Hα spectroscopy of close-in planets

Sebastian Kohl

Tigre Workshop 2016

1 Introduction and Previous Work

2 Telluric Contamination

3 Observations with TIGRE

Outline of the problem

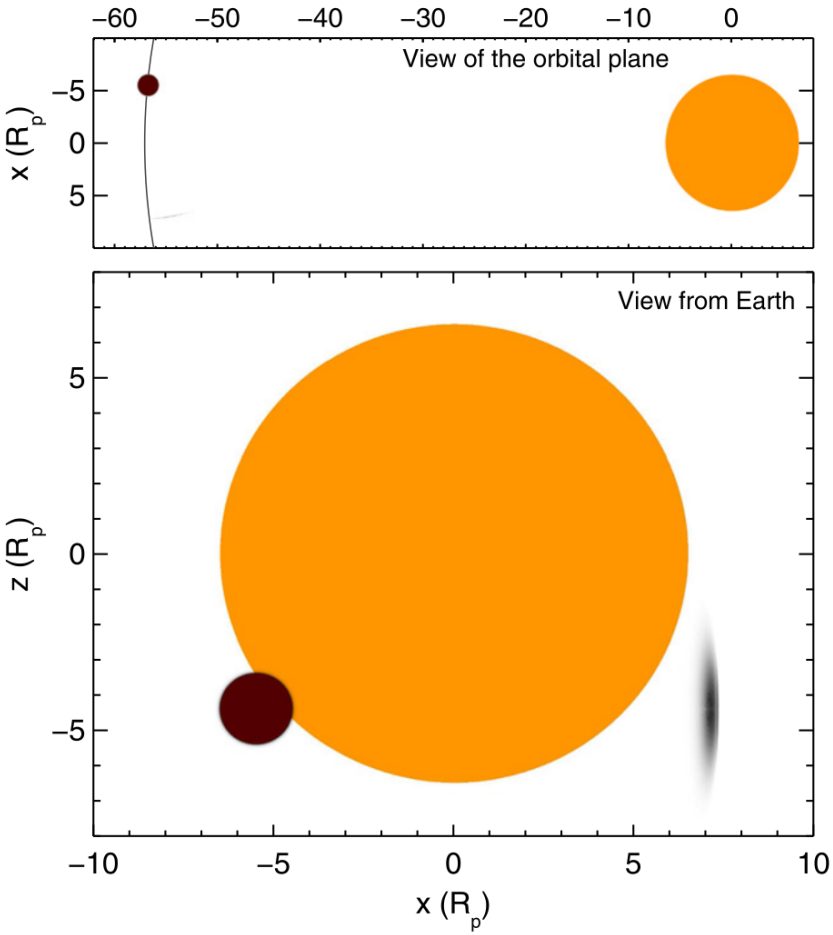

Figure: To-scale projections of the planet and bow shock. Cauley 2015

How to measure it?

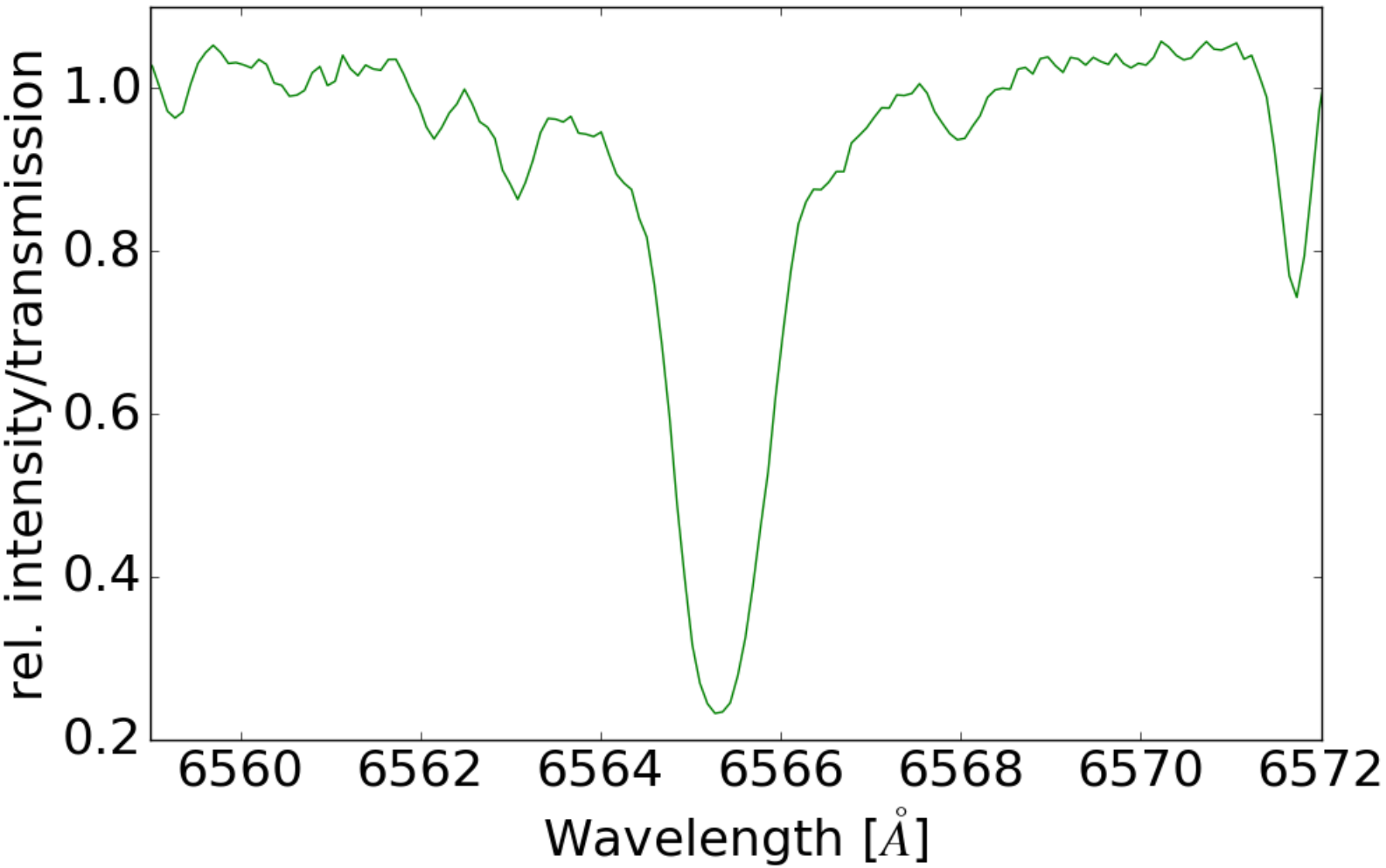

Figure: Spectrum of 55 Cnc.

