

ARM+SLS for Outer Planet Flagship Missions

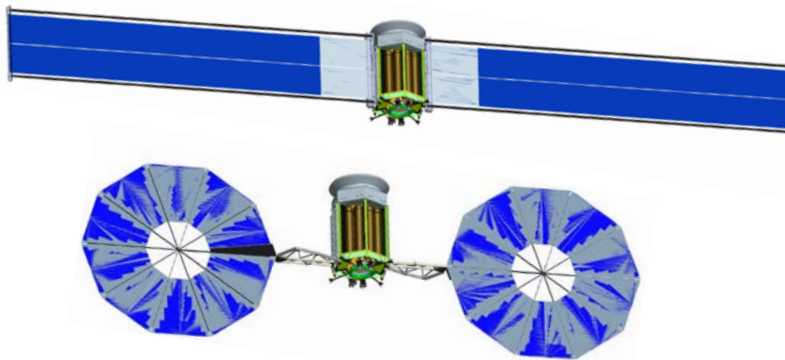
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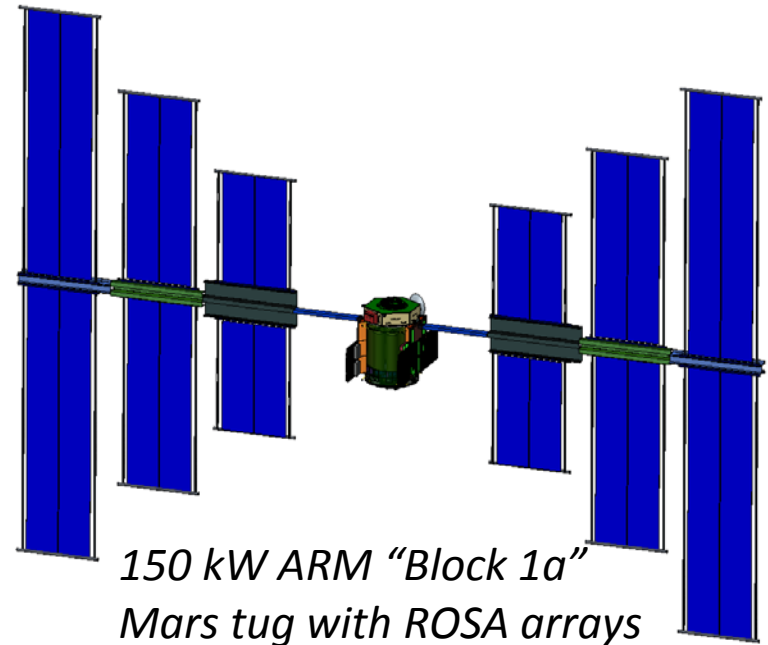
ARM-derived Mars SEP Stage

The Asteroid Redirect Mission (ARM) would develop a high power Solar Electric Propulsion (SEP) vehicle that would be extensible to a 150 kW SEP tug (the ARM "Block 1a" vehicle) that could deliver up to 70 t of cargo to Mars for human spaceflight missions.

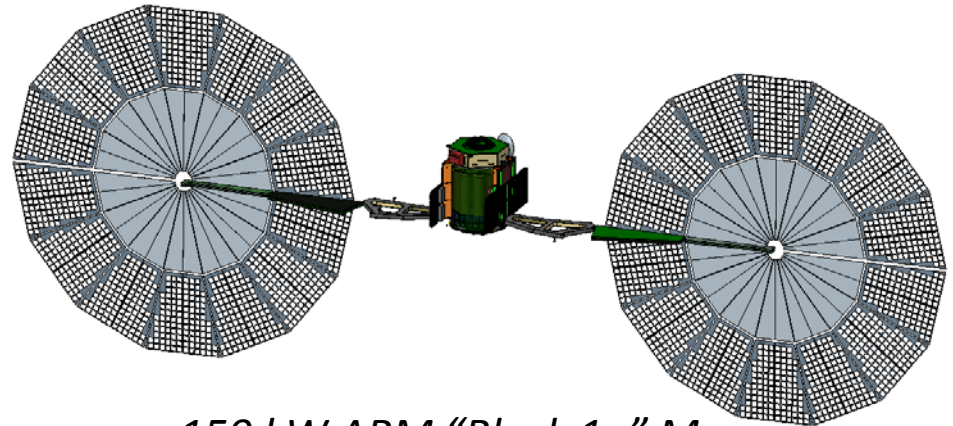
Asteroid Redirect Vehicle with ROSA arrays



