An Instrument to Determine the Surface Composition of Icy Bodies and Search for Trace Biological Signatures

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Many of the most scientifically intriguing targets in the solar system are ice covered bodies. Some of these ices may also contain trace evidence for biological activity, either extant or extinct. Examples include Europa and the Martian polar regions. The exploration of these bodies will involve the analysis of the geochemical and physical composition of the ices and also the search for organic material that may exist at or near their surfaces.

A compact instrument capable of characterising the surface chemistry of an icy body with the additional benefit of sensitivity to organic structures is proposed. This instrument will make use of the LIBS technique (Laser Induced Breakdown Spectroscopy), capable of very rapid, *in situ* elemental analysis. An additional benefit of the proposed instrument is that it may also prove sensitive to organic molecules and have the ability to detect biological markers within the ice. This instrument will be designed to be positioned within a melt probe allowing it to examine the near sub-surface of the target body. The initial focus of this study will be on Europa. Owing to the intense, ionizing radiation environment present at the surface of Europa, the survivability of any such organics is more feasible beneath the surface if the ice. Possible habitats may exist in cracks in the ice or thin liquid films around the ice grains. Any mission to the surface of Europa is going to be heavily constrained in terms of mass and power and must endure the harsh radiation regime within the Jovian system, along with the necessary planetary protection requirements. These constraints will be presented, along with the initial design concept and some test laboratory data.