

Precision Radial Velocities for Nearby Planetary Systems

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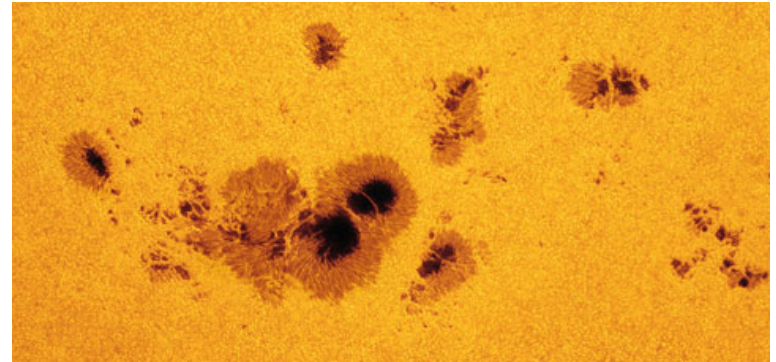


Yale

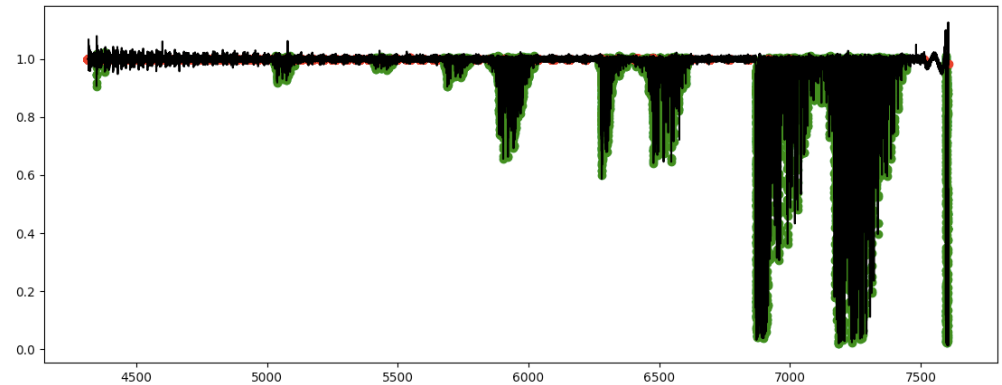


Three Challenges for Ground-based RVs

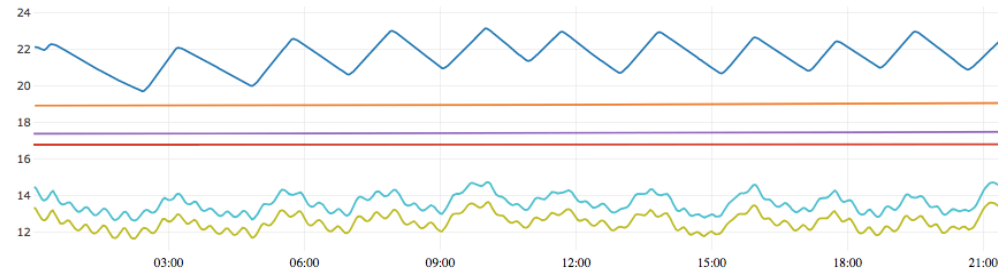
- Stellar photospheric velocities



- Telluric contamination

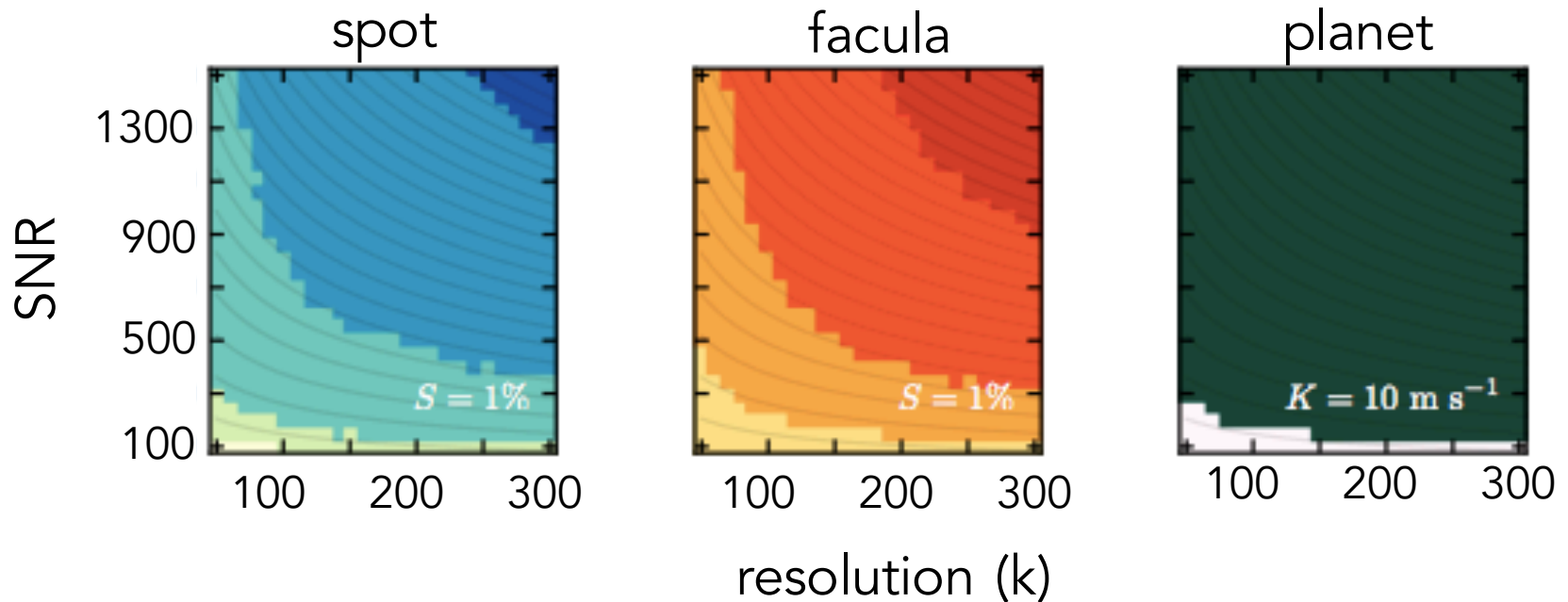


- Unstable instrumentation



EXtreme PREcision Spectrograph (EXPRES)

An experiment to disentangle stellar photospheric velocities from orbital velocities induced by exoplanets

