

Transmission Spectroscopy with the GTC 10.4 m

Paul Anthony Wilson
University of Exeter

GTC Atmospheric Survey

- Wide Survey of Hot-Jupiter Atmospheres
- Study: Na, K, TiO/VO, Haze, H₂ Rayleigh



GTC Atmospheric Survey

- Large ESO program (10 Hot Jupiters + GJ 1214b)
- First detection of Potassium (Sing et. al 2010)

Collaborators:

David Sing & Frédéric Pont (Exeter, UK)

Tom Louden	Exeter, UK
Jean-Michel Désert	CfA, USA
Gilda Ballester	UofA, USA
Jonathan Fortney	UCSC, USA
Alain Lecavelier des Etangs	IAP, France
Alfred Vidal-Madjar	IAP, France
David Ehrenreich	LAOG, France
Jordi Cepa	IAC, Spain
Mercedes Lopez-Morales	IEEC, Spain



GTC Atmospheric Survey

Tunable filter

Long slit spec.

GJ1214 b Flat spectrum

HAT-P1 b Potassium

TrES-2 b Inconclusive

XO-2 b Potassium

Na?, K

Yet to be observed

GJ436, HAT-P4, HAT-P6, TrES-4
WASP-12, WASP-6, XO-1



GTC Atmospheric Survey

Tunable filter

Long slit spec.

