The Deep Impact experiment observed from "El Roque de los Muchachos" Observatory

Javier Licandro (1,2), Noemí Pinilla-Alonso (3),Julia de León (2), Miquel Serra-Ricart (2), Ma. Teresa Capria (4), Mischa Shirmer (1), Luisa Lara-Lopez (4), Pedro Gutierrez (4), Gian Paolo Tozzi (6), Rafael Barrena (2), Cesare Barbieri (7)

(1) Isaac Newton Group of Telescopes (ING)
(2) Instituto de Astrofísica de Canarias (IAC)
(3) Fundación Galilgeo Galilei & Telescopio Nazionale Galileo (FGG&TNG)
(4) INAF-Istituto di Astrofisica Spaziale Cosmica
(5) Instituto de Astrfísica de Andalucía (IAA)
(6) INAF- Osservatorio di Arcetri
(7) INAF- U. Di Padova

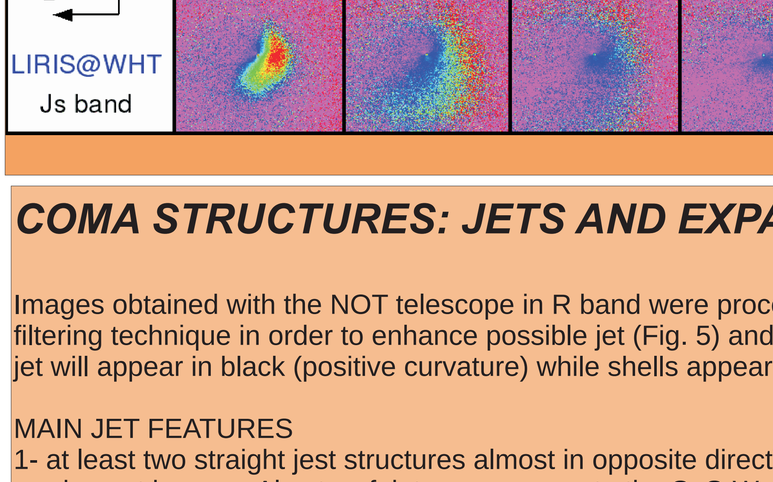
ABSTRACT

Comet 9P/Tempel was observed during the Deep Impact experiment using simultaneously 3 telescopes at "El Roque de los Muchachos" Observatory, in La Palma (Spain), We did broadband visible and near infrared images and low resolution spectroscopy in the visible and near-infrared. Observations were carried out from July 2 to 1. Data is still beeing analysed. In this work we present a brief descriptions of the observations done, and some preliminary results on the morphology of the dust coma and the evolution of the dust cloud ejected by the impact..

THE CAMPAIGN

The observational campagin comprises the use of 3 telescopes at the ORM: the 4.2 William Herschel Telescope (WHT), the 3.6m Telescopio Nazionale Galileo (TNG), and the 2.5m Nordic Optical Telescope (NOT). We used two camera-spectrographs for the visible observations, DOLORES at TNG and ALFOSC at NOT, and two camera-spectrograph for the near-infrared (0.8-2.5 microns), LIRIS at WHT and NICS at TNG. Observations were carried out from July 2 to 10 under photometric and very good seeing conditions. (< 1"). A summary is presented in the table.

Telescope	Instrument	dates	technique	program
4.2 WHT	LIRIS	3-7	broad-band infrared imaging with J and Ks filters, field=4x4'	dust
	LIRIS	3-7	low-res spectroscopy (R=1000) with zJ and HK grisms	dust
3.6m TNG	DOLORES	2	broad-band visible imaging with V,R,I filters, field=9x9'	dust
	DOLORES	2-9	low-res spectroscopy, 3000-8000A, resolution=11A	gas & dust
	NICS	8-9	broad-band infrared imaging with J and Ks filters, field=4x4'	dust
2.5m NOT	ALFOSC	3-5	low-res spectroscopy, 3200-9100A, resolution=8A	gas &dust
	ALFOSSC	3-10	broad-band visible imaging with R,I filters, field=9x9'	dust



