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BELGRADE OBSERVATIONS OF SL9 IMPACT ON JUPITER

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Abstract. CCD observations of the perturbations in Jupiter's atmosphere caused by the impact of fragments of the comet SL9 on this planet are presented. The appearance and evolution of "dark spots" in Jupiter's atmosphere in the V and R spectral region were recorded.

1. INTRODUCTION

The impact of comet Shoemaker–Levy 9 1993e (SL-9) on Jupiter occurred from 16 to 22 July 1994. At Belgrade Observatory we observed perturbation in Jupiter's atmosphere during and after the impact time.

Generally, we have three possibilities to observe the consequences of SL-9 comet crash into Jupiter. Namely, direct observations (photograph) of Jupiter's disc, spectral observations of Jupiter and the photometry of the impact flashes reflected from Jupiter's satellites. Two facts were important for the selection of our observing program. First, during the impact period Jupiter was not more than about 32° above the horizon and second, we have just prepared a CCD camera for the first use at the 65 cm refractor. So, we decided to observe Jupiter's disc with CCD camera in V and R spectral regions. Here, we present a part of results of our successful observations.

2. OBSERVATIONS

The observations were carried out at the Belgrade Observatory from 17th July till 8th August covering the impact period and 17 days after it – until the visibility of Jupiter became very poor.

Santa Barbara Instrument Group model ST–6 professional CCD imaging camera was attached to the Zeiss 65/1055 cm refractor. The refractor aperture was reduced to 40 cm. Two glass filters were used : VG–14 for the visual (V) region and RG–8 for the red (R) region.

Using the spectral response data of the camera given by the manufacturer and the spectral transmission curves of the glass filters, it was estimated that the camera plus VG–14 filter yields an overall spectral response having the maximum (normalized to 100%) at 530 nm, full width (FW) at 50% from 500 nm to 560 nm and FW at 5%

from 475 nm to 590 nm – which is close to V spectral region of Johnson and Morgan (1951). However, the camera plus RG-8 combination yields a less symmetric overall spectral response with the maximum (normalized to 100%) at 730 nm, FW at 50% from 700 nm to 920 nm and FW at 5% from 680 nm to 1000 nm. The maximum itself is close to Stebbins and Whitford's R region in their six-color system (Stebbins and Whitford, 1945), but because of the very extended red wing of the camera plus RG-8 spectral response curve, we only conditionally refer to it as "R' We also estimated that the effective sensitivity of the camera-filter system in our R region is about 15 times higher than in the V one.

Some details about our observation are given in Table 1 (date of observations, the time interval, the spot of fragments, which was seen in Jupiter's atmosphere).

Table 1 Observations of Jupiter. I – Date of observations, II – the time interval of observations, III – the spots of fragments seen in Jupiter's atmosphere and IV – number of obtained images. On July 17 and 18 were taken two and tree images in R filter (in brackets).

I	II	III	IV
17. 7.	18 : 34–20 : 14	E, A, C	22 (2R)
18. 7.	18 : 30–21 : 17	G, H	65 (3R)
20. 7.	18 : 42–19 : 44	C, K, L	12
23. 7.	18 : 10–19 : 57	K, L, GR, Q1, H	36
24. 7.	18 : 27–19 : 25	H, E, A, C	4
25. 7.	18 : 36–19 : 25	UWK, L, GR	12
26. 7.	19 : 57	H E	1
29. 7.	18 : 27–19 : 39	E, C, P2, UWK	23
30. 7.	19 : 14–19 : 23	K, L, GRQ1	4
31. 7.	18 : 31–20 : 01	GRQ1 H E	31
05. 8.	18 : 55–18 : 57	H, TV, E	2
06. 7.	18 : 30–19 : 16	UWK, LG	15
08. 7.	18 : 31–18 : 58	UWK	6

During and after impact period we made 233 images of Jupiter. Some of them are presented in Figs. 1-3.

3. DISCUSSION AND CONCLUSION

By the inspection of our CCD images we can conclude :

– All observed traces of fragments in the V spectral region were darker than surrounding Jupiter's atmosphere. For the medium-size impact traces we obtained a considerably lower contrast in the R spectral region.

