ON THE CHEMICAL NATURE AND ORBIT OF METEOROIDS FROM THE OMICRON DRACONID STREAM. J.M. García[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, trigo@ieec.uab.es.

Introduction: The omicron Draconids were first observed by Denning in the 19th Century [1]. The activity was, however, modest, with a zenithal hourly rate (ZHR) of about 10–12. Denning [2] also reported observations in 1929 but in neither case was an orbit given, only a radiant position (RA ~271º, Dec. ~60º). However, for a considerable time after Denning's observations, no records of any activity exist. Whether this is due to a lack of observers at the pertinent time (early July and thus close to the longest day and also close to the activity period of the delta Aquariids and observers may have preferred to study those) or an intrinsic lack of activity from the Omicron Draconids is not clear. The next record appears to be by Cook et al. [3] reporting on the work of the Harvard Meteor Project in the 1950s. In that paper they also suggested that the formation of the stream was associated with the disintegration of the nucleus of comet C/1919 Q2 Metcalf. In fact, our team recorded in 2008 a mag. -18 omicron Draconid fireball which was linked to this comet [4]. Here we present the analysis of a double-station omicron-Draconid fireball recorded in the framework of our continuous fireball monitoring and spectroscopic campaigns in July 2007. The unique spectrum obtained for a member of this stream has provides helpful information about the chemical nature of meteoroids in the omicron-Draconid stream.

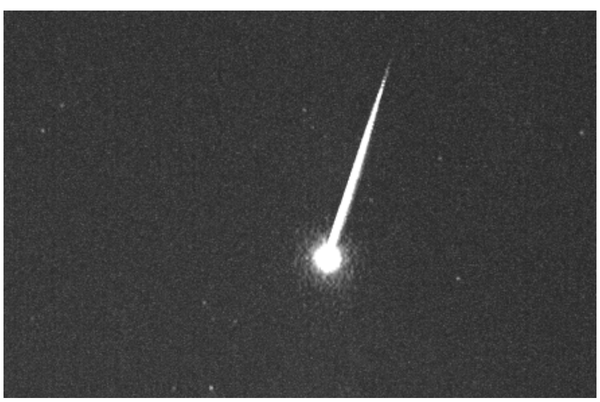

Figure 1. The omicron-Draconid fireball discussed in this work as imaged from the Cerro Negro mobile meteor observing station.

Instrumentation and methods: For this research we have setup an array of CCD video devices (models 902H and 902H Ultimate manufactured by Watec Co.) to monitor the night sky. These operate from our automate SPMN meteor observing stations at Sevilla and also from the mobile station at Cerro Negro [5, 6, 7]. For meteor spectroscopy we attached holographic diffraction gratings (500 lines/mm) to some of these video devices. For data reduction we have employed our AMALTHEA software, which employs the planes intersection method [8] to determine the atmospheric trajectory and radiant of meteor events. The orbital parameters of the meteoroid are calculated by following the procedure described in [8]. To analyze the chemical composition of the meteoroid we have employed our software CHIMET.

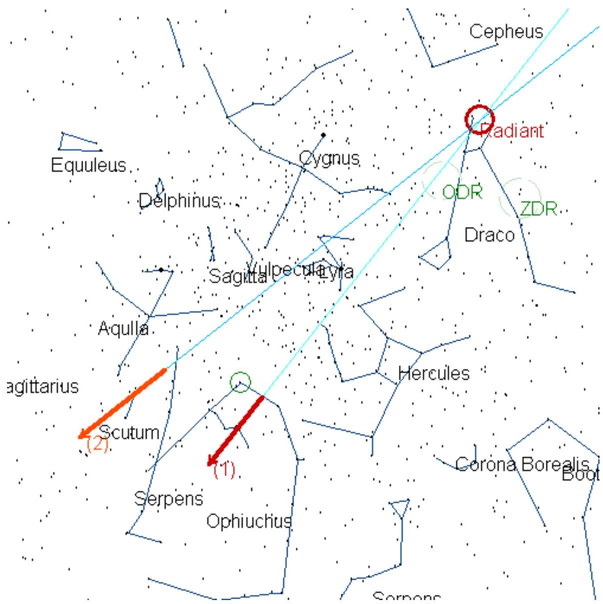

Figure 2. Apparent trajectory of the fireball as observed from Sevilla (1) and Cerro Negro (2).

