The NEID Doppler Spectrometer: a Status Report
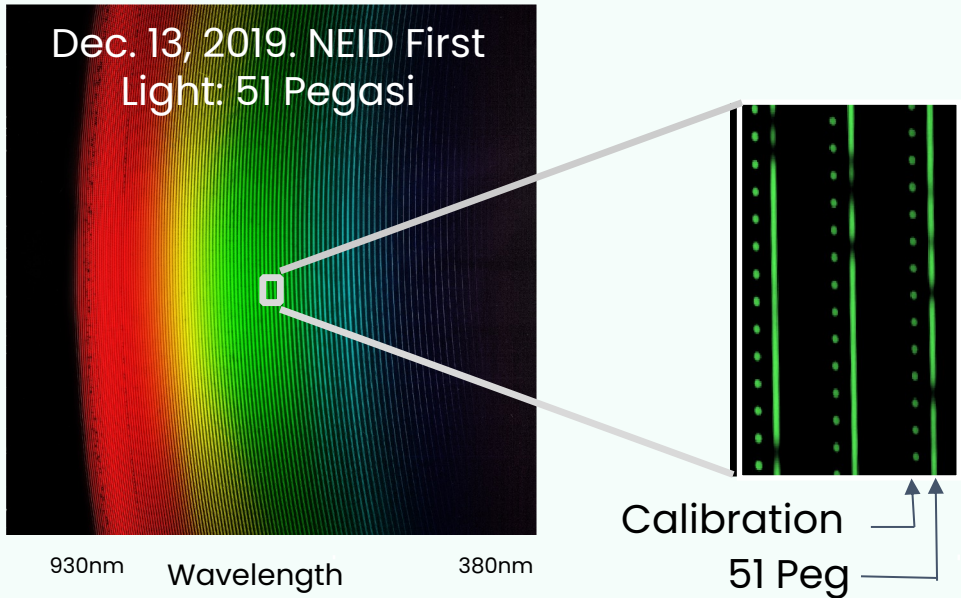
Jason Wright

Penn State

Telescope: 3.5m WIYN Telescope @ KPNO

Waveband & Resolution: 380 – 930 nm, complete coverage, R ~ 120K

Estimated Precision: ~30 cm/s (optimal circumstances)

Available to the Public via NN-EXPLORE

Dec. 13, 2019. NEID First Light: 51 Pegasi

930nm   Wavelength   380nm

Calibration

51 Peg

Two Observing Modes:
- HR (R~120,000)
  - Highest precision RVs on bright targets (V<12, e.g. TESS)
  - Simultaneous Cal
- HE (R~60,000)
  - Faint targets (V<16)
  - Poor weather
  - e.g. K2

OBSERVATION OF HD 10700

Status ⓘ

[Active]

Priority ⓘ

[0   ⌄]

Max Solar Contamination ⓘ

[Enter mag/arcsec ² (optional)   ▣]

Maximum Cloud Extinction ⓘ

[1.0   ▣]

Maximum Seeing FWHM ⓘ

[2.0   ▣]

Maximum Airmass ⓘ

[1.7   ▣]

Minimum Distance from Moon ⓘ

[Enter degrees (optional)   ▣]

Maximum Moon Illumination ⓘ

[Enter value 0.0-1.0 (optional) ▣]

Spectral Mode ⓘ

[HR   ⌄]

Start Time (UTC) ⓘ

[e.g. 2020-08-21T02:30:00 (optional)]

End Time (UTC) ⓘ

[e.g. 2020-08-21T02:30:00 (optional)]

Minimum Visit Separation ⓘ

[0.5   ▣]

Are 2 visits per night required? ⓘ

[No   ⌄]

Minimum Intra-night Separation ⓘ

[Enter float value in hours   ▣]

Timing Type ⓘ

[Date-Range   ⌄]

Queue input software allows for full customization of queue-scheduled observations:

- Custom cadence, phase coverage, timing
- Fixed-Exposure time or fixed-SNR exposures
- Automated target lookup
- Customized instrument setup and calibration scheme
- And much more!

