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Lessons learned from a detailed design study of a Highly Integrated Payload Suite for Europa

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Solar System missions typically require high delta-v for transfer and insertion and are consequently mass critical. One method of achieving a high payload to mass fraction is to consider a highly integrated approach to the instrument design; such an approach integrates multiple instruments into a single package. This yields low mass and volume, but care has to be taken to ensure suitable redundancy and management strategies.

The example of a mission to Europa is used here to demonstrate how key science requirements can be achieved and what difficulties have to be overcome within a Highly Integrated Payload Suite (HIPS). The assumed instrument package contains a stereo imaging camera pair (for high resolution mapping and stereo imagery), a laser altimeter, short-wave infrared imaging spectrometer and a radiometer.

The harsh energetic radiation environment at Jupiter/Europa adds additional difficulties to any payload design; instrument performance depends critically on the shielding provided over and above the selection of radiation hardened components. Within a HIPS design the overall shielding configuration can be optimised and the shielding mass minimised by a combination of local "spot" shielding, payload level shielding and careful positioning on the spacecraft.

The instrument suite assumed here is able to provide global high resolution mapping, near-infrared spectroscopy and temperature mapping. Magnetic field, radiation environment and (MEMS) gravity gradient measurements could also be readily added.

The results of the detailed design study for such an integrated instrument suite will be presented, along with performance models demonstrating how the key science goals can be achieved.