Emission spectroscopy of poorly-known and recently discovered meteoroid streams: the SMART Project

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Introduction

Emission spectroscopy plays a fundamental role in meteor science, since this provides information about the chemical nature of meteoroids ablating in the atmosphere [1, 2, 3, 4]. For this reason, an array of spectrographs has been deployed at several meteor observing stations operated by the University of Huelva in Spain. The first of these devices, which were based on low-lux CCD video cameras endowed with holographic diffraction gratings, started operation in 2006 at the station in Sevilla and also at the Cerro Negro mobile station [5]. Later on, slow-scan CCD spectrographs were also employed at both locations. Nowadays, these spectral cameras operate in a fully autonomous way at 9 meteor stations in the framework of the SMART project, which is the acronym for Spectroscopy of Meteoroids in the Atmosphere by means of Robotic Technologies. The spectra of meteor events associated to poorly-known and recently discovered meteoroid streams are of special interest, since these can provide new clues to improve our knowledge about these swarms.

Instrumentation

The spectrographs operating in the framework of the SMART Project work in a fully autonomous way thanks to the MetControl software [6]. Some or these systems are based on low-lux CCD video cameras (models Watec 902H and 902H Ultimate). These employ 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. Emission spectra produced by events brighter than mag. -4/-5 can be obtained in this way. On the other hand, five slow-scan CCD cameras are also employed as imaging devices. These cover a field of view of ~50ºx50º and are placed on automated alt-az mounts. In this way, they can be pointed to arbitrary regions of the sky. They can image emission spectra for fireballs brighter than mag. -6/-7.

Emission spectra

Over 200 emission spectra of meteor events belonging to recently discovered or poorly known showers have been recorded in the framework of the SMART Project. As a sample, Figure 1 shows the calibrated signal (integrated along the atmospheric path and corrected for the instrumental efficiency) obtained for a λ-Ophiuchid meteor. The atmospheric path and radiant of these events and the orbital data of the parent meteoroids were calculated in the usual way [6]. The association with the above-mentioned showers was performed by employing the Southworth and Hawkins dissimilarity criterion [7], with D_{SH}<0.15. The analysis of these spectra is providing information about the conditions in the meteor plasma and clues about the chemical composition of the progenitor meteoroids.

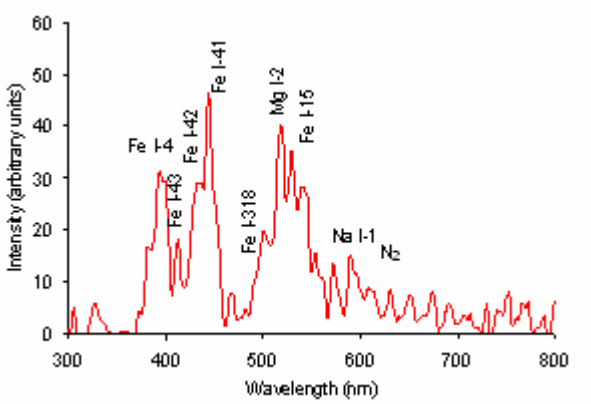

Fig 1. Emission spectrum produced by a λ-Ophiuchid meteor recorded on 22 June 2014 at 3h19m59s UT.

Conclusions

The SMART project is providing meteor spectra by means of automated video and slow-scan CCD spectrographs deployed in 9 meteor stations along Spain. The first of these systems started operation in 2006, and the main effort focuses on the analysis of spectra of meteor events associated with poorly-known and recently discovered meteoroid streams. The analysis of these signals will provide valuable information about the chemical nature of the parent meteoroids.

References

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