Towards Exoplanet Atmospheres: new data reduction for the nIR

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1) Objective

- Reduce near-InfaRed CRIRES spectra with high fidelity

- Extract spectra of exoplanetary atmospheres

2) Methods

- CRIRES reduction with in-house IRAF pipeline: Data Reduction Algorithm for CRIRES Spectra (DRACS).

- Obtain models of atmospheric absorption spectra from TAPAS web-service [Bertaux *et al.* 2014, A&A, 564, A96].
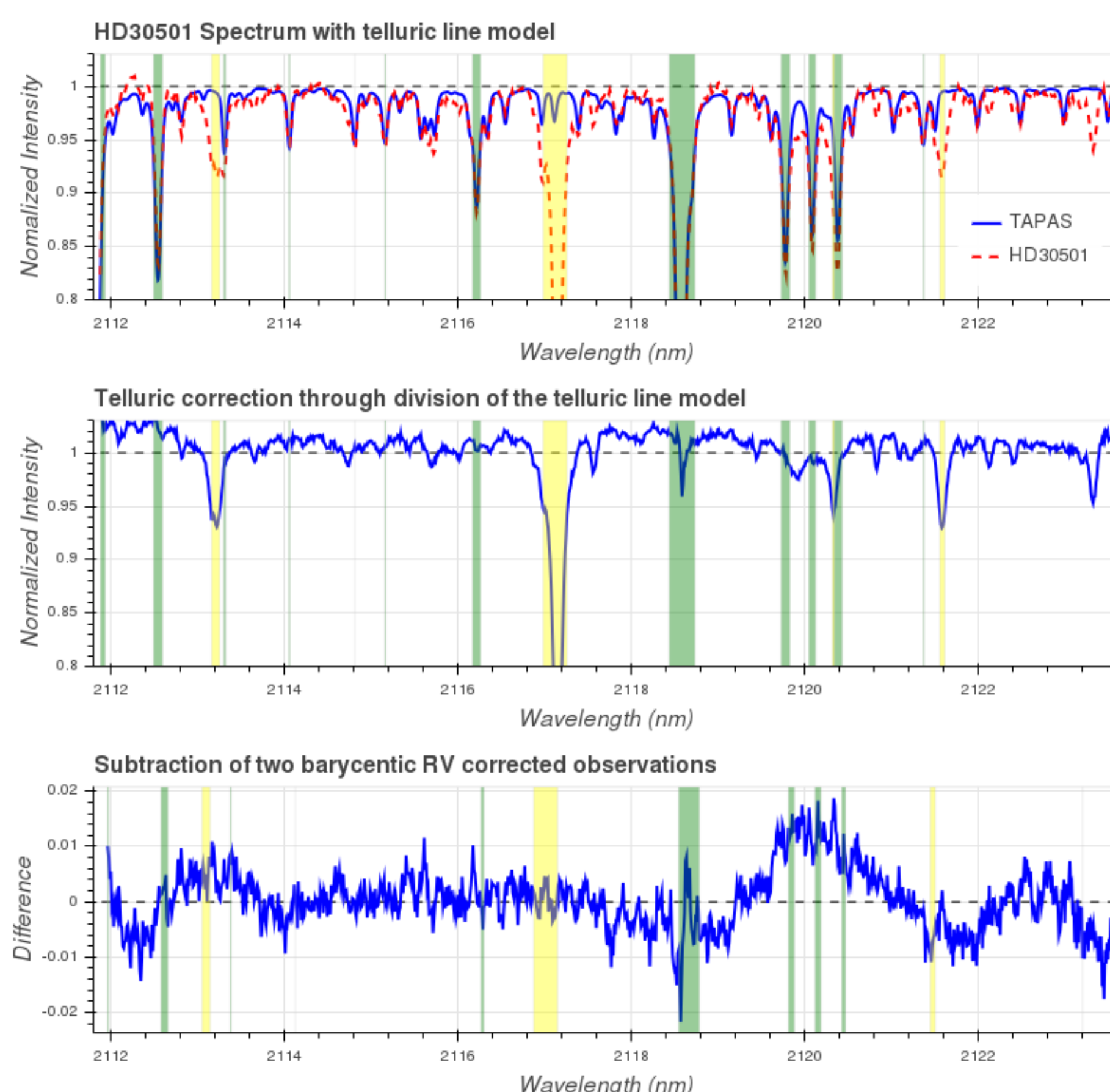
$$I_{tell}(\lambda) = 1 - \sum_{j=1}^{m} \text{Telluric lines} \qquad (1)$$

- Wavelength calibrate the observations using the telluric absorption spectrum imprinted by the atmosphere.

