**ATMOSPHERIC TRAJECTORY, ORBIT AND CHEMICAL COMPOSITION OF A SPORADIC BOLIDE IMAGED IN 2011.** L. Ordoñez[1], J.M. Madiedo[1,2], J.M. Trigo-Rodríguez[3]. [1]Facultad de Ciencias Experimentales, Universidad de Huelva, Huelva, Spain, madiedo@uhu.es. [2]Departamento de Fisica Atomica, Molecular y Nuclear. Universidad de Sevilla. 41012 Sevilla, Spain. [3]Institute of Space Sciences (CSIC-IEEC). Campus UAB, Facultat de Ciències, Torre C5-p2. 08193 Bellaterra, Spain, trigo@ice.csic.es.

**Introduction:** High-sensitivity CCD video devices are commonly employed to monitor meteor and fireball activity. These systems provide useful data for the determination, for instance, of radiant, orbital and photometric parameters [1, 2, 3]. Accurate orbital data are, for instance, of a paramount importance in order to infer information about the likely parent body of a given meteoroid stream [4]. Video spectroscopic techniques provide also very valuable data about the chemical nature of these particles of interplanetary matter [3, 5]. With this aim, The SPanish Meteor Network (SPMN) has systematically performed multiple-station video observations of major and minor meteor showers since 2006. In this work we analyze a double-station sporadic fireball imaged in the framework of our continuous fireball monitoring and spectroscopic campaigns in 2011.

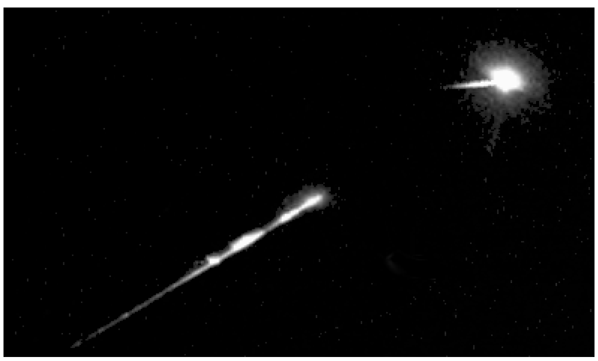

Figure 1. Composite image of the fireball (upper-right part of the figure) and its emission spectrum, imaged from El Arenosillo.

| Radiant data | | | |
|---|---|---|---|
| | Observed | Geocentric | Heliocentric |
| **R.A. (º)** | 3.7±0.2 | 3.4±0.2 | |
| **Dec. (º)** | 9.9±0.1 | 7.7±0.1 | |
| **$V_\infty$ (km/s)** | 21.1±0.3 | 17.8±0.3 | 41.5±0.3 |

| Orbital parameters | | | |
|---|---|---|---|
| **a (AU)** | 14±1 | **ω (º)** | 227.3±0.1 |
| **e** | 0.94±0.02 | **Ω (º)** | 213.9300±$10^{-4}$ |
| **q (AU)** | 0.838±0.002 | **i (º)** | 2.66±0.08 |

Table 1. Radiant and orbital data (J2000).

**Methods:** To image the fireball discussed here, we have employed an array of low-lux CCD video cameras manufactured by Watec Co. (models 902H and 902H Ultimate). These operate from two automated meteor observing stations. The operation of these systems is explained in [1, 2]. Holographic diffraction gratings are attached to the objective lens of some of these CCD devices. In this way, we can image the emission spectrum produced during the ablation of meteoroids in the atmosphere. Data reduction is performed with our AMALTHEA software, which obtains trajectory, radiant and orbital parameters by following the methods described in [6]. The analysis of emission spectra is done with our CHIMET application.

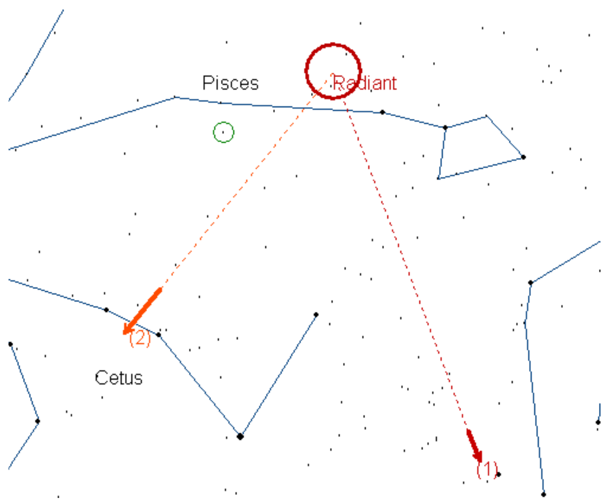


Figure 2. Apparent trajectory of the bolide as observed from Sevilla (1) and El Arenosillo (2).