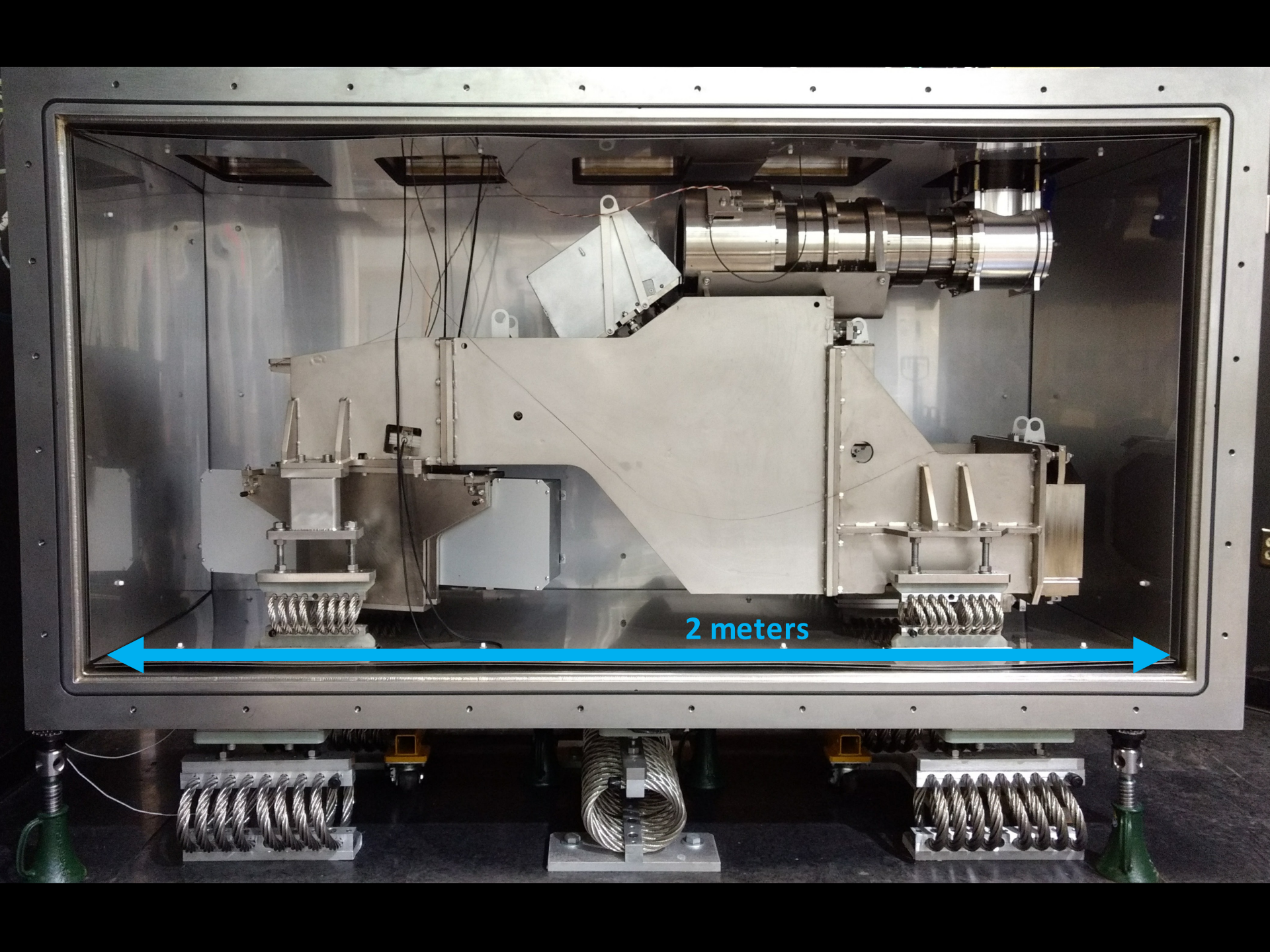


4.3 m Discovery Channel Telescope

Lowell Observatory, Happy Jack AZ, USA

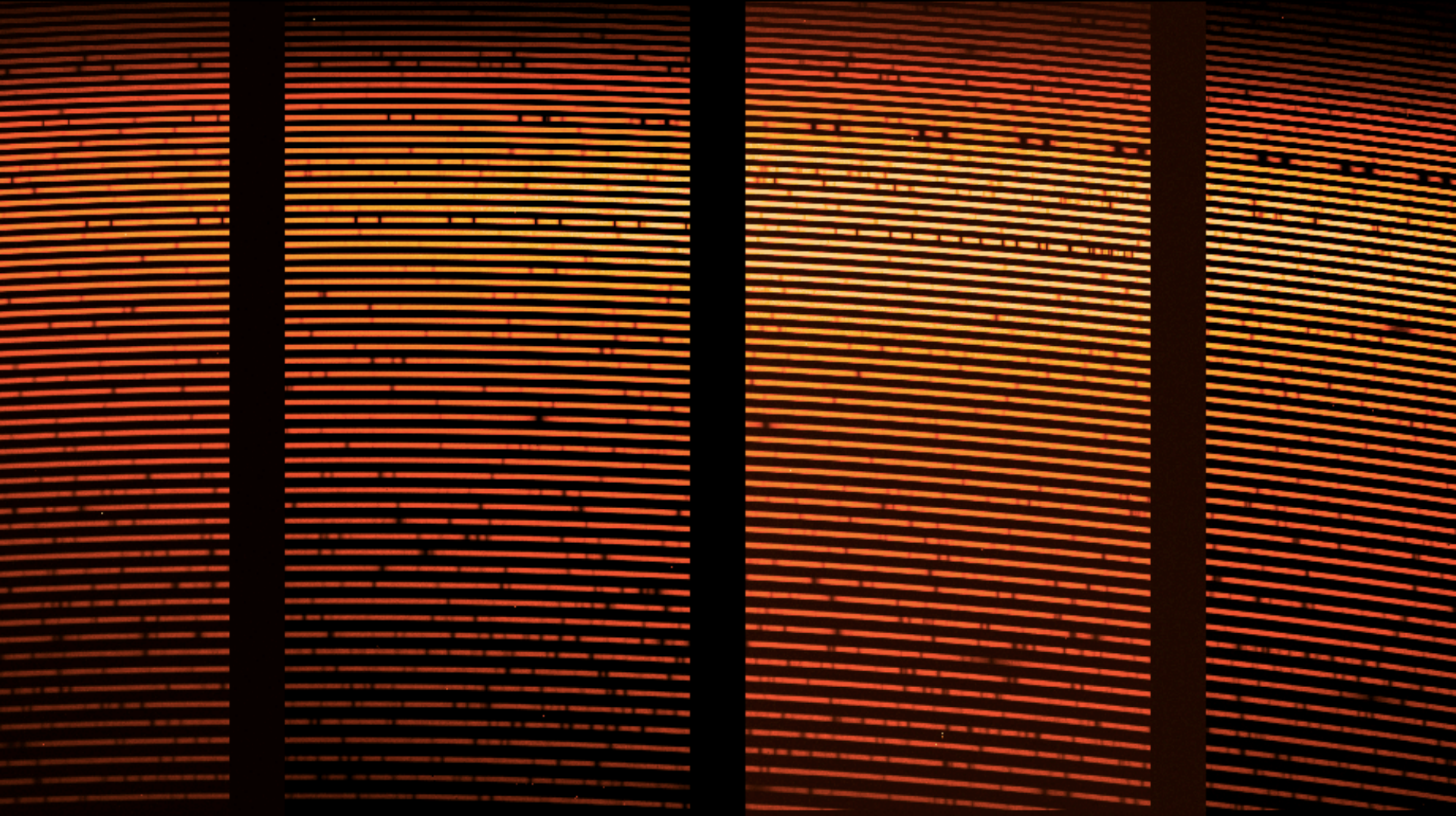


Five-port instrument cube with deployable tertiary mirrors allows for partial night cadence of science targets, 60 total nights per year