NEID Exposure Time Calculator

About **[RV Precision]** SNR Exposure Time (RV) Exposure Time (SNR)

Proposers to the NOAO call for NEID should use this calculator to estimate the exposure times for their observations given a target SNR or RV precision, and the inverse of those functions. This exposure time calculator was written by the NEID Science Team and is based on current best-estimates for the total system throughput as a function of wavelength, precision from the default data pipeline, and based on template stellar spectra at vsini = 2 km/s and solar metallicity. All throughput estimates are deliberately conservative, and there is an additional 30% margin built-in on top of this conservatism.

This calculator will be updated as better estimates of system performance become available, and as on-sky performance is measured during commissioning.

Calculate Radial Velocity Precision

Effective Temperature (K):

| 5500 | |

V-mag:

| 8 | |

Exposure Time (s):

| 300 | |

[Calculate]

Notes and Caveats

- Note that this exposure time calculator reports only the photon noise contribution to the RV precision. This contribution must be added in quadrature to the 27 cm/s instrumental floor to determine the total measurement precision.

- Saturation happens at **SNR = 625.** Do not go over this limit.

- Maximum exposure time is calculated as the exposure time to reach non-linearity for any order. This occurs at approx. SNR = 480.

- SNR is reported per 1D extracted pixel. The NEID resolution element is approx. 5 pixels wide.

Exposure time calculator provides estimates of SNR and RV precision as a function of stellar temperature and magnitude.

- Data are fully reduced by the data reduction pipeline provided by the instrument team
- Every PI has access to high-quality RVs produced by a common pipeline
- The NExScI archive hosts three levels of reduced data for each observation:

- Level 0 - Raw data
  - One FITS file for each exposure
  - Each instrument readout (16 total) in an HDU
  - HDUs for exposure meter, guider image and coherent fiber bundle

- Level 1 – Extracted Spectra
  - 2D FITS images (order x pixel column) with extensions for sky, calibration, science fibers, and wavelength solution

