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Joint observations of Lunar impact flashes

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Abstract

The nature of lunar impact flashes has been discussed for more than 10 years and is still poorly known. In order to contribute to the understanding of these radiations, we developed joint observations of lunar flashes between Morocco and France and analysed here a compilation of flash observations.

1. Introduction

The possibility of observing impact flashes from ground-based telescopes was suggested tens years ago by [1][2]. The procedure consists in evaluating the light emitted by vapor plumes for impacts with the highest velocities. It is now well established that it is possible to detect these phenomena with modest telescopes. We are creating a network of 3 telescopes involving the University Cadi Ayyad of Marrakech, Paris Observatory and Toulouse University. In order to optimise our observations, we compiled and analysed flash records from meteor showers and sporadic impacts [3][4][5][6][7][8]. We focus on two independent observable parameters: the maximum emitted detected power (or flash magnitude), and the duration of the flash.

2. Joint Observations methods

The development of a Franco-Moroccan Network dedicated to the observation of lunar impact flashes will allow us to realize the simultaneous observations between the Marrakech Observatory, Oukeimden Observatory (University Cadi Ayyad, Morocco) and Uranoscope of Ile de France observatory (Toulouse University and Paris Observatory, France). We used three 35 cm diameter telescopes (C14) with a HyperStar system to enlarge the field of observation, a high speed Watec camera (720×576 pixels - 50 fps) and a GPS system to determine the duration of the flash. Observations are done between the last and first quarters of each lunar month. We use the Ufocapture software to automatically detect impact flashes. The detections must be confirmed by at least two different observatories or be observed at least on 2 consecutive frames to take out any ambiguity.
We present our first observations results of 2011. The different weeks of joint observations demonstrated the multiple interests of simultaneous observations at several sites (confirmation of impact, spatial and temporal location).

Figure 1: C14 telescope and Watec camera used for Impact Flashes Monitoring

3. Magnitudes and durations of impact flashes

In order to optimise our observations, we compiled 54 flashes observations from different sources [3][4][5][6][7][8]. The flash magnitude ranges from 4 to 10; 27 events belong to the Leonids shower, 12 belong to the Geminids, one is a Taurid, one is Perseid, and 13 are sporadic. A histogram of visual magnitudes, divided into three groups (the Leonids, the Geminids and Sporadics) is given in Figure 2. Two distinct magnitude distributions are derived. The observed flash magnitudes associated with Leonid meteors are in the range (3 - 10) with peak values between magnitudes 5 and 7. The distribution of Geminid and Sporadic flashes are shifted towards higher values, mostly larger than 7 -8. The largest number of high magnitudes (9 - 10) is observed for Geminid flashes.

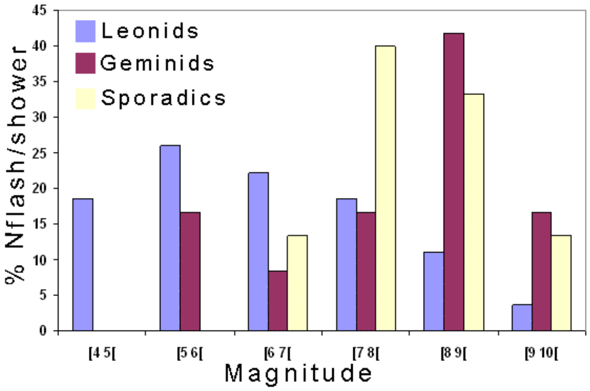

Figure 2: Bar plot of magnitudes for sporadic impact, Geminid and Leonid. The histogram of magnitude indicates the differences in magnitude distribution for the three groups.

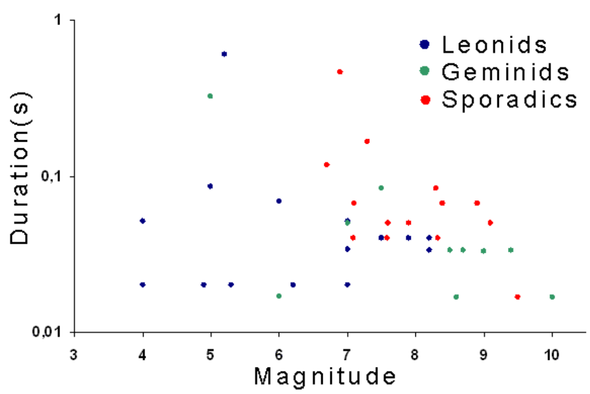

Figure 3: Magnitude of the flash as a function of the duration for sporadic impacts, geminid and leonid

The exposure time of each half frame is 1/60 s(NTSC mode) or 1/50 s (PAL/SECAM mode). The minimum flash duration observable is consequently around 0.017 or 0.02 second . We observed that brightest flashes of 4 to 7.5th magnitude have the maximum duration ranging from 0.017 to 1 second. Moreover dimmer flashes of 7.5 to 10th magnitude have the shortest duration ranging from 0.017 to 0.08 second. In first order, we can consequently observe than the brighter the flash, the longer it is. In second order, we observe a larger variability for smaller magnitude, which is due to the Leonids distribution. While the logarithms of Geminids and Sporadics flash brightness and flash duration are correlated, Leonids, which are generally brighter, have shorter duration than Geminids and Sporadics. Our compilation reveals that flashes dimmer than magnitude 10 were never reported.

4. Conclusion

A better understanding of the nature of impact flashes and of the conditions of detectability has been gained from the analysis of a compilation of magnitudes and duration of flashes for various swarms and sporadic events. This will enable us to adapt our detection facilities to improve the number of detections by testing new technical solutions (e.g. diameter of telescope, infrared cameras, sensor resolution, and acquisition speed).

The integration of the Oukeimden and Marrakech observatories in this project represents a possible first-order scientific involvement in an international frame. This Franco-Moroccan network is a good opportunity to have more lunar flashes detections and to diversify observation methods in the future (IR, visible, polarized lights).

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