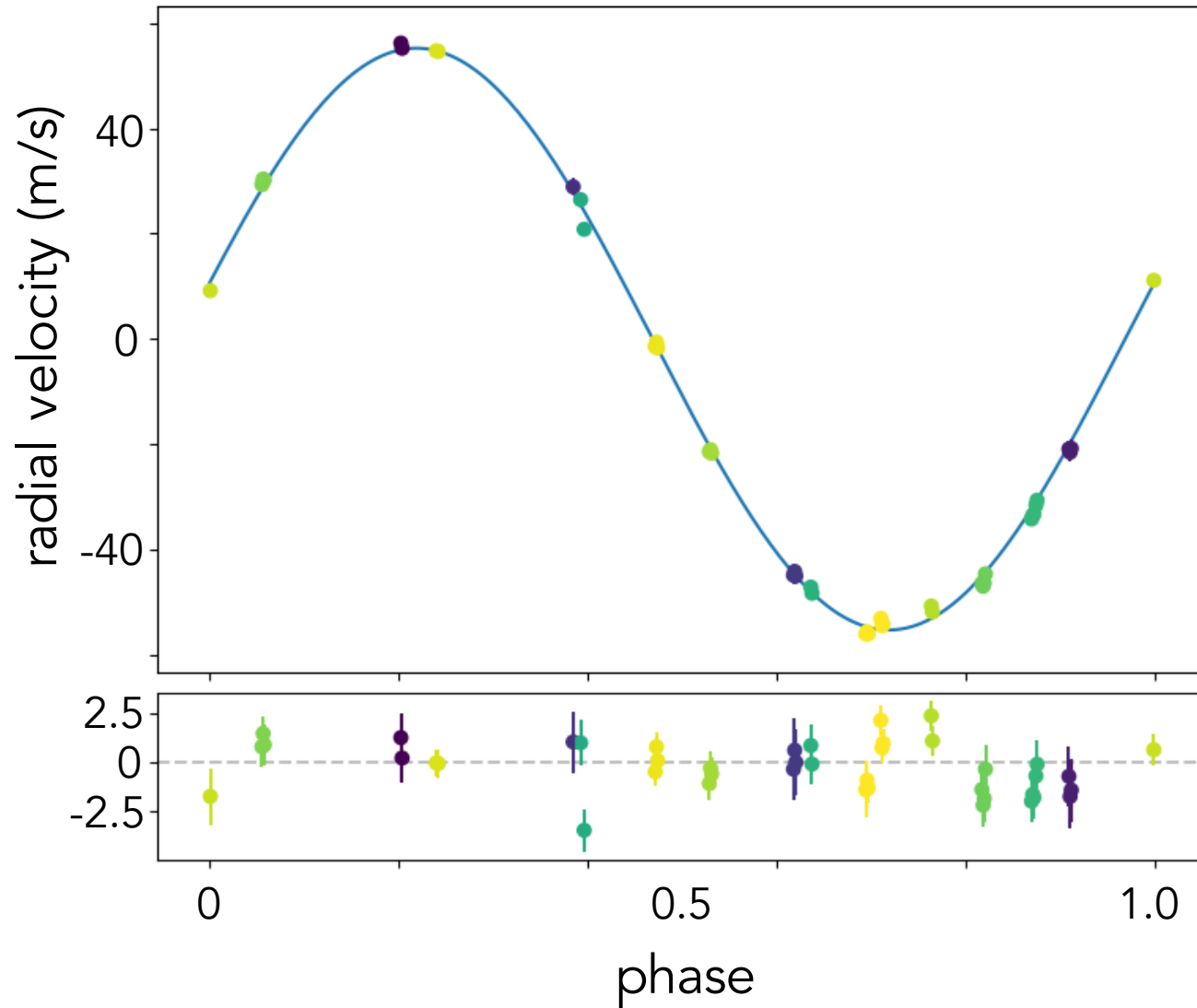


2 meters

51 Peg



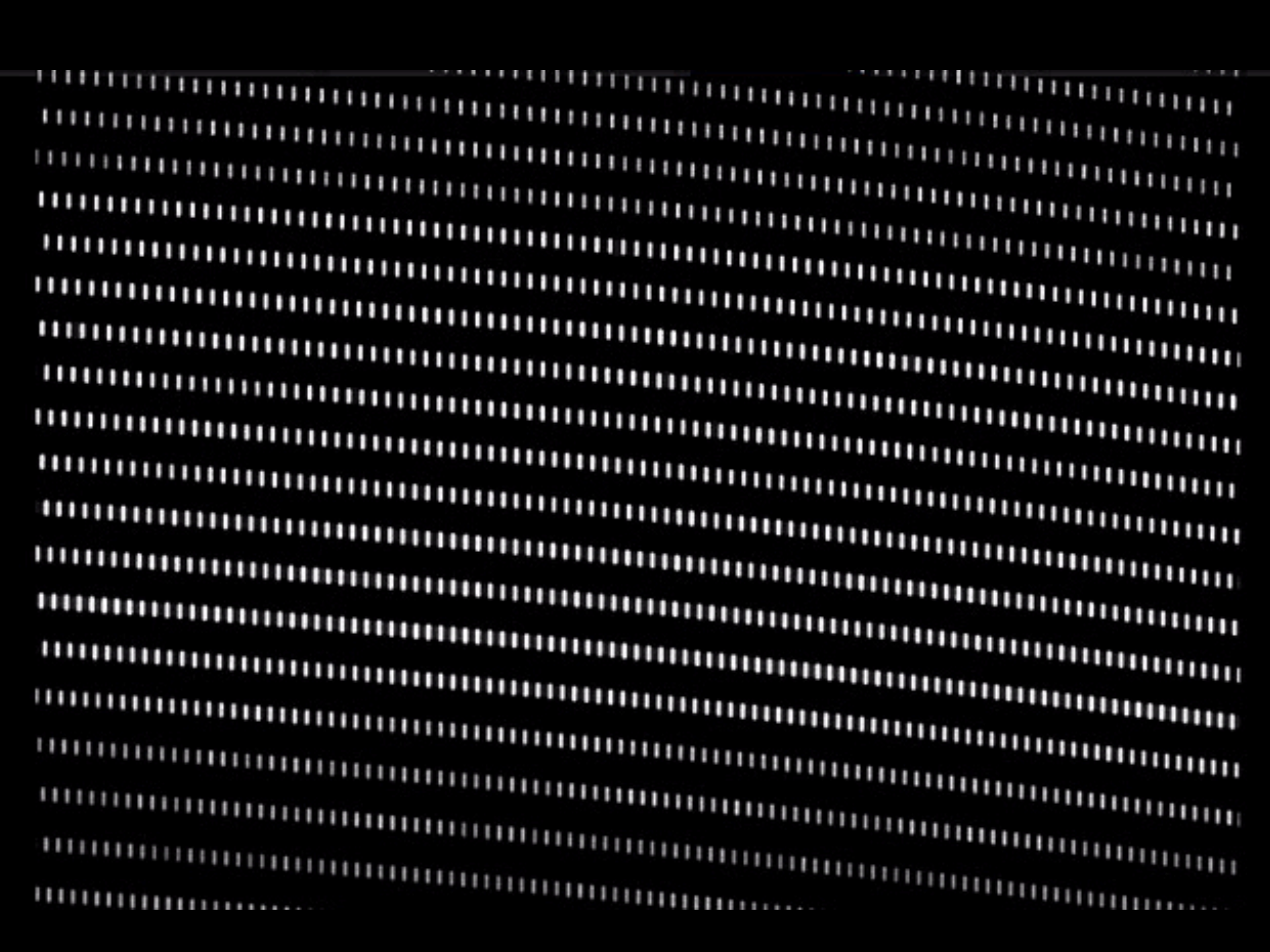
EXPRES Radial Velocities of 51 Peg



Menlo Systems Laser Frequency Comb

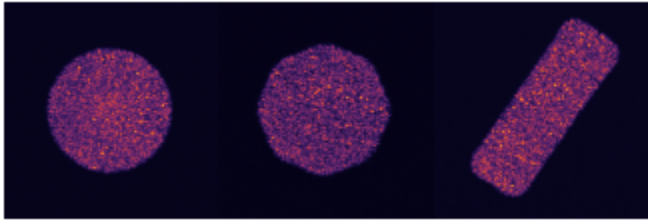
- 14 GHz mode spacing = comb line every ~ 12 pixels
