Potential Large-Aperture UVOIR Space Observatory enabled by SLS

H. Philip Stahl (h.philip.stahl@nasa.gov) and Randall Hopkins (randall.hopkins@nasa.gov)

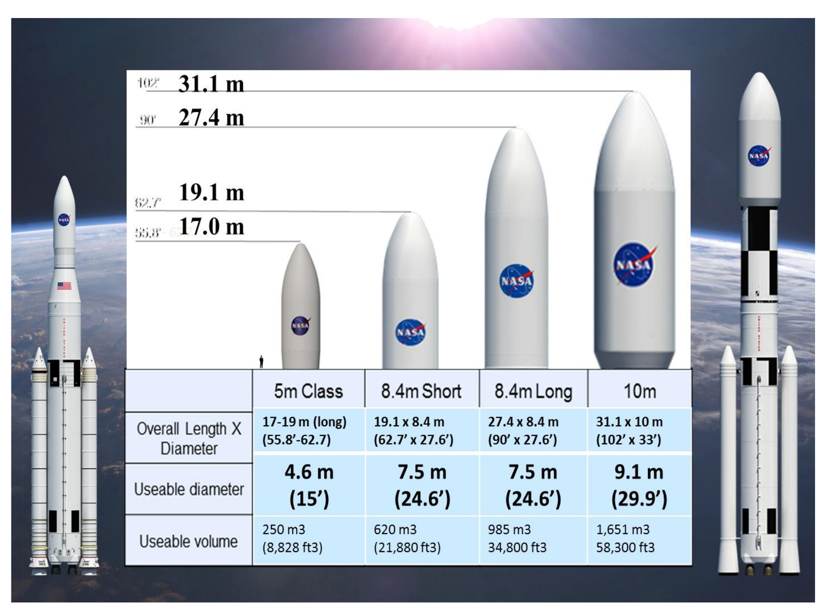
- The mass and volume capacity of NASA's planned Space Launch System (SLS) enables potential Large Space Observatories.
- ATLAST-12 mission concept specifically takes advantage of SLS capacities.

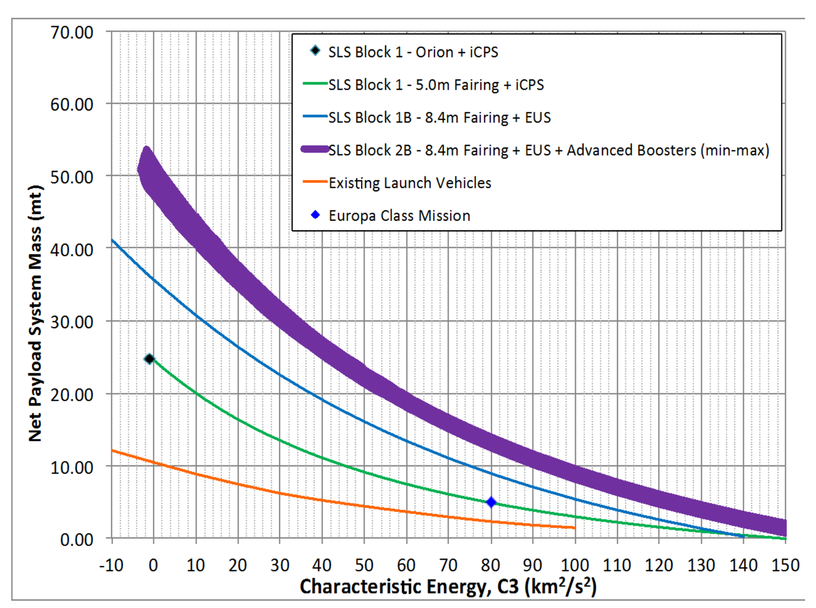
SPACE LAUNCH SYSTEM

Launch vehicle mass and volume capacity drives cost because of the complexity of engineering a large space telescope to fit inside a 5-meter fairing envelope with a 6.5 mt mass budget.

SLS mass and volume capacities mitigate this cost risk:

- ATLAST-12 is designed to fit in an SLS Block-IIB (scheduled for 2028) with a 10-m fairing (9.1-m dynamic envelop diameter) and 45 mt mass capacity to SE-L2.
- 40% margin allows for 'dry' payload mass of 27 mt.

