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Exoplanet Spectroscopy: a bright present, a brilliant future

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Spectroscopic detection of molecules in exoplanet atmospheres is revolutionizing exoplanet characterization. Today, it is possible to compare the temperature structure and composition of exoplanet atmospheres, explore the role of non-equilibrium chemistry, examine the affect of extreme radiation forcing, detect dynamical processes, and search for signatures of evolutionary history. Spectroscopy is revealing exoplanet atmospheres to be complex, with numerous parallels to the atmospheres of planets in our own solar system. Recent observations demonstrate that broad, simultaneous, spectroscopic coverage is essential for resolving the temperature composition ambiguity present in exoplanet emission spectra. While the Hubble and Spitzer space telescopes launched exoplanet spectroscopy, they have also proven the case for a purpose-built exoplanet spectroscopy mission with instantaneous broad wavelength coverage and extreme stability. Given the significant number of bright exoplanet systems, there is an important discovery space accessible with modest sized telescopes. Recent results show that ground-based telescopes will play a critical role in characterizing exoplanet atmospheres and imply that detection of molecules in the atmospheres of favorable "super-Earth" exoplanets is possible with existing instruments. Exoplanet comparative planetology via spectroscopy has already begun for hot-Jupiters and will be extended to other classes of planets in the near feature. Today, exoplanet spectroscopy stands poised to radically alter our understanding of exoplanets and to explore questions more typical of planetary atmospheres in our own solar system.