

## OPTICAL IMAGING AND SPECTROSCOPY OF THE INTER-ACTION WITH JUPITER OF COMET SHOEMAKER-LEVY 9

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In this presentation we describe various observations carried out at the Observatorio del Roque de los Muchachos on the Island of La Palma (longitude W 17° 53, latitude N 20° 46), using the 1m Jacobus Kapteyn Telescope and the 2.5m Issac Newton Telescope. Astrometric Observations of the comet in May 1994 were obtained using the Issac Newton Telescope and a Prime Focus CCD camera and these were transmitted to JPL via the Minor Planet Center and used in the final orbit determination.

At the time of the impacts themselves, images were obtained on July 6 and in the period July 15 to July 22 using the Jacobus Kapteyn Telescope with a cassegrain CCD camera. With this setup, one pixel corresponds to approximately 0.3 arc seconds so that the 512 by 52 pixel window used corresponded to a field of view of 2.6 arcminutes. Narrow band filters with a full width at half maximum of 5 nm centered at 407, 501, 620, 630, 732 and 907 nm were used. Images covering the time of impact and the interval immediately following were obtained for fragments A, H, L and Q2, and images of the impact sights of other fragments, including that of G, were also obtained. In the images of the impact sights of G AND H the asymmetric ring possibly due to deposited plume material surrounding the impact point is clearly detectable. These images allow multi-colour photometry of almost all the impact sites resolvable from Earth, while combining the 407 nm, 501 nm and 610 nm can produce near-real colours as the final image.

On the nights of July 19, 20 and 21, we were also able to carry out CCD spectroscopy using the Issac Newton Telescope and the Intermediate Dispersion Spectrograph which gave a low-resolution spectrum with  $\Delta\lambda$  at 0.6 nm. Of particular interest is that we thus had simultaneous CCD images with the 1m telescope and low resolution spectra with the 2.5 m telescope of the evolving plume resulting from the collision of fragment L. Images obtained every 2 minutes at the time of the impact of fragment L clearly show the resulting plume above the limb of Jupiter for approximately 10 minutes. Identifiable in the spectra of the event obtained at the same time are emission lines due to neutral atoms of calcium, iron, magnesium, manganese and sodium, implying that all these species are vapourized so that the plume temperature must have

been in excess of 1000K. Spectra were obtained at two minute intervals and the variation in the strength of the various lines with time is very evident with the sodium line becoming strongest at 22.34 UT and all the lines having faded almost to the level of the noise by 22.42 UT.

On the following night of July 20 spectroscopy of the Q2 plume was obtained with the same telescope/spectrograph combination, but at a higher resolution with  $\Delta\lambda$  of 0.1 nm. Again neutral sodium was detected in emission, but in addition, with the higher resolution, the sodium D-lines were well resolved and their time evolution was again recorded. When these datasets are combined, they will prove of immeasurable value in disentangling the structure of the plumes according to the various theoretical models that are already calculated.

## OBSERVATIONS FROM THE IMPACT OF COMET P/SHOEMAKER-LEVY 9 IN JUPITER FROM THE PIC-DU-MIDI OBSERVATORY, FRANCE

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The impact of comet P/Shoemaker–Levy 9 has been observed from the Pic-du-Midi Observatory, France. Observations with the 1 meter telescope were performed starting several months before the impacts, to several months after. During the event, a Nicmos infrared camera with several filters (J (1.25  $\mu\text{m}$ ), H (1.65  $\mu\text{m}$ ), K (2.0–2.3  $\mu\text{m}$ )) has been adapted to one of the Nasmith focus. The spatial resolution was 0.4 arcsec per pixel. The other focus contained a Thomson CCD with various filters between 0.4 and 1.05  $\mu\text{m}$  and a resolution of 0."28 per pixel.

At the 2 meter Bernard Lyot telescope, high resolution spectroscopy has been performed with the MUSICOS (MULTI SIDE CONTINUOUS SPECTROSCOPY) spectrograph. The instrument has a spectral resolution of about 36,000 in the spectral range between 564 and 875 nm. A total of 35 spectra of almost all impact sites and of the flash and plume of impacts L and Q<sub>1</sub> were obtained. These last ones do show at least seven metallic emission lines: Na (doublet at  $\sim$  589 nm), Fe (636 nm and 805 nm), Ca (657 nm), Li (671 nm), and K (767 nm). H $\alpha$  emission is also seen. These emissions appear about 15 minutes after