EXPRES | The EXtreme PREcision Spectrograph

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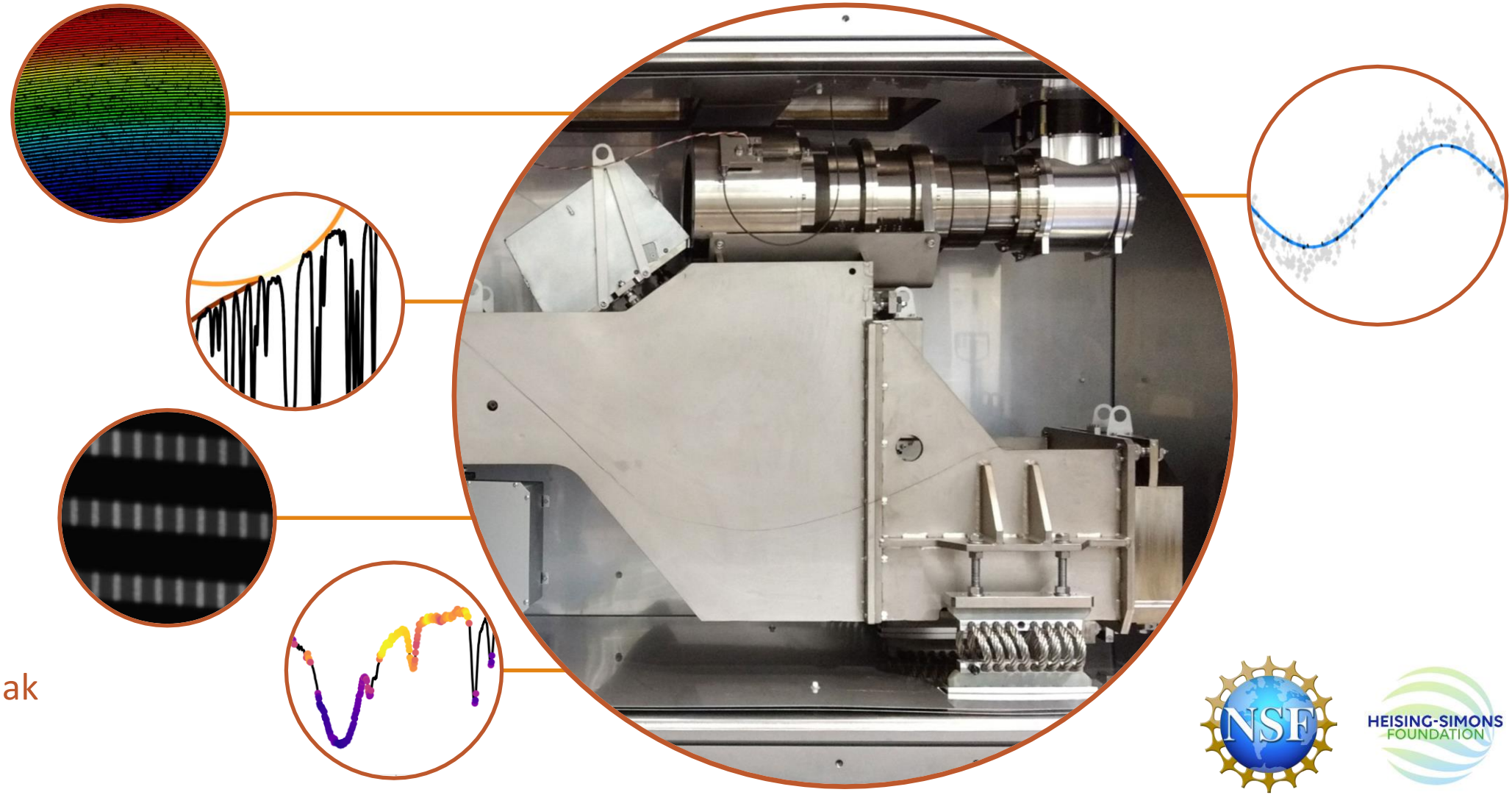
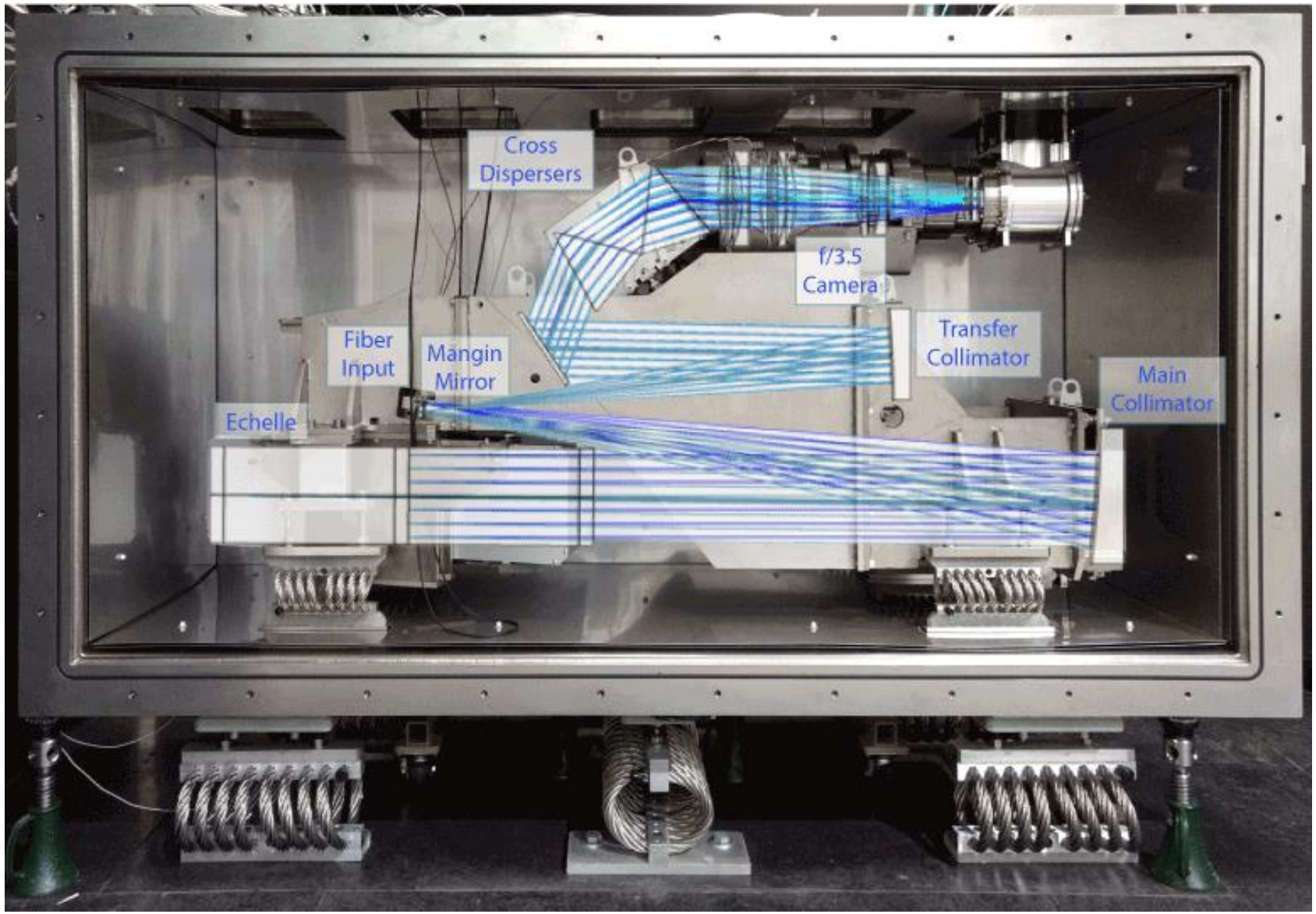
Tyler McCracken
Bo Ning
Joel Ong
Ryan Petersburg
Dave Sawyer
Andrew Szymkowiak
René Tronsgaard
Xin Xu

