SYSTEMATIC MONITORING OF LARGE METEOROIDS IN THE EARTH-MOON ENVIRONMENT. C. Martínez[1] and J.M. Madiedo[2]. [1]Observatorio Galileo, 41012 Sevilla, Spain. [2]Instituto de Astrofísica de Andalucía, CSIC, Apt. 3004, 18080 Granada (Spain).

Introduction: The analysis of large meteoroids in the Earth-Moon environment is of a paramount importance in order to study the impact hazard for our planet. And also to determine different physical and chemical properties of these particles and their parent bodies. With this aim, our group is conducting the SMART (Spectroscopy of Meteoroids by means of Robotic Technologies) project, which identifies and analyzes meteoroids interacting with the Earth's atmosphere [1, 2]. But also de MIDAS (Moon Impacts Detection and Analysis System) project, to detect and analyze impact flashes generated when these meteoroids hit the lunar ground [3-7]. An important synergy was proven to exist between both surveys, since the results obtained from the atmospheric monitoring provides information about the most likely parent bodies of meteoroids impacting the Moon [6, 7]. In this context, we present here a preliminary analysis of a superbolide generated in the atmosphere by a large meteoroid on 16 November 2020. The event was spotted by the SMART survey, which is being conducted in the framework of the Southwestern Europe Meteor Network (SWEMN).

Figure 1. Sum-pixel image of the fireball discussed in the text as recorded from the SMART meteor-observing station located in Sevilla during the initial phases of the event (up), and when the event reached its maximum brightness (down).

Instrumentation and methods: To record the fireball analyzed here and its emission spectrum we have employed an array of low-lux CCD video cameras manufactured by Watec Co. (models 902H and 902H2 Ultimate), some of which are configured as spectrographs by means of 1000 lines/mm diffraction gratings. CMOS color cameras were also employed at the meteor-observing station located in Sevilla [8]. These cameras monitor the night sky and operate in a fully autonomous way by means of software developed by J.M. Madiedo [1, 2]. The atmospheric trajectory and orbital data of the event were obtained with the Amalthea software, which was also written by the same researcher [9].

The 2020 November 16 superbolide: On 2020 November 16 at 2h49m09.5±0.1s UTC, a mag. –17±1 fireball (Figure 1) was spotted from the meteor-observing stations operated by SWEMN at the astronomical observatories of Calar Alto, El Arenosillo and Sevilla. The emission spectrum of this event was also recorded by one spectrographs located at Calar Alto. Because of its very high luminosity, it was classified as a superbolide. The event, which overflew Spain and Portugal, turned the night into day for a fraction of a second.

Atmospheric trajectory, radiant, orbit, and meteoroid size: The fireball begun over the west of Andalusia (Spain), at an altitude H_b=131.8±0.5 km over the sea level. The meteoroid hit the atmosphere with an initial velocity V_∞=63.1±0.4 km/s and the apparent radiant was located at the equatorial coordinates α=127.47º, δ=-10.46º. The event moved northwest and entered Portugal, penetrating the atmosphere till a final height H_e=61.0±0.5 km. The projection on the ground of the atmospheric trajectory of this event is shown in Figure 2. The orbital parameters of the parent meteoroid before its encounter with our planet are listed in Table 1. According to this information, the meteoroid was associated with the sporadic background component.

a (AU)	3.5±0.4	**ω (º)**	37.8±0.9
e	0.74±0.02	**Ω (º)**	53.92640±10^{-5}
q (AU)	0.900±0.002	**i (º)**	127.5±0.2

Table 1. Orbital data (J2000) of the progenitor meteoroid before its encounter with our planet.

According to the value of the Tisserand parameter with respect to Jupiter (T_J=0.8), the meteoroid followed a cometary orbit. The preliminary photometric analysis of the mass m_p of the progenitor meteoroids yields about m_p=10 kg. By assuming spherical shape and a density for cometary material of 1.8 g/cm^3, the diameter of the meteoroid yields around 22 cm.

Figure 2. Projection on the ground of the atmospheric trajectory of the fireball analyzed in this work.

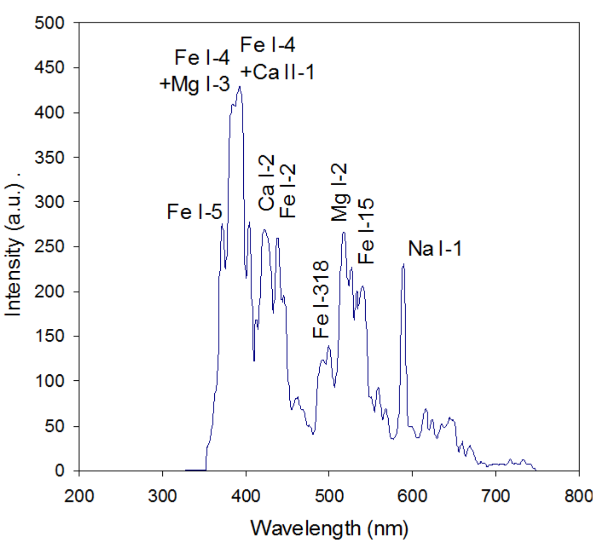

Figure 3. Emission spectrum of the fireball.

Emission spectrum: The emission spectrum of the fireball was recorded by means of one videospectrograph operated by the SMART project from the Calar Alto Observatory [1, 2]. This spectrum, corrected according to the sensitivity of the spectrograph, is plotted in Figure 3. The plot also shows the most prominent contributions to the signal and, as can be noticed, most features correspond to neutral Fe, which is usual in meteor spectra [10-16]. The most important contribution in this signal comes from the emissions from Fe I-4, Mg I-3, and Ca II-1, which appear blended. The emission lines of Ca I-2 at 422.6 nm, the Na I-1 doublet (588.9 nm) and the Mg I-2 triplet (516.7 nm) are also very remarkable. The detailed conditions in the meteor plasma are currently under analysis. For this purpose, the relative intensities of Mg I-2, Na I-2 and Fe I-15 will be compared, as has been done with previous events [17-25]. This will provide information about the chemical nature of the meteoroid.

Conclusions: Here we present a preliminary analysis of a superbolide (mag. -17) produced by a large sporadic cometary meteoroid (diameter around 22 cm) over Spain and Portugal on 2020 November 16. The event was recorded in the framework of the SMART survey. The fireball penetrated the atmosphere till and ending altitude of about 61 km. The emission spectrum of the bolide was also recorded, and a detailed analysis of this signal is currently in progress.

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