A Leonid Meteor Spectrum Obtained During the 1999 Campaign

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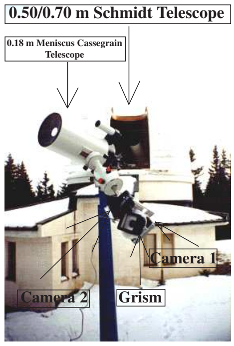
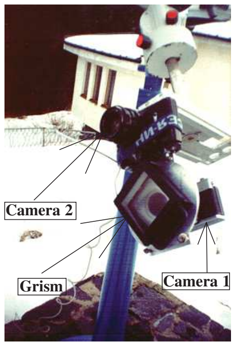
Abstract

During the 1999 Leonid campaign the spectrum of a bright meteor was recorded for the first time in Bulgaria. The observing site was organized at the National Astronomical Observatory Rozhen, (Longitude: 24°.7, Latitude: 41°.7, Altitude: 1759 m) of the Bulgarian Academy of Sciences. A Praktica MTL photocamera with 1.8/50 lens and a ZENIT TTL with 2.0/58 lens were used for the spectral observations and for direct imaging, respectively. The Praktica photocamera was equipped with a grism (300 lines mm^{-1}) used in an objective prism mode. This combination gives a first order dispersion of 596 Å mm^{-1} (24 Å px^{-1}) in the range $3500 \div 8000$ Å. The spectrum was detected on a Kodak T-MAX P3200 professional film pushed to ISO 12500 by appropriate development. For the direct parallel observations an ILFORD 400 Plus film was used. The low dispersion spectrum of a -6 magnitude Leonid fireball was registered on November 18th, 1999 (UT: $02^{\mathrm{h}}04^{\mathrm{m}}20^{\mathrm{s}} \div 02^{\mathrm{h}}07^{\mathrm{m}}55^{\mathrm{s}}$). A direct image of the fireball was also recorded. The spectral and direct images were digitized with the microdensitometer PDS 1010^{plus} of the Sofia Sky Archive Data Center (SSADC) at the Institute of Astronomy, Bulgarian Academy of Sciences. The image processing revealed 42 lines of neutral atoms CoI, CrI, CaI, FeI, HI, NI, NiI, OI, singly ionized CaII, and possibly FeO and N2.

1 Equipment

The equipment used for the Leonid meteor spectral observations is shown on the background of the 0.50/0.70 m Schmidt telescope of the National Astronomical Observatory (NAO) Rozhen. The 0.18 m Meniscus Cassegrain telescope was used for guiding. At the right picture a close lookup of the equipment is shown. Camera 1 was used for spectral observations, Camera 2 – for direct imaging. The grism is placed in front of Camera 1 and the optical axes of both devices are aligned. The grism is rotated around its axis in order to select an appropriate dispersion orientation.





Parameters of the equipment

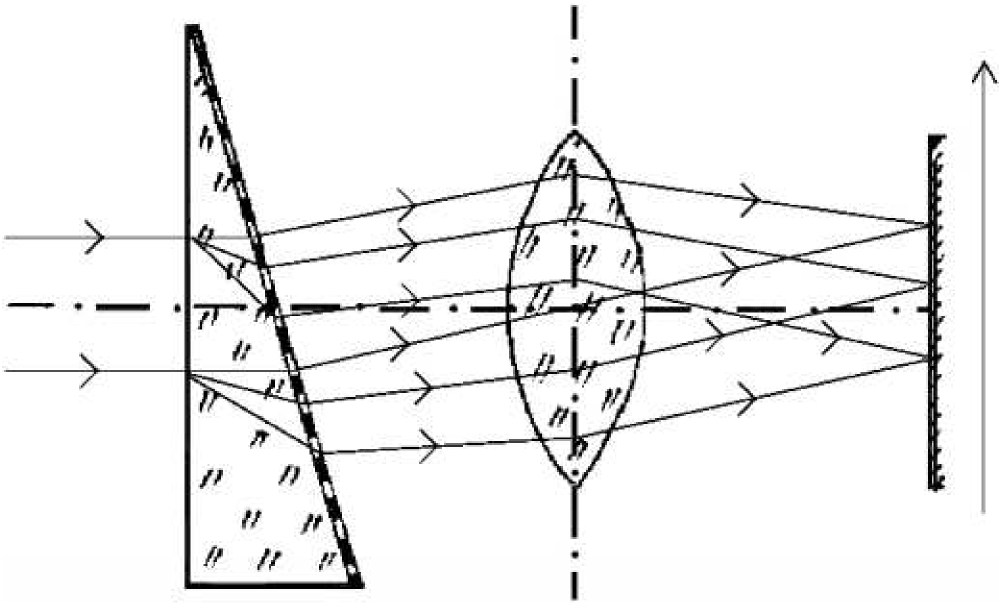
Camera 1: Praktica MTL with 1.8/50 lens;
Camera 2: ZENIT TTL with 2.0/58 lens;
Grism: 300 lines mm^{-a}, blazed at 17°, transmitting the first order in straight foreword direction, designed by Bausch & Lomb.

