Deep Impact at the William Herschel Telescope

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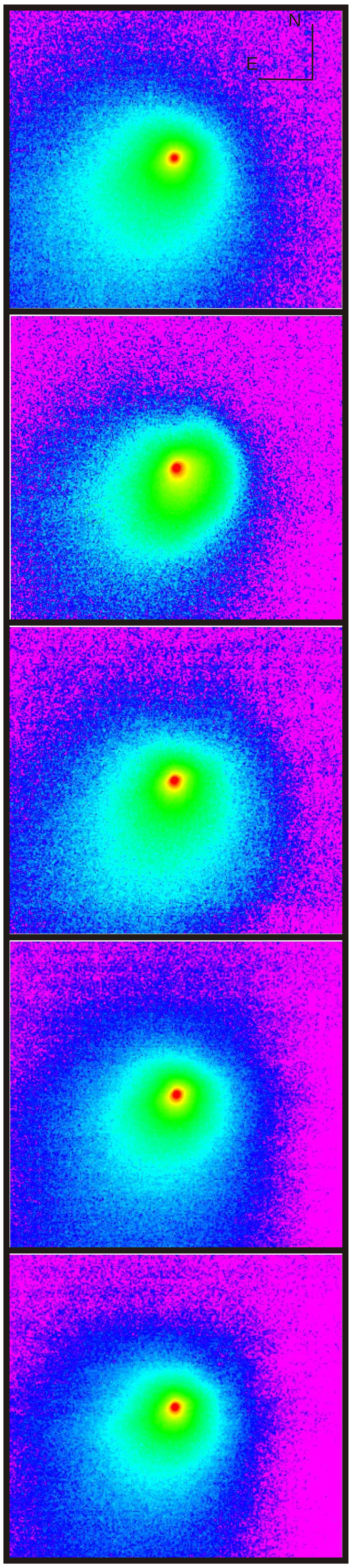
On July 4th 5:52UT a 370km-size projectile released by the NASA Deep Impact spacecraft impacted the surface of comet 9P/Tempel 1. The aims of the experiment were: Observe how the crater forms; Measure the crater's depth and diameter; Measure the composition of the interior of the crater and its ejecta; Determine the changes in natural outgassing produced by the Impact.

Earth-based observations were crucial to study the consequences of the impact on the coma of Tempel 1. For this reason NASA organised a worldwide network of observers that included all the large observatories around the world. The biggest telescopes of the Roque de Los Muchachos Observatory were part of this international effort. The objectives of our group's project include imaging and spectroscopy in the near-infrared and in visible wavelenghts using the 4.2m WHT, the 3.6m TNG and the 2.5m NOT telescopes. Preliminary results of the near-infrared imaging programme using LIRIS @ WHT are summarised in this poster.

Near-infrared images in the J band obtained with LIRIS @ WHT. Images are flux calibrated considering heliocentric and geocentric comet distance variations, and are all displayed in the same scale to visualize the change of the coma after the impact.



