

Status update on the Keck Planet Finder

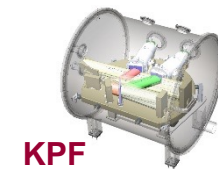
Jan 9, 2023

Sam Halverson, on behalf of the KPF team

Major funding provided by: Heising-Simons Foundation, NSF, WMKO, Private donors, Keck Foundation, Simons Foundation, JPL, Mt. Cuba Foundation, UC Berkeley, Caltech, Univ. Hawaii



KPF system overview – a precision RV facility for Keck I

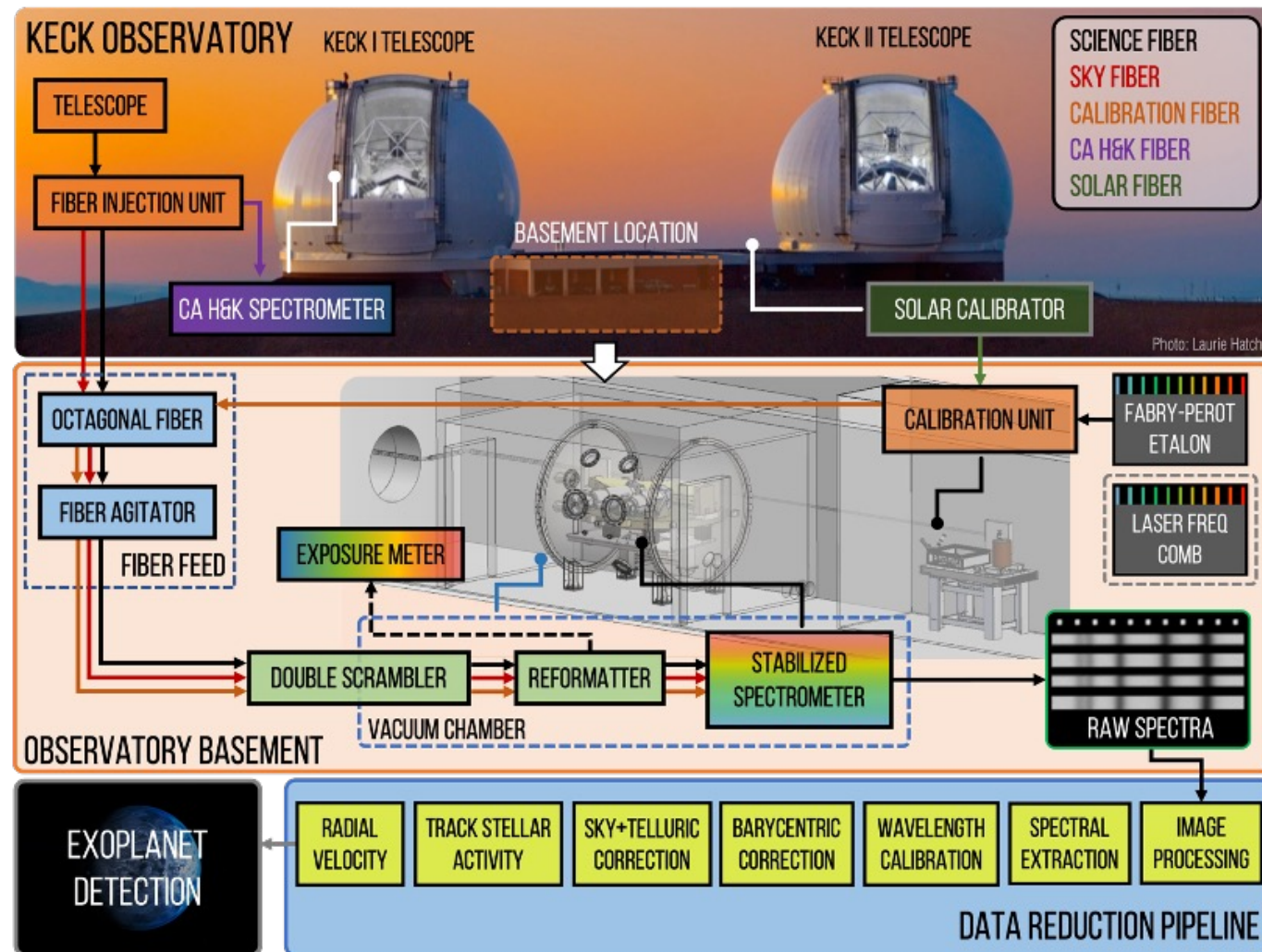


Design:

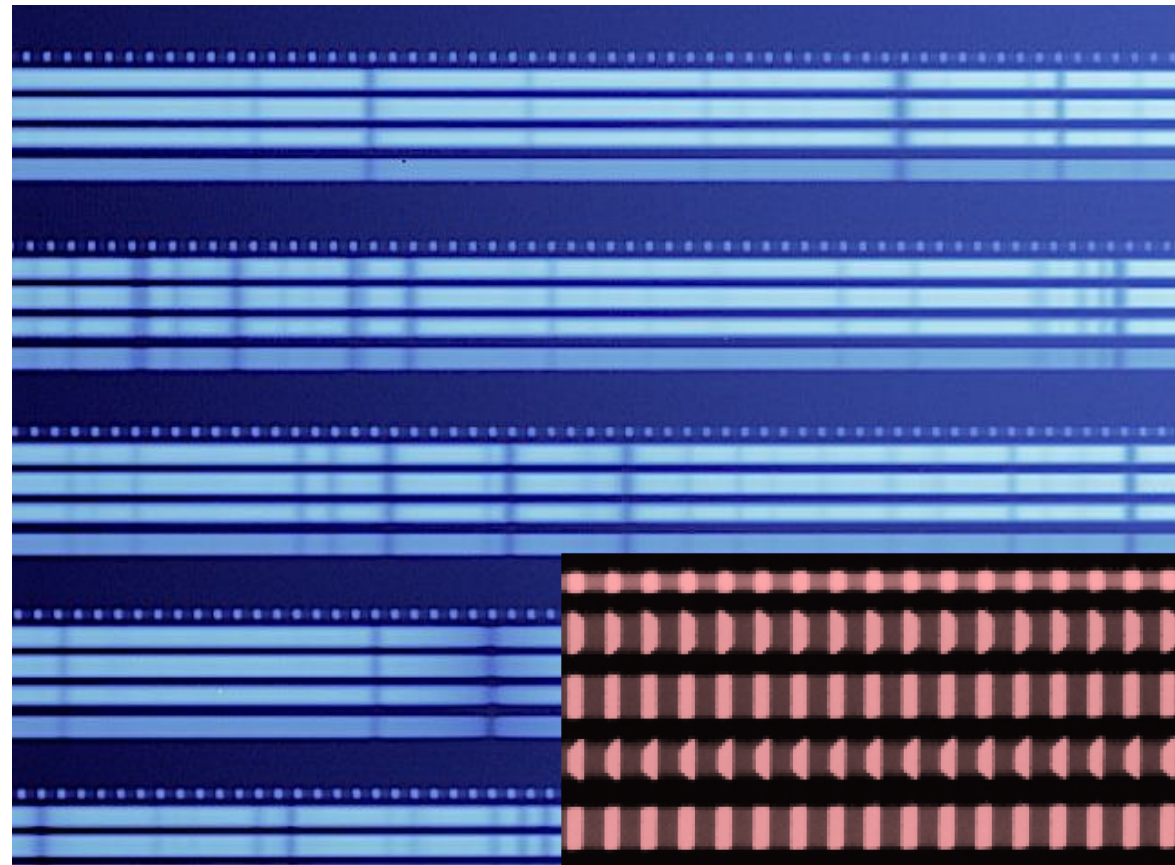
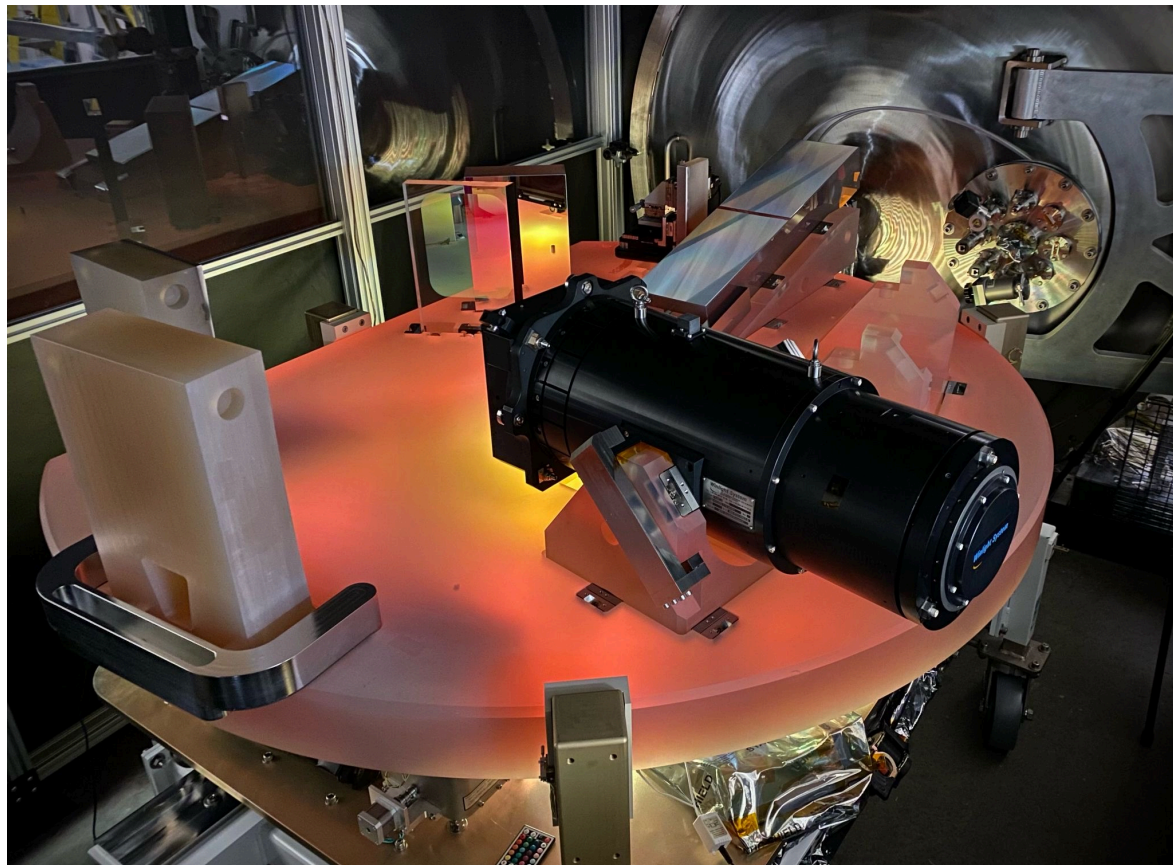
- Cross-dispersed echelle: $R \sim 95,000$
- 2 spectral channels: 445-595 nm, 595-870 nm
- Highly stable Zerodur bench
- Fed by optical fiber + image slicer (3x slices)
- Separate spectrometer for Ca H&K monitoring
- Menlo LFC + Etalon for drift monitoring.
- Chromatic exposure meter
- Vacuum chamber + thermal enclosure

Capabilities:

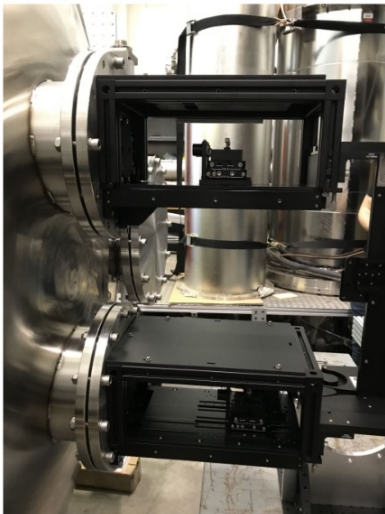
- RV precision: <0.3 m/s, requirement of <0.5 m/s
- [PRV science down to \$V \sim 14-16\$](#)
- RVs delivered as facility data product
- Solar calibration used for sun-as-a-star studies
- PDR passed Nov 2017
- NSF MSIP funded 9/2020
- PSR passed in July 2022
- Commissioning kickoff **November 2022**
- Shared risk science begins in Summer 2023



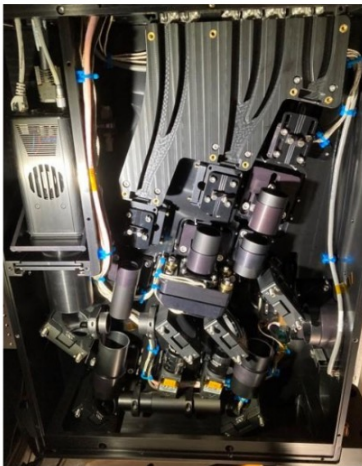
Spectral format -- image slicing inside the spectrometer



