Technical report - The 2001 Optical Mission

Simona Righini

The ***Project Hessdalen*** activities have by now spanned almost twenty years.
During this period a lot of photographic and video material has been collected, providing evidences about the phenomenology of the light events.
However, a definitively convincing set of quantitative data hasn't been achieved yet.

The 2001 optical mission started with the main purpose of obtaining a meaningful spectrum of the light phenomenon, allowing scientists to perform an astronomy-like analysis to unveil the emission mechanism and determine its main parameters.
The full instrumentation to properly reach this goal had extensively been described in many articles by Massimo Teodorani (*), but due to the lack of funds the 2001 mission was held using semi-professional devices and instruments usually known among amateur astronomers.

(*) as in **M. Teodorani** (June 2000), Studio di Luci Notturne nel Mondo con il Metodo Scientifico-Sperimentale http://web.tiscalinet.it/lareteufo/rete248.htm

Selection and adjustment of the instrumentation.

Long before the departure it was necessary to chose and customize the proper instrumentation to be brought to Norway. Many variables had to be considered: working on field required compact devices, easy to be mounted and transported, while the random behaviour of the lights suggested to avoid too complicated procedures, that would have prevented successful observations of the sudden events.

Considering that in several occasions the light phenomenon had been seen lasting even tens of minutes, it was decided to employ a small telescope, equipped with a CCD camera and a laptop computer. To produce the spectra, as a prism spectrograph was beyond the accessible budget, a diffraction grating filter seemed a good choice. Along with this astronomical instrumentation, a couple of reflex cameras and a video-camera were available.
Here follows the complete instrumentation list. Detailed fact sheets about the main devices are included at the end of the report.

Meade *Cometracker* Telescope on equatorial mount
Starlight XPress SXL8 CCD camera
Geo Prodigy PentiumIII 800MHz laptop
Rainbow Optics Spectrograph (ROS) filter for eyepiece
Meade 20mm eyepiece
Custom built aluminium telextender for Cometracker
Canon XM-1 video-camera
Reflex cameras
Tripods

Some peculiar adjustments were necessary to combine the different devices, e.g. the manufacture of an aluminium plaque to adapt the telescope to the equatorial mount and the production of a telextender to perform the eyepiece projection imaging technique.
Once all of these pieces were ready, they were tested at the "Alfio Betti" Observatory in Imola.
A first spectrum was obtained by means of the ROS filter using the 410mm telescope host inside the observatory, to check if this grating assured the expected performances (see fig.1).

