CALAR ALTO OBSERVATIONS OF THE A, H, L, Q1 AND Q2 IMPACTS

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During the Shoemaker-Levy 9 impacts on Jupiter, the Calar Alto 3.5 meter and 2.2 meter telescopes were equipped with the MAGIC infrared camera/spectrometer and a high speed infrared photometer, respectively. We had excellent weather and were able to successfully observe during the ten impact events available to us: A,E,H,L,P2,Q1,Q2,S,T, and U. Herbst et al. summarize the Calar Alto observing campaign, which utilized multiple telescopes and instruments, in a separate abstract in this issue. By the August IAU meeting, we had obtained 2.3μm lightcurves for the A,H,L,Q1 and Q2 events; here we report on the details of these impacts.

Although we observed the impacts under different conditions – some fragments were large (H,L,Q1), some small (A,Q2), some hit pre-existing impact scars (Q1,Q2), some were observed at or before sunset in Spain (A,H,Q2), etc. – they had features in common. In particular, each of our five lightcurves shows a small pulse, or precursor, that precedes a much brighter and longer-lasting peak. These precursors occur within a minute of the actual impact times as determined from the best orbital solution or, for the case of H and L, from direct Galileo observations. The agreement between predicted and observed times suggests that precursors are entry phenomena. The Table shows the timing of these key features of our lightcurves.

Impact	Date (July)	Impact Time (Accepted)	Start of Precursor	Start of Main Event	Precursor-Main Event Delay
A	16	20:11:00 ± 3 min	20:11:00	20:18:00	7 min
H	18	19:31:59 ± 1 min	19:33:00	19:38:00	5 min
L	19	22:16:48 ± 1 min	22:16:30	22:17:30	1 min†
Q2	20	19:44:00 ± 6 min	19:44:00	19:52:00	8 min
Q1	20	20:12:00 ± 4 min	20:13:00	20:20:00	7 min

† *The table shows the time between the first and second L precursors rather than the time between the second precursor and the main event.*

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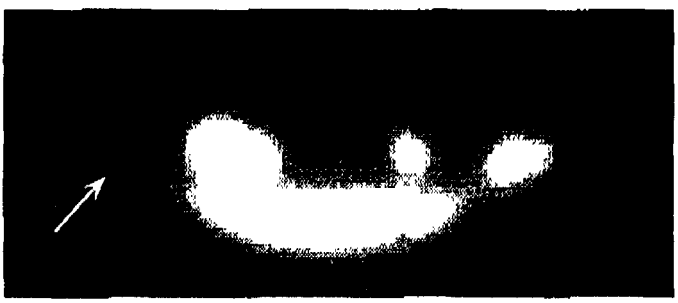
Since the IAU meeting, we have reduced new, more sensitive lightcurves and accounted for saturation effects. These data now show *two* separate precursors for the H and L impacts rather than just one. We believe that the first precursor marks the meteor entry, the second is the expanding fireball, and the main event observed by infrared ground-based telescopes is due to ejecta from the primary impact reentering the jovian atmosphere.

Finally, we see evidence, in the form of a faint spot, for an unknown fragment that struck Jupiter at least forty minutes before the main L impact. The spot is visible in reflected light in nearly 100 frames covering the twenty minute period from 21:56 to 22:16. One of these frames is displayed in Fig. 1. In this highly stretched image, the south polar hazes and the scars from the previous K, C, and A impacts (left to right) appear to be merged. Two of the south temperate ovals can be seen as faint blobs slightly north of the C spot and west of the central meridian. The L mystery spot is clearly visible near the south-eastern limb, just to the left of the bright K complex. We suspect that this spot is the impact scar of the lost J fragment, although a small previously unknown SL9 fragment cannot be ruled out.



AAT OBSERVATIONS OF COMET SHOEMAKER LEVY-9 COLLISIONS WITH JUPITER

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We used the InfraRed Imaging Spectrometer (IRIS) on the Anglo Australian Telescope to monitor the collisions of Comet Shoemaker-Levy 9 fragments C, D, G, K, N, R, V, and W with Jupiter. We also monitored the impact sites for up to 10 hours each day from 16 to 23 July UT 1994. IRIS is a near-infrared camera/spectrometer with a 128 by 128 element Mercury–Cadmium–Telluride (NICMOS2) detector. This instrument was used primarily as an imaging spectrometer for these observations. In this mode, each

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