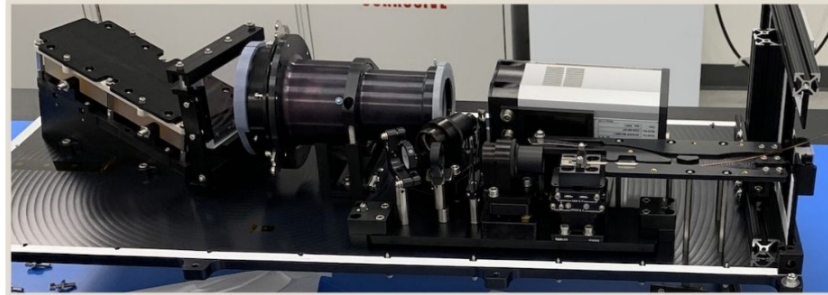
Collage of subsystems



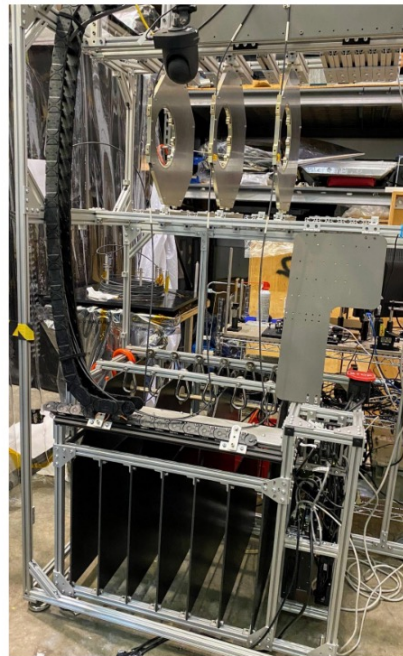
Scramblers



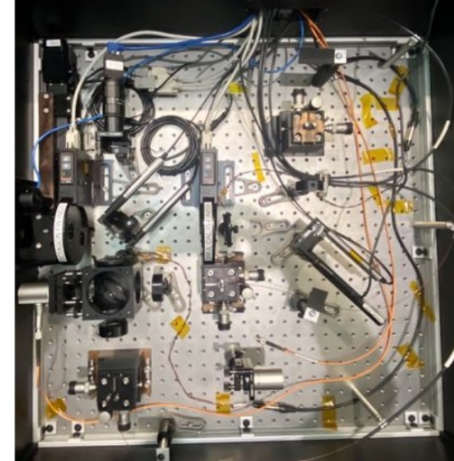
Fiber Injection Unit



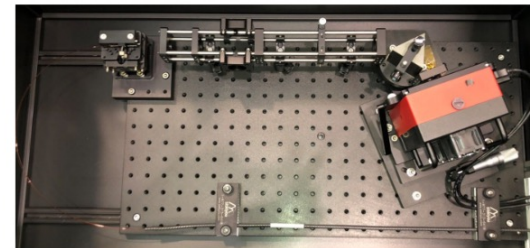
Calcium H&K Spectrometer



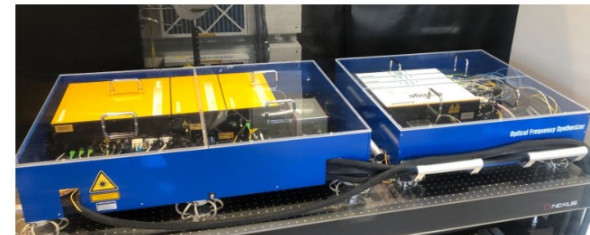
Agitator



Calibration System

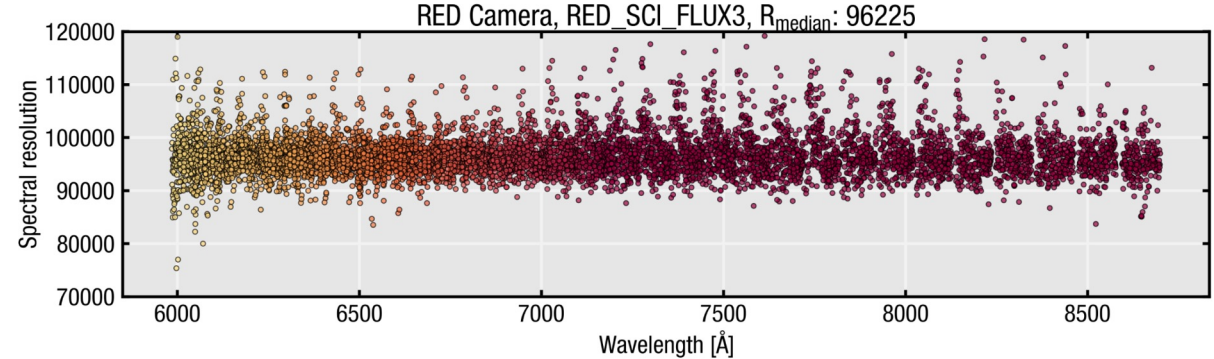
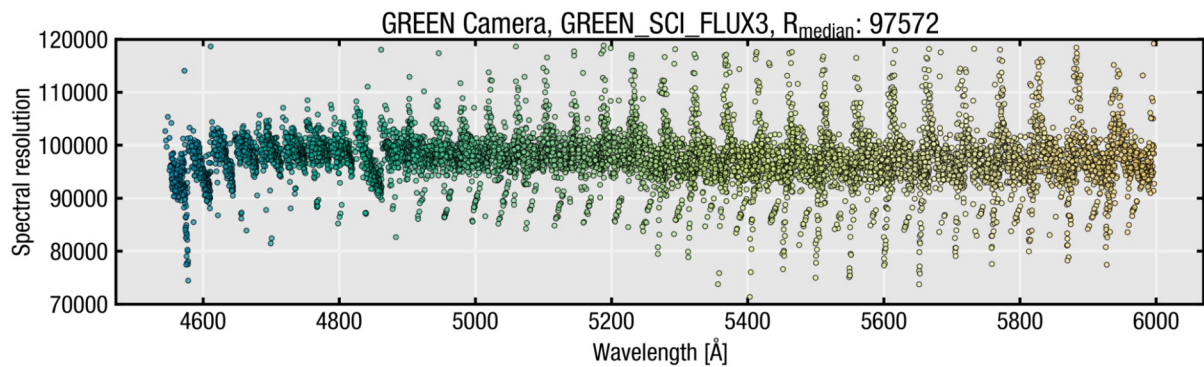
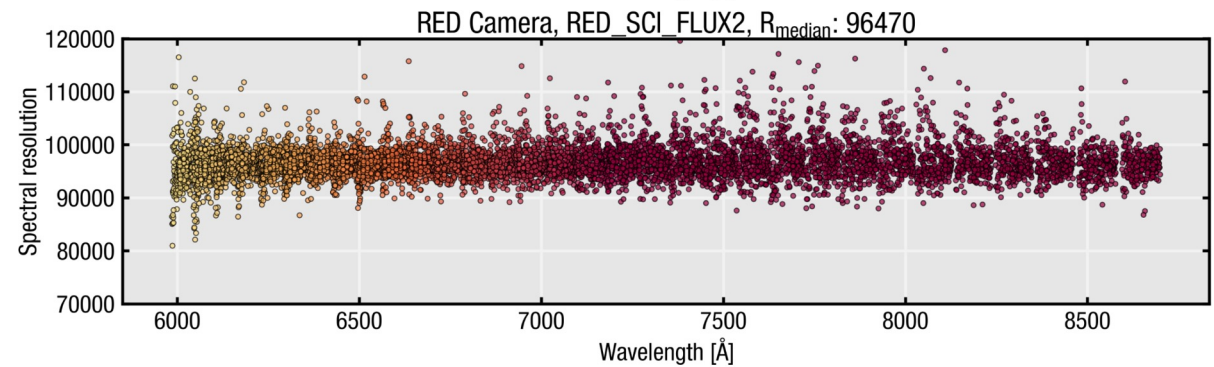
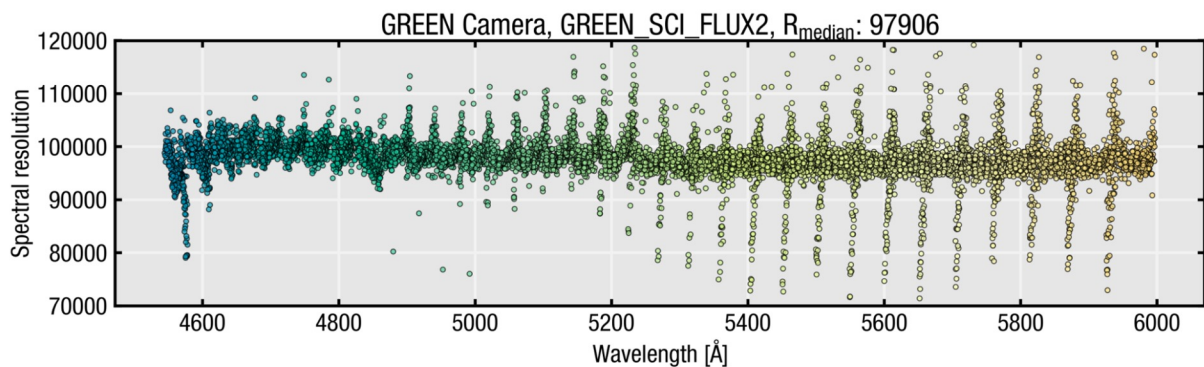
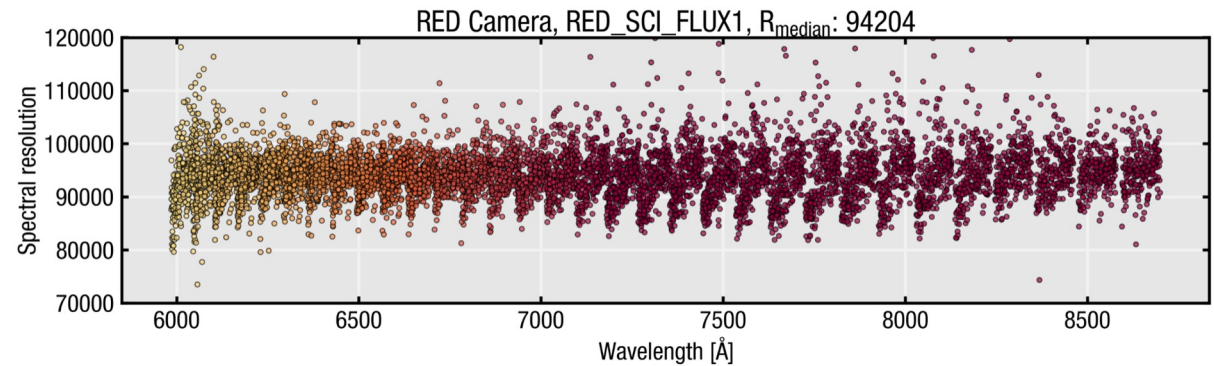
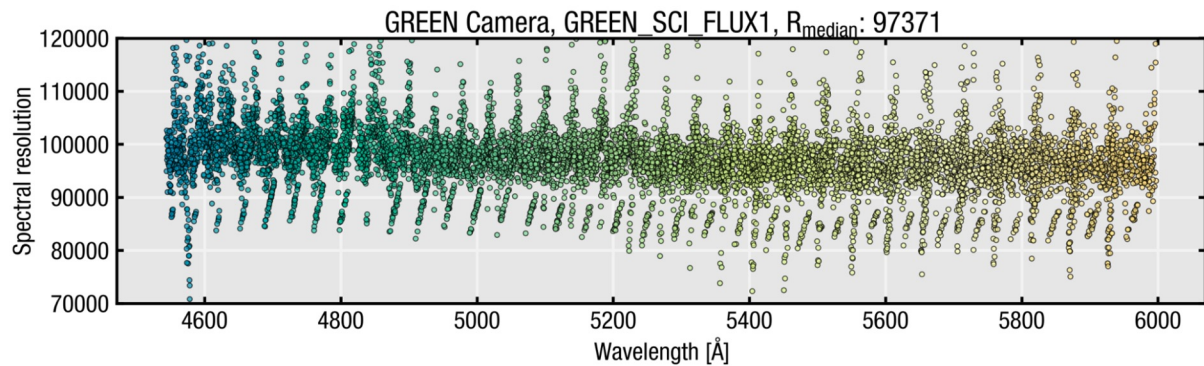
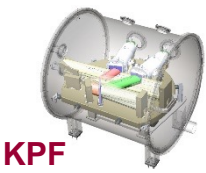


