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# THE POTENTIAL OF SKYLON TO SUPPORT SPACE EXPLORATION

**Abstract**

Together SKYLON and the SKYLON Upper Stage (SUS) offer a medium class launch system with interplanetary capability. The SUS is reusable, using a two perigee burn mission design that gives the orbital phasing required for it to return to the SKYLON that launched it for recovery and return to Earth. The SUS is specified for 10 flights with the last flight being expended. In both reusable and expendable modes the greatest injected mass is achieved by launching a payload that matches the maximum capability of SKYLON/SUS and then using the payload's on board propulsion to achieve the required velocity. For a Martian mission this would be around 2.5 tonnes with the SUS reused and 4 tonnes when the SUS is expended.

The SKYLON cost, reusability and unique programmatic aspects suggest new opportunities for planetary missions. For example the test flight programme is expected to include at least 20 SUS test flights and they will require a test payload mimicking a geostationary satellite. The impact of making these test payloads interplanetary probes is comparatively small. It is proposed that a series of asteroid fly-bys is the most suitable candidate mission to exploit this opportunity. Each test fight would launch an identical probe into geostationary transfer orbit then at perigee the probe's internal propulsion would launch it on to an escape trajectory. Various past studies have found that typically 3 or 4 main belt asteroids to be reached by such a mission, so over the entire SKYLON test programme 30 to 80 asteroids could be visited. The science objectives of the programme would be to get a random statistically significant sample of "ground truth" data from main belt asteroids for comparison with telescopic observations.

Another example is a standardised lunar lander which could be the basis of robotic missions and also as a logistics carrier in support of human operations on the Moon. This would be placed into an intermediate earth orbit by the SUS in reusable mode and then perform the Trans-lunar burn and the Lunar landing manoeuvres with its internal propulsion system. The delivered payload depends upon the landing site but a typical value would be around a tonne. Although the Lander itself is expendable the use of a fully reusable launch system combined with a long production run promises to reduce the cost to lunar surface by an order of magnitude.