VELOCITIES AND RELATIVE AMOUNTS OF MATERIAL EJECTED AFTER THE COLLISION OF DI IMPACTOR WITH COMET 9P/TEMPEL 1. S. I. Ipatov[1] and M. F. A'Hearn[2], [1]Catholic University of America, Dept. of Physics, IACS, Washington, DC 20064, U.S.A., siipatov@hotmail.com; [2]Department of Astronomy, University of Maryland, College Park, MD 20740, U.S.A., ma@astro.umd.edu.

1. Introduction: The cloud of material ejected after the impactor collided with Comet 9P/Tempel 1 [1] was observed by Deep Impact (DI) cameras, by space telescopes (e.g., Rosetta, Hubble Space Telescope, Chandra, Spitzer), and by over 80 observatories on the Earth. We studied [2] velocities and relative amounts of particles ejected from the comet, based on the images made by the DI cameras during the first 7 min after the collision. We considered velocities of the particles that give the main contribution to the brightness of the cloud of ejected material, i.e., mainly of particles with diameter d<3 μm. The ACM presentation will be put on the site http://www.dtm.ciw.edu/ipatov/present.htm just before the conference (our presentation on this item made at LPSC-2008 is already on this website; the conclusions presented below are based on analysis of the plots that can be found on the site).

2. Images Considered: Our studies were based on analysis of reversibly calibrated (RADREV) images made by DI cameras. The images made by MRI (Medium Resolution Instrument) and HRI (High Resolution Instrument) can be found on the website of the Small Bodies Node of the Planetary Data System (e.g., http://pdssbn.astro.umd.edu/holdings/dif-c-mri-3_4-9p-encounter-v2.0/dataset.html). We analyzed several series of images made by the same camera with the same total integration time (INTTIME). A CLEAR filter was used for all these images. Considered time t corresponds to the middle of the exposure. At $t \leq 20$ s we analyzed not the images themselves as it was done in [3], but the differences in brightness between the images and the image made just before the impact. Results of our studies presented below are based on analysis of the contours of constant calibrated physical surface brightness (hereafter CPSB, always in W m^{-2} $sterad^{-1}$ $micron^{-1}$) of a cloud of ejected material.

3. Relative Amounts of Material Ejected after the Impact: Our studies do not allow one to estimate accurately the time of the end of ejection. They do not contradict to a considerable continuous ejection of material during 7 minutes after the collision, but this time can be smaller. The rate of production of observed ejected material probably has a peak at 0.5-0.7 s. The amount of particles with d<3 μm ejected per unit of time at $8<t_e<20$ s could be greater than that at $4<t_e<8$ s. It was about the same at different $t_e \sim 20$-40 s. The rate probably mainly decreased with time t_e after the 1st minute after the ejection, but this decrease could be slower at $t_e \sim 6$ min.

4. Velocities of Ejected Material: Velocities of most of observed material ejected at $t_e \sim 0.2$ s were about 10 km/s. Some particles ejected during the first three seconds had velocities greater than 1 km/s, but the contribution of such material to the total amount of material ejected after the impact was small. Velocities of most of material that contributed to the brightness of the cloud and was ejected at $t_e>4$ s were smaller by an order of magnitude than those at $t_e<1$ s (hundreds of m/s instead of several km/s). Our estimates of projections of mean velocities of the fast material that mainly contributed to the brightness of the observed dust cloud onto the plane perpendicular to the line of sight are ~200 m/s and are in accordance with the previous estimates based on various ground-based observations and observations made by space telescopes.

5. Rays of Ejected Material: The excess ejection of material to a few directions (rays of ejected material) took place mainly during the first 100 s.

6. Comparison with Theoretical Models: At v>100 m/s, characteristic velocities v of observed material ejected at time t_e can be considered proportional to $t_e^{-0.6}$, as it was suggested in [4], but ejection with velocities greater than 100 m/s could last for a longer time interval than it was predicted by theoretical models [4-5] and could take place when there was ejection with smaller velocities. Analysis of observations made by Deep Impact cameras testifies in favor of a model close to gravity-dominated cratering (i.e., in favor of greater amounts of ejected material and greater size of a crater) and that particles with different velocities and masses could be ejected at the same time.

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