Imprint on Spectra

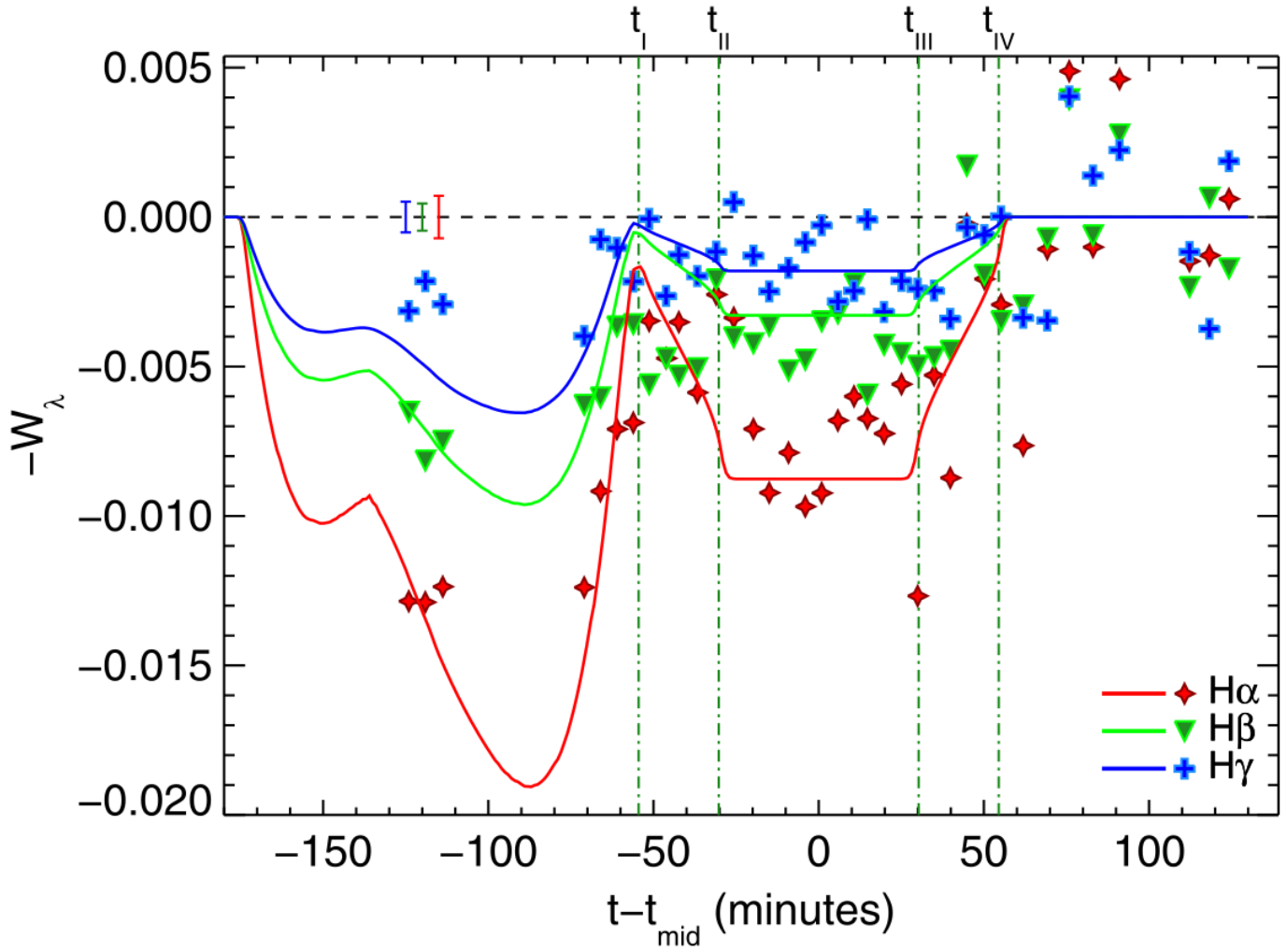

Figure: Absorption as a function of time for a single transit. Cauley 2015

Can TIGRE really do that?

- faintest object: m_V=8.54
- we have to detect an absorption excess of 1%
- in Hα line core we get S/N=50 per pixel for t_{exp}=20 min.
- $>$ 36 pixels cover Hα line core
- $\Rightarrow$ S/N $\approx$ 300
- $\Rightarrow$ 1% corresponds to 3σ signal

