A POTENTIAL METEORITE-DROPPING FIREBALL RECORDED ON 19 JANUARY 2016. M. Granados[1]. J.M. Madiedo[1]. J.L. Ortiz[2], J. Aceituno[3], E. de Guindos[3]. [1]Facultad de Ciencias Experimentales, Universidad de Huelva, 21071 Huelva, Spain. [2]Instituto de Astrofísica de Andalucía, CSIC, Apt. 3004, 18080 Granada (Spain). [3]Centro Astronómico Hispano-Alemán, Calar Alto (CSIC-MPG), E-04004 Almería, Spain.

Introduction: The atmosphere behaves as a very efficient shield that destroys most rocks that cross the Earth's path around the Sun before these materials reach the ground. Thus, when large meteoroids enter the Earth's atmosphere these produce bright fireballs during the so-called ablation process. Most meteoroids ablate completely, but some fireballs may produce, under favorable conditions, a non-zero terminal mass. In these rare cases the surviving materials reach the ground as meteorites. These are unique samples coming from other celestial bodies that may provide helpful information about the origin and evolution of our Solar System. For this reason, the analysis of potential meteorite-producing fireballs is one of our goals. Our project also focus on meteor and fireball spectroscopy, since this technique provides information about the chemical nature of meteoroids ablating in the atmosphere. In this work we perform a preliminary analysis of a potential meteorite-dropping bolide that overflew the North of Africa and the Mediterranean Sea on 19 January 2016. The emission spectrum produced by this event is also presented.

Figure 1. Image of the fireball discussed here, spotted over the domes of the Calar Alto Astronomical Observatory.

Instrumentation and methods: To record the fireball analyzed here we have employed an array of low-lux CCD video cameras manufactured by Watec Co. (models 902H and 902H2 Ultimate). These 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 [2].

The 19 January 2016 event: The fireball discussed here was recorded on 19 January 2016 at 23h59m07.2±0.1s UT from our meteor-observing stations located at Calar Alto and La Sagra astronomical observatories (Figure 1). The peak luminosity of this event corresponded to an absolute mag. of –14±1, and its emission spectrum was also recorded from both stations.

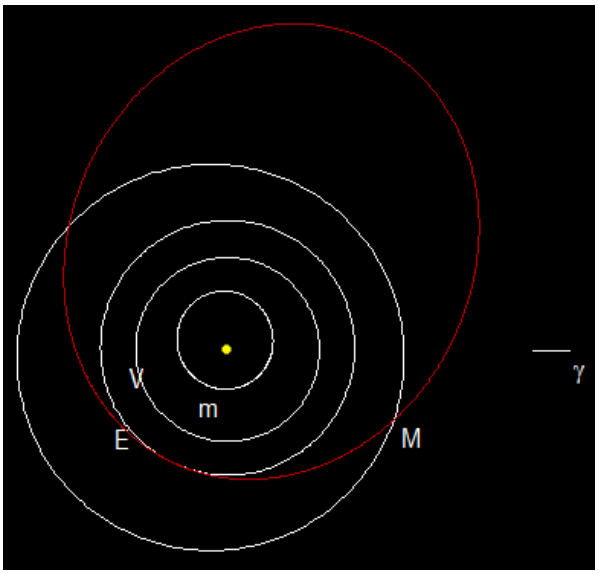

Figure 2. Projection on the ecliptic plane of the heliocentric orbit of the parent meteoroid.

a (AU)	1.83±0.06	**ω (º)**	174.7±0.5
e	0.46±0.01	**Ω (º)**	299.13344±10^{-5}
q (AU)	0.9826±0.0002	**i (º)**	12.0±0.3

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

Atmospheric trajectory, radiant and orbit: According to our analysis, the sporadic fireball started at an altitude H_b=89.1±0.4 km over the Mediterranean Sea. The meteoroid stroke the atmosphere with a velocity V_∞=14.3±0.2 km/s and the apparent radiant was located at the equatorial coordinates α=6.11º, δ=68.54º. The bolide penetrated till a final height H_e=23.2±0.4 km over the sea. The orbital parameters

of the parent meteoroid before its encounter with our planet are listed in Table 1. The projection on the ecliptic of this heliocentric orbit is shown in Figure 2. According to the value of the Tisserand parameter with respect to Jupiter (T_J=3.87), the meteoroid followed an asteroidal orbit.

We have analyzed the terminal point of the luminous trajectory of this event. According to our results, the meteoroid was not completely destroyed in the atmosphere. Thus, a fragment with a mass of about 180 g survived the ablation process and fell into the Mediterranean Sea as a meteorite. The emission spectrum of this event and the precise circumstances of the dark flight are currently under analysis.

Emission spectrum: The emission spectrum of the fireball was recorded by means of two spectrographs operating in the framework of the SMART project [3]. This spectrum is shown in Figure 3, where the most important contributions to the signal have been highlighted. As usual in meteor spectra, most lines identified in this signal correspond to neutral Fe. Thus, as Figure 1 shows, several multiplets of this element have been identified. The emission lines of the Na I-1 doublet (588.9 nm) and the Mg I-2 triplet (516.7 nm) are very prominent. The detailed conditions in the meteor plasma are currently under analysis. This will provide an insight into the chemical nature of the progenitor meteoroid.

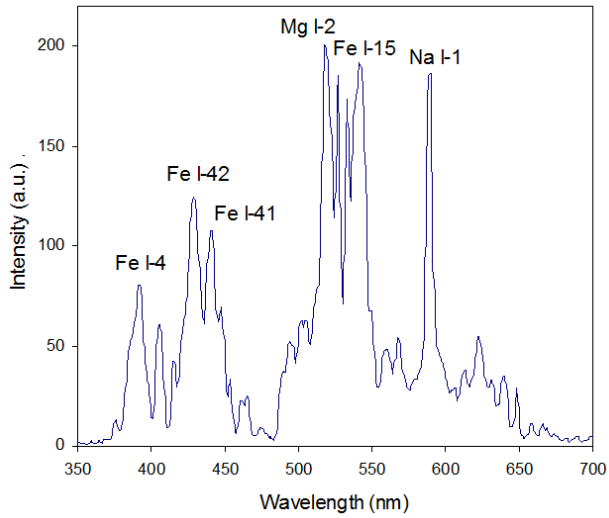

Figure 3. Emission spectrum of the fireball.

Conclusions: We have presented a preliminary analysis of a potential meteorite-dropping multi-station fireball recorded over the Mediterranean Sea on 19 January 2016. The atmospheric trajectory of the event was calculated, and the orbital elements of the meteoroid were obtained. The meteoroid followed an asteroidal before its encounter with our planet. The progenitor meteoroid penetrated the atmosphere till and ending altitude of about 23 km. A 180 gram fragment survived the ablation process and fell into the Sea as a meteorite. The emission spectrum of the fireball was recorded, and the main contributions to this signal were identified.

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References: [1] Madiedo J.M. (2014), Earth, Planets & Space, 66, 70. [2] Madiedo J.M. et al. (2011), NASA/CP-2011-216469, 330. [3] Madiedo J.M. (2017), Planetary and Space Science, 143, 238.