

ExEP 2024 Technology Update



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Developing Technologies for Future Exoplanet Missions

National Aeronautics and Space Administration

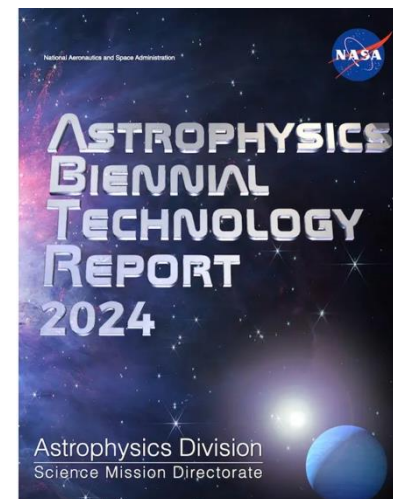
- 1 NASA/ESA Partnership
- 2 NASA/ESA/CSA Partnership
- 3 CNES/ESA
- 4 ESA/Swiss Space Office
- 5 NSF Partnership (NN-EXPLORE)



2024 Highlights

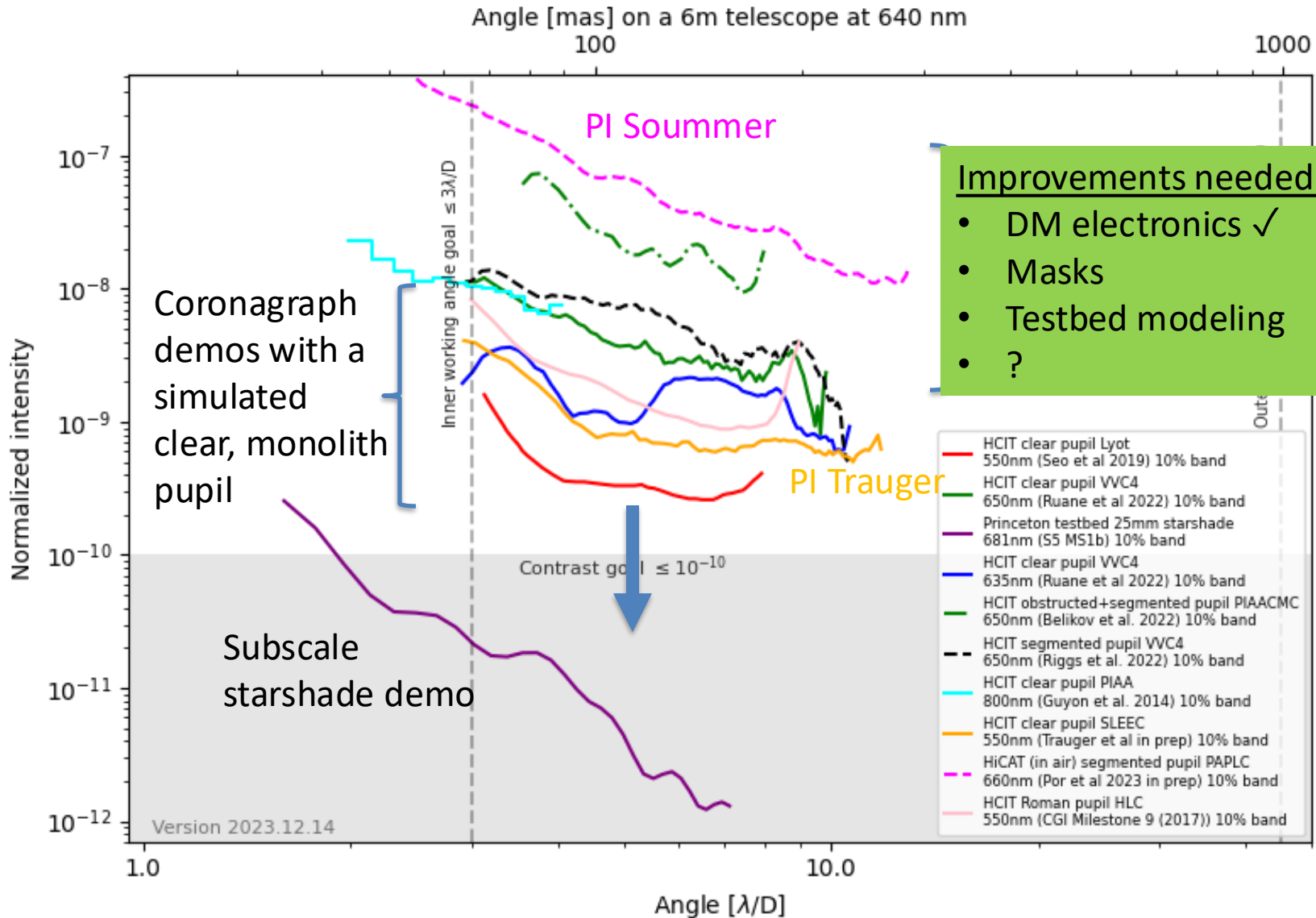
Update to Astrophysics Technology Gap List