GJ1214 b Flat spectrum

HAT-P1 b Potassium

TrES-2 b Inconclusive

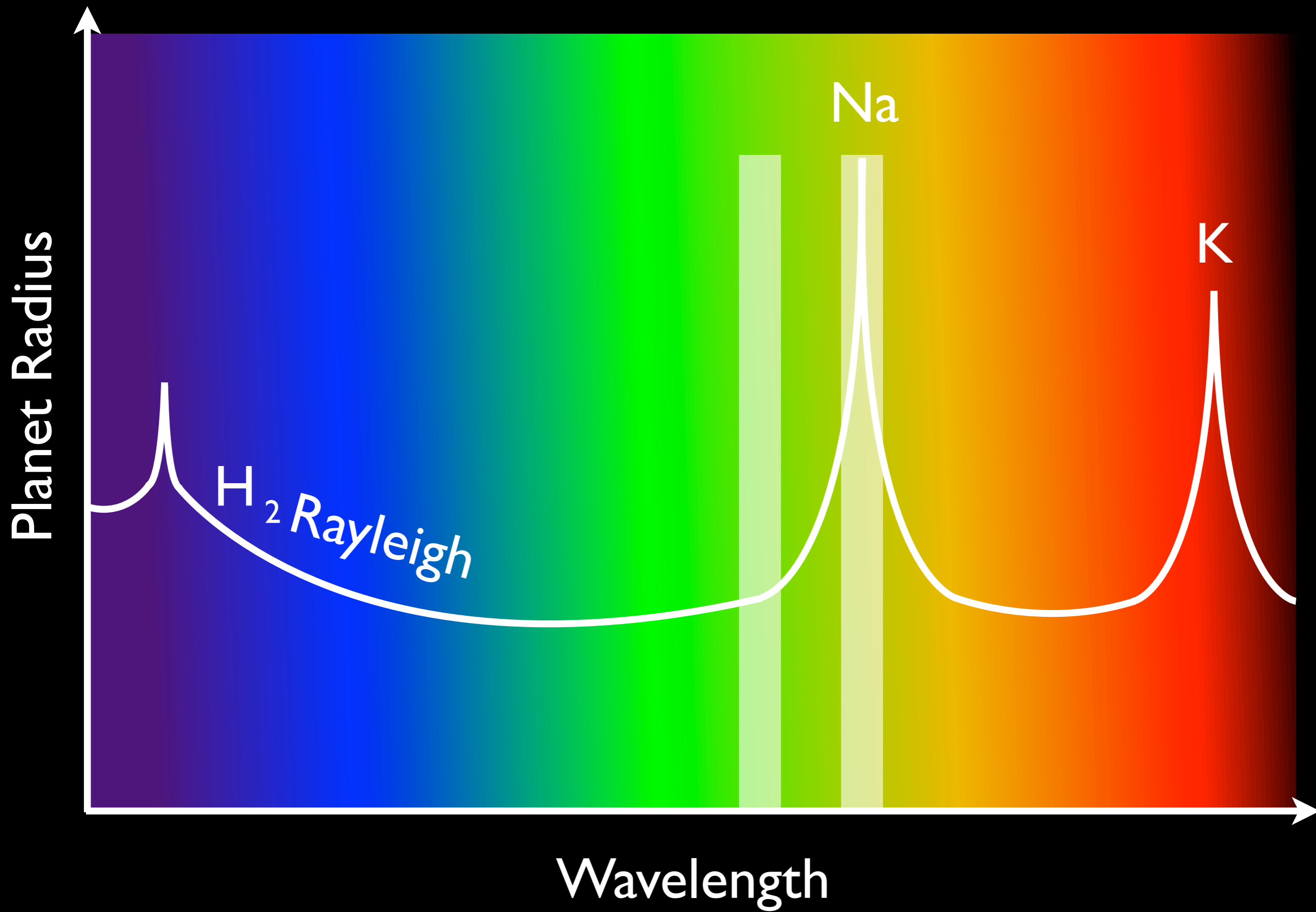
XO-2 b Potassium

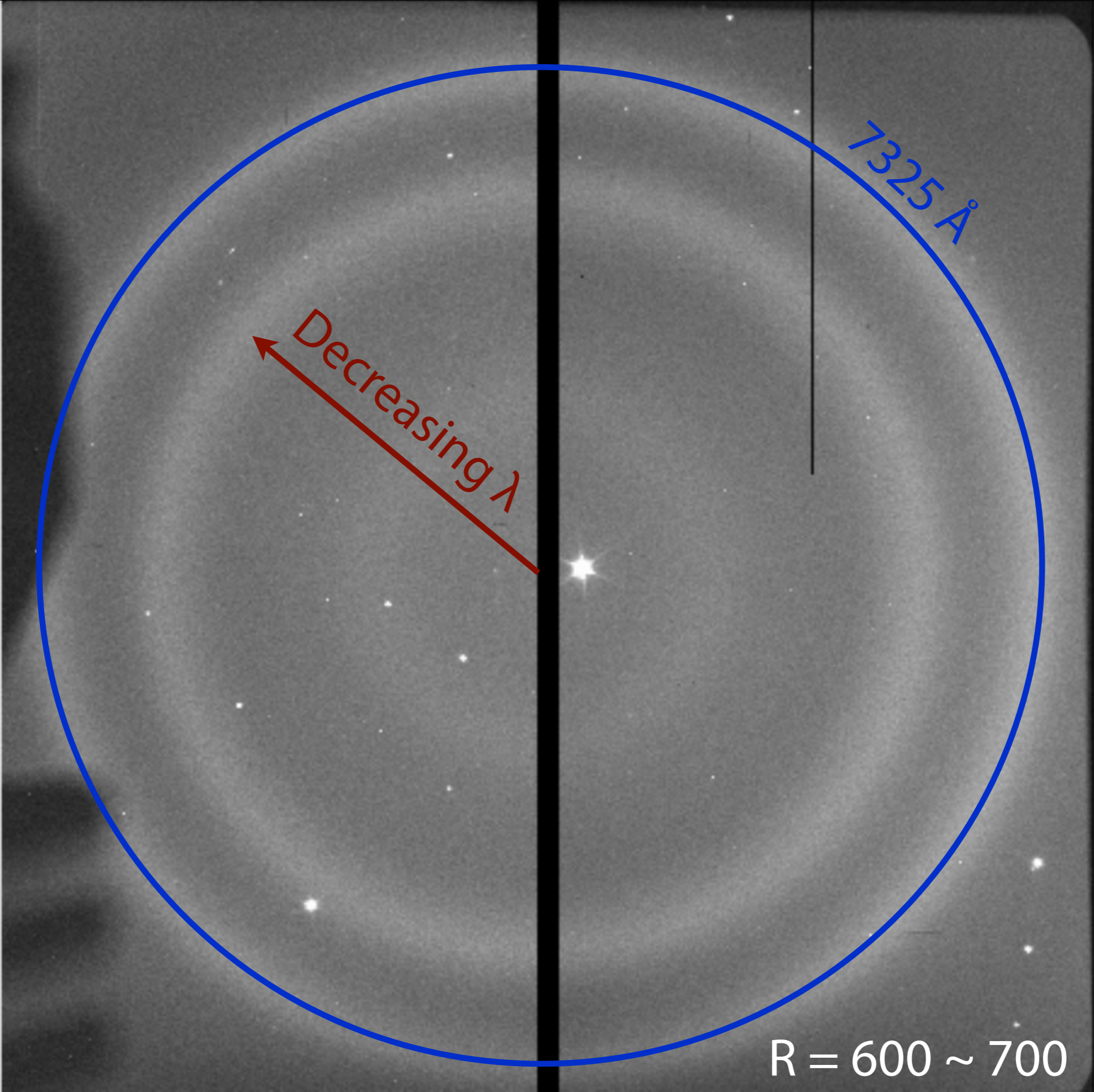
Na?, K

Yet to be observed

GJ436, HAT-P4, HAT-P6, TrES-4
