ORBIT AND EMISSION SPECTRUM OF A QUADRANTID FIREBALL RECORDED IN 2023. J.M. Madiedo[1], J.L. Ortiz[1], J. Aceituno[2], E. de Guindos[2], A.I. Aimee[3]. [1]Departamento de Sistema Solar, Instituto de Astrofísica de Andalucía (IAA-CSIC), 18080 Granada, Spain. [2]Observatorio Astronómico de Calar Alto (CAHA), E-04004, Almería, Spain. [3]Southwestern Europe Meteor Network, 41012 Sevilla, Spain.

Introduction: The Quadrantid meteoroid stream produces a display of meteors that peaks around January 3-4, with its main activity confined to a 12 to 14 h window [1]. Despite it has one of the highest ZHR of all annual showers (above 100 meteors/hour), it is very difficult to observe because of frequent bad weather in early January in the northern hemisphere. This shower has been observed in 2023 in the framework of the SMART project [2] in order to obtain physical and chemical properties of the progenitor meteoroids and their parent body. The SMART survey is being conducted in the framework of the Southwestern Europe Meteor Network [3]. This work focuses on the preliminary analysis of a mag. -9 Quadrantid bolide recorded on 2023 January 4. Its emission spectrum is also presented.

Methods: We have used Watec 902H2 and Watec 902 Ultimate cameras to record the event discussed here. Their field of view ranges from 62x50 degrees to 14x11 degrees. To record meteor spectra we have attached holographic diffraction gratings (1000 lines/mm) to the lens of some of these cameras. The atmospheric path of the event was triangulated with the SAMIA software, developed by J.M. Madiedo. This program employs the planes-intersection method [2]. The emission spectrum was analyzed with the CHIMET software [2]. This work has been fully written by AIMEE (acronym for Artificial Intelligence with Meteoroid Environment Expertise) from the records included in the SWEMN fireball database [3, 4].

Figure 1. Stacked image of the SWEMN20230104_061218 event as recorded from Sierra Nevada.

Description of the 2023 January 4 bolide: This striking bolide was captured on 2023 January 4, at 6h12m18.0±0.1s UT (Figure 1). The peak brightness of this bright meteor was equivalent to an absolute magnitude of -9.0±1.0. The bolide was added to our meteor database with the code SWEMN20230104_061218.

This bolide overflew the province of Granada (Spain). The luminous event began at an altitude H_b=108.3±0.5 km. The bright meteor penetrated the atmosphere till a final height H_e=65.5±0.5 km. The equatorial coordinates of the apparent radiant yield α=227.78º, δ=47.67º. Besides, we obtained that the meteoroid impacted the atmosphere with a velocity V_∞=42.9±0.3 km/s. The obtained atmospheric trajectory of the fireball is shown in Figure 2.

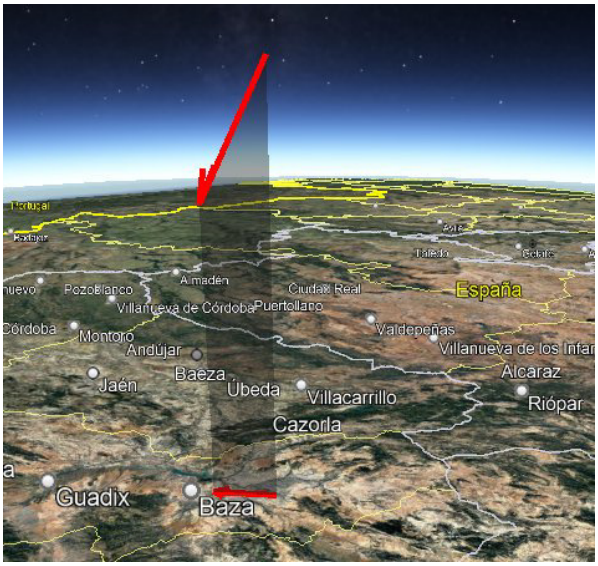

Figure 2. Atmospheric path of the SWEMN20230104_061218 event, and its projection on the ground.

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=41.3±0.3 km/s. The Tisserand parameter referred to Jupiter (T_J =2.48) shows that the meteoroid followed a cometary (JFC) orbit before colliding with our atmosphere. By taking into account this orbit and the radiant position, the event was associated with the Quadrantids (IAU code QUA#0010). Since the Quadrantids reach their peak on January 3, this bright meteor was spotted near this activity peak. The

proposed progenitor body of this shower is 2003 EH1 [1].

