National Aeronautics and Space Administration

Astrophysics

New Telescope Assets

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NAC Science Committee Brief

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NRO Telescope Assets

- Over a year ago, the National Reconnaissance Office (NRO) informed NASA that there was residual spacecraft hardware available for transfer.
- The NRO had determined that this hardware was not suitable for future intelligence missions.
- The NRO supported the complete declassification of this hardware.
- A NASA team working in a classified environment determined there was sufficient merit in the concept to accept the hardware.
- An external ad-hoc science team was asked for their opinion and to share their thoughts with the wider community.
  - The following charts are from the report of the external ad-hoc science team, as presented by Alan Dressler to the NRC Committee on Astronomy and Astrophysics, June 4, 2012.

Ad Hoc Science Team

The external ad hoc science team included Matt Mountain, (STScI) David Spergel (Princeton), Alan Dressler (Carnegie Obs.), Marc Postman (STScI), Jeremy Kasdin (Princeton), and Erin Elliott (STScI).

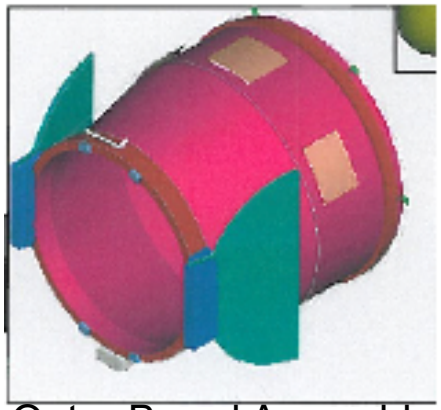
Dr. Alan Dressler gave a presentation at the June 2012 meeting of the NRC Committee on Astronomy & Astrophysics. His presentation represented a preliminary answer to the question "Can a 2.4-m NRO-developed telescope make substantial progress on the priority goals of the NWNH survey?"

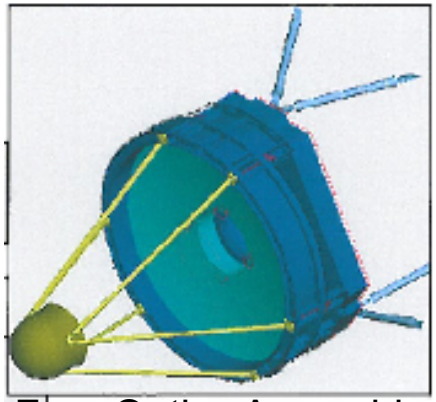
The team's results give confidence that this is a reasonable approach to consider.

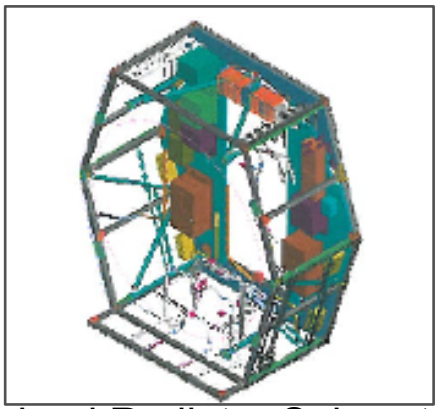
"... the potential exists to have greater capability for the WFIRST science, add additional scientific opportunities, match or reduce cost, and improve schedule, and that this possibility should be pursued as vigorously as possible." – Alan Dressler