WASP-12, WASP-6, XO-1







7325 Å

Decreasing λ

R = 600 ~ 700

- Good Spectral Resolution
- Tune between sky lines

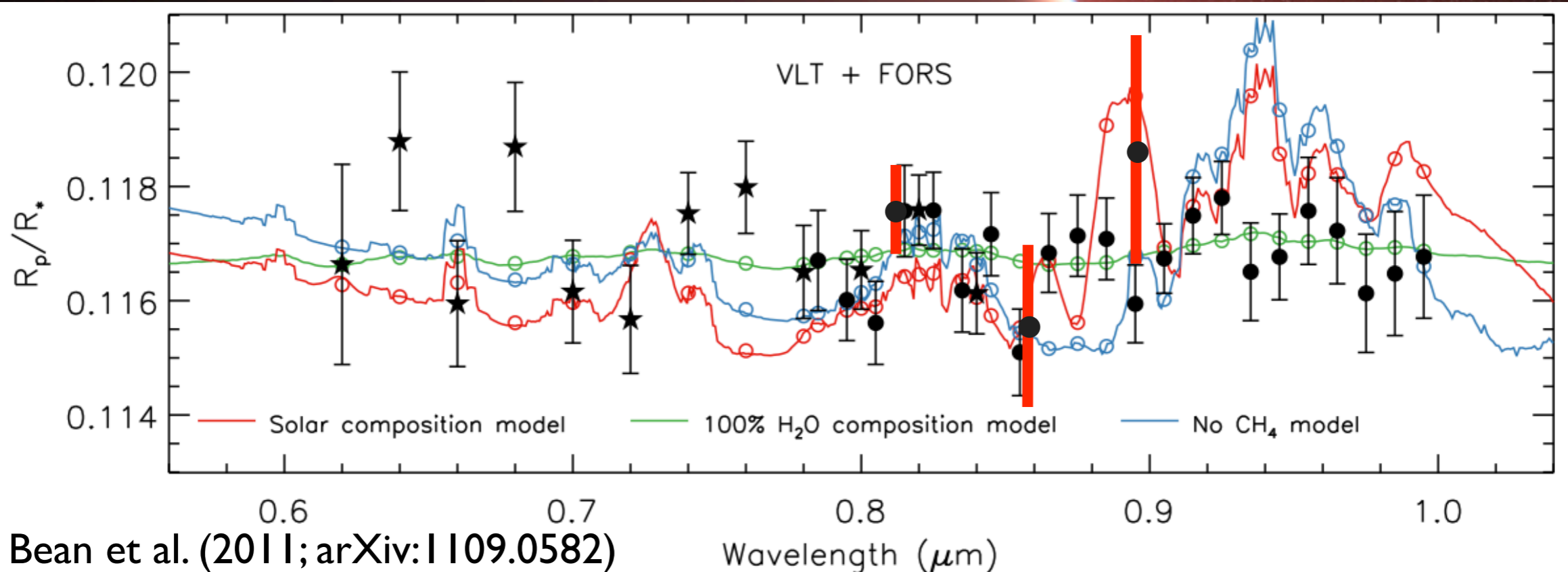
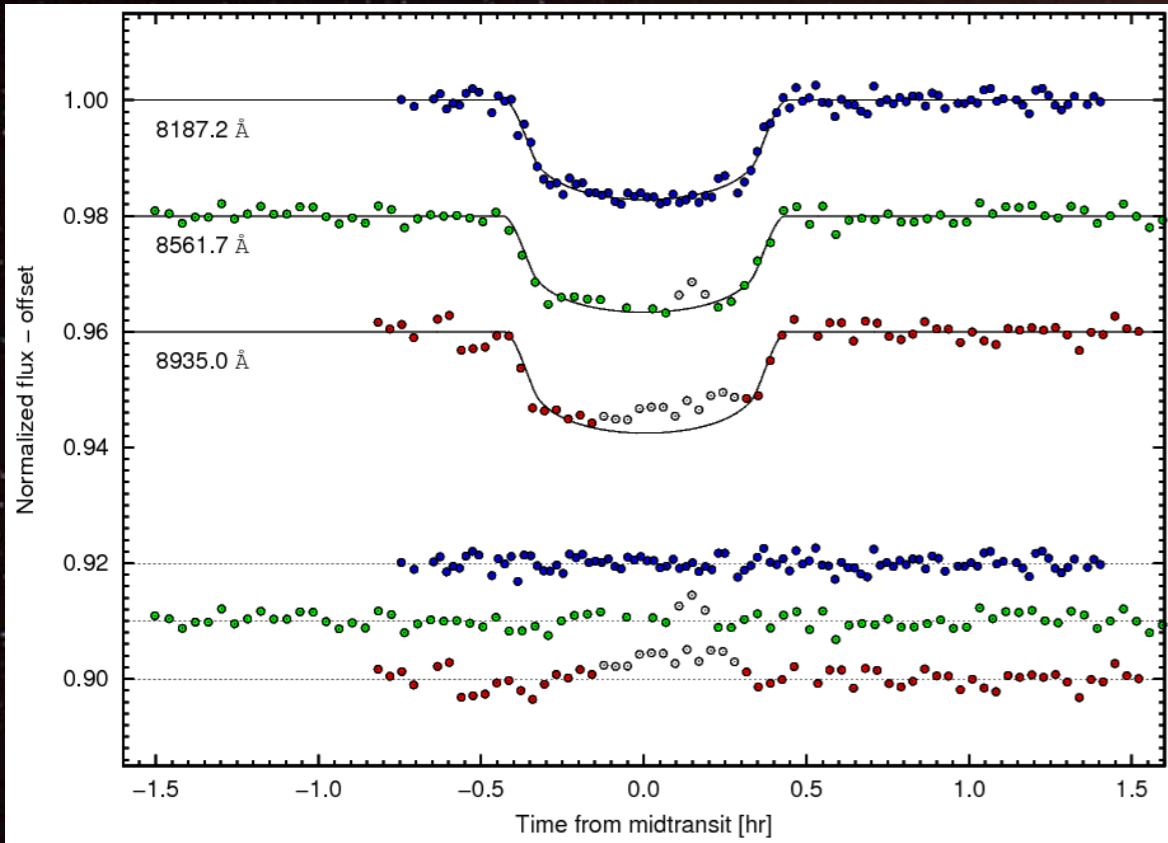


