ORBITAL PARAMETERS AND CHEMICAL NATURE OF OMICRON CYGNIDS METEOROIDS.

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Introduction: The first observations of meteor activity in July from a radiant in the vicinity of Deneb were performed by Denning between 1885 and 1918 [1]. This minor shower, that was called the omicron-Cygnids, was described in detail by Jenniskens [2], who determined an entry velocity for meteoroids of about 37 km/s and a radiant located at α=305º, δ=47º. In a latter paper by Olech et al [3], the activity period of the omicron-Cygnids was determined to extend from around June 30 to July 31, with a clear maximum near July 18 and an entry velocity of meteoroids of about 41 km/s. In any event, our knowledge about the omicron-Cygnids is poor. Thus, observations during the activity period of this shower are desirable in order to obtain precise orbital information, but also to determine different physico-chemical properties of meteoroids in this stream. In particular, meteor spectroscopy can be very useful to obtain information about the chemical nature of these particles. In this context, we present here the analysis of an omicron Cygnid fireball recorded in the framework of the SPanish Meteor Network (SPMN) in 2012 (Figure 1).

Figure 1. Composite image of the fireball as observed from El Arenosillo.

Instrumentation and methods: In this work we have employed an array of high-sensitivity CCD video cameras (models 902H and 902H Ultimate, from Watec Corporation) to monitor the night sky. They work in a fully automatic way by means of our own software [4, 5]. For meteor spectroscopy we have attached holographic transmission gratings to the objective lens of some of these cameras. In this way, we can infer information about the chemical nature of these particles [6, 7, 8, 9].

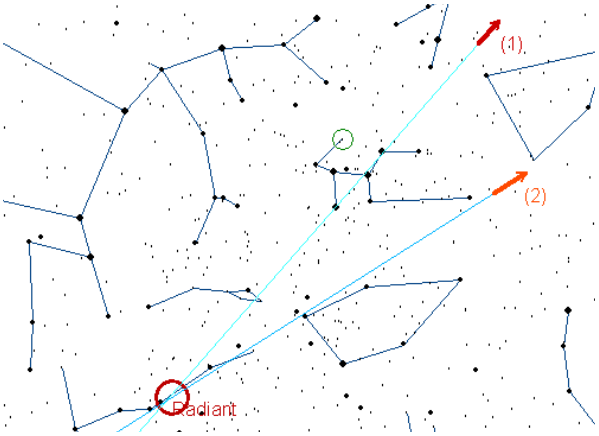

Figure 2. Apparent trajectory as observed from Sevilla (1) and El Arenosillo (2).

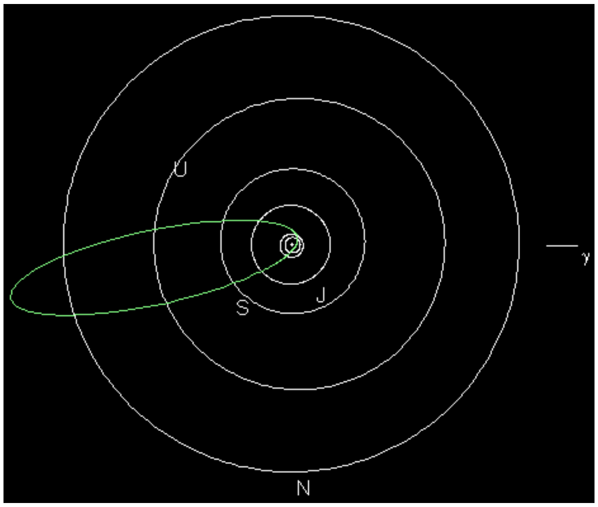

Figure 3. Projection on the ecliptic plane of the orbit followed by the meteoroid in the Solar System.