Target Selection

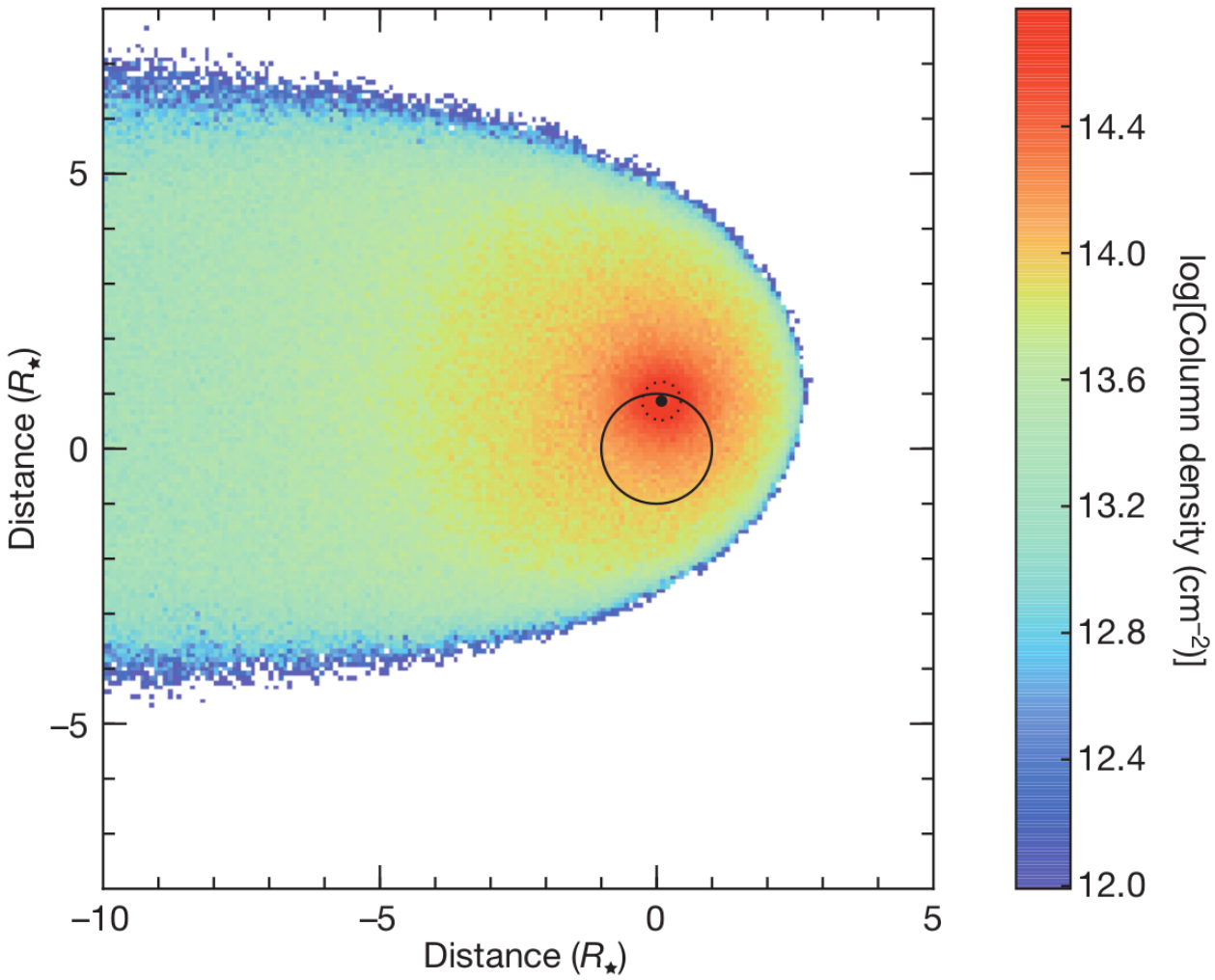

Figure: Hydrogen comet tail behind GJ 436b. Ehrenreich 2015

Target Selection

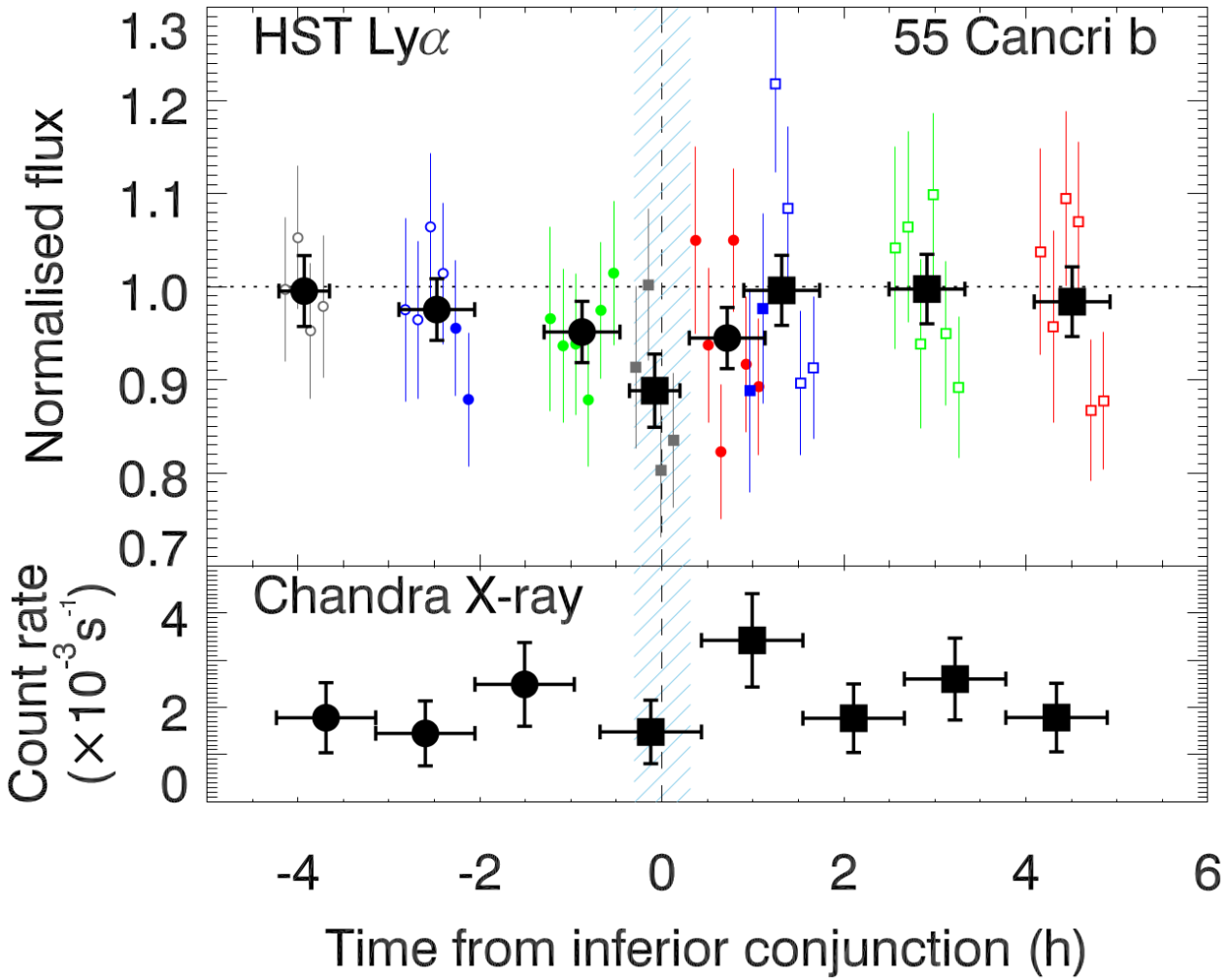

Figure: Lightcurve of 55 Cnc b in different spectral ranges. Ehrenreich 2012

Telluric Contamination

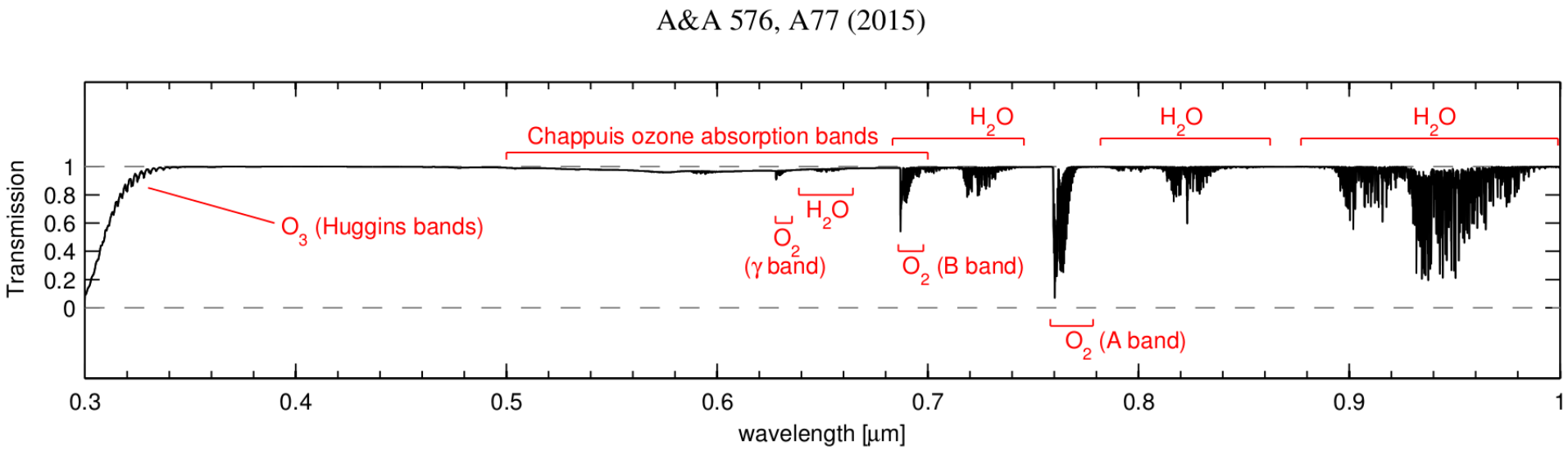