- Level 2 – Radial Velocities
  - Cross correlation function data
  - Sky and telluric models
  - Activity indicators
  - Additional keywords include
  - Barycentric correction
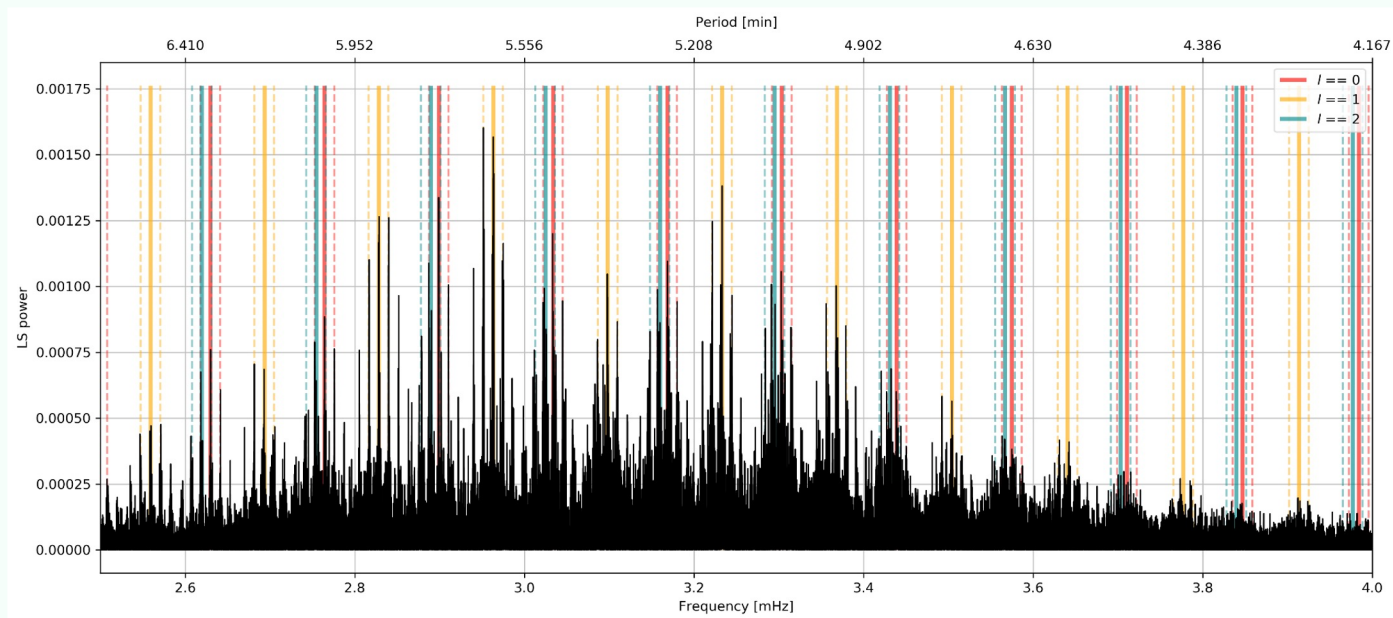 - RV per order
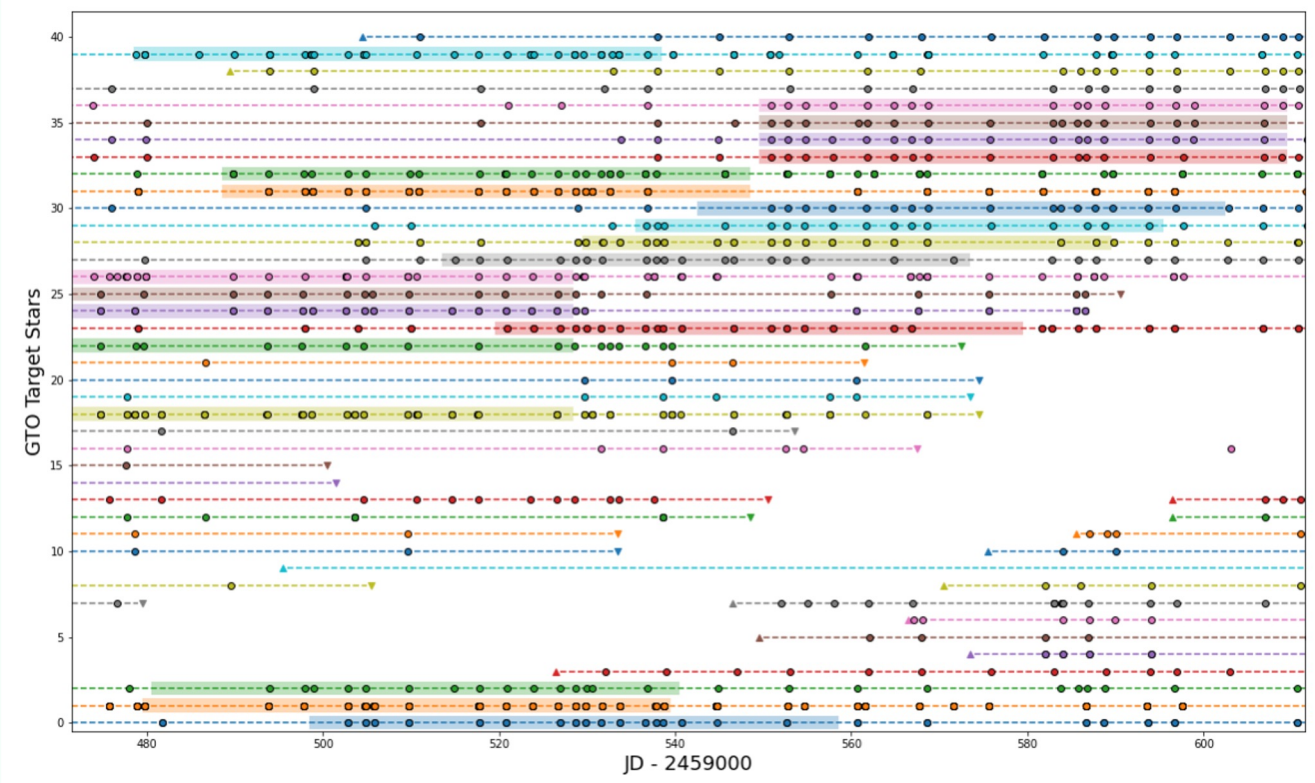 - Drift terms

