"Beyond JWST: Future NASA Telescopes for Space and Earth Science"

Dan Coulter

Jet Propulsion Laboratory, California Institute of Technology, Pasadena CA, USA 91109

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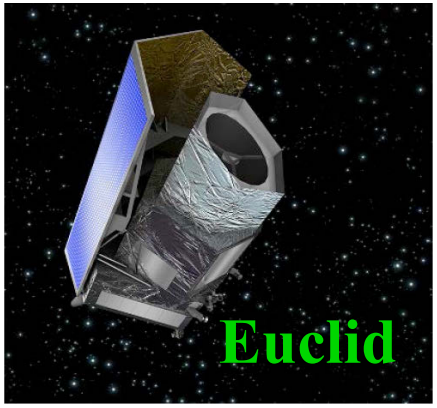
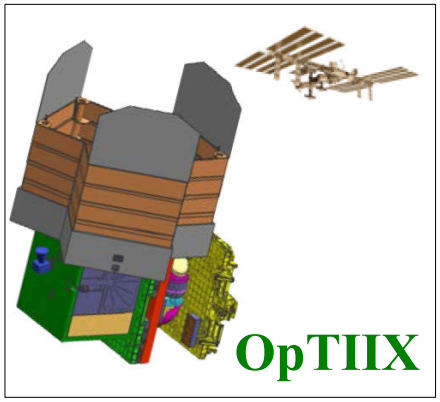
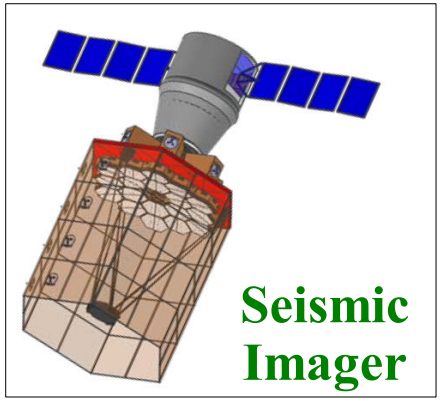
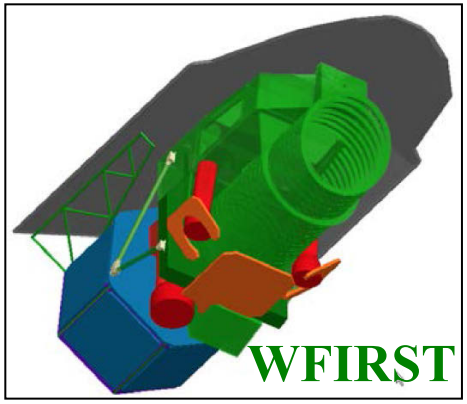
Planned Future Telescope Missions and Concepts