Observations and results: The fireball was imaged on August 2, 2012, at 0h48m03.4±0.1s UTC from the meteor observing stations operating from Sevilla and El Arenosillo. A composed image of this event, obtained by adding the frames contained in the video sequence recorded by one of the cameras operating from Sevilla, is shown in Figure 1. A remarkable feature in the image is the bright fulguration exhibited at the end of the luminous path. The absolute magnitude determined at this point was of about -7±1. The apparent trajectory as observed from both stations is shown in Figure 2. The trajectory in the atmosphere was characterized by following the planes intersection method [10]. In this way, we inferred that the meteoroid impacted the atmosphere with an initial velocity V_∞=41.0±0.3 km/s. The fireball began at a height of about 94.1±0.5 km and ended at 80.7±0.5 km above the ground level. The bright flare exhibited at this point indicates that the meteoroid suffered a violent break-up. We made an estimation of the aerodynamic pressure under which this disruption took place [11]. Thus, by using the average atmospheric density from the US standard atmosphere [12], this pressure would be of about $1.9\pm0.3\times10^4$dyn/cm^2. The radiant and orbital parameters calculated with our AMALTHEA software are summarized in Table 1. The projection of this orbit on the ecliptic plane is shown in Figure 3.

Radiant data			
	Observed	Geocentric	Heliocentric
R.A. (º)	319.8±0.3	318.6±0.3	
Dec. (º)	40.7±0.3	40.7±0.3	
V_∞ (km/s)	41.0±0.3	39.5±0.4	41.4±0.4
Orbital parameters			
a (AU)	29.6±5.2	**ω (º)**	240.8±0.7
e	0.97±0.01	**Ω (º)**	129.9723 ± 10^{-4}
q (AU)	0.757±0.004	**i (º)**	61.3±0.3

Table 1. Radiant and orbital data (J2000).

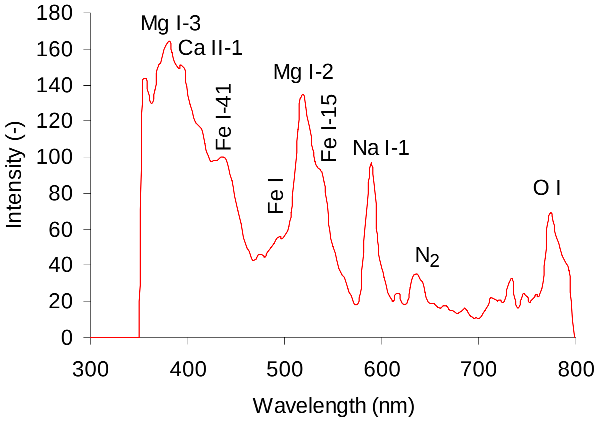

Figure 4. Calibrated emission spectrum. Main emission lines have been highlighted.

One spectrograph operating from El Arenosillo imaged a low resolution video spectrum for this bolide. This spectrum, calibrated in wavelengths and corrected by taking into account the instrumental efficiency, is shown in Figure 4. Most prominent emission lines have been highlighted in this plot. As can be noticed, the contribution of atmospheric N_2 in the red part of the spectrum was identified. Besides, the O I triplet at 777.4 nm is prominent. Different Fe I lines were also identified, and most lines correspond to this element. The ionized calcium H and K lines, the Mg I-2 line at 516.7 nm and the contribution from Na I-1 multiplet at 588.9 nm are also very bright.

Conclusions: We are performing a continuous fireball monitoring and spectroscopic campaign by means of automatic meteor stations based on an array of high-sensitivity CCD video devices. As a result of this observational effort, we are obtaining helpful information about poorly known meteoroid streams. Thus, for the double-station omicron Cygnid event analyzed here we have calculated the orbital elements of the meteoroid. We have also determined the atmospheric trajectory of this fireball and the position of the radiant. The tensile strength of the meteoroid was also estimated. On the other hand, a unique emission spectrum was also recorded, which provided information about the chemical nature of the parent meteoroid. This is dominated by the emission from Mg I-2 and Mg I-3 multiplets, but also by the contribution from Ca II H and K lines. The intensity of the Na I-1 line is also strong.

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