

Frequency Comb Spectroscopy at Extreme Temperature and Pressure in Support of Exoplanet Research

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We present a suite of laboratory facilities for high-resolution absorption spectroscopy covering a wide range of temperature and pressure. These facilities include multiple atmospheric-pressure burners covering 1400-2200K, a low-pressure three-zone tube furnace covering 0-1atm and 300- 1300K with tunable uniformity, and a high-pressure, high-temperature optical cell capable of up to 100atm and up to 1000K. The facilities are instrumented with a dual frequency comb absorption spectrometer to record spectra in the 1-2 μm range with a resolution of ~ 0.0014 nm and 10-5 nm wavelength accuracy. A new mid-infrared dual frequency comb spectrometer will enable operation beyond 3 μm . The combination of the broadband, high-resolution spectrometers with high pressure, high temperature measurement capabilities provides a unique opportunity for developing and validating absorption models for exoplanetary atmospheres in a controlled laboratory setting.

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