THE OBSERVATIONS: AN EJECTED DUST CLOUD

Broadband R and J images obtained with the NOT and WHT respectively, calibrated in the *Af* quantity (e.g. Tozzi & Licandro, 2002), are presented in Fig. 1 and 2. Spectra in visible and near-ir show that in R and J bands most of the light come from dust reflection, so we assume that the obvious variations of the observed coma are due to variations in the amount of dust or dust properties.
To better see the "new" dust post-impact images are divided by the pre-impact ones obtained on July 3. This way obtain the variations respect to the pre-impact conditions. Results in J and R are presented in Fig.1 and 3 respectively.
MAIN FEATURES:
1- An expanding dust cloud in the SW direction up to 12-13.000km is visible on July 4, about 15hs after the impact. The rapid fading on the brightness of the cloud is indicative that most of the dust was ejected by the impact.
2- The cloud is visible the following days until July 7. After that the comet looks very similar to its pre-impact state, which is indicative that or the projectile do not create a new active region or any new active region generated has very few volatiles.

FIGURE 1
Broad band R images calibrated in Af and displayed in the same scale. An obvious increase in the brigtness of the coma is visible in July 4, about 15 hours after the impact, in the SW direction.

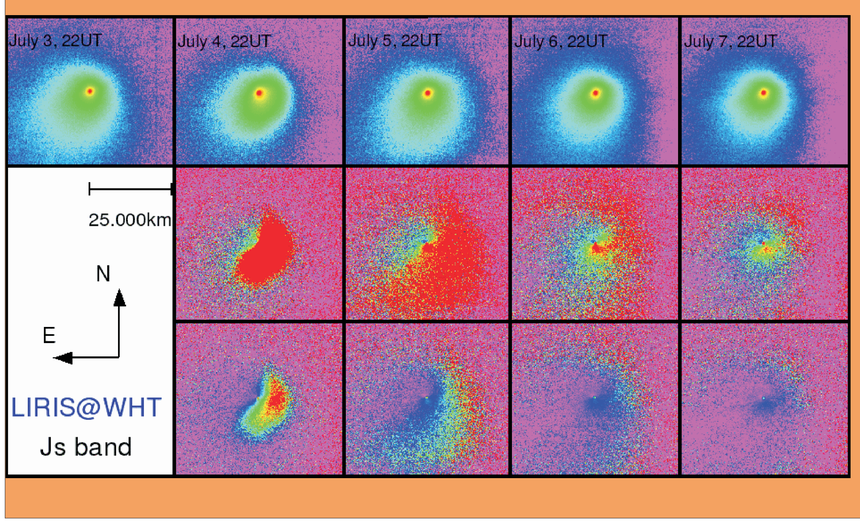


FIGURE 2
column 1- J images calibrated in Af
column 2- post-impact J images divided by Jun. 3 image. All in red is more than 1.25 time brighter than in July 3. Scale goes from 1(violet) to 1.25 (red).
Column 3- same images in a different scale to see the structure of the cloud.

FIGURE 3
Post-impact R band imagesl divided by pre-image obtained on Jul 3. Scale goes from 1 (violet) to 1.5 (red). Notice that after July 8 the coma looks very similar to that during pre-impact..

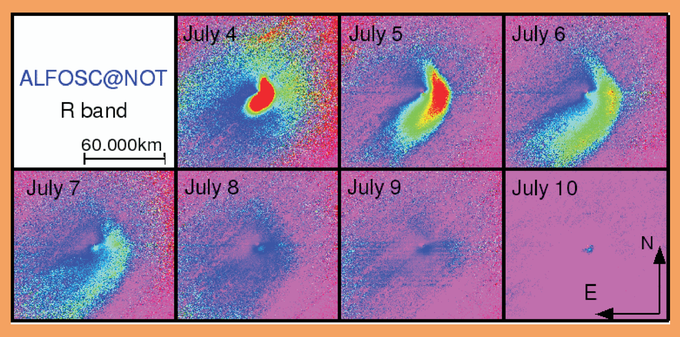
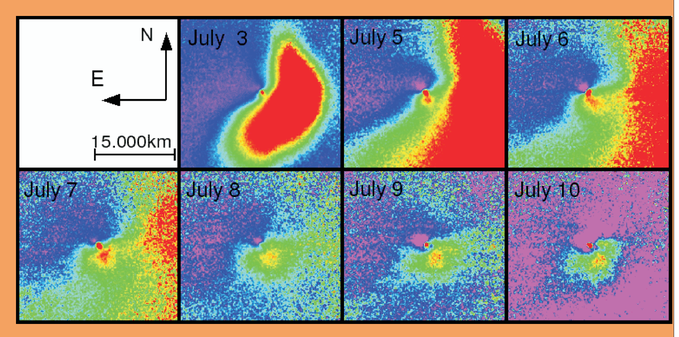


FIGURE 4
Close up of Fig. 3 to see details in the inner coma region.