Figure: Telluric absorption bands in the visible wavelength range. Smette 2015

Telluric Contamination

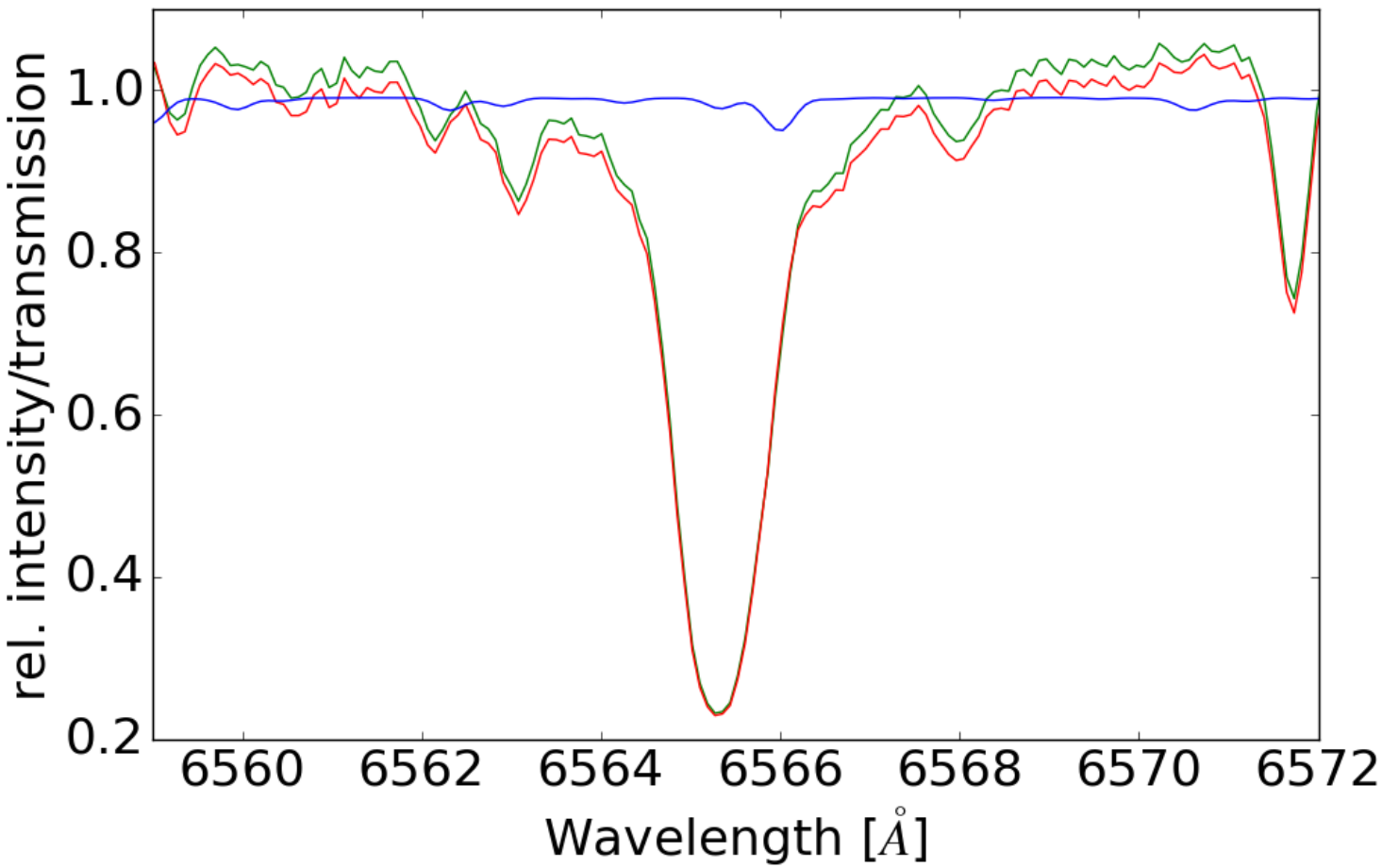

Figure: Uncorrected stellar spectrum of 55 Cnc (red), corrected stellar spectrum (green), telluric transmission spectrum (blue).

Sanity check: HD 189733 b

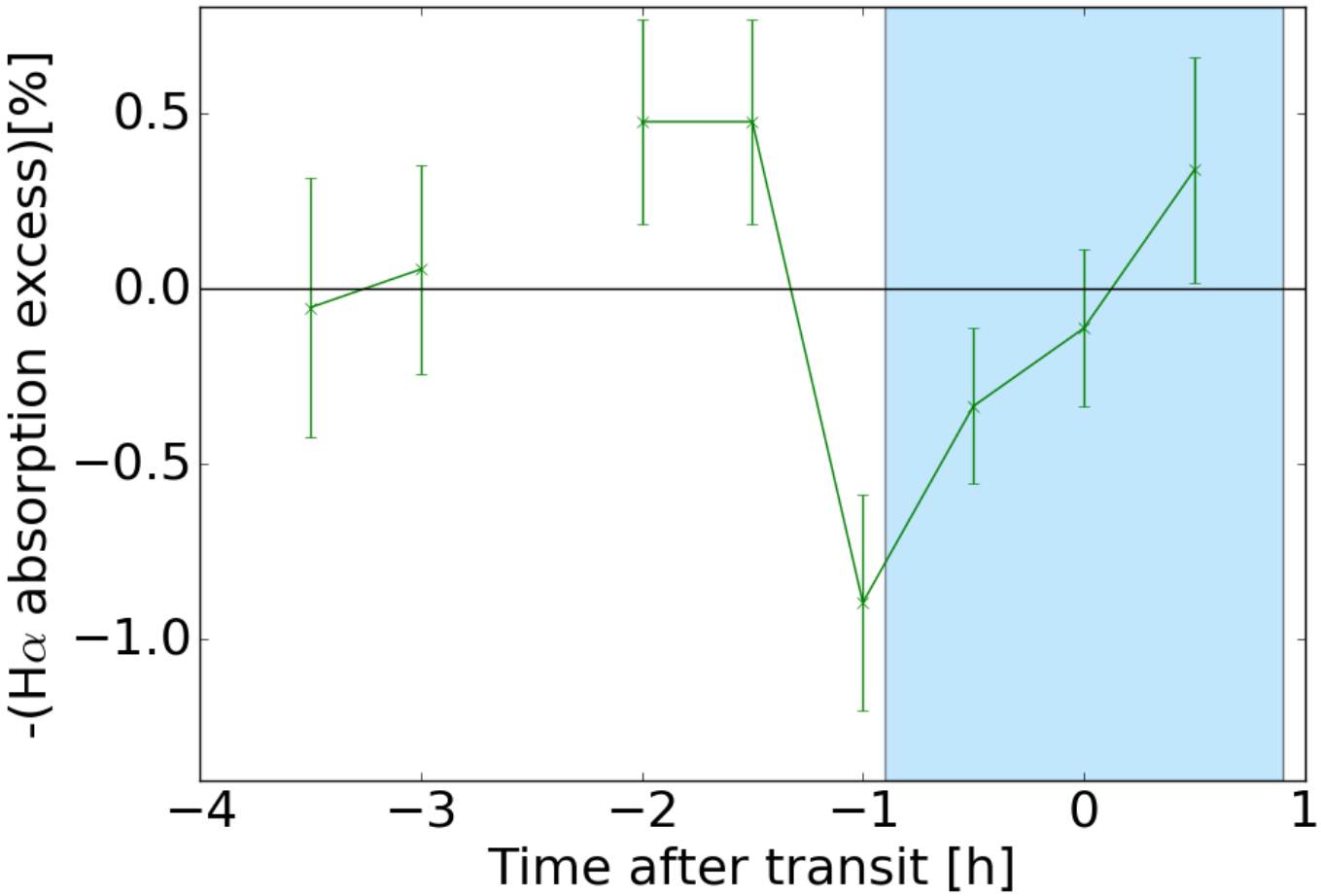

Figure: Transit on September 30th 2015.