5
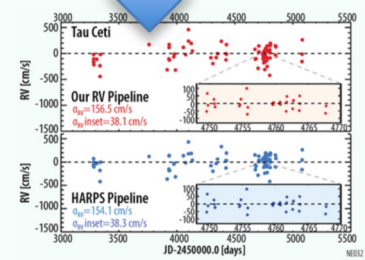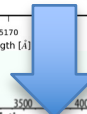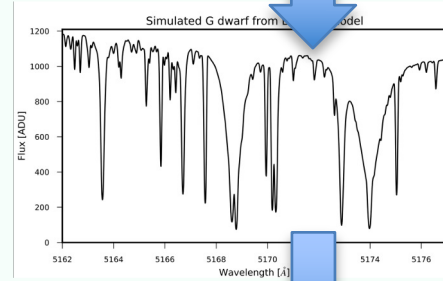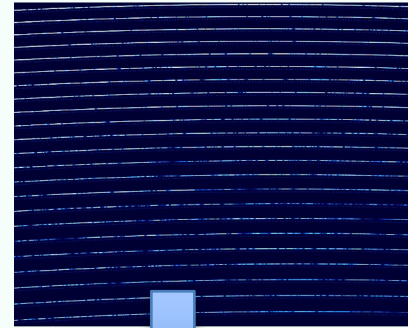
