**HIGH RESOLUTION MONITORING OF 9P/TEMPEL 1 WITH SARG AT LA PALMA DURING THE FLYBY OF DEEP IMPACT.** M.T. Capria[1], G. Cremonese[2], M.C. De Sanctis[1], A. Boattini[1], E. Epifani[3], V. Lorenzi[4], L. Saba[5], J. Licandro[6], [1]INAF-IASF, Rome, Italy, mariateresa.capria@rm.iasf.cnr.it,[2]INAF-OAPD, Padua, Italy, gabriele.cremonese@oapd.inaf.it , [3]OAC, Naples, Italy, [4]INAF-TNG, La Palma, Spain, [5] INAF-OAT, Turin, Italy, [6]INGT, Tenerife, Spain.

**Introduction:** On July 4, 2005 the NASA spacecraft Deep Impact delivered an impactor on the comet 9P/Tempel 1, to study the explosion and the possibly fresh material underneath the surface of the nucleus. A worldwide observation campaign accompanied the mission, to characterize the activity of Tempel 1 before and after the impact. At La Palma (Canary Islands), the comet was observed during the days of the event using the echelle spectrograph SARG on the Telescopio Nazionale Galileo (TNG).

**Observations:** Comet Tempel 1 has been observed every night from July 2 to July 6 and then the night of July 9 with the cross dispersed echelle spectrograph SARG on the 3.5m TNG telescope in La Palma (Canary Islands, Spain). At the moment of observation, the comet had a heliocentric distance of 1.51 AU and a geocentric distance of 0.9 AU. The spectra have been obtained using a slit 8. arcsec long, providing a resolving power R=29000, with a yellow grism allowing to cover a spectral range of 4620-7920 Å and blazed at 5889 Å; most of the orders have an overlapping region with the adjacent orders.

Three spectra were acquired every night, with an exposure time of 1800 sec. The detector is a mosaic of 2 2Kx4K thinned and back illuminated CCDs with a 13.5 μm pixel size (0.16 arcsec/pixel), where the first chip include the first 34 orders (blue chip) and the second one the following 21 (red chip).

**Data Analysis.** The data have been reduced using the ECHELLE package of IRAF. Incandescent lamp observations have been used to determine the flat field and ThAr lamp spectra for calculating the dispersion curve. By fitting the Thorium line positions for each order, a dispersion solution has been achieved with rms errors lower than 7 mÅ. Fig. 1 shows one of the orders of a spectrum acquired on July 3, the order number 7 of the red chip, from 7270 to 7350 Å.

As can be seen from Fig. 1, a number of emission lines are visible in our spectra, and we are now cataloguing them. We are using as a help and a comparison list the catalogue obtained from a spectrum of 153P/2002 Ikeya-Zhang, taken on April 20, 2002 [1], [2]. Many more lines were visible in the spectrum of this comet: Ikeya-Zhang was more active, closer to the Sun and it was also observed at a higher resolution.

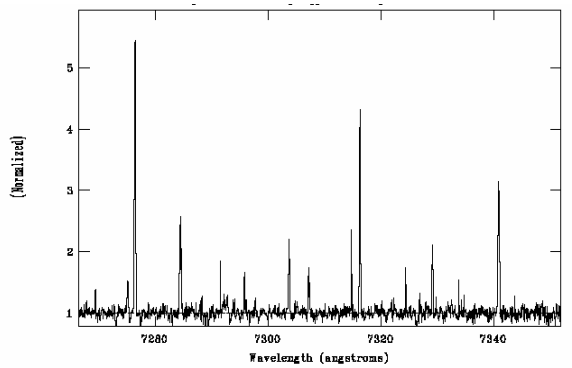


**Fig. 1 –** Order 7, red chip, from a spectrum acquired on July 3, 2005.

**Discussion.** While we have now pictures of the surface of comet nuclei, little is known about the composition and properties of comet matter, in particular in the inner layers. Coma spectroscopy is one of the few tools that can be used to infer the composition of the nucleus. The visible spectral range is crowded with emission lines, and between them many lines of daughter molecules and ions are still to be identified. Even new species could be hidden in this forest of lines, but high resolution is necessary to study this kind of spectra, and only in the last years the availability of high resolution spectrographs has been increasing. The study of these lines could provide a large amount of information on the composition and the chemical processes working in the coma, on the environment of molecular formation or condensation and of the thermal history of cometary ices.

We are presently listing and identifying all the lines present in the spectra by comparison with the catalogue of 153P/2002 Ikeya-Zhang [1] and with existing catalogs [3]. Most of the lines visible in the spectra can be attributed to $C_2$, $NH_2$ and CN; the atomic oxygen lines, both the green line at 5577 Å and the red doublet at 6300 and 6364 Å are clearly visible in every spectrum. The data quality is such that at least the lines of the red doublet can be distinguished from the corresponding telluric lines. In Fig. 2 it can be seen a detail of the order 20, from the red chip, of one of the three spectra acquired on July 3, few hours before the impact. The atomic oxygen emission line at 6300 is the most prominent line in the plot; the telluric line, while blended with the cometary one, is distinguishable.

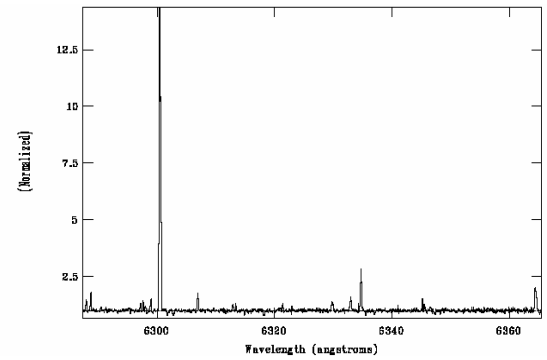


**Fig. 2 –** A detail of the order 20, red chip**,** from a spectrum acquired on July 3, 2005, showing the atomic oxygen line at 6300.

The comet has been observed before and after the impact with the projectile for several nights. One of our aims is also to compare between them these spectra, looking for differences in the lines visible in the orders before and after the impact.

**References:** [1] Cremonese G. et al. (2006) *A&A*, in press. [2] Capria M.T. et al. (2005) *A&A, 442*, 1121-1126 [3] Cochran, A.L. and Cochran, W.D. (2002) *Icarus, 157*, 297-308.