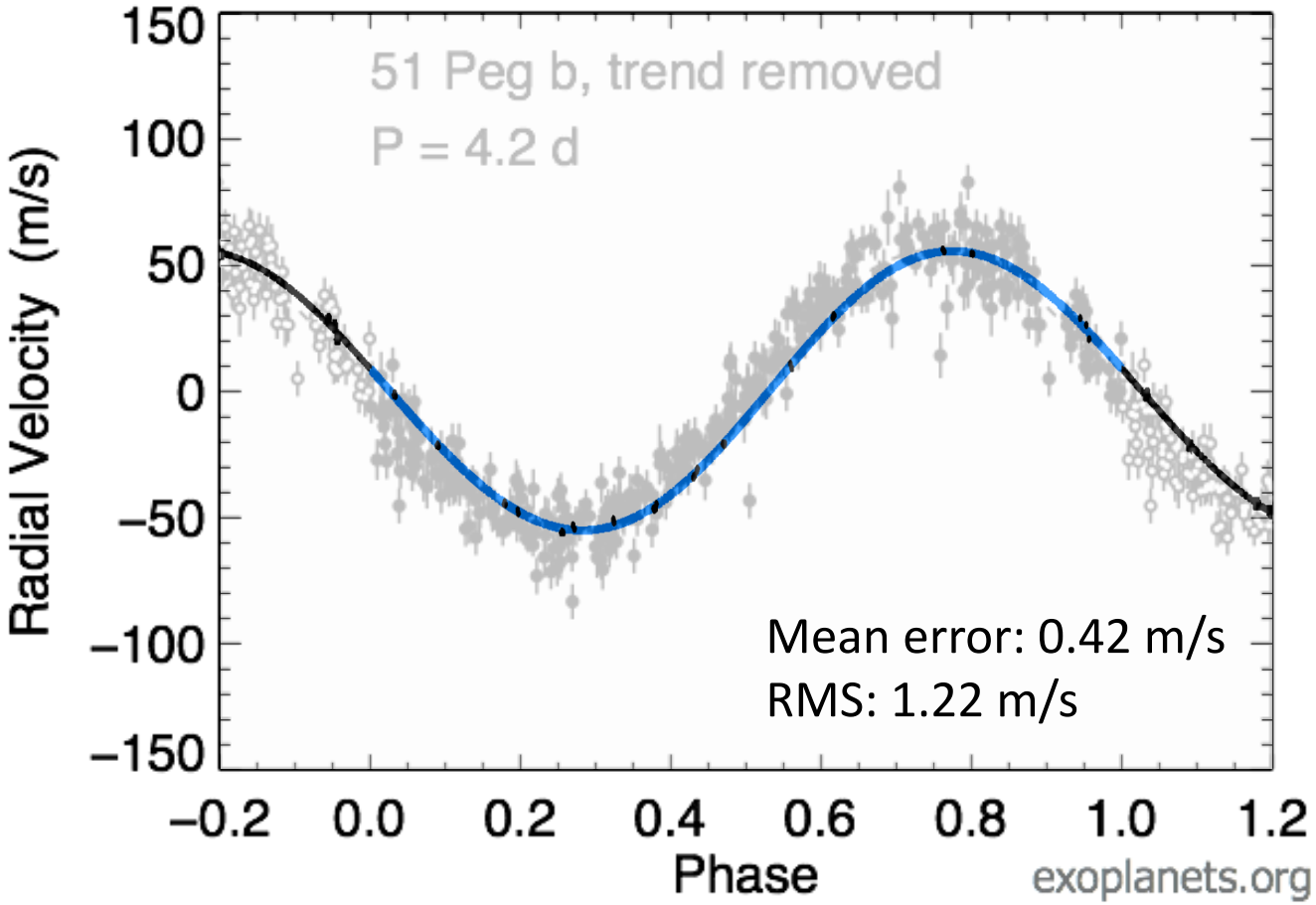


EXPRES by the Numbers

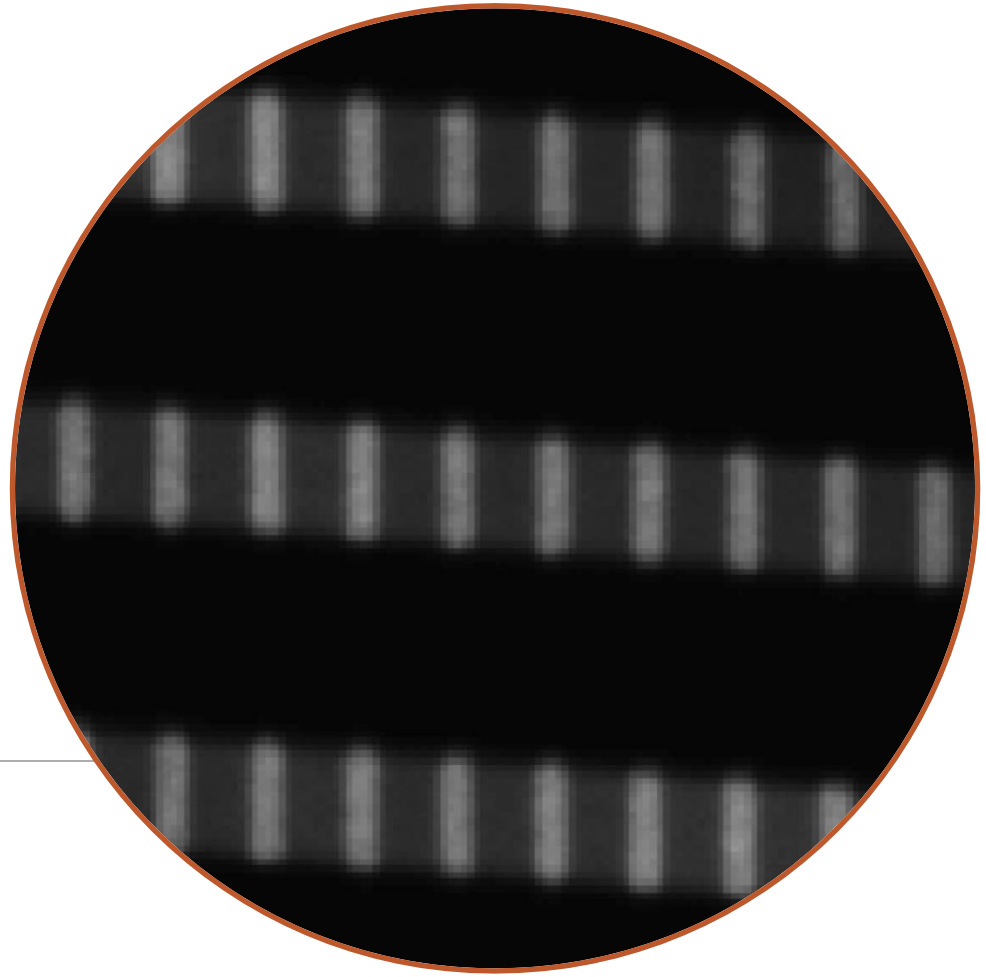
- Environmentally stabilized
- R~150,000
- 390-700 nm
- DCT (4.3 m) in Flagstaff, AZ
- Up to 280 partial nights/year
- Comissioned in 2018



