**LARGE METEOROIDS BELONGING TO THE α-CAPRICORNID METEOROID STREAM.** J. Zamorano[1], J.M. Madiedo[2], J.M. Trigo-Rodríguez[3], J. Izquierdo[1], F. Ocaña[1], A. Sánchez de Miguel[1] and F.M. Toscano[4]. [1]Dpto. de Astrofísica y CC. de la Atmósfera, Facultad de Ciencias Físicas, Universidad Complutense de Madrid, 28040 Madrid, Spain, jzamorano@fis.ucm.es. [2]Facultad de Ciencias Experimentales, Universidad de Huelva, 21071 Huelva, Spain, madiedo@uhu.es. [3]Institute of Space Sciences (CSIC-IEEC). Campus UAB, Facultat de Ciències, Torre C5-p2. 08193 Bellaterra, Spain, trigo@ieec.uab.es [4]Facultad de Química, Universidad de Sevilla, 41012 Sevilla, Spain.

**Introduction:** Several objects have been proposed as the parent body of the α-Capricornid meteoroid-stream. Among them we can find the short period comets 141P/Machholz and 45P/Honda-Mrkos-Pajdusakova, but also asteroids such as (2101) Adonis, 2002 EX12(=169P/NEAT) and (9162) 1987 OA [1-5]. The debris produced by the fragmentation of the parent body give rise to an annual display of meteors from July 19 to August 18, with a maximum activity around the end of July and a ZHR of about 10 [5]. Although most of these meteors are faint, this meteoroid stream also presents a population of large (cm-sized) meteoroids that produces extraordinary bright bolides. Thus, for instance, the brightest event recorded on 2006 by the SPanish Meteor Network SPMN was associated with this meteor shower [6]. Unfortunately these events are rare, but the development of a network of meteor observing stations that can simultaneously register these fireballs is fundamental in order to fully characterize them in order to obtain precise physico-chemical properties of the meteoroids, to study possible pausicity in the Earth-arriving flux, and to get more detailed radiant and orbital information. This would also provide useful data to establish which is the parent body of this stream. We present here the analysis of another very bright α-Capricornid fireball simultaneously registered from three meteor observing stations on July 31, 2011 with an absolute magnitude of -9±1.

**Methods:** The three SPMN stations that imaged the fireball considered here operate from central Spain and employ high-sensitivity 1/2" monochrome CCD video cameras (Watec Co., Japan). A detailed description of these systems has been given elsewhere [7, 8]. The station operating from La Hita Astronomical Observatory works in an autonomous way by means of proper software [9]. Besides, some of these cameras have attached holographic diffraction gratings, so that they provide useful information about the chemical composition of meteoroids by registering the emission spectrum produced during ablation in the Earth's atmosphere [10-13].

**Results and discussion:** The mag. -9±1 fireball analyzed here (code SPMN310711) was recorded on July 31, 2011 at 21h50m09.6±0.1s UT (Fig. 1). The radiant and orbital parameters of the fireball are shown on table I. The preatmospheric velocity calculated from the velocities measured at the beginning of the meteor trail was $V_\infty$=25.1±0.4 km/s.

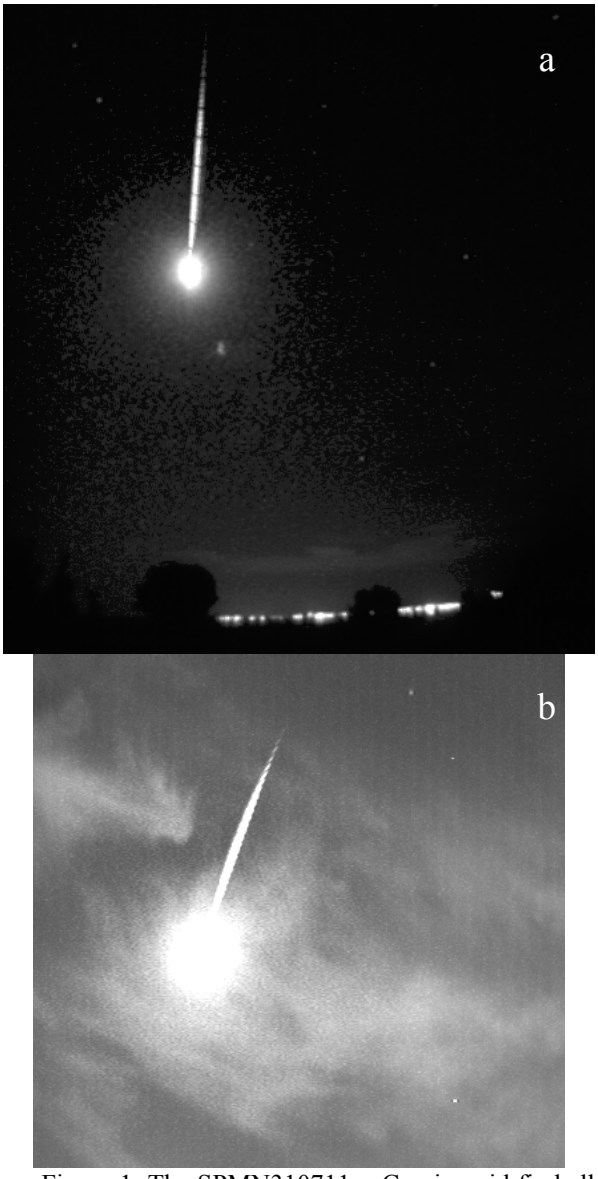


Figure 1. The SPMN310711 α-Capricornid fireball imaged from a) La Hita Astronomical Observatory and b) Madrid (Observatory UCM).

