Europlanet TNA Report

PROJECT LEADER

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COLLABORATORS

Name:	**Affiliation:**
Anton Kearsley	The Natural History Museum, London, SW7 5BD, UK.
Mark Burchell	University of Kent, Canterbury, Kent, CT2 7NH, UK.
Steve Armes	University of Sheffield, Sheffield, S3 7HF, UK.
Jon Hillier	The Open University, Milton Keynes, MK7 6AA, UK.
Host laboratory:	The Dust Accelerator Facility, Heidelberg.

Project Title –

Determining micrometre-scale crater dimensions from monodisperse impactors: application for *Stardust* interstellar calibration and hydrocode validation

- Report on the outcomes of the TNA visit (approx 1 page)

The initial proposal had two main goals:

1) Providing data for calibration of the size of impact craters in foils at very high velocities beyond the capability of light gas guns (ie., > 7.5 km s^{-1}). This has direct and immediate application to the Interstellar Preliminary Examination (ISPE) stage of the interstellar dust exposed aluminium foils recovered from the *Stardust* collector.
2) Validation of hydrocode models (mostly via strength models of aluminium at very high strain rates, and at pressures that cause impact melting of the target material).

Initially we proposed to fire monodisperse 100 nm and 500 nm electrically conducting silica spheres onto analogue foil (Al-1100). Unfortunately, however, there wasn't sufficient time to change the projectile dust within the accelerator and perform the tests that we needed. Thus we decided to use the existing projectile material (platinum coated orthopyroxene dust) which, although not tightly monodisperse, had been successfully accelerated: an unknown with our 100 and 500 nm diameter platinum coated silica.

Two runs were successfully completed firing the metal coated OPX dust onto foil at velocities of 5.8 – 6.2 km s^{-1}, and 15 – 20 km s^{-1} respectively. Both runs generated upwards of several hundred impacts on each foil, deemed sufficient for subsequent analysis of the projectile residue.

Analysis of the foils was carried out at the Natural History Museum (London) by M. Price, L. Howard and A. Kearsley. Initial results indicate that the Mg/Si ratio in the projectile residue seems to change with increasing impact velocity. This result (if verified) has very important implications for the analysis of the ISPE foil craters.

To assist in the validation of this result Dr Natalie Starkey of the Open University was contacted and she very kindly provided the foil she had shot during her run at the Heidelberg facility. The analysis of this foil is currently being undertaken.

Initial measurements of the crater morphometry (assuming a projectile size range of 150 – 450 nm, and an average impact velocity of 17.5 km s^{-1}) do also show that the hydrocode modelling reproduces the crater dimensions at this high impact speed and gives further confidence in the high strain rate yield strength model used.

In summary, although we did not fire the projectiles we had originally intended, the main outcomes of the project were successfully achieved and have led to a need to further investigate the change of the Mg/Si ratio as a function of impact speed. To this end, collaboration is actively being sort within the Heidelberg Dust Accelerator facility for further accelerator time.

Please include:

- Publications arising/planned (include conference abstracts etc)

M. C. Price et. al., "Stardust interstellar dust calibration: modelling impacts on Al-1100 foil at velocities up to 300 km s^{-1}", Proceedings of the EPSC (Rome, 2010). Note, the poster presented included additional data from the VdG experiments.

Additionally, the initial investigation has generated enough results (at least) for two futher conference abstracts to be presented at LPSC 2011.

One will discuss the EDX analysis of the crater residues, and the other will look at validation of the hydrocode modelling at impact velocities >6 km s^{-1}.

- Host approval

The host is required to approve the report agreeing it is an accurate account of the research performed.

Dr. Ralf Srama (ralf.srama@mpi-hd.mpg.de, Heidelberg) has been e-mailed and will provide verification.