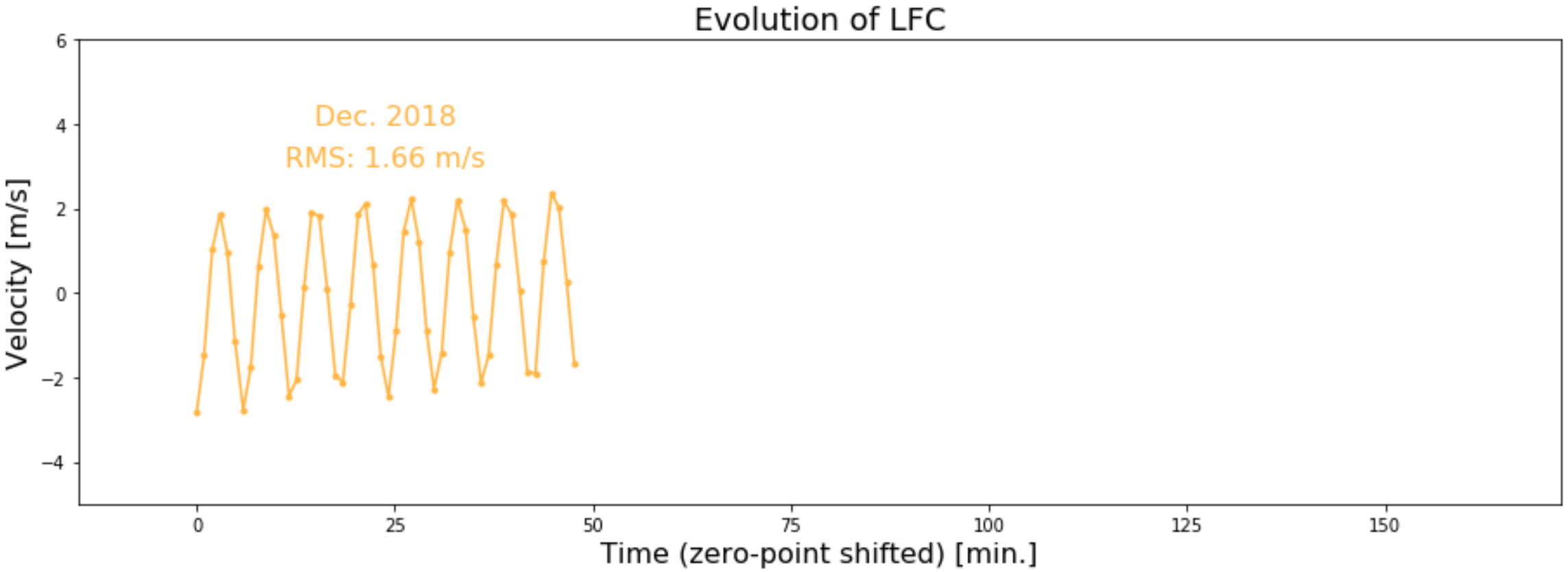
Observations of 51 Peg



LFC Variability



Consecutive LFCs consistently showed a sinusoidal variation with a period of ~6 min.



The ~6 min variation was due to a beat frequency.

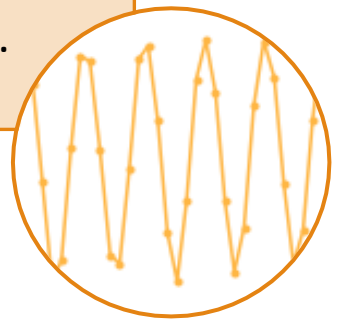
Frequency One

The CCD's CryoTel cooler's active vibration correction system

Frequency Two

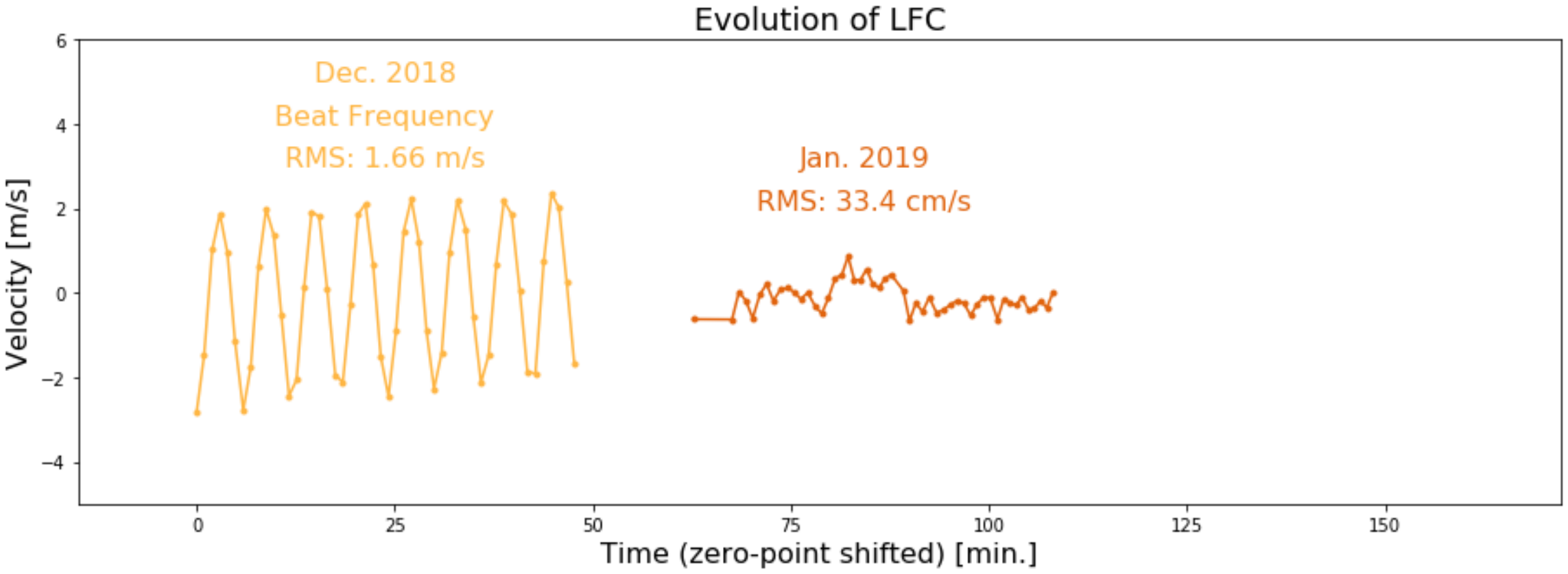
The LFC's Spatial Light Modulator (SLM) using a pulse width modulation technique
Frequency: ~120 Hz

Beat frequency with a period of ~6 min. and an amplitude of ~1.2 m/s.

