ON THE ORBIT AND CHEMICAL NATURE OF PHI-BOOTIDS METEOROIDS. J. Segura-Pinto[1], J.M. Madiedo[1,2], J.M. Trigo-Rodríguez[3]. [1]Facultad de Ciencias Experimentales, Universidad de Huelva, Huelva, Spain. [2]Departamento de Fisica Atomica, 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

Introduction: The phi-Bootids is a minor meteor shower whose activity period extends from April, 4 to May, 15, with a maximum peak around May, 2. An asteroidal origin has been postulated for the phi-Bootid meteoroid stream, although its parent body remains unknown [1]. Thus, additional observations during the above-mentioned activity period may provide helpful information to improve our knowledge about this stream. Here we present here the preliminary analysis of a sporadic double-station phi-Bootid fireball recorded by us on May 10, 2011. It was recorded together with its emission spectrum in the framework of the continuous spectroscopic campaign developed by the SPanish Meteor Network (SPMN). From this analysis we have inferred information about its atmospheric trajectory and radiant, but also about some physico-chemical properties of the corresponding meteoroid, such as tensile strength and chemical composition.

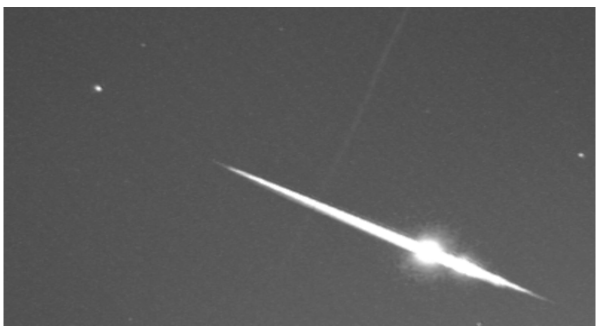

Figure 1. The SPMN100511 fireball imaged from Sevilla.

Radiant data			
	Observed	Geocentric	Heliocentric
R.A. (º)	218.9±0.3	220.1±0.3	
Dec. (º)	45.1±0.3	46.2±0.3	
V_∞ (km/s)	19.2±0.3	15.5±0.3	37.4±0.3
Orbital parameters			
a (AU)	2.5±0.1	**ω (º)**	205.8±0.3
e	0.61±0.02	**Ω (º)**	49.7397±10^{-4}
q (AU)	0.971±0.001	**i (º)**	20.6±0.3

Table 1. Radiant and orbital data (J2000) for the phi-Bootid fireball analyzed here.

Instrumentation: The phi-Bootid bolide considered here was simultaneously imaged from our meteor stations in Sevilla and El Arenosillo. These stations employ high-sensitivity CCD video systems (Watec 902H and 902H Ultimate, from Watec Corporation) to monitor the night sky [2, 3]. Our video spectrographs, which employ transmission diffraction gratings, are based on the same video devices. This provides information about the chemical composition of meteoroids ablating in the Earth's atmosphere [4, 5, 6, 7].

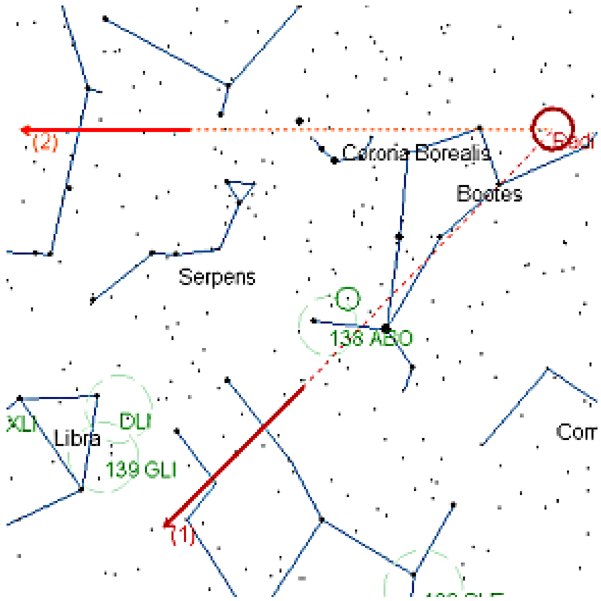

Figure 2. Apparent trajectory of the SPMN100511 fireball as recorded from (1) Sevilla and (2) El Arenosillo meteor observing stations.

