QUASI-SIMULTANEOUS OBSERVATIONS OF THE INTERACTION OF TAURID METEOROIDS WITH THE EARTH AND THE MOON

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Abstract

Here we focus on a preliminary analysis of lunar impact flashes and bright meteors produced by meteoroids impacting the Moon and the Earth's atmosphere, respectively. These events were quasi-simultaneously recorded by the MIDAS and the SMART surveys during the 2015 Taurid outburst.

1. Introduction

The Taurid meteoroid complex contains a resonant swarm responsible for an enhanced activity of Taurid fireballs in specific years. One of these outbursts was forecast for 2015 [1]. To study this phenomenon, our team organized that year a campaign to detect the impact of large Taurid meteoroids with the surface of the Moon and the Earth's atmosphere. The recording of Taurid fireballs in the atmosphere was done in the framework of the SMART project (Spectroscopy of Meteoroids in the Atmosphere by means of Robotic Technologies). Our MIDAS survey (Moon Impacts Detection and Analysis System) also identified a series of impact flashes on the Moon's surface. Here we focus on the preliminary analysis of these events, which can provide information about the Taurid meteoroid stream and the flux of meteoroids impacting the Moon and the Earth [2, 3, 4, 5, 6].

2. Instrumentation

Fireball activity in the atmosphere was monitored by using an array of CCD cameras and spectrographs operating in the framework of the SMART project [7, 8]. These devices work autonomously thanks to the MetControl software [9]. All of them are based on CCD video cameras (models Watec 902H and 902H Ultimate) covering fixed fields of view ranging from about 90ºx60º to 8ºx5º [10]. The spectra were analyzed with the CHIMET software [11]. The atmospheric path, radiant and orbital elements of the fireballs were obtained with the Amalthea software [12, 13]. The detection of lunar impact flashes was performed by using 4 Schmidt-Cassegrain telescopes. Two of them had an aperture of 28 cm, and the aperture of the other two was 36 cm. The telescopes employed f/3.3 focal reducers and Watec 902H Ultimate video cameras. The recordings were analyzed with the MIDAS software [14, 15].

3. Lunar impact flashes

The monitoring of lunar impact flashes took place between Nov. 7 and Nov. 18, during the activity period of the Southern and Northern Taurid meteor showers. In total, 15 of these flashes were identified. One of these events, which was recorded on Nov 15th at 18h13m57.1s UT, is shown in Figure 1.

Figure 1. *Lunar impact flash recorded on 15 Nov. 2015 at 18h 13m 57.1s UT.*

By following the methods described in [16, 17, 18] we have found that the most likely origin of the projectiles is the Taurid meteoroid complex. So, the collision of these particles with the Moon took place at about 28 km/s. Further analyses are in progress to derive the mass and size of the impactors, and the diameter of the new craters produced by these collisions.

4. Meteor events and emission spectra

Our video-spectrographs recorded about 40 emission spectra of multi-station fireball events belonging to the Southern and the Northern branches of the Taurids. One of these fireballs and its spectrum are shown in Figures 2 and 3, respectively. Most emission lines identified in these spectra correspond to neutral Fe, as usually found in meteor spectra [19, 20, 21]. In all cases the contributions from Na I-1 (588.9 nm) and Mg I-2 (516.7 nm) are very noticeable. The H and K lines of ionized Ca have been also identified, but these appear blended with Fe I lines. These signals show in addition the emissions of multiplets Ca I-2

(422.6 nm) and Fe I-41 (441.5 nm). Additional analysis of these fireball spectra is currently in progress in order to infer information about the chemical nature of the progenitor meteoroids.

Figure 2. *Northern Taurid fireball recorded on 28 October 2015 at 22h16m38s UT.*

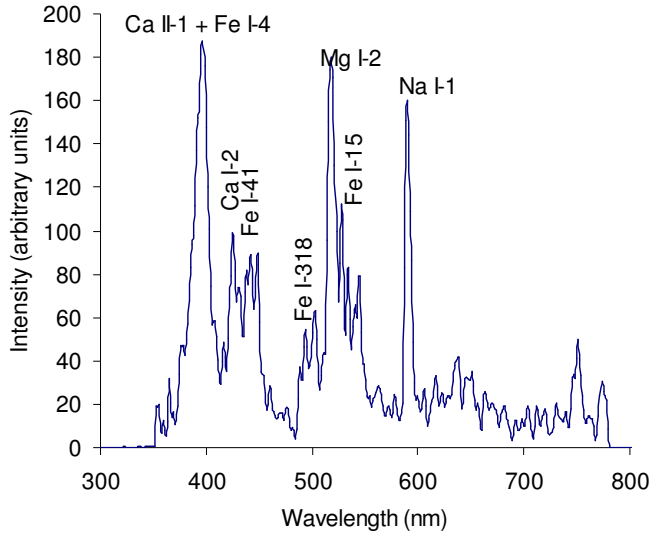

Figure 3. *Spectrum of the fireball shown in Figure 2.*

5. Conclusions

We have monitored the interaction of meteoroids with the lunar soil and the Earth's atmosphere during the activity period of the 2015 Taurids. Because of the enhanced activity of this meteoroid complex, the SMART and MIDAS surveys recorded that year about 40 Taurid fireball emission spectra and 15 lunar impact flashes produced by particles in this stream, respectively. We have shown here a few examples of our recordings and some preliminary results. The main contributions in the fireball spectra have been identified. Additional analysis of these events is currently in progress to infer information about the chemical nature of the progenitor meteoroids, their size, mass, orbital data, and diameter of the new craters generated on the Moon by these collisions.

6. Acknowledgements

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7. References

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