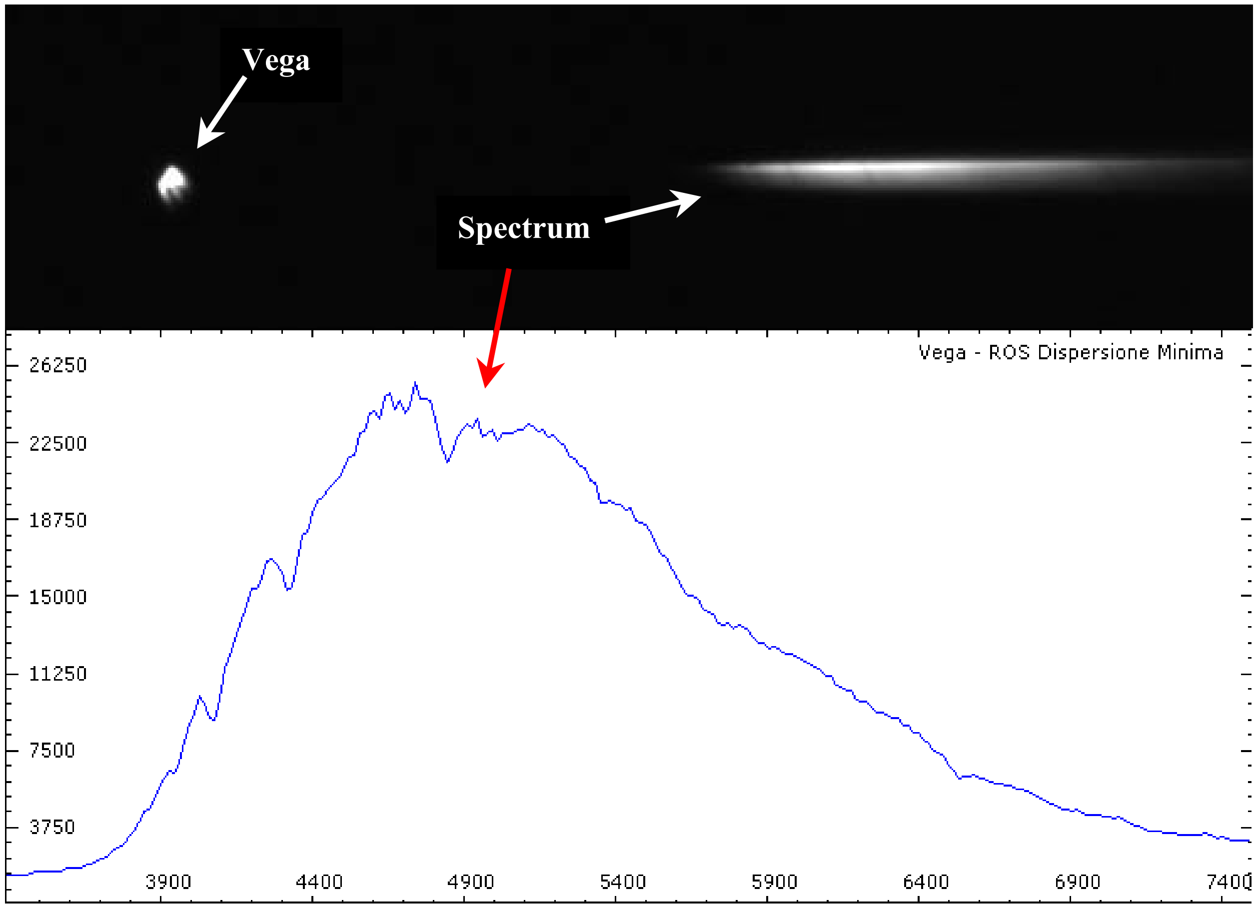


Figure 1 Vega spectrum obtained with ROS and 410mm telescope

Wavelength (Å)

Subsequently a test session was held using the complete system (Meade + ROS + CCD), and this experiment immediately underlined that the operative procedure (telescope pointing, source focusing, image acquisition) required a consistent amount of time. This implied that on-field usage could turn out to be more difficult than expected, especially for short-lasting light phenomena and under uncomfortable weather conditions. However, some test spectra were taken pointing distant street lamps and house lamps.

Optical activity in Hessdalen (July 25th – August 21st).

During every observing session, both from Aspaskjolen and other sites, the reflex cameras and the video-camera were employed to record as many events as possible, and several pictures and videotapes were successfully obtained.

The first attempts to use the telescope system, once this instrumentation was finally shipped from Italy (which did not happen until August 3rd), were ineffective: the focus adjustment was tried pointing a distant lamp at the end of the visible valley, but the process was not as smooth as planned, because the lamp was very dim and no reference points had been fixed on the telextender while at home, as there had not been time to perform all of the necessary tests to identify the system "standard focus position".
Besides, the telescope and, even more, the CCD cameras and the laptop computer could be used only in rare occasions, when the weather was sufficiently dry. Unfortunately, in fact, the absolute majority of the nights was characterized by rainy or highly moist weather, preventing the observers

to make use of the telescope. Moreover, as the events logbook clearly shows, during the mission the light phenomena were not very abundant, and tended to last only for a few seconds.

Such being the overall situation, it was decided not to employ the telescope anymore, but instead to find a method to adapt the ROS filter to the video-camera, whose usage was easier and more direct. The ROS filter was then fixed onto a 58mm skylight filter in order to be screwed in front of the camera lenses. This offered the single possible solution applicable on field, and indeed it was using this configuration that the only light phenomenon spectrum was finally achieved (see fig.2-3). It is important to underline that this system produced a low resolution spectrum, and future missions should focus on the achievement of more significant spectra.

