Welcome to the Workshop on Advanced Wavefront Sensing for Coronagraphs!

May 1, 2020

Brendan Crill

Deputy Program Chief Technologist, NASA Exoplanet Exploration Program
(Jet Propulsion Laboratory / California Institute of Technology)

Today's Workshop

Agenda

- 09:00 Pacific time 10 min Brendan Crill (NASA ExEP) - Wavefront Sensing and NASA's Goals for Exoplanet Direct Imaging
- 09:10 20 min Laurent Pueyo (STScI) –Wavefront Sensing in a space-based coronagraph instrument
- 09:30 20 min Mamadou N'Diaye (Cote D'Azur) – ZELDA results on VLT/SPHERE
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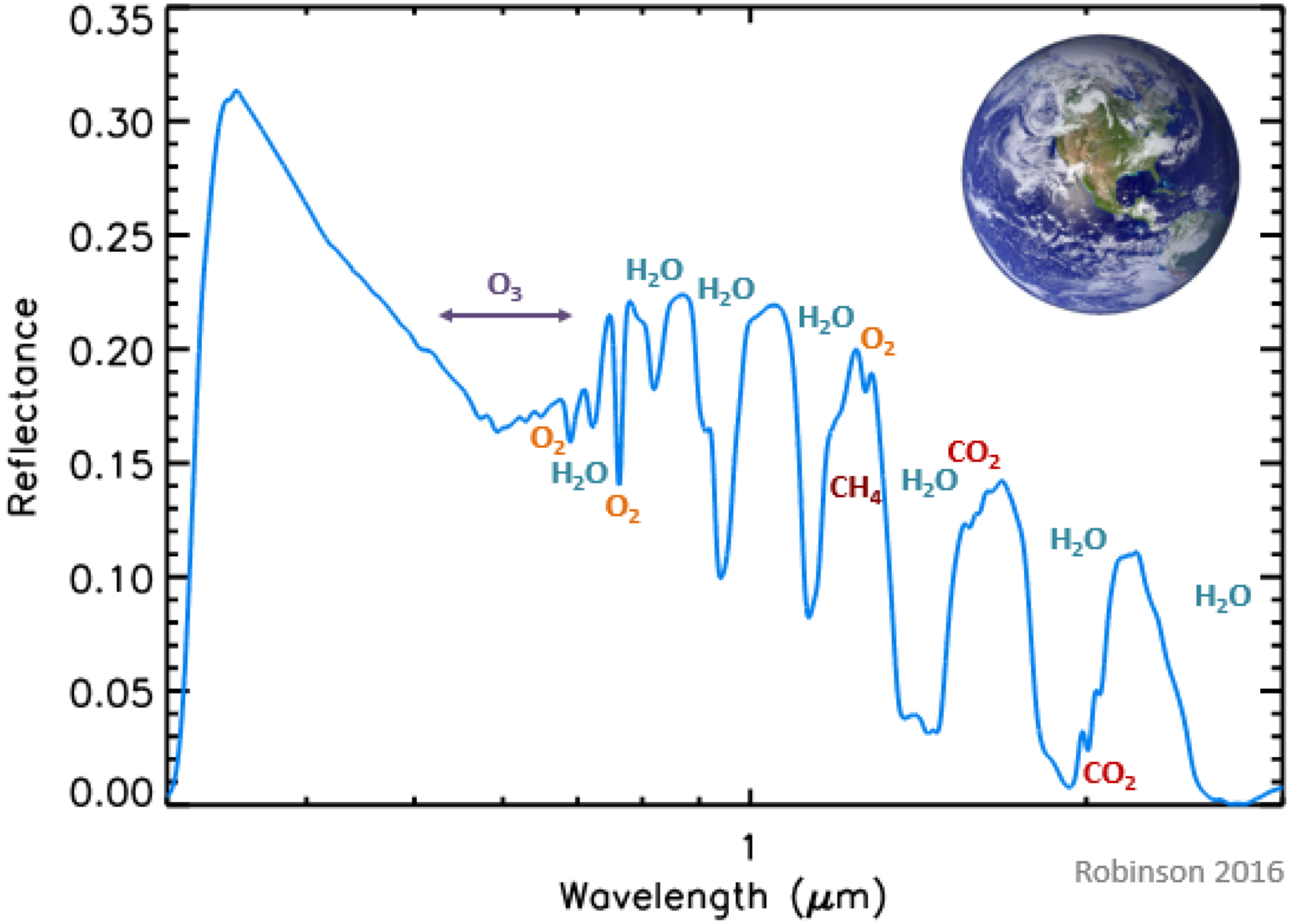
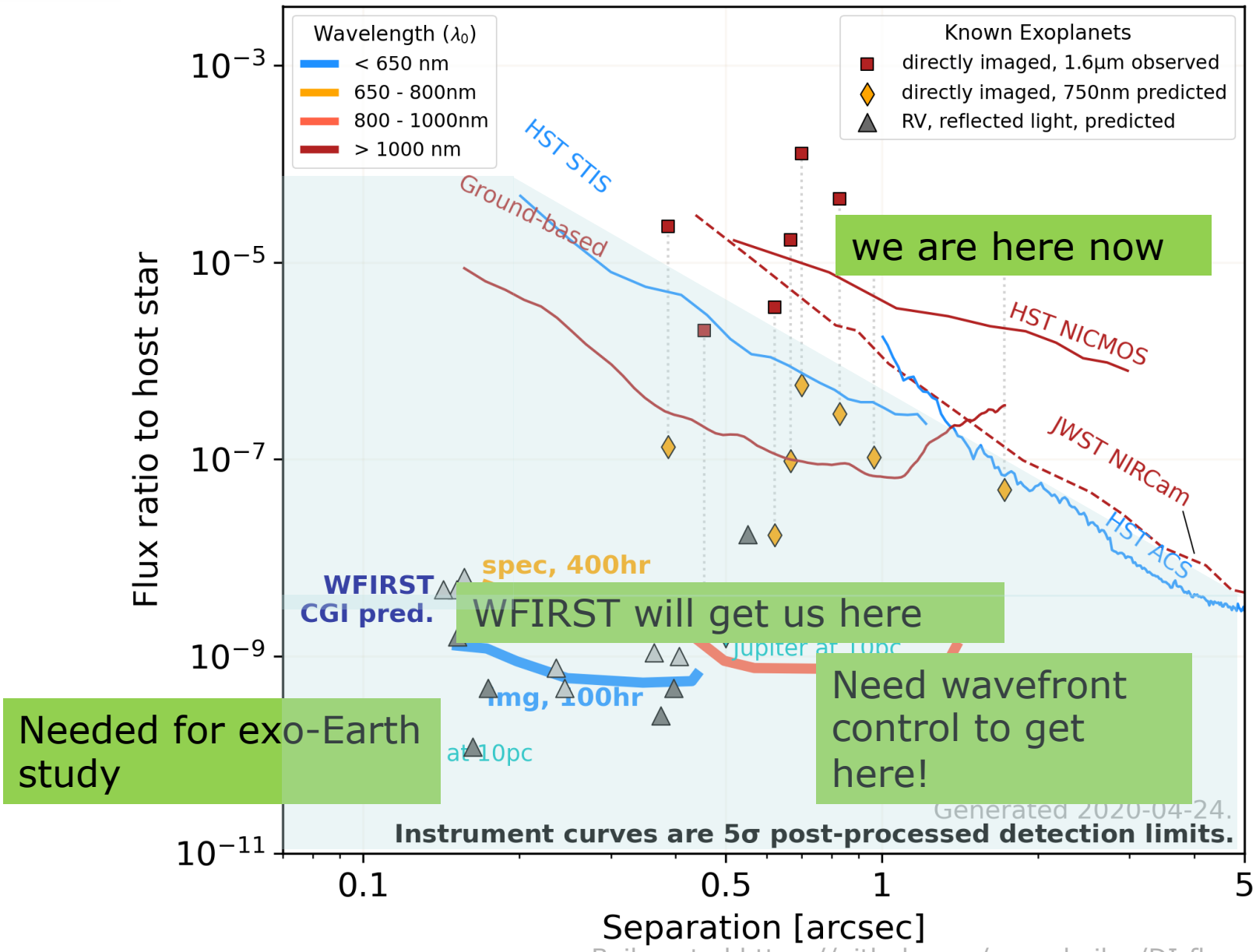
Searching for Life in the Universe – reflected light spectroscopy of terrestrial exoplanets



