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Analysis of a deep-penetrating sporadic fireball observed over Portugal in 2011

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Abstract

We analyze a slow-moving fireball observed over Portugal on October 5, 2011. The event, which lasted about 10 seconds, travelled over 100 km in the atmosphere and was recorded from several meteor observing stations operating from Portugal and Spain. The orbit of the parent meteoroid is calculated and the possibility of meteorite survival is also discussed.

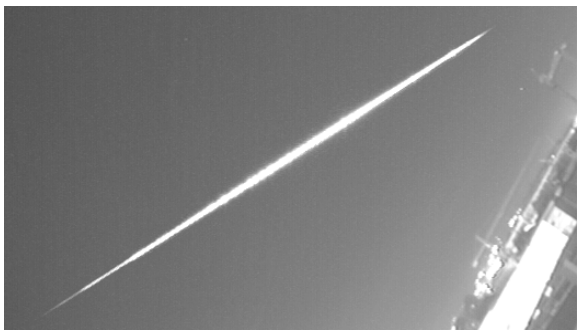

Figure 1: Composite image of the fireball as recorded from Sevilla.

1. Introduction

On October 5, 2011 a slow-moving fireball (Figure 1) was witnessed over the Iberian Peninsula. Numerous casual observers could see the bolide from Portugal and Spain. Some of these reported a thunder-like sound associated to this event. The bolide, which followed the SW-NE direction, was recorded from two meteor observing stations in both countries. From these recordings we have calculated the atmospheric trajectory of the fireball, for which a terminal mass of around 10 grams was inferred. The detailed circumstances of this sporadic event are presented here and the orbit of the parent meteoroid is also discussed.

2. Instrumentation

The fireball was recorded from one of the stations operated by the SPanish Meteor Network (SPMN) in Sevilla (southwest Spain). This employs an array of high-sensitivity CCD video cameras (models 902H and 902H2 Ultimate from Watec Co.) to monitor the night sky. A detailed description about how these devices are operated has been given elsewhere [1, 2]. The bolide was also imaged from a meteor observing station located in Tomar (Portugal), which employs four low-lux CCD video cameras (models Mintron 12V6HC-EX / 12V1C-EX and Watec 902H2 Ultimate) named TEMPLAR1 to TEMPLAR4 and controlled by the METREC software [3].

Radiant data			
	Observed	**Geocentric**	**Heliocentric**
R.A. (º)	273.12±0.01	261.7±0.7	-
Dec. (º)	-19.39±0.01	-34.4±1.0	-
V_∞ (km/s)	13.9±0.3	8.5±0.4	37.8±0.5
Orbital parameters			
a (AU)	2.6±0.3	**ω (º)**	351.1±0.1
e	0.62±0.06	**Ω (º)**	12.05662 ± 10^{-4}
q (AU)	$0.\ 9953\pm10^{-4}$	**i (º)**	2.5±0.1

Table 1: Radiant and orbital parameters (J2000).

3. Data reduction and results

The bolide was included in our database with the SPMN code 051011. This code was assigned after the recording date. Thus, the fireball was imaged on Oct. 5, 2011, at 19h48m09s ± 1s UTC. The analysis of the atmospheric trajectory was performed by means of the planes intersection method [4]. This reveals that the luminous phase began over Portugal at a height of 85.2±0.5 km above the ground level and ended at 31.9±0.5 km. The meteoroid struck the atmosphere with an initial velocity V_∞=13.9±0.3

km/s and the inclination of the trajectory with respect to the ground was of about 26º. The apparent radiant was located at α=273.12±0.01º, δ=-19.39±0.01º. The bolide lasted about 10 seconds and travelled around 102 km in the atmosphere. Its apparent path in the sky as seen from Tomar and the projection on the ground of this trajectory are shown, respectively, in Figures 2 and 3. The radiant and orbital data are summarized in Table 1. Figure 4 shows the projection on the ecliptic plane of the orbit of the meteoroid. This orbit reveals a likely asteroidal origin for this particle.

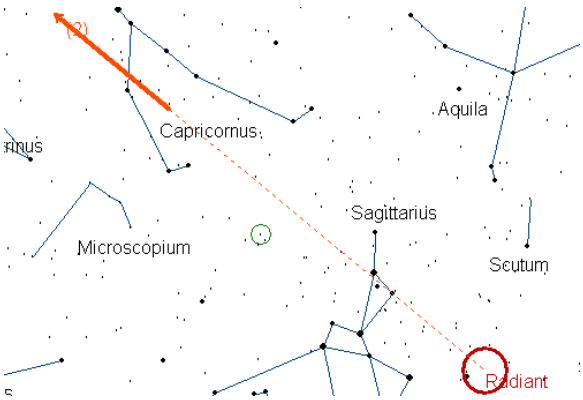

Figure 2: Apparent path of the SPMN051011 fireball as seen from Tomar.

Figure 3: Projection on the ground of the atmospheric trajectory of the fireball.

According to its deep penetration in the atmosphere we considered this fireball as a potential meteorite-dropper. The analysis of the terminal point of the trajectory reveals, however, that the surviving mass would be very small: 11±10 g. The nominal impact point, by including wind effects, would be located around the coordinates lat.=39.005º N, lon.=7.280º W, although this calculation is affected by a very big error because of the small value of the meteorite mass.

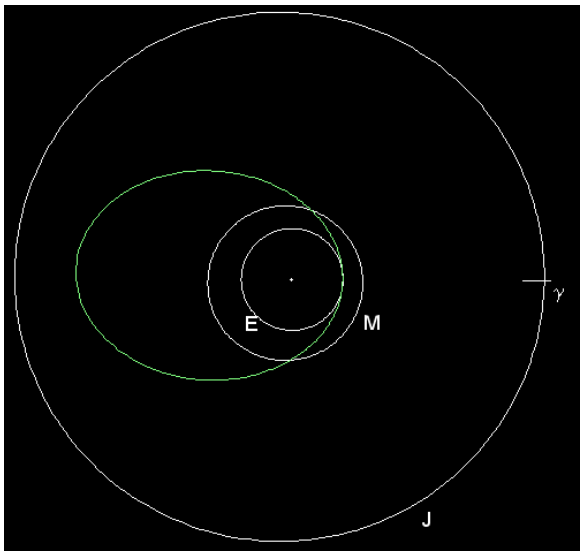

Figure 4: Projection on the ecliptic plane of the orbit of the meteoroid.

6. Summary and Conclusions

The fireball observed on Oct. 5 2011 over the south of Portugal has been analyzed. The bolide, produced by a meteoroid with an asteroidal origin, travelled about 102 km and penetrated the atmosphere till a final height of 31.9±0.5 km. The surviving mass was 11±10 g, with the likely landing point located in Portugal.

Acknowledgements

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References

[1] Madiedo, J.M. and Trigo-Rodríguez, J.M. Earth, Moon, and Planets 102, pp. 133-139, 2007. [2] Madiedo, J.L., Trigo-Rodriguez, J.M., Ortiz, J.L., Morales, N. Advances in Astronomy, Vol. 2010, 1-5, 2010. [3] Molau S., Proc. of the International Meteor Conference, Stara Lesna 20-23 August 1998, Eds.: Arlt, R., Knoefel, A., International Meteor Organization, p. 9-16, 1999. [4] Ceplecha, Z., Bull. Astron. Inst. Cz. 38, 222-234, 1987.