Velocities of material ejected from comet Tempel 1

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The brightness of a cloud of ejected material on calibrated MRI (Medium Resolution Instrument) images made several seconds after the impact on comet 9P/Tempel 1 during the Deep Impact mission was studied. In order to make more accurate conclusions on brightness, on some images we didn't consider pixels with brightness less than some limit [1]. This allowed us to use higher-contrast images. The velocities of a level of brightness (the edge of the region of pixels with calibrated physical surface brightness CPSB$>$*lim*, where *lim* is some constant) give us a lower limit of velocities of ejected particles. Actual velocities are greater than velocities of the level of brightness for several reasons: (1) we see only a projection of velocity on the plane perpendicular to a view of sight; (2) if the same amount of material moves from distance r_1 from the place of impact to distance r_2, then the number of particles on a view of sight (and so the brightness) decreases by a factor of r_2/r_1 . We assumed that it was a continuous ejection of material during several minutes. On some images (with the North to the upper part of an image) one can see that the left edge of the border of a region with CPSB$>$0.1 has two 'bumps' (the leftmost pixels of two ellipses). The upper bump can be caused by a pre-existing jet in this area. Let us consider another hypothesis of the origin of these two bumps. We suppose that these two bumps correspond to two cones, the more elongated cone with a right bump corresponds to material ejected from the surface of the comet just after the impact, and the more wide cone (more circular and with a lower bump) includes also the material ejected with a delay after the impact. Analysis of some images showed that there could be a noticeable ejection of material 2-3 seconds after the initial ejection. The projection of the velocity of the center of the brightest spot on an image perpendicular to a line of sight (considered as the ratio of the distance from the place of impact to the time t elapsed after the impact) was about 70 m/s both at t=7.67 s and t=15.6 s if we consider that material of this spot was ejected immediately at the impact. As the velocity is the same for different t, then probably the above assumption is correct. Some particles got much greater velocities, up to several km/s. We concluded that the brightest material began to move approximately at the beginning of the impact and moved with velocity of not more than a few hundred m/s during first 10 seconds. The ratio of semi-major axes of the ellipse corresponding to a level of brightness of bright ejected material was about 4/3. The ellipse doesn't have an ideal form, as we see different sides of the cone from different angles. Inside the bordering ellipse, besides the brightest region, there is a less bright region, which corresponds to a later ejection of material. [1] Ipatov S.I., A'Hearn M.F., 37^{th} *LPSC*, #1462, 2006.