

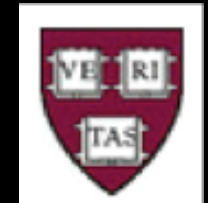
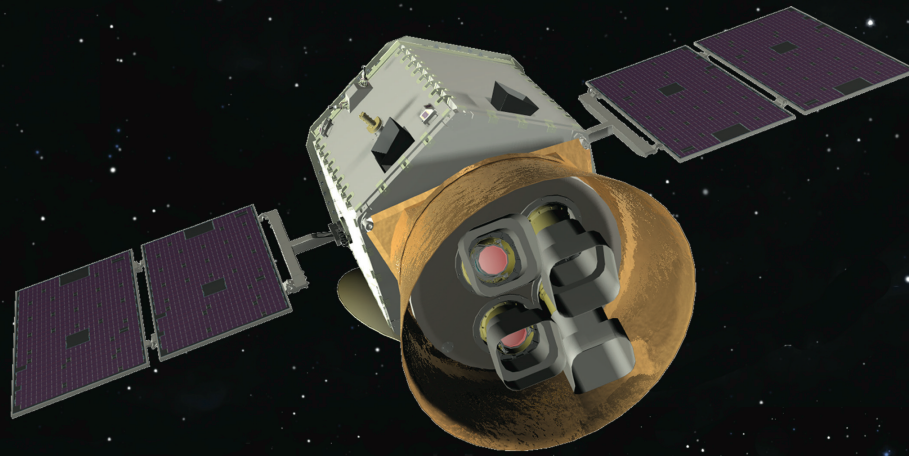


Explorer Proposal

Transiting Exoplanet Survey Satellite

Dr. George R. Ricker, PI, MIT

Dave Latham, Science Director, CfA



Selected for
launch in 2017



Genealogy of TESS

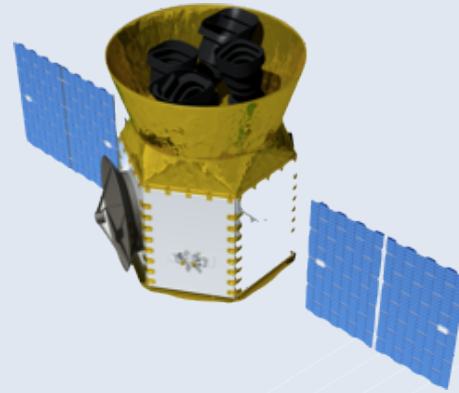
- ◆ 2006: Proposal to monitor bright stars for hot Jupiters
 - Mission of opportunity to re-use the HETE-2 optical camera
- ◆ 2007: Re-structured as a privately-funded small mission
 - Efforts to convince donors failed
- ◆ 2008: Re-configured as a NASA Small Explorer (SMEX)
 - Selected for Phase A (1 of 3 Astrophysics Missions)
 - GEMS won the selection (\$104M cap)
- ◆ 2010: Re-proposed as a NASA Explorer (\$200M cap)
 - Selected for Phase A (1 of 2 Astrophysics Missions)
- ◆ 2013: Selected for formulation (April 5, 2013)
 - Innovative orbit for continuous light curves (video on U-Tube)
 - Launch scheduled for 2017



TESS and Kepler Answer Different Questions

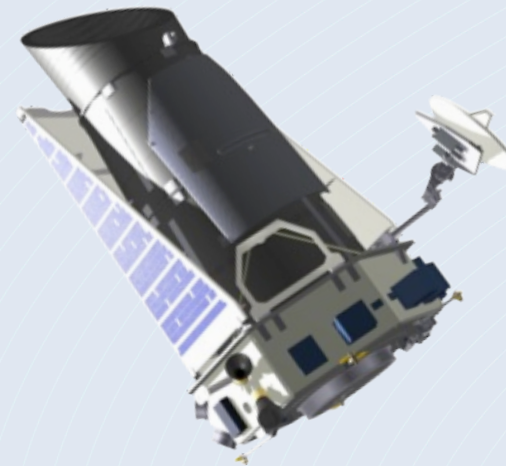
- ◆ TESS:

Where are the nearest transiting rocky planets, the best for characterization?