– Scrutinizing all obtained images we were not able to detect small impact traces like, e.g., D, N, or Q2. According to the marvelous images taken by Hubble Space Telescope (Macchetto, 1994) our estimate of the angular sizes of these impact spots were approximately $0''6$, $0''3$ and $0''2$, respectively. Slightly bigger one as, for example, Q1 being about $1''1$, was detected in our images of Jupiter. We consider this as an

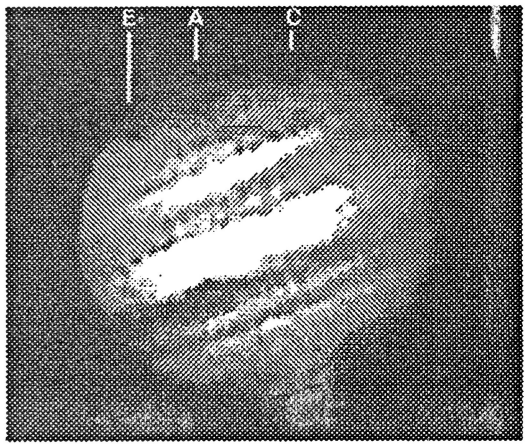

Fig. 1. Jupiter on 17. 7. 94. at 18 : 56 UT. The image shows, from west to east, the impact sites of fragments E, A and C. The darkest and most complete feature corresponds to the fragment E, which is the youngest, being old only 3.8 hours. South is up and west is to the left.

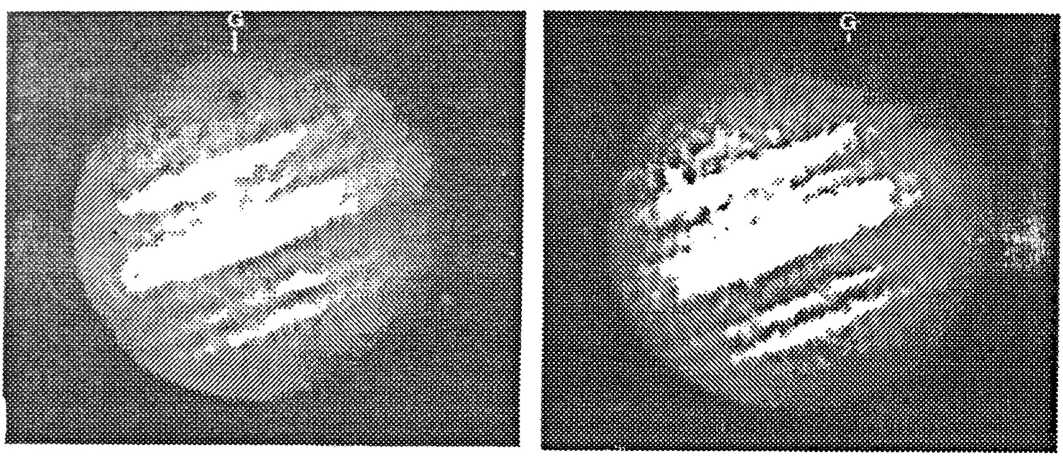

Fig. 2. Jupiter on 18. 7. 94. at 19 : 20 UT (left) and 20 : 06 (right). A huge dark elliptical spot with a dark core at its north–east is seen around the impact site of the fragment G just 11.5 hours after the impact (left). About one hour later, at 20 : 06 UT the impact structure G was close to the central meridian (right).

indication that our overall realized resolution (atmosphere + telescope + CCD + displaying facility) is somewhere around 1″. Obviously, the nominal CCD resolution of about 0.5 arc sec per pixel was not achieved because of the other contributors – most probably the Earth's atmosphere, especially considering the high zenith distance

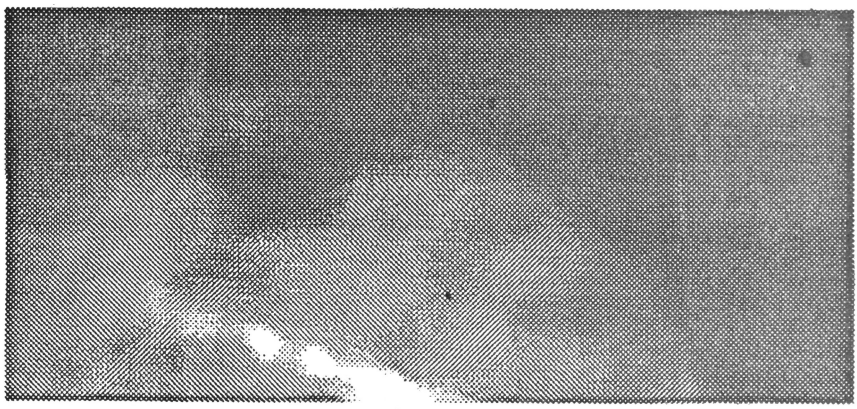

Fig. 3. Jupiter on 6. 8. 94. at 19 : 04 UT. Dark structure is seen east from the central meridian. It comprises the impact-traces U, W and K. The age of K trace is 488.3 hours. Here one can see that formation of a new dark belt, "SL-9 belt", in the atmosphere of Jupiter takes place.

of Jupiter.

– None of the large observed spots disappeared during the observation campaign. They gradually lost their individuality by extending in longitude, merging with neighboring impact traces and behaving as though they were taking part in building a "new" dark belt in Jupiter's atmosphere. This "SL-9 belt" was not yet completed till the end of our observational campaign (8. 8. 1994).

References

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