

On the likely parent body of the χ -Orionid meteoroid stream

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Abstract

One of the aims of the SPanish Meteor Network (SPMN) is the monitoring of the activity of minor meteor showers and the analysis of the potential parent bodies of the corresponding meteoroids. For this purpose we employ, among other devices, high-sensitivity CCD video cameras with attached holographic diffraction gratings. In this context, we analyze here the emission spectrum, trajectory, orbital parameters and potential parent body of a Northern χ -Orionid bolide imaged in 2011.

1. Introduction

The χ -Orionid shower is a part of the Taurid complex [1]. This annual display of meteors is split into northern and southern branches. The activity period of the Northern χ -Orionids (ORN) extends from November 16 to December 16, with a maximum on December 10. The Southern χ -Orionids (ORS), however, are active from about December 2 till December 18, with a maximum also on December 10. Both of them are currently included in the IAU working list of showers with codes 0256 ORN and 0257 ORS, respectively. Thus, the continuous meteor and fireball monitoring during the activity period of these relatively-unknown swarms can provide very useful information about their origin, the chemical composition of the corresponding meteoroids and the orbit in the Solar System of these particles. With this aim, we analyze here a Northern χ -Orionid fireball recorded from two of our meteor observing stations on December 6, 2011.

2. Instrumentation

We have employed high-sensitivity Watec 902 Ultimate CCD video cameras (Watec Corporation,

Japan) to image the fireball analyzed here. The event was simultaneously recorded from our meteor observing stations in Sevilla and El Arenosillo. The operation of these systems was described elsewhere [2, 3]. Some of these CCD cameras have attached holographic diffraction gratings (1000 lines/mm) to image the emission spectrum resulting from the ablation of meteoroids in the Earth's atmosphere. In this way we can obtain radiant and orbital data, but also information about the chemical composition of these particles of interplanetary matter [4, 5, 6, 7].

2. Observations and results

A mag. -7 ± 1 Northern χ -Orionid fireball (SPMN code 061211) was imaged on December 6, 2011, at 20h32m59.4 \pm 0.1s UT from the meteor observing stations operating from Sevilla and El Arenosillo, in the south of Spain. Its atmospheric trajectory was derived by means of the planes intersection method [8]. According to this, the fireball started its luminous path at a height of about 98.7 \pm 0.5 km. The terminal point of the trajectory was reached at a height of 55.0 \pm 0.5 km above the ground level. The preatmospheric velocity, obtained by extrapolating the velocities measured at the beginning of the meteor trail, was $V_{\infty} = 28.0 \pm 0.3$ km/s. The apparent trajectory as imaged from both stations is shown on Fig. 1. The radiant and orbital parameters (J2000) are summarized on table 1. These orbital data can be used to infer information about the likely origin of the Northern χ -Orionid meteoroid stream. Thus, one NEO, 2002 XM35, was proposed as the potential parent body of this swarm [1]. By using our ORAS software (ORbital Association Software) with the Southworth and Hawkins dissimilarity criterion [9] we have found, however, that a more recently discovered NEO (2008 XM1) provides a much better

result ($D_{sh}=0.05$) than 2002 XM35 ($D_{sh}=0.14$). Thus, this implies that 2008 XM1 could be a better candidate as parent body of the ORN meteoroid stream.

Table 1: Radiant and orbital data (J2000) for the SPMN061211 ORN fireball.

Radiant data			
	Observed	Geocentric	Heliocentric
R.A. (°)	77.6±0.3	79.3±0.3	
Dec. (°)	27.3±0.2	26.5±0.2	
V_{∞} (km/s)	28.0±0.3	25.4±0.3	37.4±0.3
Orbital parameters			
a (AU)	2.2 ±0.1	ω (°)	281.5±0.6
e	0.79 ±0.01	Ω (°)	254.2322 ±10 ⁻⁴
q (AU)	0.462 ±0.004	i (°)	3.2 ±0.2

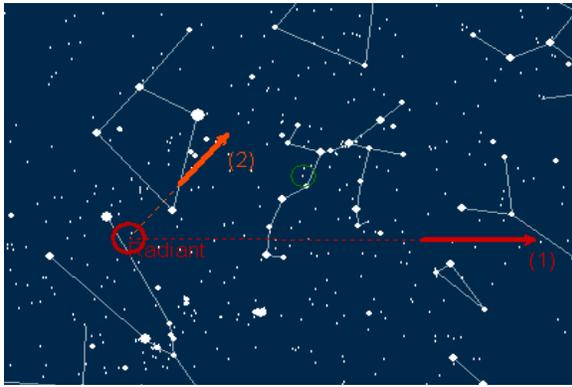


Figure 1: Apparent trajectory of the SPMN061211 ORN fireball as recorded from Sevilla (1) and El Arenosillo (2) meteor observing stations.

On the other hand, one of the CCD cameras operating from El Arenosillo meteor station could image the emission spectrum of this fireball. The raw signal recorded by the camera was calibrated in wavelengths by using typical metal lines (Ca, Fe, Mg, and Na multiplets) and then corrected by considering the instrumental efficiency. The raw spectrum is shown on Fig. 1, where the processed spectrum obtained by using the deinterlacing and the background removal filters implemented in our CHIMET software is also included in an upper window. The reduced main order with the most prominent lines is plotted on the top of the figure. The main lines correspond to Fe I-5 (374.5 nm), Ca I-2 (422.6 nm), Mg I-2 (516.7 nm) and Na I-1 (588.9 nm) multiplets. Atmospheric oxygen and nitrogen lines can also be noticed. Additional improvements

are currently being made on this software to calculate also the relative abundances of the corresponding chemical species from the measured intensity of lines.

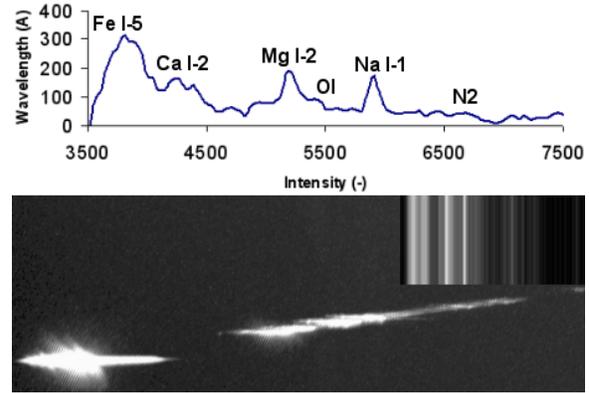


Figure 2: Raw and processed emission spectrum of the SPMN061211 ORN fireball.

6. Summary and Conclusions

By analyzing the images of the mag. -7 double-station ORN fireball considered here, we have obtained radiant and orbital data. These reveal that 2008 XM1 could be the parent body of the Northern χ -Orionids. The emission spectrum imaged during the ablation of the meteoroid has also provided information about the chemical composition of this particle.

References

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