SPECTROSCOPIC AND DYNAMICAL ANALYSIS OF METEORS ASSOCIATED WITH POORLY-KNOWN METEOROID STREAMS

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Abstract

This work shows a preliminary analysis of the orbit, atmospheric path and spectrum of fireballs associated with poorly-known meteoroid streams. These events were recorded in the framework of the Southwestern Europe Meteor Network (SWEMN).

1. Introduction

Emission spectroscopy provides information about the chemical nature of meteoroids ablating in the atmosphere, and also about the mechanisms that control this ablation process [1-8]. For this reason the Southwestern Europe Meteor Network (SWEMN) has deployed in Spain an array of spectrographs at several meteor observing stations operated by the University of Huelva. These devices work in the framework of the SMART project (Spectroscopy of Spectroscopy of Meteoroids in the Atmosphere by means of Robotic Technologies) [9, 10]. The spectra of meteor events produced by meteoroids belonging to poorly-known and recently discovered meteoroid streams are of special interest, since these can provide clues to improve our knowledge about the composition of particles in these swarms and their parent comets and asteroids. This work presents a preliminary analysis of the orbit, emission spectrum, and atmospheric path of a series of bright meteors associated with some of these meteoroid streams.

2. Instrumentation

The spectrographs operating in the framework of the SMART project work autonomously thanks to the MetControl software [10]. Some of these systems are based on CCD video cameras (models Watec 902H and 902H Ultimate). These use aspherical fast lenses (f1.0 to f1.2) covering fixed fields of view ranging from about 90ºx60º to 8ºx5º. To disperse light emitted by bright meteors, a holographic transmission diffraction grating is attached to the objective lens. On the other hand, five slow-scan CCD cameras manufactured by ATIK and SBIG are also employed as imaging devices. These cover a field of view of ~50ºx50º.

3. Sample cases

Up to date, over 400 multi-station fireballs belonging to recently discovered or poorly known showers have been recorded in the framework of the SMART Project together with their emission spectra. As a sample, Figures 1 to 3 show the calibrated spectrum obtained for three fireballs recorded on 2019 January 6, 2018 July 23 and 2018 December 10, respectively. The first of them was associated with the ρ-Geminids, the second with the July ρ-Herculids, and the third one with the Northern χ-Orionids. These associations were performed from the calculation of their radiant and orbital elements. These data were derived with the Amalthea software [11, 12].

The identification of lines in these meteor spectra was performed with the ChiMet software [13-15]. The main emission lines found in this way have been highlighted in Figures 1 to 3. Most of these correspond to Fe I. The detailed conditions in the meteor plasma are currently under analysis. This will provide an insight into the chemical nature of the parent meteoroids.

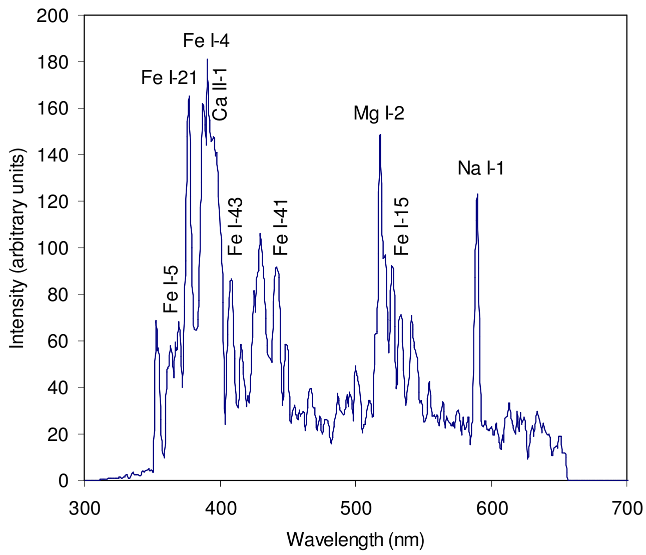

Figure 1. *Calibrated emission spectrum of a ρ-Geminid fireball recorded on 2019 January 6, at 2h35m26s UT.*

In the ρ-Geminid spectrum (Figure 1) the most important contributions correspond to Fe I-4, Fe I-21, the Na I-1 doublet (588.9 nm) and the Mg I-2 triplet (516.7 nm). In the red region of the spectrum molecular bands of atmospheric N_2 were also identified. This agrees with results previously observed for other meteor events generated by this meteoroid stream [3].