- Science observations are bracketed by LFC exposures
- Long term stability of several cm/s



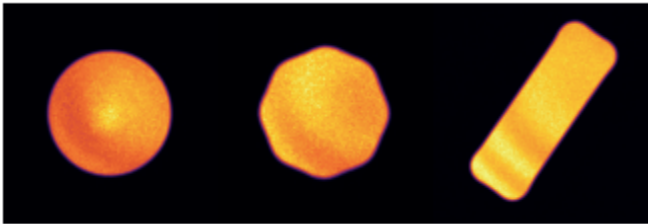


Fiber Agitation

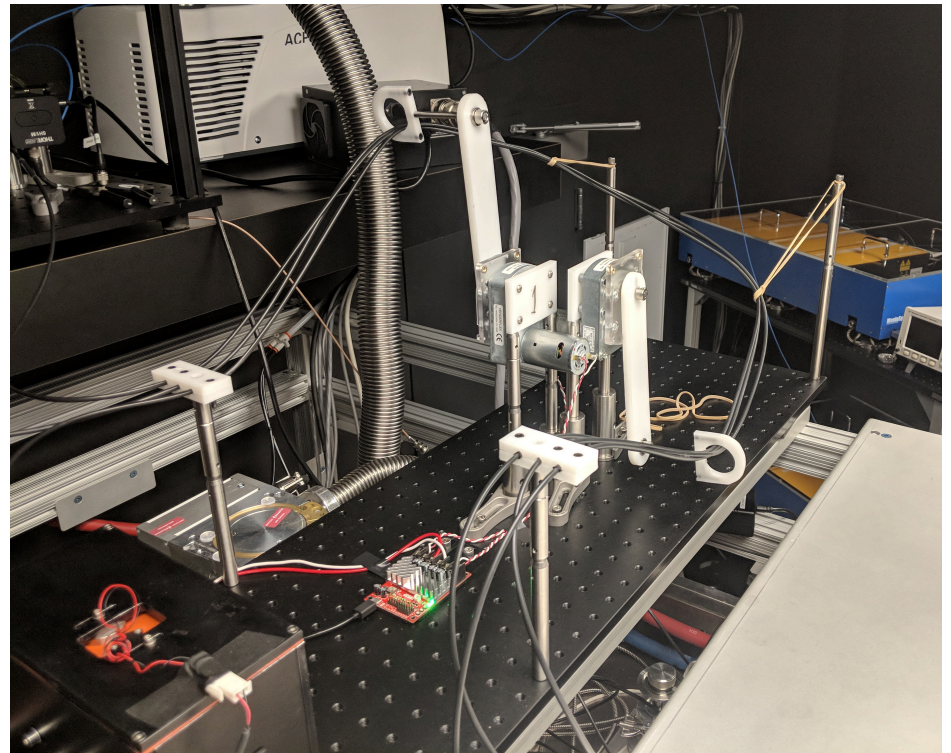
Not agitated fibers:



Agitated fibers:

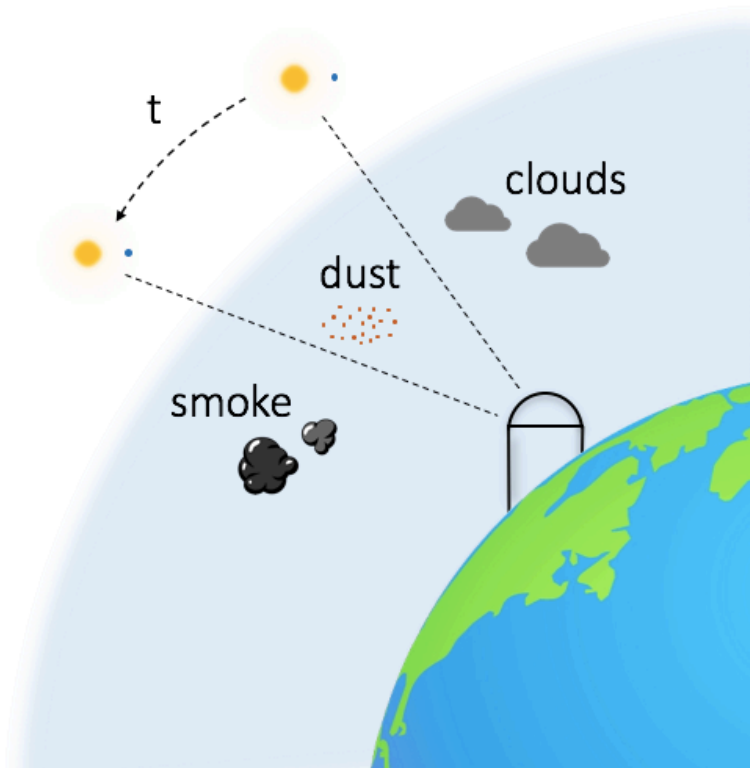


See Petersburg et al. 2017

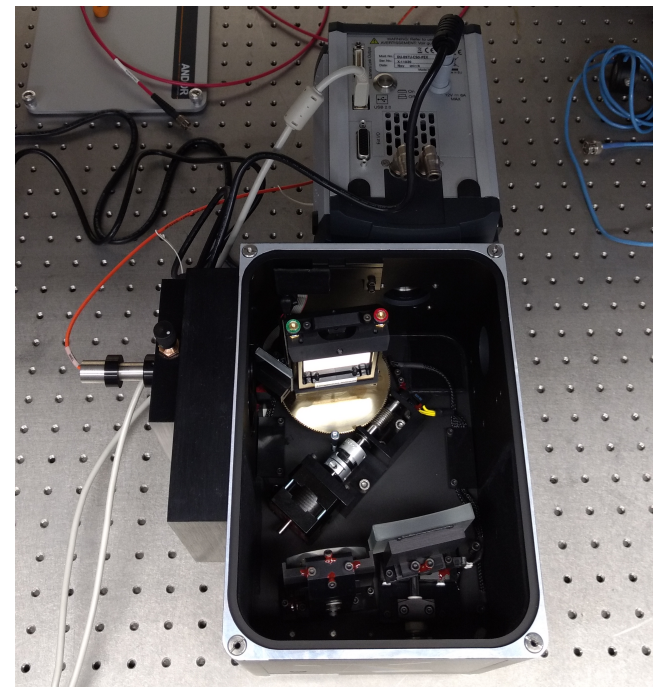


Chromatic Barycentric Corrections

Wavelength dependence in atmospheric attenuation



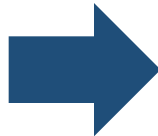
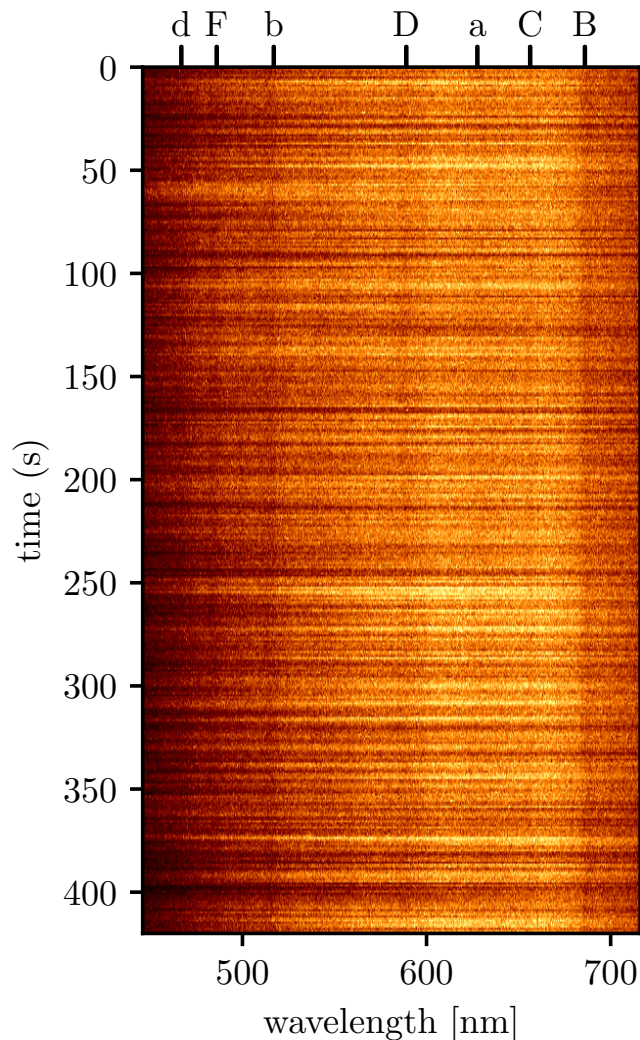
EXPRES records this with the exposure meter spectrograph



