A POTENTIAL METEORITE FALL OBSERVED IN 2022 IN THE FRAMEWORK OF THE SOUTHWESTERN EUROPE METEOR NETWORK.

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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-dropping bolide that overflew the south of Spain on 2022 January 14.

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 2022 January 15 event: This bolide was spotted from the SWEMN meteor-observing stations located at Calar Alto, Sierra Nevada, Sevilla, La Sagra, Huelva, El Aljarafe, and La Hita (Figure 1). The fireball was spotted on 2022 January 14, at 21h27m07±0.1s UT and reached a peak absolute magnitude of -12.0±0.5. Its code in the SWEMN meteor database is SWEMN20220114_212707. The event, which exhibited a bright flare by the end of its trajectory as a consequence of the sudden breakup of the meteoroid, was also observed by a wide number of casual eyewitnesses.

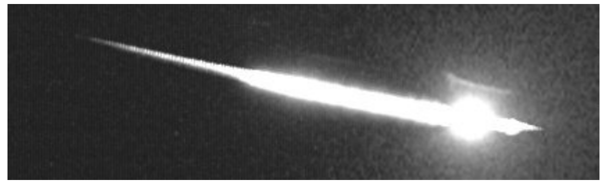

Figure 1. Stacked image of the SWEMN20220114_212707 bolide.

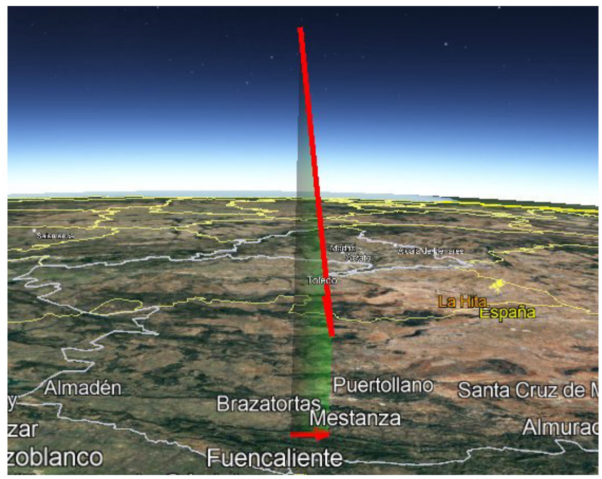

Figure 2. Atmospheric path of the fireball and its projection on the ground.

a (AU)	1.9±0.1	**ω(º)**	201.8±00.5
e	0.49±0.03	**Ω (º)**	294.433674±10^{-5}
q (AU)	0.960±0.001	**i (º)**	3.9±0.2

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

Atmospheric trajectory, radiant and orbit: According to our calculations, the fireball overflew the south of Spain. Its initial altitude was H_b=85.3±0.5 km near from the zenith of the locality of Ventillas (province of Ciudad Real). The bolide penetrated the atmosphere till a final height H_e=23.6±0.5 km near from the zenith of the locality of Solana del Pino (province of Ciudad Real). The position found for the apparent radiant corresponds to the equatorial coordinates α=63.68º, δ=39.26º. The entry velocity in the atmosphere concluded for the parent meteoroid was V_∞=13.6±0.3 km/s. The atmospheric path of the luminous event is shown in Figure 2. We named this bright meteor "Ventillas", because the bolide was located near from the zenith of this locality during its initial phase. The orbital parameters of the parent meteoroid before its encounter with our planet are included in Table 3, and the geocentric velocity derived in this case was V_g=7.9±0.5 km/s. By taking into account these orbital data and the radiant position, it was concluded that the fireball was generated by a sporadic meteoroid. From the value derived for the Tisserand parameter with respect to Jupiter (T_J =3.77), we found that the meteoroid was moving on an asteroidal orbit before entering our atmosphere. This orbit is shown in Figure 3.

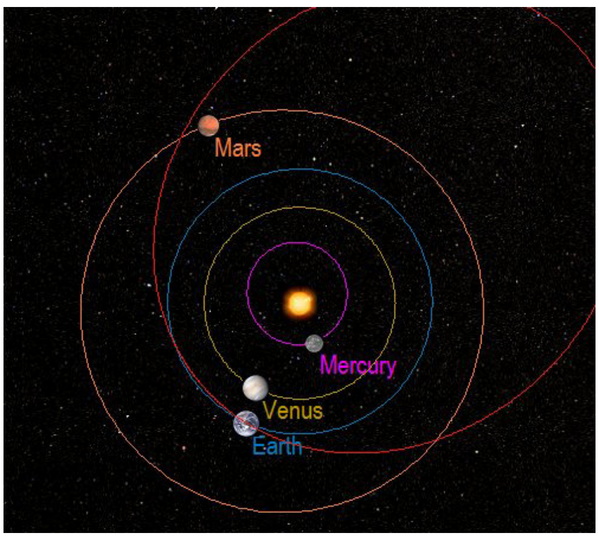

Figure 3. Projection on the ecliptic plane of the heliocentric orbit of the parent meteoroid.

Our analysis reveals that the meteoroid was not completely ablated in the atmosphere. Thus, we obtained a non-zero but small (below 50 grams) terminal mass. The dark flight was also analyzed and the landing area of the surviving mass was determined. An expedition was organized to that area. However, the meteorite was not found.

Emission spectrum: The emission spectrum of the bolide was also recorded from the meteor-observing station located at La Hita. 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 recording device. The resulting calibrated emission spectrum is shown in Figure 4. This plot shows the most remarkable lines identified in the spectrum. These contributions 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.

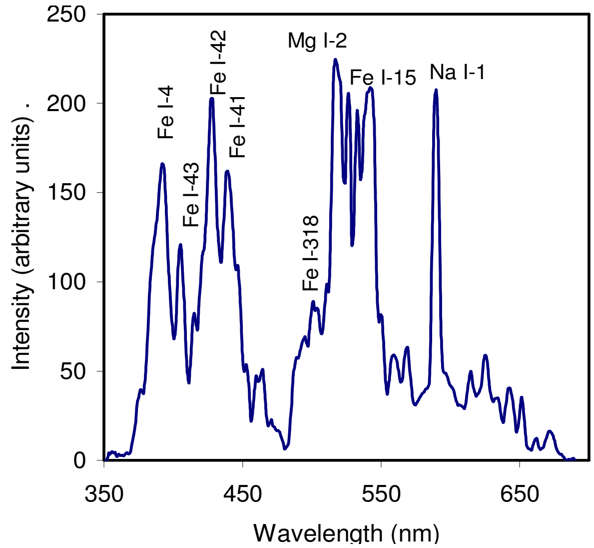

Figure 4. Calibrated emission spectrum.

Conclusions: The "Ventillas" bolide, recorded on 2022 January 14, was associated with the sporadic background. Its peak magnitude was -12.0, and overflew the south of Spain. The meteoroid was moving on an asteroidal orbit before striking our atmosphere. At the final stage of its luminous phase this deep-penetrating bolide was located at a height of about 23 km. Since the analysis of the final stage revealed a non-zero mass, this meteor was considered as a potential meteorite-dropper. The emission spectrum of the bolide was also registered and analyzed.

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