SPECTRAL ANALYSIS AND ORBIT OF THE "DOÑANA" FIREBALL, RECORDED ON JAN. 25, 2012.

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Introduction: The continuous monitoring of meteor and fireball activity provides helpful information about meteoroid streams, but also about the mechanisms that deliver these particles of interplanetary matter to the Earth [1, 2, 3]. Besides, by means of meteor spectroscopy we can obtain an insight into the chemical nature of meteoroids ablating in the atmosphere. Very bright fireball events are particularly interesting, as under appropriate circumstances they may give rise to meteorite falls. With this aim, the SPanish Meteor Network (SPMN) is performing a continuous meteor monitoring and spectroscopic campaign from 25 observing stations located in Spain. These monitor the night sky over the Iberian Peninsula and neighbouring areas. In this work we present the analysis of a mag. -9 sporadic fireball recorded over the Doñana Natural Park on Jan. 25, 2012.

Instrumentation: The Geminid fireball discussed here was imaged from two meteor observing stations (Sevilla and El Arenosillo) that employ low-lux 1/2" CCD video cameras (models 902H and 902H Ultimate, from Watec Co.). The operation of these robotic stations is explained in [1, 2]. For meteor spectroscopy some of these cameras employ holographic diffraction gratings (500 or 1000 lines/mm) attached to the objective lens.

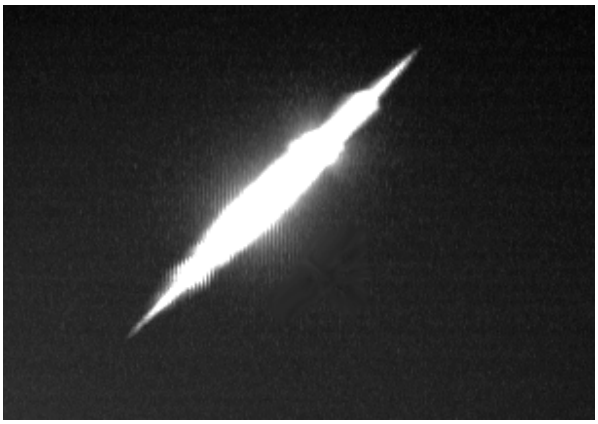

Figure 1. Composite image of the Doñana fireball, as imaged from Sevilla.

Atmospheric trajectory and orbit: A mag. -9±1 slow-moving fireball was simultaneously recorded from the above-mentioned meteor stations on Jan. 25, 2012, at 20h20m07.3±0.1s UT (Figure 1). The apparent trajectory of this bolide, which is included in our database with code SPMN250112, is shown in Figure 2. The parent meteoroid struck the atmosphere with an initial velocity V_∞=14.7±0.3 km/s and a zenith angle of 38.2º, with an apparent radiant located at α=42.3º, δ=3.8º. The luminous phase begun at 65.8±0.5 km above the ground level and ended at about 29.6±0.5 km. The projection of this trajectory on the ground is shown in Figure 3. The fireball received the name "Doñana", as its atmospheric path was contained over this natural park. Once this trajectory was obtained, the orbital parameters of the meteoroid were calculated (Table 1). The projection of this orbit on the ecliptic plane is plotted in Figure 4.

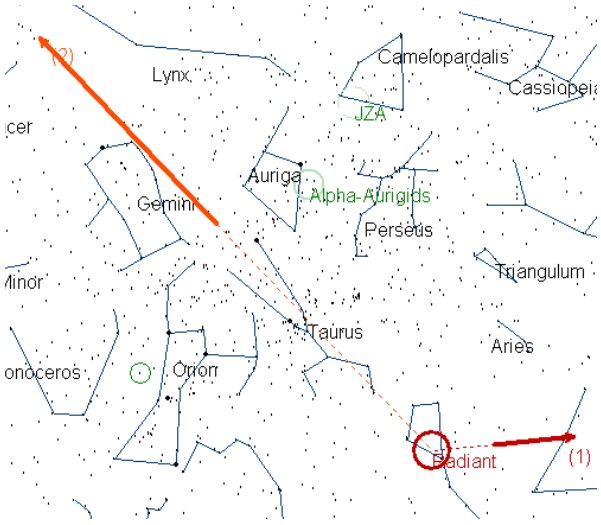

Figure 2. Apparent trajectory of the fireball as recorded from Sevilla (1) and El Arenosillo (2) meteor observing stations.