50.000 km

July 3

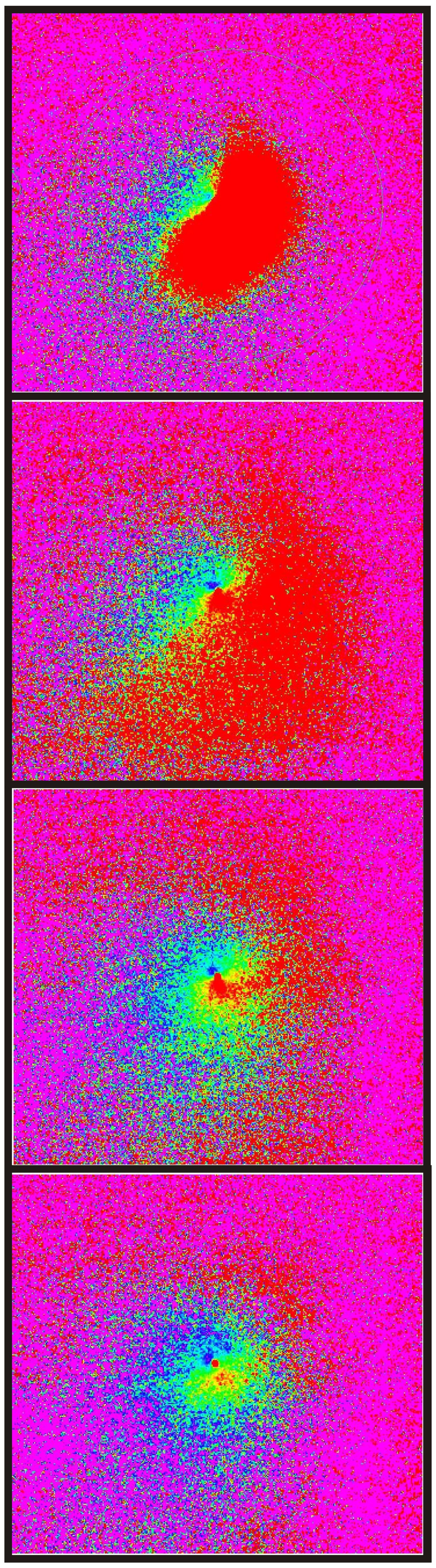
July 4

July 5

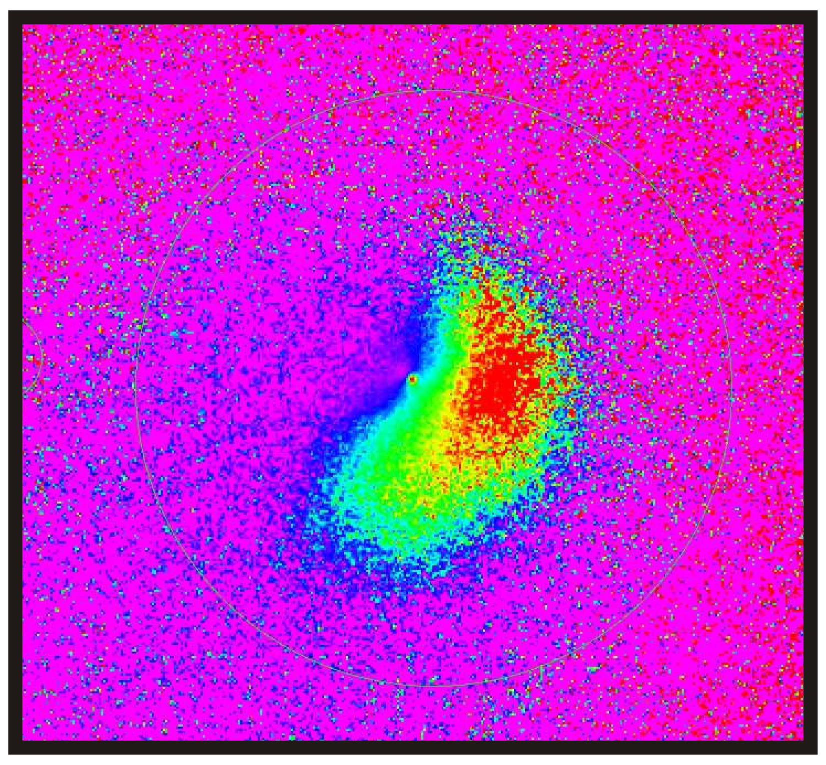
July 6

July 7

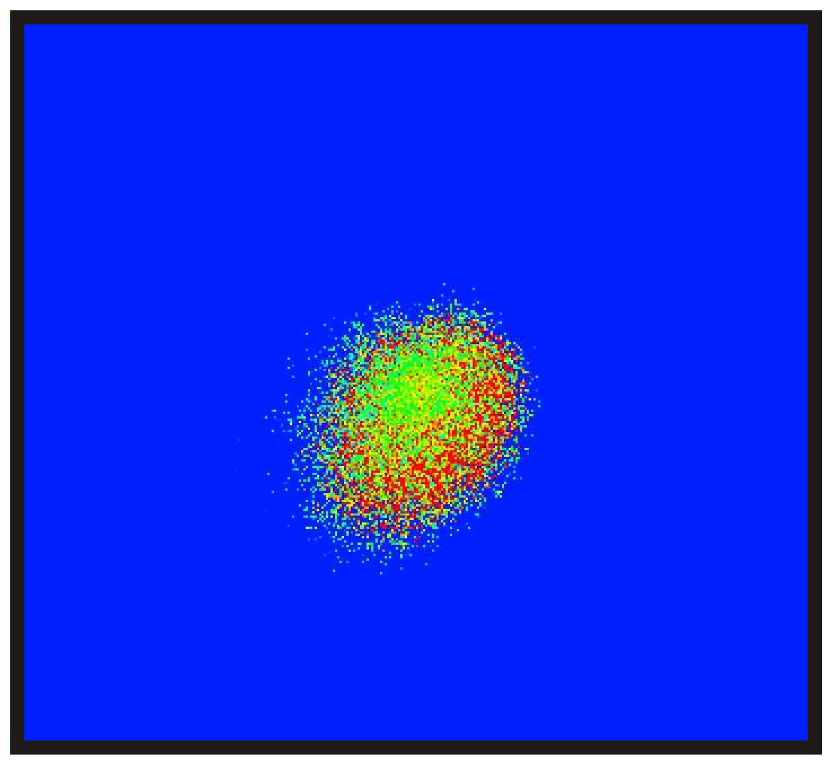
Post-impact images presented in column 1, divided by the pre-impact image obtained in July 3. The rainbow colour scale goes from 0.95 (violet) to 1.25 (red). The evolution of the dust cloud produced by the impact is easily seen. Notice also a jet structure at PA=220°



Same image of July 4 seen in column 2 at a different colour scale (from 0.95 to 3.0) to see the structure inside the cloud and the jet at PA=220°. Notice that the brightness of the cloud is between 2 and 3 times that of the pre-impact coma.



J-K colour map obtained on July 4th. Colour scale goes from 0.5 (blue) to 0.65 (red). Notice that the dust cloud is redder (*J-K*= 0.65) than the rest of the coma (*J-K*=0.55) which is indicative of larger dust particules. *J-K*=0.55 is also the colour index of the coma the other days.



PRELIMINARY RESULTS

From July 3rd to July 7th comet 9P/Tempel 1 was observed with the 4.2m William Herschel Telescope using the camera-spectrograph for the near-infrared LIRIS. High S/N images were obtained through broad-band *J* and *Ks* filters, and spectra were obtained using the *zJ* and *HK* grisms in order to cover the 0.8-2.5 micron region.

While comet spectra show strong gas emission bands in the visible region, very little is seen in the near-infrared. Most of the light in the 1-2.5 micron region is sunlight scattered by the dust in the coma - this spectral region is excellent to study the properties of dust in cometary comae.

A first look at LIRIS spectra confirms the pesence of a faint emission band at 1.1 microns attributable to CN. A complete reduction of the spectra has still to be done.