- Limited λ coverage
- Limited simultaneous λ coverage

Ideal for the detection of Na, K

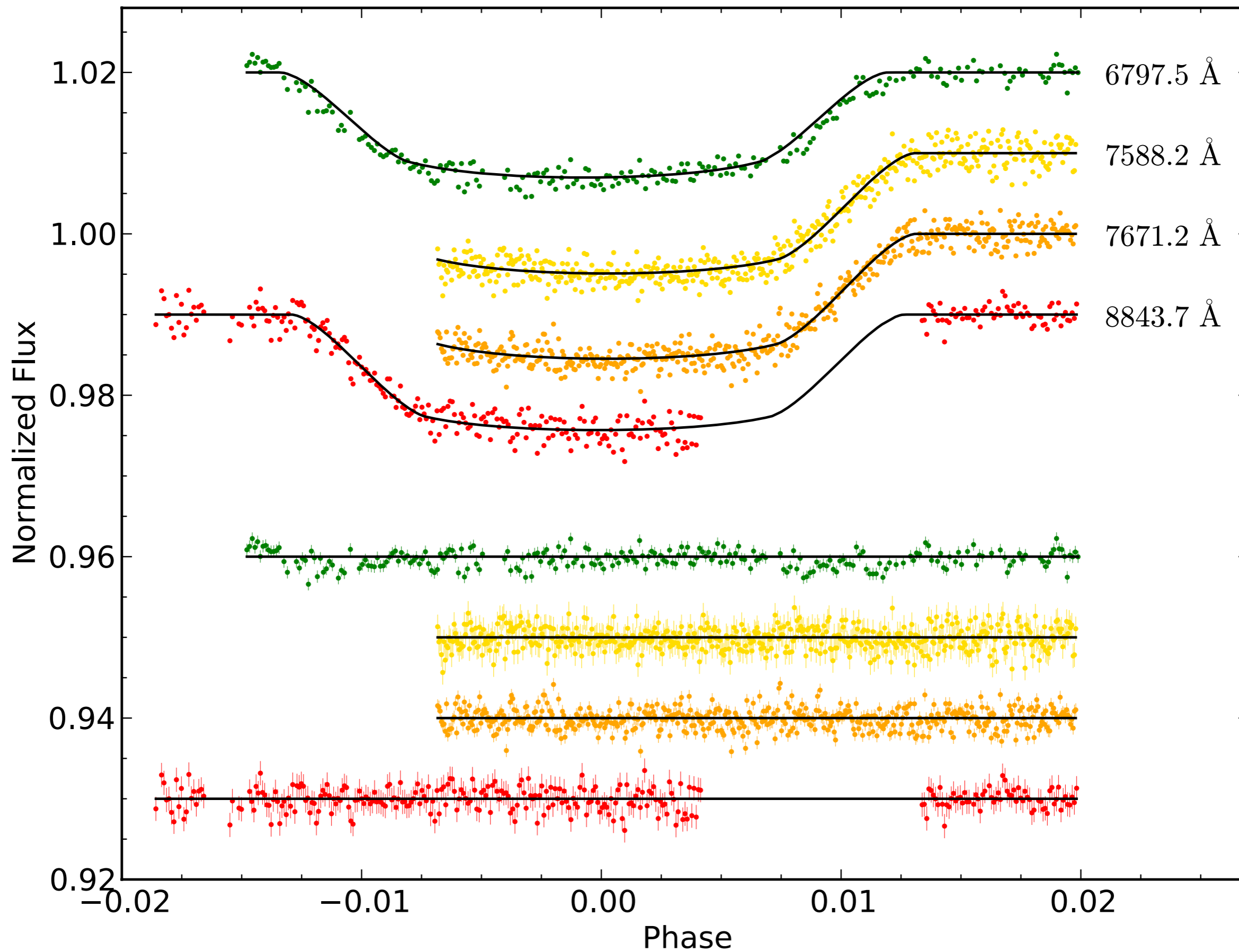
GJ1214 The world is flat

- Much Higher resolution
- Still flat
- Spots common



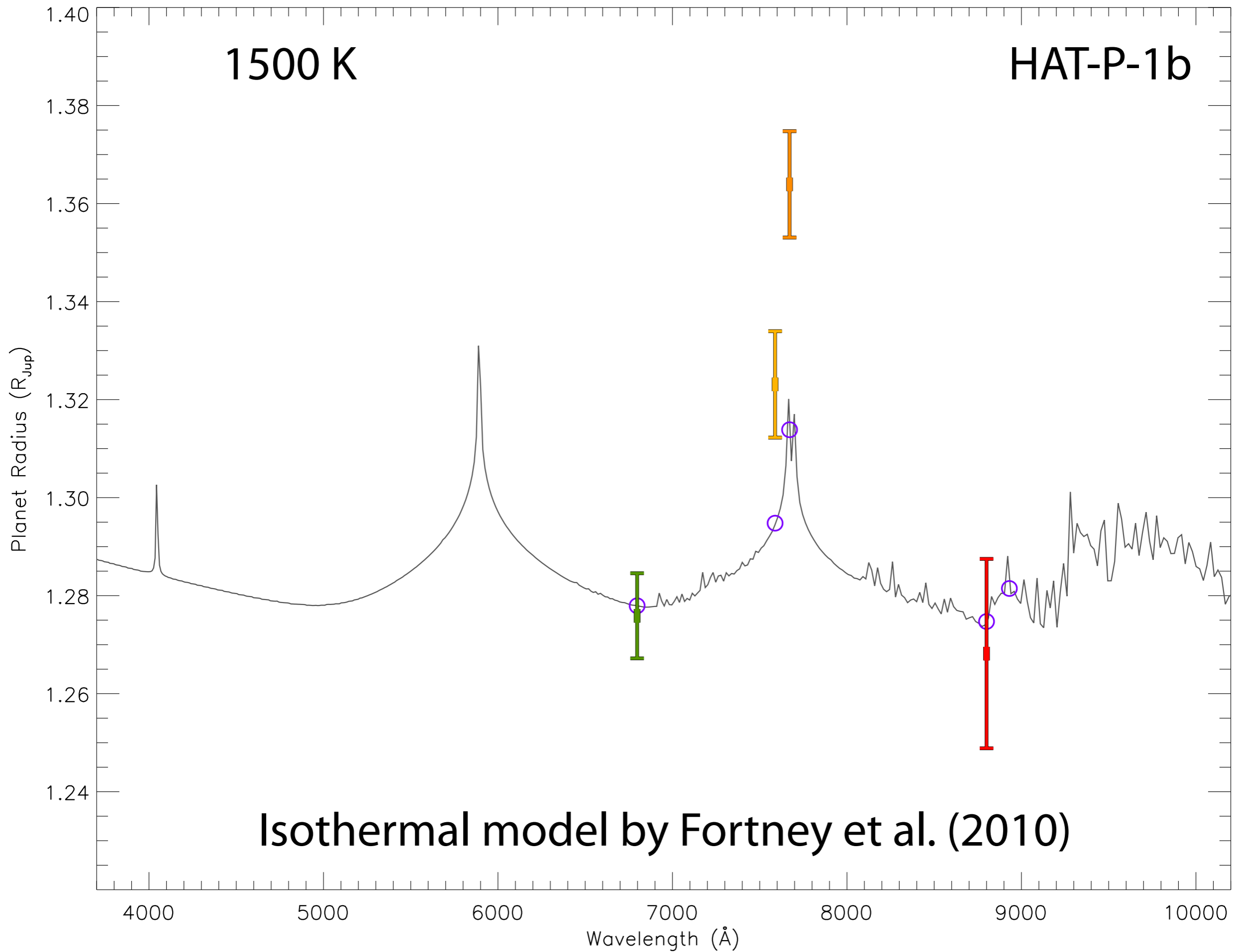
Bean et al. (2011; arXiv:1109.0582)