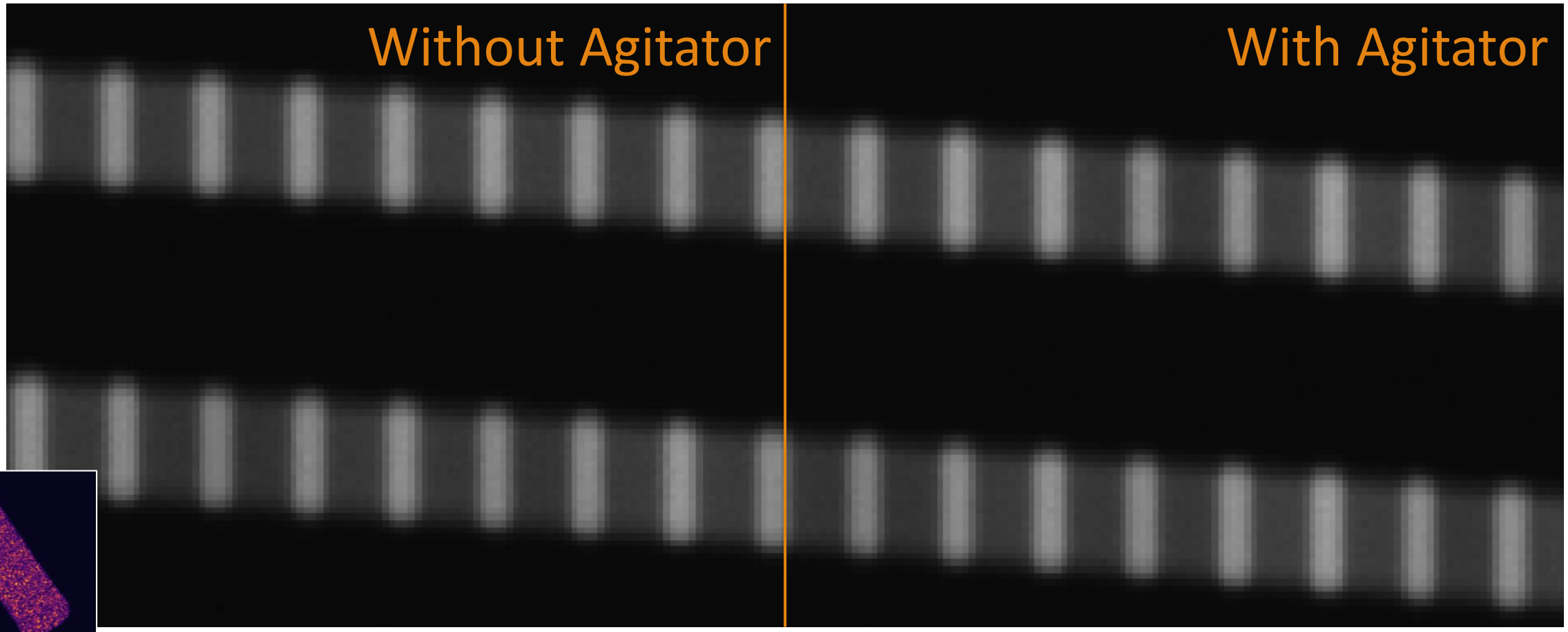


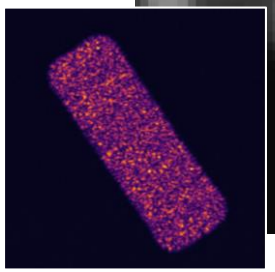
Changed the LFC's flicker to ~110 Hz

A ~ 30 cm/s variation persisted.

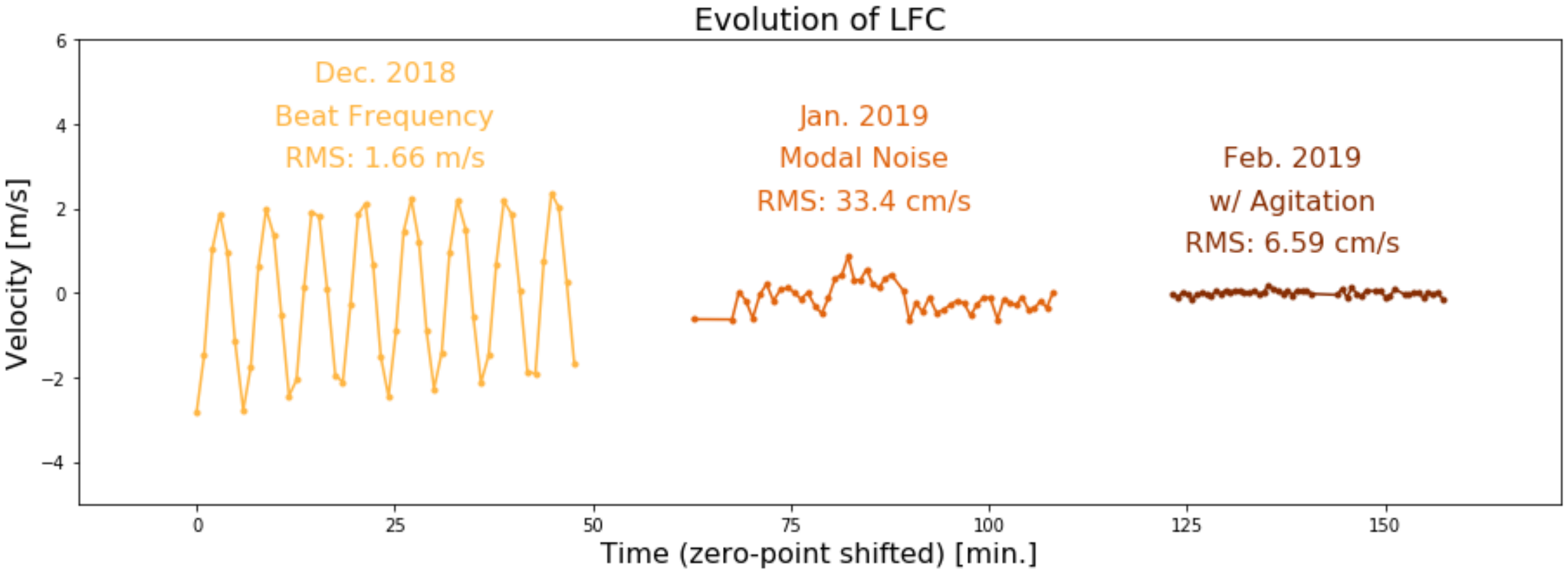


Modal noise was actually visible in the LFC lines. Our agitator had stopped working.