Sanity check: HD 189733 b

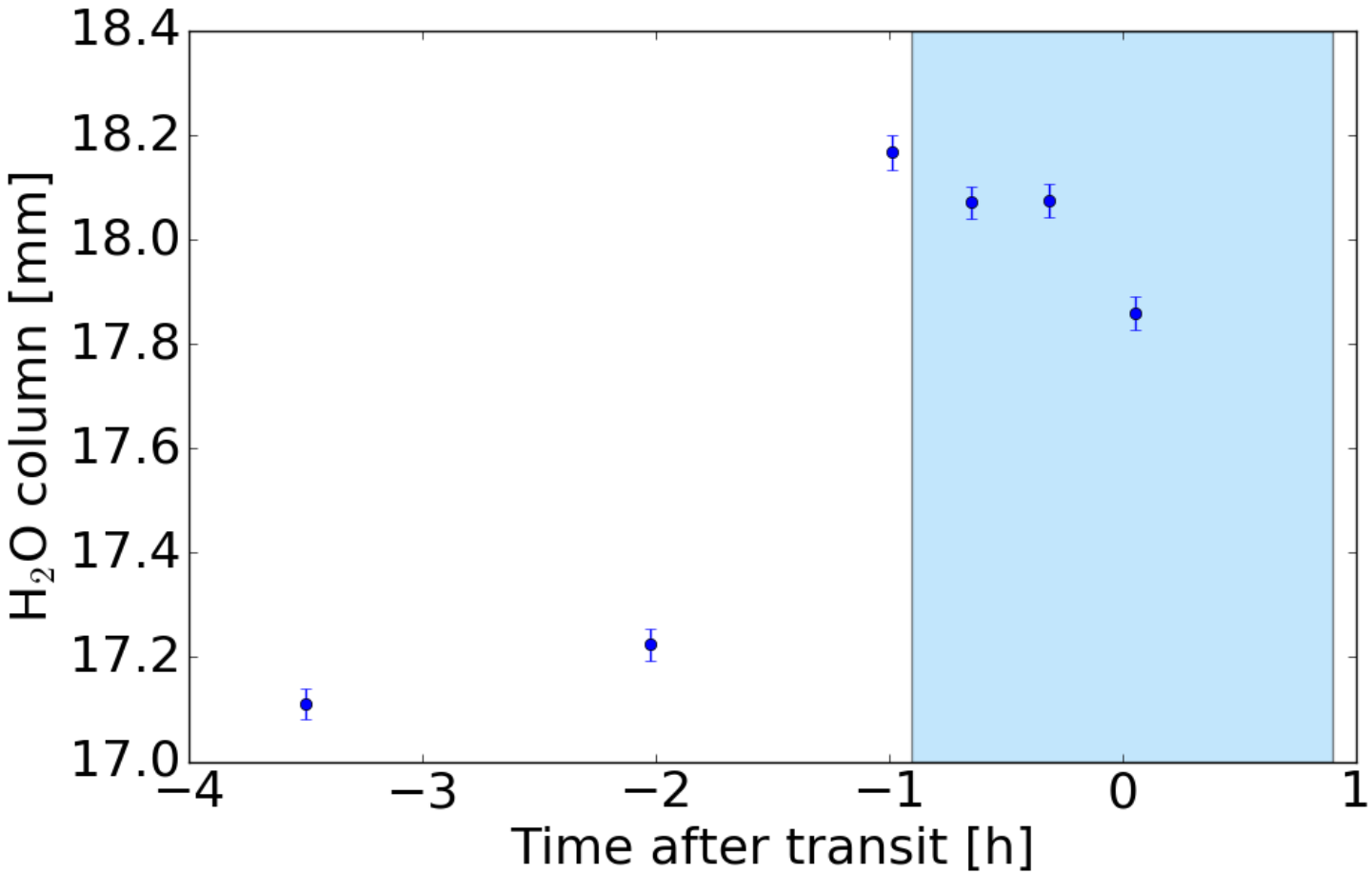

Figure: Water column over the telescope on September 30th 2015.

Sanity check: HD 189733 b

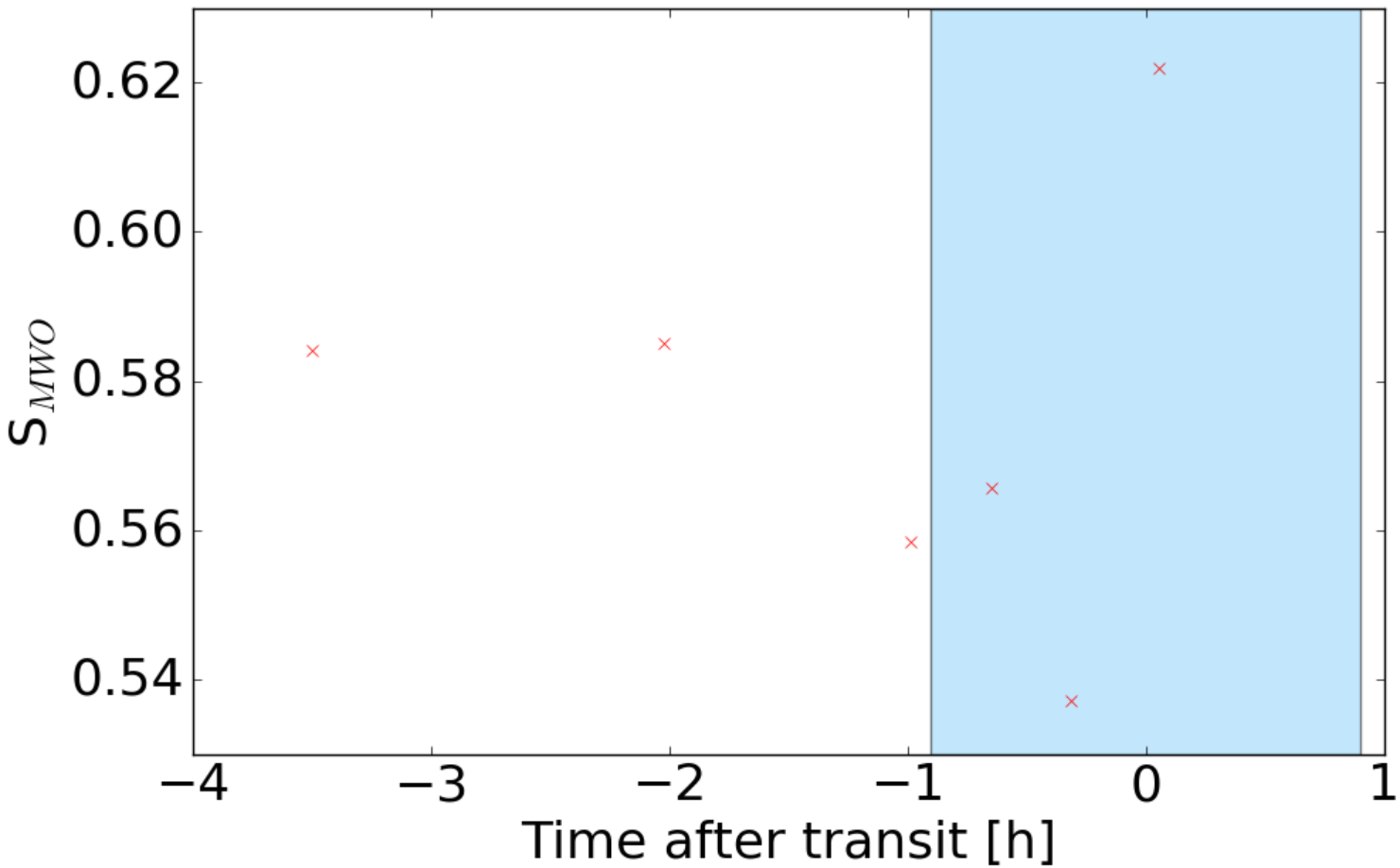

Figure: Stellar activity on September 30th 2015.

