# A **Solar Cal**ibrator for the Keck Planet Finder

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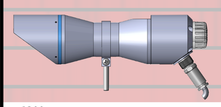
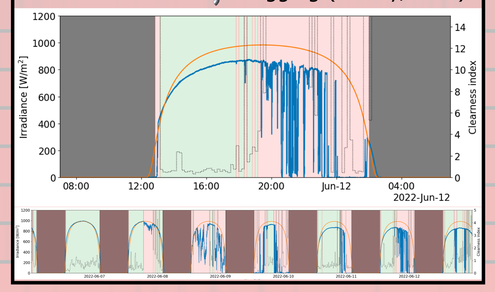
California Institute of Technology · W. M. Keck Observatory · JPL Jet Propulsion Laboratory, California Institute of Technology


## SoCal Hardware

### 3. Pyrheliometer



Directional irradiance sensor (W/m²) used for automatic data quality flagging (cloudy/clear)




### 1. VIS-NIR lens

3″ diameter

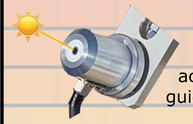
200 mm focal length

### 2. Integrating sphere

2″ diameter
0.5″ ports
99% reflectivity

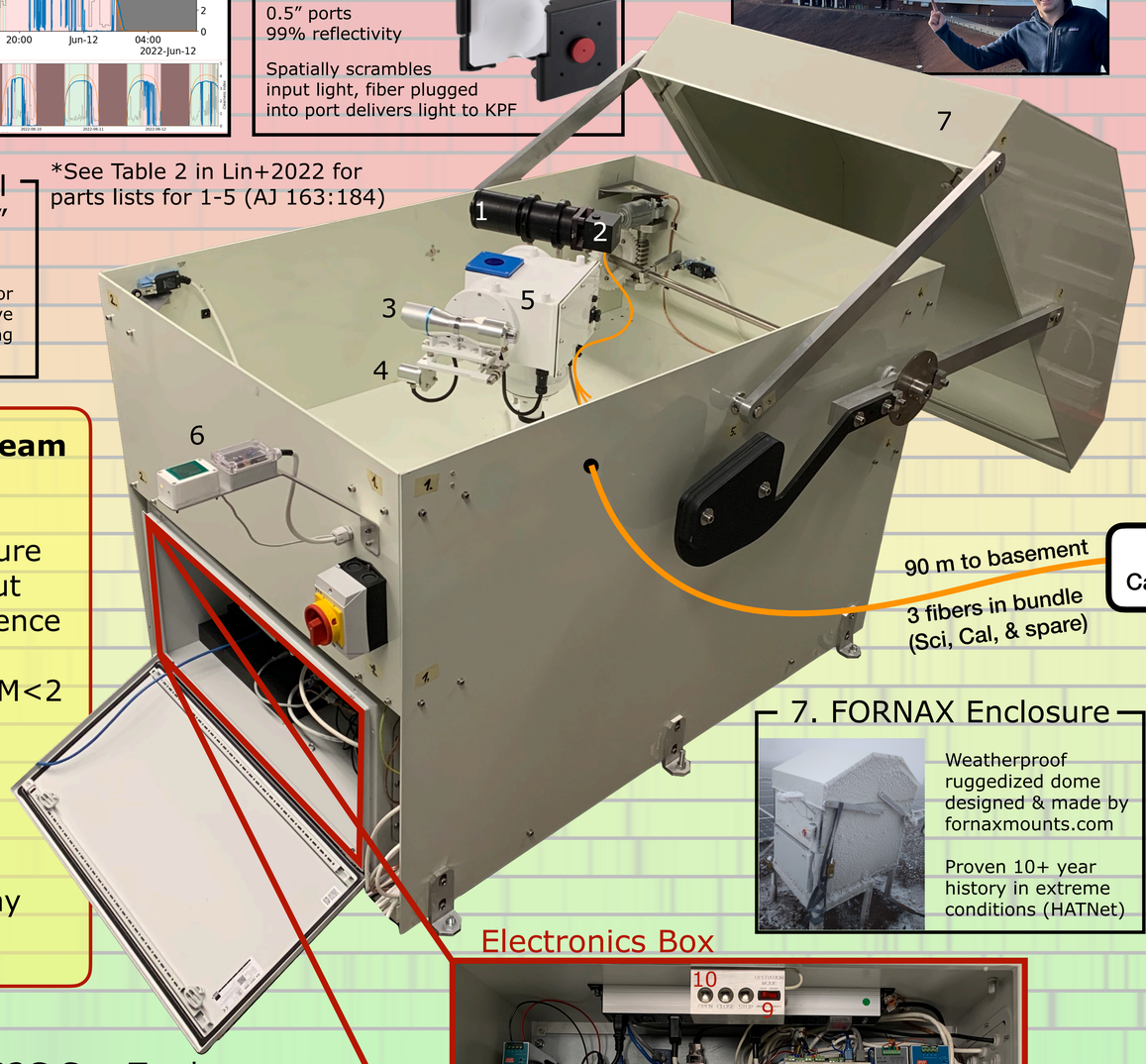
Spatially scrambles input light, fiber plugged into port delivers light to KPF