NEID RV standard star performance
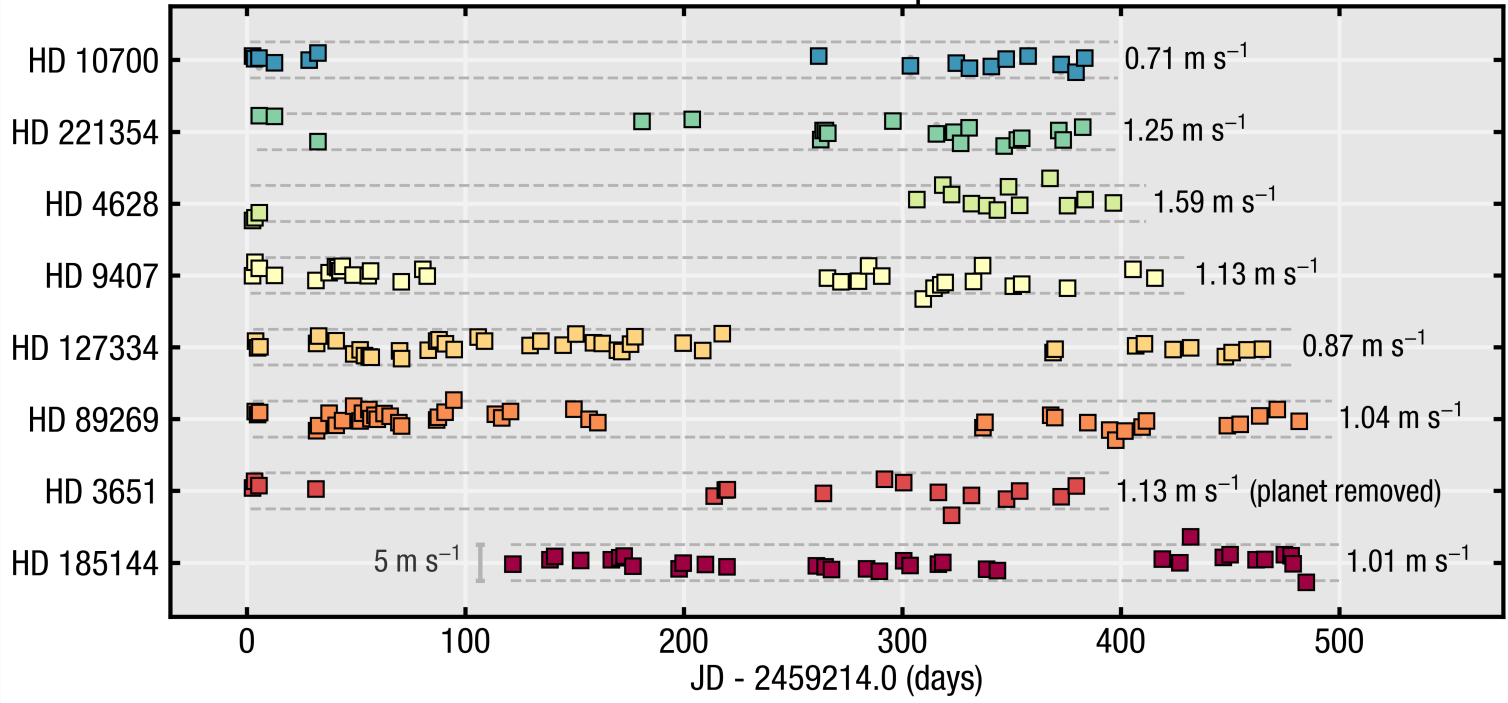
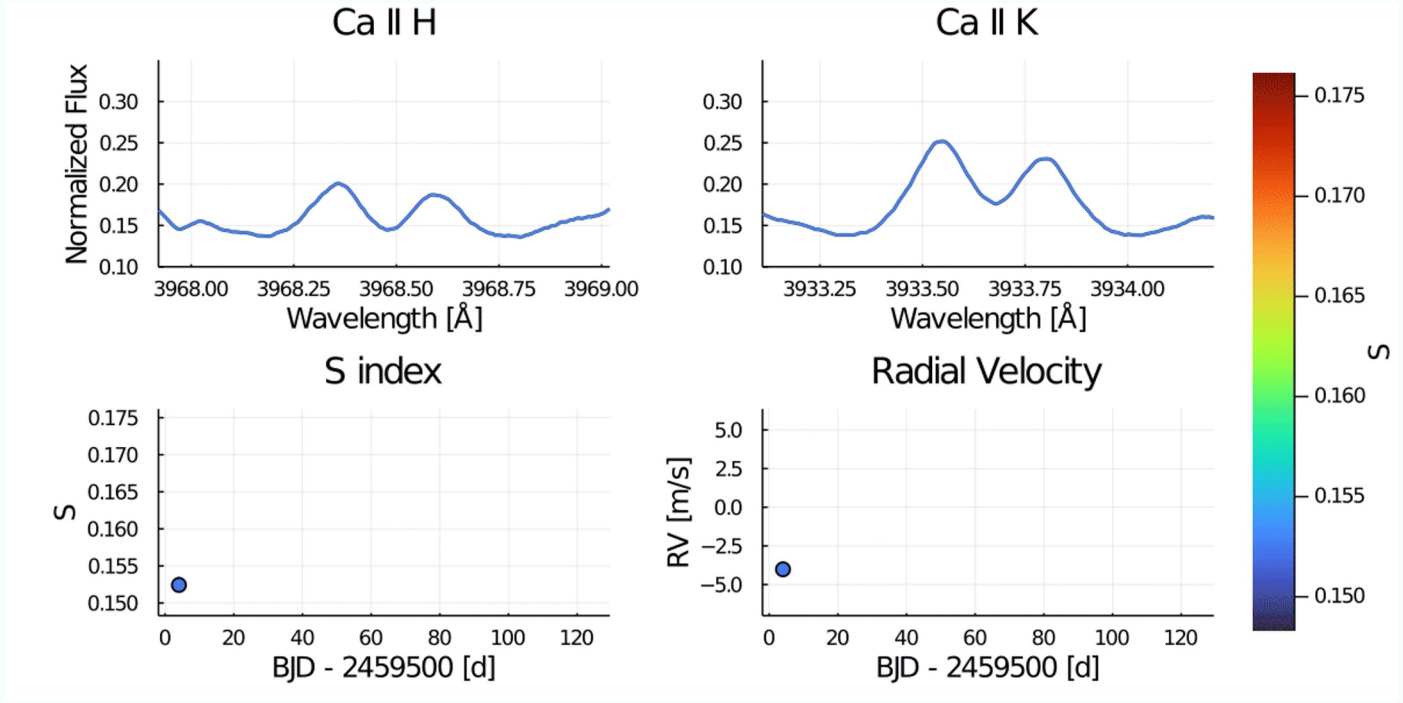**Bottom Line**: NEID achieves <1 m/s precision on quiet stars