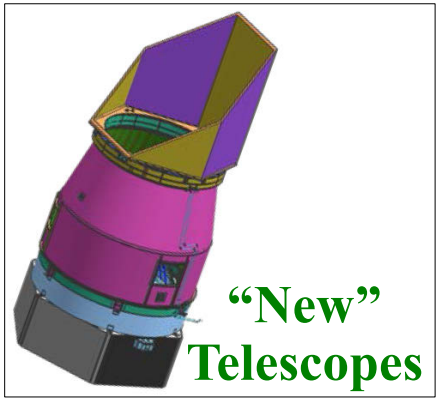


Actively Controlled Segmented Apertures

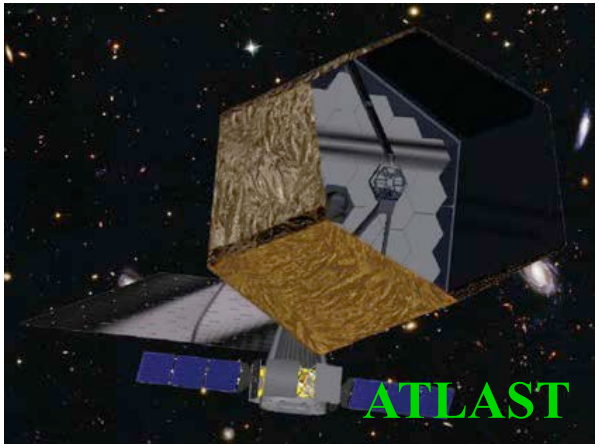






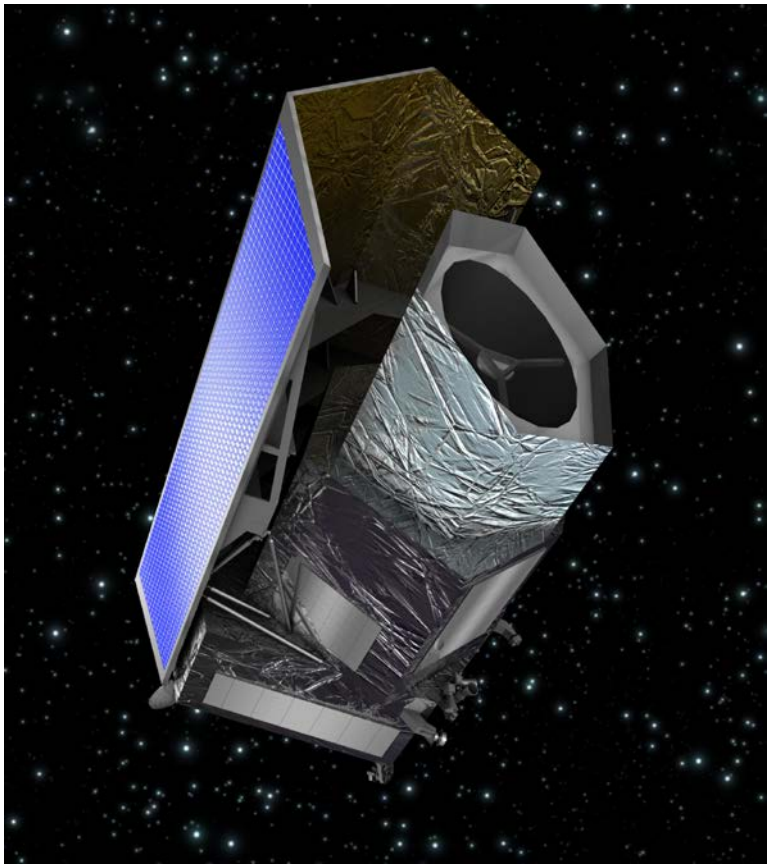


“Classical Monoliths”



Euclid

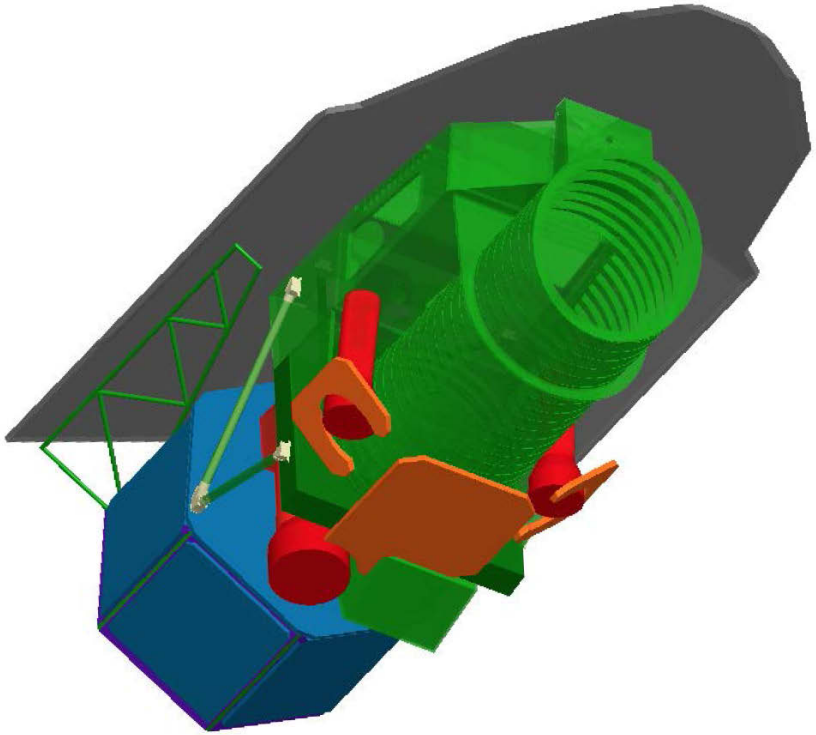
- Euclid is an ESA-led mission to map the geometry of the dark Universe with participation from NASA.
- Dark energy & dark matter science; general relativity on a cosmic scale.
- Euclid incorporates 1.2m TMA telescope with 0.79 x 1.16 deg^2 FOV in a Sun-Earth L2 halo orbit operating at <240K
- Visible imager (550-900 nm) and near IR spectrometer (0.92-2.0 μm); IR detectors provided by NASA (JPL lead)
- STATUS: The Euclid mission has been selected by ESA for implementation with launch planned for 2019.