We have employed our ORAS software (ORbital Association Software) to get information about the parent body of the meteoroid. By using the Southworth

and Hawkins dissimilarity criterion [14], the best candidate is minor planet 2002 EX12, with a value of $D_{SH}$=0.07. This is consistent with recent studies about the origin of the α-Capricornid meteoroid stream [15].

The emission spectrum of this fireball was recorded from the SPMN station operating from Villaverde del Ducado (Guadalajara). This was corrected by taking into account the instrumental efficiency, and then calibrated in wavelengths by using typical metal lines (Ca, Fe, Mg, and Na multiplets). The raw spectrum is shown on Fig. 2, where the synthetic spectrum generated by our recently developed CHIMET software is also included [16]. Most prominent lines correspond to Fe I-5 (374.5 nm), Ca I-2 (422.6 nm), Fe I-318 (495.7 nm) Mg I-2 (516.7 nm) and Na I-1 (588.9 nm). Some of the lines corresponding to atmospheric nitrogen and oxygen have been also highlighted.

| **Radiant data** | | | |
|---|---|---|---|
| | Observed | Geocentric | Heliocentric |
| **R.A. (º)** | 307.5±0.1 | 308.0±0.1 | - |
| **Dec. (º)** | -8.2±0.1 | -11.2±0.1 | - |
| **Ecliptical longitude(º)** | - | - | 255.3±0.5 |
| **Ecliptical latitude(º)** | - | - | 4.4±0.1 |
| **$V_\infty$ (km/s)** | 25.1±0.4 | 22.3±0.4 | 37.2±0.4 |

| **Orbital data** | | | |
|---|---|---|---|
| **a(AU)** | 2.4±0.1 | **ω (º)** | 269.1±0.2 |
| **e** | 0.76±0.01 | **Ω (º)** | 128.1743±$10^{-4}$ |
| **q(AU)** | 0.538±0.004 | **i (º)** | 5.5±0.2 |
| **Q(AU)** | 4.3±0.3 | | |

Table 1. Radiant and orbital data (J2000) for the Alpha Capricornid fireball SPMN310711.

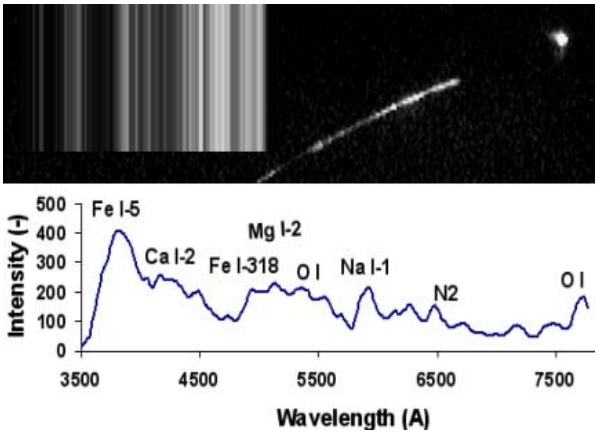


Figure 2. Raw and processed spectrum of the α-Capricornid fireball considered here.

As can be seen in Fig. 1, the fireball exhibited a very bright fulguration at the end of its atmospheric trajectory, at about 69 km over the ground level and with a velocity of about 20 km/s. The aerodynamic strength at which this break-up took place was obtained in the usual way [17], by calculating the atmospheric density from the US standard atmosphere model [18]. A value of 2.9±0.7×$10^4$dyn/cm$^2$ was obtained for this parameter, which is higher than typical values obtained for α-Capricornid fireballs [19] that exhibited violent break-ups at earlier parts of their atmospheric trajectory (i.e., at higher heights). This might indicate that this meteoroid belongs to an older population that has been thermally altered as consequence of continuous heating in the perihelion, but other possibilities exist like the existence of high-strength rocks forming part of the parent body structure.

**Conclusions:** The analysis of the mag. -9±1 α-Capricornid fireball studied here has provided information about the orbit and chemical composition of the corresponding meteoroid. Our data are consistent with the recently established idea that minor planet 2002 EX12 is the parent body of the α-Capricornid meteoroids stream.

**Acknowledgements:** We thank *Fundación Astro-Hita* for its support in the establishment and operation of the automated meteor observing station located at La Hita Astronomical Observatory (La Puebla de Almoradiel, Toledo, Spain). We also acknowledge support from the Spanish Ministry of Science and Innovation (projects AYA2009-13227, AYA2011-26522 and AYA2009-06330-E) and CSIC (grant #201050I043).

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