A 2010 TAURID BOLIDE IMAGED IN THE FRAMEWORK OF THE SPANISH FIREBALL NETWORK

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Introduction: Many cometary meteoroid streams crossing the Earth were formed the continuous sublimation of the ice-rich regions in cometary nuclei [1,2,3]. Presumably only fragile aggregates of the type released from 81P/Wild 2 [4] are lifted off from ice-rich regions by gas drag. However, other important mechanism to deliver cometary materials to Earth is the catastrophic disruption of cometary nuclei [5, 6, 7, 8]. Several cometary streams can have m-sized meteoroids generated in cometary disruptions, being the Taurid complex associated with comet 2P/Encke among them. Several NEOs have been identified as part of this complex [9] whose existence suggests that this comet suffered catastrophic disruptions in the past.

We describe here a bolide as bright as the full Moon recorded by several high-sensitivity video cameras. The event was recorded on Oct. 19th, 2010 at 04h40m30.4s UTC during the continuous monitoring of fireball activity over the Iberian Peninsula performed in the framework of the Spanish Fireball Network (www.spmn.uji.es). With this effort we wish to get new clues on the meteoroid streams that are forming the so-called Taurid complex. Although several meteoroid streams from this complex have been already identified [10], additional high-precission orbital determinations of large meteoroids can provide new clues on the formation, and evolution of this intrincate cloud of debris considered to be an important source of Zodiacal Dust [11]. Interestingly, the Taurid streams also suffer resonant trapping with Jupiter [12], and are suspicious to produce unusual fireball activity during determinate years [13]. We describe here one bright bolide that flew over many of the instruments operated by the SPanish Meteor and Fireball Network (SPMN) so that measurements of its properties were obtained.

Methods: A continuous monitoring of the night sky all over Spain is being made currently from 27 stations. This observational challenge involves the recording over a very large surface area of about 500,000 km^2. In order to achive this goal, state-of-the-art CCD and video cameras are operated by members and collaborators of the Spanish Meteor and Fireball Network (SPMN). We have used high-sensitivity 1/2" black and white CCD video cameras (Watec, Japan) attached to modified wide-field lenses covering a 120×80 degrees field of view. Coordinate measurements on the images were obtained for comparison stars and the bolide by using our implemented software package [9]. The fireball described here was imaged by CSIC-IEEC-AAO high-resolution video cameras located in Folgueroles and Montseny SPMN stations in Barcelona province. From the sequential measurements of the video frames and the trajectory length, the velocity of the bolide along the path was obtained. The pre-atmospheric velocity V_∞ is found from the velocity measured at the earliest part of the fireball trajectory.

Preliminary results and discussion: From the astrometric measurements of the images the atmospheric trajectory, velocity and height were obtained. The fireball studied here was called La Jonquera (SPMN191010) as its main flare occurred over this town nearby the French border (Fig. 1). From the atmospheric trajectory and the computed initial velocity and geocentric radiant, the heliocentric orbit was determined (Table 1). This fireball ended at a height of 64.0±0.4 km so a meteorite fall is unlikely. When noticeable mass produces a fireball below 40 kms height we also obtain the dynamic mass of the meteoroid from modeling the deceleration data measured from the video frames.

SPMN191010 "La Jonquera"			
Radiant data			
	Observed	Geocentric	Heliocentric
R.A. (º)	45.5±0.6	43.74±0.61	-
Dec. (º)	+20.4±0.6	19.27±0.61	-
Ecliptical longitude(º)	-	-	-5.70±0.52
Ecliptical latitude(º)	-	-	2.23±0.55
V_∞ (km/s)	33.5±0.30	31.86±0.31	35.26±0.31
Orbital data			
a(AU)	1.65±0.07	**ω (º)**	315.1±1.3
e	0.878±0.005	**Ω (º)**	205.69575
q(AU)	0.200±0.007	**i (º)**	4.31±1.06
Q(AU)	3.10±0.13		

Table 1. Radiant and orbital data for the bolide described in the text.

The fireball suffered a very bright flare at 79 km over the ground level (see Fig. 2). We can use the height corresponding to such fragmentation event in order to infer the aerodynamic strength at which the particle suffered the break-up. Taking into account the average atmospheric density for the US standard atmosphere [14], and the fireball velocity at that point (32.1 km/s) we computed the aerodynamic strength as usual [15], obtaining $1.9\pm0.7\times10^5$dyn/cm^2.

Conclusions: We are identifying probable meteorite-dropping bolides from the ending heights, and computed terminal masses of several meteoroid streams. A good candidate to produce meteorites with the right geometry is the Taurid complex associated with comet 2P/Encke. In any case, this event was peculiar. The aerodynamic strength value for the SPMN191010 bolide is lower than the averaged for the Taurids [16]. This, together with the higher ending height, suggests that the meteoroid was more fragile than other members of the Taurids complex. In fact, the reported scattering in Taurids' strength suggests a structural diversity in meteoroids forming this complex.

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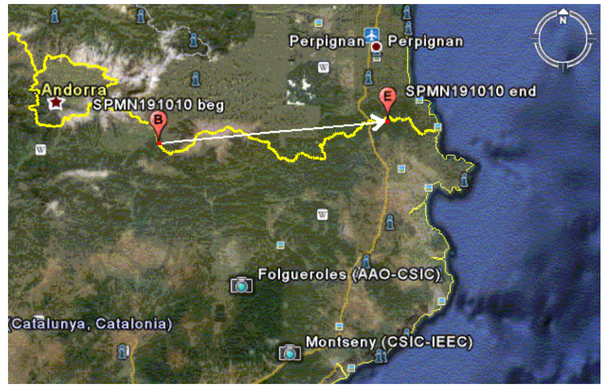

Figure 1. The trajectory projected on the ground of La Jonquera bolide (SPMN 191010) where the two video recording stations are plotted.

Figure 2. The magnificence of La Jonquera bolide (SPMN 191010), with an absolute magnitude of –12, is well exemplified in this composite image of the full sequence imaged from Folgueroles.

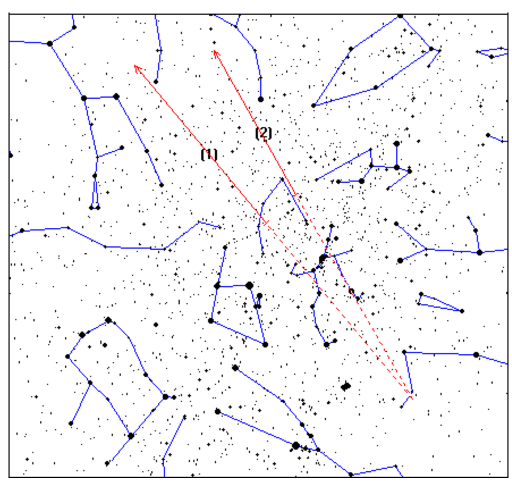

Figure 3. The astrometric calibration from two stations (1. Folgueroles, and 2. Montseny) allowed us to compute the radiant. This radiant suggests a clear association with the Taurid complex.