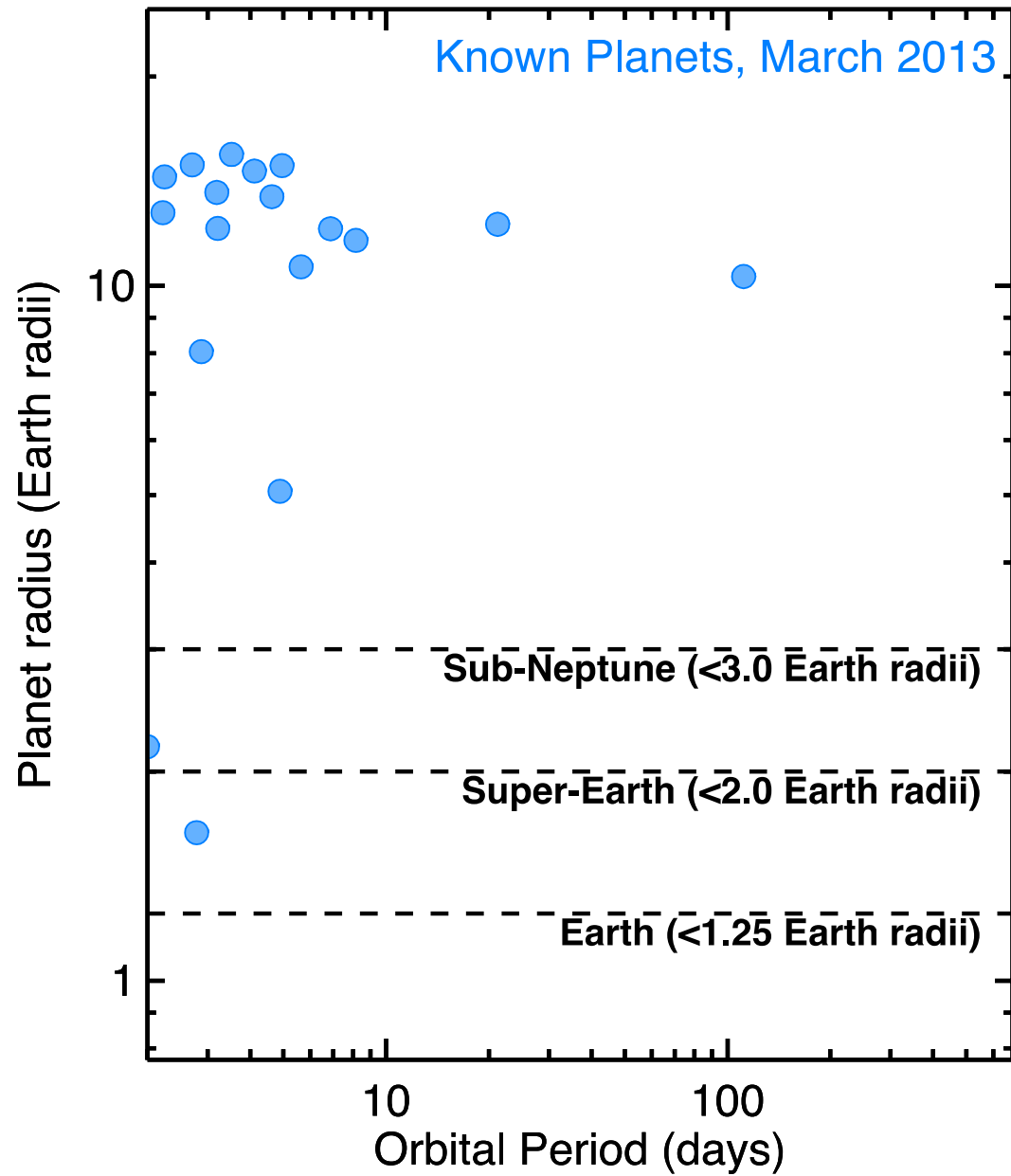


- ◆ Kepler:

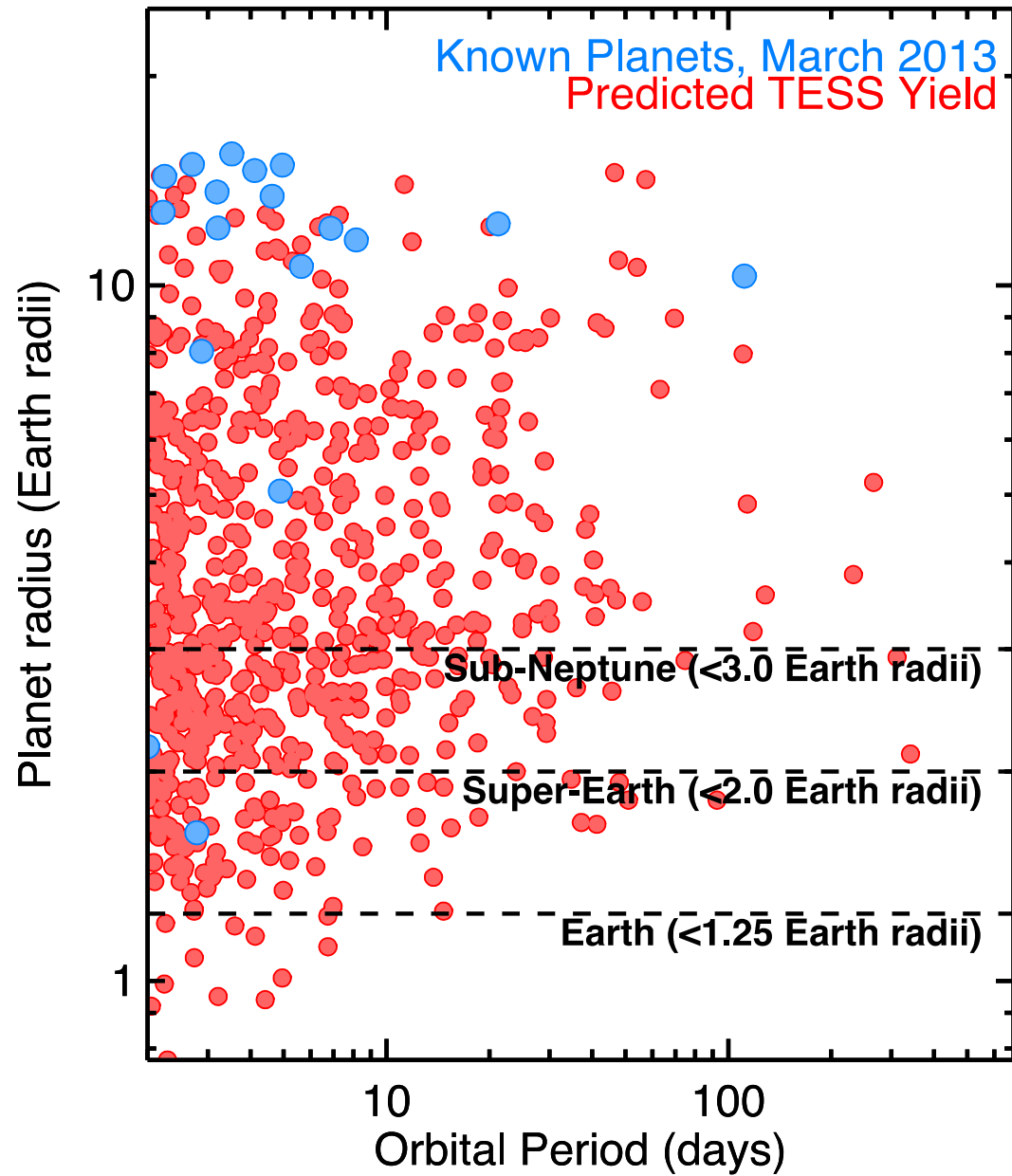
How common are true Earth analogs?