$$I_{obs}(pix) = 1 - \left(\sum_{j=1}^{m} \text{Telluric} \times \sum_{k=1}^{n} \text{Stellar} \right) \qquad (2)$$
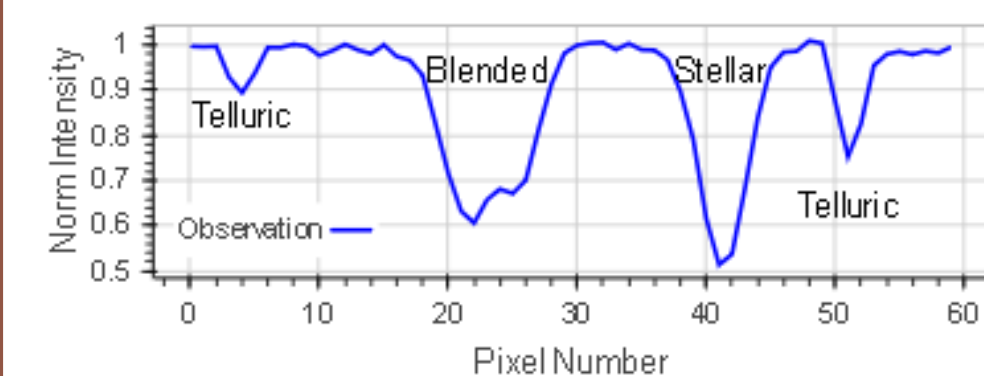
- Correct observations for telluric absorption by dividing by the same TAPAS telluric absorption models.

- Correct for Earth's barycentric motion then subtract two observations to cancel out the stellar absorption lines.

4) Results

HD30501 Spectrum with telluric line model

Telluric correction through division of the telluric line model

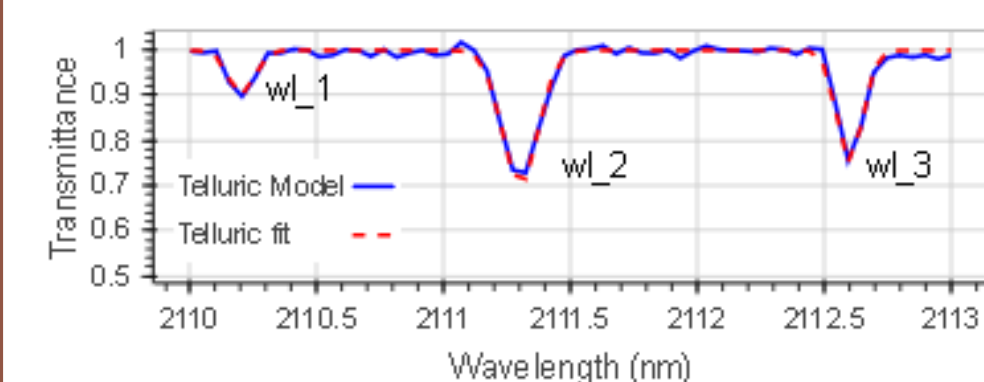Subtraction of two barycentic RV corrected observations
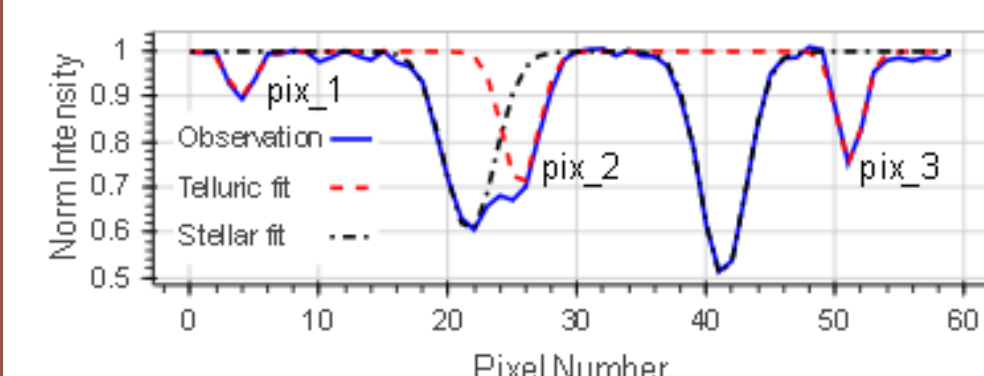
3) Calibration

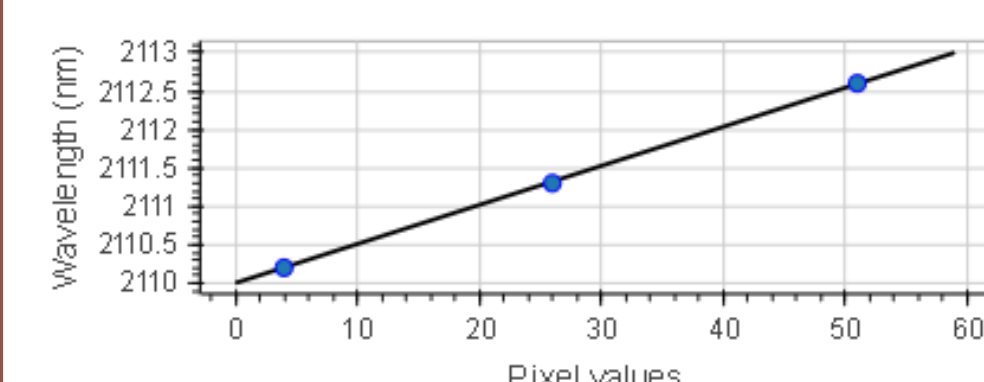Simulated observation of 2 stellar and 3 telluric lines

Fit Eq. 1 to telluric model to obtain the line centers in wavelength space (wl_i).

Fit Eq. 2 to the observation to obtain the telluric line centers in pixel space (pix_i).

A second order polynomial is applied to the fitted gaussian line centers wl_i and pix_i.

5) Future Work

- Model and extract the exoplanetary lines in the subtracted spectra.

- Apply these tools to 7 stars that host brown dwarf companions.