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Experimental and theoretical research on the dust clouds around atmosphereless bodies and its application to the design of a new hybrid dust detector for a Europa orbiter

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Space in the vicinity of atmosphereless bodies in the solar system bodies is often populated by dust originating from the surface. Fragments of the surface are ejected mostly due to hypervelocity meteoroid impacts. It is also possible that material from sub-surface layers may be vented through cracks in the ice (as detected near Enceladus).

The understanding of Europa's dust cloud (and dust clouds of this sort in general) is done by mimicking micrometeoroid impact into simulated Europan regolith/ice using the light gas gun at the Open University. The research is complemented with impact modelling using the finite element hydrocode, ANSYS Autodyn 3D. The results are implemented in IDL in order to calculate the approximate dust cloud population (size and spatial density) of the surface fragments at different altitudes. It is, therefore, investigated whether orbit-based detection and analysis of material ejected from the surface may provide an alternative method for sampling material without landing.

In the case of Europa, relative impact speeds from these dust sources onto an in-orbit detector would, typically, be about 2 km/s. This impact speed is generally too low for complete vapourisation of the impactor/target, hence analysis of the impact plasma generated via time-of-fight through charged grids (as used on the Cassini CDA instrument) will only be partially successful. Our current work is aimed at the development of a new hybrid dust detector for any Europa orbiter.