**DYNAMICAL ANALYSIS OF AN EARTH-GRAZING SPORADIC BRIGHT METEOR OBSERVED IN 2022.** A. San Segundo[1], J.M. Madiedo[2], B. Tossar[3], A.I. Aimee[4]. [1]Observatorio El Guijo (MPC J27), Galapagar, Madrid, Spain. [2]Departamento de Sistema Solar, Instituto de Astrofísica de Andalucía (IAA-CSIC), 18080 Granada, Spain. [3]Casa das Ciencias, Museos Científicos Coruñeses, Coruña, Spain. [4]Southwestern Europe Meteor Network, 41012 Sevilla, Spain.

**Introduction:** Our planet's atmosphere is a very efficient shield, since the ablation process destroys most rocks that enter it before these materials reach the ground. However, under appropriate conditions, large and tough enough meteoroids may survive this process and reach the ground as meteorites. But meteoroid survival can also occur if these particles of interplanetary matter impact our atmosphere with a near-horizontal trajectory. Then, if the meteoroid is big enough and the closest height is not too low, only a part of the incoming mass might be ablated, so that the remaining material could leave the Earth with a modified orbit. These Earth-grazing fireballs are very scarce in the scientific literature [1-6].

In this work we present the preliminary analysis of an Earth-grazing fireball generated by the sporadic background on 2022 October 16. This bright meteor reached a peak luminosity equivalent to an absolute magnitude of -7.

Figure 1. Stacked image recorded from El Guijo Observatory of the SWEMN20221016_030032 bolide.

**Instrumentation and methods:** The fireball discussed here was spotted from several meteor observing stations operating from Spain in the framework of the SWEMN meteor network and the SMART project [7]. The event has been recorded with Watec 902H2 and Watec 902 Ultimate cameras. Their field of view ranges from 62x50 degrees to 14x11 degrees. The atmospheric path of the meteor was triangulated with the SAMIA software, developed by J.M. Madiedo. 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 [8, 9].

**The 2022 October 16 event:** This bright meteor was spotted on 2022 October 16 at 3h00m32.0±0.1s UT from the SWEMN meteor-observing stations located at La Hita Observatory (Toledo), El Guijo Observatory (Madrid), and Coruña (Figure 1). It had a peak absolute magnitude of -7.0±0.5. The code assigned to this event in the SWEMN meteor database [8] is SWEMN20221016_030032. We named this meteor "Arquillinos", since it was located near the zenith of this locality in the north of Spain during its initial luminous phase.

**Preliminary results:** It was deduced from the analysis of the atmospheric path of the event that this bright meteor overflew Spain and the Atlantic Ocean. The luminous event began at an altitude $H_b$=128.7±0.5 km. The bolide penetrated the atmosphere till a final height $H_e$=101.3±0.5 km. The position deduced for the apparent radiant corresponds to the equatorial coordinates α=138.67º, δ=-10.62º. The entry velocity in the atmosphere inferred for the parent meteoroid was $V_\infty$=61.1±0.2 km/s. The calculated projection on the ground of the trajectory in the Earth's atmosphere of the fireball is shown in Figure 2.

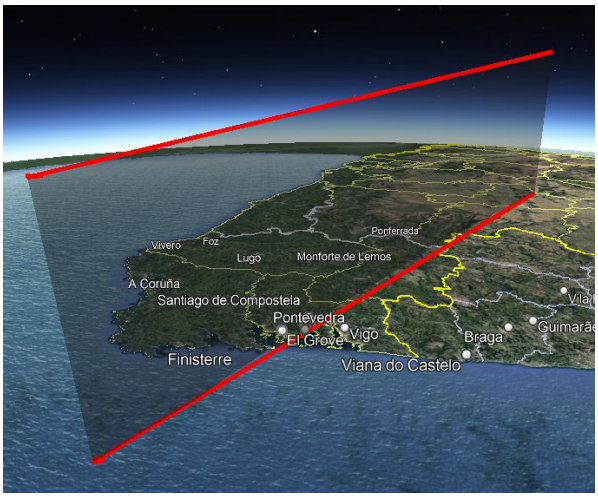


Figure 2. Atmospheric trajectory of the bolide discussed in this work. Its projection on the ground is also drawn.

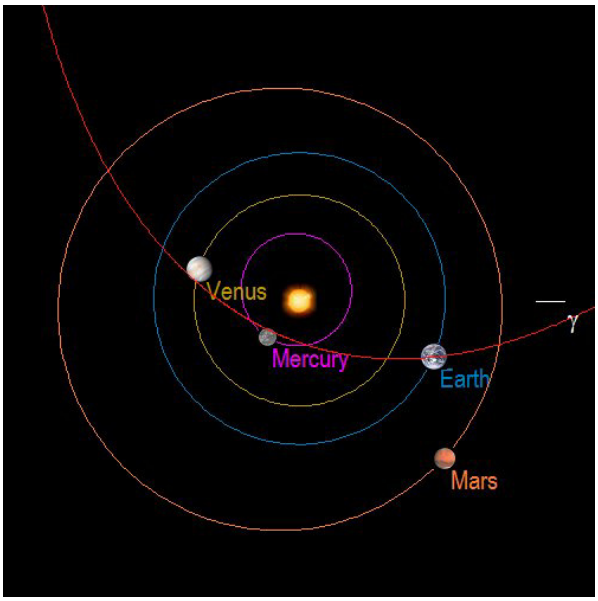


Figure 3. Projection on the ecliptic of the orbit of the progenitor meteoroid before its encounter with our planet.

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|---|---|---|---|
| **a (AU)** | 16.4±4.5 | **ω (º)** | 271.6±00.6 |
| **e** | 0.968±0.008 | **Ω (º)** | 22.424283±$10^{-5}$ |
| **q (AU)** | 0.520±0.003 | **i (º)** | 120.7±0.1 |

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

The orbital data of the parent meteoroid before its encounter with our planet are listed in Table 1. The value calculated for the geocentric velocity was $V_g$=59.8±0.2 km/s. From the value obtained for the Tisserand parameter with respect to Jupiter ($T_J$=-0.14), we found that the particle followed a cometary (HTC) orbit before impacting our atmosphere. By taking into account these orbital data and the radiant position, it was inferred that the meteor was generated by a sporadic meteoroid.

In this case the meteoroid did not survive. It was completely destroyed over the Atlantic Ocean after traveling a total distance of about 311 km in the atmosphere.

**Conclusions:** We have presented here the results obtained from the preliminary analysis of the "Arquillinos" fireball, which was recorded on 2022 October 16. This sporadic bolide had a peak absolute magnitude of -7.0 and overflew Spain and the Atlantic Ocean. Before striking our atmosphere the particle was moving on a cometary (HTC) orbit. The analysis of the trajectory of the meteor event shows that this was an Earth-grazer. The meteoroid did not survive. It was completely destroyed after traveling a total distance of about 311 km in the atmosphere.

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