COMA STRUCTURES: JETS AND EXPANDING SHELL

Images obtained with the NOT telescope in R band were processed using a variation of the Laplacian filtering technique in order to enhance possible jet (Fig. 5) and shell (Fig. 6) structures. The edge of a jet will appear in black (positive curvature) while shells appear in white.

MAIN JET FEATURES
1- at least two straight jest structures almost in opposite directions close to the E-W are present on pre-impact images. Also two faint more appear to the S, S-W.
2- Several straight jet structures appear on July 4. In the following days the same structures observed pre-impact clearly appear. After the ejected dust cloud disappears, the jet structures observed resemble those during pre-impact (consider that S/N on July 2 and 3 is lower than in the post-impact)

THE EXPANDING SHELL

A curved expanding shell, indicative of the border of the dust cloud, is visible (in white) in Fig. 6 until June 7.

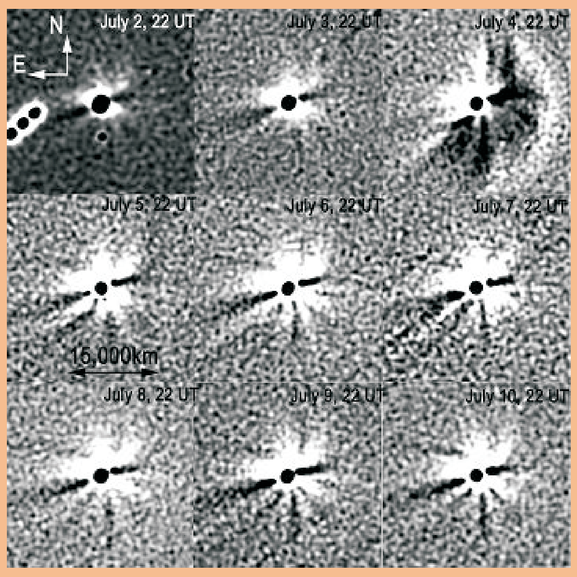


FIGURE 5
R band images processed with a Laplacian filter to enhace jet structures. Notice the straigh jets in black.

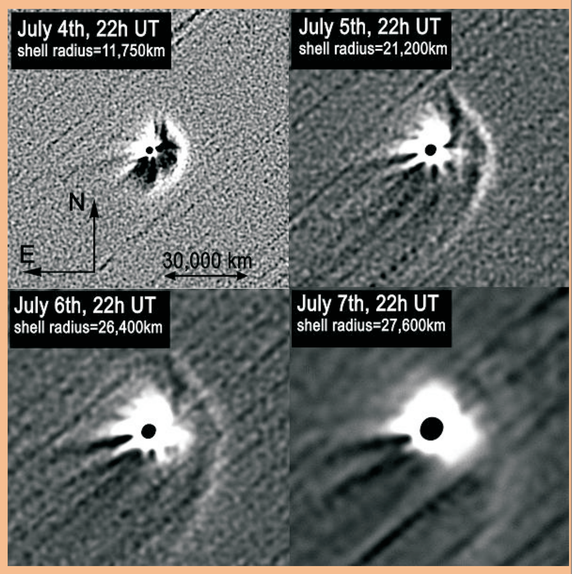


FIGURE 6
R band images processed with the Laplacian filter to enhace the curved shell structure (in white) that appeared after the impact. This defines the external border of the expanding dust cloud.

FURTHER WORK

1- spectroscopic data has to be reduced and used to determine gas production rates and dust colour.

2- images need to be further analyzed, an used together with MC models to determine properties of the ejected dust like size distribution, ejection velocity, and amount of dust released during the impact.