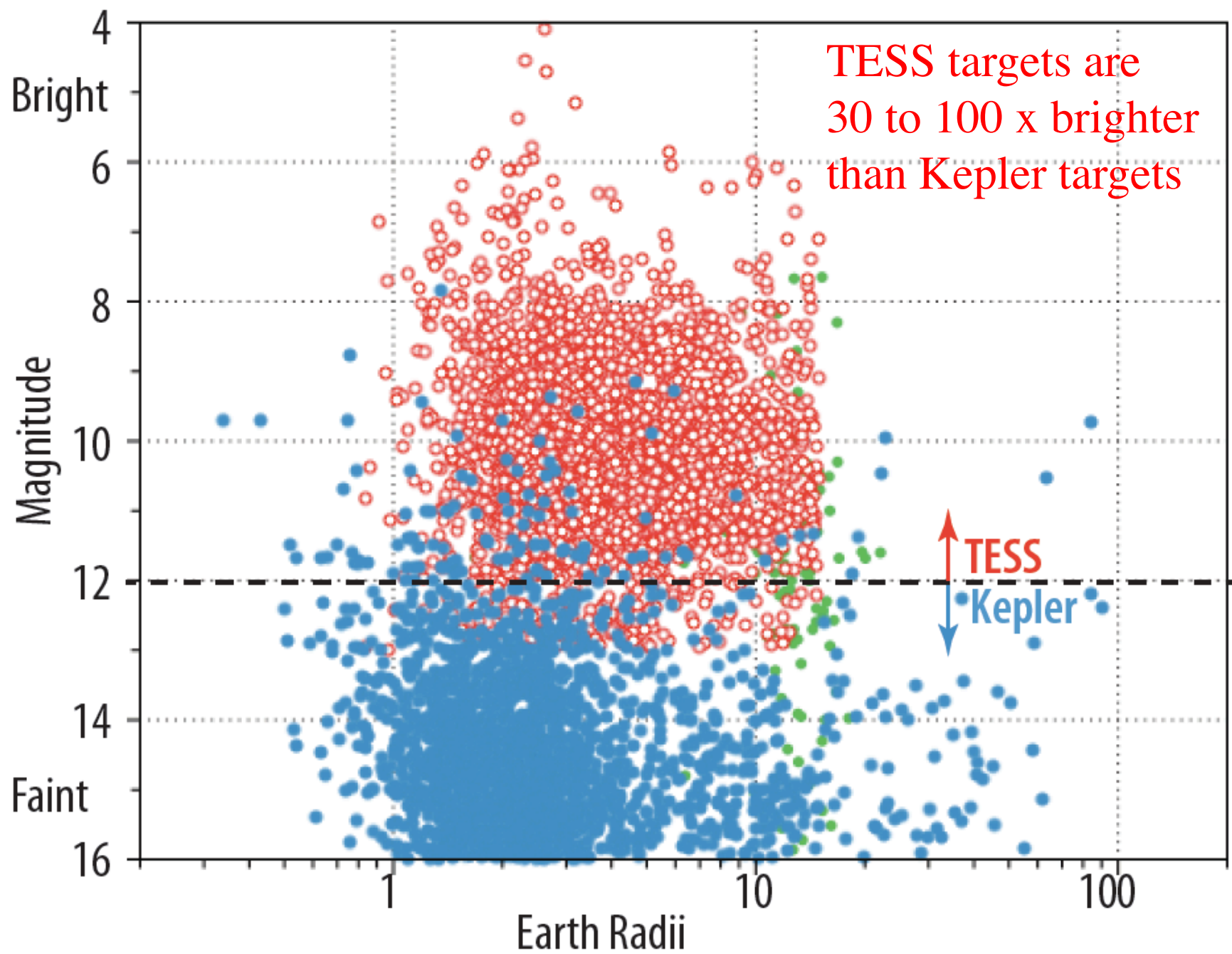


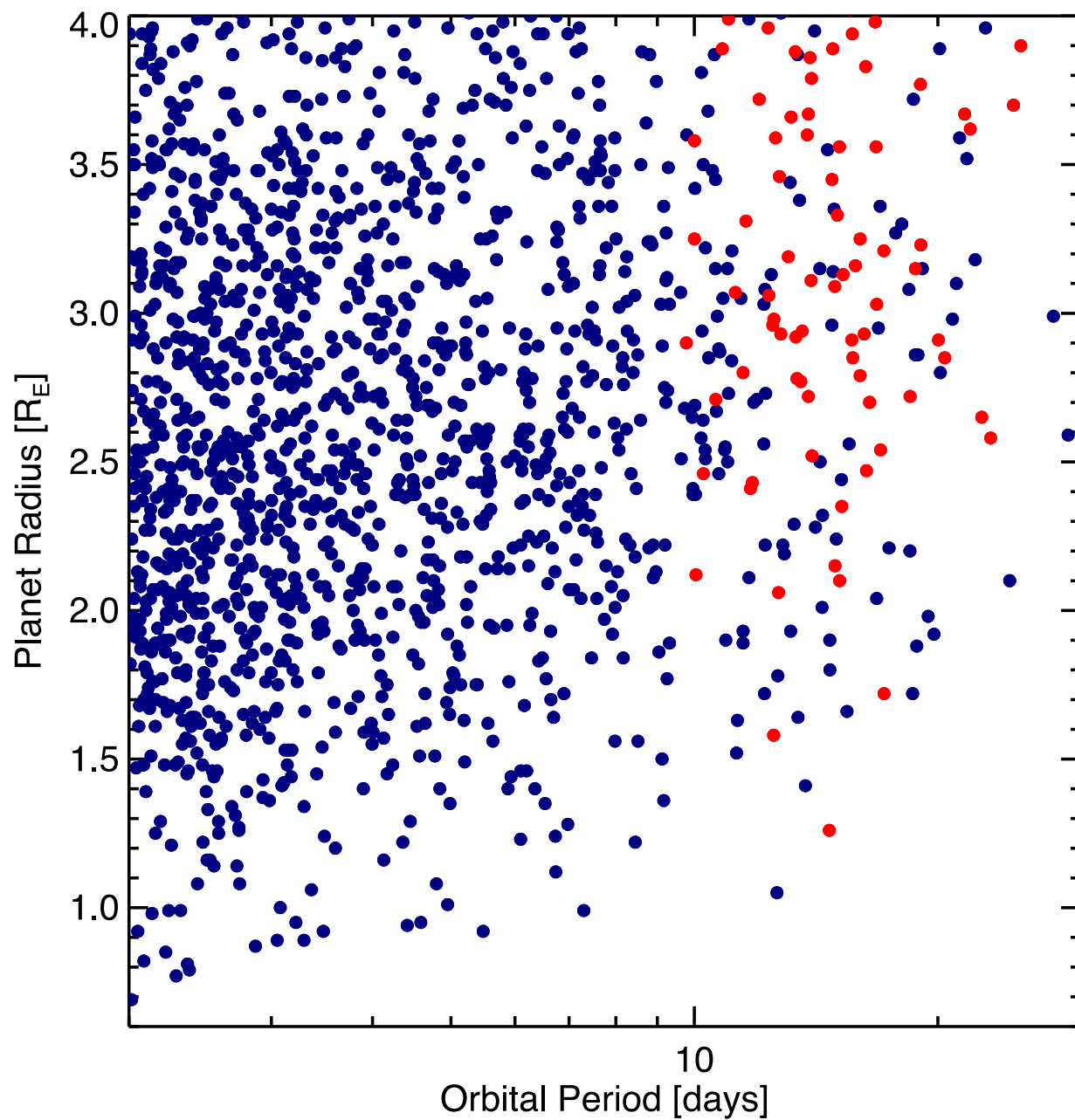
Planets that Transit Stars Brighter than V=10



