Observation of Lunar Impact Flashes

by video recording technique from Belde Observatory, Istanbul/TURKEY

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Abstract

In this study, results of 20 hours observations to detect the lunar impact flashes are presented. A video recording technique with a 40 cm reflecting telescope and a fast frame camera system of Belde Observatory has been used in this project. Belde Observatory is the only place which is working on Lunar Impact Flash observation in Turkey. The detected flashes has been discussed whether they are caused by the impactor or by the iridium flares. Also the detected a few atmospheric micro meteorites are examined. A brief of video recording observation technique and the number of validated flashes from the literature are given.

Lunar İmpact Flashes

Meteorites are small natural bodies which are fragments from comets and asteroids travel through space and sometimes they strike planets and the moon in the solar system. When they reach the Earth we can see them as a fireball on the sky because of the atmosphere and only small parts of them reach the surface. The Moon has no atmosphere like Earth so we can not see any fireball but only the flash on the surface of the Moon. Flashes can be detected on the nightside of the Moon by the video recording technique.

Technique

The observer needs only a few equipments to start to detect impact flashes. A telescope with clean optics, a fast frame camera, computer with any capture software, a moon map and a clear sky. Recommended set up for visual observers are given below.

-Wide field of view enough to see night side of the moon(focal reducer can be used if necessary).
-1/30fps or 1/60fps for exposures
- LunarScan software for automatically detection.

TimeLine

A number of attempts have been made previously to observe and document lunar meteor impacts. Scientifically confirmed observations need observed from two or more widely separate locations or observe using two different filters at the same time. Timeline of impact flash studies are given below.

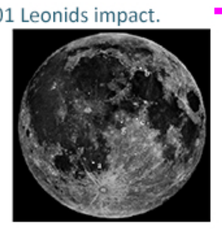
Melosh et al. (1993) *made a theoretical assessment of impact flash detection by using photometers.* Using meter class telescope, if impactors are bigger than 1 meter, impact flashes can be detected by photometry technique.

Dunham et al. (2000), Ortiz et al. (2000) *detected Leonids impact flashes on the Moon in 1999.* ***It was the first confirmed observation of impact flash.***

Ortiz et al. (2002) determined the mass distribution of 2001 Leonids impact.

Basic Data for the Confident Lunar Impact Flashes Detected during the 2001 Lunar Leonids

Impact	Time (UT)	Number of Telescopes	Longitude (deg)	Latitude (deg)	Magnitude	Duration (s)	Entry Angle (deg)
a.....	18:27:46	1	W16	S23	5.2 ± 0.2	>0.6	76 ± 3
b.....	18:10:36	2	E15	N39	7.5 ± 0.2	~0.04	63 ± 3
c.....	18:12:21	2	E11	N5	7.9 ± 0.2	~0.04	43 ± 3
g.....	18:19:55	2	E0	N4	8.2 ± 0.5	~0.04	53 ± 3

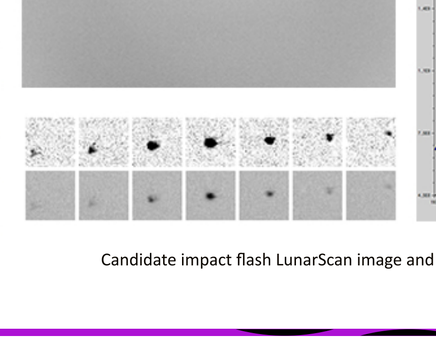


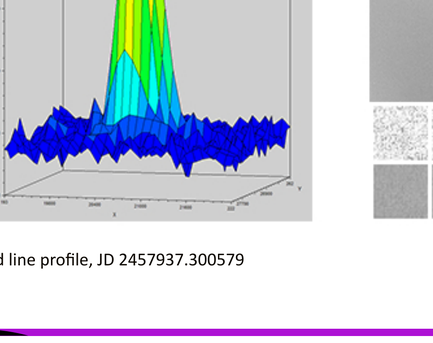
Yanagisawa et al. (2007) *detected Geminid impacts and determined the mass of particals, duration of flashes and impact angles.*

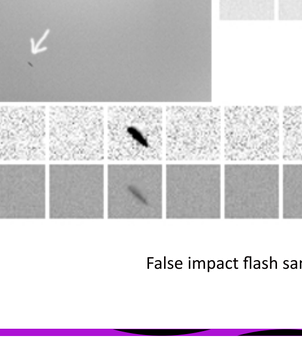
Table 1. Geminids Lunar Impact Flashes on 15 December 2007.

