Analysis of crater locations for recently formed crater clusters on Mars

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In recent years, more than 700 fresh dated meteoroid impact sites were discovered on Mars, which formed single craters and crater fields with crater sizes up to 50 m. Due to more rarefied Mars atmosphere (in comparison with Earth) falling meteoroids are less destroyed, nevertheless near half of meteoroids are fragmented in the Martian atmosphere and are forming crater fields (clusters). On Earth meteoroids are usually observed during a short flight through the atmosphere; in rare cases, their fragments are found. The study of craters on Mars allows us to study the fragmentation details that cannot be detected in terrestrial conditions.

The scattering ellipses constructed for 55 clusters, containing more than 5 craters, by various methods for crater clusters on Mars are considered. According to them, the azimuth of the meteoroid trajectory and the entry angle are estimated, ellipse size contains information about fragmentation. Our results are in good agreement with previously published independent results.

In the case of oblique impacts, the crater ejecta are distributed asymmetrically and permits to determine the direction of flight. Ejecta distribution and corresponding azimuth are found for considering meteoroids based on Mars images for crater clusters made by HiRISE cameras. Ejecta-based estimates of azimuth for 42 clusters are compared with azimuths obtained by constructing the scattering ellipses. For azimuths calculated by craters ejecta inclination of meteoroid trajectory projection fits independent results for about 70% of clusters, direction of meteoroid flight fits in about third of clusters. Discrepancy between azimuth estimations based on ejecta pattern and on scattering ellipses requires other approaches.

Preliminary results of mathematical modeling show that the developing fragmentation model will make it possible to describe clusters and to suggest better methods for estimation of flight direction and impactor properties.