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Lines identification in the emission spectrum and orbital elements of a sporadic video meteor

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Abstract
Since 2006 the SPanish Meteor Network (SPMN) employs high-sensitivity CCD video cameras to monitor meteor and fireball activity over the Iberian Peninsula and neighboring areas. These allow us to obtain the trajectory and orbit for multi-station events and, when combined with holographic diffraction gratings, also provide information about the chemical composition of the corresponding meteoroids. In this context, we analyze here the emission spectrum, trajectory and orbital parameters of a sporadic bolide imaged on 2010.

1. Introduction

High-sensitivity CCD video cameras have been commonly used for the study of the activity of meteoroid streams. These provide useful data for the determination, for instance, of radiant, orbital and photometric parameters [1, 2, 3]. These devices can also be used to record emission spectra of meteoroids ablating in the Earth's atmosphere when holographic diffraction gratings are employed [3].

The SPMN is currently performing a continuous monitoring of meteor activity by means of 25 meteor observing stations in Spain. One important goal of our network is the study of the physico-chemical properties of meteoroids from multiple station data. These include radiant and orbital parameters, but also chemical information obtained from the emission spectra produced during the ablation of these particles of interplanetary matter in the atmosphere. This continuous monitoring can provide useful data to improve our knowledge about meteoroid streams and meteoroids of sporadic origin, and the mechanisms that deliver these materials to the Earth. With this aim, we analyze here a sporadic fireball recorded from two of our meteor observing stations.

2. Instrumentation

The sporadic fireball described here was imaged by cameras located in *Villaverde del Ducado* and *Universidad Complutense de Madrid* (UCM) SPMN meteor observing stations. Both of them employ high-sensitivity 1/2" b&w CCD video cameras (Watec Co., Japan) whose operation has been given elsewhere [1, 2]. Besides, some of the cameras operating from Villaverde del Ducado have attached holographic diffraction gratings (750 lines/mm) to obtain emission spectra resulting from the ablation of meteoroids in the atmosphere. This provides chemical information about these particles of interplanetary matter [3, 4, 5, 6].

2. Observations and results

A mag. -10 fireball (SPMN code 160810) was imaged on Aug. 16, 2010, at 20h06m16±1s UT from the meteor observing stations operating from UCM and Villaverde del Ducado, in Spain. By using the method of planes intersection [7] we could obtain its atmospheric trajectory and radiant. The fireball, which exhibited several bright fulgurations along its trajectory, started its luminous path at a height of about 93.7±0.5 km, with an entry zenith angle of 21±1º. The preatmospheric velocity, obtained by extrapolating the velocities measured at the beginning of the meteor trail was V_{∞}=21.0.±0.5 km/s. The terminal point of the trajectory was reached at a height of 45.9±0.5 km, which makes a meteorite fall unlikely. The radiant and orbital parameters (J2000) are summarized on table 1. The apparent trajectory as seen from both stations is shown on Fig. 1.

The spectrum (first and second order) of this fireball was also imaged from Villaverde del Ducado station. The raw signal imaged by the video system 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. 1, where the processed spectrum obtained by using the deinterlacing and the background removal filters implemented in our recently developed 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 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.

Table 1: Radiant and orbital data (J2000) for the SPMN160810 sporadic fireball.

Radiant data			
	Observed	Geocentric	Heliocentric
R.A. (º)	287.2±0.5	287.5±0.5	
Dec. (º)	22.8±0.4	21.4 ±0.4	
V_∞ (km/s)	21.0±0.5	17.6±0.5	39.6±0.5
Orbital parameters			
a (AU)	4.9 ±0.9	**ω (º)**	217.1±0.6
e	0.81 ±0.03	**Ω (º)**	143.6993 $\pm 10^{-4}$
q (AU)	0.920 ±0.002	**i (º)**	18.6 ±0.5

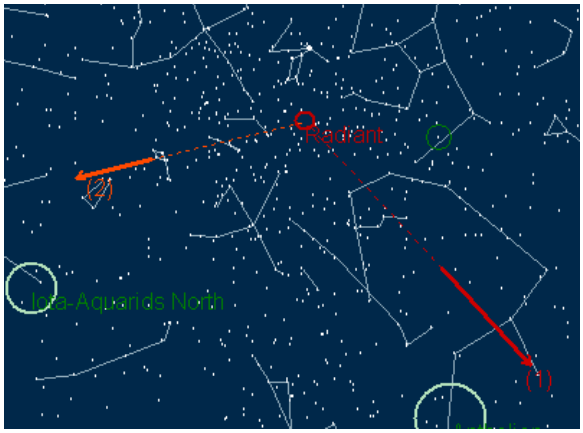

Figure 1: Apparent trajectory of the SPMN160810 sporadic fireball as recorded from Villaverde del Ducado (1) and UCM (2) meteor observing stations.

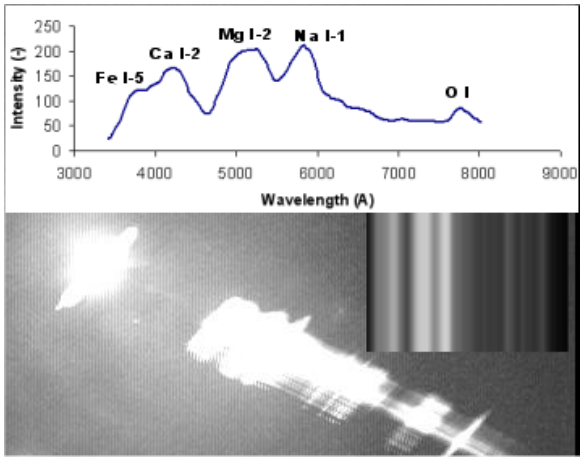

Figure 2: Raw and processed emission spectrum of the SPMN160810 sporadic fireball.

6. Summary and Conclusions

We are employing high-sensitivity CCD video cameras endowed with holographic diffraction gratings to obtain radiant, orbital and chemical information about meteoroids ablating in the Earth's atmosphere. This continuous monitoring provides data that improve our knowledge about meteoroid streams and meteoroids of sporadic origin. From the physical conditions at the terminal point of the luminous trajectory of very bright events we can also identify potential meteorite-dropping candidates. The analysis of the mag. -10 fireball of sporadic origin studied here has provided information about the chemical composition of the corresponding meteoroid.

References

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