A POTENTIAL METEORITE FALL OBSERVED OVER SPAIN IN 2023 IN THE FRAMEWORK OF THE SOUTHWESTERN EUROPE METEOR NETWORK. A. I. Aimee1, J.M. Madiedo2, 3. 1Southwestern Europe Meteor Network, 41012 Sevilla, Spain. 2Instituto de Astrofísica de Andalucía, CSIC, Apt. 3004, 18080 Granada (Spain). 3Observatorio Galileo, 41012 Sevilla, Spain.

Introduction: The Earth’s atmosphere destroys most meteoroids that cross our planet’s path around the Sun before these materials reach the ground. Thus, most meteoroids ablate completely at high altitudes, but some fireballs may produce, under favorable conditions, a non-zero terminal mass that can reach the ground as meteorites. The analysis of potential meteorite-producing fireballs is one of the objectives of the SWEMN meteor network. For this purpose SWEMN is running the SMART project (Spectroscopy of Meteoroids in the Atmosphere by means of Robotic Technologies). This survey employs an array of automated cameras and spectrographs deployed at meteor-observing stations placed at different locations in Spain, included the major astronomical observatories in this country [1, 2]. SMART also provides valuable information for our MIDAS project, which we conduct to study lunar impact flashes generated when large meteoroids hit the Moon [3-7]. With SMART we can determine the atmospheric trajectory of meteors and the orbit of their parent meteoroids, but also the evolution of the conditions in meteor plasmas from the emission spectrum produced by these events [1, 2, 9]. In this work we present a preliminary analysis of a meteorite-droping sporadic bolide that overflew Spain on 2023 April 2.

Instrumentation and methods: In order to record the fireball analyzed here, and also its emission spectrum, an array of low-lux CCD video cameras manufactured by Watec Co. (models 902H and 902H2 Ultimate) was employed. Some of these devices are configured as spectrographs by using 1000 lines/mm diffraction gratings. CMOS color cameras were also employed [8]. These devices monitor the night sky and operate in a fully autonomous way by means of software developed by J.M. Madiedo [1, 2, 9]. The SAMIA software was used to calculate the atmospheric trajectory and the orbital data of the event [1, 2, 9].

The 2023 April 2 fireball: This bolide was recorded on 2023 April 2, at 19h28m46.0±0.1s UT. The event had a peak absolute magnitude of -13.0±1.0 (Figure 1). The recordings reveal that the meteoroid was fragmented into several pieces along the fireball’s atmospheric path. The code assigned to the bolide in the SWEMN meteor database is SWEMN20230402_192846. The fireball could also be observed by a wide number of causal eyewitnesses. We named it “Torrejón the Velasco”, since it was located over this location during its initial phase.

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Figure 1. Stacked image of the SWEMN20230402_192846 event.

Figure 2. Atmospheric path of the fireball and its projection on the ground.

Table 1. Orbital data (J2000) of the progenitor meteoroid before its encounter with our planet.
Atmospheric trajectory, radiant and orbit: This bright meteor overflew the provinces of Madrid and Toledo (Spain). Its initial altitude was $H_b=87.4\pm0.5$ km. The bolide penetrated the atmosphere till a final height $H_e=24.7\pm0.5$ km. The position inferred for the apparent radiant corresponds to the equatorial coordinates $\alpha=165.40^\circ$, $\delta=65.96^\circ$. According to our calculations, the meteoroid hit the atmosphere with an initial velocity $V_\infty=13.5\pm0.3$ km/s. The calculated luminous path of the fireball is shown in Figure 2.

The parameters of the heliocentric orbit of the progenitor meteoroid before its encounter with our planet are listed in Table 1. The value calculated for the geocentric velocity was $V_g=7.5\pm0.5$ km/s. From the value calculated for the Tisserand parameter referred to Jupiter ($T_J=4.84$), we found that before colliding with our atmosphere the particle was moving on an asteroidal orbit. By taking into account these parameters and the derived radiant coordinates, the event was associated with the sporadic component.

![Figure 3. Projection on the ecliptic plane of the orbit of the parent meteoroid of the SWEMN20230402_192846 event.](image)

Emission spectrum: The emission spectrum of the bolide could also be recorded from several SWEMN stations. This signal was calibrated in wavelength by employing typical lines appearing in meteor spectra, and then corrected by taking into account the sensitivity of the corresponding spectograph. The resulting calibrated spectrum shows that the most remarkable emission lines correspond to Na I-1 (588.9 nm), Mg I-2 (516.7 nm), Fe I-4 (385.6 nm), Fe I-41 (441.5 nm), Fe I-42, Fe I-43 (414.3 nm), Fe I-15 (526.9 nm), and Fe I-318.

Conclusions: The "Torrejón de Velasco" fireball was recorded on 2023 April 2. This sporadic meteor event had a peak absolute magnitude of -13.0 and overflew Madrid and Toledo (Spain). The particle followed an asteroidal orbit before colliding with the atmosphere. At the ending stage of its luminous phase this deep-penetrating bolide was located at an altitude of about 24 km. The analysis of the terminal point of the fireball shows that this was a likely meteorite-dropper. The emission spectrum of the bolide was also registered and analyzed. This spectrum has provided interesting information about the composition of the meteoroid.

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