NONDESTRUCTIVE 3D CONFOCAL LASER IMAGING AND ANALYSIS OF STARDUST TRACK #82 AND DECONVOLUTION TECHNIQUES

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Introduction: The Stardust mission to comet Wild 2 returned cometary and ISM particles trapped in aerogel, leaving 'tracks' of melted silica aerogel on both sides of the collector [1,2,3]. It has been our goal to perform non-destructive 3D textural analysis on *both* types of tracks. We have utilized Laser Scanning Confocal Microscopy (LCSM) as an accessible alternative to synchrotron-based techniques [4]. Here, we present greatly improved LCSM images of track #82 and analogous images of aerogel shot with basaltic glass. We also present a method of removing the axial distortion inherent in LCSM images, by means of a computational 3D Deconvolution algorithm. LCSM images provide full 3D maps, from which we will also present a full textural analysis of track #82.

Results: Stardust track #82 (C2092,1,82,00) is a single track in a keystone mounted on a standard 'forklift' apparatus. Images were taken at the American Museum of Natural History LCSM facility. Scans of varying magnification on regions of track #82 were performed, without disturbing the keystone. The structure of the tracks is best observed via our 3D projections, and in our movies of these 3D projections. Earlier work demonstrated the feasibility of wet microscopy with resolution at or better than 0.04 μm/pixel edge on stardust samples [5].

We made extensive use of a deconvolution method involving calculation of a theoretical PSF, followed by iterative deconvolution. We used a classic maximum likelihood estimation (CMLE) method to deconvolve blocks of the image stack, one at a time. We are currently working to further improve these results by experimentally determining a PSF for aerogel. We will present a full textural and particulate analysis on the deconvolved datasets, including track diameter measurements, and particulate fragment counting.

Conclusions: We have demonstrated technical improvements in using LCSM for non-destructive sub-micron 3D analysis of grains and tracks in aerogel returned by the Stardust mission. Most importantly, our deconvolved image stacks allow rapid, high-resolution, nondestructive textural analysis of whole tracks, and our techniques will easily transfer to primary ISM dust analysis

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