Planets that Transit Stars Brighter than V=10

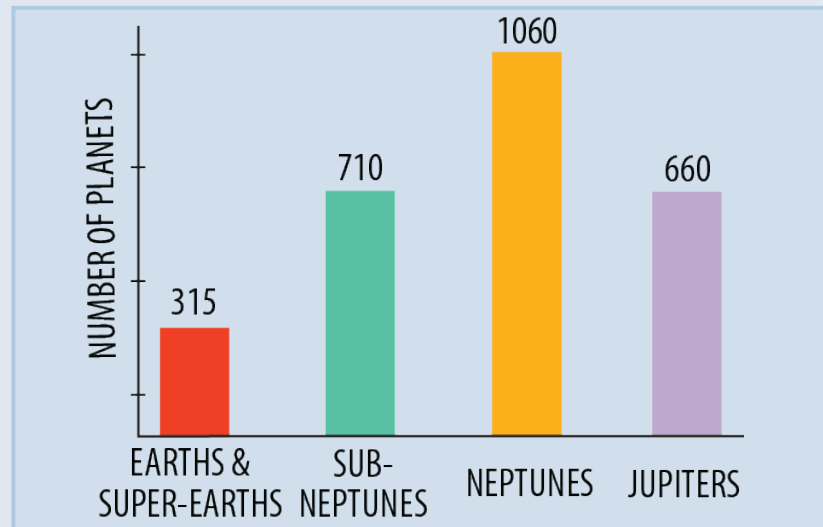
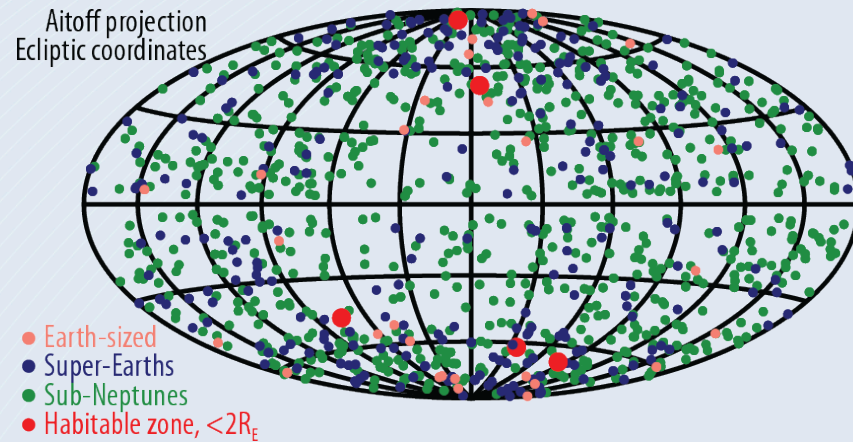






