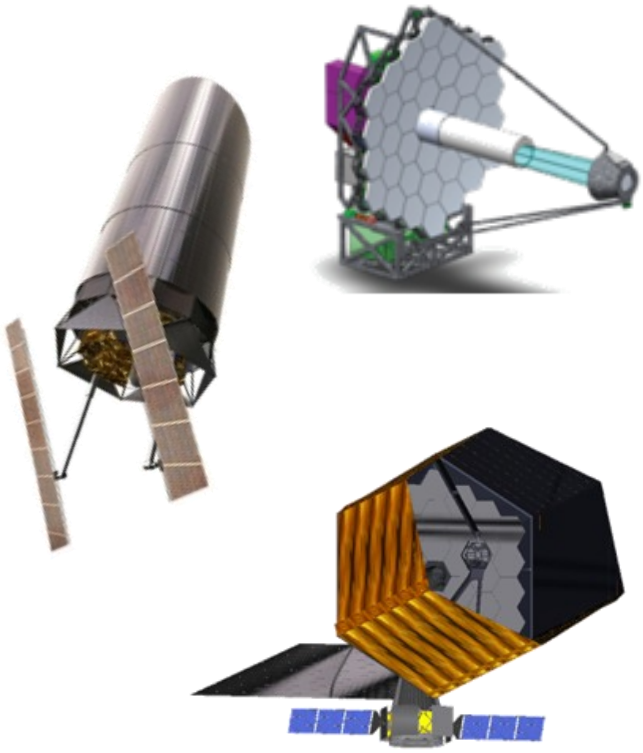
Long Term Needs

ASTRO2010 Decadal stated that an advanced large-aperture ultraviolet, optical, near-infrared (UVOIR) telescope is required to enable the next generation of compelling astrophysics and exoplanet science; and, that present technology is not mature enough to affordably build and launch any potential UVOIR mission concept.

AMTD builds on the state of art (SOA) defined by over 30 years of monolithic & segmented ground & space-telescope mirror technology to mature six key technologies.

AMTD is deliberately pursuing multiple design paths to provide the science community with options to enable either large aperture monolithic or segmented mirrors with clear engineering metrics traceable to science requirements.



Key Technology Development

- *Large-Aperture, Low Areal Density, High Stiffness Mirror Substrates:* Both (4 to 8 m) monolithic and (8 to 16 m) segmented primary mirrors require larger, thicker, and stiffer substrates.

- *Support System:* Large-aperture mirrors require large support systems to ensure that they survive launch and deploy on orbit in a stress-free and undistorted shape.

- *Mid/High Spatial Frequency Figure Error:* Very smooth mirror is critical for producing high-quality point spread function (PSF) for high contrast imaging.

- *Segment Edges:* The quality of segment edges impacts PSF for high-contrast imaging applications, contributes to stray light noise, and affects total collecting aperture.

- *Segment to Segment Gap Phasing:* Segment phasing is critical for producing high-quality temporally-stable PSF.

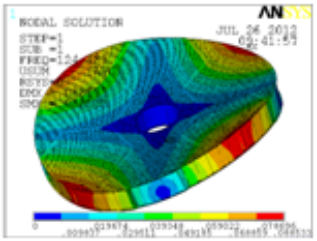
- *Integrated Model Validation:* On-orbit performance is driven by mechanical & thermal stability. Compliance cannot be 100% tested, but relies on modeling.

Accomplishments

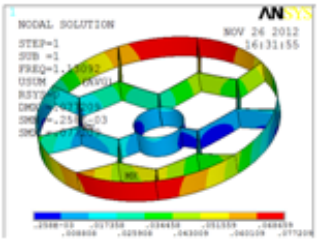
AMTD derived, from Science Requirements, Engineering Specifications for 4 to 8 m monolithic space mirrors and is working on segmented primary mirror specifications.

Integrated Model Validation: AMTD has developed a powerful tool which quickly creates monolithic or segmented mirror designs; and analyzes their static & dynamic mechanical and thermal performance. These models will be validated by test.

Support System: AMTD has expanded its substrate design tool to include launch support systems. Pre-Phase-A point designs for candidate primary mirror architectures have been produced.



