DEVELOPMENT OF A CONTINUOUS SPECTROSCOPIC CAMPAIGN IN THE FRAMEWORK OF THE SPANISH METEOR NETWORK.

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Introduction: One of the aims of the SPanish Meteor Network (SPMN) is the study of the chemical composition of meteoroids from the analysis of the emission spectrum produced when these particles ablate in the atmosphere. Besides, these spectra provide useful information about the mechanisms that control this ablation process and also about the chemical nature of the parent bodies of meteoroid streams [1, 2, 3, 4]. For this reason, a significant part of our effort has focused on the deployment of spectrographs at our meteor observing stations. The first of these devices, which were based on high-sensibility CCD video cameras endowed with holographic diffraction gratings, started operation in 2006 from our station in Sevilla and also from the mobile station at Cerro Negro. The first of these stations is performing since that year a continuous spectroscopic campaign. Nowadays, these spectral video cameras work continuously from 8 SPMN stations. Favourable weather conditions in Spain play a key role in the successful development of this continuous spectroscopic campaign. We present here a description of our systems together with some preliminary results we have obtained so far.

Instrumentation: Our video spectrographs work in a fully autonomous way thanks to software developed by us. These systems are based on high-sensitivity CCD cameras manufactured by Watec Corporation (models 902H and 902H Ultimate). They employ aspherical fast lenses (f1.0) covering fields of view ranging from 90 to 8 º. To disperse light emitted by bright meteors, a holographic transmission diffraction grating is attached to the objective lens. With this configuration, we can record the emission spectrum produced by events brighter than mag. -4/-5. They can even work under twilight conditions. On the other hand, a software called CHIMET (CHemical Information of METeoroids) has been developed for data processing in the framework of the SPMN. A brief description of this program is given below.

The spectra analysis software: CHIMET is a Windows compatible application designed to analyze meteor spectra recorded on AVI files by our spectral CCD video devices. But it is also possible to process spectra contained in FITS files generated by our slow-scan CCD spectrographs.

In general, AVI files produced by video spectrographs need to be processed before analyzing the spectra. Thus, for instance the video frames should be dark-substracted and flat-fielded. Besides, our CCD video cameras generate interlaced video and these must be deinterlaced. So, several video processing filters have been implemented in the software in order to accomplish these tasks.

The spectrum is initially obtained as an intensity profile (pixel brightness, in arbitrary units, vs. pixel number). This signal is then converted to intensity versus wavelength by identifying typical lines appearing in meteor spectra. At this stage, the spectral resolution is also calculated. Most lines are produced by neutral Fe, but prominent lines produced by chemical species such as Mg, Ca and Na can also be very helpful for this calibration. Then, the spectrum is corrected by taking into consideration the spectral response of the detection device. Finally, the relative abundances are calculated, together with the temperature and the electronic density in the meteor plasma.

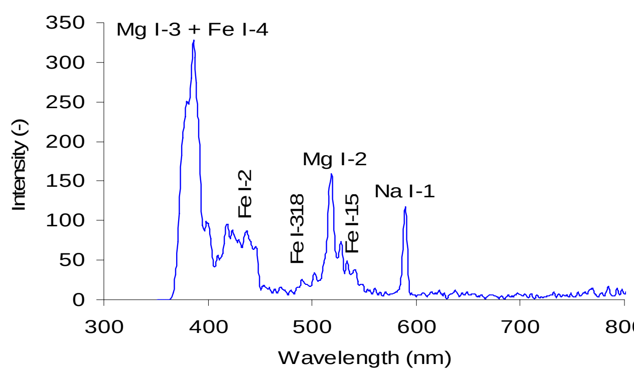

Figure 1. Emission spectrum produced by the SPMN140707 o-Draconid fireball.

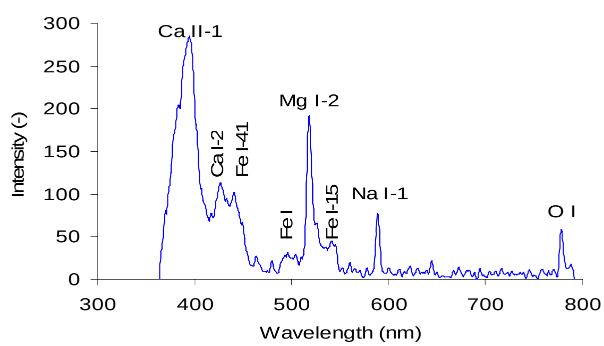

Figure 2. Emission spectrum produced by the SPMN131207 Geminid fireball.