Artist's Conception of Euclid

Wide Field Infrared Survey Telescope (WFIRST)

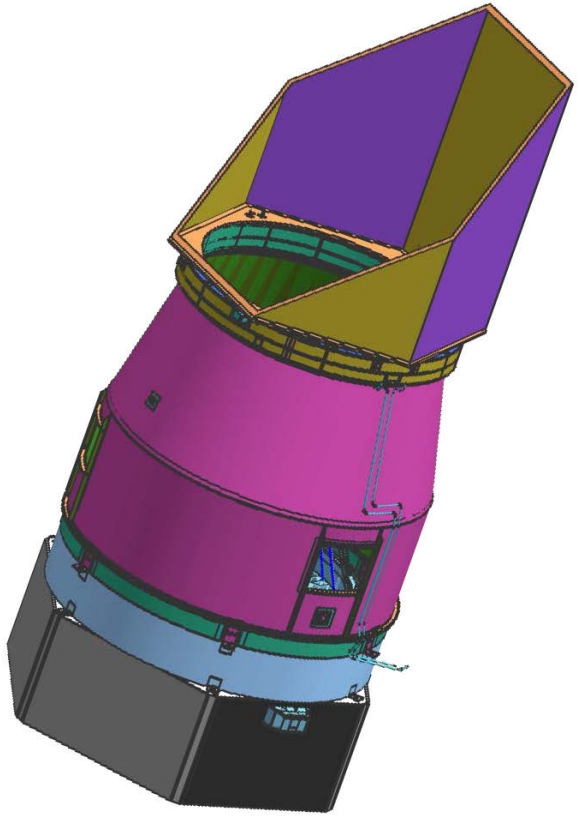
- Top ranked astrophysics mission in the Astro2010 Decadal Survey
- Dark energy science; exoplanets (via microlensing); near IR survey
- Design Reference Mission 1 (DRM1) incorporates 1.3m un-obscured TMA telescope with 1 deg^2 FOV in a Sun-Earth L2 halo orbit operating at 205K
- Imaging and spectroscopy in the range of 0.7-2.4 μm
- STATUS: Mission study ongoing (GSFC lead w/ support from JPL for the telescope); Science Definition Team report completed.



WFIRST "DRM1" Telescope Design

The "New" NASA Telescopes

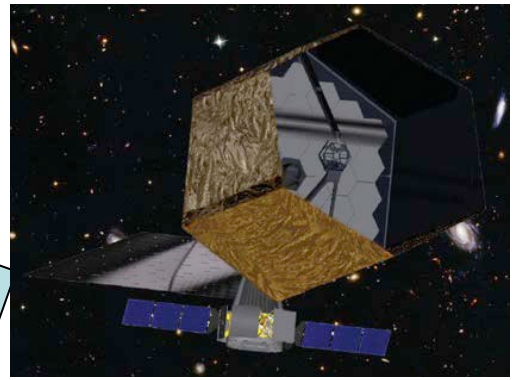
- NASA has taken possession of two sets of residual telescope hardware from the National Reconnaissance Office
- These telescopes are suitable for NASA science missions
- 2.4m apertures; can be configured as TMAs providing wide FOV; designed for near room temperature operation- lower temperatures possible; can operate in multiple orbits
- Suitable for visible imaging and spectroscopy
- STATUS: NASA preparing for two studies: (1) Possible scientific uses of this hardware "for advancing the scientific priorities of the 2010 Decadal Survey"; and (2) Assess "a range of potential uses…across (the) SMD portfolio"