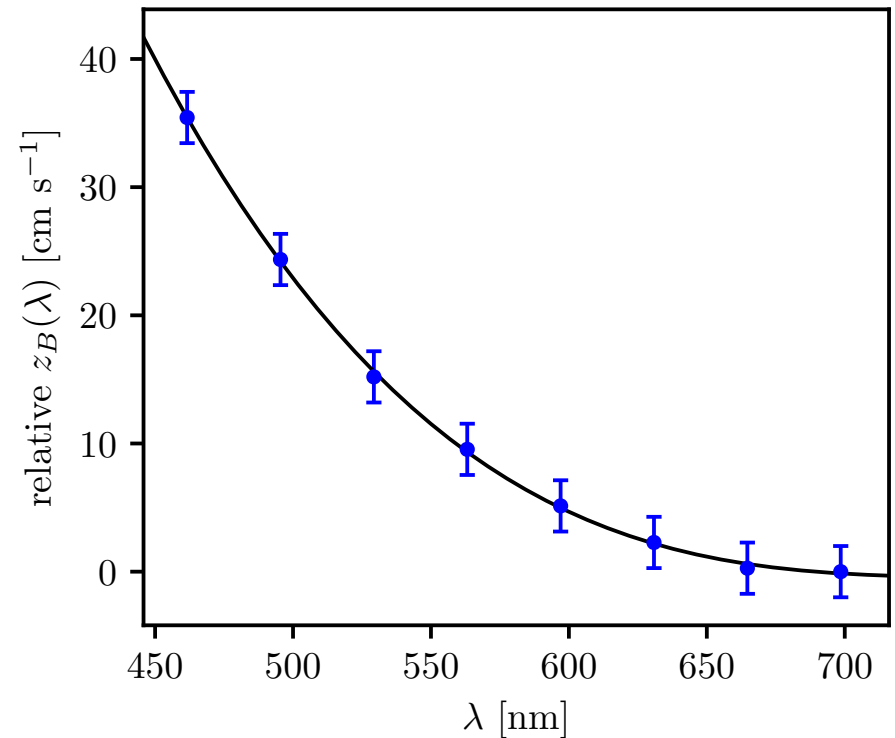
Blackman et al. 2017

Chromatic Barycentric Corrections

Stellar flux changing during exposure

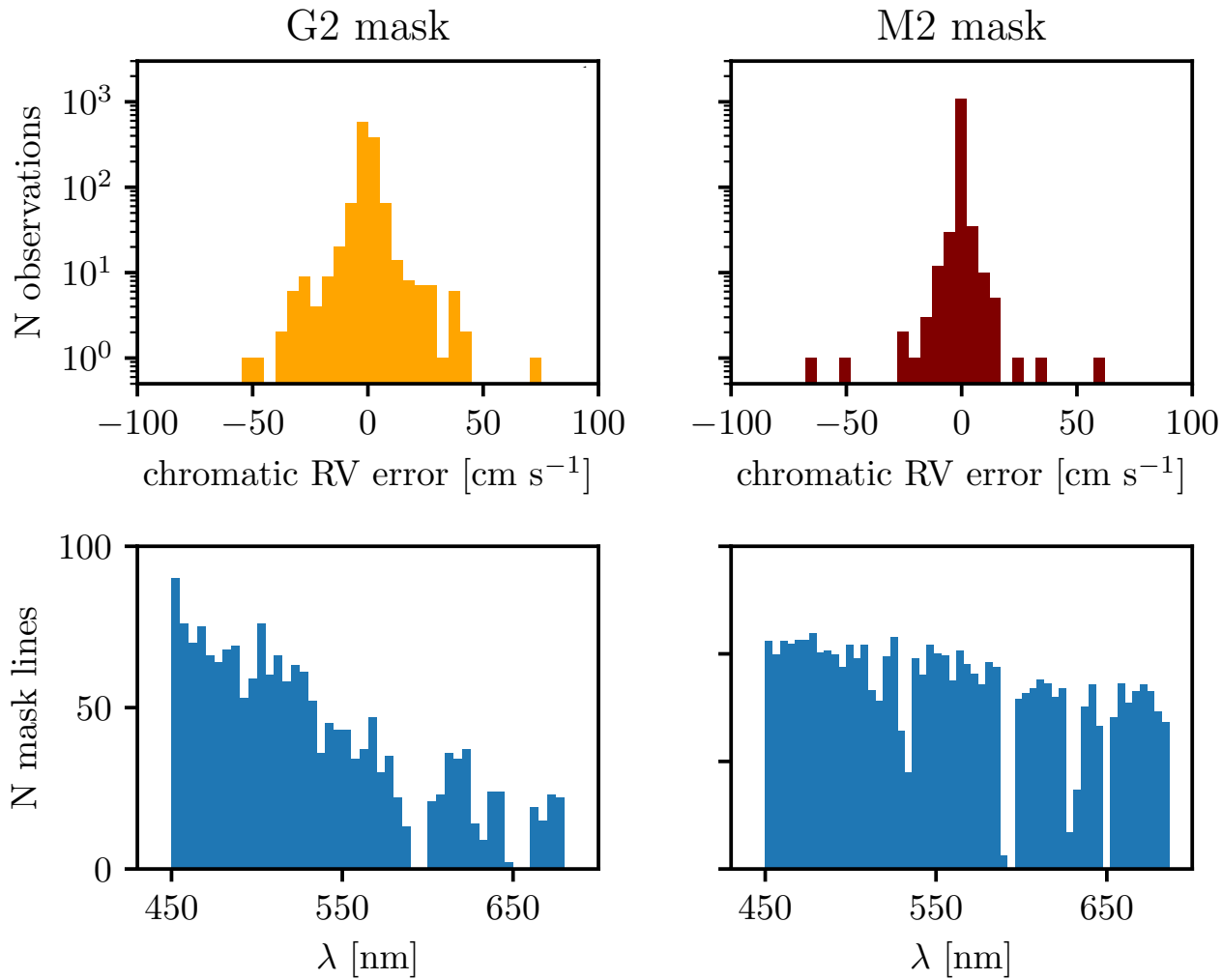


Barycentric corrections with wavelength dependence



Blackman et al. 2019, in prep

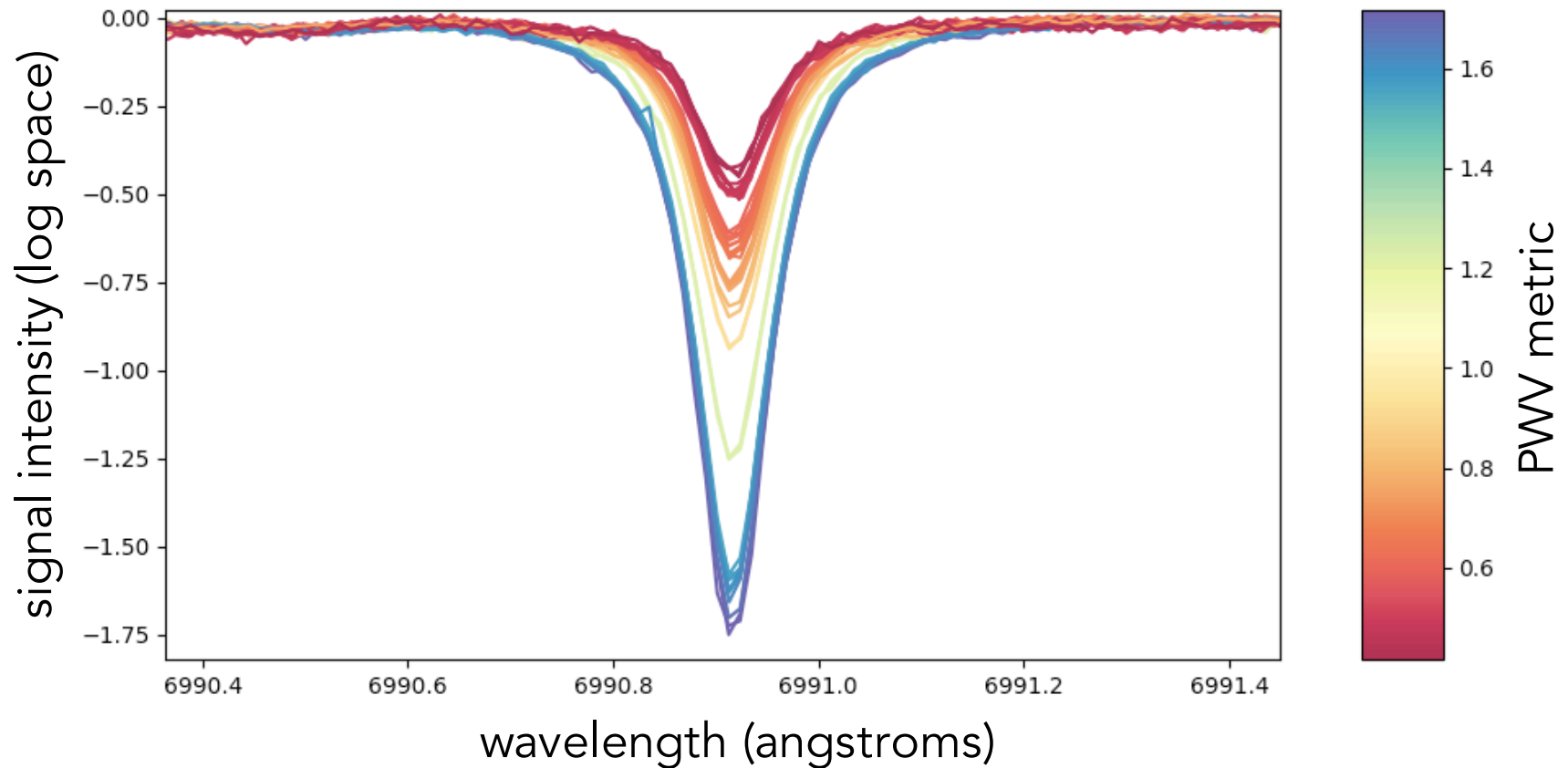
Radial Velocity Error due to Color Effect



See poster 467.09 on Thursday

Telluric Contamination

Telluric lines “move” across the spectrum because of barycentric motion, and line depth changes! See talk 303.02 by Allen Davis on Wednesday.



EXPRES Science Goals

- RV survey of nearby GK stars
- Transit follow-up
- Transit spectroscopy
- Rossiter-McLaughlin Effect

