# Automated detection and analysis of Moon impact flashes from Spain

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## 1 Introduction

One of the techniques suitable for the estimation of the flux of interplanetary matter impacting the Earth is based on the monitoring of the night side of the Moon to detect flashes produced by the impact of meteoroids on the lunar surface. The first steps to detect such flashes date back to 1999 [1]. Thus, impact flashes were unambiguously detected during several mayor meteor showers by using this technique and flashes of sporadic origin were also recorded [2-6]. In this context our team has developed the MIDAS project (Moon Impacts Detection and Analysis System). Its main objective is the identification of these flashes by means of an automated system that employs small telescopes operating from different locations in Spain. The identification of these events is performed by the MIDAS software (Moon Impacts Detection and Analysis Software).

## 2 Methods and preliminary results

Figure 1 shows the location of our impact flashes detection systems. We currently monitor the Moon from Sevilla (south of Spain). Our observatory can employ several SC Celestron telescopes (two C14, a C11 and a C9.25), all of them endowed with Watec 902H Ultimate CCD video cameras. Besides, a new 40 cm telescope is being setup in central Spain. This will operate from La Hita Astronomical Observatory.

GPS time inserters are used to stamp time on every video frame with a precision of 0.001 seconds. Meade 3.3 focal reducers are also used. With this configuration we monitor about $5.8 \cdot 10^6$ km$^2$ $\pm$ 10% on the lunar surface. Large enough lunar features are easily visible in the earthshine and these can be used to determine the selenographic coordinates of impact flashes. The Watec CCD cameras we employ work according to the PAL standard (25 fps), with a resolution of 720x576 pixels. The images taken by them are stored and digitized on multimedia hard disks. Then, they are sent to a computer for further processing and analysis.

The MIDAS software (Moon Impacts Detection and Analysis Software) was developed to automatically identify impact candidates [7]. The main kernel in the software is related to the automated identification of impact flashes. Several algorithms are available to perform these detections, and new algorithms are currently being implemented in order to increase the efficiency of the software. During the detection process a database with potential impact candidates is created for every telescope. These databases are automatically compared to establish which events are produced by the impact of meteoroids and which of them are related to other phenomena (cosmic rays, etc.). The software can also perform a photometric analysis of impact flashes in order to calculate the absolute magnitude of these events and the mass of the impactors. Figures 2 and 3 show, respectively, confirmed impact flashes detected on March 27, 2012 at 20h47m16.281$\pm$0.001 s UT and July 26, 2012 at 21h35m04.686$\pm$0.001 s UT.

MIDAS is endowed with additional tools, such as video processing filters, a lunar phase calendar and a database containing information about meteoroid streams.

## 3 Conclusions

We are operating a system that monitors the night side of the Moon in order to detect flashes produced by the collision of meteoroids on the lunar surface. A software package (MIDAS) has been developed to automatically identify and analyze these flashes. Our detection network will be expanded in a near future, as we are currently setting up a new telescope in central Spain. On the other hand, new detection algorithms are currently being implemented in the MIDAS software. As a result of this we expect to identify impact flashes more efficiently.

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## References

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Figure 1. Location of the moon impact flashes detection systems.

Figure 2. Confirmed impact flash recorded from Sevilla on March 27, 2012, at 20h 47m 16.281s UT.

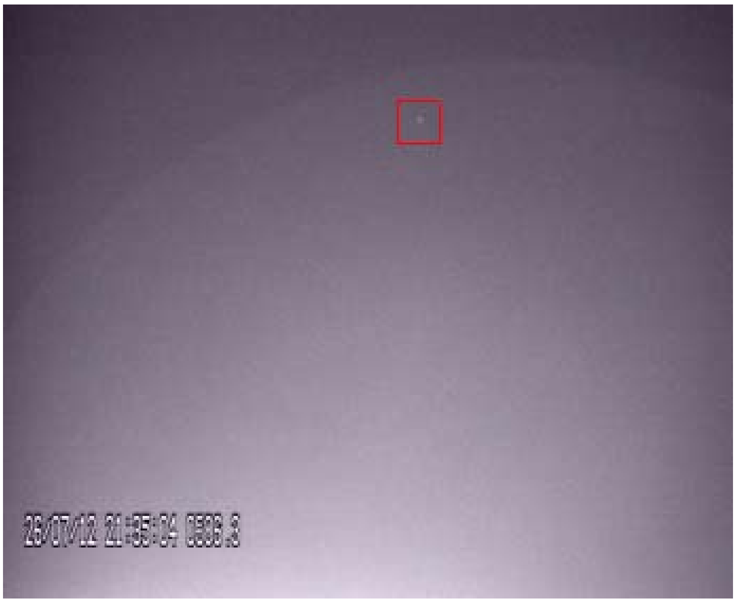

Figure 3. Confirmed impact flash recorded from Sevilla on July 26, 2012, at 21h 35m 4.686s UT.