A QUADRANTID FIREBALL IMAGED IN 2011. F. Díez[1], J.M. Madiedo[1,2], J.M. Trigo-Rodríguez[3], S. Pastor[4] and J.A. de los Reyes[4]. [1]Facultad de Ciencias Experimentales, Universidad de Huelva, Huelva, Spain. [2]Departamento de Física Atómica, 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@ieec.uab.es. [4]Observatorio Astronómico de La Murta. Molina de Segura, 30500 Murcia, Spain.

Introduction: The Quadrantid meteor shower peaks on Jan. 3-4, with its main activity confined to a 12 to 14 h window. Despite it has one of the highest ZHR of all annual showers (above 100 meteors/hour), it is very difficult to observe because of frequent bad weather in early January in the northern hemisphere. One asteroid, the near-Earth object 2003 EH1, is the accepted parent body of the Quadrantid meteoroid stream [1]. Several studies have revealed changes in the orbital elements of this stream within a period of a few thousand years [2-6]. So, the determination of precise orbital and radiant information can be very useful to improve our knowledge about the Quadrantids. For this reason, in the framework of the SPanish Meteor Network (SPMN) we focus our attention on the activity of this stream when weather conditions are favourable. Thus, as a result of our continuous monitoring of meteor activity, tens of double-station Quadrantid meteors were recorded from our observing stations in January 2011. Among these, several fireballs are included. For events brighter than mag. -5 our spectral cameras, which perform a continuous spectroscopic campaign, imaged the emission spectrum produced during the ablation of meteoroids in the atmosphere. We present here the preliminary analysis of one of these bolides.

Methods: We have employed high sensitivity CCD video cameras (models Watec 902H and 902H Ultimate from Watec Corporation) to monitor the activity of the Quadrantids. The operation of our video systems has been explained in [7, 8]. We also employ transmission diffraction gratings for meteor spectroscopy. In this way we can obtain useful information about the chemical nature of the meteoroids [9-13].

Results and discussion: The Quadrantid bolide analyzed here (code SPMN040111_015358) was simultaneously imaged on Jan. 4, 2011 at 1h53m58.4±0.1s UTC from our video meteor observing stations located in La Hita and La Murta (Fig. 1). Its brightness (magnitude -7±1) was estimates from the photometric analysis of these images. As can be seen in Fig. 1, the fireball exhibited two flares during the last part of its atmospheric trajectory. Its projection on the ground is shown in Figure 2. This trajectory was characterized by applying the planes intersection method [14]. The calculation, which was performed with our AMALTHEA software [10], also provided the position of the radiant. The preatmospheric velocity, which was calculated from the velocities measured at the beginning of the meteor trail, was V_∞=43.3±0.3 km/s. The orbit of the meteoroid was obtained by using the method described in [14]. Orbital and radiant parameters are summarized in Table I.

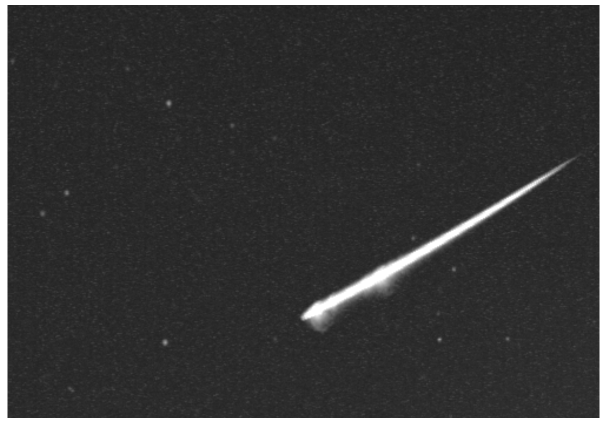

Figure 1. Composite image of the mag. -7 SPMN040111_015358 Quadrantid fireball imaged from La Murta Astronomical Observatory.