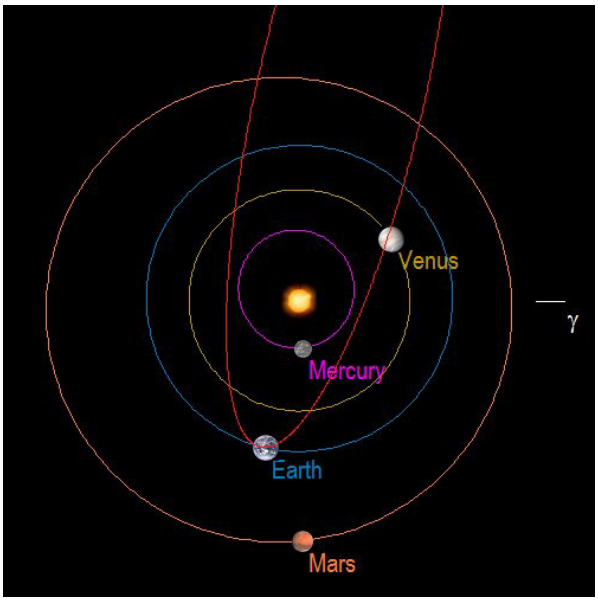

Figure 3. Projection on the ecliptic plane of the orbit of the SWEMN20230104_061218 meteor.

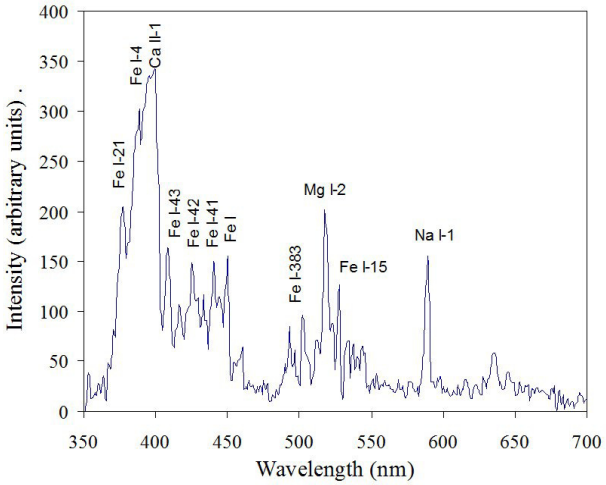

Figure 4. Calibrated emission spectrum of the SWEMN20230104_061218 fireball.

The emission spectrum of the meteor was recorded from the meteor-observing stations located at Sierra Nevada and La Sagra (Granada). This spectrum was calibrated in wavelength by identifying typical lines appearing in meteor spectra, and then corrected by taking into account the sensitivity of the recording device. The resulting calibrated spectrum is shown in Figure 4. This plot also shows the most noticeable emissions identified in the signal. These contributions correspond to Na I-1 (588.9 nm), Mg I-2 (516.7 nm), Ca II-1, Fe I-21, 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.

a (AU)	2.3±0.1	**ω (º)**	171.9±00.1
e	0.59±0.01	**Ω (º)**	283.297723±10^{-5}
q (AU)	0.97973±0.00007	**i (º)**	73.6±0.3

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

Conclusions: The bolide discussed here was observed on 2023 January 4. This Quadrantid (QUA#0010) meteor had a peak absolute magnitude of -9.0 and overflew Granada (Spain). The meteoroid followed a cometary (JFC) orbit before entering the atmosphere. This supports the idea that its parent body (2003 EH1) is a comet fragment. The analysis of the emission spectrum of the fireball was also performed. The main contributions found in this emission spectrum are those generated by Na I-1 (588.9 nm), Mg I-2 (516.7 nm), Ca II-1, Fe I-21, 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.

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References: [1] Jenniskens, P. et al. (2016) Icarus, 266, 331-354. [2] Madiedo J.M. (2014), Earth, Planets & Space, 66, 70. [3] Madiedo J.M. et al. (2021), eMeteorNews, 6, 397. [4] Madiedo J.M. et al. (2022), e MeteorNews, 7, 199.