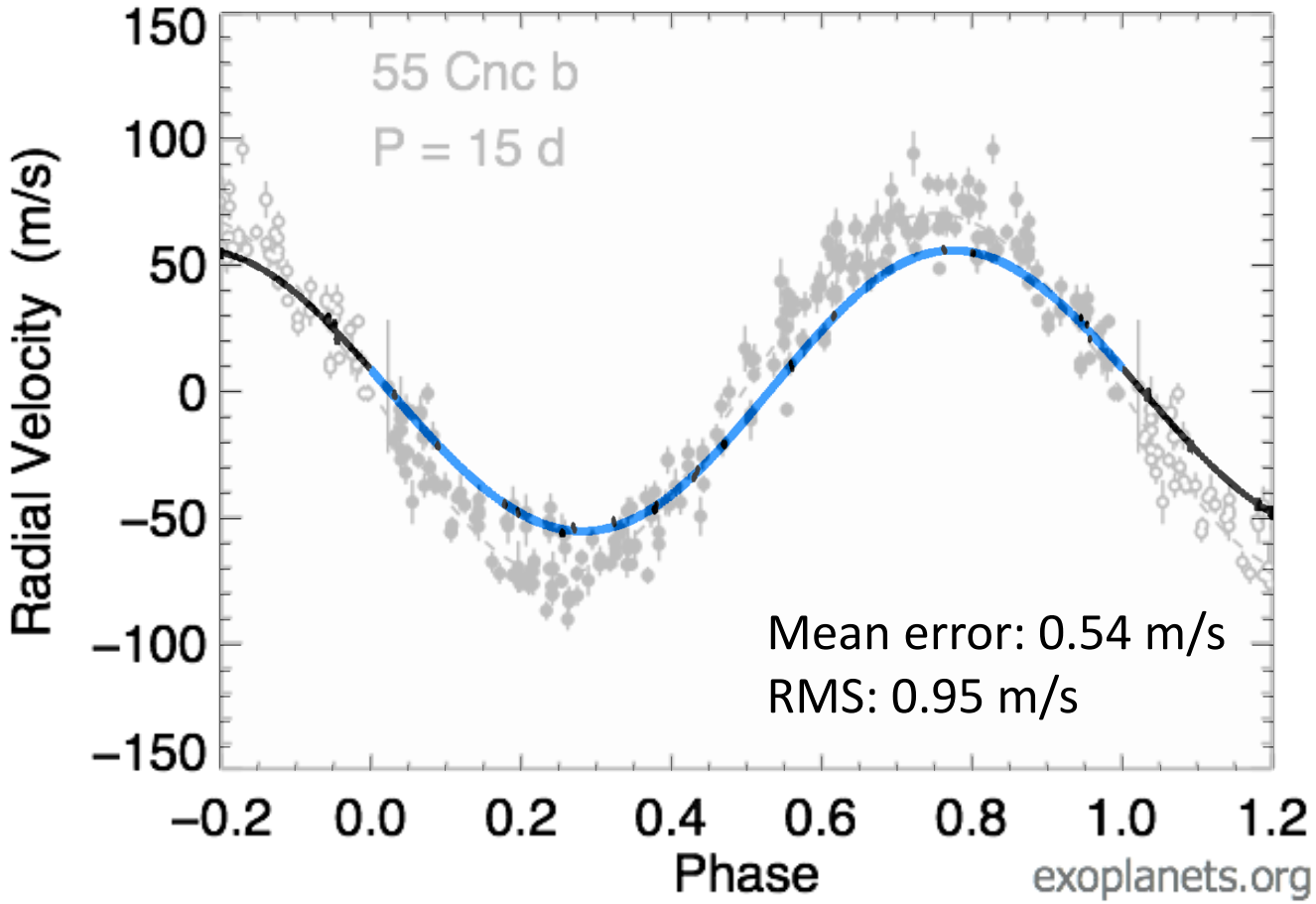




LFC measurements now show an instrument stability of 5-7 cm/s.



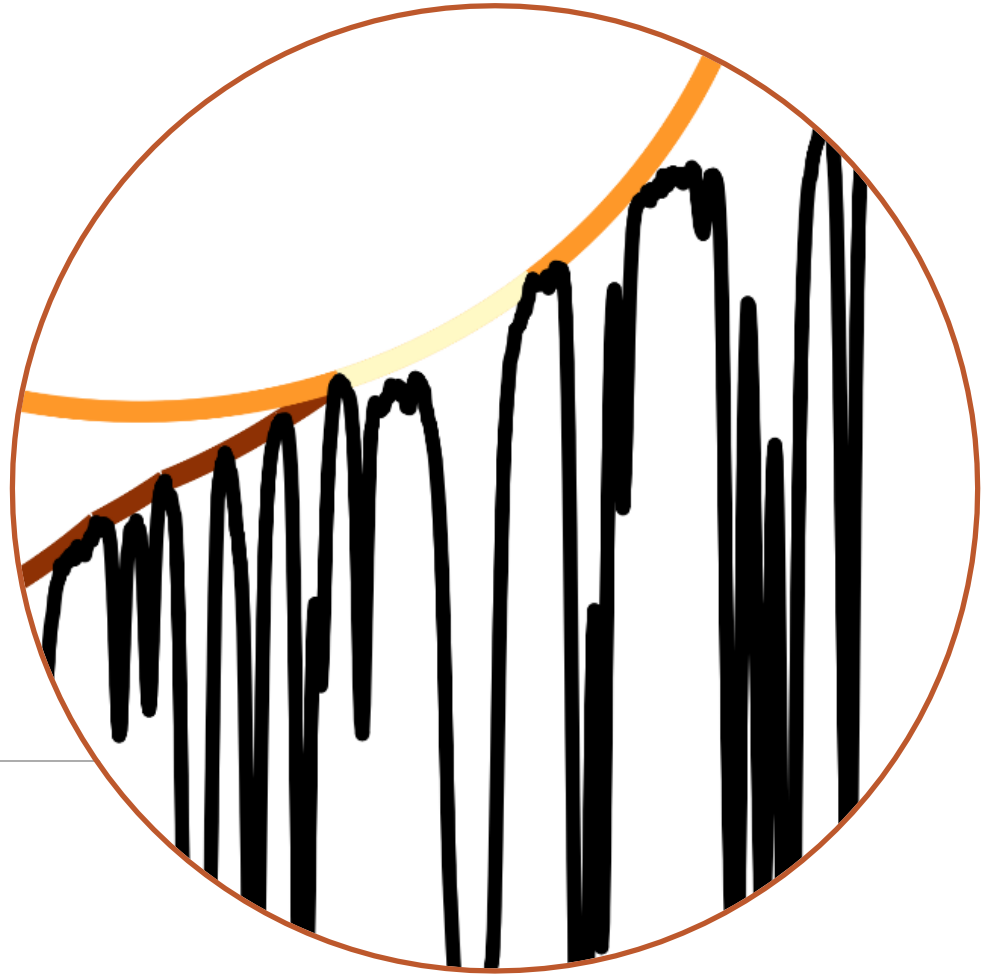
Observations of 55 Cnc



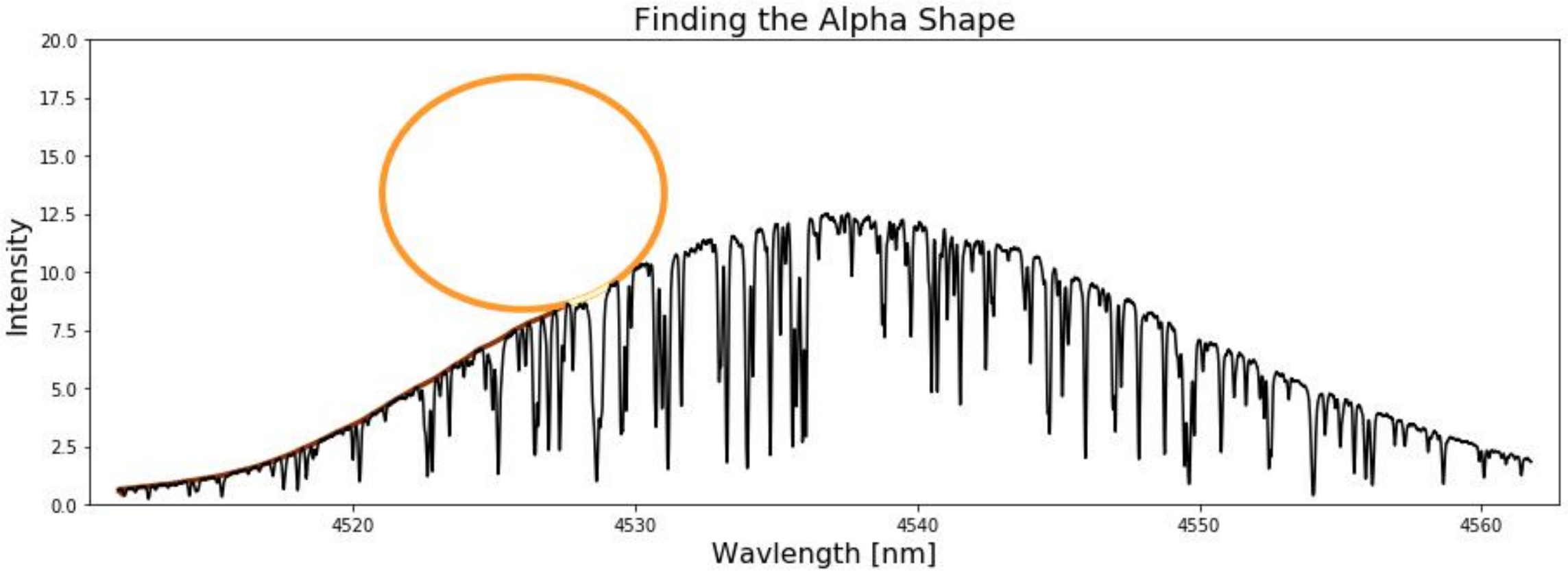
Results still include stellar noise and are affected by transit data.

