A 2010 SUPERBOLIDE PRODUCED BY A METEOROID FROM A SHORT PERIOD COMET.

A. Cruz[1], J.M. Madiedo[1, 2], J.L. Ortiz[3], A.J. Castro-Tirado[3] and J.M. Trigo-Rodríguez[4]. [1]Facultad de Ciencias Experimentales, Universidad de Huelva, Avda. de las Fuerzas Armadas S/N. 21071 Huelva, Spain. [2]Depto. de Física Atómica, Molecular y Nuclear, Facultad de Física, Universidad de Sevilla, 41012 Sevilla, Spain, madiedo@uhu.es. [3]Instituto de Astrofísica de Andalucía, CSIC, Apt. 3004, 18080 Granada, Spain. [4]Institute of Space Sciences (CSIC-IEEC). Campus UAB, Facultat de Ciències, Torre C5-p2. 08193 Bellaterra, Spain.

Introduction: In 2009 our team established a meteor observing station in the Sierra Nevada Astronomical Observatory (Granada, Spain), with the aim to monitor meteor and fireball activity over the south of the Iberian Peninsula and to develop a continuous meteor spectroscopy campaign in the framework of the SPanish Meteor Network (SPMN). In this work, we analyze a very bright fireball that reached its maximum brightness next to the zenith of this observatory in 2010. In fact, with an absolute magnitude of about -18, this event was classified as a superbolide.

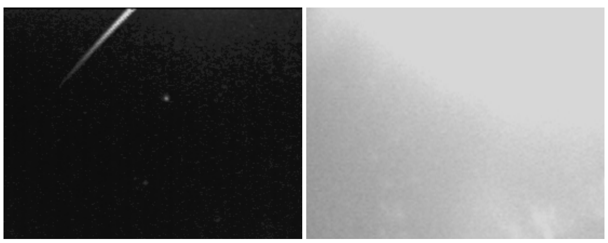

Figure 1. Composite image of the fireball, taken from Sierra Nevada, during its beginning (left) and maximum phase (right).

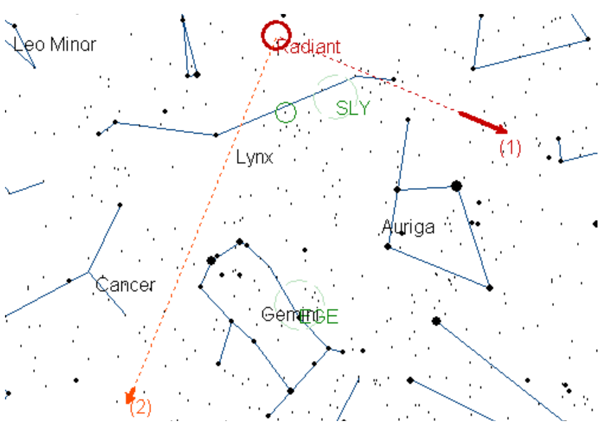

Figure 2. Apparent path of the superbolide as recorded from Sierra Nevada (1) and Sevilla (2).

Instrumentation and data reduction methods: The bolide considered in this work was recorded from two of our meteor observing stations: Sierra Nevada and Sevilla. These employ an array of low-lux CCD video cameras (models 902H and 902H Ultimate from Watec Corporation, Japan) whose operation has been explained in [1, 2]. Some of these CCD devices are configured as spectral cameras, with transmission diffraction gratings attached to the objective lens. For trajectory, radiant and orbital parameters calculation we have employed our AMALTHEA software, which follows the methods described in [3].

Figure 3. Image of the surroundings of the Sierra Nevada Astronomical Observatory just before the beginning of the fireball (top) and at the instant of its final fulguration (bottom).