Blue = 3+ transits
Red = 2 transits

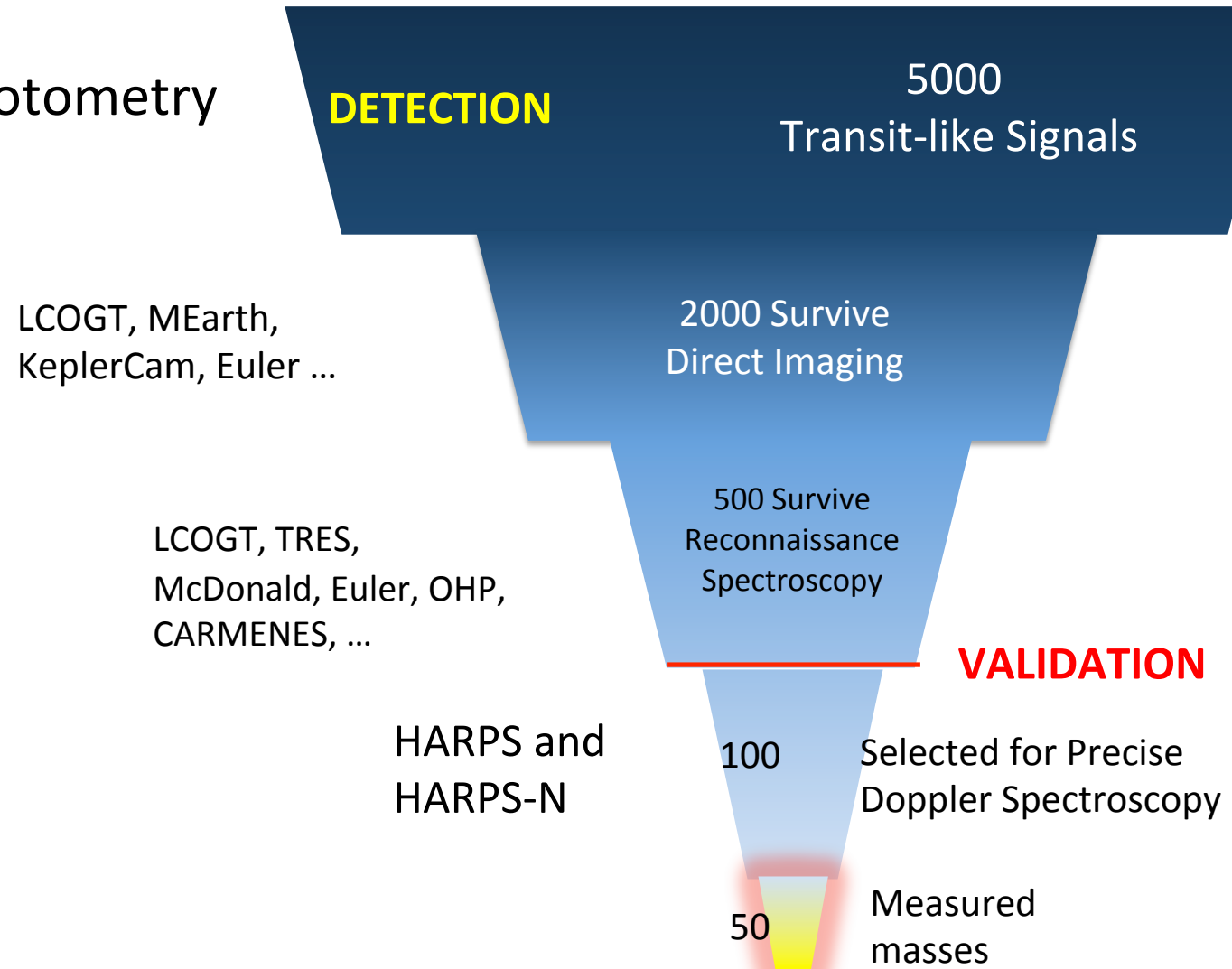
Predicted Science Yield from TESS Mission