Exposure meter

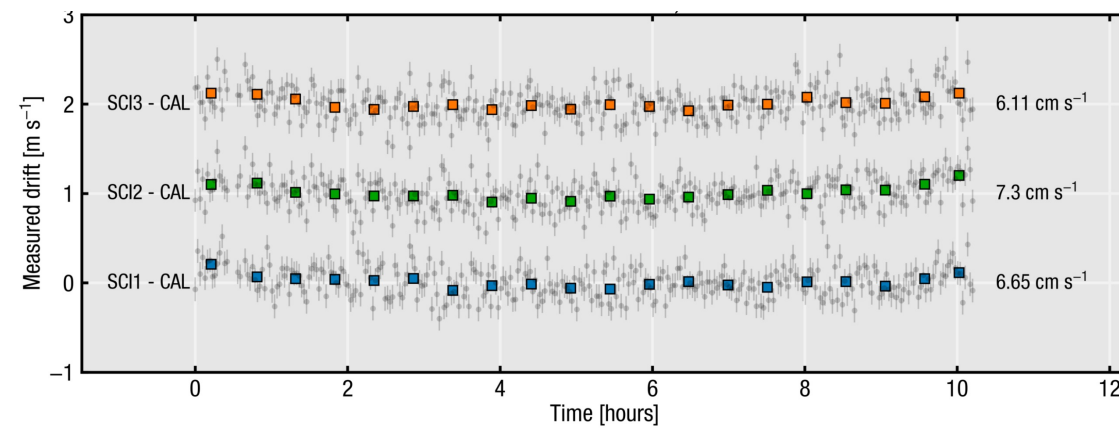
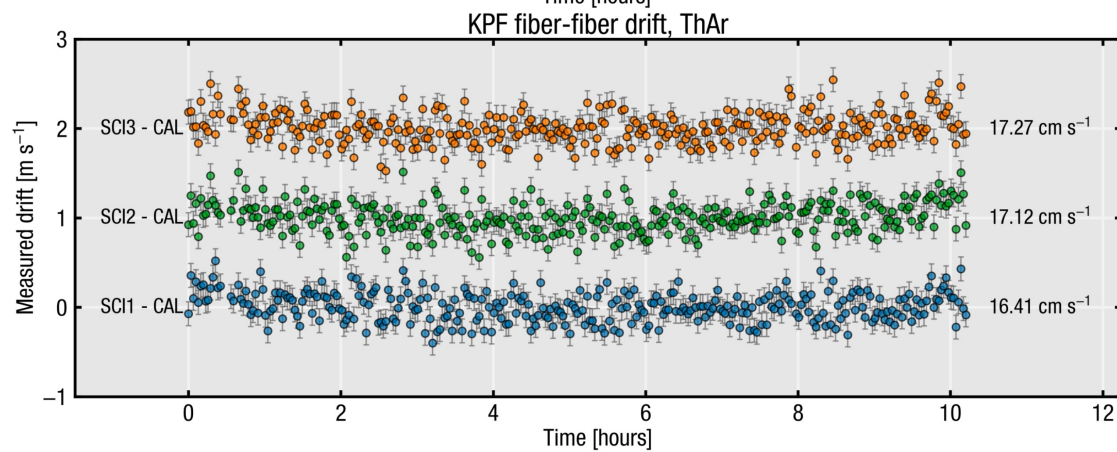
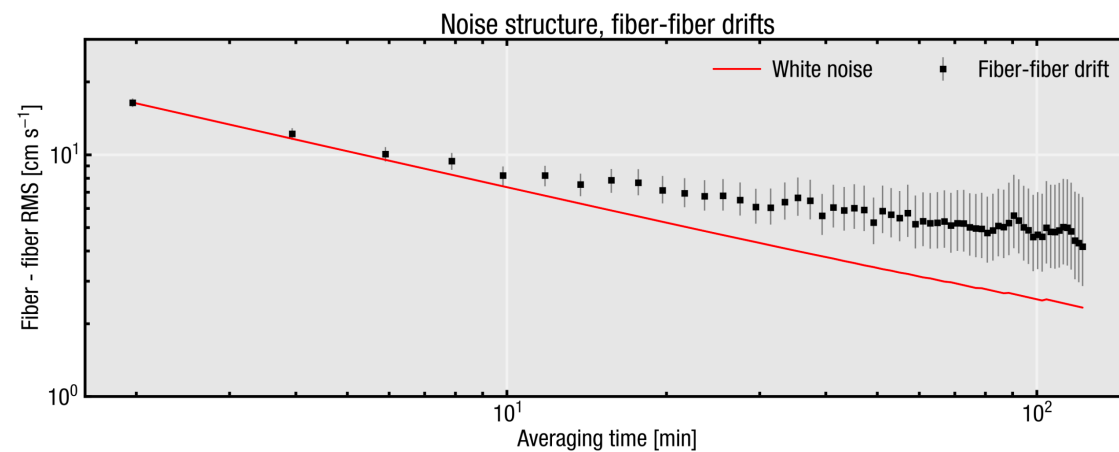
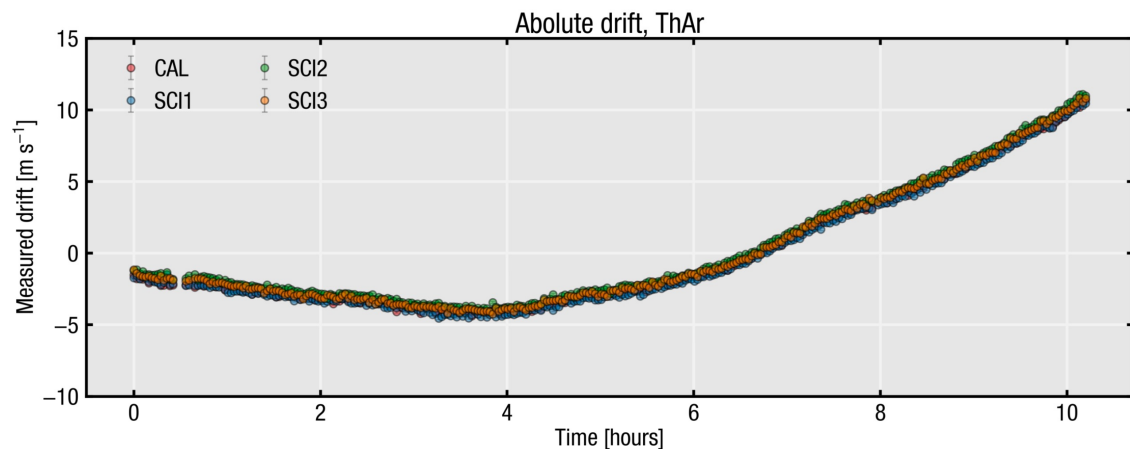