**Atmospheric path, radiant and orbit:** Figure 1 shows a composite image of the double-station fireball we recorded on October 27, 2011, at 20h31m44.4±0.1s UTC. Its apparent trajectory as seen from both stations is shown in Figure 2. As can be noticed in Fig. 1, the bolide experienced a bright fulguration at the end of its atmospheric path because of the sudden disruption of the parent meteoroid. At that point, the fireball reached an absolute magnitude of -7±1. The analysis of the atmospheric trajectory indicates that the bolide began at about 97.4±0.5 km above the ground level, with the terminal point located at about 72.7±0.5 km. The meteoroid impacted the atmosphere with an initial velocity $V_\infty$=21.1±0.3 km/s. The apparent radiant was located at α=3.7º, δ=9.9º. With this information, the orbit was obtained (Fig. 3). The radiant and orbital parameters are shown in Table 1.

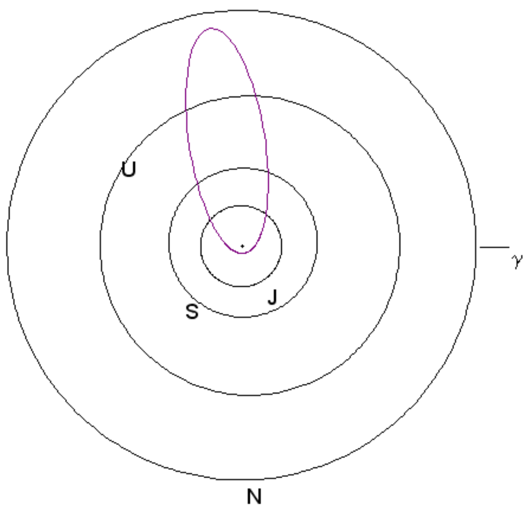


Figure 3. Projection on the ecliptic plane of the orbit of the parent meteoroid.

On the hand, the aerodynamic pressure under which the final flare shown in Figure 1 took place was determined. The calculation, which was performed in the usual way [7], yields $1.8\pm0.3\times10^4$dyn/cm$^2$.

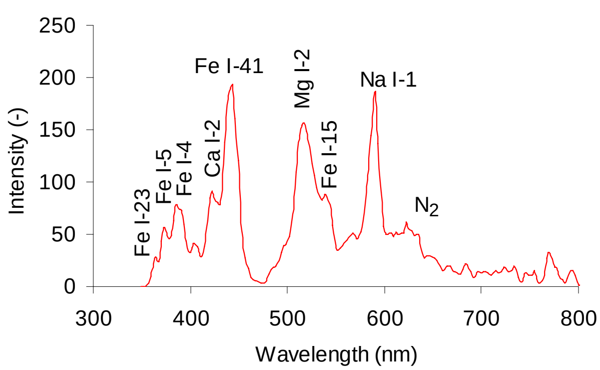


Figure 4. Calibrated emission spectrum.

**Chemical composition:** The emission spectrum of the fireball was recorded by one of the video spectrographs operating from El Arenosillo (Figure 1). The signal, once calibrated in wavelengths and corrected by taking into account the spectral response of the device, is shown in Figure 4. As can be noticed, most lines correspond to Fe I multiplets. The spectrum is dominated by the emission from Na I-1 (589.5 nm), Mg I-2 (516.7 nm) and Fe I-41 (441.5 nm). The contribution from Ca I-2 at 422.6 nm was also identified. Atmospheric $N_2$ bands can also be noticed in the red region of the spectrum.

**Conclusions:** We have analyzed a double station mag. -7±1 bolide. Its atmospheric trajectory and radiant were obtained and the orbit of the parent meteoroid was also calculated. These data proved the sporadic origin of this event, which penetrated in the atmosphere till a height of about 72 km above the ground level, exhibiting at that state a sudden disruption of the meteoroid. The aerodynamic pressure under which this event took place was obtained. The analysis of the emission spectrum indicates a high abundance of Na.

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**References:** [1] Madiedo J.M. and Trigo-Rodríguez J.M. (2007) *EMP* 102, 133-139. [2] Madiedo J.M. et al. (2010) *Adv.in Astron*, 2010, 1-5. [3] Trigo-Rodriguez, et al. (2009) *MNRAS*. 392, 367–375. [4] Madiedo J.M. et al. (2012) MNRAS, submitted. [5] Madiedo J.M. et al. (2012) MNRAS, submitted. [6] Ceplecha, Z. Bull. Astron. Inst. Cz. 38, 222-234, 1987. [7] Bronshten V. A., (1981), Geophysics and Astrophysics Monographs. Reidel, Dordrecht.