Large UV / Optical / Infrared Surveyor

Telling the story of life in the universe

LUVOIR

Technologies to Enable the Next Great Observatory

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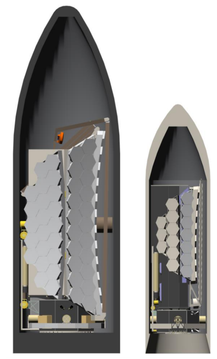
The Large Ultraviolet/Optical/Infrared Surveyor (LUVOIR) is one of four mission concepts being studied by NASA for the 2020 Decadal Survey in Astronomy and Astrophysics. Enabling a mission as ambitious as LUVOIR requires an array of technologies. Critically, a systems-level approach must be taken to developing these technologies, guided by architecture studies to place each technology in the appropriate system context. We describe here the technologies that enable the LUVOIR mission and their current Technology Readiness Level (TRL), as well as a plan to mature these technologies to TRL 6 through a series of component, sub-system, and system-level demonstrations.

LUVOIR-A (left) makes full-use of NASA's Space Launch System (SLS) Block 2 vehicle, with an 8.4 x 27 m fairing.

LUVOIR-B (right) fits within a conventional 5 x 19.8 m fairing, but requires the lift capacity of the SLS Block 1B vehicle. LUVOIR-B could also use a SpaceX Starship & Super Heavy, or possibly a Blue Origin New Glenn.



High-contrast Segmented Aperture Coronagraphy

Technology Development:
- Coronagraph Architecture (**TRL 4**)
- Post-processing and data extraction (**TRL 4**)

Engineering Development:
- Coronagraph masks
- Integral field spectrograph instrument

Optics & Coatings

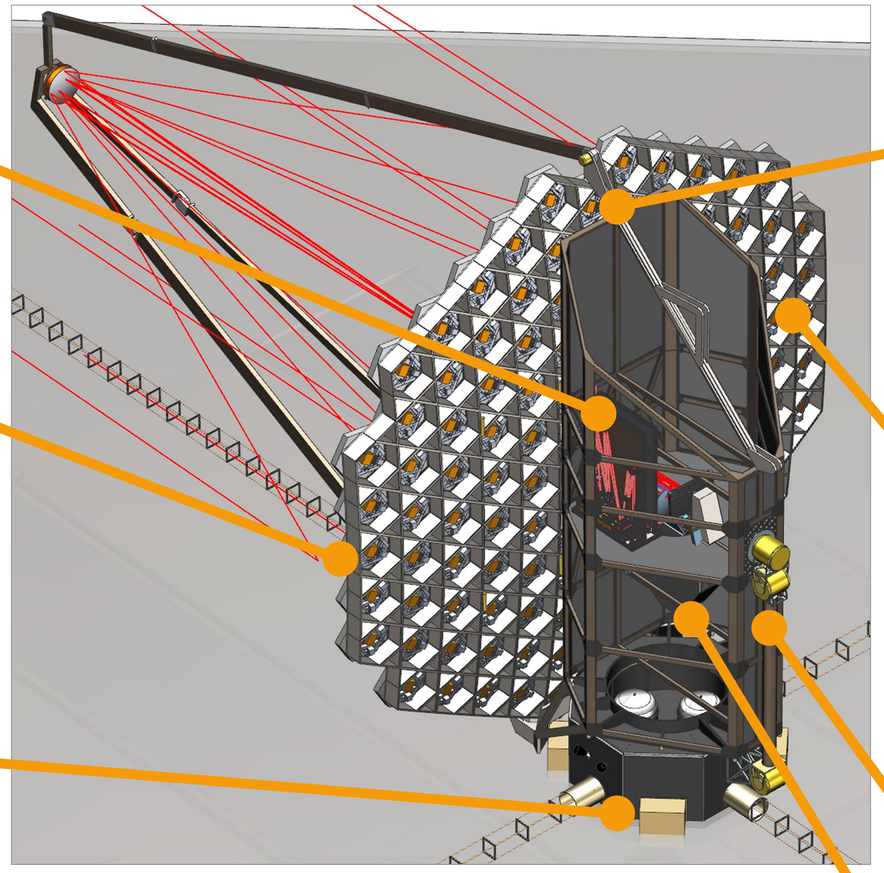
Technology Development:
- Far-UV broadband optical coating (100 nm - >2.5 μm) (**TRL 3**)
- Lightweight mirror segment substrates (**TRL 5**)
- Next-generation micro-shutter arrays (**TRL 4**)
- Meter-class UV quality freeform optics (**TRL 5**, *enhancing*)

Engineering Development:
- Protected silver and gold optical coatings for visible and near-IR instrument optics
- High-performance dichroics for channel separation
- Half-meter-class aspheric UV gratings

Spacecraft Systems

Engineering Development:
- Sunshade material and deployment system
- Roll-out solar array system
- Launch-vehicle interface system

Optical Communication not required for LUVOIR's primary science objectives; would provide improvements in data bandwidth, downlink times, margin for bandwidth growth with future instruments



Ultra-stable Systems

Technology Development:
- Milli-kelvin-level thermal sensing and control (**TRL 4**)
- Ultra-stable Deployable Composite Structure (**TRL 5**)