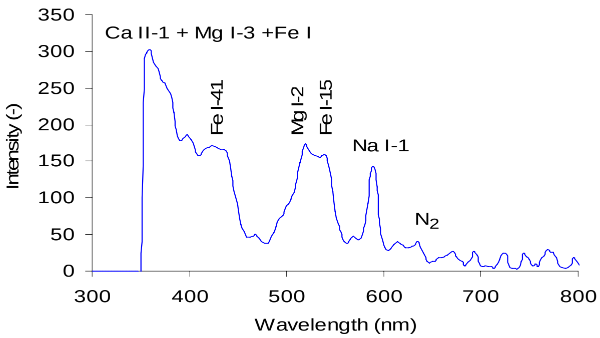

Figure 3. Emission spectrum produced by the SPMN120509 α-Virginid fireball.

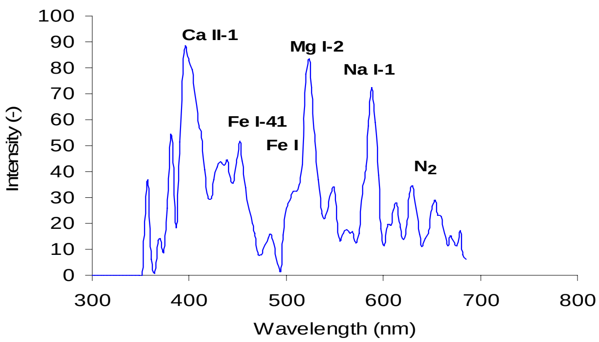

Figure 4. Emission spectrum produced by the SPMN040111 Quadrantid fireball.

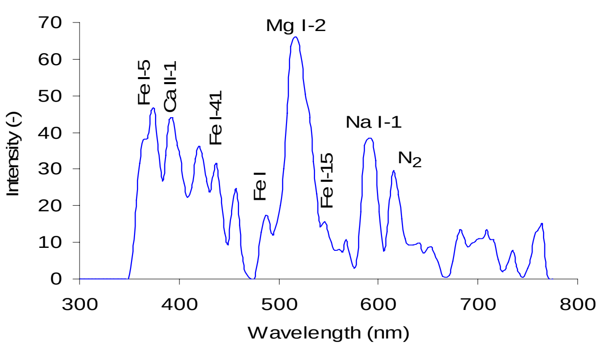

Figure 5. Emission spectrum produced by the SPMN200111 γ-Ursae Minorid fireball.

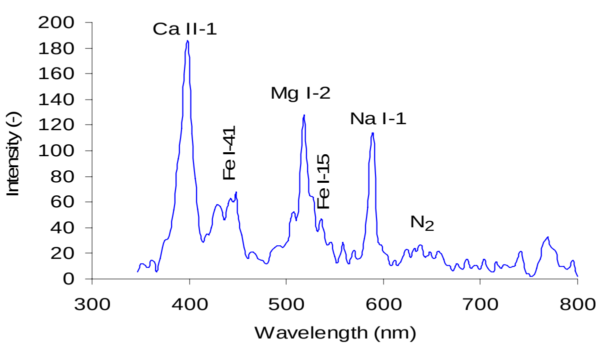

Figure 6. Emission spectrum produced by the SPMN220412 Lyrid fireball.

Preliminary results: Figures 1 to 6 show some selected examples of meteor spectra recorded since we started our spectroscopic campaign in 2006. These provide chemical information about meteoroids from several streams. These include, for instance, poorly known streams such as the o-Draconids (Fig. 1) and even newly discovered streams, such as the γ-Ursae Minorids (Fig. 5) [5]. All of them have been processes by following the above-defined procedure. Most lines present in the spectra we have recorded so far correspond to Fe I. Thus, several multiplets of this element have been identified. Calcium is also observed, although H and K lines of Ca II are usually blended with Fe I lines. Multiplet Ca I-2 (422.7 nm) is in many cases easily identified. Two typical features in these spectra are the usually prominent emission lines of Na I-1 (588.9 nm) and Mg I-2 (516.7 nm). The contribution of Mg I-3 (382.9 nm) is also seen, although it appears blended with Fe I lines. The triplet O I at 777.4 nm is often recorded in the infrared. The forbidden O I line at 557.7 nm has also been identified in our spectra. On the other hand, the contribution of atmospheric N_2 is present in most of them.

Conclusions: Since 2006 we are performing a continuous spectroscopic campaign by means of high-sensitivity CCD video devices with attached diffraction gratings. A significant effort has been made in the deployment of these spectral cameras among our meteor observing stations. As a result of this, we are obtaining valuable meteor spectra that provide helpful information about the chemical composition of meteoroids. As an example, we are obtaining valuable chemical information about poorly known or even recently discovered meteoroid streams.

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