Sanity check: HD 189733 b

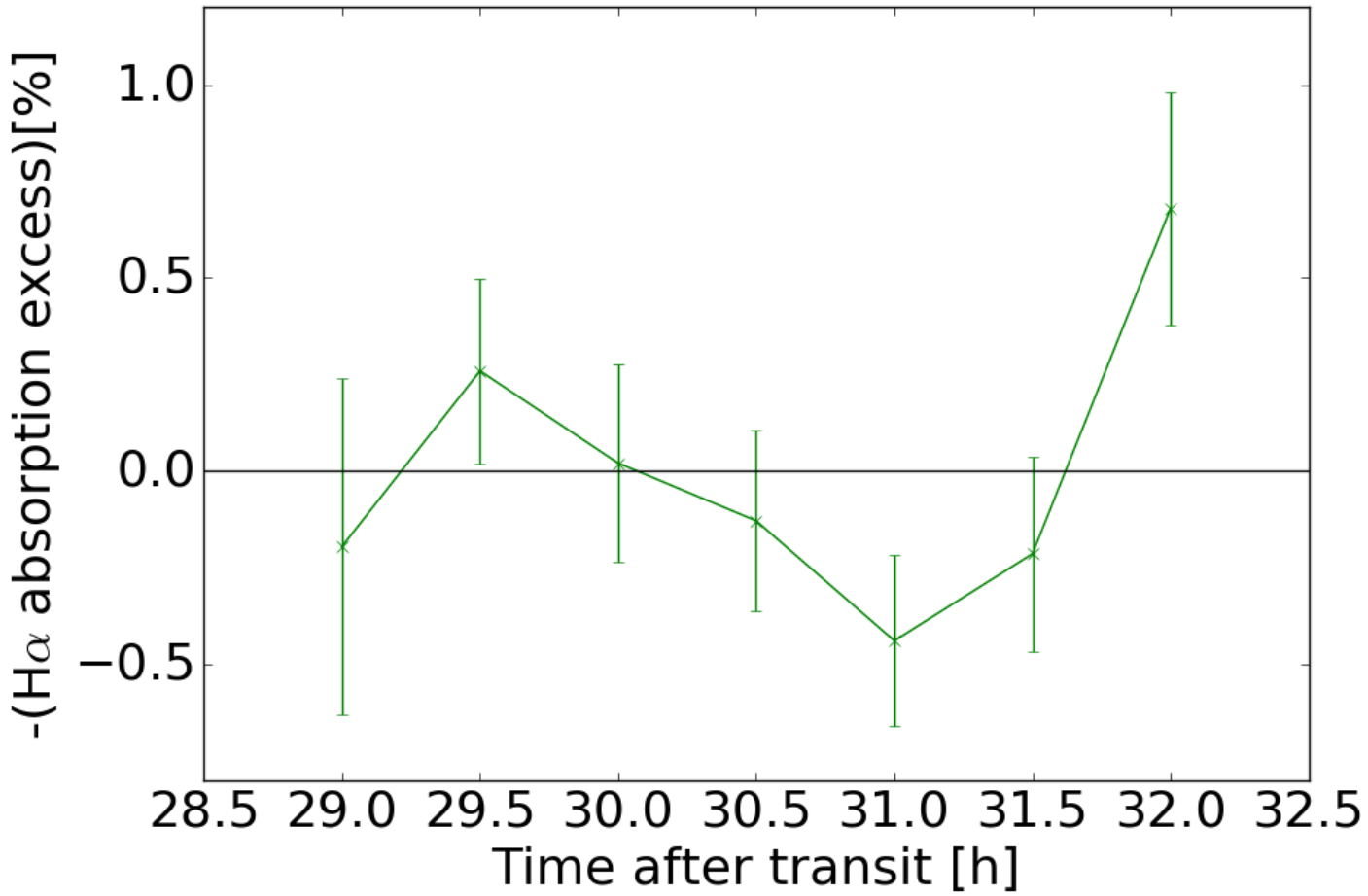

Figure: Repeated observations out of transit on July 31th 2015.

Sanity check: HD 189733 b

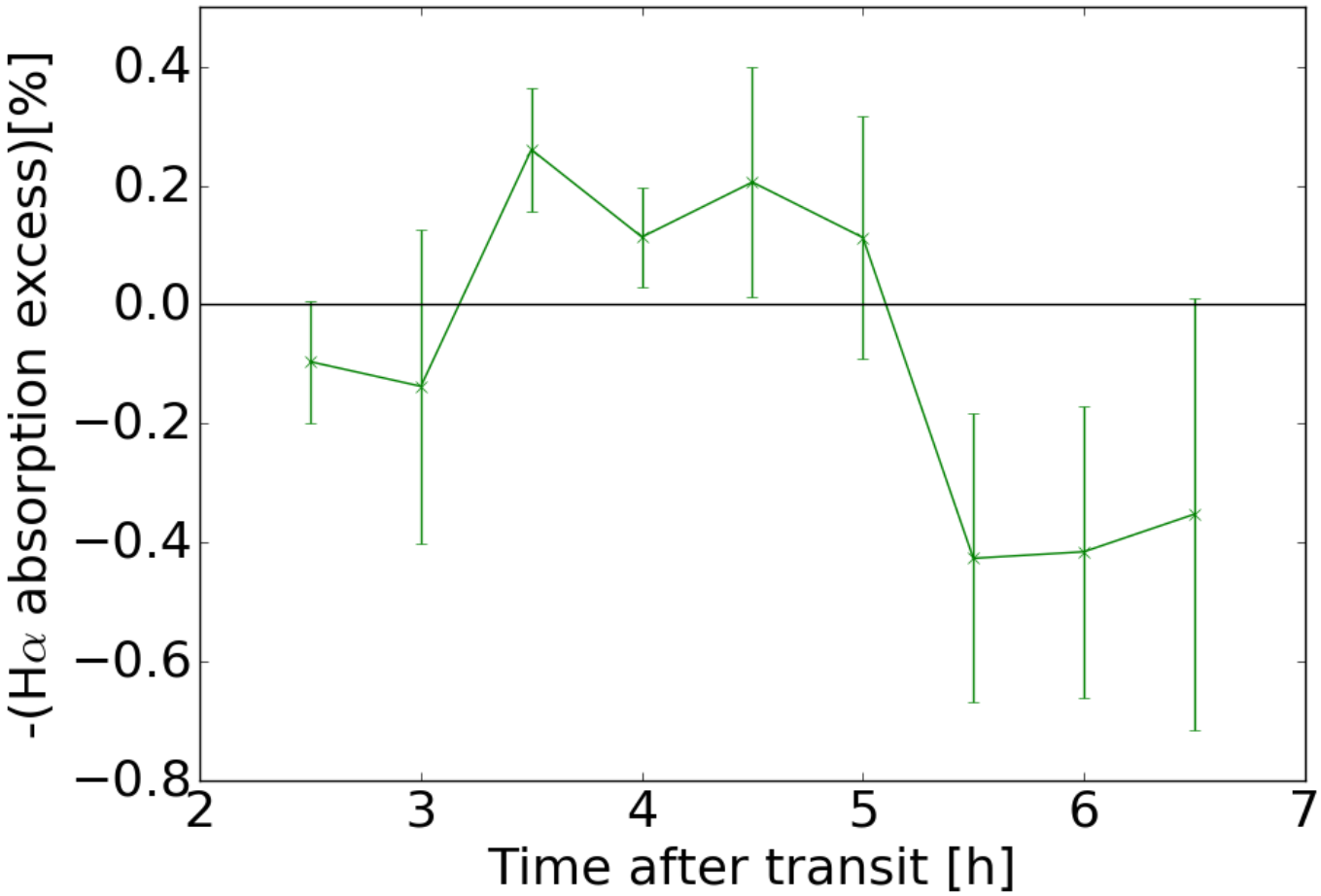

Figure: Repeated observations out of transit on September 28th 2015.