Atmospheric trajectory, radiant and orbit: On September 25, 2010 at 3h16m15.5±0.1s UTC, a bolide was recorded over the south of Spain (Figure 1). Its apparent trajectory in the sky, as seen from both observing stations, is shown in Figure 2. Unfortunately, clouds did not allow recording its whole atmospheric trajectory from our meteor station in Sevilla, although the beginning of the event could be imaged from there. It exhibited a very bright fulguration because of the sudden disruption of the parent meteoroid. At that state, the fireball reached an absolute magnitude of -18±1 and caused the saturation of images taken by the CCD cameras pointing to the direction of the fireball. This flare was so intense that it illuminated the surroundings of the Sierra Nevada Astronomical Observatory (Figure 3). In fact, according to the analysis of the atmospheric path, the fireball began at a height of 137.7±0.5 km and reached its maximum brightness next to the zenith of this observatory, when the meteoroid was located at a height of about 94.5±0.5 km above the ground level and broke-up under an aerodynamic pressure, calculated in the usual way [4], of $3.2\pm0.4\times10^{3}$dyn/cm^2. This value provides an estimation of the tensile strength of the particle [5]. Besides, the meteoroid struck the atmosphere with an initial velocity V_∞=58.4.±0.3 km/s and a zenith angle of about 51.6º. The projection on the ground of this atmospheric trajectory is shown in Figure 4. The orbit in the Solar System of the meteoroid was also evaluated (Figure 5). Radiant and orbital parameters are summarized in Table 1.

Figure 2. Projection on the ground of the atmospheric path of the Sierra Nevada event.

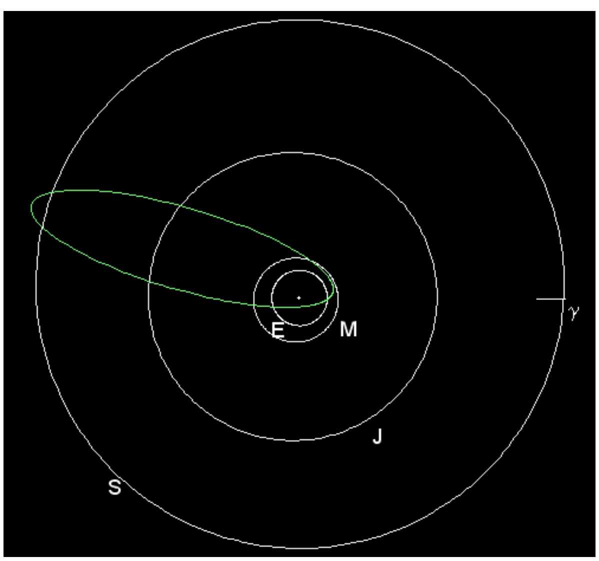

Figure 3. Orbit of the parent meteoroid projected on the ecliptic plane.

Radiant data			
	Observed	Geocentric	Heliocentric
R.A. (º)	126.6±0.4	126.9±0.4	
Dec. (º)	58.2±0.3	58.3±0.3	
V_∞ (km/s)	58.4±0.3	57.1±0.3	40.6±0.3
Orbital parameters			
a (AU)	7.5±0.9	**ω (º)**	130±1
e	0.88±0.02	**Ω (º)**	181.8132 ± 10^{-4}
q (AU)	0.834±0.006	**i (º)**	108.9±0.4

Table 1. Radiant and orbital data (J2000).

Conclusions: The atmospheric trajectory and radiant of the double-station mag. -18 "Sierra Nevada" superbolide have been calculated. The orbit of the parent meteoroid and its tensile strength have been also derived. The results confirm the sporadic nature of this event, which was produced by a meteoroid from a short-period comet following a retrograde orbit (T_J=0.34). The event ended at an altitude of about.94.5 km above the ground level and, so, no fragments survived as meteorites.

Acknowledgements: We acknowledge support from the Spanish Ministry of Science and Innovation (projects AYA2009-13227, AYA2011-26522 and AYA2009-06330-E).

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] Ceplecha Z. (1987) *Bull. Astron. Inst. Cz.* 38, 222-234. [4] Bronshten V. A. (1981) *Geophysics and Astrophysics Monographs*. Reidel, Dordrecht. [5] Trigo-Rodríguez J.M. and Llorca J. (2006) *MNRAS*, 372, 655.