Note: We calculate a lower mass of 232 Earth masses (vs. 253) though the exact same period.

Convex Hull Blaze Removal



The continuum/blaze function can be well fit by constructing an α shape of each order.



Xu et al. (submitted)

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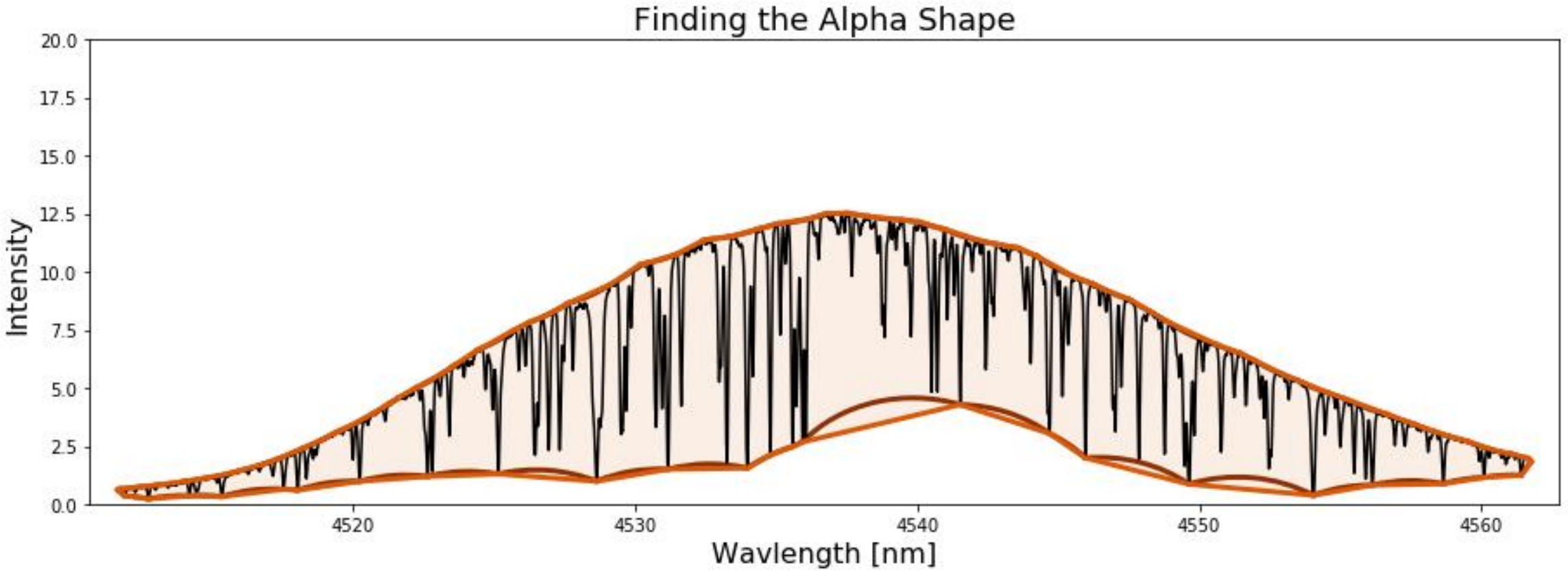
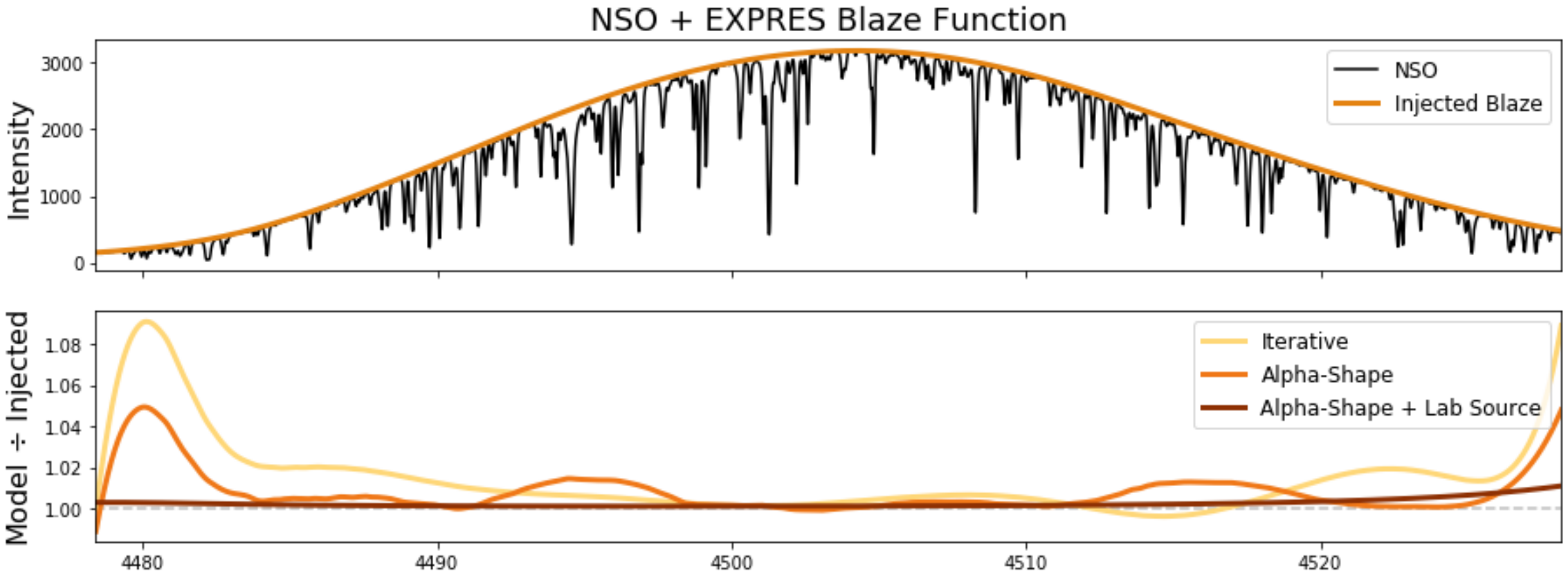


