Exploring the Outer Planets Sooner with SLS

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Abstract

The recently released Decadal Survey serves to determine priorities for science missions encompassing the upcoming decade. Both novel and continuing 'Outer Planet' missions are discussed and analyzed to determine which missions best set precedent in pushing boundaries in the advancement of science. Amongst all considerations, the Uranus Orbiter and Probe took highest priority as this decade's 'Flagship Mission', followed by the Enceladus Orbilander. Additionally, while Neptune, and Pluto were not high priority destinations, their potential for exploration is likely to escalate over time.

Currently, few launch vehicles have the means to complete such missions, and even fewer possess both the design maturity and payload capability to confidentially perform these feats. However, amongst the few reliable vehicles, is NASA's Space Launch System (SLS), which performs well in both aforementioned categories. The recent launch of SLS proves the reliability of a launch vehicle assembled from reliable and experienced components.

Additionally, payloads on SLS are benefited by its large fairing, allowing ample volume for payload. The payload volume available on SLS is greater than that of any of the other vehicles shown. Greater payload volume reduces spacecraft complexity to meet fairing packaging requirements, as well as potentially reducing the number and complexity of in-space deployment operations.

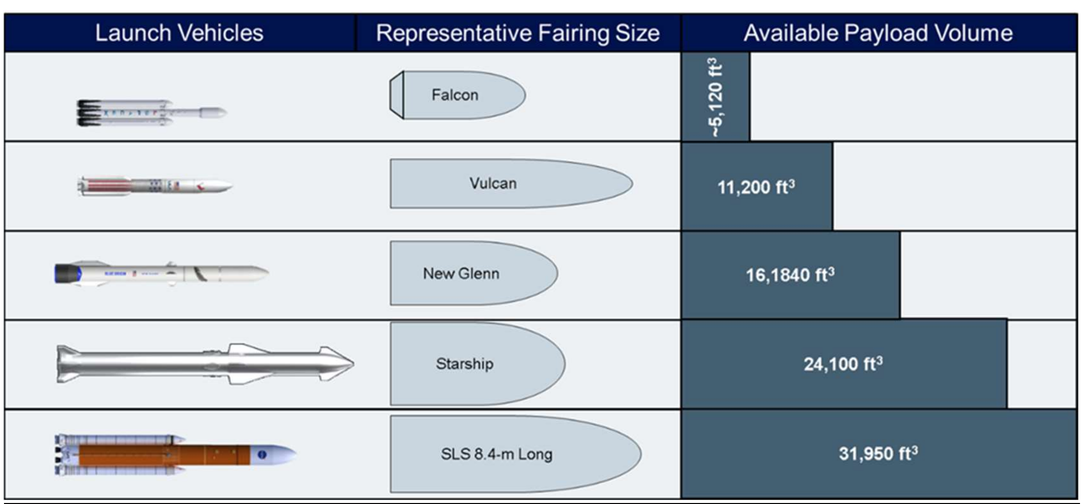

Figure 1. Comparing Launch Vehicle Payload Fairing Volume [1-5]

The SLS can deliver payload to these far-off destinations in fractions of typically estimated times. On average, SLS is calculated to deliver payload to orbit around Uranus, Saturn (Enceladus), Neptune and Pluto in 8, 3.5, 16, and 13 years respectively. By comparison, historical fly-by times to these destinations are approximately the same, even though rendezvous trajectories require substantially more performance than fly-bys -- achieving similar times for an orbital mission is a massive step forward. Furthermore, within the bounds of SLS's capabilities include adding kick-stages to the payload, potentially completing the trip in even less time. Lower trip times means getting science back sooner, a worthy goal.

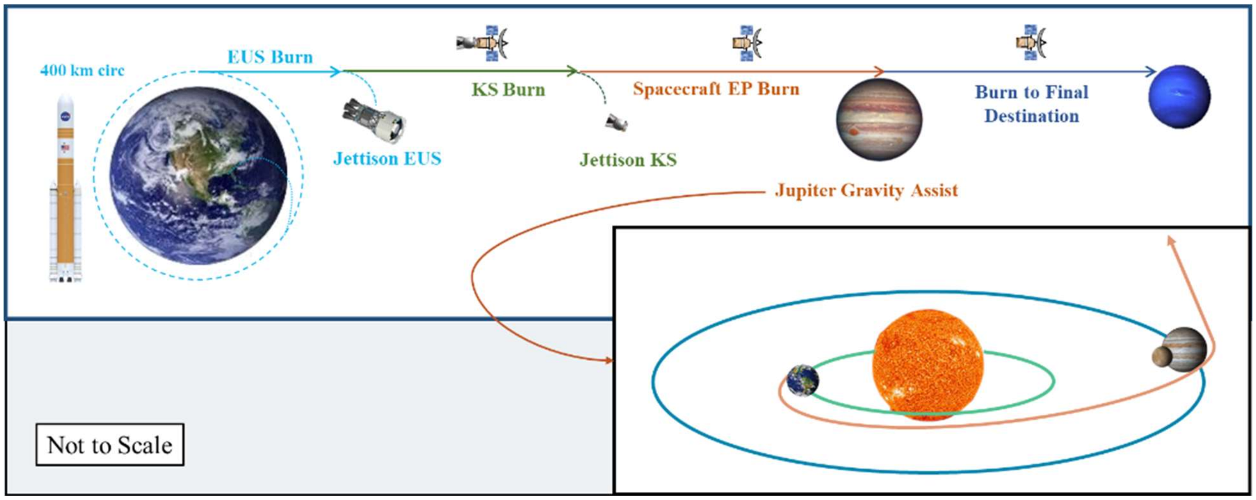

Figure 2. Sample Mission Profile Using SLS and a Kick Stage

This paper will look at missions targeted at the last 3 planets of our solar system, Uranus, Saturn, and Neptune, as well as to Pluto. While it's impossible to back up all the analysis using historical data, due to the scarcity of missions to these regions, parallels may still be drawn to come to a rough-order conclusion. Thus, the data and analysis support a very resounding advantage in using SLS. SLS allows a given spacecraft to far exceed typical time of flight expectations seen previously, making it a uniquely suited launcher for deep space exploration missions.

Thus, SLS serves as a vessel in which lie hopes and potentials for not only nearby missions to the moon, and Mars, but also missions to the vastly unexplored outer planets of our solar system.

The information in this paper will come from analysis performed by Northrop Grumman Propulsion Systems under its internal efforts.

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