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Spectroscopically Unlocking Exoplanet Characteristics

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Spectroscopy plays a critical role in a number of areas of exoplanet research. The first exoplanets were detected by precisely measuring Doppler shifts in high resolution (R$\sim$100,000) stellar spectra, a technique that has become known as the Radial Velocity (RV) method. The RV method provides critical constraints on exoplanet masses, but is currently limited to some degree by robust line shape predictions. Beyond the RV method, spectroscopy plays a critical role in the characterization of exoplanets beyond their mass and radius. The Hubble Space Telescope has spectroscopically observed the atmospheres of exoplanets that transit their host stars as seen from Earth giving us key insights into atmospheric abundances of key atomic and molecular species as well as cloud optical properties. Similar spectroscopic characterization of exoplanet atmospheres will be carried out at higher resolution (R$\sim$100-3000) and with broader wavelength coverage with the James Webb Space Telescope. Future missions such as WFIRST that seek to the pave the way toward the detection and characterization of potentially habitable planets will have the capability of directly measuring the spectra of exoplanet atmospheres and potentially surfaces. Our ability to plan for and interpret spectra from exoplanets relies heavily on the fidelity of the spectroscopic databases available and would greatly benefit from further laboratory and theoretical work aimed at optical properties of atomic, molecular, and cloud/haze species in the pressure and temperature regimes relevant to exoplanet atmospheres.