Laser Frequency Comb

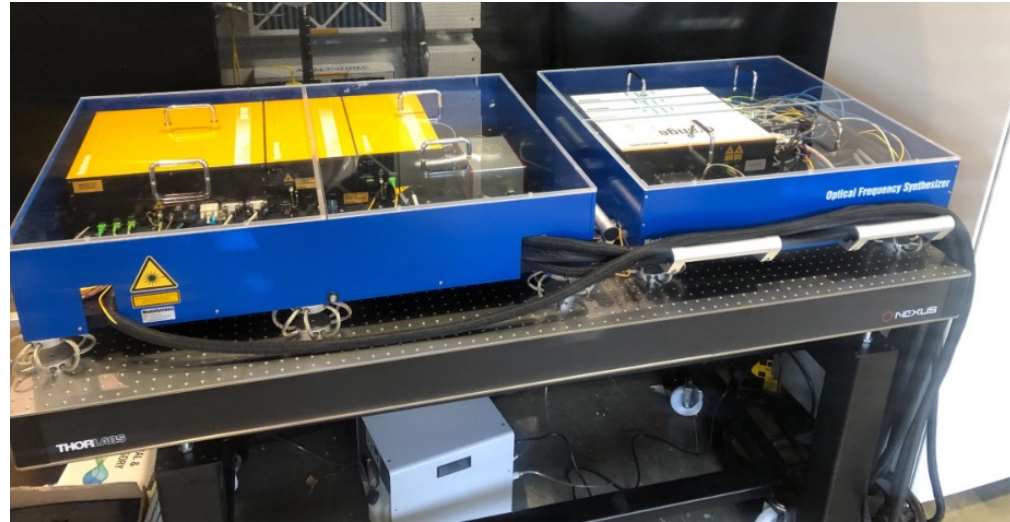
Instrument performance, spectral resolution, wavelength coverage