2 Optics

The dome of the largest instrument in the NAO Rozhen, as well as in South-Eastern Europe the 2m Ritchey-Chretien-Coude telescope, is shown.

3 SSADC PDS 1010^{plus}

The PDS 1010plus of the Sofia Sky Archive Data Center, donated by ESO, is shown at the right picture. The microdensitometer has begun to work in Sofia since August 1999, equipped with a new logarithmic amplifier (Tsvetkov et al. 1999). The Leonid meteor spectrum was digitized with $10\,\mu$m square diaphragm and $10\,\mu$m step size.

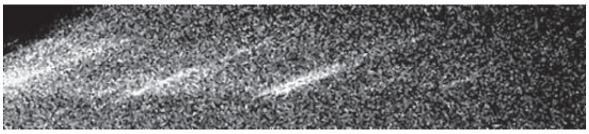


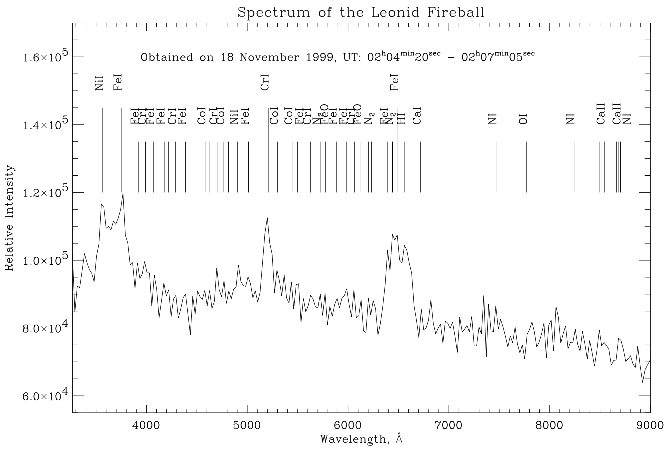
4 Data reduction

The most reliably identified lines, NiI, FeI, CrI, and FeI, are marked with longer ticks in the figure. These lines were used as reference points for the wavelength calibration. The best result was achieved with a polynomial fit of second degree, giving the following solution:

$$\lambda_0 = 3266.03\,\text{Å}$$
$$\text{Dispersion} = 23.86\,\text{Å}\,\text{px}^{-1}$$
$$\text{Parabolic correction} = 0.0021\,\text{Å}\,\text{px}^{-2}$$

The other lines were identified by using these coefficients and looking for them in tables (Rendtel 1993, Smirnov 1994) with more then a thousand meteor spectral lines.



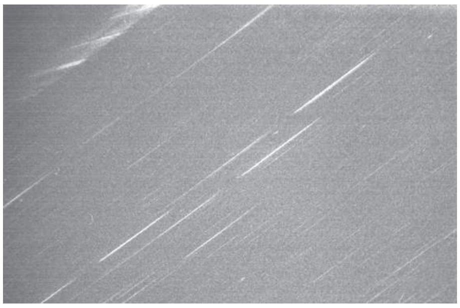


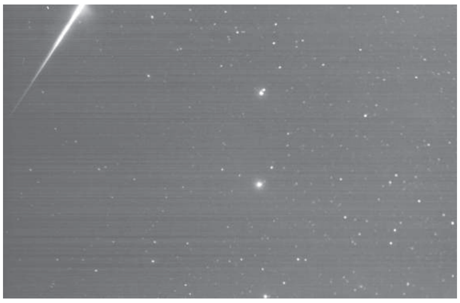
Conclusions

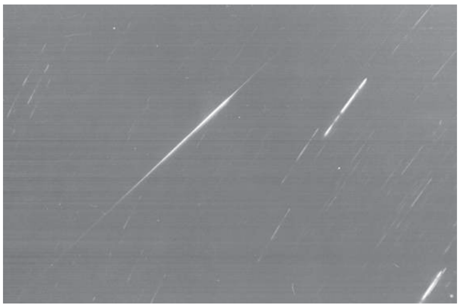
- We recorded for the first time in Bulgaria a meteor spectrum;
- The spectrum contains 42 emission lines, most of them belonging to FeI, CoI, and NiI;
- Four of the lines, NiI, FeI, CrI, and FeI, appear significant above the continuum level;
- The remaining lines are marginally detected at 1–σ level of the background noise.

Apendix

Images of the fireball taken with the two cameras and a picture of the whole fireball.







References

[1] Rendtel J., 1993, Handbook for photographic meteor observations, The International Meteor Organization

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[3] Tsvetkov M., Lukarski H., Budell R., 1999, Proc. 6th Nat. Conference of the Problems on Solar-Earth Connections,