- **The three Program Office technologists jointly carried out an update to the Technology Gap List**
 - It is published in the NASA Astrophysics Biennial Technology Report
 - https://apd440.gsfc.nasa.gov/images/tech/2024_ABTR.pdf
- **Informed by the 2020 Decadal Survey, community inputs, and the HWO Project Office**
- **Three new exoplanet-related technology gaps added:**
 - Split “Coronagraph Contrast and Efficiency” gap by wavelength
 - Added integrated modeling



Recent SAT Starlight Suppression Lab Demos

10% science bandwidth



Technology Roadmap Activities Completed



Three ExEP-commissioned activities intended to inform HWO technology considerations were all completed in 2024.

- 1. Coronagraph Design Survey**
Database of 19 coronagraph designs: traditional to immature to emerging
- 2. Deformable Mirror Technology Roadmap**
Identified three DM vendors capable of meeting HWO requirements
- 3. Coronagraph Technology Roadmap Working Group**
A comprehensive plan to mature coronagraph technology

Read Final Reports here:

<https://exoplanets.nasa.gov/exep/resources/documents/>



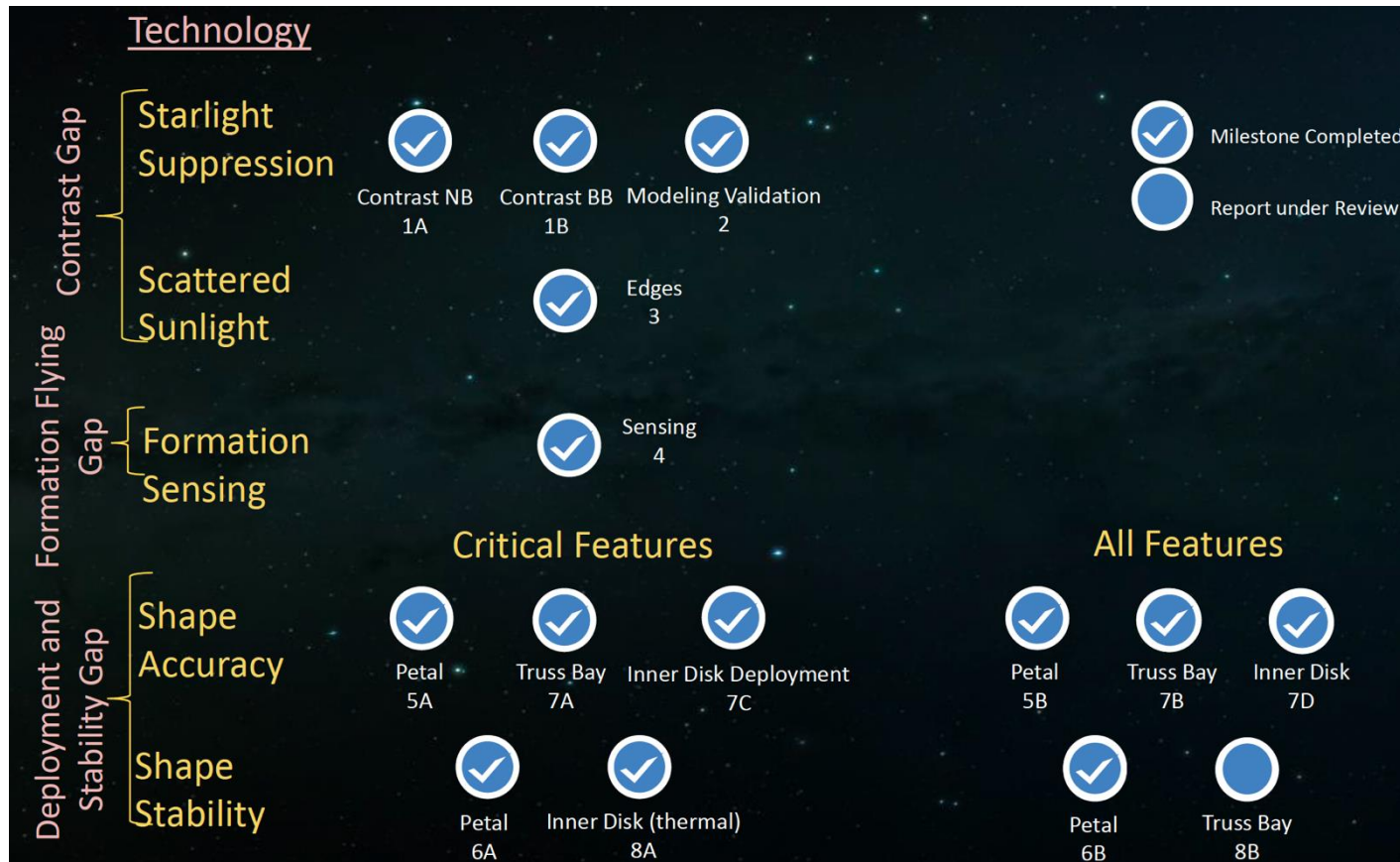
See Presentations on each Activity here:

https://exoplanets.nasa.gov/exep/technology/tech_colloquium/



Starshade Tech Dev Activity Completed

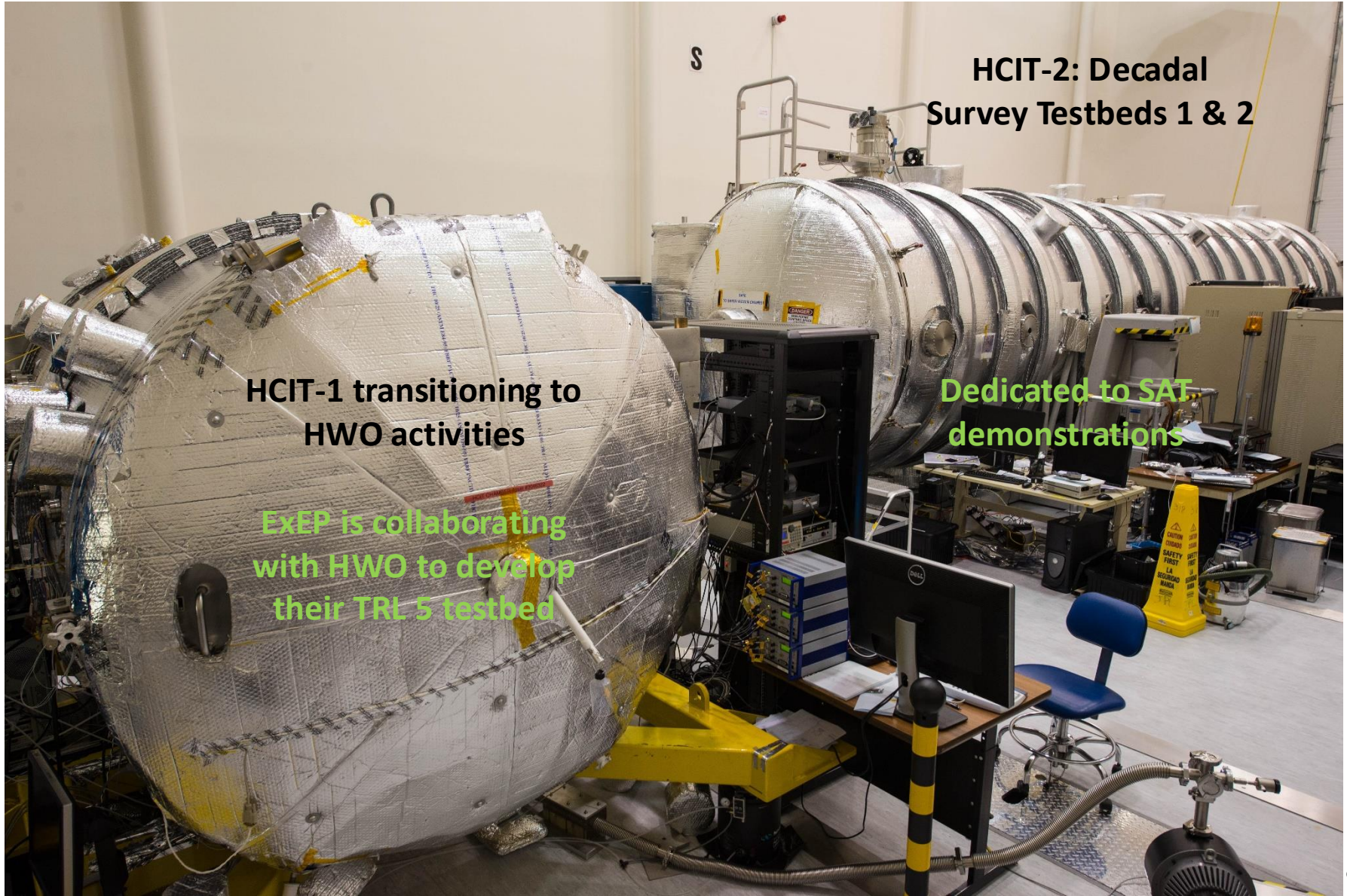
- 14 of 15 Milestones completed and reviewed (15th being reviewed)