HAT-P-1b

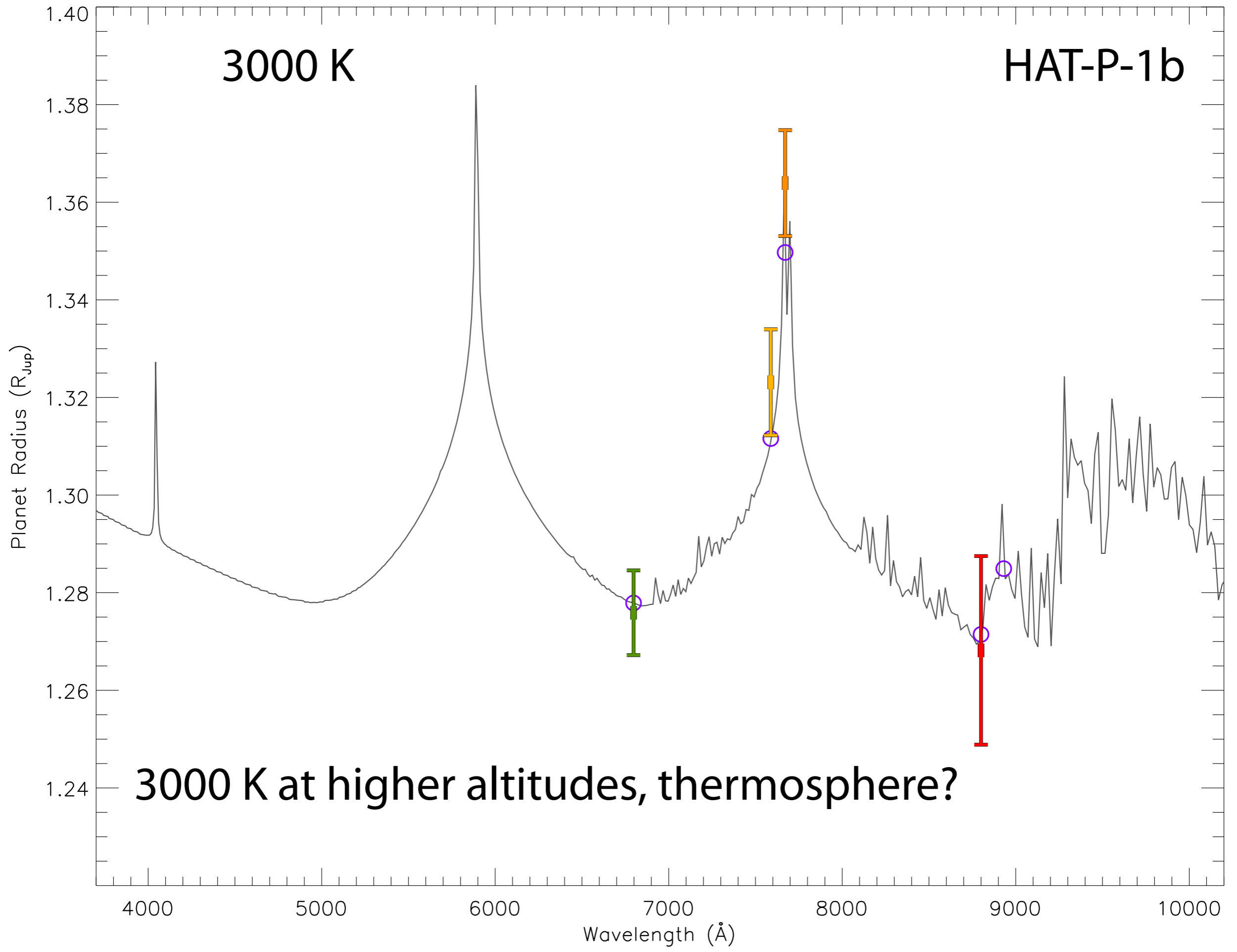


1500 K

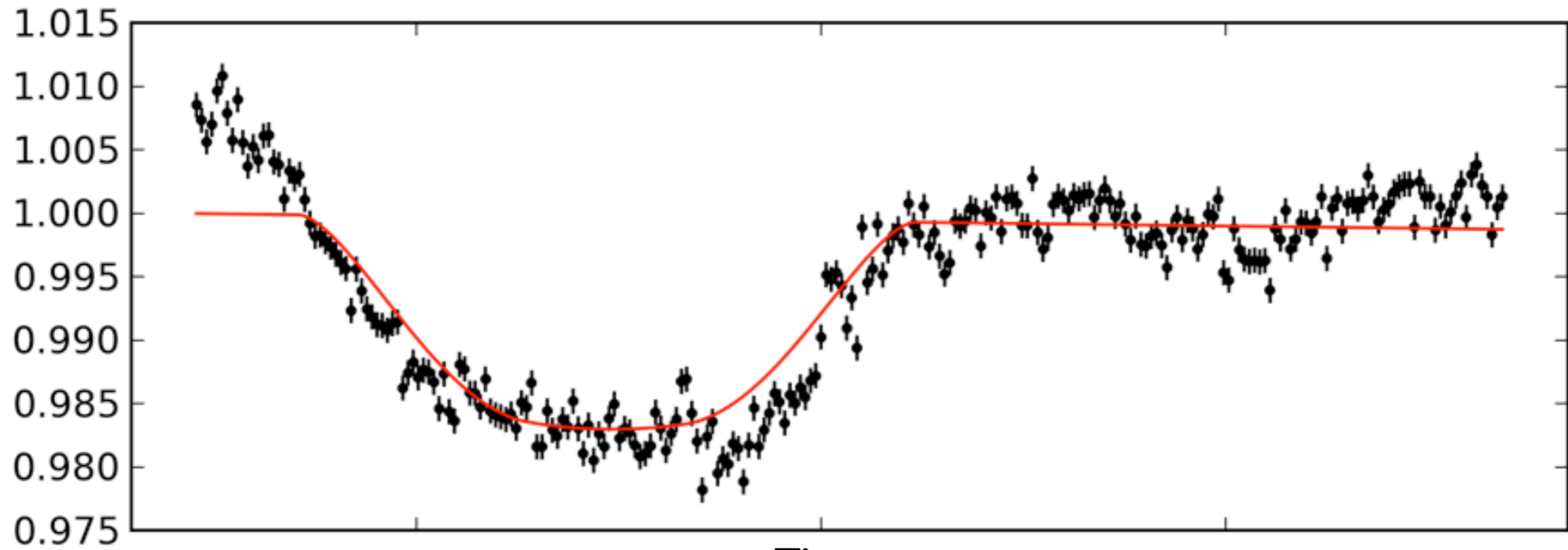
HAT-P-1b



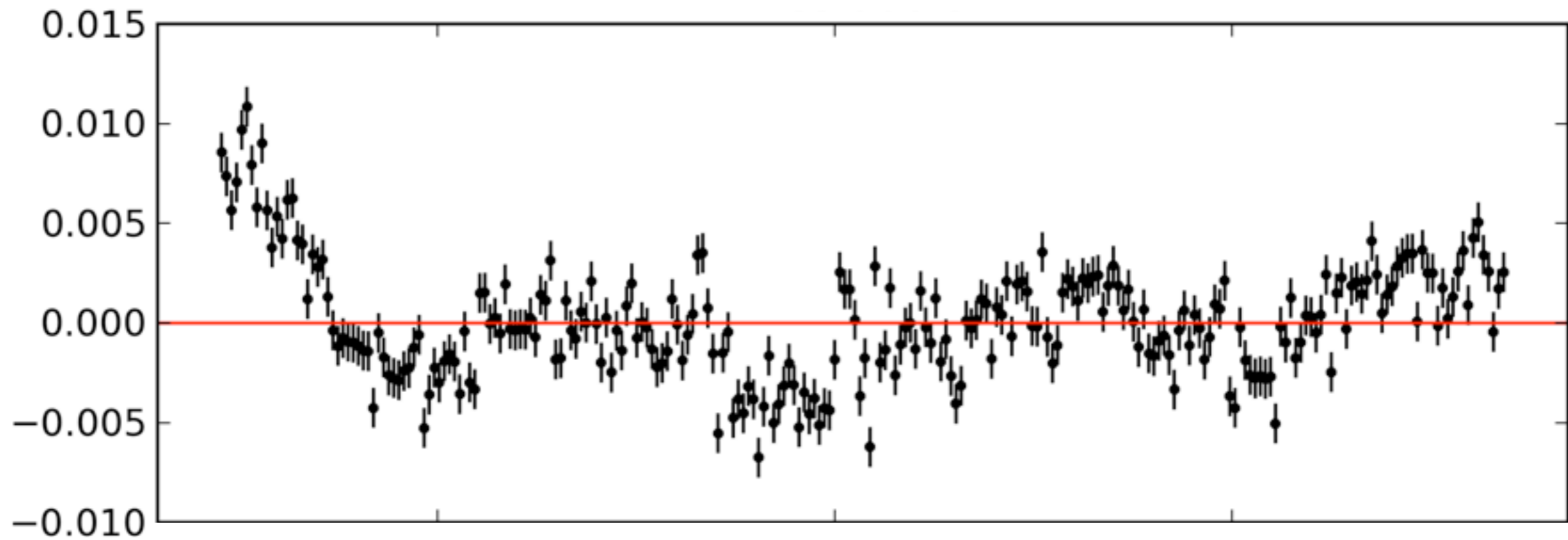
Isothermal model by Fortney et al. (2010)