### 4. Quad-pixel "sun sensor"



for active guiding

*See Table 2 in Lin+2022 for parts lists for 1-5 (AJ 163:184)




**SoCal datastream highlights:**

~10 sec exposure
~20 sec readout
= ~30 sec cadence

All day when AM<2 (~8 hrs daily)

SNR ~1000
$\sigma_{RV}$ ~ 30 cm/s

~1k spectra/day
~500 GB/day

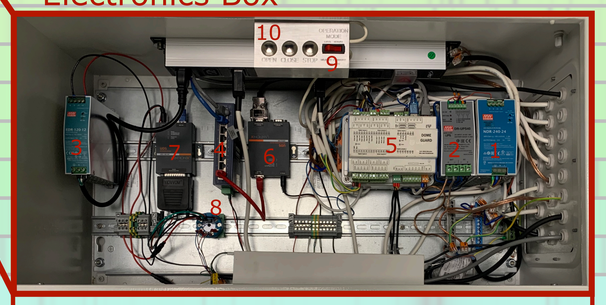
### 7. FORNAX Enclosure



Weatherproof ruggedized dome designed & made by fornaxmounts.com

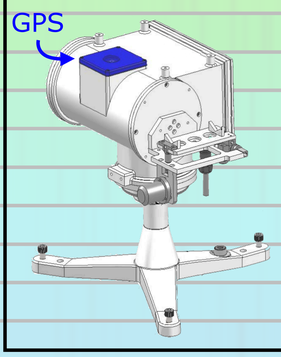
Proven 10+ year history in extreme conditions (HATNet)

### Electronics Box




1. 24 V DC power supply
2. UPS (not shown: 2x 12 V lead acid batteries)
3. 12 V DC power supply
4. Network switch
5. DomeGuard (Raspberry pi)
6. RS232/TCP gateway
7. RS485/TCP gateway
8. Modbus signal converter
9. Manual/remote operations switch
10. Dome open/close/stop buttons

### 5. EKO STR-22G Sun Tracker




Type: Alt/az mount
Pointing: <0.01 deg
Op Temp: -40 to 60 C
Comms: RS232
Mass: 15.5 kg
Power: < 10 W
Highly ruggedized

NEID solar feed (Lin+2022)

### 6. Rain sensor

independent sensor hard-wired into DomeGuard

## Why a Solar Calibrator?

1. **Track drift** between nights and over long baseline at very high signal-to-noise + cadence
2. **Optimize** KPF performance (pipeline & overall stability)
3. **Study stellar activity** on the only star for which we know* all sources of RV variability

