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CCD imaging of Jupiter during its impact with comet Shoemaker-Levy 9 : Observations from Jaisalmer

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Abstract. CCD imaging observations of Jupiter were carried out, from the desert location of Jaisalmer in Rajasthan, during the period of its collision with the comet Shoemaker-Levy 9.A Celestron 8 telescope was used with a Lynx PC Plus Digital Imaging System and a large number of images (~ 100) were acquired. Good sky conditions prevailed on 21st, July 1994 when sites of earlier impacts (KLG) were clearly seen on the disk of Jupiter and recorded. Image processing of these frames were carried out to obtain one dimensional impact image profiles in E-W as well as N-S directions. The profiles were subsequently corrected for the aspect effects. In this paper a limited sample of 12 profiles are used to look for trends in the temporal development of the K impact site. The time coverage of the G and L sites are not enough for any detail work.

1. Introduction

The impact of the fragments of the Comet Shoemaker-Levy 9 (1993e) on Jupiter during the period 16th - 22nd July 1994 has been one of the most remarkable astronomical events in recent memory. The impacts also have brought into sharp focus the importance of 'sudden' events. The events have been observed extensively worldwide and also from various space platforms. In the Indian subcontinent due to peak monsoon conditions prevailing over large parts of the country, optical observations of the collision have been extremely limited. At PRL a special effort was made to observe the impact from a location in the Rajasthan desert.

2. Observations

The observations which are reported here were carried out from a camp site set up in the northern outskirts of Jaisalmer (26° 53N', 70° 55'E). A f/10 Celestron 8 Schmidt-Cassegrain telescope with 0.1 arcsec / μm plate scale was used. A 192 x 165 Lynx PC Plus Digital Imaging System was used. It has rectangular pixels of size 13.75 μm x 16 μm. Careful