Robinson 2016

Extreme Starlight Suppression with a Coronagraph requires Wavefront Control



Bailey et al https://github.com/nasavbailey/DI-flux-ratio-plot

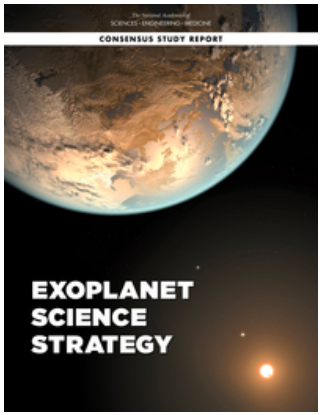
NASA Exoplanet Exploration Program's Focus on Exoplanet Direct Imaging from Space

2010 Decadal Survey

TABLE ES.4 Space: Recommended Activities—Medium-Scale (Priority Order)

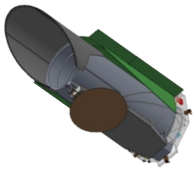
Recommendation	Science	Appraisal of Costs[a]
1. New Worlds Technology Development Program	Preparation for a planet-imaging mission beyond 2020, including precursor science activities	$100M to $200M
2. Inflation Probe Technology Development Program	Cosmic microwave background (CMB)/ inflation technology development and preparation for a possible mission beyond 2020	$60M to $200M

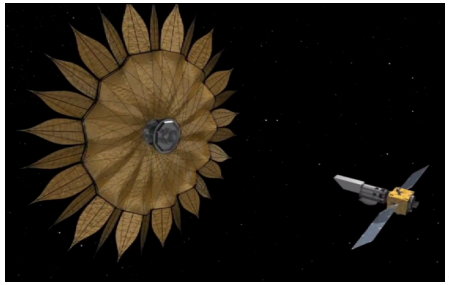
2018 Exoplanet Science Strategy



Recommendation: NASA should lead a large strategic direct imaging mission capable of measuring the reflected-light spectra of temperate terrestrial planets orbiting Sun-like stars.

2020 Decadal Survey ….?



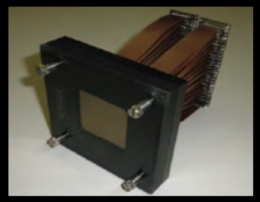


V-NIR Coronagraph/Telescope Technology Gaps

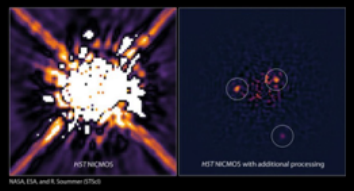
(ExEP Technology Gap List)