Flash	Time (UT)	mag.	duration	mass	Impact Angle
A	8:28:18	9	0.033 s	0.1 kg	51
B	8:54:25	6	0.017	2	57
C	8:55:26	5	0.32	3	42
D	9:13:36	7	0.05	0.8	79
E	10:08:10	5	0.32	5	47

Suggs et al. (2014) *determined the kinetic energy and mass distribution of 126 detected impacts by NASA ALaMO (Automated Lunar and Meteor Observatory) data.*







İSTEK Belde Observatory *started monitoring the Moon impact flashes in 2017 with 40 cm telescope and detected possible flashes in 20 hours observation data. Belde Observatory is the only place which is working on lunar impact flashes observation in Turkey.*

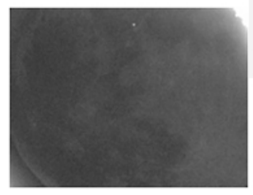
Rubio et al. (2000) *pointed out that luminous efficiency of collisions processes can be determined.* They used 20 cm telescope and 8'x6' video camera.

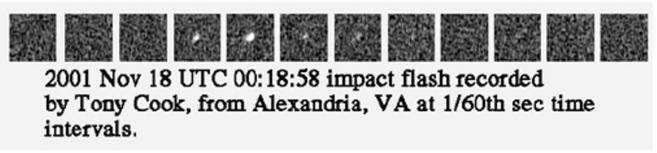
Data of Impact Flashes Caused by Leonid Meteoroids Striking the Moon on 1999 November 18

Time (±0.02 s UTC)	Magnitude	E_J (J m^{-2})	Estimated Mass (kg)
03:49:40.38	+3	1.81×10^{-11}	4.9
04:32:50.79	+4	7.21×10^{-12}	1.9
04:34:49.52	+7	4.54×10^{-13}	0.12
05:14:12.92	+6	1.14×10^{-12}	0.30
05:15:20.22	+5	2.87×10^{-12}	0.77

Note.—E_J stands for the energy per unit area received on Earth. The mass of the impactor is computed assuming $\eta = 2 \times 10^{-3}$.

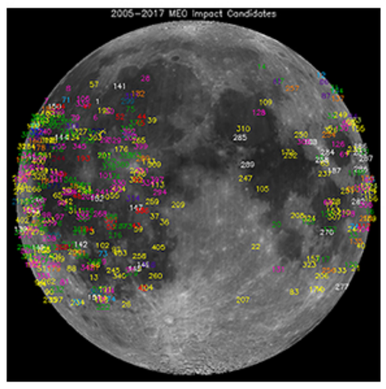
Chudnick et al. (2002) observed the1999 and 2001 Leonids impact and showed the position of impacts on the Moon.



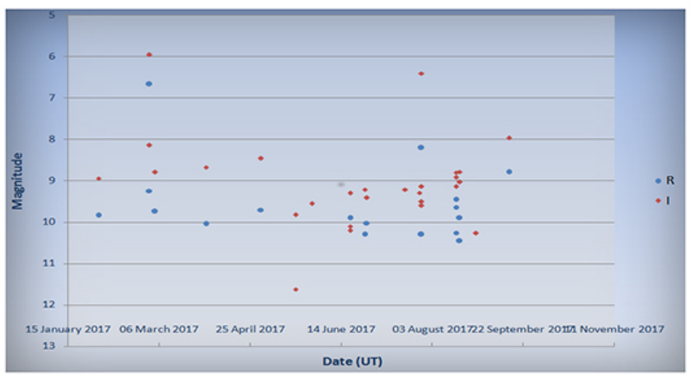


2001 Nov 18 UTC 00:18:58 impact flash recorded by Tony Cook, from Alexandria, VA at 1/60th sec time intervals.

NASA MEO(Meteoroid Environment Office) *started monitoring lunar impacts in* ***2006*** and detected 399 impact flashes in between 2005-2016.



NELIOTA (2017) *started monitoring the Moon for faint NEO impacts, using the 1.2m telescope and detected 27 impacts.*



Equipments
Meade 16'', f/8 telescope, Celestron Skyriss (1600X1200) camera, Antares f/6.3 and Meade f/3.3 focal reducer.

We started to study on lunar impact flash observation in 2017. In 20 hours observation we detected a few flashes. Most of them are false flashes as satellites flare or cosmic rays. After reduction of our observation we have two impact flash candidates. No other observers observed that two events without us so we can't say these are impact flashes.

For confirmation of lunar impact events, two or more observer should detect the flashes. We would like to collaborate with someone who interest or expert on this field.

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Candidate impact flash LunarScan image and line profile, JD 2457937.300579

False impact flash samples

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