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Near-IR Monitoring Photometry of Comet 9P/Tempel 1 in South Africa

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NASA's Deep Impact (DI) spacecraft successfully hit the target comet 9P/Tempel 1 with 370 kg cooper-based impactor on July 4 (UT). Comet 9P/Tempel 1 was observed with many telescopes all over the world. We carried out long-term observations, covering time from 7.5 days before the impact to 24.5 days after (i.e., June 27 to July 28). However, most of observations cover only a short period of time (one to two days after the impact). Thus, this will allows us to detect to possible long-term phenomena induced by the DI collision. Broad band imaging in near-IR enable us to observe only the dust component because there was no strong gas emission in this wavelength. This way, our observations had two important characteristics. The observations were performed with the near-infrared camera SIRIUS (Simultaneous Three-Color Infrared Imager for Unbiased Survey) mounted on the IRSF (Infrared Survey Facility) 1.4 m telescope at the Sutherland South African Astronomical Observatory. Images were taken in J (center wavelength = 1.25 micron), H (1.65 micron), Ks (2.15 micron) simultaneously. Four results were obtained. (1) The variation of brightness of the comet before and after the impact was observed. After the impact, the comet brightened by 0.3-0.4 magnitude in each filter band. However, the brightness did not continue; it gradually darkened and returned almost to the pre-impact brightness about three days later. This result suggests that no active region was formed on the nucleus of the comet by the impact (2) No color change was observed before and after the impact. The difference between J and H (i.e., J-H) was $\sim$0.45 and H-Ks was $\sim$0.15 over the observing period. (3) Ejecta velocity was estimated to be 115$\sim$150 m/s with an assumption that the ejecta moved at an approximately constant velocity. (4) The time variation of angular distribution of ejecta was observed.1.5 days after the impact; the track of the ejecta departed from straight path by the effect of solar radiation pressure. Such data on the trajectory of ejecta particles will allow us estimate the beta value (the ratio of solar radiation pressure to momentum), which is directly related to the mean size of the ejecta dust. The mean size of the ejecta is an important parameter to determine the total mass of ejecta. The fact will help us estimate the crater size created by the DI collision. Because excavation depth is known to be about 1/10 of the diameter of gravity-controlled impact craters, we can further infer the depth of the cometary surface fresh material exposed by the impact. Such information on crater excavation depth if combined with the observation that no new active region was created on the cometary surface by this impact will place an important constraint on the vertical volatile distribution underneath the comet.