Large UV / Optical / Infrared Surveyor

Telling the story of life in the universe

Exoplanet Transmission Spectroscopy with LUVOIR

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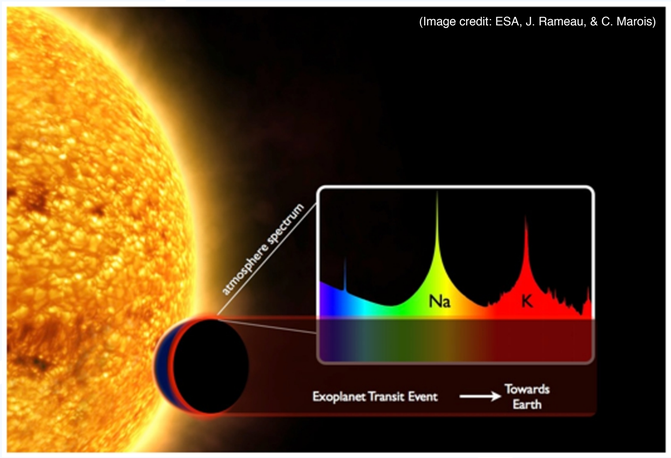
Transmission spectroscopy is one of our primary tools for measuring the structure and composition of exoplanet atmospheres, especially for close-in exoplanets. During an exoplanet transit part of the host stars' light passes through the planet's atmosphere imparting atomic and molecular absorption features on top of the stellar spectrum.



The HDI instrument on LUVOIR will allow us to measure high S/N transmission spectra at moderate spectral resolution (up to R~500) from 200 nm to 2.5 μm for a wide array of transiting exoplanets.

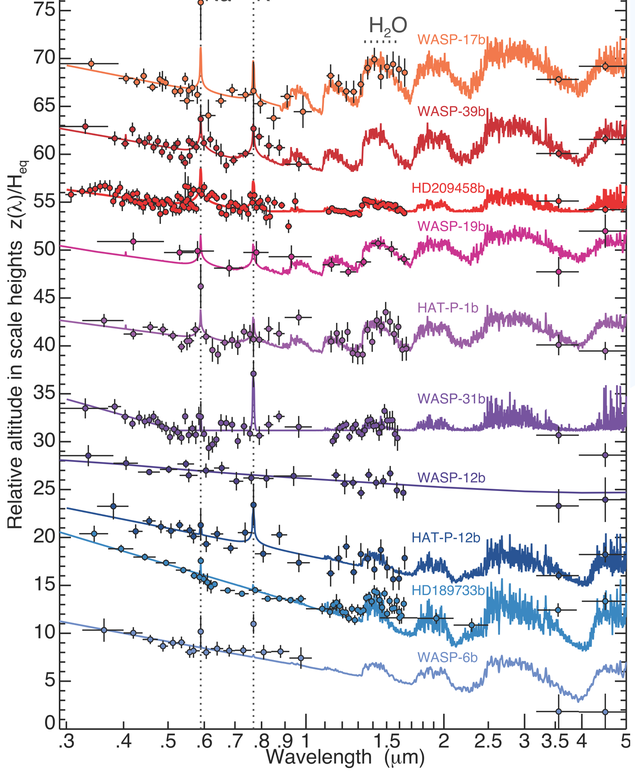
With the UVIS channel on HDI we will be able to:

- Measure Rayleigh scattering slopes to constrain cloud properties in the NUV.
- Detect atomic absorption from alkali metals, including from hot rocky exoplanets with silicate vapor atmospheres.

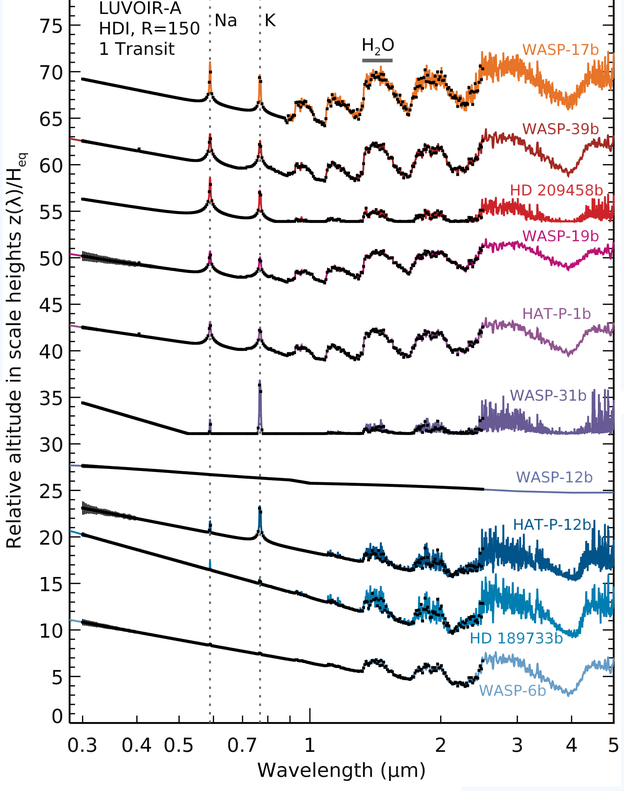
With the NIR channel on HDI we will be able to:

- Detect and measure abundances for molecules including H_2O, CO_2, & CH_4.