55 Cnc b

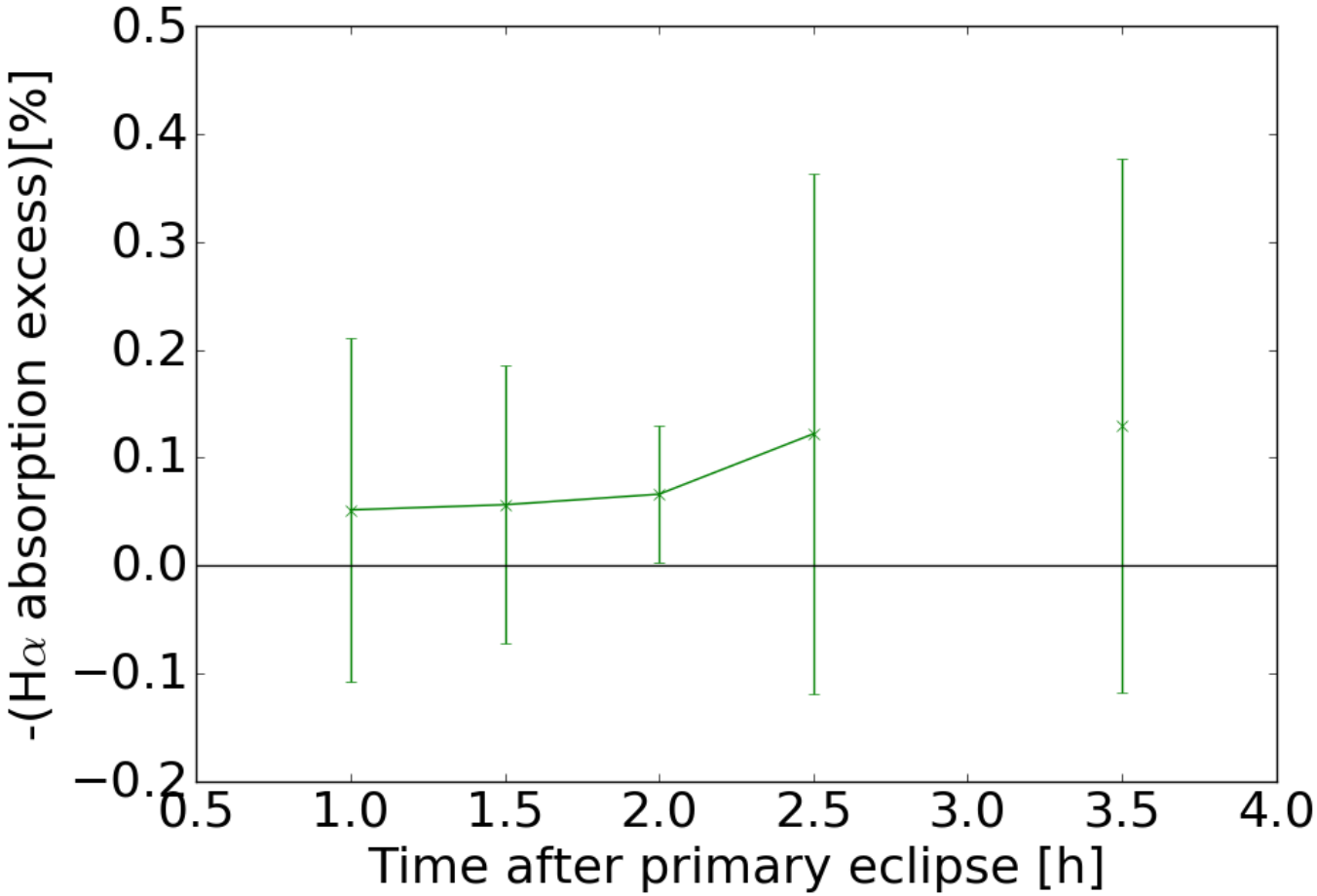

Figure: Primary eclipse on March 25th 2016.