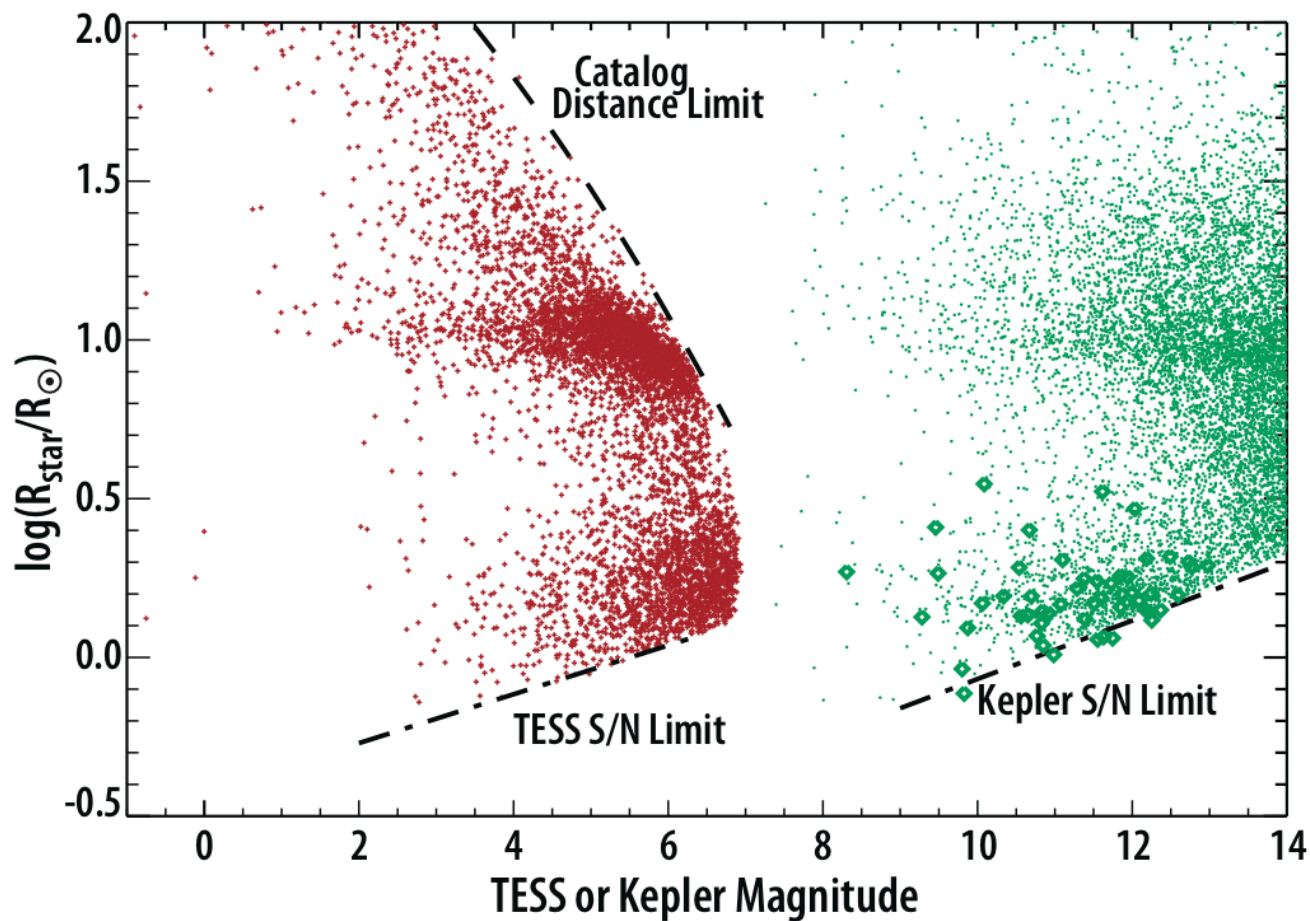


TESS Will Discover ~300 Earths & Super-Earths

TESS Ground-Based Facilities

- TESS photometry

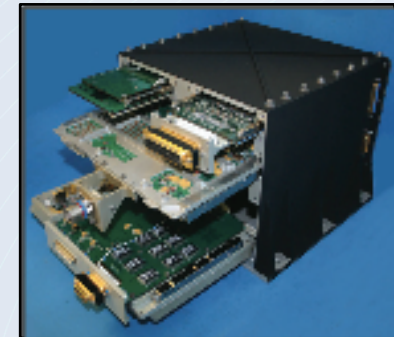
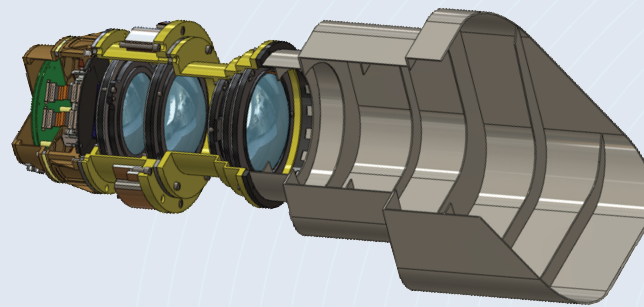
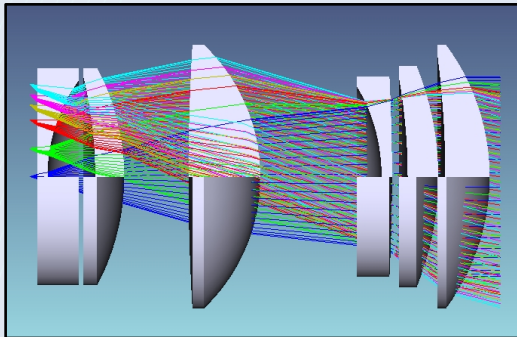