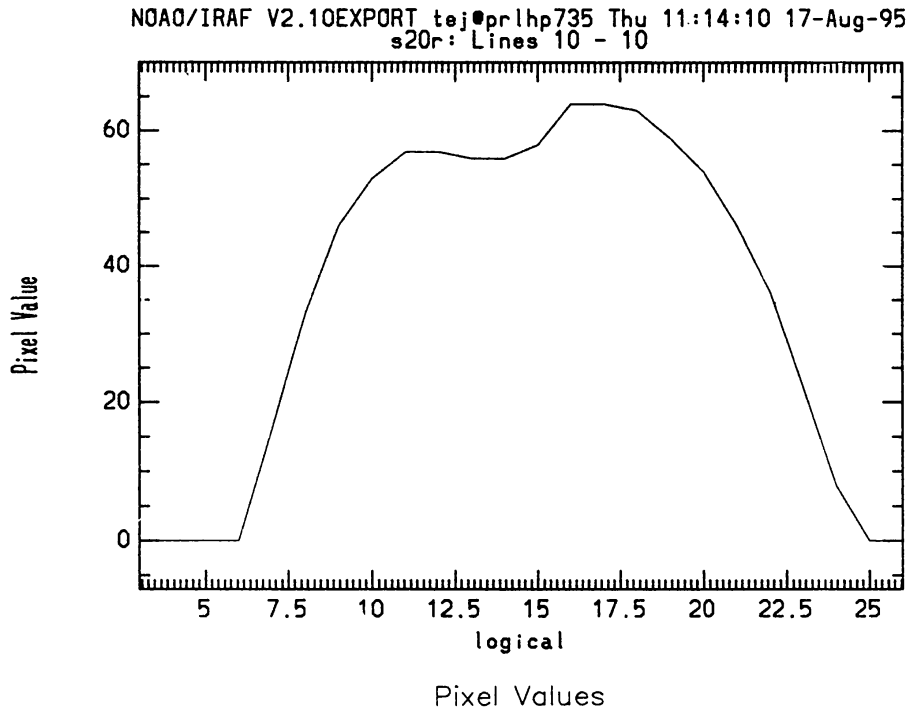

Fig 1. A typical E–W scan

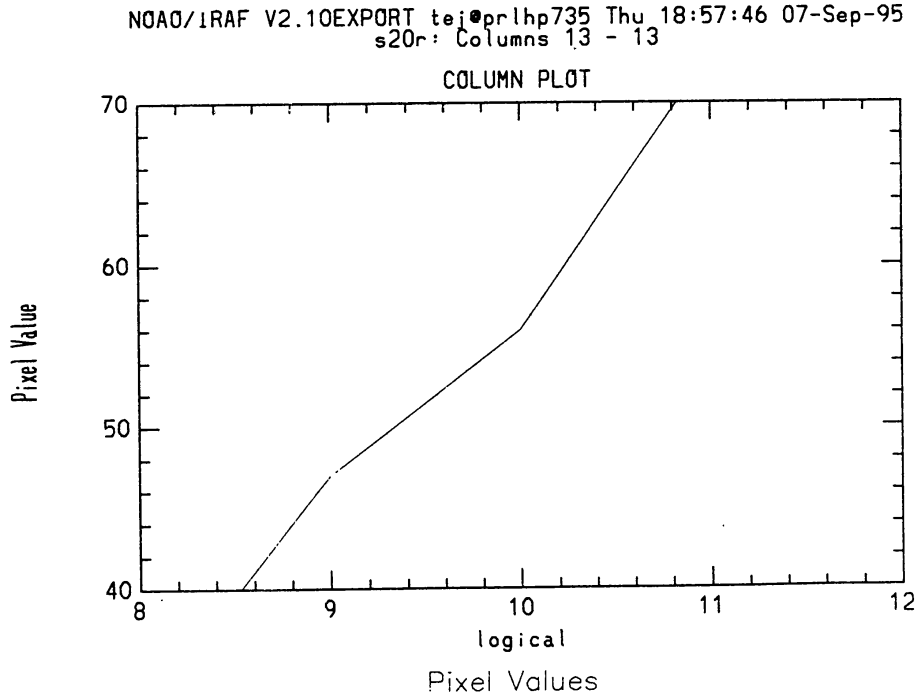

Fig. 2. A typical N–S scan

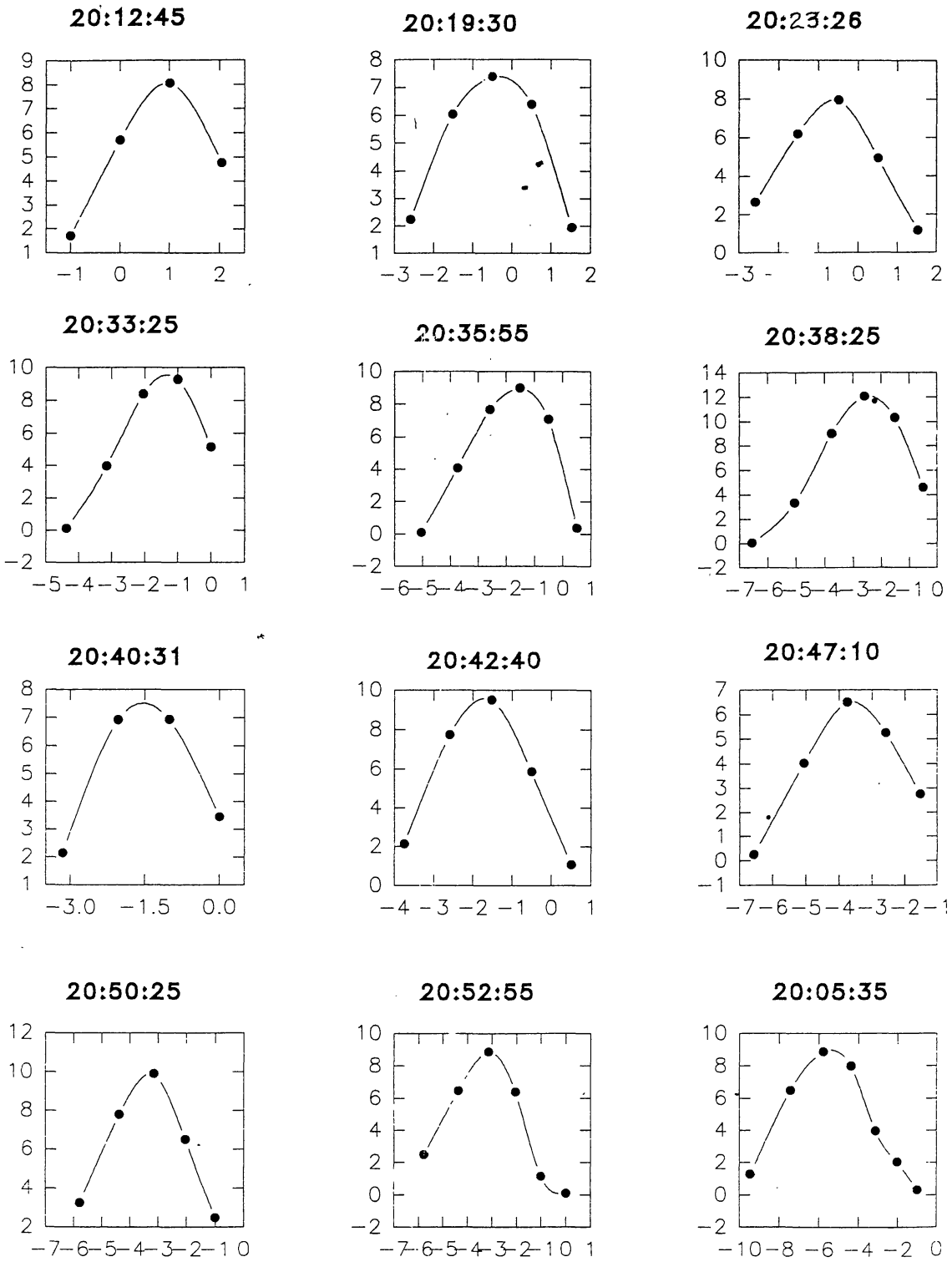

Fig 3. This shows the mosaic of the spot profiles.X–axis gives the pixels and Y–axis gives the pixel values.The time of each frame in IST is given at the top of each profile

