ORBIT AND EMISSION SPECTRUM OF A DEEP-PENETRATING METEOR EVENT RECORDED ON 2018 JULY 2. I.Salas[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 SMART (Spectroscopy of Meteoroids by means of Robotic Technologies) project is being developed since 2006 with the aim to obtain information about the chemical composition of meteoroids ablating in the atmosphere. This survey employes an array of automated spectrographs deploted at 10 meteor-observing stations in Spain [1]. In this way 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. In this work we present a preliminary analysis of a deep-penetrating and very bright fireball that was spotted over the south of Spain on 2018 July 2.

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. 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, which was also written by the same researcher [3].

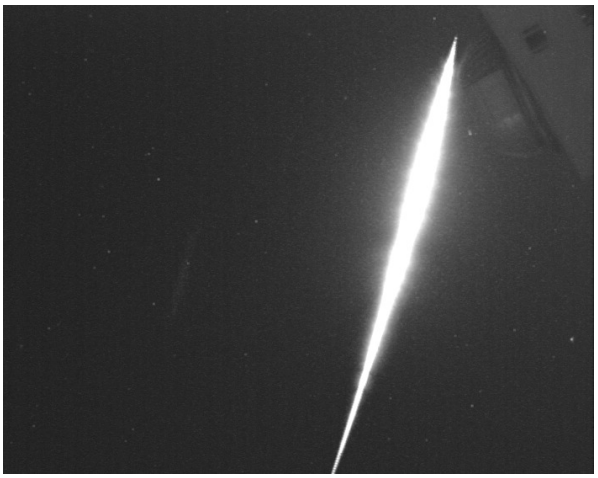

Figure 1. Sum-pixel image of the fireball discussed here as recorded from the Astronomical Observatory of Sierra Nevada (OSN).

The 2 July 2018 meteor event: On 2 July 2018 at 1h58m06.4±0.1s UTC a mag. –10±1 fireball (Figure 1) was recorded by our meteor-observing stations located at the astronomical observatories of Calar Alto, Siera Nevada, La Sagra, La Hita, Sevilla and Huelva. The emission spectrum of this bolide was also recorded by three spectrographs located at La Hita, La Sagra and Calar Alto.

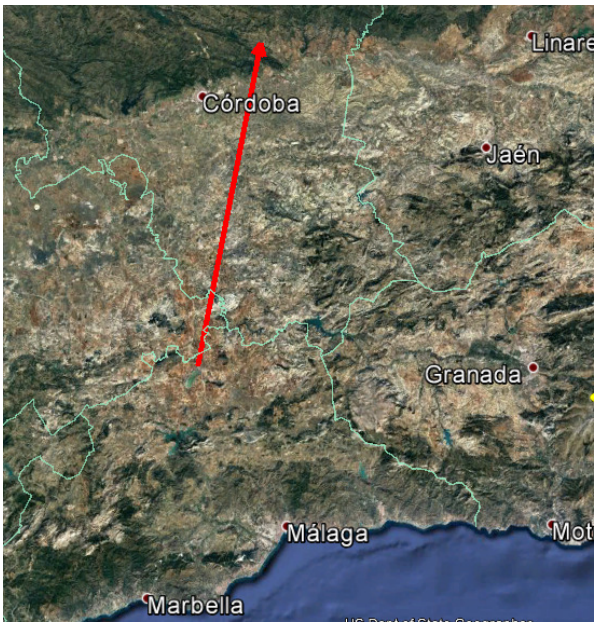

Figure 2. Projection on the ground of the atmospheric trajectory of the fireball analyzed in this work.

a (AU)	2.8±0.2	**ω (º)**	301.5±1.9
e	0.899±0.006	**Ω (º)**	99.87129 ± 10^{-5}
q (AU)	0.28±0.01	**i (º)**	2.8±0.2

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

Atmospheric trajectory, radiant and orbit: The fireball begun at an altitude H_b=99.0±0.4 km over the province of Malaga, in Andalusia. The meteoroid stroke the atmosphere with a velocity V_∞=33.9±0.2 km/s and the apparent radiant was located at the equatorial coordinates α=297.0º, δ=-17.8º. The bolide penetrated till a final height H_e=30.6±0.4 km over the province of Cordoba. 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. The projection on the ecliptic of this heliocentric orbit is shown in Figure 3. According to the value of the Tisserand parameter with respect to Jupiter

(T_J=2.5), the meteoroid followed a Jupiter Family Comet orbit.

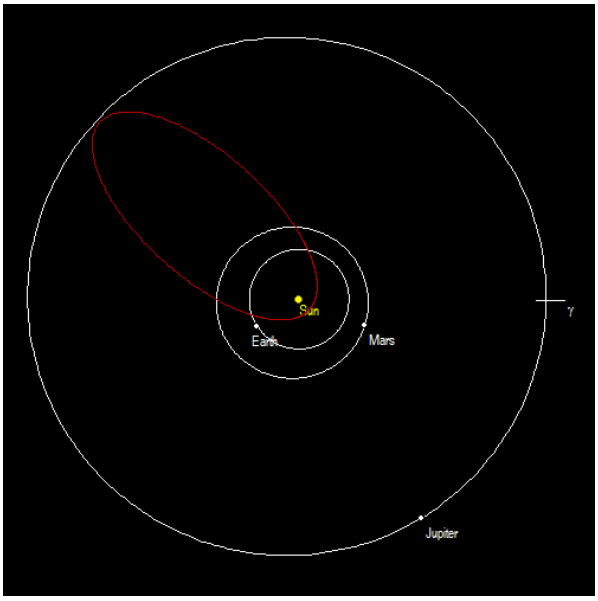

Figure 3. Projection on the ecliptic plane of the heliocentric orbit of the parent meteoroid.

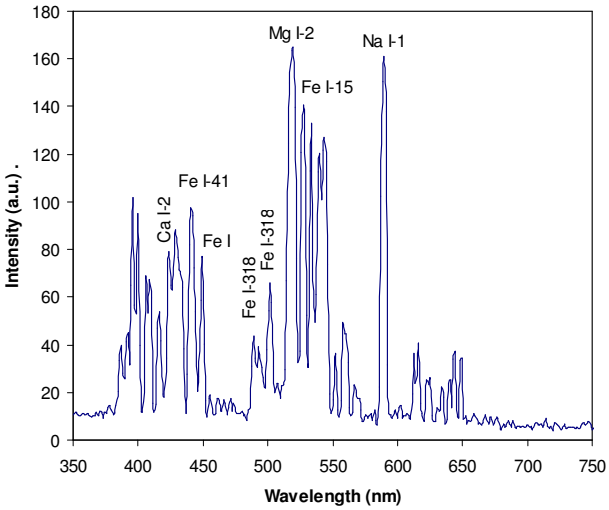

Figure 4. Emission spectrum of the fireball.

Emission spectrum: The emission spectrum of the fireball was recorded by means of three spectrographs operating in the framework of the SMART project [1, 2]. This spectrum is shown in Figure 4, 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. 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 [1]. This will provide an insight into the chemical nature of the progenitor meteoroid.

Conclusions: We have presented a preliminary analysis of a deep-penetrating fireball recorded over Spain 2018 July 2. The meteoroid followed a Jupiter Family Comet orbit before its encounter with our planet. The high-tensile-strength progenitor meteoroid penetrated the atmosphere till and ending altitude of 30.6 km. The emission spectrum of the bolide was recorded, and contained as main contributions those of Mg I-2, Na I-1 and several neutral Fe multiplets.

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