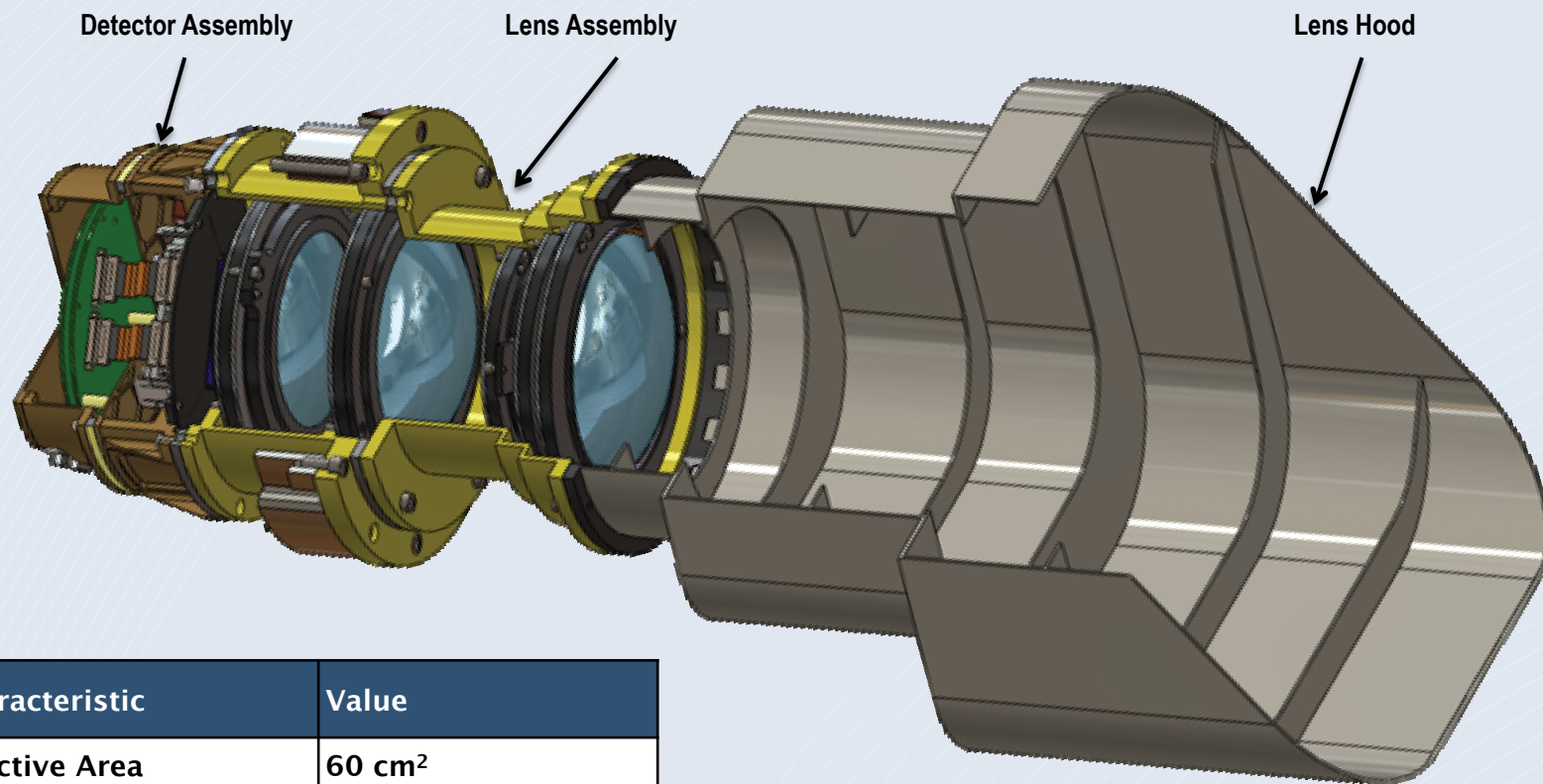


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Figure E-15: TESS will perform asteroseismology of brighter stars than Kepler. Plotted are the properties of nearby bright Hipparcos stars ($M_V < 7.5$, $d < 165$ pc) for which simulations indicate that TESS will detect stellar oscillations (red symbols) along with similar results for Kepler stars (green). TESS stars are of similar size and evolutionary status and are 6–7 magnitudes brighter.

- ◆ Four identical wide-field CCD imaging cameras
 - Straightforward optical design
 - Cameras passively cooled in a stable thermal environment
 - Heritage MIT/LL focal plane array
- ◆ SEAKR Data Handling Unit (DHU)
 - FPGA front-end processors select & stack “postage stamps” around target stars





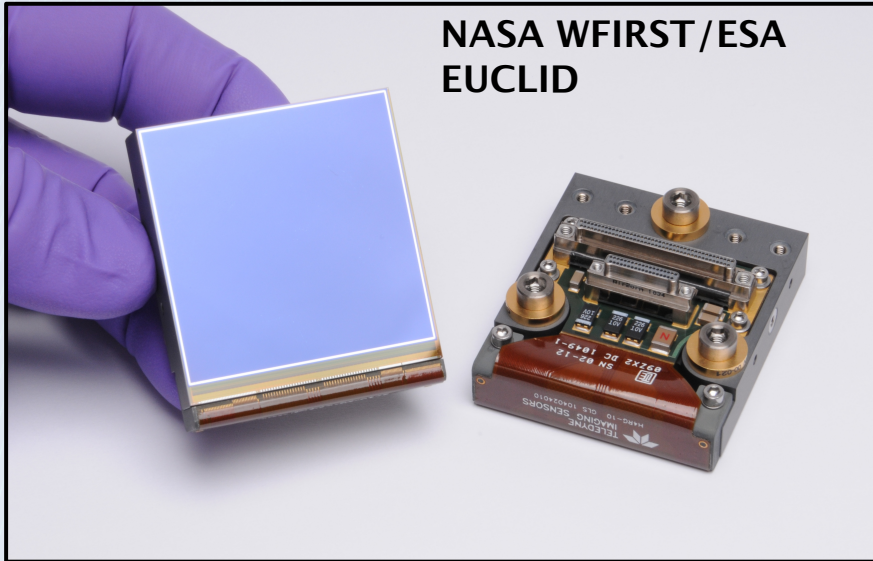
Characteristic	Value
Effective Area	60 cm ²
Lens Focal Ratio	1.6
CCD Focal Plane Array (Frame Store Mode)	4 @ 2K x 2K pixels 15 μm/pixel
Lens Focal Length	154 mm
Camera FOV	23° x 23°

