Potential Micro-Penetrator Applications in the Solar System

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ABSTRACT

For relatively low cost and mass, penetrators offer the ability to perform major science investigations in the near-surface regions of many Solar System bodies. As well as airless bodies such as the Moon, Europa, Ganymede, Enceladus and asteroids, penetrators are also applicable to bodies with atmospheres such as Titan and Mars where the presence of an atmosphere could allow such penetrators to be delivered with much simpler and lower mass systems.

We consider penetrators (~5-15kg) which impact at high speed (up to ~500m/s) burying themselves into the surfaces of these bodies, and unlike impactors, the contained scientific instruments must survive to perform investigations post impact, telemetering their results back to a host orbiter or direct to Earth. Pros and cons of penetrators compared with soft landers will be discussed; followed by a brief history of their development; their architecture and corresponding technical challenges.

Their science capabilities include the ability to provide key geophysical, environmental and associated astrobiological observations, which are realised through low mass, rugged scientific instruments. Already, there are a number of such instruments which have either been previously developed, or for which key elements survived the May 2008 full scale Pendine impact trials.

Specific penetrator applications for the Moon (MoonLITE) and the proposed EJSM mission to Europa and Ganymede are described in more detail, including their ability to provide key ground truth and synergistic measurements to orbital instruments. This will include an overview of the current technical study of the key delivery system and penetrator platform elements, and discussion of the specific science goals and candidate instruments.

The current status of the penetrator consortium, the opportunities being pursued, and future plans will also be presented.