For the July ρ-Herculid spectrum (Figure 2), the spectral resolution is lower and so fewer lines could be identified. The spectrum is also dominated by the emissions from Na I-1, Mg I-2 and several neutral Fe lines. The most important of them corresponds to Fe I-4.

The Northern χ-Orionid spectrum in Figure 3 shows an important contribution of Fe I-4, Fe I-41, Fe I-42 and Fe I-43, and the Mg I-2 triplet. However, the emission of the Na I-1 doublet is less significant.

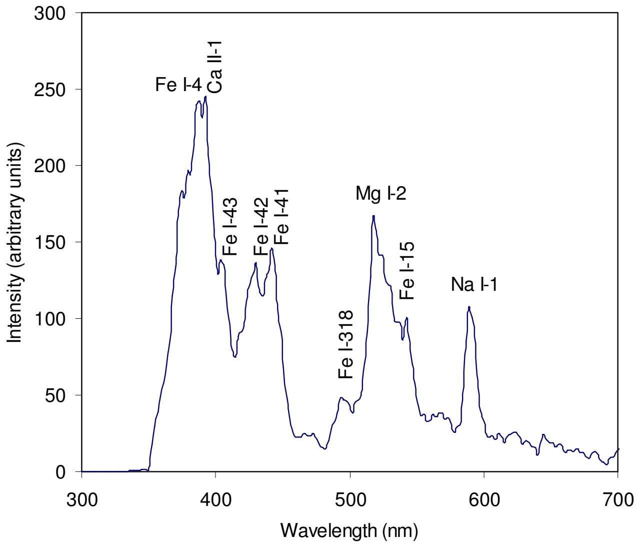

Figure 2. *Calibrated emission spectrum of a July ρ-Herculid fireball recorded on 2018 July 23, at 20h22m43s UT.*

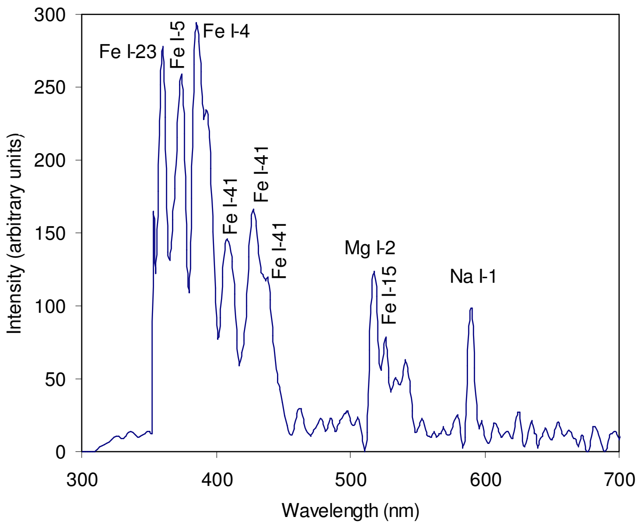

Figure 3. *Calibrated emission spectrum of a Northern χ-Orionid fireball recorded on 2018 December 10, at 2h51m01s UT.*

As in previous works (see, for instance [16-18]), the nature of the progenitor meteoroids and that of their parent bodies, can be investigated by means of the relative intensities of Fe I-15, Mg I-2 and Na I-1 contributions. These analyses are currently in progress.

4. Conclusions

The Southwestern Europe Meteor Network is conducting the SMART survey to obtain information about the chemical composition of meteoroids ablating in the atmosphere. In this context, a preliminary analysis has been presented here for 3 spectra produced by fireballs associated with poorly known streams: the ρ-Geminids, the July ρ-Herculids, and the Northern χ-Orionids.

5. Acknowledgements

Support from the following project is acknowledged by the author: AYA2015-68646-P (MINECO/FEDER).

6. References

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