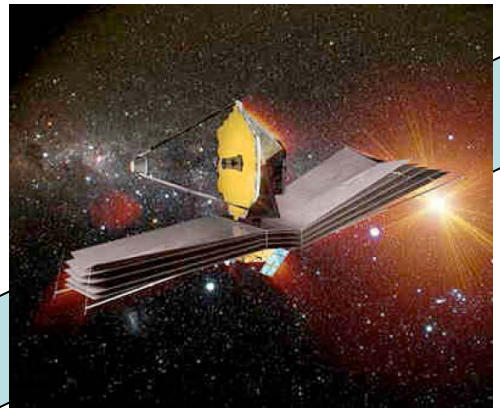
Artist's Conception of a 2.4m Aperture Astronomical Telescope

Space Telescopes Into the Future

"Incrementalism is innovation's worst enemy. We don't want continuous improvement, we want radical change." - Sam Walton



2030?: 16m active SiC segments

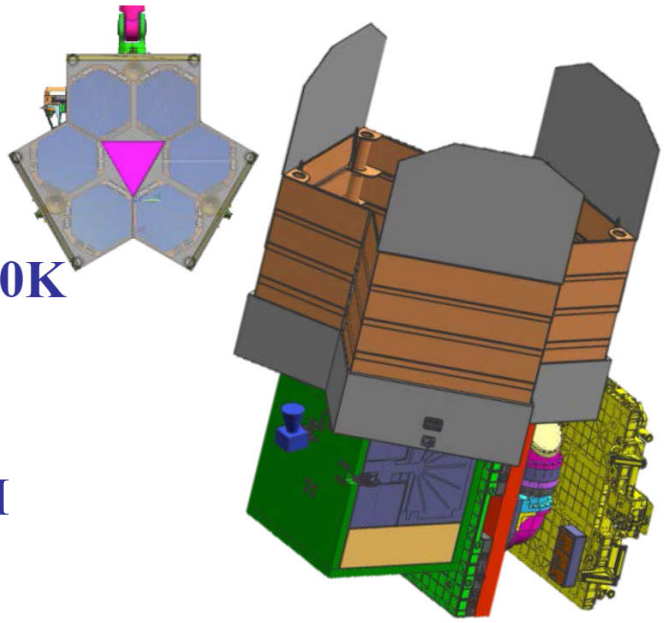


2018: 6m Be segments

1990: 2.4m glass monolith

The Optical Testbed and Integration on ISS eXperiment (OpTIIX)

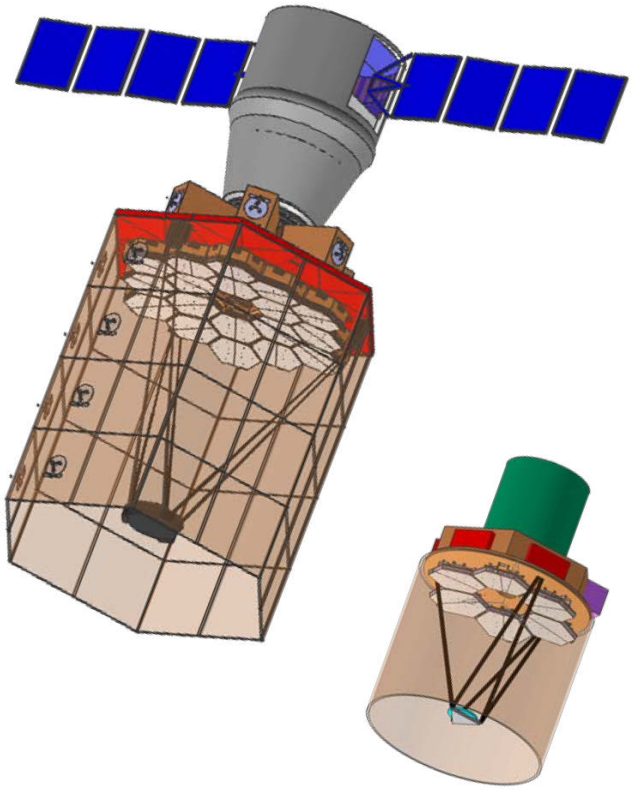
- OpTIIX is a technology demonstration of a system architecture enabling future very large *affordable* space telescopes for astrophysics & exoplanet missions
- In space robotically assembled low cost, modular, segmented optical telescope with active alignment & wavefront control validating diffraction limited imaging of astronomical targets in the visible
- 1.45m segmented TMA telescope; six 51cm silicon carbide/nanolaminate segments with active shape control; 6 DOF alignment control; realtime laser metrology & WF sensing; operating in LEO at ~290K
- Visible imaging camera (450-850 nm); robotically replacable
- OpTIIX Team: JPL/CIT (lead), GSFC, JSC, STScI
- OpTIIX Support: HEOMD (ISS), SMD, OCT, Satellite Servicing Capabilities Office (GSFC)
- STATUS: Mission study is in progress; PDR planned for later this month; LRD late 2015