TrES-2b

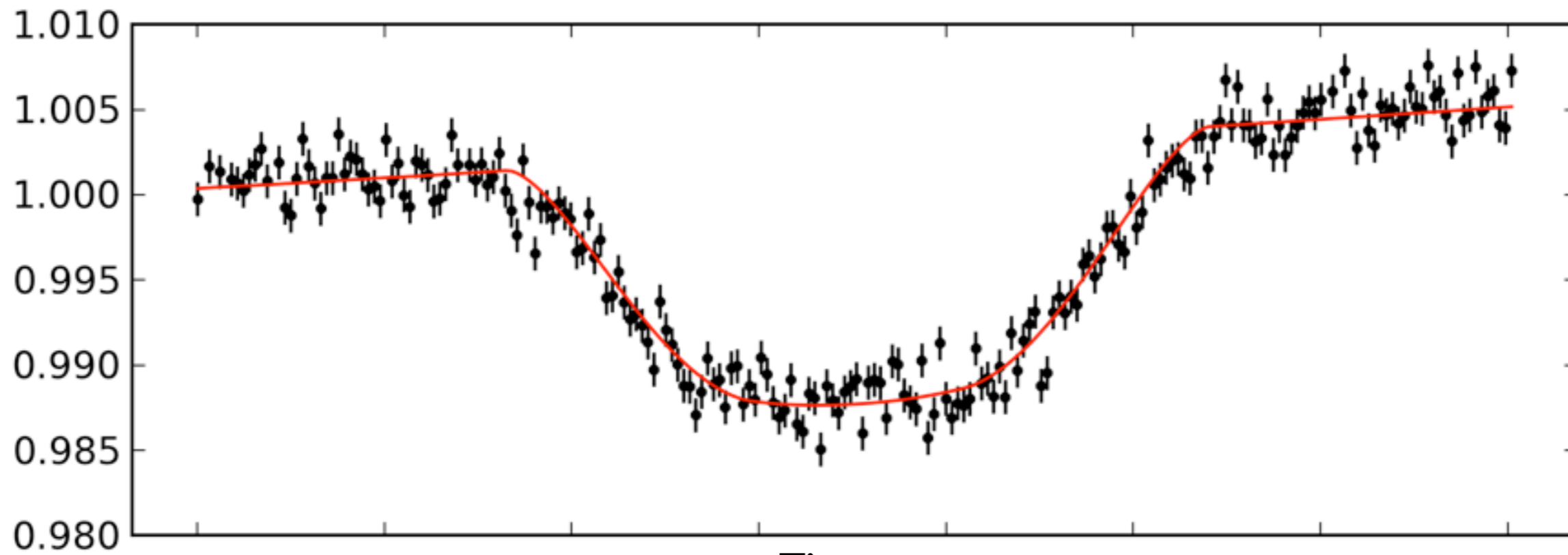


Time

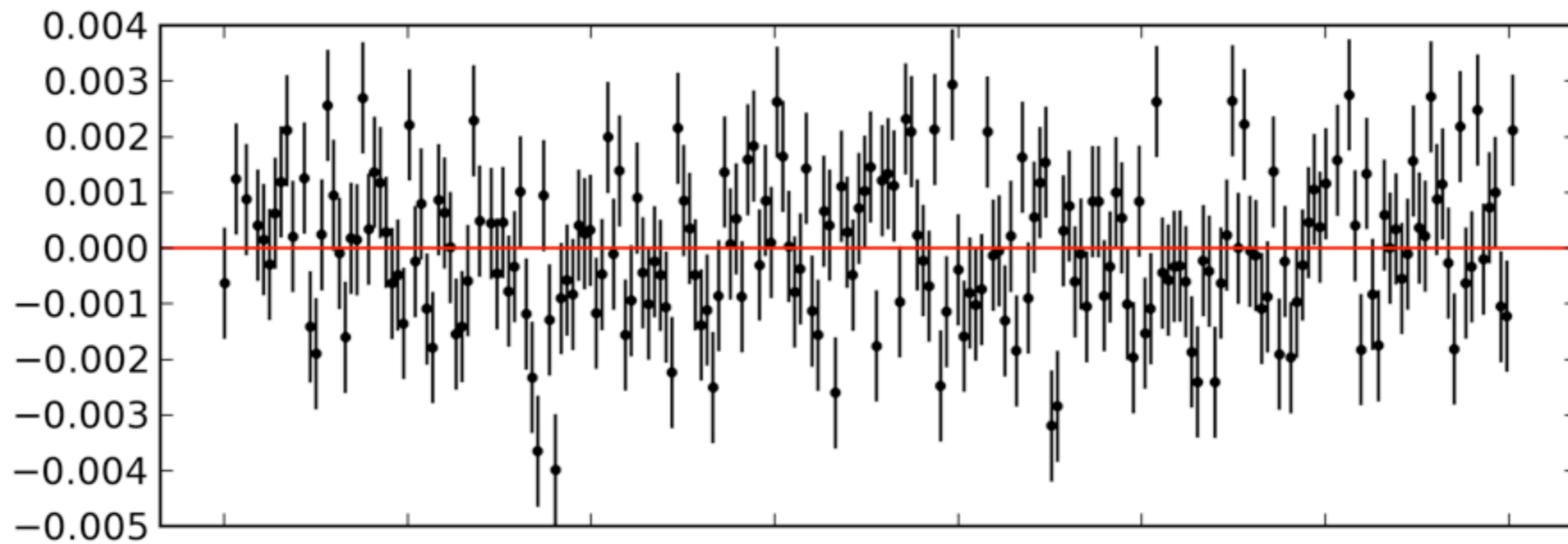


Time

TrES-2b



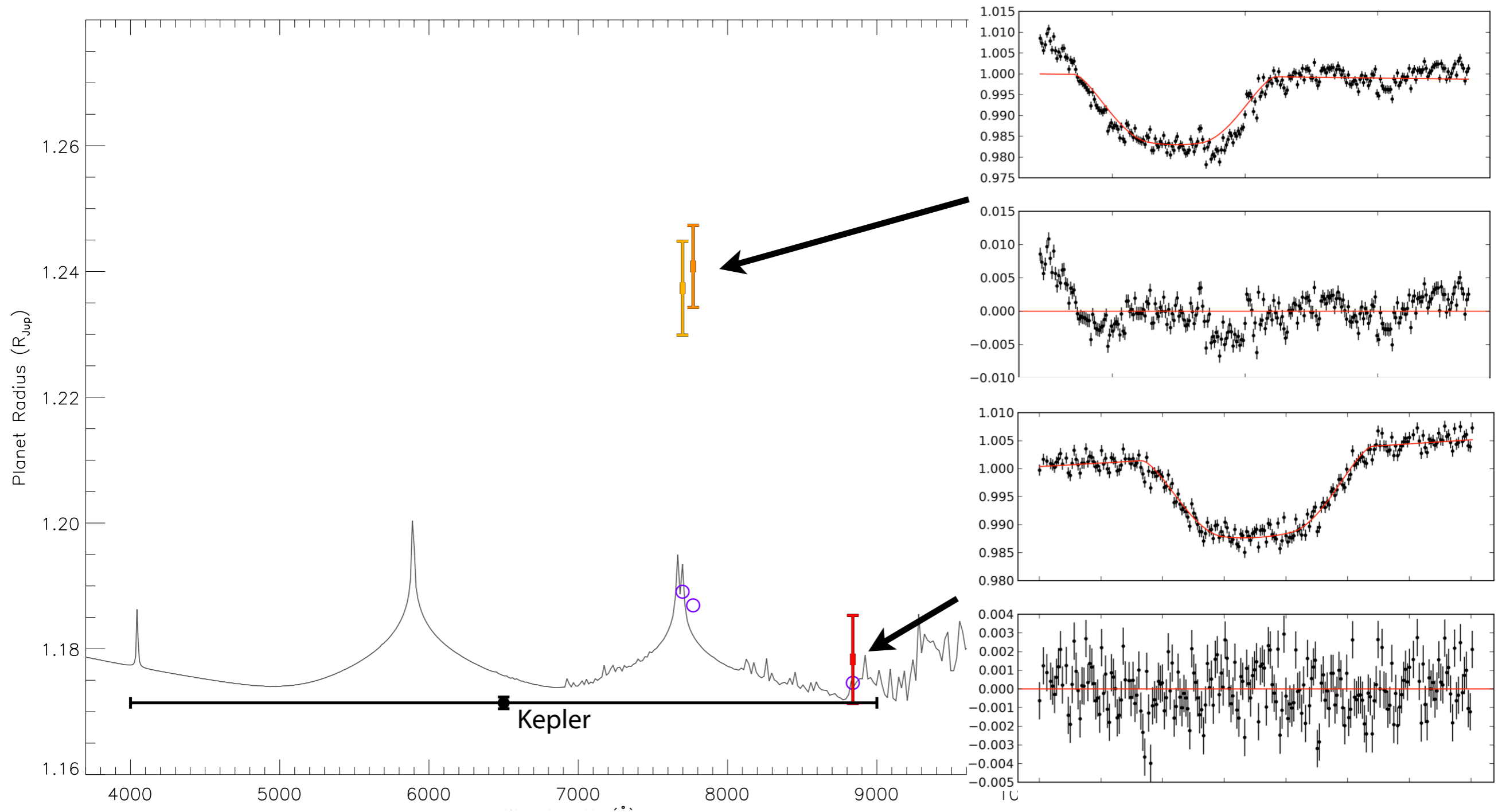
Time



Time

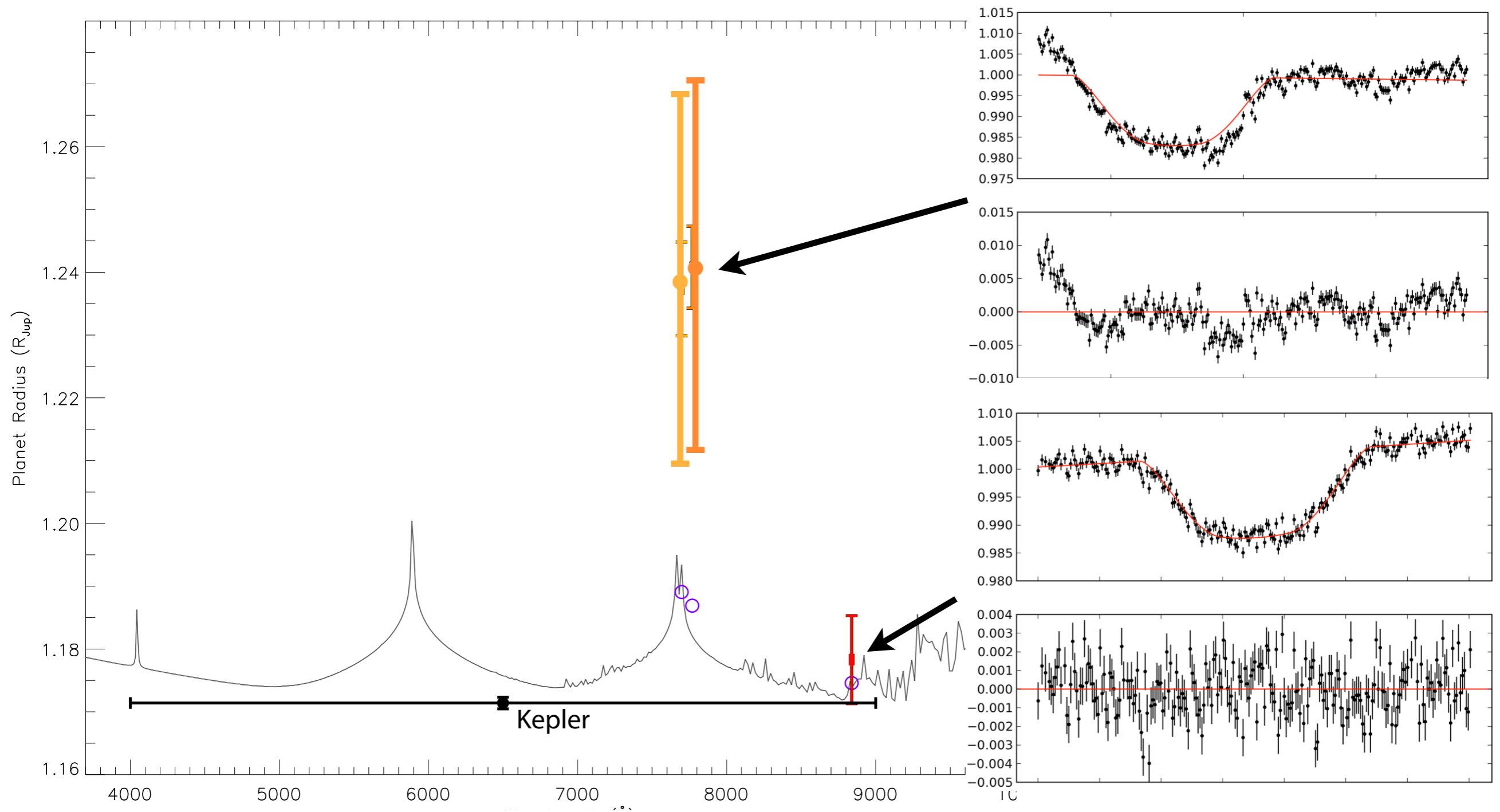
Possible FWHM trends

Dominated by systematic
noise (**red noise**)



Possible FWHM trends

Dominated by systematic
noise (**red noise**)



GTC Atmospheric Survey

Tunable filter

