LUNAR IMPACT FLASHES RECORDED DURING THE 2018 GEMINIDS: PRELIMINARY RESULTS.

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Introduction: To identify and analyse lunar impact flashes, our team is performing a monitoring of the night side of the Moon from different observatories in Spain in the framework of the MIDAS survey (Moon Impacts Detection and Analysis System) [see e.g. 1-4]. For this purpose we employ several telescopes equipped with high-sensitivity CCD and CMOS video cameras. In this work we present a preliminary analysis of the lunar impact flashes recorded during the activity period of the 2018 Geminid meteor shower. These events can provide very useful information about different parameters related to Geminid meteoroids, such as for instance the luminous efficiency for the impact of these particles with the lunar ground [5].

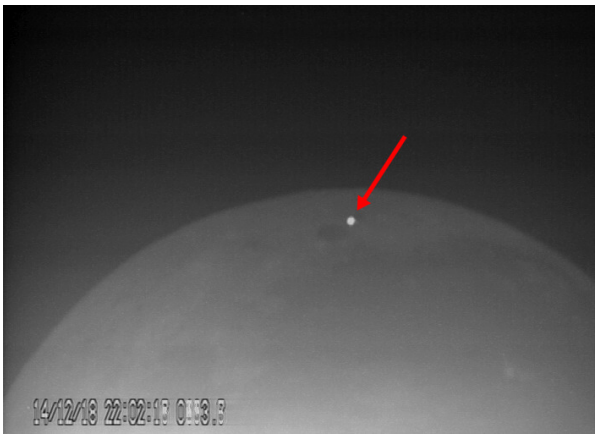

Figure 1. Lunar impact flash recorded on 2018 Dec. 14 at 22h 02m 16s UT.

Instrumentation and methods: We have monitored the night region of the lunar disk from two different sites in Spain: Sevilla (lat: 37.34ºN, lon: 5.98ºW) and El Purche (lat: 37.13ºN, lon: 3.52ºW). From Sevilla we have employed five Schmidt-Cassegrain telescopes. Two of these have an aperture of 36 cm, and the remaining three instruments have an aperture of 28 cm). All of them employ f/3.3 Meade focal reducers. From El Purche, a 63 cm reflector telescope was used. Analogue Watec 902H Ultimate CCD video cameras with output digitized to 8-bits have been employed, and also digital 12-bit CMOS devices based on the Sony IMX174LLJ sensor. The Watec cameras produced interlaced AVI video files with a resolution of 720x576 pixels at a frame rate of 25 fps. The 12-bit digital cameras generated imagery at 128 fps with a resolution of 1936x1216 pixels. Time was stamped on every video frame with a precision of 0.001 s. The recordings were analyzed with the MIDAS software [3, 4].

Observations: We performed a monitoring of lunar impact flashes between Dec. 9 and Dec. 14, during the activity period of the 2018 Geminid meteor shower. This activity extends from about Nov. 27 to Dec. 18, and peaks on Dec. 13-14 [6]. In total, as far as now 11 of these flashes were identified in the images recorded by our telescopes during this campaign (Table 1). The brightest and longest of these events, which was recorded on Dec. 14 at 22h02m16s UT, is shown in Figure 1. Its apparent magnitude was of about 5, with a duration of 0.16 s. According to our preliminary analysis, this impact flash was produced by a Geminid meteoroid with a mass of around 7 kg, and the resulting fresh crater would have a diameter of over 9 m.

Date and time (UT)	Most likely source	p
Dec. 13 19h38m49s	GEM	0.9
Dec. 14 19h51m00s	GEM	0.9
Dec. 14 20h03m48s	GEM	0.9
Dec. 14 20h11m39s	GEM	0.9
Dec. 14 20h11m47s	GEM	0.9
Dec. 14 20h53m45s	GEM	0.9
Dec. 14 22h02m16s	GEM	0.9
Dec. 14 22h29m38s	GEM	0.9
Dec. 14 22h37m49s	GEM	0.9
Dec. 14 22h47m20s	GEM	0.9
Dec. 14 23h17m55s	GEM	0.9

Table 1. Preliminary list of confirmed lunar impact flashes identified during the activity period of the 2018 Geminids. The probability that a flash is associated with this meteoroid stream is p.

The preliminary calculation of the probability of association parameter p [3, 4] of these impact flashes with the Geminids yields values of p of about 0.9,

which shows that the most likely origin of the projectiles that gave rise to these events is the Geminid meteoroid stream. A population index r=2.5 has been considered in the calculation of this probability parameter. This result for p implies that the collision of these meteoroids with the Moon took place at velocities of about 35 km/s. We are currently performing a detailed analysis of these events, including the calculation of the projectile mass and size, and the diameter of the new craters produced by these collisions.

Conclusions: We have presented a preliminary analysis of the lunar impact flashes recorded on 2018 December 9-14, during the activity period of the Geminid meteor shower on Earth. We have employed 8-bit and 12-bit cameras working at 25 and 128 fps, respectively. In total, 11 events were recorded and confirmed as far as now. All of them can be associated with the Geminid meteoroid stream with probabilities of about 90%. The brightest impact flash had an apparent magnitude of about 5, with a duration of 0.16 s. According to our preliminary analysis, it was produced by a meteoroid with a mass of around 7 kg. The resulting fresh crater would have a diameter of over 9 m.

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