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Abstract

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Penetrators for in situ sub-surface investigations of europa

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Abstract

We present the scientific case for inclusion of penetrators into the European surface, and the candidate instruments which could significantly enhance the scientific return of the joint ESA/NASA Europa-Jupiter System Mission (EJSM). Moreover, a surface element would provide an exciting and inspirational mission highlight which would encourage public and political support for the mission. Whilst many of the EJSM science goals can be achieved from the proposed orbital platform, only surface elements can provide key exploration capabilities including direct chemical sampling and associated astrobiological material detection, and sensitive habitability determination. A targeted landing site of upwelled material could provide access to potential biological material originating from deep beneath the ice. Penetrators can also enable more capable geophysical investigations of Europa (and Ganymede) interior body structures, mineralogy, mechanical, magnetic, electrical and thermal properties. They would provide ground truth, not just for the orbital observations of Europa, but could also improve confidence of interpretation of observations of the other Jovian moons. Additionally, penetrators on both Europa and Ganymede, would allow valuable comparison of these worlds, and gather significant information relevant to future landed missions. The advocated low mass penetrators also offer a comparatively low cost method of achieving these important science goals. A payload of two penetrators is proposed to provide redundancy, and improve scientific return, including enhanced networked seismometer performance and diversity of sampled regions. We also describe the associated candidate instruments, penetrator system architecture, and technical challenges for such penetrators, and include their current status and future development plans.

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