Long slit spec.

GJ1214 b Flat spectrum

HAT-P1 b Potassium

TrES-2 b Inconclusive

XO-2 b Potassium

Na, K?

Yet to be observed

GJ436, HAT-P4, HAT-P6, TrES-4
WASP-12, WASP-6, XO-1



GTC Atmospheric Survey

Tunable filter

Long slit spec.

GJ1214 b Flat spectrum

HAT-P1 b Potassium

TrES-2 b Inconclusive

XO-2 b Potassium

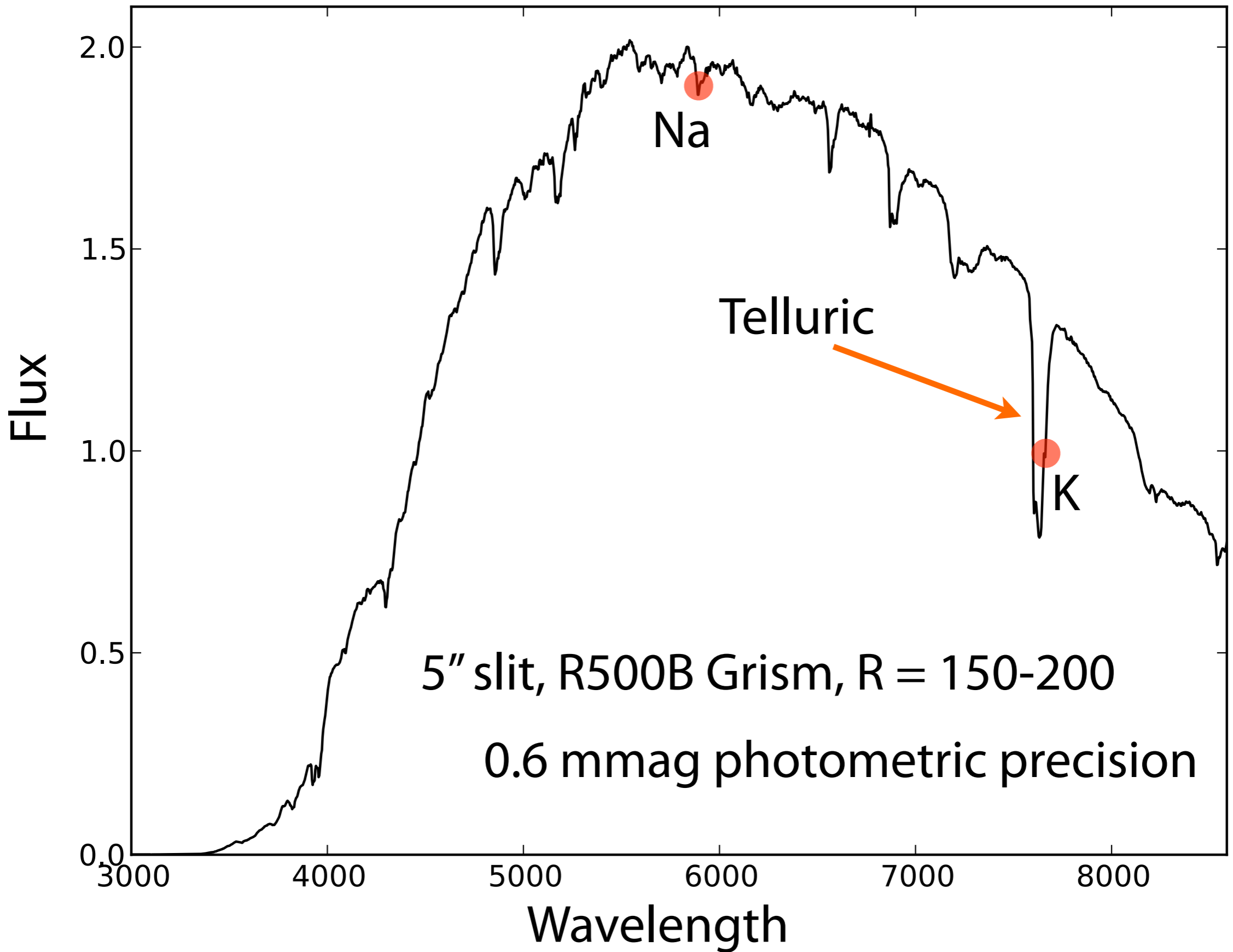
Na, K?

Yet to be observed

GJ436, HAT-P4, HAT-P6, TrES-4
WASP-12, WASP-6, XO-1



Differential Long Slit Spectroscopy



Summary

- Potassium present in HAT-P-1 b.
- Large K feature indicates thermosphere (3000 K) in HAT-P1-b.
- Long slit spectroscopy has potential to observe Na and possibly also K simultaneously.

Future

- Analyse the other exoplanets in the survey
- With this perform comparative exoplanetology