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Lunar Impact Flashes amateurs' observations: first results of the 2025-2026 campaigns

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Lunar Impact Flashes (LIFs) are flashes that can be observed on the surface of the Moon, resulting from meteoroid impacts. Their characterization in terms of energy release and temporal and spatial flux is important for many reasons. First, it can help to improve our knowledge on the dynamics and size of the small body's population. Moreover, the design of a future lunar base and corresponding activities should consider the risk posed by these events. Finally, it should be possible to associate the brighter LIFs with moonquakes generated by impacts and to use this to understand the internal structure of the Moon.

The ESA CubeSat mission LUMIO (Lunar Meteoroid Impact Observer) [1], led by Politecnico di Milano, will observe LIFs on the far side of the Moon from the neighbourhood of the L_2 point in the Earth-Moon system. The observations that it will gather will need to be compared to ground-based observations to have an overall understanding of differences in rates of these phenomena between the near and far sides. To train amateur astronomers in this regard, we have organized a series of LIF observing campaigns starting from the Geminid meteoroid stream in December 2025.

The first campaign was supported by two webinars to explain how to observe, to analyse the observations and to estimate the magnitude of the detections. A dedicated web interface was developed to collect the data. It was improved and enriched after the first campaign, thanks to the feedback and suggestions provided by the users (36 people submitting data from 13 countries all over the world). It allows the user to upload images and videos of a suspected LIF, together with technical information regarding the observing instruments. The users are allowed to see what others have uploaded and a specific tool allows them to see whether different users have detected LIFs at the same time.

The final confirmation of the events requires a specific expertise in analysing the images and videos provided. In the case of the Geminids campaign, this was done by firstly looking for close overlaps in time between the reported LIFs. These were called 'suspected events'. Secondly, these temporally overlapping events were examined to see if they were located at the same location on the Moon. Observations at the same time by at least two observers were called 'confirmed events'. Thirdly, observers who were observing, but did not report a LIF at these times, were asked to re-check their videos in case they have not noticed the flash. In this way, in the case of the Geminid campaign we have obtained at least 14 confirmed events.

The interest demonstrated by amateurs within about five months is very encouraging and it has shown the importance of the amateur community also for challenging tasks and how a continuous communication between experts and non-experts is really an added value.

References

[1] Cipriano A. M., Dei Tos D. A. and Topputo F. (2018), Front. Astron. Space Sci. 5:29.

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