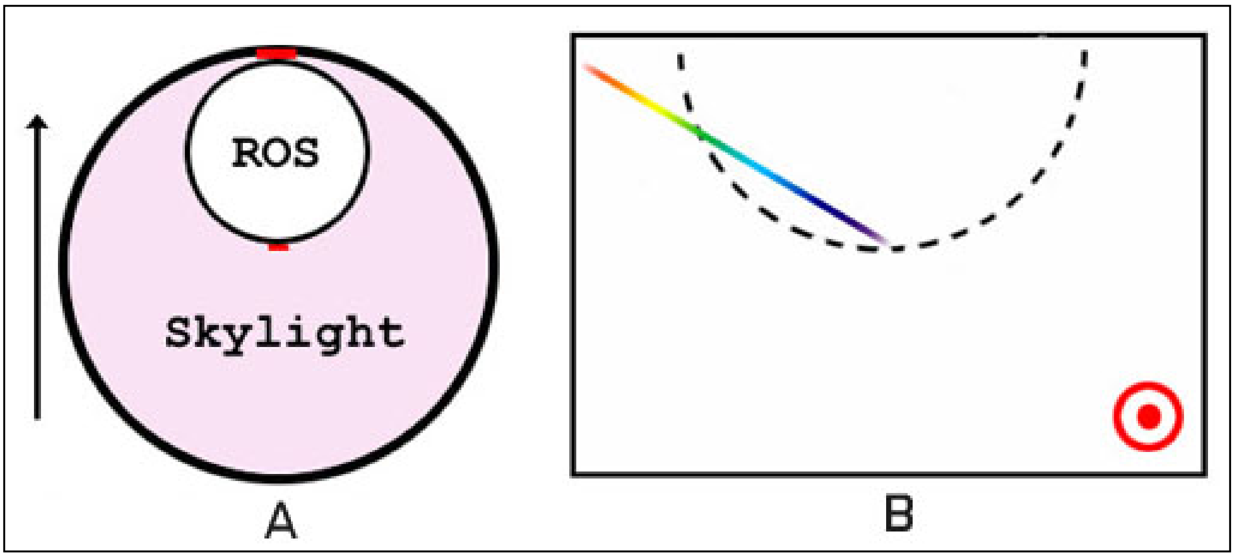


Figure 2 A-ROS positioning on the skylight filter B-View field using the video-camera and production of a spectrum by means of the ROS filter (dotted)

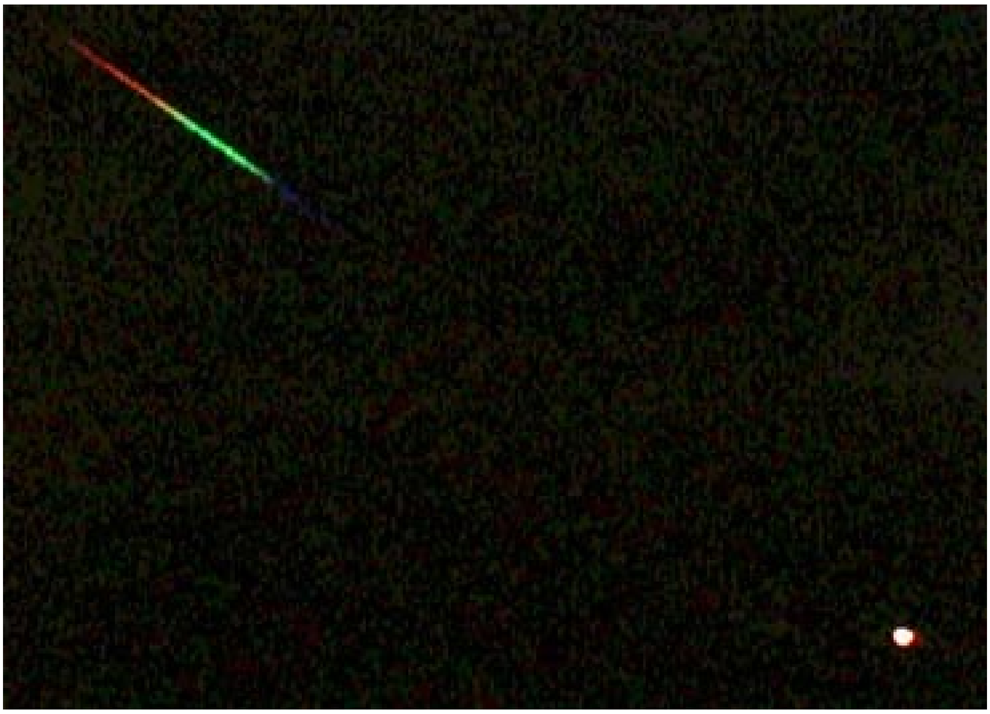


Figure 3 Light phenomenon and spectrum achieved with the ROS filter and the video-camera

Post processing of the acquired data.

Interpreting a spectrum requires some calibration processes.
When we record a spectrum using an optical system, in this case a 3-CCDs video-camera, we need to know the wavelength-dependant response of our device, as our instrument is not equally sensitive (or efficient) to every part of the spectrum.
This can be done either knowing the device specific features (as the factory provides them) or obtaining an experimental curve by means of a calibrating spectrum - i.e. a spectrum of well known shape that can be used as a reference. Both the wavelength and the intensity scales must be regulated using these methods.