Transit Spectra with HST/Spitzer



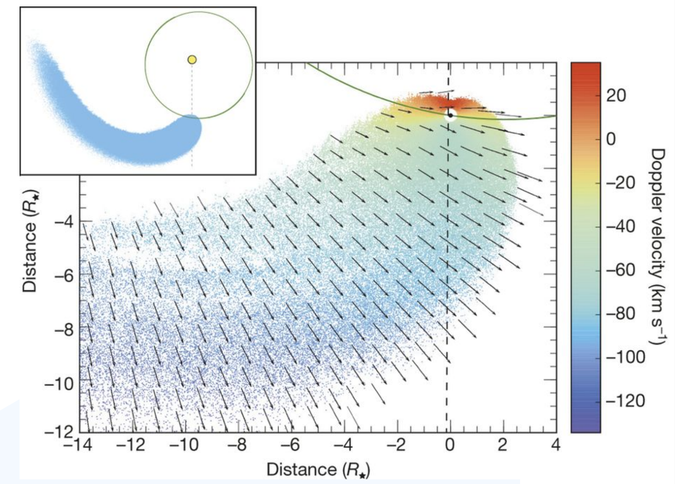
One transit with LUVOIR-A



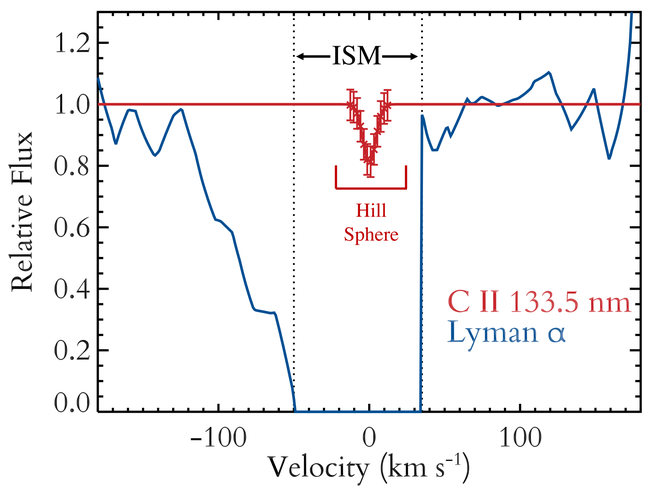
UV to NIR Spectra ten benchmark Hot Jupiters from Sing et al. (2016).

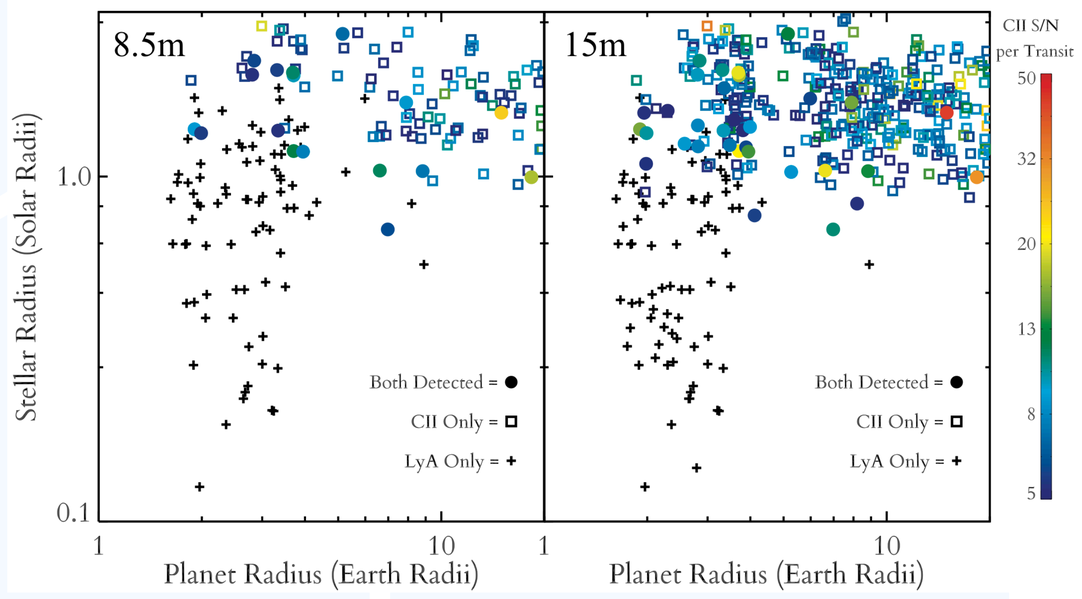
FUV transit spectroscopy with LUVOIR LUMOS will also revolutionize our knowledge of exospheres and atmospheric escape. We will be able to measure transiting exospheres not only in Lyman α, but also in FUV metal lines like CII (133.5 nm) and OI (130.4 nm). For dozens of planets we will be able to fully map the structure of their exospheres within the hill sphere, and to measure atmospheric compositions, including C/O, in a region that is immune to clouds.

Simulated observations of GJ 436b with just 20 minutes with the G120M grating mode on LUMOS for LUVOIR A. By observing in metal lines like CII, we can map material within the planet's Hill sphere, which is blocked by ISM extinction in Lyman α.



A comet-like tail of escaping hydrogen has been observed with HST STIS in Lyman α for hot Neptune GJ436b from Ehrenreich et al. (2015)





Simulated TESS planets for which we will be able to detect transiting exospheres in either Lyman α or CII at >5 σ in a single transit with LUMOS for either a 8.5m or 15m LUVOIR.

LUVOIR is a mission concept being studied in preparation for the *2020 Astronomy and Astrophysics Decadal Survey* https://asd.gsfc.nasa.gov/luvoir/