SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS SYMPOSIUM (D2)
Upper Stages, Space Transfer, Entry and Landing Systems (3)

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EXTENDING NASA PLANETARY SCIENCE CAPABILITY WITH AN IMPROVED AFFORDABLE UPPER STAGE

Abstract

The current generation of two-stage medium-lift launch vehicles has, in general, been optimized for the largest market: delivery of payloads to GTO. However, there is a continuing market for a capability to deliver spacecraft to higher-energy trajectories at an affordable cost; this class of missions benefits from the addition of a third stage to optimize injection performance. In recent years, and for the foreseeable future, many of these missions are likely to be "Discovery Class" and would typically use an affordable medium-lift launch vehicle such as the Delta II; the imminent retirement of this launcher highlights the loss of a low-cost planetary injection capability. Aerojet Rocketdyne and Ball Aerospace are currently developing the Asterion Upper Stage, a low-cost, high-reliability stage, compatible with the new generation of launch vehicles. We plan to inject new technologies and design into the stage and will also maximize the use of existing infrastructure investments. The Asterion stage will be provided to the payload customer as an end-to-end service for payload delivery, independent of the launch vehicle. Our design is driven by the mission requirements for near-term inner-Solar-System missions, and as an example, will accommodate payload masses up to 3000 kg and a C3 of 20 km2/s2 on a Falcon 9. We based our stage around the Aerojet Rocketdyne LEO-7 solid propellant motor of the Leonidas low-cost small satellite launcher, which is being prepared for its first flight in 2014. This motor uses up-to-date design production techniques with the objective of delivering high reliability at low cost. Our stage avionics suite uses proven flight units and is designed to be modular, to be kitted to meet varied mission requirements at the lowest cost: for example, the stage can be flown three-axis-stabilized or as a spinner. Attitude control uses a new "green propellant", which reduces handling at the launch site compared to hydrazine systems, while providing higher on-orbit performance. Performance analysis predicts that Asterion will increase the injection capability of the Falcon 9 to typical Mars trajectories by about 50The Asterion stage allows a

current medium-lift launcher to deliver planetary spacecraft to destinations that would otherwise be cost prohibitive.