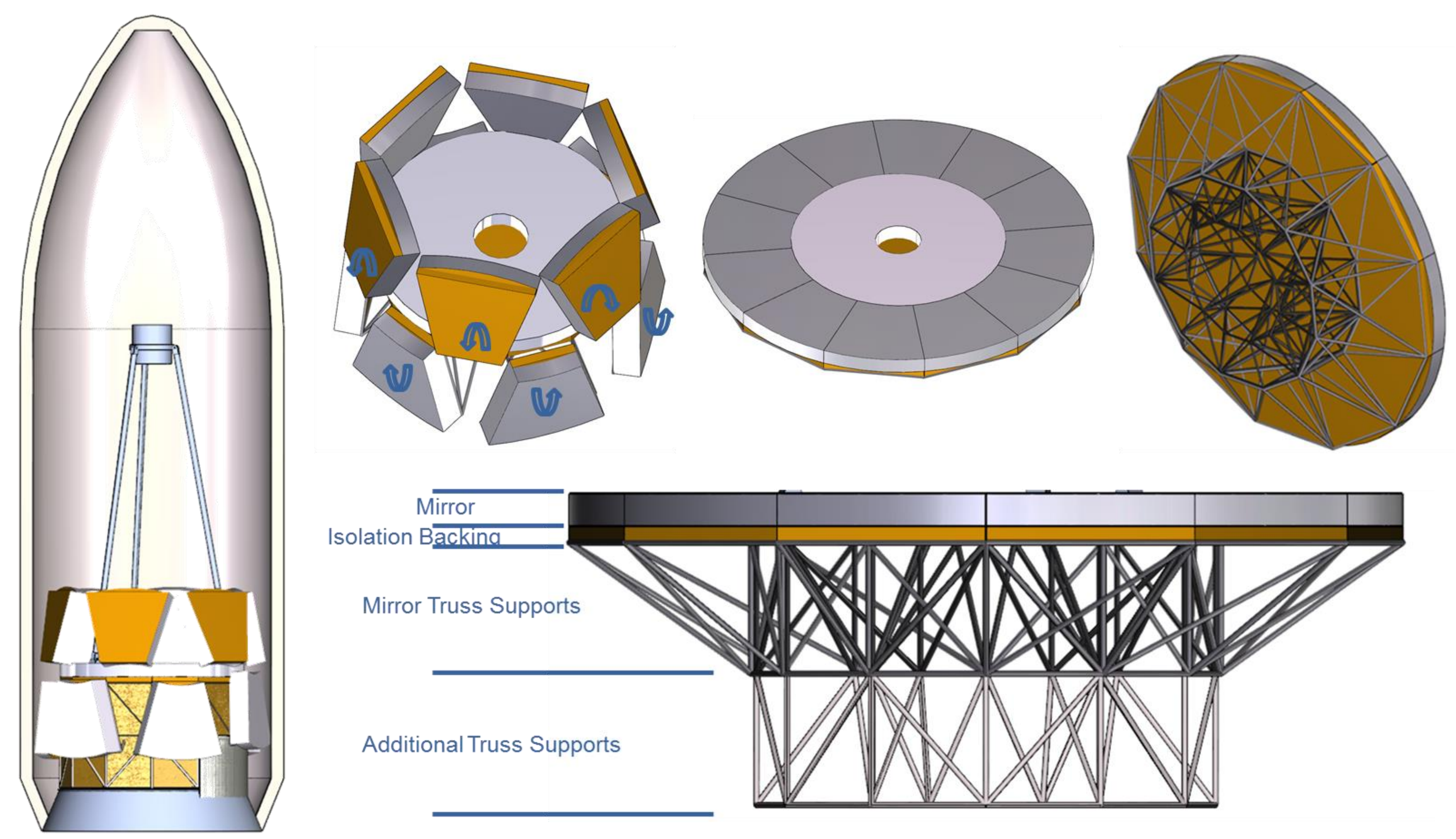




SLS is a phased development effort. Block I (scheduled for 2018) will have a 5-m 'commercial' fairing and provide 25 mt to SE-L2. Block IB (2024) will have an 8.4-m diameter 19-m tall 'short' fairing and provide 35 mt to SE-L2. Block II (2026) will have an 8.4-m 27-m 'long' fairing and an additional booster segment to provide ~45 mt to SE-L2. Finally, Block IIB (2028) will have a 10-m x 31-m fairing which can be delivered ~ 45 mt to SE-L2. A planned advanced booster and composite fairing are expected to raise this mass to ~55 mt.

VOLUME

SLS volume capacity enables a 12.5 meter class primary mirror using an architecture with fold-forward/fold-aft petals around a central 6 to 8 meter monolithic mirror.



MASS

SLS mass capacity enables fabricating a 12.5-meter class primary mirror using existing technology. Allocating 12-mt to the primary mirror assembly is only 100 kg/m2. Using existing 65 kg/m2 technology, produces a 8-mt primary mirror.

Analysis indicates that a 4-mt support structure is stiff enough to survive launch loads.

-	Ares V ATLAST	SLS ATLAST
	mass [kg]	mass [kg]
TOTAL OBSERVATORY WET MASS	50,449	32,310
TOTAL OBSERVATORY DRY MASS		27,644
Optical Tube Enclosure (OTE)	38,417	21,658
Primary mirror assembly	29,800	12,738
Primary mirror	22000	8500
Primary mirror support truss	4000	4000
Primary mirror flexures	-	6
Launch lock mechanisms	3500	132
Primary mirror central baffle	300	100
Secondary mirror assembly	1,050	637
Aft Optics	2,167	1,481
Structure	5,400	5,350
Active Thermal Control	-	1,452
Science Instruments	1,789	1,789
Spacecraft Bus	4,577	4,197
Attitude Control System	312	499
Command And Data Handling (C&DH)	120	140
Instrumentation and Monitoring	212	0
Communications	114	114
Power Subsystems	1104	1,104
Thermal Management System	974	554
Structures	1300	1,345
Propulsion	401	401
Docking	40	40
Propellant allocation	5,666	4,666

POINTING CONTROL

ATLAST-12 body points the observatory with a stability of < 1 mas for a period of up to 3000 minutes without interruption. Pointing stability enables exoplanet and UV science. Exoplanet science requires stability to minimize contrast leakage. UV science requires stability to maximize throughput by placing the science object of interest directly onto the entrance slit of the UV spectrograph without the need of a fine steering mirror. Pointing duration is also required to enable faint object science.

Pointing is accomplished via the attitude control system, including: Fine Guidance Sensor; coarse pointing system (gyros, star-trackers, reaction wheels); and Active Vibration Isolation system between the spacecraft and observatory.

To enable up to 3000 minutes of continuous observing time, ATLAST-12 uses solar panels with solar pressure kites on 10 m deployable booms to balance solar pressure exerted on the scarfed telescope baffle tube.