- All three gaps are closed for 2-4 meter-class telescopes (TRL 5)
- A closeout briefing will take place in spring 2025
 - Will assess remaining tech dev risk for a HWO application (6m-class telescope)

Towards HWO

High Contrast Imaging Testbed (HCIT) Facility



**HCIT-2: Decadal
Survey Testbeds 1 & 2**

**HCIT-1 transitioning to
HWO activities**

**Dedicated to SAT
demonstrations**

**ExEP is collaborating
with HWO to develop
their TRL 5 testbed**

New Exoplanet SAT-2023s Awarded



- **Coronagraphy:**

- Vortex Phase Mask Development and Testing

PI: Serabyn (JPL)

- Technology development in UV coronagraphy to enable characterization of Earth-like exoplanets

PI: Van Gorkom (Arizona)

- Demonstration of High Contrast Using PAPLC with High-Order Wavefront Sensor

PI: Pueyo (STScI)

- **Deformable Mirrors:**

- A Novel Asynchronous Integrating Latching (NAIL) controller for MEMS deformable mirrors

PI: Cook (U Mass Lowell)

- **Segmented Telescope:**

- Thermo-Optical Metrology for Exoplanet Observatories

- PI: Guzman (Arizona)

- **Ultra-Stable Mid-IR Detectors for Transit Spectroscopy**

- Demonstration of an HgCdTe Detector-Based Ultra-Stable Mid- Infrared Spectrometer for Transit Spectroscopy and Phase Curve Observations of Habitable Planets Around M-Stars

PI: Staguhn (Johns Hopkins)

- **Other awards relevant to exoplanet technology, managed by PhysCOS/COR program office:**

- Single-photon counting with SiSeRO to search for Earth-like planets

PI: Estrada (Chicago)

- Large area ALD-protected aluminum mirror coatings for HWO

PI: Hennessey (JPL)

Looking Ahead and How You can be Involved

- **Emerging Technologies for Astrophysics**
 - AI/ML, advanced materials, astrophotonics, quantum sensors
 - Invite-only workshop taking place at Ames in March to discuss potential NASA Astrophysics applications
 - Intended as a first step – more public events coming soon
- **Propose to NASA programs to help develop technology:**
 - Strategic Astrophysics Technology (SAT)
 - Astrophysics Research and Analysis (APRA) [proposals due Jan 30]
 - Nancy Grace Roman Technology Fellowships
 - *Please reach out ASAP if you are applying for SAT and will propose to use ExEP-managed testbeds (High Contrast Imaging Testbed lab)*
- **Review HWO technology roadmap**

<https://exoplanets.nasa.gov/exep/events/560/habitable-worlds-observatory-hwo-technology-roadmap-webinar/>