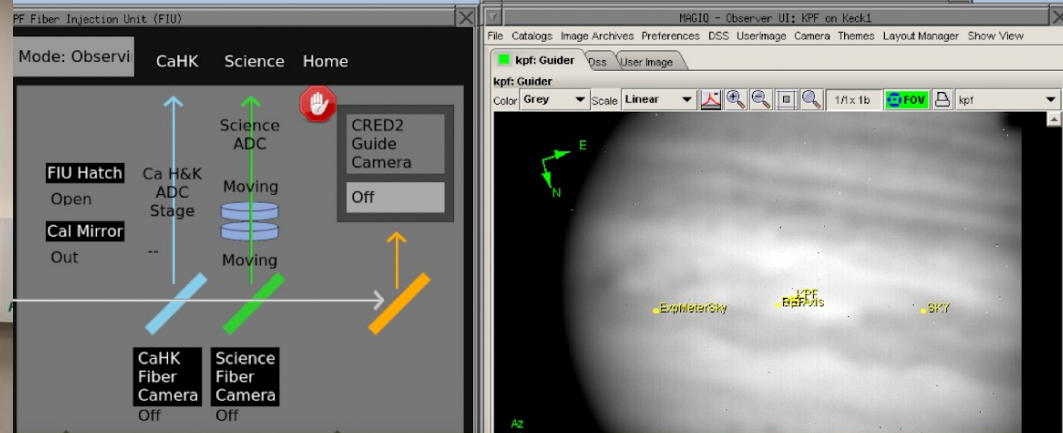
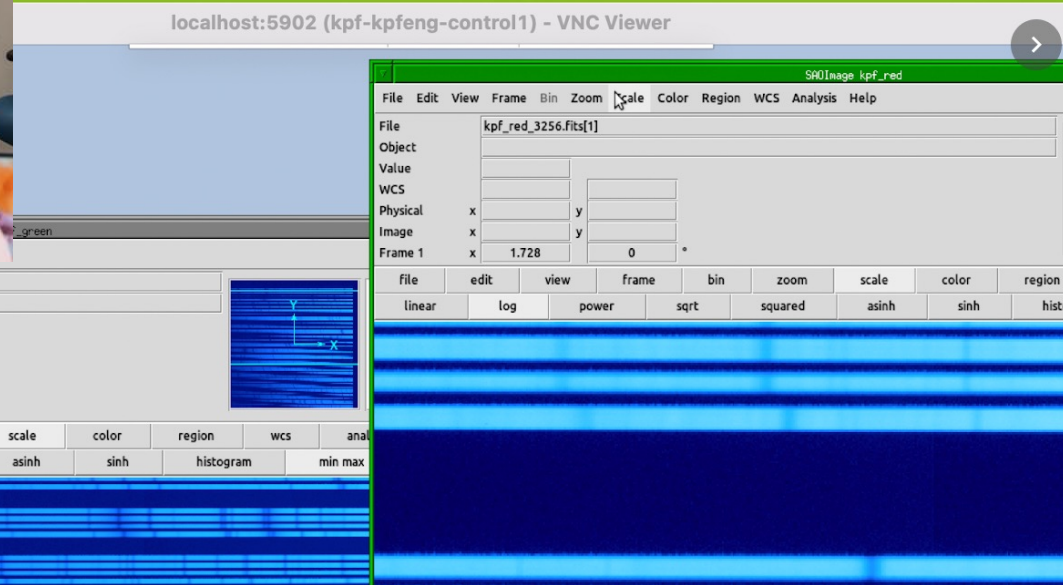
Instrument performance, stability in the lab (short term)



