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Spectroscopy and orbital analysis of two Taurid bolides imaged in 2010

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Abstract
The SPanish Meteor Network (SPMN) is performing a continuous monitoring of meteor and fireball activity over Spain and neighboring countries. Most of our meteor observing stations are endowed with high-sensitivity CCD video cameras, and some of these employ diffraction gratings to record emission spectra generated during the ablation of the corresponding meteoroids. In this context, we analyze here two Taurid bolides imaged on 2010.

1. Introduction

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 Earth's atmosphere. This continuous monitoring can provide useful data to improve our knowledge about cometary meteoroid streams and the mechanisms that deliver these materials to the Earth. One of this is the Taurid complex, whose parent body is comet 2P/Encke [1]. This is known to have suffered catastrophic disruption processes in the past, as this swarm is known to contain m-sized meteoroids and several NEOs have been identified as part of this complex [2]. The determination of precise orbital parameters of large meteoroids, together with the spectroscopic analysis, can provide new clues on the formation, evolution and chemical composition of this stream. With this aim, we analyze here two Taurid fireballs recorded from several of our meteor observing stations.

2. Instrumentation

We perform a continuous monitoring of the night sky from 25 meteor observing stations in Spain. The two SPMN stations involved in the detection of the two Taurid fireballs considered here (Sevilla and La Hita) work in an autonomous way by means of proper software [3]. Both stations, which are separated by a distance of about 350 km, employ high-sensitivity 1/2" b&w CCD video cameras (Watec Co., Japan). A detailed description of these stations has been done elsewhere [4, 5]. The cameras operating from La Hita have attached holographic diffraction gratings (500 to 1000 lines/mm) to obtain the emission spectra resulting from the ablation of meteoroids in the atmosphere. This provides chemical information about these particles of interplanetary matter.

2. Observations and results

Favorable weather conditions allowed the observation of the Taurids from several of our CCD video stations during most of its activity period during 2010. The fireballs analyzed here (SPMN20101005 and SPMN20101024) were imaged on Oct. 5 and Oct. 24, respectively. Their radiant and orbital parameters are shown on table I.

We could also image the spectrum of both fireballs from our meteor observing stations operating from El Arenosillo and La Hita. The signal obtained in the spectrum is corrected by taking into account the instrumental efficiency, and then calibrated in wavelengths by using typical metal lines (Ca, Fe, Mg, and Na multiplets). Raw spectra are shown on Figs. 1 and 2, where the processed spectra obtained by using the deinterlacing and the background removal filters implemented in our recently developed CHIMET software are also included. Most prominent lines correspond to Fe I-5 (374.5 nm), Ca I-2 (422.6 nm), Fe I-41 (440.4 nm) Mg I-2 (516.7 nm) and Na I-1 (588.9 nm). 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 these spectra.

Table 1: Radiant and orbital data (J2000) for the SPMN20101005 and SPMN20101024 Taurid fireballs.

Radiant data (SPMN20101005)			
	Observed	Geocentric	Heliocentric
R.A. (º)	20.9±0.2	18.3±0.2	
Dec. (º)	0.9±0.1	-1.0±0.1	
V_∞ (km/s)	27.5±0.5	25.4±0.5	37.8±0.5
Orbital parameters (SPMN20101005)			
a (AU)	2.5±0.2	**ω (º)**	261.2±0.4
e	0.81±0.01	**Ω (º)**	11.6586 ± 10^{-4}
q (AU)	0.482±0.007	**i (º)**	7.4±0.1
Radiant data (SPMN20101024)			
	Observed	Geocentric	Heliocentric
R.A. (º)	33.0±0.2	31.6±0.2	
Dec. (º)	12.8±0.1	11.6±0.1	
V_∞ (km/s)	27.1±0.5	24.7±0.5	38.0±0.5
Orbital parameters (SPMN20101024)			
a (AU)	2.6±0.2	**ω (º)**	264.0±0.2
e	0.81±0.01	**Ω (º)**	30.3079 ± 10^{-4}
q (AU)	0.503±0.006	**i (º)**	0.98±0.07

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 is providing useful information about cometary meteoroid streams, as is the case for the Taurid complex. Thus, we have obtained radiant, orbital and chemical information for two Taurid fireballs imaged from several of our meteor observing stations.

Acknowledgements

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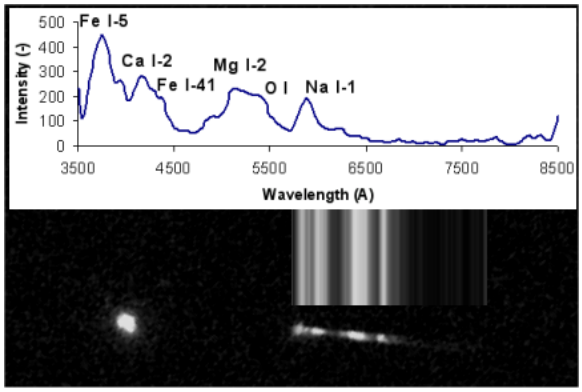

Figure 1: Raw and processed emission spectrum of the SPMN20101005 Taurid fireball.

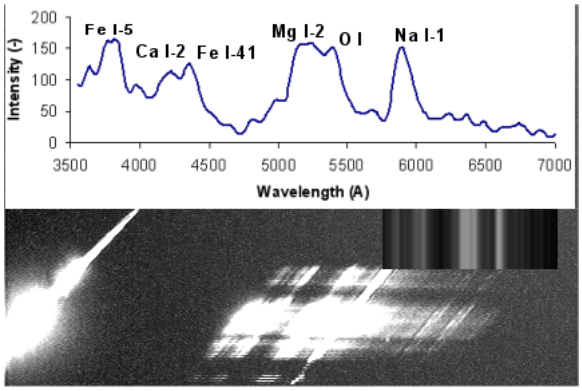

Figure 2: Raw and processed emission spectrum of the SPMN20101024 Taurid fireball.

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