What it is

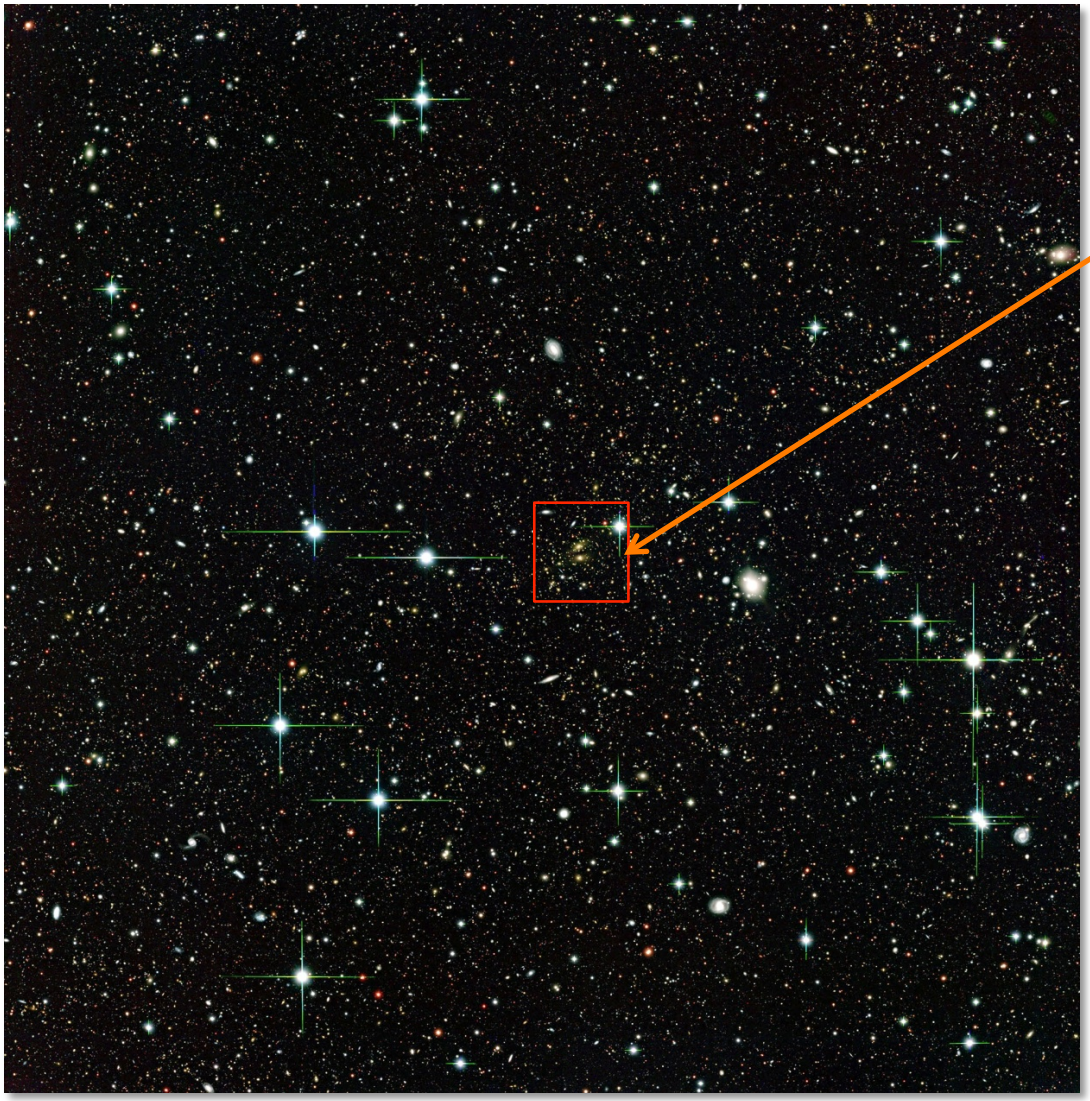
- 2+ sets of space qualified telescope hardware:
  - 2.4m, system f/8 with < 20% Obstructed Aperture
  - Field of View:
    •Unvignetted Field of View: ~ 1.8^0 Dia.
    •<u>Limiting Apertures</u>: PM: 93.4 in. dia; PM Baffle Flange: 22.3 in. dia, center
  - Wavefront Quality: < 60 nm rms
  - Stable, f/1.2, Lightweight ULE Primary Mirror
  - Stable, Low CTE Composite and Invar Structures
  - Actuated Secondary Mirror Positioning
  - 1,700 kg mass, including Telescope, Outer Thermal Barrel and Payload Radiator Subsystem.