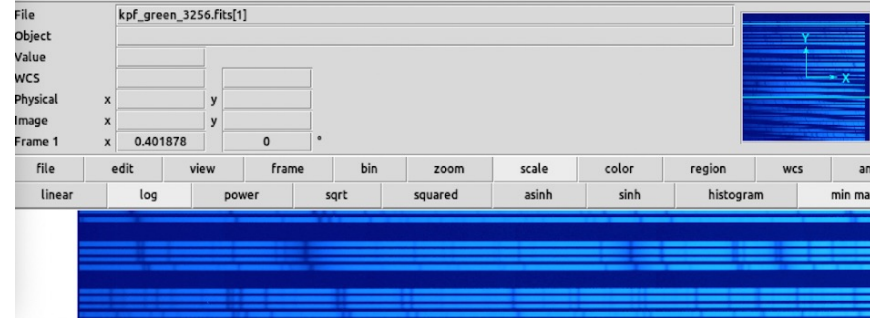
Delivered to the summit in Summer 2022



First light in November 2022

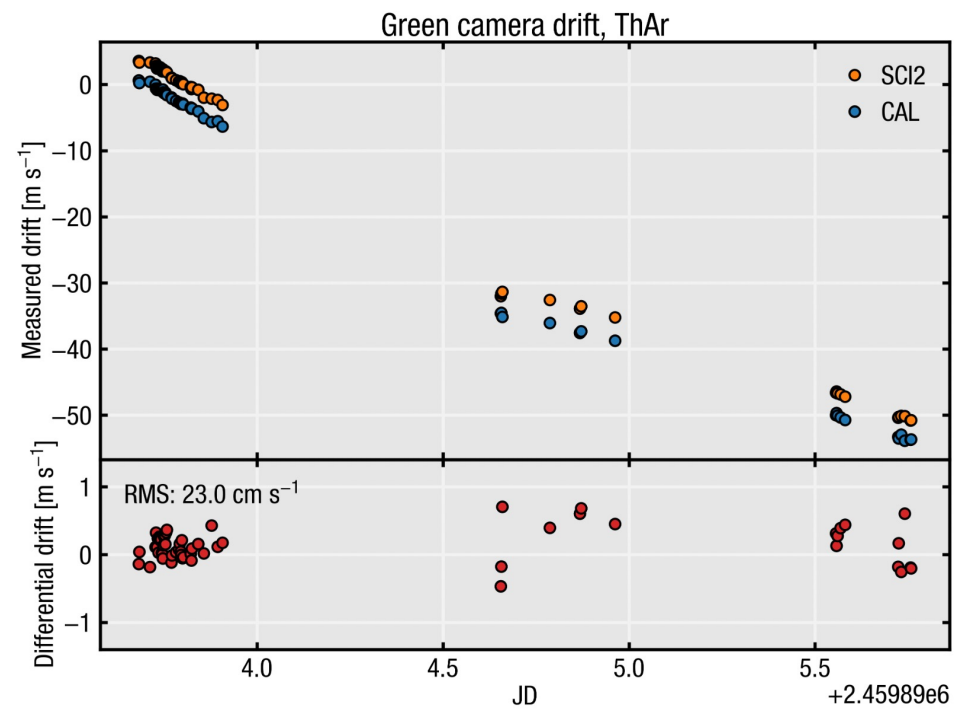
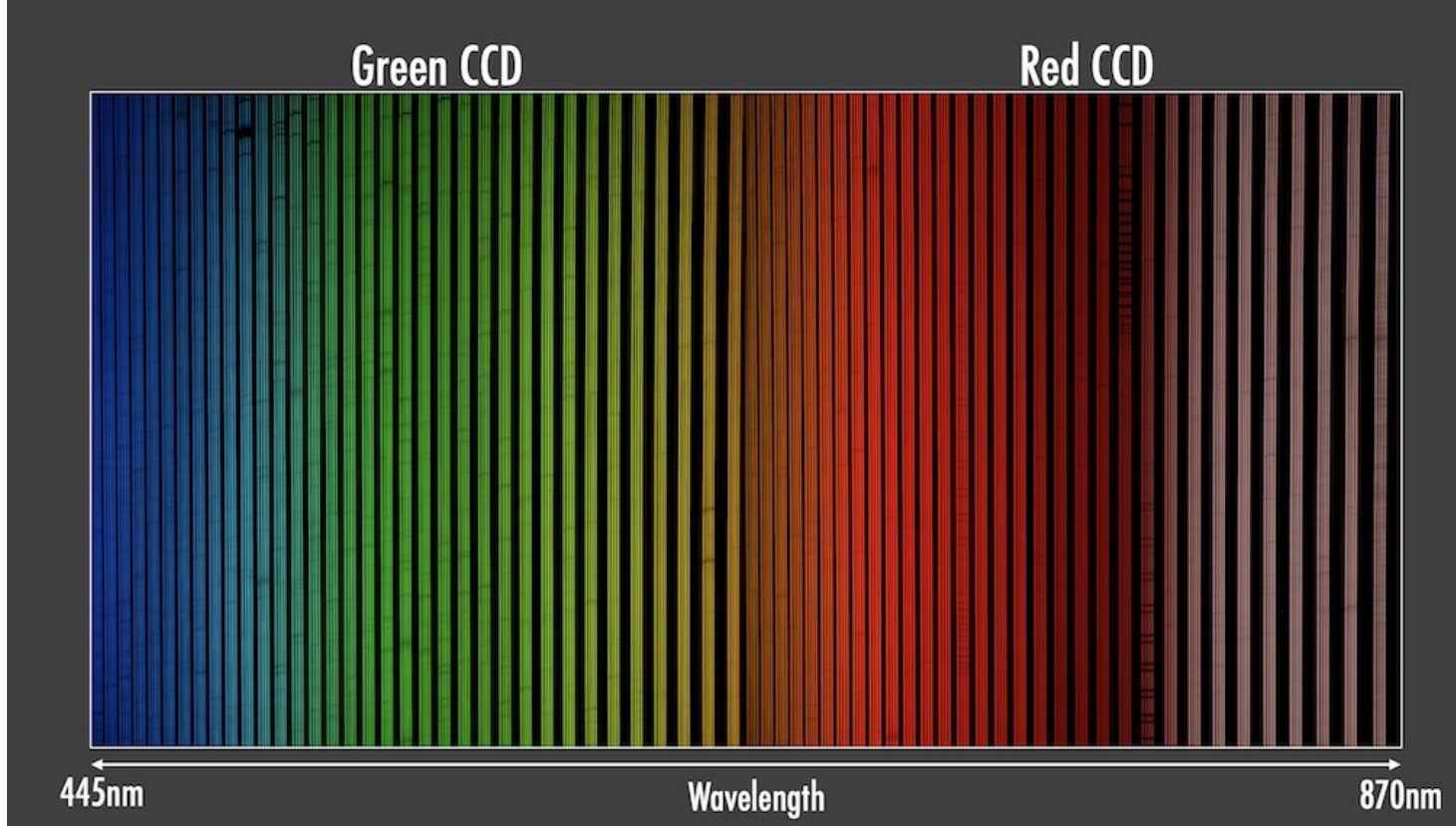




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Physical	x	y	
Image	x	y	
Frame 1	x	1.728	0



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Value	Value		
WCS	WCS		
Physical	x	y	
Image	x	y	
Frame 1	x	0.401878	0

KPF First Light: Jupiter



Internal calibration stability during initial commissioning

Solar Calibrator now installed



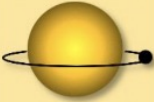

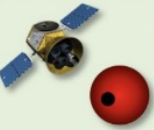
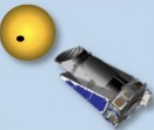
.....and immediately stress-tested

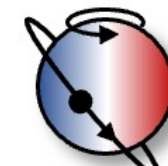
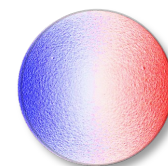
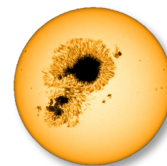
Keck Observatory MastCam 2022-12-22 09:47:23



Commissioning: November 2022 – Spring 2023

- System and subsystem performance verification
 - Fiber injection unit
 - Spectrometer
 - Calibration injection system
 - Detector cryostat
 - Broadband etalon
 - H&K spectrometer
 - ...
- DRP optimization, Stellar RVs
- Thermal enclosure final design, delivery
- Solar Calibrator operations begin in coming weeks
- *Shared risk sciences begins in late 2023A!*
- Time available through Institutional, NASA, and NOIRLab TACs

KPF KEY SCIENCE PROJECTS	
1. Characterize super-Earths orbiting nearby Sun-like stars and chart a path to the 10 cm s ⁻¹ sensitivity needed to detect Earth-twins for NASA imaging missions.	
2. Discover Earth-mass planets orbiting nearby M dwarfs that will be targets for direct imaging and spectroscopy by GSMTs.	
3. Measure the bulk densities and compositions of hundreds of small planets from TESS.	
4. Study the densities and compositions of the Earth-size planets from Kepler.	



•This document has been reviewed and determined not to contain export controlled technical data. CL#23-0760