TESS Prototype
Package & CCID47

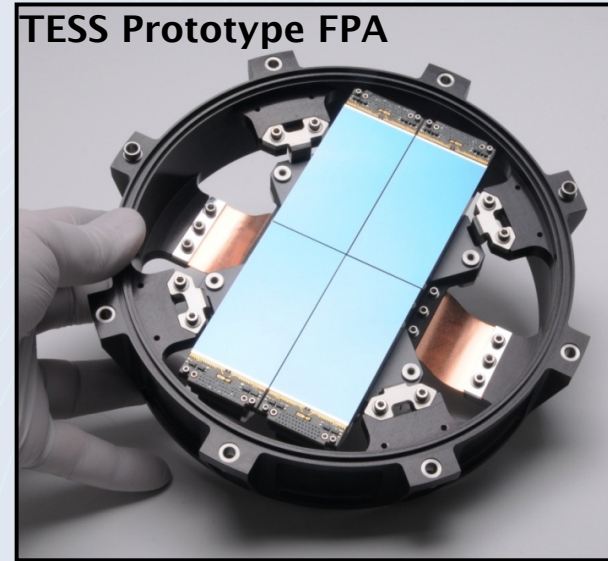


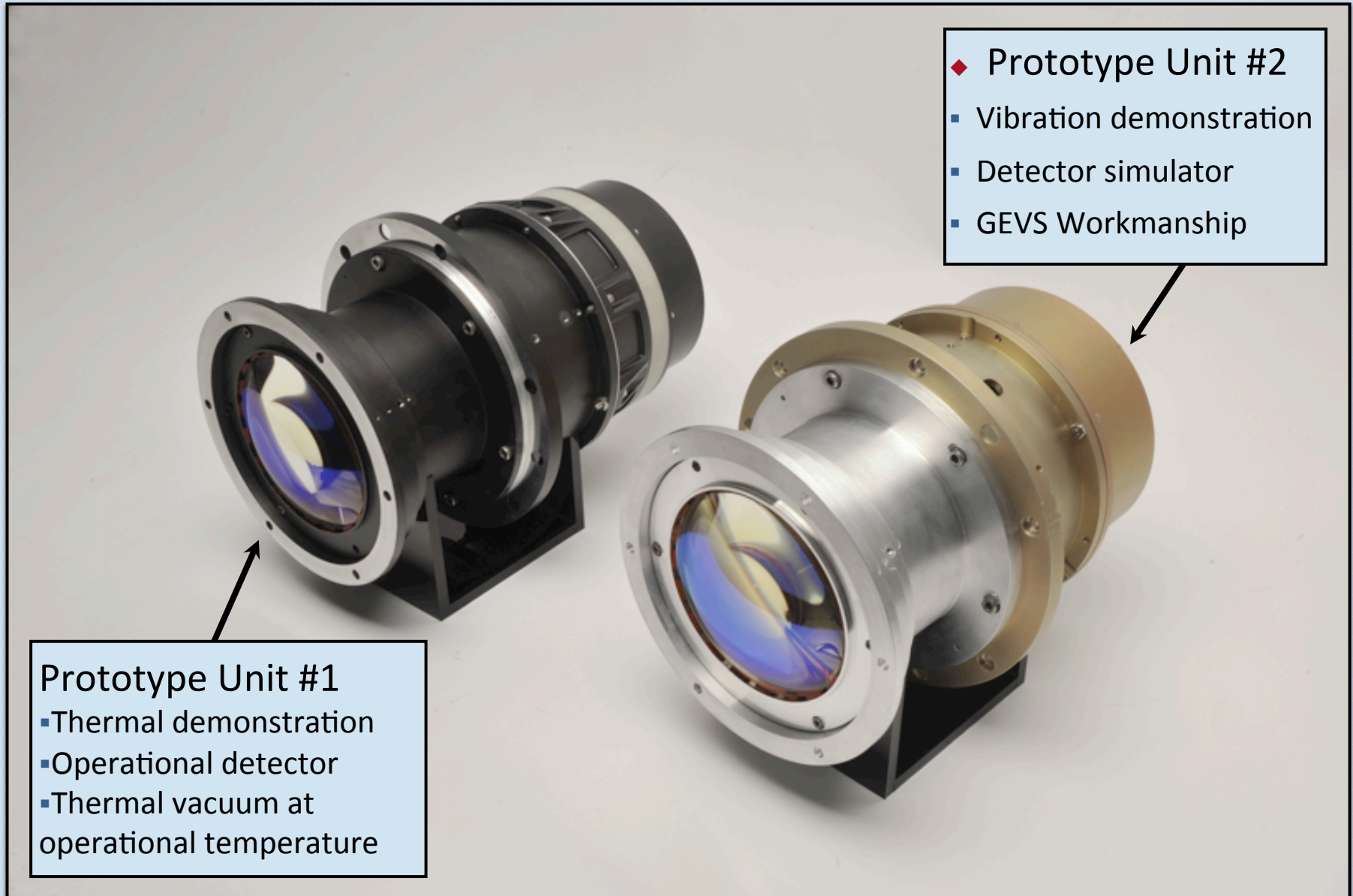
- ◆ TESS CCD package derived from qualified designs:
 - NASA WFIRST
 - ESA EUCLID
- ◆ Prototype FPA identical to flight FPA
 - Identical SiC material and vendor

NASA WFIRST/ESA
EUCLID



TESS Prototype FPA





Prototype Unit #1

- Thermal demonstration
- Operational detector
- Thermal vacuum at operational temperature

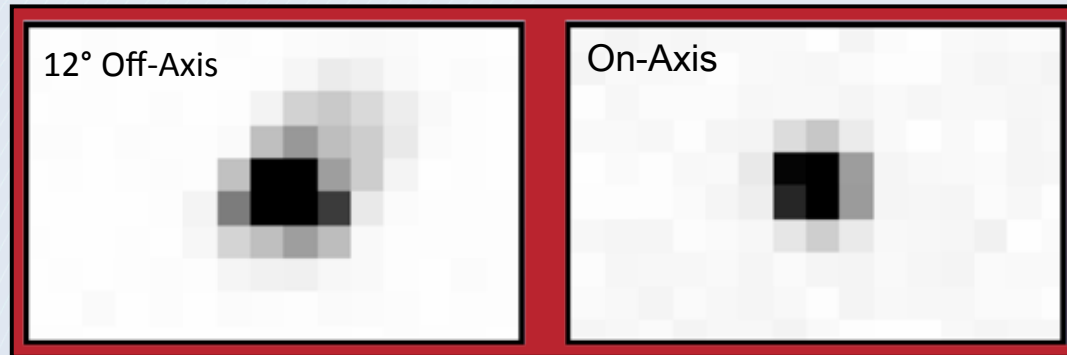
◆ Prototype Unit #2

- Vibration demonstration
- Detector simulator
- GEVS Workmanship

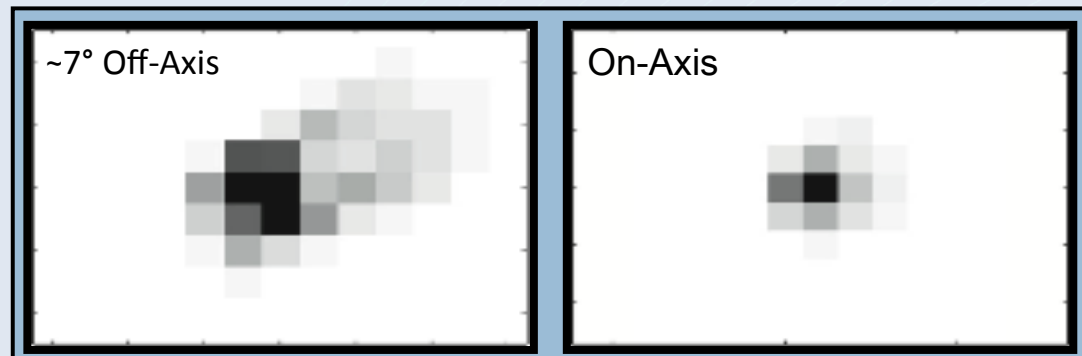


Polychromatic TESS and Kepler PSFs Compared

TESS PSFs @ -75°C (Prototype Lens + CCDs)



Kepler PSFs (Flight Optics & CCDs)



PSF = Point Spread Function



TESS Enables Atmospheric Characterization

- ◆ TESS will identify the best and smallest exoplanet targets for characterization of atmospheres using:
 - JWST, missions such as CHEOPS, EChO, ...
 - Extremely Large Telescopes (ELTs)
 - Future Exoplanet Explorers, Probes, and Large Missions

