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].

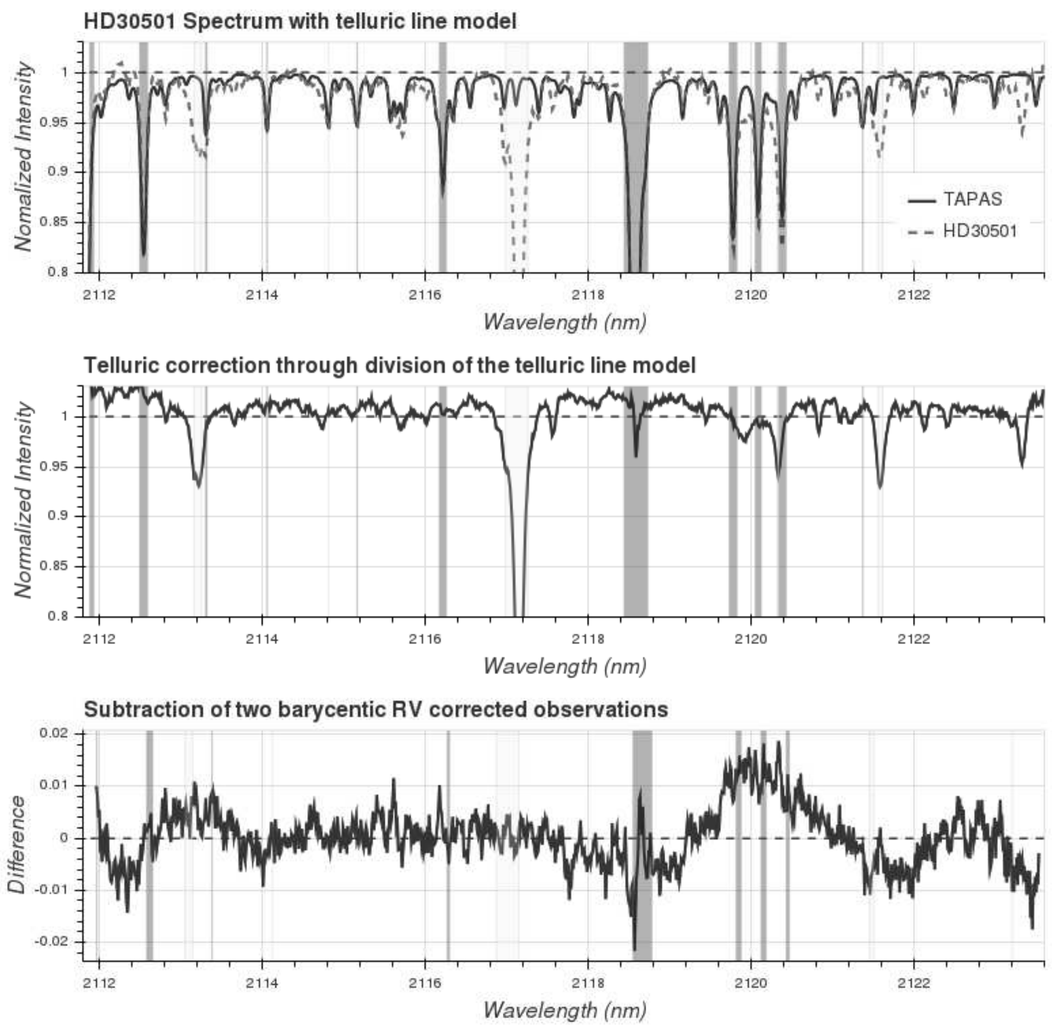
$$I_{tell}(\lambda) = 1 - \sum_{j=1}^{m} \text{Telluric lines} \qquad (1)$$

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

$$I_{obs}(pix) = 1 - \left(\sum_{j=1}^{m} \text{Telluric} \times \sum_{k=1}^{n} \text{Stellar} \right) \qquad (2)$$

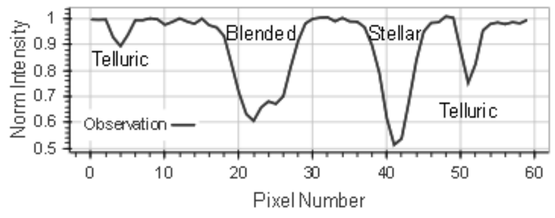
- Correct observations for telluric absorption by dividing by the same TAPAS telluric absorption models.
- Correct for Earth's barycentric motion then subtract two observations to cancel out the stellar absorption lines.

4) Results

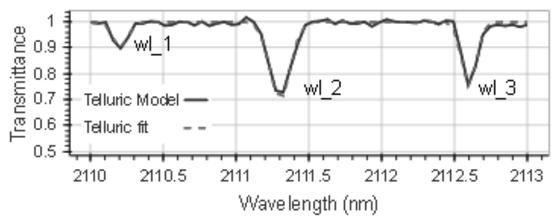


3) Calibration

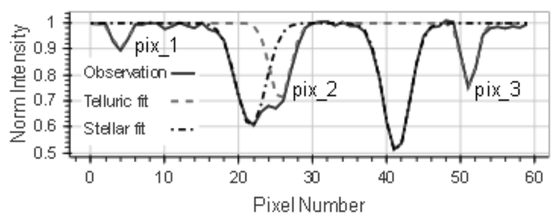
Simulated observation of 2 stellar and 3 telluric lines



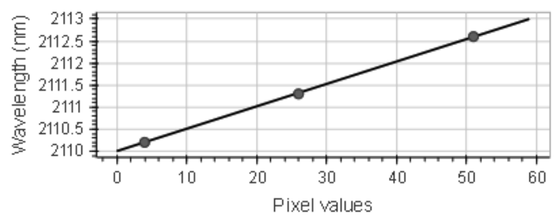
Fit Eq. 1 to telluric model to obtain the line centers in wavelength space (wl_i).



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.

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