OpTIIX Telescope on ISS

GEO Seismic Imager (GSI)

- GSI is a large telescope, stationed in geosynchronous orbit for imaging ground motion, surface deformation and rupture propagation from large earthquakes
- Capable of observing $M_v \geq 6$ earthquakes and correlating surface effects to subsurface geology, revolutionizing earthquake seismology
- 6m and 3.75m segmented TMA telescopes under study with up to 300 x 300 km FOV from GEO; silicon carbide/nanolaminate segments with active shape control; 6 DOF alignment control; realtime laser metrology & WF sensing
- Visible 1-2 Hz video camera (400-900 nm); post-processing correlates 50-200m ground "cells" to observe ground motion of 1-2cm/sec
- GSI Team: CIT, JPL, Keck Institute, Université Pierre et Marie Curie- Institut des Sciences de la Terre de Paris
- STATUS: Mission concept study is in progress

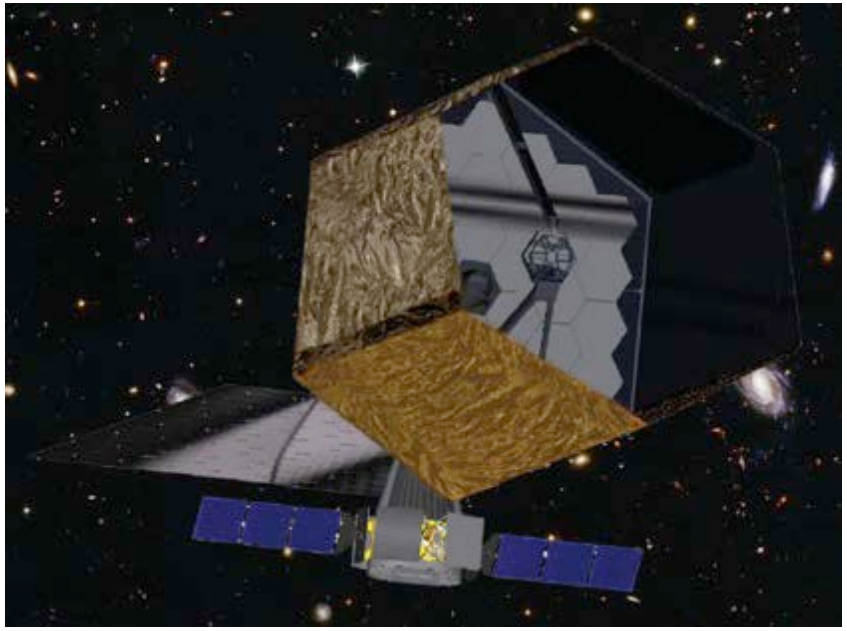


6m (in-space assembled on a Dragon) and 3.75m GSI Concepts

National Aeronautics and Space Administration
Jet Propulsion Laboratory
California Institute of Technology

Advanced Technology Large Aperture Space Telescope (ATLAST)

- A NASA Astrophysics Strategic Mission Concept Study of the technology needed to build an AFFORDABLE large UV/Optical filled-aperture space telescope
- Science Drivers: Characterizing "earthlike" exoplanets in the habitable zone around other stars and a wide rage of astrophysics research
- Studied three telescope designs: (1) 8m monolithic glass primary launched on Ares V; (2) 9m lightweight active segmented primary (deployed); (3) 16m lightweight active segmented primary (deployed or possibly assembled)
- UV-Optical-near IR instrumentation; imager, spectrometer, coronagraph….
- STATUS: Study completed 2009 and submitted to the NRC in response to the Astro2010 Decadal Survey Technology RFI



Artist's Conception of 16m ATLAST Telescope

ATLAST Team: STScI (M. Postman PI), Ball, GSFC, JPL, JSC, MSFC, Northrop Grumman, Princeton University, University of Colorado, University of Massachusetts