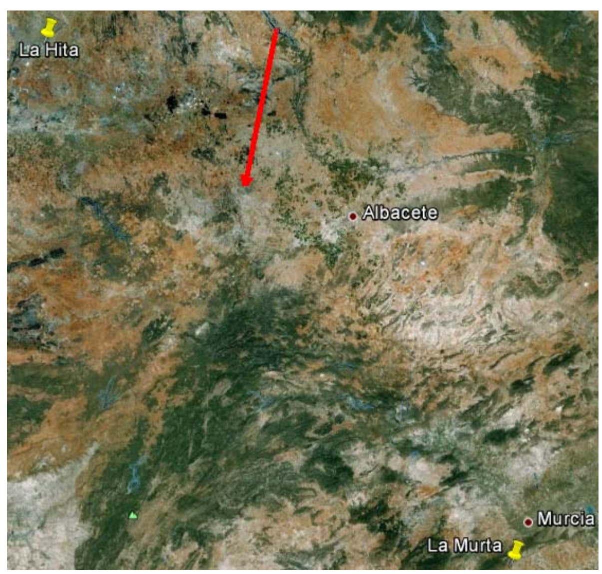

Figure 2. Projection on the ground of the atmospheric trajectory of the SPMN041011_015358 fireball.

One of the spectral cameras operating from La Hita Astronomical Observatory recorded the emission spectrum of this fireball. This spectrum was analyzed by following the procedure described in [12]. Thus, the images were dark-substracted and flat-fielded. The signal was corrected by taking into account the spectral efficiency of the device and then calibrated in wavelength by using typical metal lines appearing in meteor spectra (Ca, Fe, Mg, and Na multiplets). This analysis was performed with our CHIMET software [15]. The raw and calibrated signals are shown in Figure 3. The main lines identified in the calibrated spectrum are shown in Figure 4. The most remarkable emission lines correspond to multiplets Ca II-1 (396.8 nm), Fe I-41 (440.5 nm) Mg I-2 (516.7 nm) and Na I-1 (588.9 nm). Some of the lines produced by atmospheric nitrogen have been also highlighted.

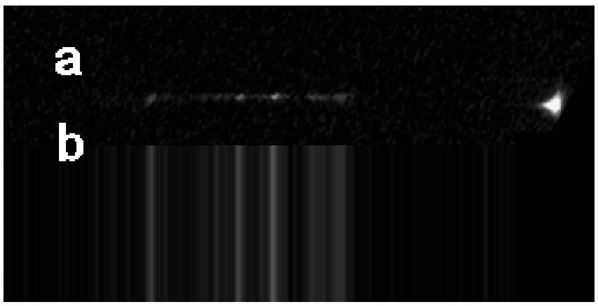

Figure 3. Raw (a) and processed (b) emission spectrum of the SPMN040111_015358 Quadrantid fireball. The fireball (order zero) appears on the right.

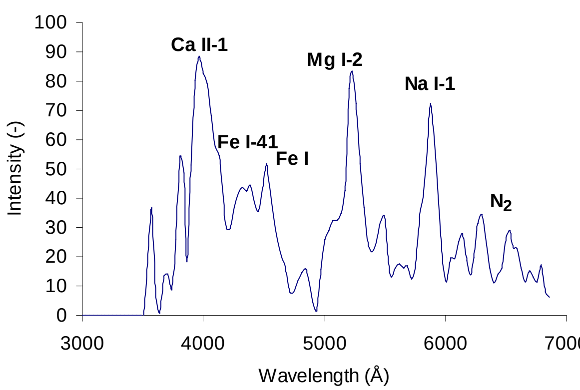

Figure 4. Main emission lines identified in the calibrated spectrum.

Radiant data			
	Observed	Geocentric	Heliocentric
R.A. (º)	226.4±0.3	228.0±0.3	
Dec. (º)	49.5±0.2	49.4±0.2	
V_∞ (km/s)	43.3±0.3	41.6±0.3	38.7±0.3
Orbital parameters			
a (AU)	2.9±0.1	**ω (º)**	174.0±0.5
e	0.66±0.02	**Ω (º)**	283.1935 ± 10^{-4}
q (AU)	0.981±0.01	**i (º)**	72.9±0.4

Table 1. Radiant and orbital data (J2000) for the SPMN040111_015358 fireball.

Conclusions: The analysis of the mag. 7±1 Quadrantid fireball studied here has provided information about its atmospheric trajectory and radiant. The orbital parameters of the parent meteoroid and the strength of this particle have been also inferred. We have also obtained information about its chemical composition from the analysis of its emission spectrum.

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