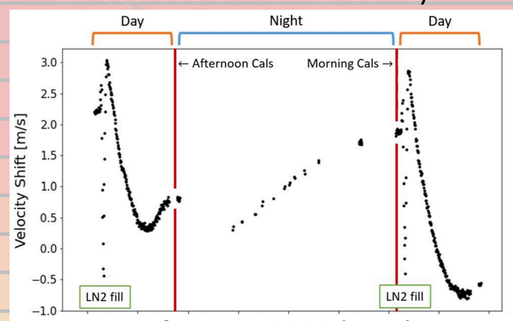
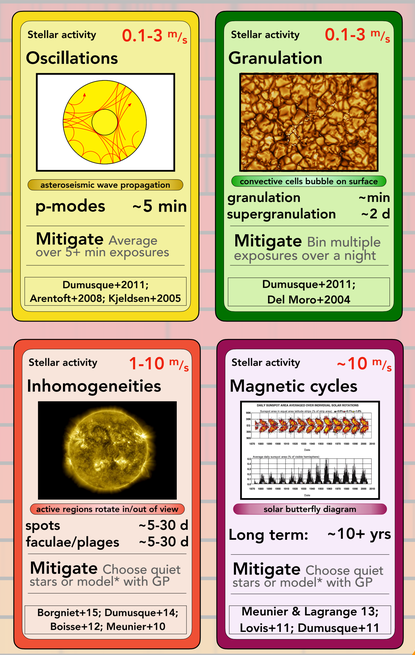
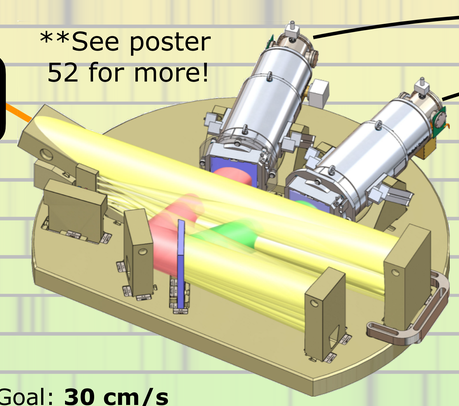


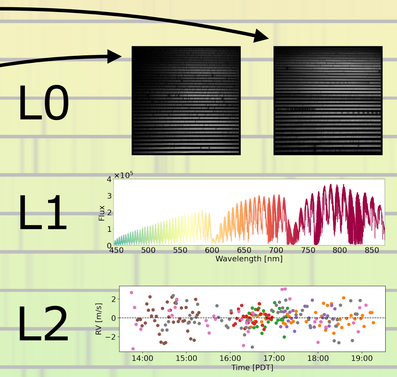

Fig from Lin+2022 (NEID)




## Keck Planet Finder

**See poster 52 for more!



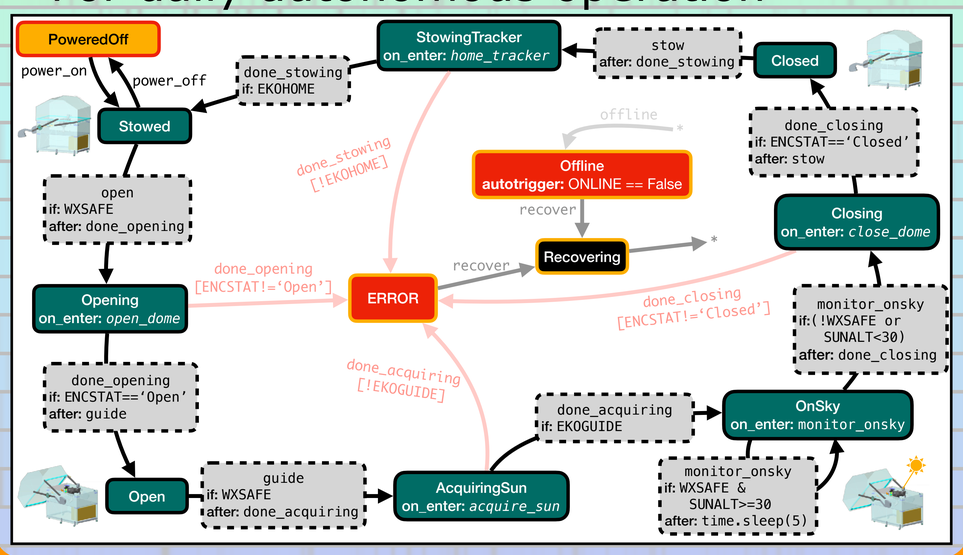



Goal: **30 cm/s**
Main: **445** — **870** nm, R ~ 98k
H&K: **385** — **405** nm (see poster 45!)
**Zerodur:** CTE = 0.000 ± 0.004 x $10^{-6}$ $K^{-1}$

All SoCal data products will be immediately public on Keck Observatory Archive!

## SoCal Software

For daily autonomous operation





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