Results and discussion: The phi-Bootid fireball analyzed here (SPMN code 100511) was imaged on May 10, 2011, at 21h59m45.6±0.1s UT from our meteor observing stations operating from Sevilla and El Arenosillo (Figure 1). An absolute magnitude of -7±1 was inferred from the photometric analysis of these images. Its atmospheric trajectory and radiant were characterized by means of our AMALTHEA software, which employs the method of planes intersection [8]. The fireball started its luminous path at a height of about 85.3±0.5 km and ended at 41.0±0.5 km above the ground level. The preatmospheric velocity, obtained by extrapolating the velocities measured at the beginning of the meteor trail was V_∞=19.2±0.3 km/s. The radiant and orbital parameters are summarized on Table 1. The apparent trajectory as seen from both stations and the projection on the ground of the atmospheric path are shown, respectively, on Figures 2 and 3. The light curve shown in Figure 4 shows that the fireball suffered several flares along its trajectory, the most prominent ones taking place at 54.5 and 51.8 km over the ground level. With the velocities calculated at these positions we can obtain the aerodynamic strength at which the particle suffered this break-up [9]. Thus, by using the average atmospheric density from the US standard atmosphere [10] these events occurred under an aerodynamic pressure of $1.8 \pm 0.1 \times 10^5$ dyn/cm^2 and $2.4 \pm 0.1 \times 10^5$ dyn/cm^2, respectively.

Figure 3. Projection on the ground of the atmospheric trajectory of the SPMN100511 fireball.

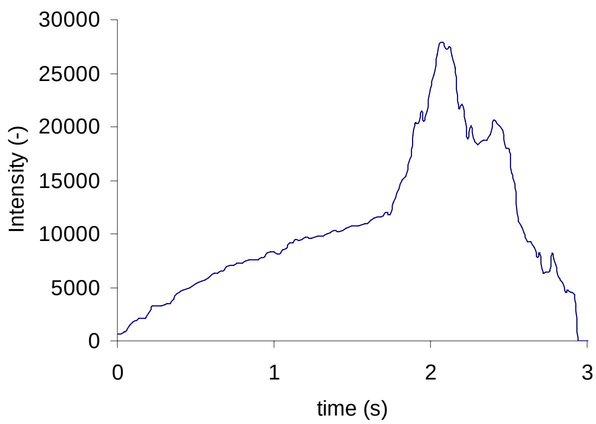

Figure 4. Light curve (pixel intensity in arbitrary units vs. time) of the SPMN100511 fireball.

The emission spectrum was imaged by one spectrograph at El Arenosillo. It was calibrated in wavelengths and corrected by taking into account the instrumental efficiency. The raw spectrum is shown on Fig. 5, where the synthetic spectrum obtained with our CHIMET software is also included. Most important emission lines are shown in Figure 6. Several Fe-I multiplets have been identified and also the emissions corresponding to Mg I-3 (383.2 nm), Ca I-2 (422.6 nm), Mg I-2 (516.7 nm) and Na I-1 (588.9 nm). The emission of atmospheric N_2 between 600 and 700 nm is also highlighted.

Figure 5. Raw (a) and processed (b) emission spectrum. Order zero appears on the left.

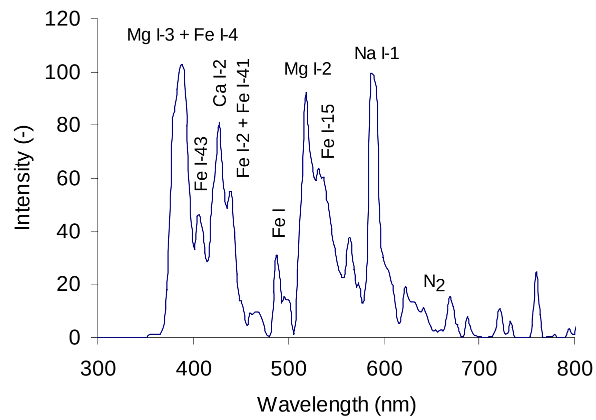

Figure 6. Main emission lines identified in the spectrum.

Conclusions: As a result of our continuous spectroscopic campaign we are obtaining helpful data related to the chemical nature of meteoroids ablating in the atmosphere. Thus, for instance, the emission spectrum of the double-station phi-Bootid fireball analyzed here provided information about the composition of the corresponding meteoroid. The atmospheric trajectory, radiant, orbital parameters have also been inferred.

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References: [1] Jenniskens, P. (2006) *Meteor Showers and their Parent Comets.* Cambridge University Press. [2] Madiedo J.M. and Trigo-Rodríguez J.M. (2007) *EMP* 102, 133-139. [3] Madiedo J.M. et al. (2010) *Adv.in Astron*, 2010, 1-5. [4] Trigo-Rodriguez, et al. (2009) *MNRAS*. 392, 367–375. [5] J.M. Trigo-Rodríguez et al. (2003) *MAPS* 38, 1283-1294. [6] Trigo-Rodríguez et al. (2004) *MNRAS* 348, 802-810. [7] Borovicka, J. (1993) *Astron. Astrophys*. 279, 627-645. [8] Ceplecha, Z. (1987) *Bull. Astron. Inst. Cz.* 38, 222-234. [9] Bronshten V. A., 1981, *Geophysics and Astrophysics Monographs*. Reidel, Dordrecht. [10] U.S. Standard Atmosphere (1976), NOA-NASA-USAF, Washington.