Atmospheric trajectory, radiant and orbit: Four meteor cameras (two at Sevilla and other two at Cerro Negro) recorded the fireball studied here on July 14, 2007, at 1h43m39.6±0.1s UTC. Figure 1 shows a composite image of this event (code SPMN140707), as observed from Cerro Negro. Its absolute magnitude, inferred by direct comparison with the brightness of stars appearing in the images, was -6±1. The analysis of the atmospheric trajectory reveals that the fireball began at a height of 103.2±0.5 km and ended at 71.1±0.5 km above the ground level. The meteoroid impacted the atmosphere with an initial velocity V_∞=31.2.±0.4 km/s. The apparent trajectory as seen from both stations and the projection on the ground of the atmospheric path are shown, respectively, in Figures 2 and 3. On the other hand, the apparent radiant was located at α=294.5º, δ=66.5º. With this information, the orbit was calculated. The geocentric radiant and orbital parameters (J2000) are summarized on Table 1. The meteoroid suffered a break-up at the end the atmospheric path of the fireball. This resulted in the bright flare shown in Figure 1. From this we can estimate the aerodynamic strength at which the particle disrupted [9]. Thus, by using the average atmospheric density from the US standard atmosphere [10] the aerodynamic strength yields $3.7\pm0.3\times10^4$dyn/cm^2.

Figure 3. Projection on the ground of the atmospheric path of the bolide.

Radiant data			
	Observed	Geocentric	Heliocentric
R.A. (º)	294.5±0.3	290.6±0.3	
Dec. (º)	66.5±0.2	66.9±0.2	
V_∞ (km/s)	31.2±0.4	29.2±0.4	38.3±0.4
Orbital parameters			
a (AU)	3.3±0.3	**ω (º)**	182.6±0.3
e	0.68±0.02	**Ω (º)**	111.1774±10^{-4}
q (AU)	1.0160±0.0001	**i (º)**	48.9±0.5

Table 1. Radiant and orbital data (J2000).

Emission spectrum: The spectrum of the SPMN140707 bolide was simultaneously recorded from both stations. We have analyzed it by following the data reduction method described in [11, 12]. The identification of several emission lines (mainly the contribution of Na I-1 and Mg I-2 multiplets) made possible its calibration in wavelengths. The signal was the corrected by taking into account the spectral response of the spectrograph. The calibrated spectrum is shown in Figure 4. Most lines are associated to neutral Fe. Although some atmospheric oxygen lines were identified, the contribution of N_2 between 600 and 700 nm is very weak.

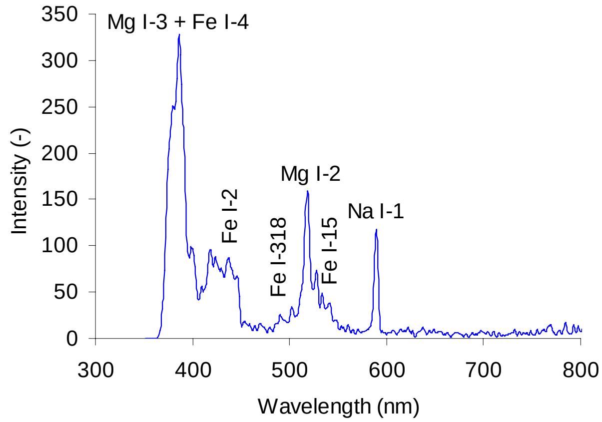

Figure 4. Spectrum of the SPMN140707 fireball.

Conclusions: The orbital elements of a meteoroid belonging to the omicron-Draconid stream were calculated. This has been performed by analyzing the mag. -6 fireball produced during the ablation of this particle in the Earth's atmosphere. Radiant and trajectory data could also be inferred. The emission spectrum recorded during the brightest phase of the bolide has provided information about the chemical composition of the meteoroid.

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References: [1] Denning W. F. (1879) Observatory, 3, 116. [2] Denning W. F. (1929) Observatory, 52, 329. [3] Cook A. F. et al. (1973) Smithsonian Contrib. Astrophys., 15, 1. [4] Trigo-Rodriguez, et al. (2009) MNRAS, 394, 569–576 (2009). [5] Madiedo J.M. and Trigo-Rodríguez J.M. (2007) EMP 102, 133-139. [6] Madiedo J.M. et al. (2010) Adv.in Astron, 2010, 1-5. [7] Trigo-Rodriguez, et al. (2009) MNRAS. 392, 367–375. [8] Ceplecha, Z. Bull. Astron. Inst. Cz. 38, 222-234, 1987. [9] U.S. Standard Atmosphere (1976), NOA-NASA-USAF, Washington. [10] Bronshten V. A., 1981, Geophysics and Astrophysics Monographs. Reidel, Dordrecht. [11] J.M. Trigo-Rodríguez et al. (2003) MAPS 38, 1283-1294. [12] Trigo-Rodríguez et al. (2004) MNRAS 348, 802-810.