Contrast

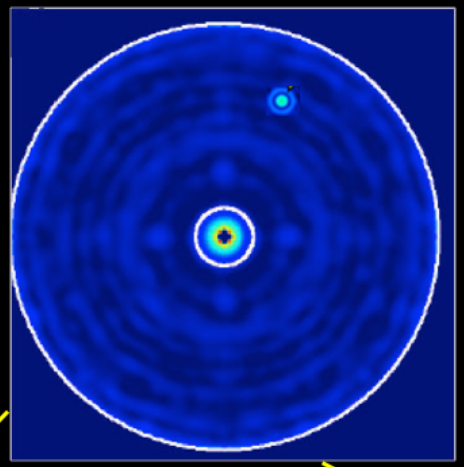
CG-2: Coronagraph Architecture



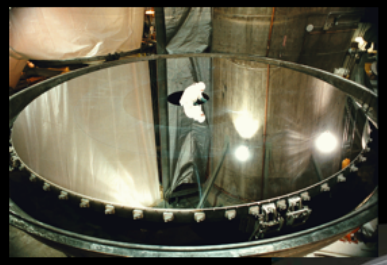
CG-3: Deformable Mirrors



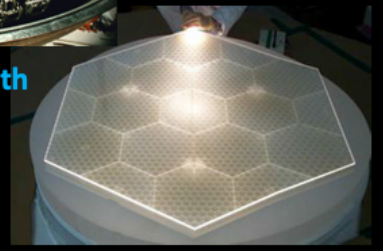
CG-4: Data Post-Processing



Angular Resolution

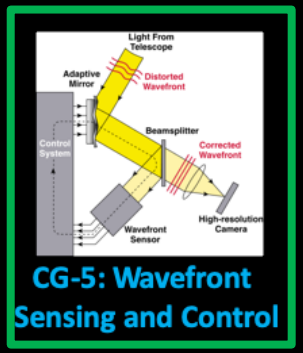


CG-1: Large Monolith Mirrors



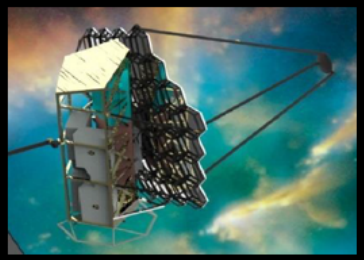
CG-1: Segmented Mirrors

Contrast Stability



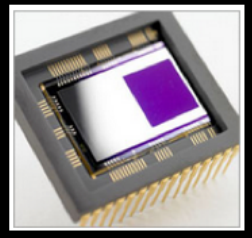
CG-5: Wavefront Sensing and Control

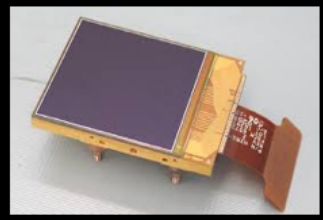
CG-6: Mirror Segment Phasing



CG-7: Telescope Vibration Sensing and Control or Reduction

Detection Sensitivity

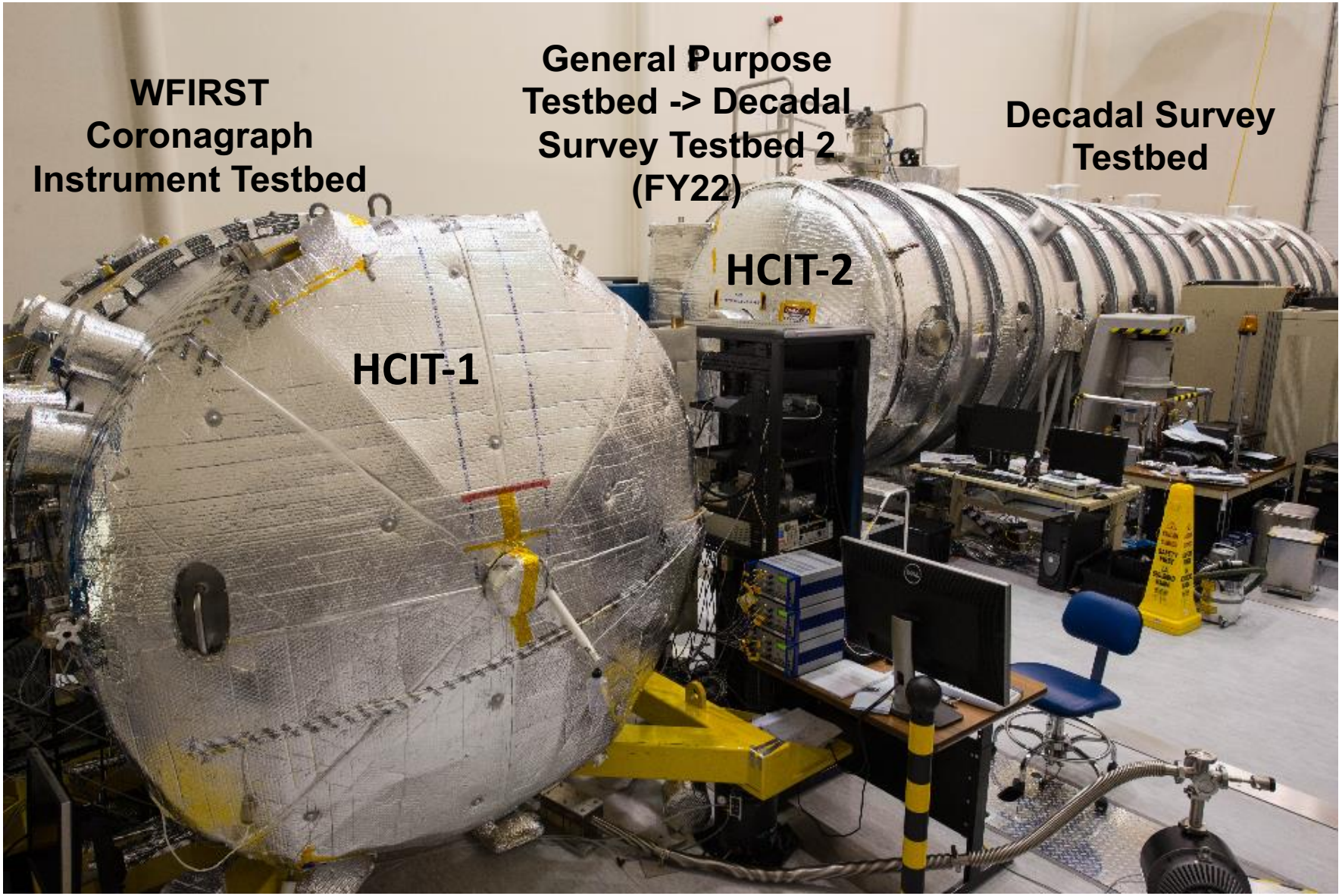




Ultra-low Noise Visible (CG-8) and Infrared (CG-9) Detectors

https://exoplanets.nasa.gov/exep/technology/gap-lists/

ExEP's High Contrast Imaging Testbed



Decadal Survey Testbed

- Available to investigations funded by Strategic Astrophysics Technology grants
- Commissioned using a Lyot coronagraph – 3.8×10^{-10} contrast, working angles 3-9 λ/D, 9% bandwidth (Seo et al 2019)
- A new Zernike Wavefront Sensor has been installed and demonstrated (Garreth's talk)
- Decadal Survey Testbed roadmap here: https://exoplanets.nasa.gov/internal_resources/1170/
- Aim is to commission a testbed capable of demonstrating $< 10^{-9}$ contrast with a simulated dynamic environment

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- Type questions into WebEx chat (I'll monitor that)
- Remember to keep your mic muted
- Keep video feed off (except for the presenter)

10-MINUTE BREAK
RESTARTING AT 11:10 PACIFIC TIME

Q&A / Discussion

- If you ask a question, please identify yourself and state to whom you are directing your question

- Remember to go on mute if you're not talking