Engineering Development:
- Materials with low coeffs. of thermal and moisture expansion
- Stable interfaces, joints, latches, and hinges
- Passive isolation at disturbance sources

Active Wavefront Control

Technology Development:
- Out-of-band Wavefront Sensing (WFS) (**TRL 3**)
- Segment metrology via edge sensors and laser truss (**TRL 3**)
- Deformable Mirrors (**TRL 3**)
- Picometer segment rigid-body actuators (**TRL 3**)
- Ultra-stable active control system architecture (**TRL 2**)
- Artificial guide star (**TRL 3**, *enhancing*)

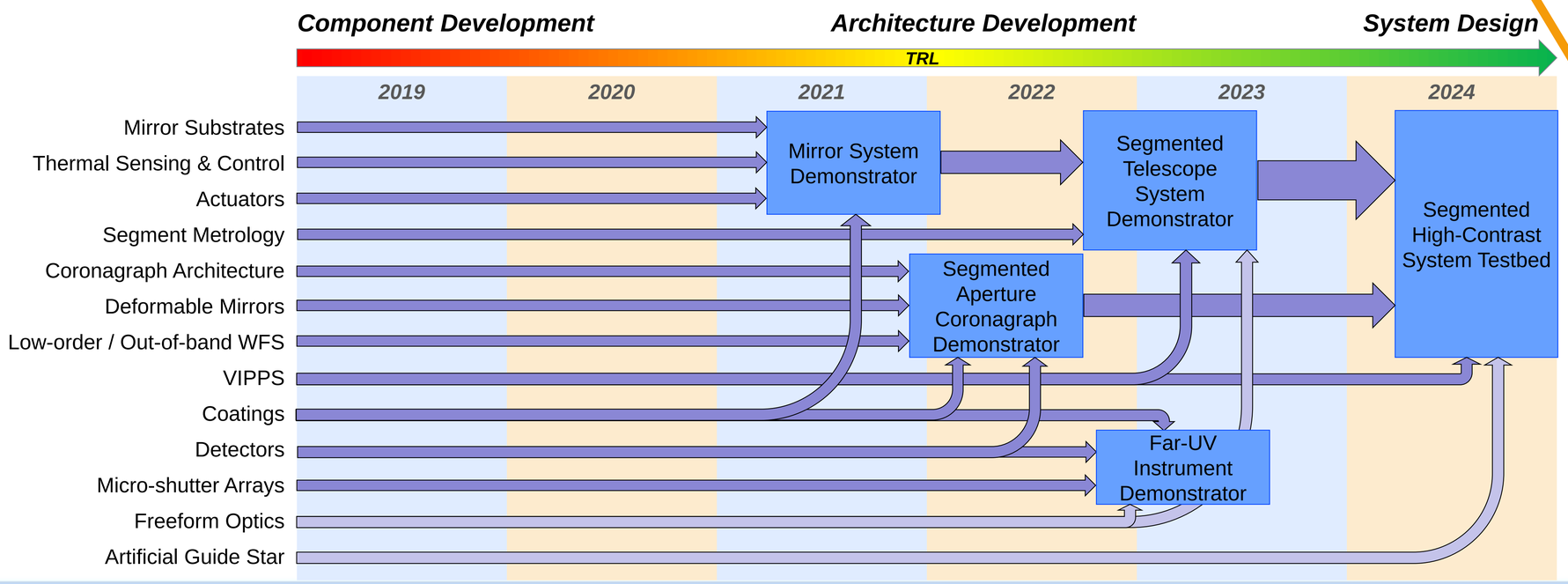
Engineering Development:
- Low-order WFS
- Dark-hole wavefront control
- Segment coarse and fine rigid-body actuators
- Image-based wavefront sensing Onboard control electronics

Pointing Control

Technology Development:
- Vibration isolation & precision pointing syst. (VIPPS) (**TRL 4**)

Engineering Development:
- Payload pointing gimbals
- Control moment gyroscopes
- Fast steering mirror

Technology Development Plan



Detectors

Technology Development:
- UV-enhanced electron-multiplying CCDs (**TRL 5**)
- Deep-depletion electron multiplying CCDs (**TRL 5**)
- GaN or Bi-alkali Microchannel Plates (**TRL 4**)
- UV-enhanced 8k x 8k CMOS arrays (**TRL 4**)

Engineering Development:
- H4RG-10 HgCdTe Photodiode Arrays
- CsI Microchannel Plates
- Pixel calibration system for high-precision astrometry

Numerous, potentially enhancing detector technologies exist, including: p-channel standard and hole-multiplying CCDs, Skipper CCDs, HgCdTe Avalanche Photodiode Arrays, scientific CMOS arrays, and Quanta Image Sensors. Superconducting technologies such as Transition Edge Sensors and Microwave Kinetic Inductance Detectors are also possible, if cryo-cooler disturbances can be effectively mitigated.

LUVOIR is a mission concept being studied in preparation for the *2020 Astronomy and Astrophysics Decadal Survey* https://asd.gsfc.nasa.gov/luvoir/