Asteroid Redirect Vehicle with MegaFlex arrays



150 kW ARM "Block 1a" Mars tug with ROSA arrays



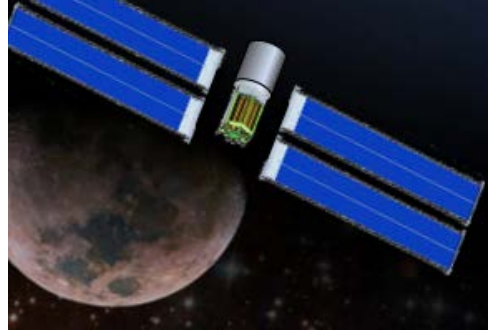
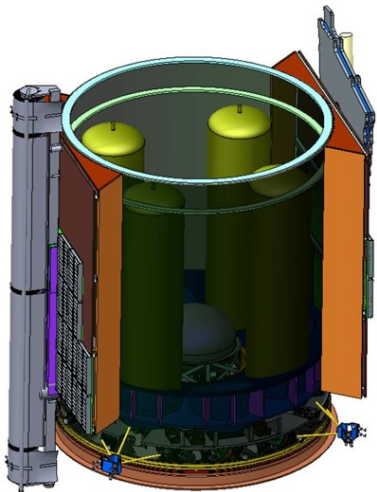
150 kW ARM "Block 1a" Mars tug with MegaFlex arrays

SEP Mars Missions



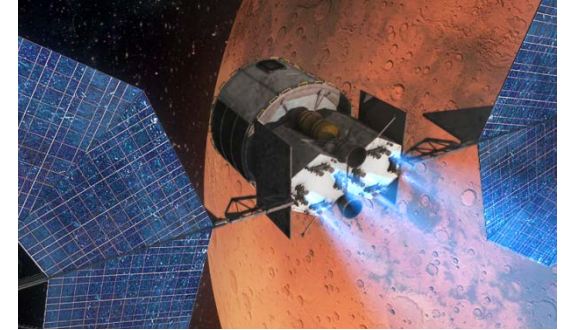
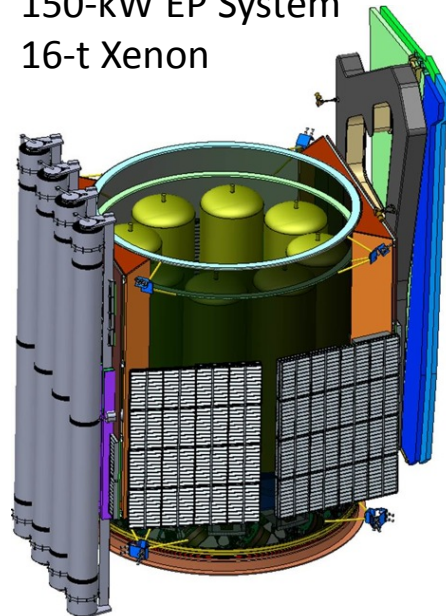
ARM Block 1

50-kW Solar Array
40-kW EP System
10-t Xenon



**ARM Block 1a
(SEP Cargo)**

190-kW Solar Array
150-kW EP System
16-t Xenon



**Mars Hybrid
(SEP Crew)**

250 to 400-kW Solar Array
150 to 200-kW EP System
16-t Xenon w/ refueling



SLS+ARM Jupiter Flagship

**ARM Block 1a
Mars tug
(150 kW @ 1AU)**

**SLS+ARM could
deliver 12,276 kg
to Jupiter orbit in
3 yrs**

**Spacecraft
performs JOI &
 ΔV at Jupiter**

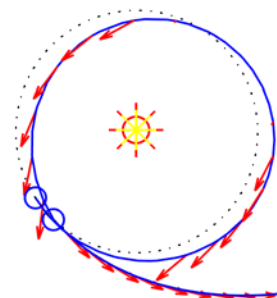


**SLS Block 1
with EUS**

**3 years to Jupiter &
launch any year**

Jupiter Arrival
 V_{∞} : 6.8 km/s

| | |
|--------------------------|-----------|
| Jupiter Arrival Mass | 23,870 kg |
| SEP Tug Mass | 8,000 kg |
| JOI Propellant (bi-prop) | 5,594 kg |
| Mass in Jupiter Orbit | 12,276 kg |



