Mock Proposal: Spectral followup to exoplanet transit observation

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Abstract

We have recently obtained V-band photometric observations of an exoplanet transit. From this observation we have obtained the planet's orbital period, ratio of the planet to stellar radii, ratio of the orbital semi-major axis to the stellar radius, and even the mean stellar density. Given the paucity of data on the host star, and the dependence of transit properties on the host properties, the study would greatly benefit from further stellar characterization. This proposal involves acquiring high-resolution spectra obtained via CFHT's SIPRou eschelle spectrograph which will allow for an extremely complimentary follow-up study to solidify the parameters of this exoplanetary system. We propose to obtain spectra at several phases of the exoplanet orbit including the transit itself. By observing the transit at multiple wavelengths we can lift the degeneracy between impact parameter and limb darkening, as only the latter is wavelength dependent. Careful spectral characterization will provide the temperature, surface gravity, and metallicity of the host star which will much more tightly constrain estimates of its radius. This will lead to similar constraints on the stellar mass and the planetary radius, semi-major axis, and inclination. Radial velocity (RV) measurements of the star throughout the exoplanet's orbit will allow us to fit an RV curve to determine the planetary mass, orbital eccentricity, and finally get a measure of the planet's mean density, providing a glimpse into its composition. High-resolution spectra will also allow us to look for the Rossiter-McLaughlin effect, where the transiting planet sequentially blocks the blue- and red-shifted edges of a rotating star, to determine any misalignment between the stellar spin axis and the orbital plane. The extreme complementarity of the transit and RV exoplanet detection methods is plainly evident.