55 Cnc b

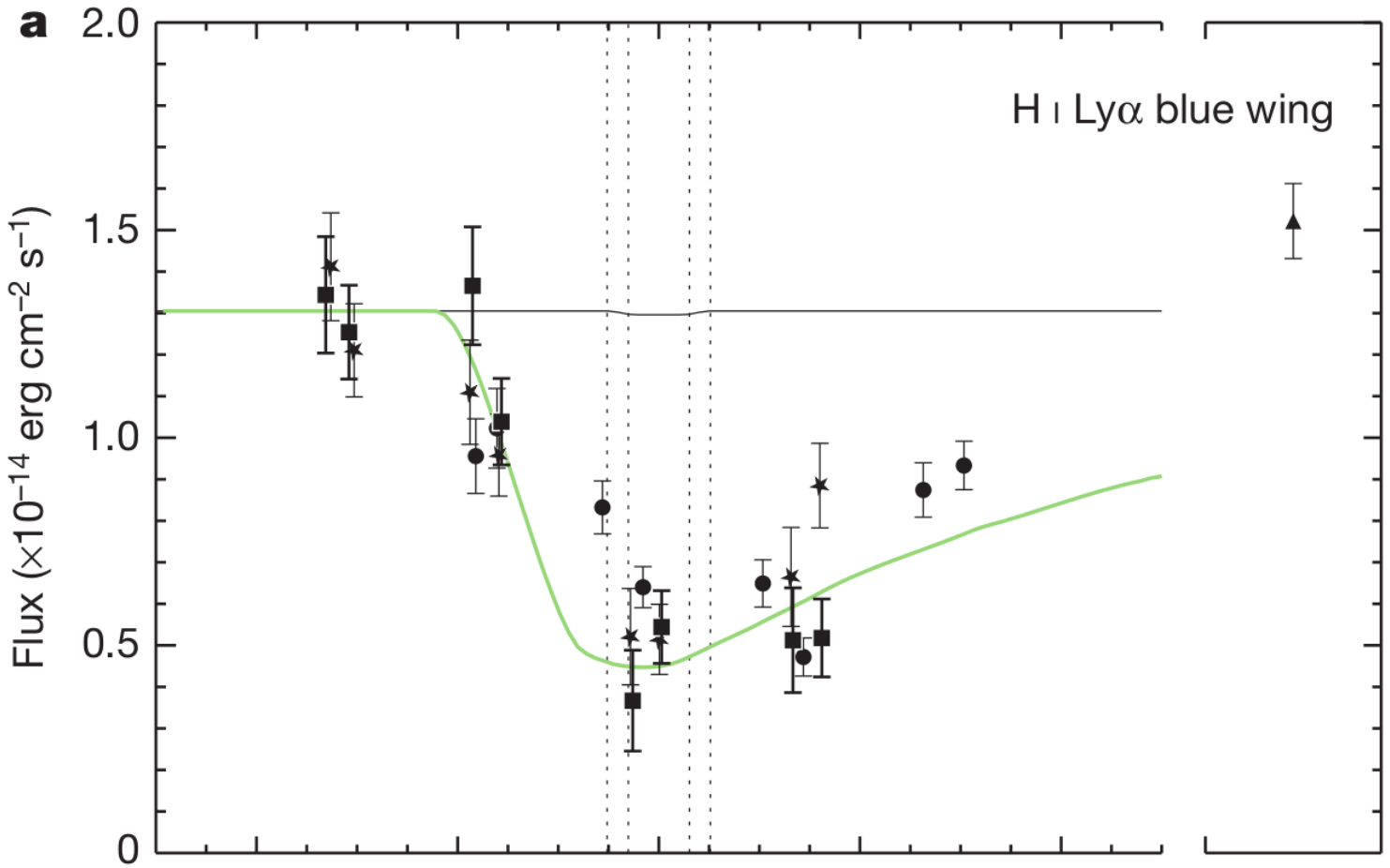

Figure: Lyman-α transit light curves of GJ 436b. Ehrenreich 2015

55 Cnc e

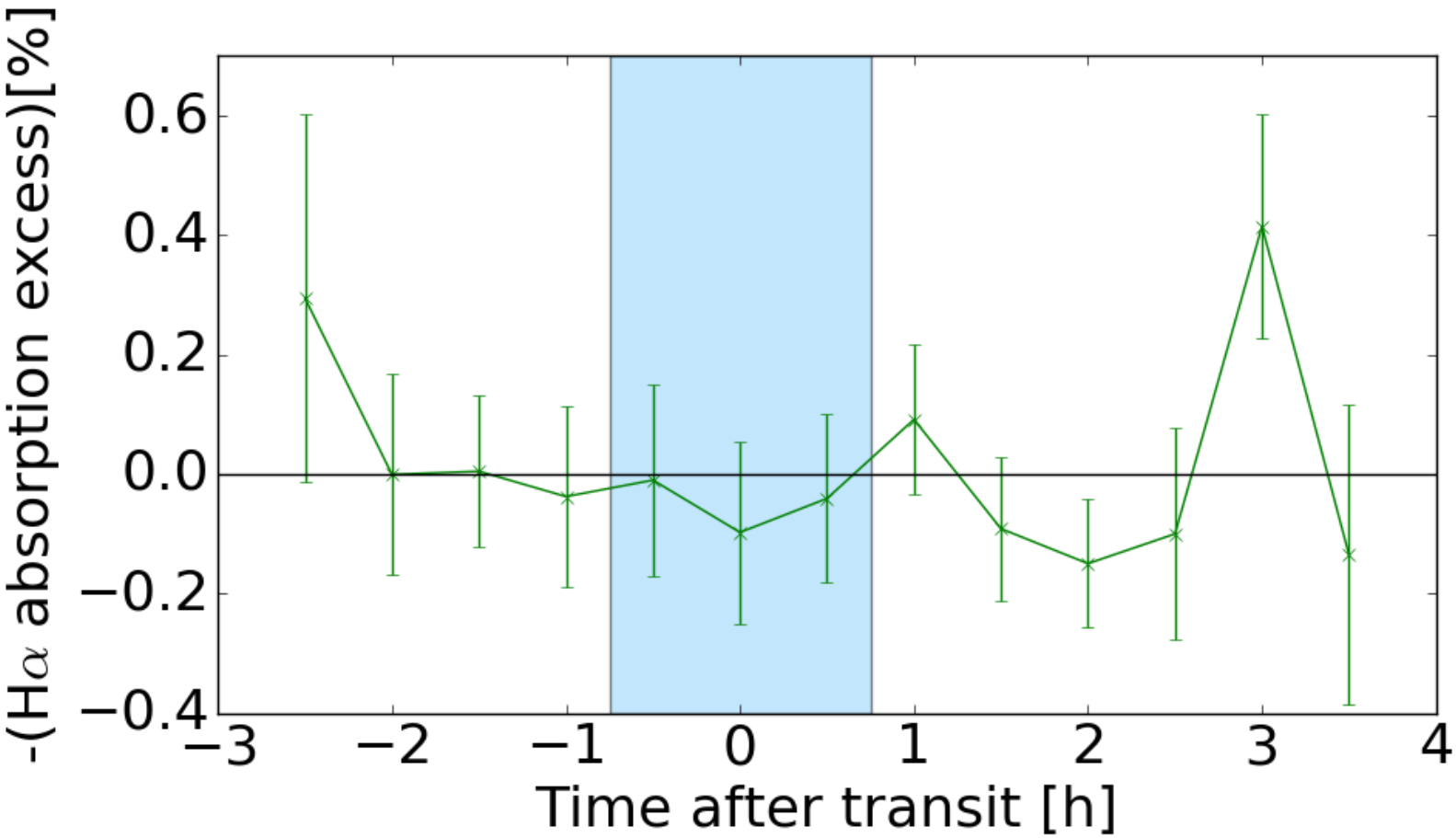

Figure: Transit on January 23rd 2016.

55 Cnc e

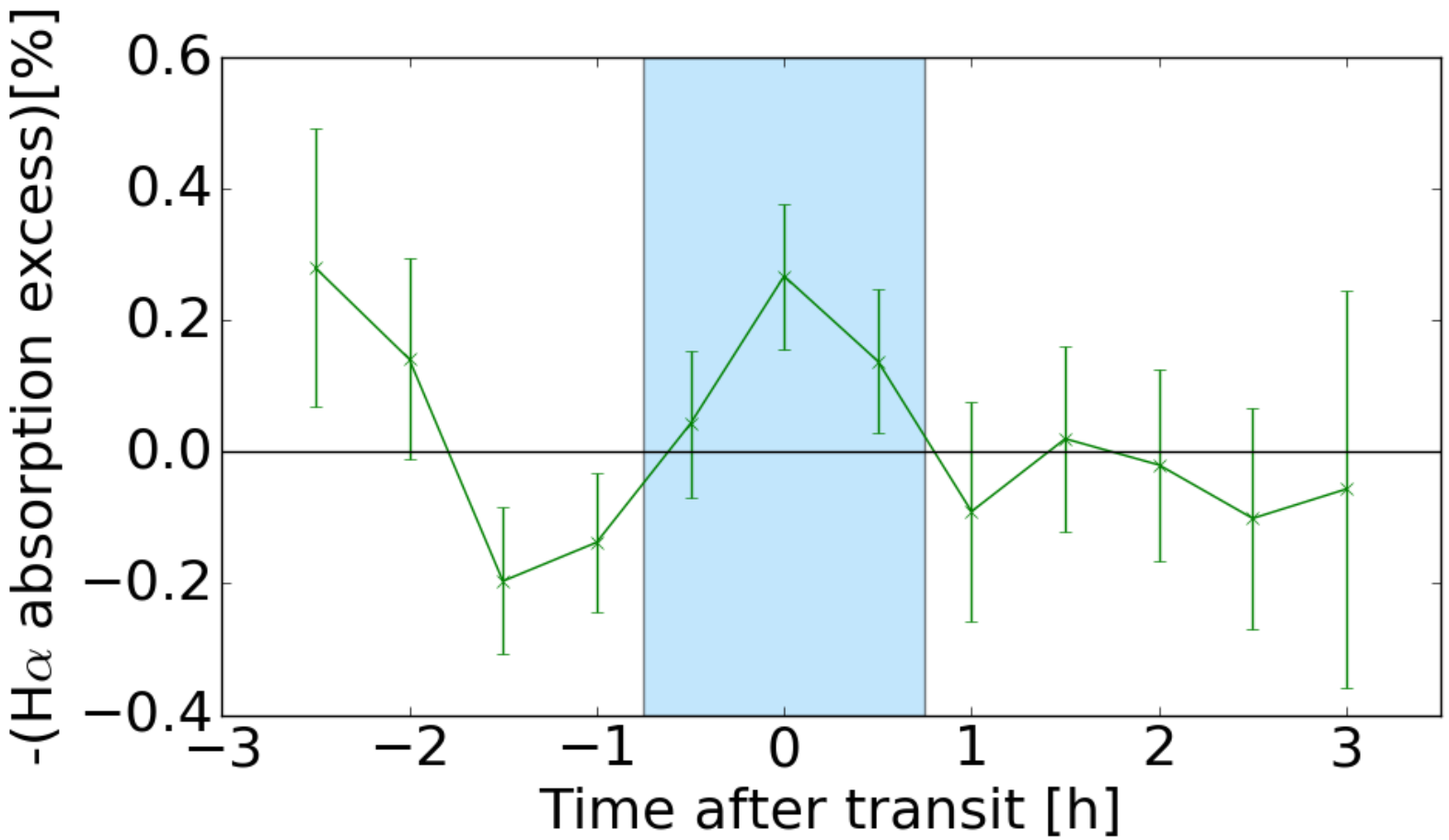

Figure: Transit on February 6th 2016.