Dust in the Deep Impact Ejecta Cloud during the First Seconds

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In July 2005, Deep Impact space mission reached comet 9P/Tempel 1 and the spacecraft released an impactor that collided with the comet nucleus. The collision produced a large ejecta cloud with material excavated from the comet nucleus. The surprisingly thick cloud completely obscured the impact crater and cast a shadow on the surface of the comet nucleus. Analysis of the images taken by the Deep Impact Medium Resolution Instrument (MRI) showed that the shadow had a complex structure, thus revealing variations in optical thickness within the cloud. Over a few seconds of image data, the brightness distribution within the shadow changed with time, reflecting density and/or compositional variations of the dust in the ejecta cloud.

We model the scattering of sun light by the ejecta cloud to reproduce the shadow structure and its change with time. The modeling is based on the 3D radiative transfer code HYPERION[1]. Following [2], the ejecta cloud is presented as an oblique, hollow cone. The cone is populated with dust particles whose properties, primarily line-of-sight column and single scattering albedo, we adjust to get the best fit to the characteristics of the shadow. The variations in the properties of the dust that we study most likely reflect variations of the structure and composition of the nucleus of Comet Tempel 1, thus providing us an insight into the comet interior.

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