NEID RVs clearly following known Solar oscillations.

NEID Earth Twin Survey (NETS): Now operating at full capacity

Arvind Gupta

Jacob Luhn
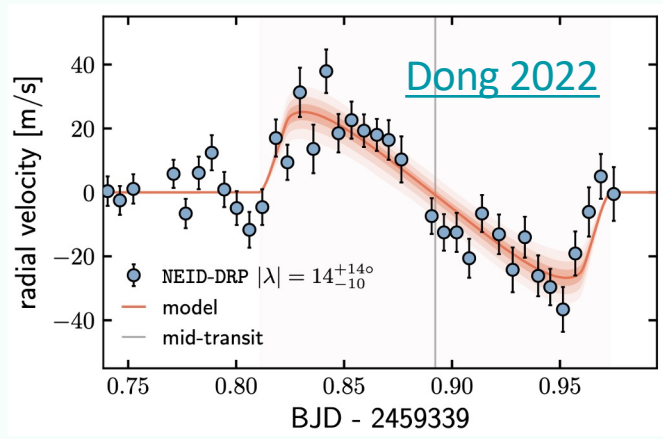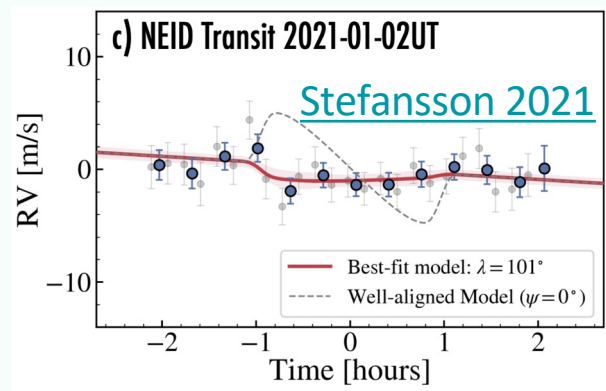
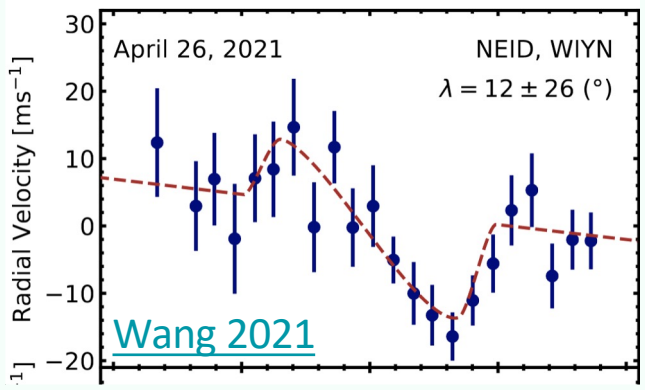NEID papers starting to emerge! Topics include: R-M

Twitter: @NEID_at_WIYN

Instrument & Science updates: http://neid.psu.edu

Specs, proposals, exposure time calculator:
https://www.wiyn.org/Instruments/wiynneid.html

Questions?