Outer Barrel Assembly


Fore Optics Assembly


Payload Radiator Subsystem

What it is



0.25 sq deg FOV

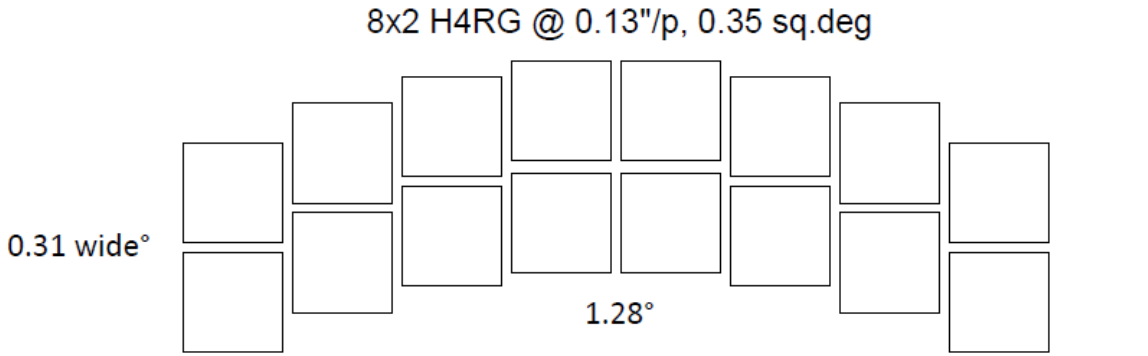
HST WFC3/IR FOV

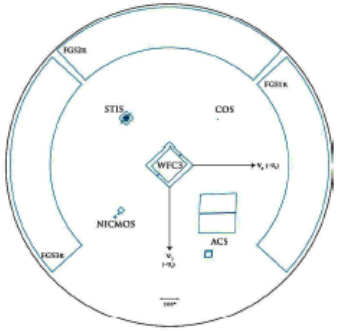
NRO telescope system has a 2.4-m f/1.2 primary with a 20% obscuration secondary that produces a 1/20 wave near-IR optical system at about f/8 assembled and tested.

This provides 100x the area of HST's WFC3/IR camera.

What it is

- Comparison Field of View
  - Initial instrument, 0.35 deg^2 exceeds JDEM-Omega
    - FOV >> other wide field cameras
  - Additional aperture diameter & area yields improved resolution and sensitivity





HST [all instruments]

JWST [all instruments]

Moon (average size seen from Earth)

What it is

Use for wide-field near infrared surveys: Fine point spread function (PSF) and larger mirror aperture compared to SDT WFIRST design reference missions (DRMs)

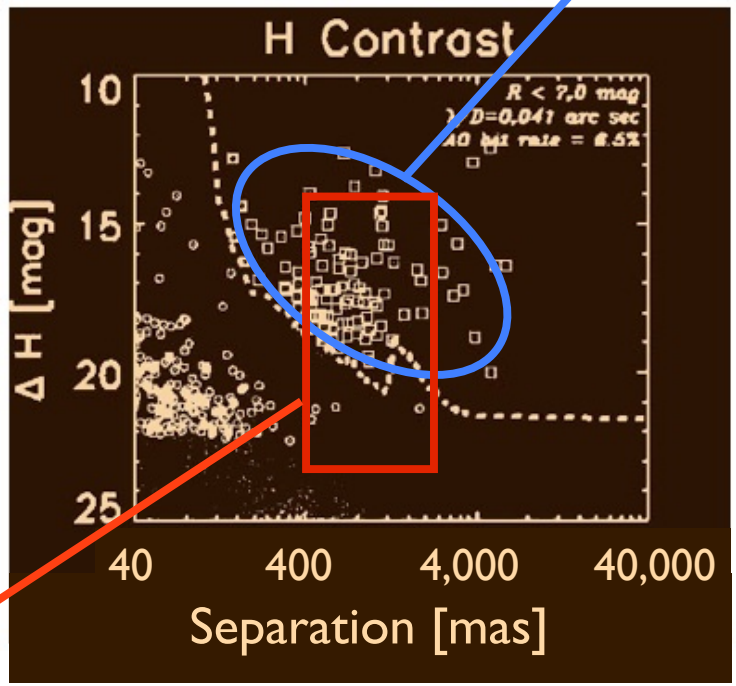
- Larger mirror enables faster IR surveys.
- Fine point spread function enables images of evolving galaxies and star formation regions.
- More sensitive, higher resolution images enable guest observer (GO) programs such as deep-color-magnitude diagrams in neighboring galaxies, mapping of Milky Way halo, etc.

What it is

Use for coronagraphy: Recent advances allow high-contrast imaging at small angles with on-axis telescopes

- Uncorrected contrast of up to 10^{-5}, corrected (with deformable mirror) to 10^{-8} or better
- Corrected contrast limited by telescope stability
- Another order of magnitude possible via post-processing
- Inner working angles from 2.5-3 λ/D depending on contrast
- Experimental verification of designs and approach in place

Gemini Planet Imager



Repurposed Telescope

dots - all planets
circles - RV
squares - GPI

Image from GPI website (planetimager.org/pages/science_planets.html)

Current Status

- The hardware, support equipment, documentation and records are in Rochester at the ITT-Exelis facility.
  - While the elements have been declassified, there are still issues relating to ITAR and other sensitivities that limit our ability to share detailed information widely.
- NASA does not have any funding dedicated to taking advantage of these telescopes.

NASA is reviewing this opportunity through the Agency Strategic Implementation Planning process to help decide on our path forward.