Free-Free 1st Mode: 4 m dia 40 cm thick substrate

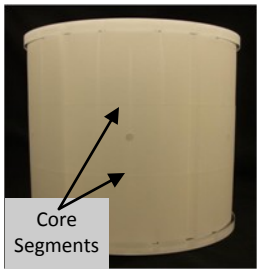


Internal Stress: 4 m dia with 6 support pads

Segment to Segment Gap Phasing: AMTD is investigating the viability of various passive and active dampening and positioning technologies.

Accomplishments (cont.)

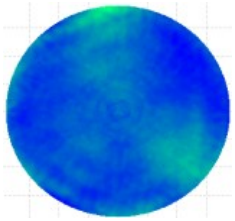
Large-Aperture, Low Areal Density, High Stiffness Mirror Substrates: AMTD partner Exelis developed & demonstrated a technique to manufacture a 400 mm thick substrate via 'stacking and fusing' three core structural elements to front and back faceplates; making a 40 cm 'cut-out' of a 4 meter diameter 60 kg/m^2 mirror. This new process offers a lower cost approach for manufacturing large-diameter high-stiffness mirrors.



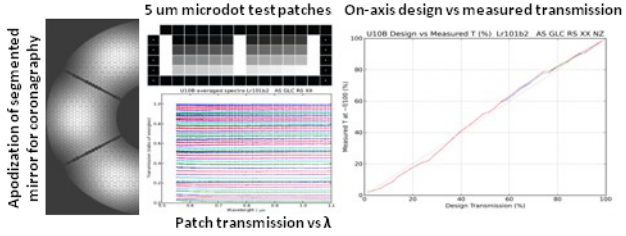
Post-Fusion: *3 Core Layers & Vent Hole Visible*

Post Slump: *2.5 m Radius of Curvature*

Demo mirror in V-block mount and the resulting multiple orientation 5.5nm rms surface.



Segment Edges: AMTD Partner STScI demonstrated a microdot apodization technique to mitigate edge diffraction effects for high contrast im-



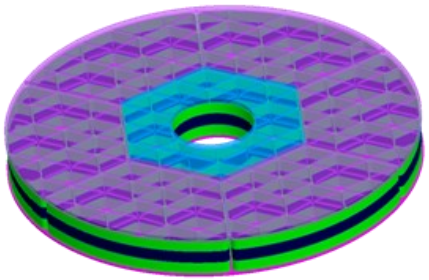
Microdot attenuation is achromatic & linear with density

Accomplishments (cont.)

Mid/High Spatial Frequency Figure Error: AMTD partner Exelis polished the 40 cm mirror to a zero-gravity figure of 5.5 nm rms. MSFC tested 43 cm mirror from 250 to 300K. Its thermal deformation was insignificant (smaller than 4 nm rms shape change).

Phase II Award

Plan to build subscale 1.3m-1.5m Pathfinder mirror using same processes and techniques developed under Phase I.



Pathfinder mirror will be stacked core with pocket milled face plates like the Phase I Demo mirror

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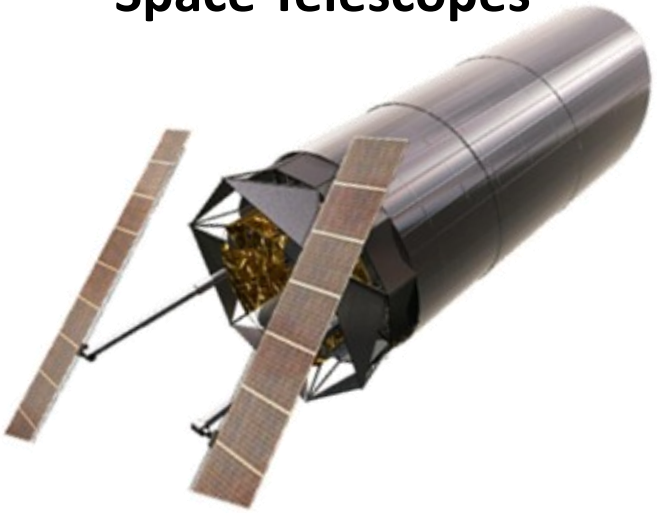
Advanced UVOIR Mirror Technology Development (AMTD) for Very Large Space Telescopes



AMTD is a multiyear effort to develop, demonstrate and mature critical technologies to TRL-6 by 2018 so that a viable flight mission can be proposed to the 2020 Decadal.

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