500 km
Earth flyby 1
year after
launch

Launch C3: $2.3 \text{ km}^2/\text{s}^2$



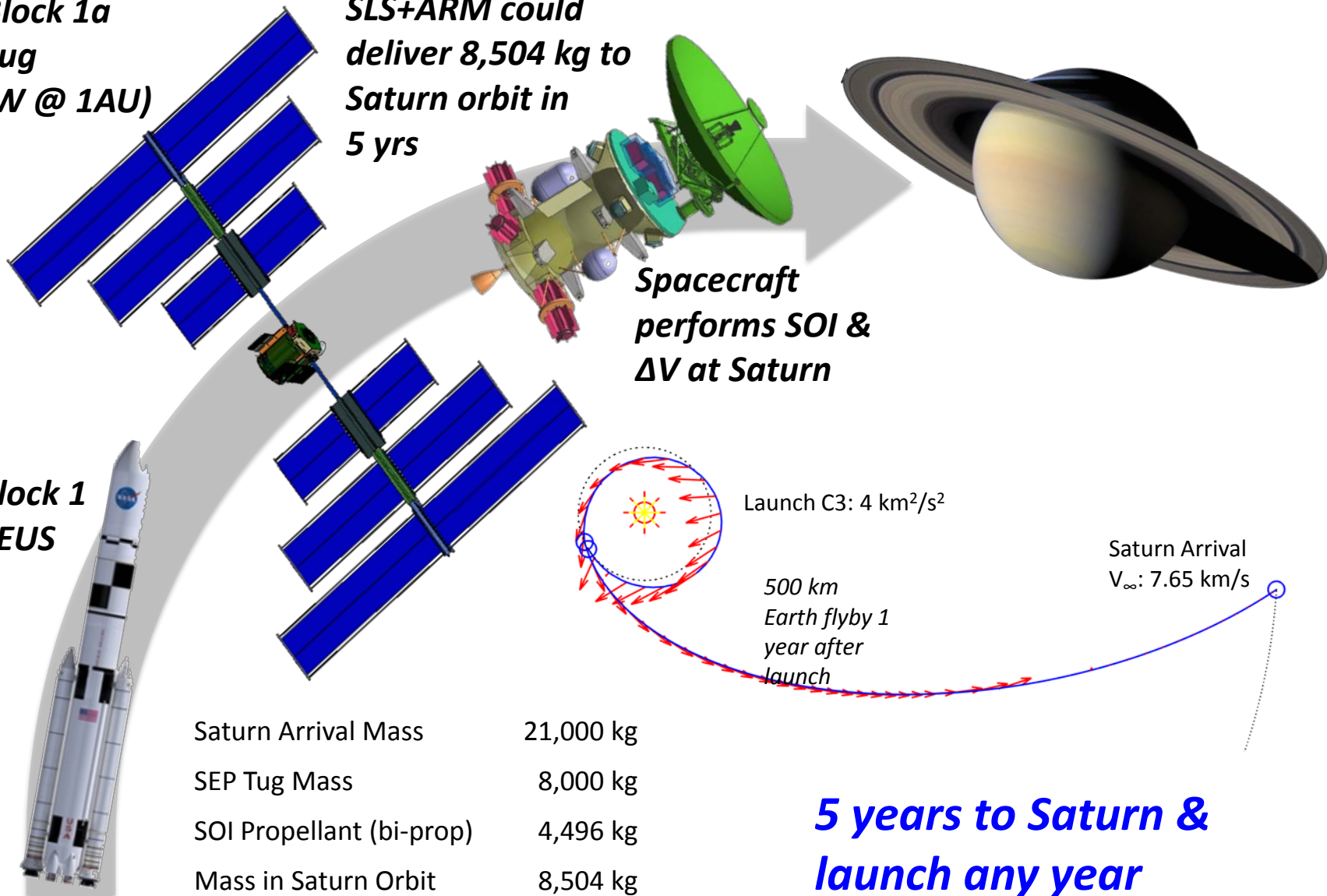
SLS+ARM Saturn Flagship

**ARM Block 1a
Mars tug
(150 kW @ 1AU)**

**SLS+ARM could
deliver 8,504 kg to
Saturn orbit in
5 yrs**

**Spacecraft
performs SOI &
 ΔV at Saturn**

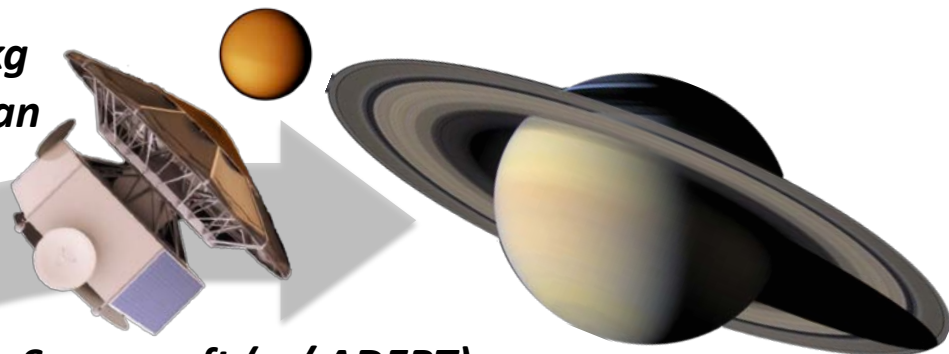
**SLS Block 1
with EUS**



SLS+ARM & Titan Aerocapture

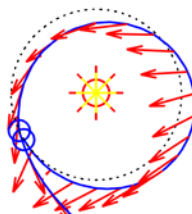
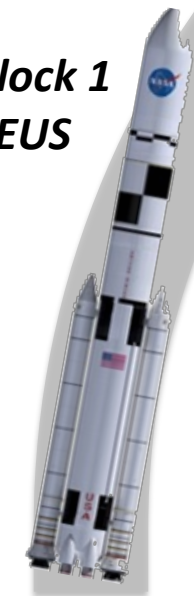
**ARM Block 1a
Mars tug
(150 kW @ 1AU)**

**SLS+ARM could
deliver 13,000 kg
to Saturn or Titan
orbit in 5 yrs**



**Spacecraft (w/ ADEPT)
aerocaptures at Saturn
with Titan and avoids SOI**

**SLS Block 1
with EUS**



Launch C3: $4 \text{ km}^2/\text{s}^2$

500 km
Earth flyby 1
year after
launch

Saturn Arrival
 V_∞ : 7.65 km/s
Titan Entry
Speed: 6
km/s

| | |
|-------------------------------|-----------|
| Saturn Arrival Mass | 21,000 kg |
| SEP Tug Mass | 8,000 kg |
| Mass in Saturn or Titan Orbit | 13,000 kg |