J and *Ks* images were reduced in the usual way, combined, flux calibrated and scaled to the same pixel size in km. A first look to the images obtained with the J filters (column 1) shows obvious variations in the intensity and shape of the coma. By dividing post-impact *J* images by the pre-impact image obtained on July 3rd we can study the effects of the impact (see column 2). On July 4th we see the dust of cloud ejected by the impact expanding in the SW direction, and a dust jet at PA=220°. The cloud of dust continues expanding the following days and it is almost non-visible on July 7th. Notice that the expansion is slower in the NW direction because of the solar radiation pressure (the Sun is NW). These images, together with those in the *R*-band obtained at the 2.5m NOT telescope, will allow us to carry out a detailed dynamical analysis of the dust ejected during the impact, and determine properties like size evolution or the distribution of ejection velocities.

The size evolution of the dust cloud ejected during the impact is also different from what it is seen in normal comet activity. This is derived from the change in colour observed on July 4th. The dust in the cloud is redder than the "normal" dust, which is indicative of larger particles. The large amount of dust ejected, in contrast to the low increase in the activity level of the comet in terms of gas production, and the fast return of the comet to activity levels similar to that of pre-impact indicate the presence of a deep dust insulating mantle on its surface.

On the other hand the new dust jet appeared after the impact at PA=220° is indicative of new activity in the crater created by the impact. This is an important result as it means that the impactor attained the fresh ices below the large dust mantle of the comet.