

Imaging Observations of the Deep Impact from India — Modeling of the Pre-/Post-Impact Jets

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Imaging of the Deep Impact event in the R band was carried out from the VainuBappu Observatory at Kavalur and the high altitude Indian Astronomical Observatory at Hanle during June 29 - July 08, 2005, in response to the International campaign for ground based observations. The expanding impact debris was recorded in the images on July 04 ~ 8.9 hours after the deep impact. This deep impact related feature is seen superposed on several other jet/fan structures that are also present in the pre- and post-encounter images. From our limited data sample we find that the position angle of these jets do not appear to change with the rotational phase. Our photo-dynamic model is used to simulate the trajectories of the dust grains ejected from distributed sources on the nucleus for comparison with the persistent jets. Moving under the action of solar radiation pressure forces, the loci of the dust grains trace out spiraling shells or cones depending on the solar illumination and Earth viewing geometries. When the features of successive rotations overlap, which happens in the case of a fast rotator or at large geocentric distances of the comet, the edges of rotating cones appear as jets due to large line of sight column density of the dust grains. One pair for each cone, not necessarily equally illuminated, is possible when the activity of the source lasts through out or most part of the rotation period. This scenario is attractive as it explains the fixed orientation of the observed jets of comet Tempel 1. For the reported rotation period of ~40 hours for this comet, the grain velocities would have to be very low, of the order of 10-20 m/s for a narrow source to produce a tight cone. Assumption of a broad source will relax the constraint on the upper limit on the grain velocity. We consider an alternative scenario in which a burst of activity occurs when an active region is at a certain preferred azimuth. We attempt to constrain the direction of the rotation pole of the nucleus and the location of the sources on the nucleus by fitting the orientation of the jets/fans.