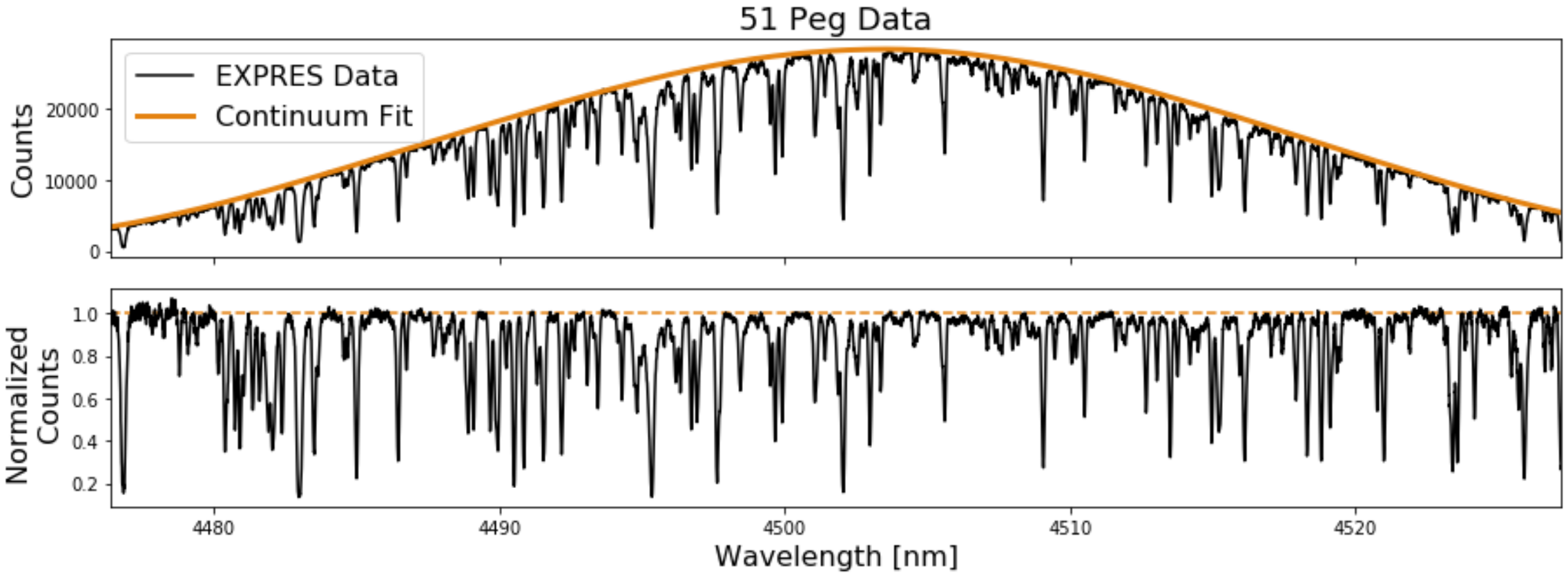
Xu et al. (submitted)

Using the α shape returns flatter results than an iterative, continuum fitting method.



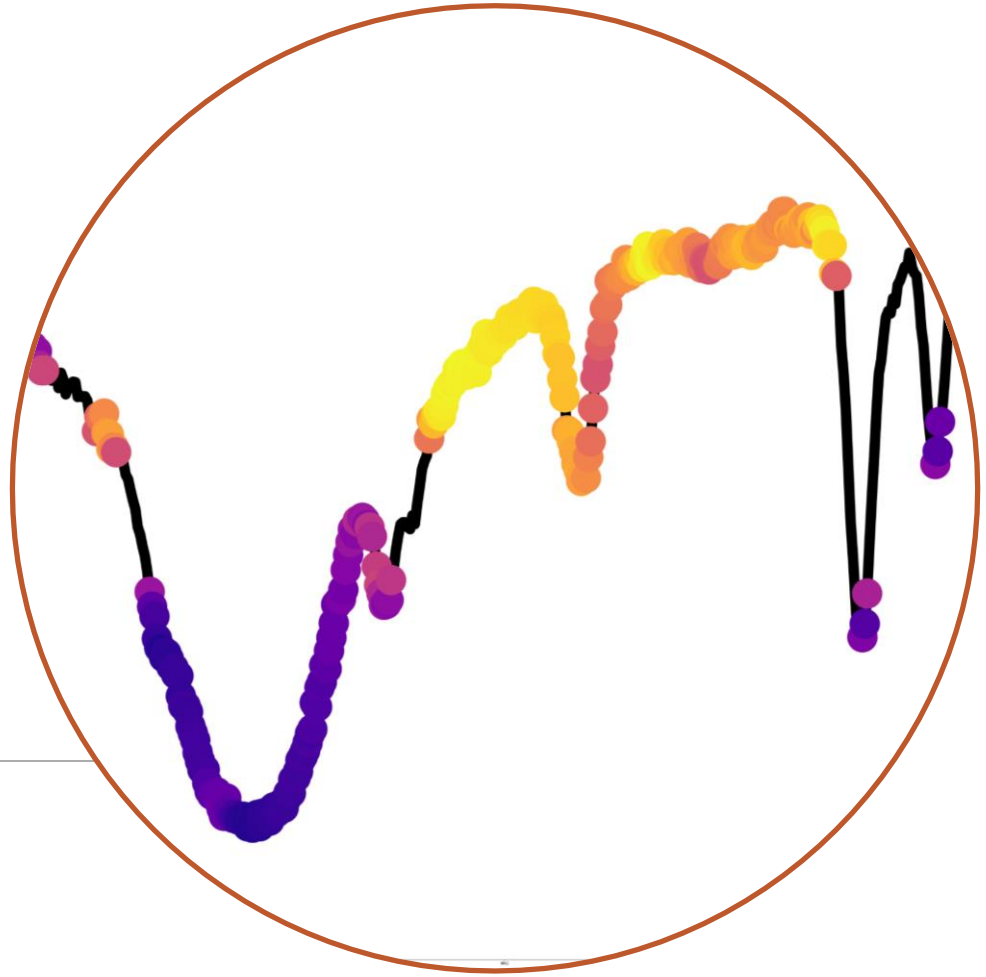
Xu et al. (submitted)

The α shape method is shown to work well on actual EXPRES data.

