which is often attributed to the presence of haze in the atmosphere of exoplanets.