**5 years to Saturn &
launch any year**

SLS+ARM Uranus Flagship

**ARM Block 1a
Mars tug
(150 kW @ 1AU)**

**SLS+ARM could
deliver 4,400 kg to
Uranus orbit in
9 yrs**

**Spacecraft
performs UOI &
 ΔV at Uranus**

**SLS Block 1
with EUS**

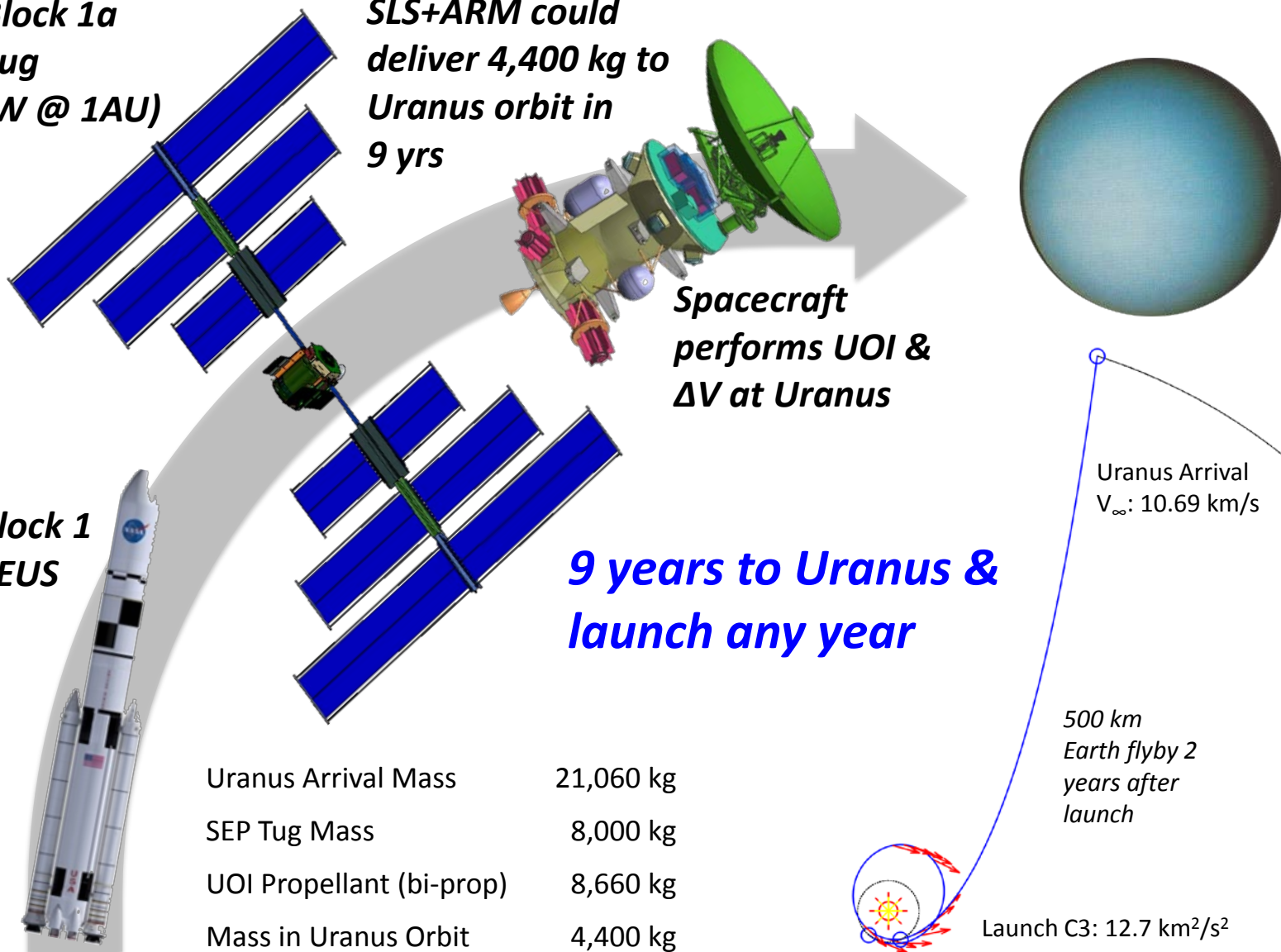
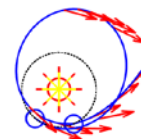
**9 years to Uranus &
launch any year**

| | |
|--------------------------|-----------|
| Uranus Arrival Mass | 21,060 kg |
| SEP Tug Mass | 8,000 kg |
| UOI Propellant (bi-prop) | 8,660 kg |
| Mass in Uranus Orbit | 4,400 kg |

Uranus Arrival
 V_{∞} : 10.69 km/s

500 km
Earth flyby 2
years after
launch

Launch C3: 12.7 km²/s²



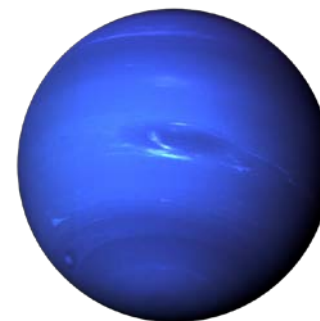
SLS+ARM Neptune Flagship

**ARM Block 1a
Mars tug
(150 kW @ 1AU)**

**SLS+ARM could
deliver 4,500 kg to
Neptune orbit in
13 yrs**

**Spacecraft
performs NOI &
 ΔV at Neptune**

**SLS Block 1
with EUS**



Neptune Arrival
 V_{∞} : 10.69 km/s

Launch C3: 12.3 km²/s²



500 km
Earth flyby 2
years after
launch

| | |
|--------------------------|-----------|
| Neptune Arrival Mass | 20,260 kg |
| SEP Tug Mass | 8,000 kg |
| NOI Propellant (bi-prop) | 7,760 kg |
| Mass in Neptune Orbit | 4,500 kg |

**13 years to Neptune &
launch any year**