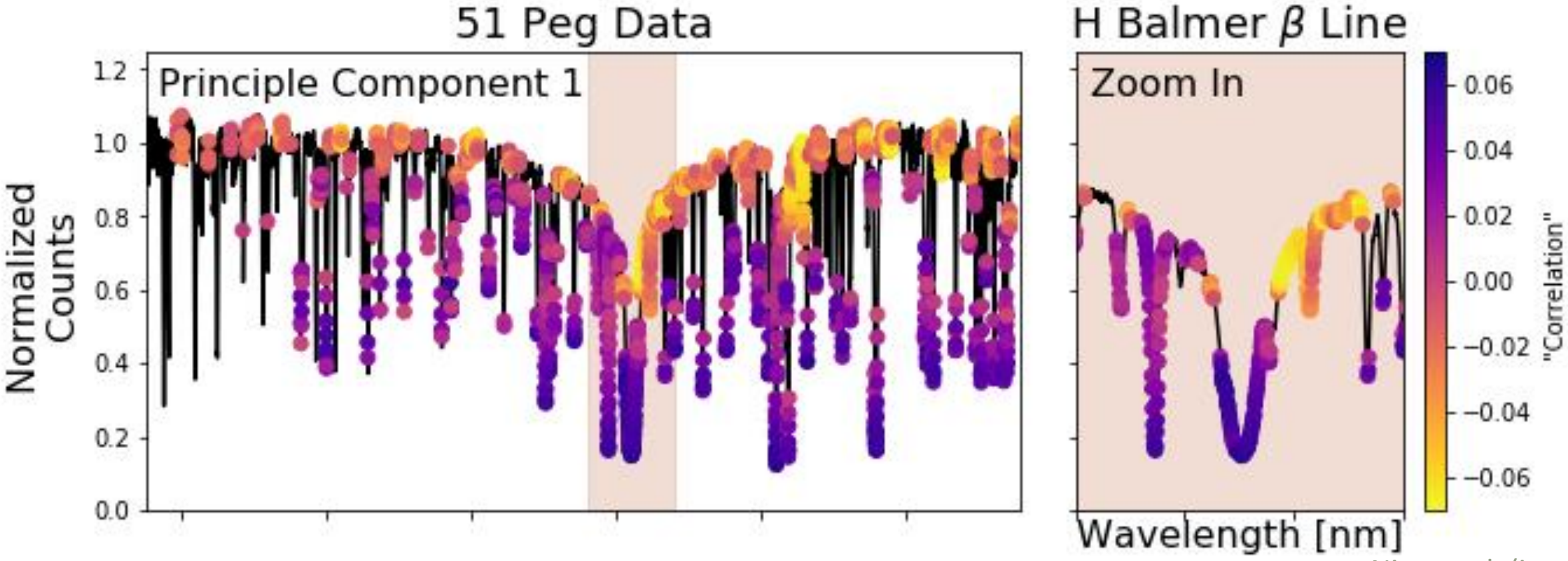


Xu et al. (submitted)

Line Variability w/ Sparse PCA



We are using sparse PSA to identify lines with variability that may be indicative of stellar activity.



Ning et al. (in prep.)

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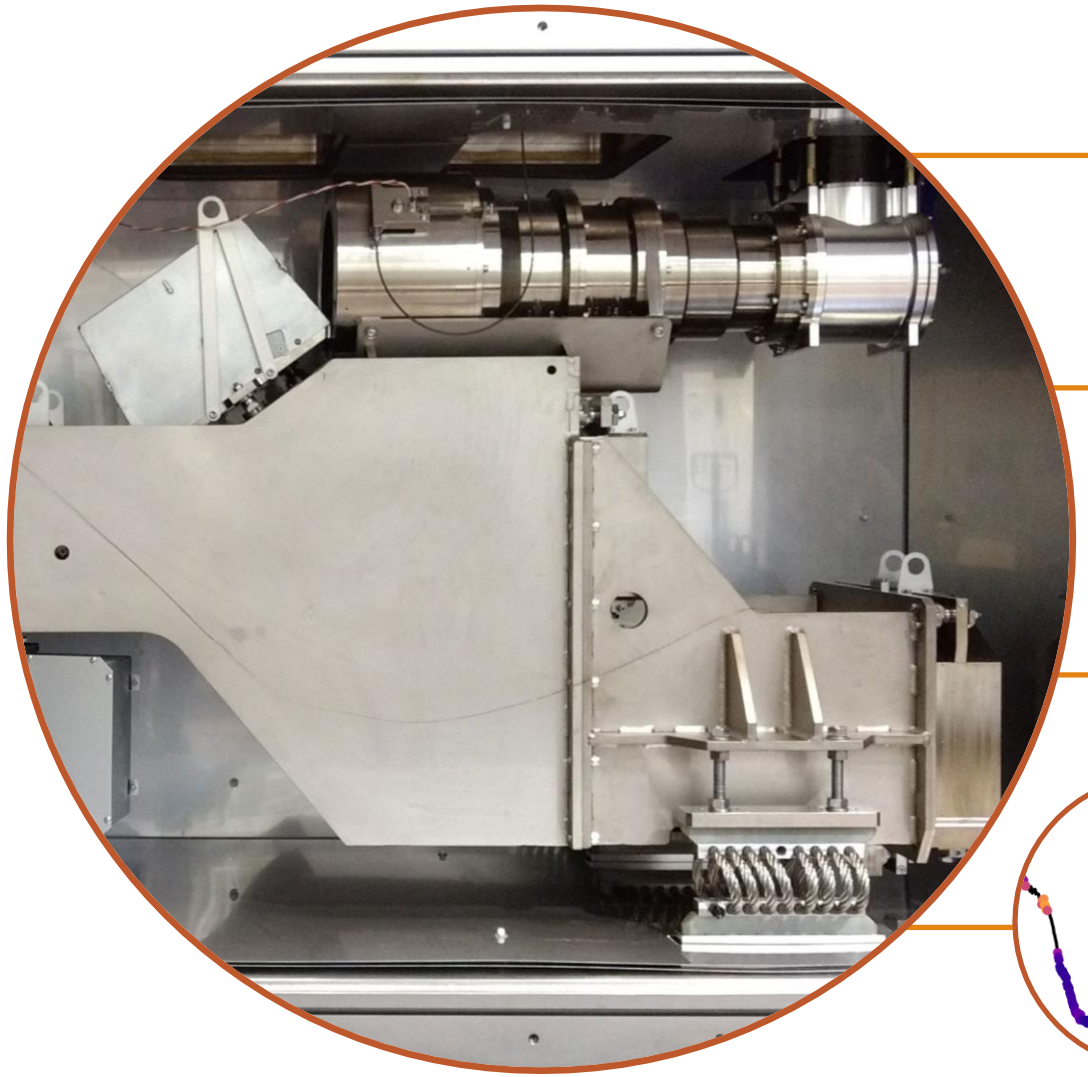
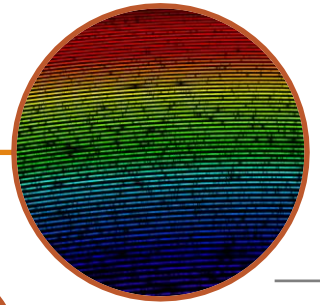
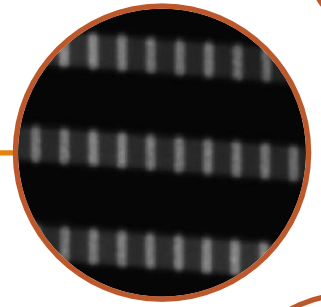
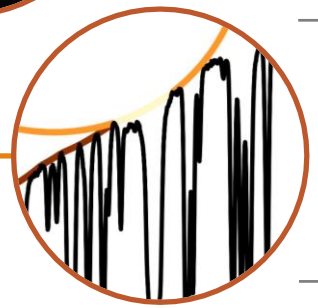
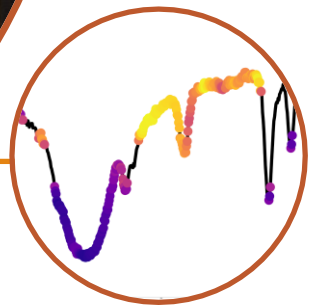
Summary











EXPRES is running smoothly and returning sub-meter precision data. (Ong +)

A ~ 6 min. beat frequency arose between the LFC SLM and the CCD CryoTel, creating a ~1 m/s variability. (Symkowiak +)

Using the α shape of each order allows for better continuum fitting than an iterative model. (Xu +)

Sparse PCA is promising for identifying lines with greater variability, likely due to stellar activity. (Ning +)