

# A second Leonid outburst in 1995

Peter Jenniskens

NASA/Ames Research Center

After its first awakening in 1994 [1], the Leonid stream has continued to impress observers. A first impression has been given by Juergen Rendtel in an IMO Meteor shower circular under the header: "short summary: no outburst" [2]. This short communication is to point out that there was in fact a meteor outburst in this second year of the International Leonid Watch, the disagreement being merely one of semantics, however. I adopt the following definition of a "meteor outburst": any significant increase of rates above the usual annual meteor stream activity [3]. In most cases, those enhancements will be due to relatively fresh cometary ejecta that have not scattered so widely as to become part of an annual stream.

The 1995 Leonid stream was well observed, amongst others in a campaign by the Dutch Meteor Society with photographic stations in Spain and California. At the time of writing, only a very small portion of the visual observations have been extracted from the tape recordings and prepared for analysis. Visual data are available from Marco Langbroek, Koen Miskotte (Gaudix, Spain) and the author (San Jose, CA) [4].

Additional visual counts were kindly provided by Carl Johannink (The Netherlands), Neil Bone (UK), and a long series of counts by George Zay (CA). The resulting Zenith Hourly Rates are shown in Figure 1 and were calculated for an adopted magnitude distribution index of 2.3 and a radiant altitude dilution exponent of 1.4.

I confirm the impression by Neil Bone and others that the Leonid rates were "substantially better than in the late 1970s, 1980s and early 1990s" [5].

Rates were enhanced on November 17 and 18, with best rates over Europe during the night of November 18. The

peak rate was about  $ZHR = 32 \pm 5$  at a time that annual Leonid activity was about  $ZHR = 12$ . The peak rate is in good agreement with rates calculated by Rendtel [2], but is also 2-3 times higher than normal rates, sampled in many time intervals in a systematic way and confirmed by at least five independent visual observers. In summary: there was an outburst.

The outburst is confirmed by radio meteor scatter data by Ilkka Yrjola from Kuusankoski, Finland, who kindly forwarded his data shortly after the event.

At this time, I know of similar results by Maurice de Meyere, Deurle, Belgium, and Peter Bus, Groningen, The Netherlands. Yrjola's counts of meteor reflections for the past three years show nicely the significant increase of Leonid rates in 1995. On November 18, the count rose above the typical sporadic background at this time of year (dashed line), while no such increase was observed in 1993. The radio data, too, suggest that the event was of long duration as in 1994. After correction for observability [6], I have a peak at  $234.60^\circ \pm 0.05$  (1950.0) and an exponent  $B = \Delta \log ZHR / \Delta \lambda_0 = 1.0 \pm 0.1$ . Hence, rates started to increase at about  $233^\circ.6$  and the event was over by  $235^\circ.6$ . Visual observations suggest a peak at about  $234.65 \pm 0.10$ . In addition, the mean reflection duration was much longer than those of the sporadic meteors, consistent with a high abundance of bright meteors (as mentioned by many visual observers).

Assuming that Leonid rates would follow patterns of activity during the last return in the 1960's, I was expecting a broad activity profile of relatively bright Leonid meteors, with peak activity of about  $ZHR = 40$  (30 from the outburst, 10 from the annual

stream), an exponent of  $B = 1.05 \pm 0.1$  and a time of maximum at solar longitude  $235^\circ.2 \pm 0.1$  (Noting that the time of maximum could well scatter considerably around the node of the comet orbit at  $234^\circ.5$ ) [7].

Disappointing to me was only that the peak did not happen over California; much to the joy of European observers

who had a very good time.

I conclude that, thus far, the Leonids behave much the same way as during the previous return. If this trend is going to continue next year, then there will again be a broad shower of bright Leonids but with higher rates, perhaps up to  $ZHR = 100$ .

In addition, observers are requested to keep attention to a possible narrow component of faint Leonids that may start to appear on top of that broad shower in 1996 or 1997, most likely somewhat after the solar longitude  $234^\circ.5$  (1950.0).

## References

- [1] Jenniskens P., 1994, WGN **22**, 194-198
- [2] Rendtel J., 1995, IMO meteor shower circular (Leonids, Nov. 1995)
- [3] Jenniskens P., 1995, Astronomy & Astrophysics **295**, 206-235
- [4] Langbroek M., 1995, priv. communication.
- [5] Bone N., 1995, priv. communication.
- [6] Hines C.O., 1955, Can. J. Phys. **33**, 493-503
- [7] Jenniskens P., 1996, Meteoritics (March issue - in press)