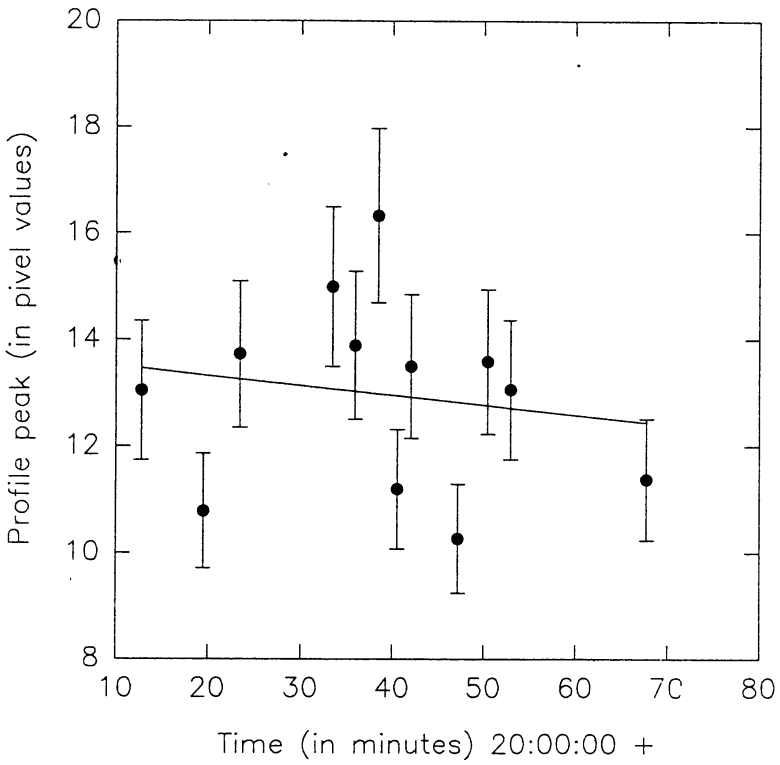

Fig 4. The normalized spot profile peak values as a function of time. The straight line is the least squares fit

focussing of the instrument was done using the Galilean satellites of Jupiter. The CCD was used in the uncooled mode. The sky conditions though better than most place in the country were not ideal. Only on one day viz. 21st. July 1994 was kay clear for three hours when continuous meaningful observations could be taken. The exposure of each frame was 0.01 secs. Attempts to observe from Gurushikhar (72° 47'E, 24° 39'N) with a 14 inch telescope and a 1K x 1K HPC-1 spectra source CCD were completely clouded out.

3. Image processing and analysis

The Jupiter images acquired on 21st July 1994 were subjected to the standard procedures of CCD image calibration namely, flat fielding, bias subtraction and thermal adjustment. The images were converted to specific formats to make them IRAF compatible. The IRAF image processing package was used for detail analysis. From the given central meridian passage of the impact sites on 18th. July 1994 (IAUC 6026), the central meridian passage on 21st was calculated and comparing it with the our CCD frames, the sites were identified as L, K and G impact sites. Here, we have taken the rotational velocity of the impact belt as clost to the of system III with a period of 0.413538 days (IAUC 6026). A cross identification was also done by calculating the longitude of the spots, from the central mefidian longitude, and matching

them with the published longitudes. The images were rotated through 14° to correct for the tilt of the CCD frames with respect to the equatorial plane of Jupiter. Image scans were taken along the latitudes and the longitudes of the impact sites.

4. Results and discussion

Fig. 1 shows a E-W scan across the disk of Jupiter, at the latitude of the K impact site. The Signature of the impact site is seen as the departure from the smooth curve representing the disk of Jupiter. Fig. 2 shows a N-S scan across the spot. As is clearly evident from the figures, the spot is more extended in the E-W direction. This may be due to the horizontal shear of the zonal flow. Fig. 3 shows the actual profiles of the 12 scans taken over a period of ~ 70 minutes on 21st July 1994. These are derived as departures from the Gaussians representing the disk values, normalized to the peak values of the Gaussian for a given scan, as a function of time. The least squares fit shown in the figure would literally mean the spot disappearance in ~ 12 hours. However, due to the large errors involved (~ 20%), it is not possible to conclude from the limited data set any temporal development during the period of observations. It is however proposed to use the entire data set of 100 images for a more detail study which would bring down the errors and reveal fine trends in the evolution of the spot.

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