At present, a reliable and definitive calibration has not been achieved yet, because the video-camera and the ROS filter were not planned to work together and no tests had been carried out before the mission. As a consequence the spectrum features and quantitative parameters so far estimated are to be intended as approximated, while an ultimate calibration process is underway.

FACT SHEETS

Meade Cometracker Telescope

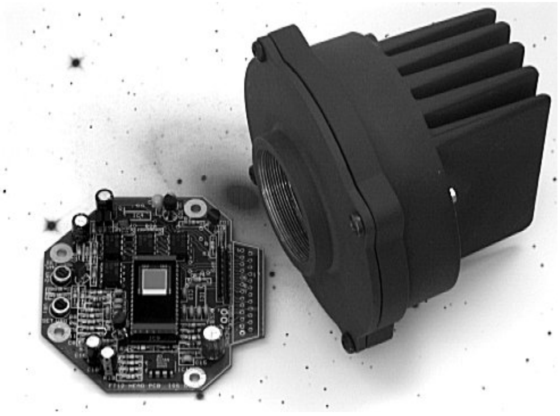
Focal Length	549 mm
Aperture	153 mm (f/3.6)
Optical configuration	Schmidt-Newton
Eyepiece diameter	31.8 mm
Mount	Vixen New Polaris

ROS filter

Diameter	31.8 mm – screwed for eyepiece
Grating	Diffracting – 200 lines per mm
Dispersion	Linear

SXL8 Black and white CCD camera

Pixel matrix	512 x 512
Pixel dimensions	
Cooling system	Peltier cells
Temperature	Down to –30° below the environmental temperature
Quantum efficiency	



Canon XM-1 video-camera

Sensors	3 CCDs ¼" – 320.000 Pixels
Recording system	Mini DV
Lenses	Fluorite coated
Zoom	Optical 40x – Digital 100x
Minimum illumination	6 lux
Working temperature	0°C – 40°C
Shutter speed	1/16.000 – 1/50 sec

GEO Prodigy notebook

Processor	Intel Pentium III 800 MHz
RAM	128 Mb SDRAM
Display	LCD XTFT 14.1" 1024x768
Battery	Smart Li-Ion (> 46W)

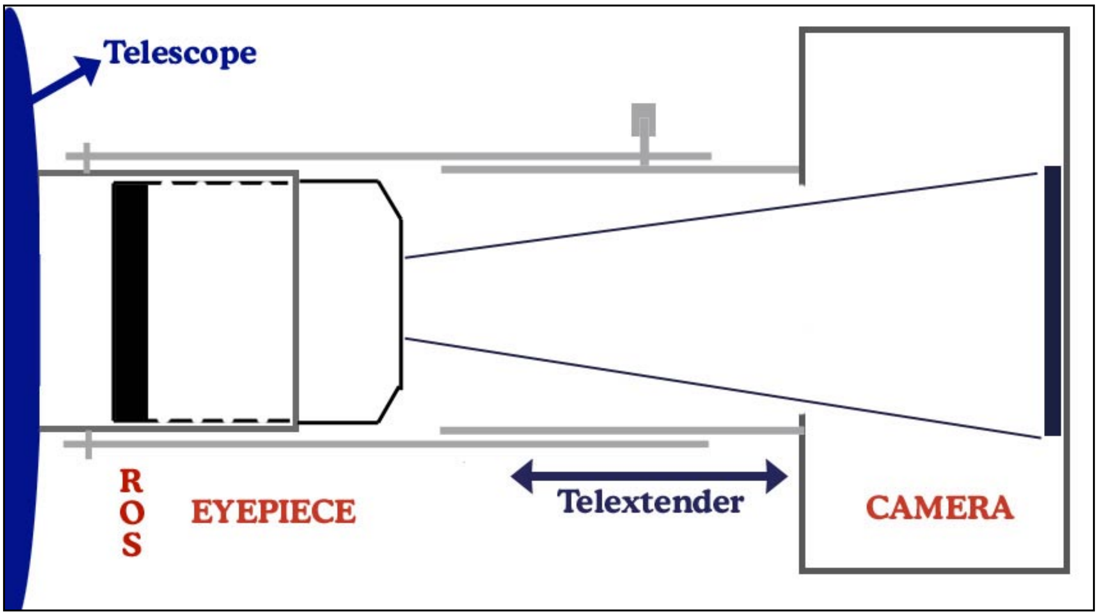


Figure 4 - Eyepiece projection imaging scheme