Figure 3. Projection on the ground of the atmospheric trajectory followed by the Doñana fireball.

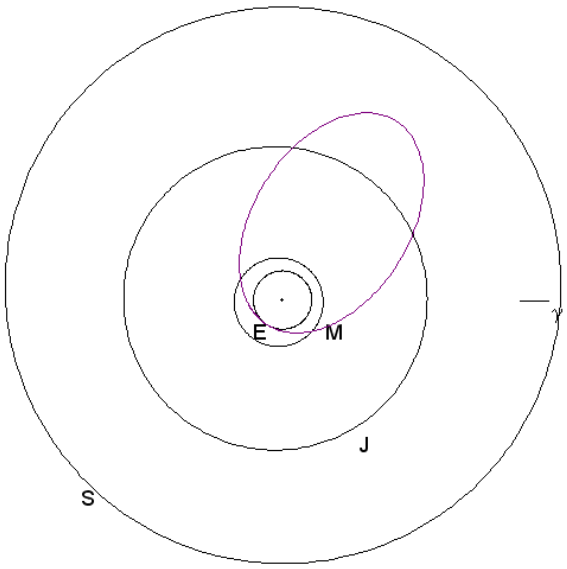

Figure 4. Projection on the ecliptic plane of the orbit of the parent meteoroid.

Radiant data			
	Observed	Geocentric	Heliocentric
R.A. (º)	42.3±0.5	34.5±0.3	
Dec. (º)	3.8±0.3	-3.8±0.2	
V_∞ (km/s)	29.5±0.3	9.9±0.4	39.8±0.4
Orbital parameters			
a (AU)	4.1±0.6	**ω (º)**	357.0±0.3
e	0.76±0.04	**Ω (º)**	125.0826 ± 10^{-4}
q (AU)	0.9839±0.0001	**i (º)**	4.0±0.1

Table 1. Radiant and orbital data (J2000) for the Doñana fireball.

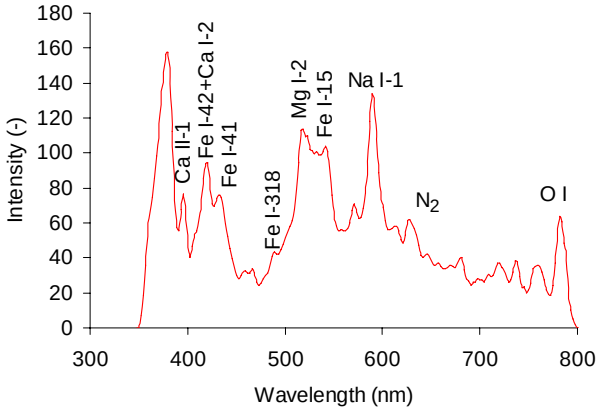

Figure 4. Calibrated emission spectrum of the Doñana fireball.

Emission spectrum: The spectrum of the Doñana fireball was obtained by spectral cameras operating from both observing stations. It was analyzed with our CHIMET software, which follows the method described in [5, 6]. Thus, the images containing the spectrum were dark-substracted and flat-fielded. The signal was integrated and calibrated in wavelengths by using typical lines produced by meteor plasmas (Ca, Fe, Mg, and Na multiplets). Then, the spectrum was corrected by taking into account the spectral efficiency of the instrument. The result is shown in Fig. 4. As can be seen, most prominent lines correspond to Fe I-21 (377.9 nm) and Na I-1 (589.5 nm). The H and K lines of ionized calcium were also identified in the ultraviolet, together with the emission from Mg I-2 (516.7 nm) and the contribution from atmospheric N_2 in the red region. In fact, nitrogen bands are particularly prominent in this spectrum. The O I triplet at 777.1 nm is also seen.

Conclusions: A double-station mag. -9±1 fireball was imaged in the framework of our continuous fireball monitoring and spectroscopic campaigns. Its atmospheric path and radiant were calculated. The orbit of the parent meteoroid was also obtained. These data confirm the sporadic nature of this event. The emission spectrum reveals a high Na content.

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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. [5] J.M. Trigo-Rodríguez et al. (2003) *MAPS* 38, 1283-1294. [6] Trigo-Rodríguez et al. (2004) *MNRAS* 348, 802-810.