LIGHT POLLUTION

A subject for spectroscopic measurement

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Observatorium C31 , 51° 12' 32.25" N, 6° 58' 57" E / Spektroskopie AG 2021

Since several decades a remarkable increase of night sky brightness by artificial light sources has been influencing humans, animals and environment in different manners. The consequences are mostly not yet known. Visual observing and photographic astronomy are especially hurt by this. Astronomical spectroscopy is the working area able to measure and analyse the light pollution of the night sky.

Sky photography can block out such interfering light by band blocking filters. On the other side, terrestrial photography can make use of such light by band passing filters.

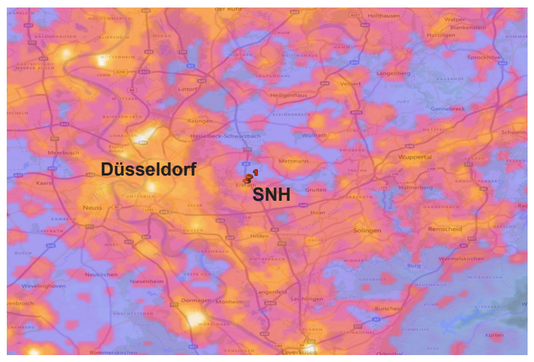

Fig. 1: Map of night-brightness in our sourrounding.

Fig. 2: Recorded spectra from different directions and their light curves.

The majority of published maps of brightness are “looking from above“ when photographed from satellites. Fig.1 is showing such a photograph of our greater area by data of www.lightpollutionmap.info . Our technique of recording is not measuring absolute brightness level but the spectral distribution of the light seen „from below“.

At Observatory of SNH we have among others a spectrograph type DADOS. This device consists of two housings containing the optical slit and the reflection grating for dispersing the light.

After the grating one can see visually the coloured spectrum from red to blue. For actual measurement this picture is photographed by a monochrome electronic camera.

The DADOS contains three different wide slits and a grating of 200 lines per mm. Fig.2 shows an example of raw pictures.

Each horizontal strip shows the picture of one slit. In front of the slit a telephoto lens was used.

The pictures are then transformed into a curve of light intensity. The base axis is the wavelength of the light. In general, spectra are shown with blue end at the left and red end at the right. The wavelength scale was calibrated by use of a known light source. In our case a plasma light bulb with Ne and Xe gas was used. The processing of spectra was done with the BASS programme.

A first test was made out of downtown in a 45°angle into the sky above Düsseldorf and vertically into zenith. Intensity of various lines was found to be not isotropic and brightness above Düsseldorf was increased as expected from the visual impression.

Measurements in different directions of the sky then took place from our observatory in a night of full cloudy sky and without moon. Fig.2 shows the recorded spectra aligned above each other with the emission lines. The alignment of the curves above each other is for better comparing and has nothing to do with brightness. Several emission profiles are visible above the significant background noise showing with remarkable differences in their intensity depending on the direction of measurement.

The next step was the identification of those light sources (Fig.3, 4 and 5). To be mobile a CMOS digital single-lens reflex camera (DSLR) was attached to the spectrograph. With that configuration we made spectroscopy of several types of street lights in the town. The influence of car lights was not considered.

This enabled the identification of those sources in the spectra of the cloudy sky, see Fig.6 .

At the end there are lines remaining whose sources could not be identified. For example in the city of Düsseldorf there are still streets with gaslight whose emission curves would be of interest already for historical reasons.

We thank Stadtwerke Erkrath for technical information on the applied types of light sources of the street lights we had measured by spectroscopy.

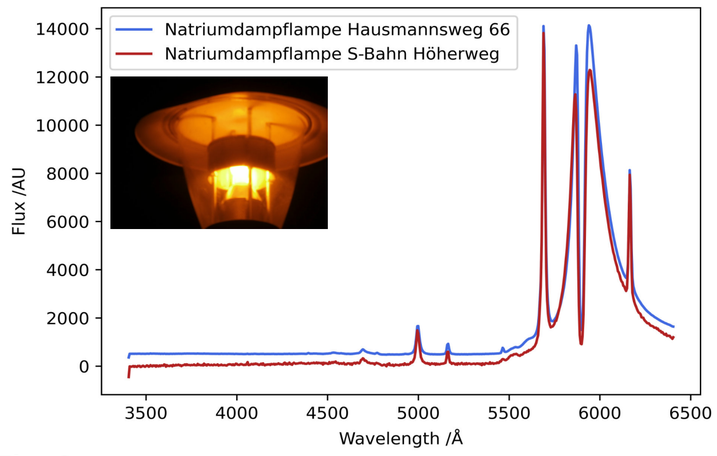

Fig. 3: Na light NAV-T 70W and NAV-E 50 W (Osram).

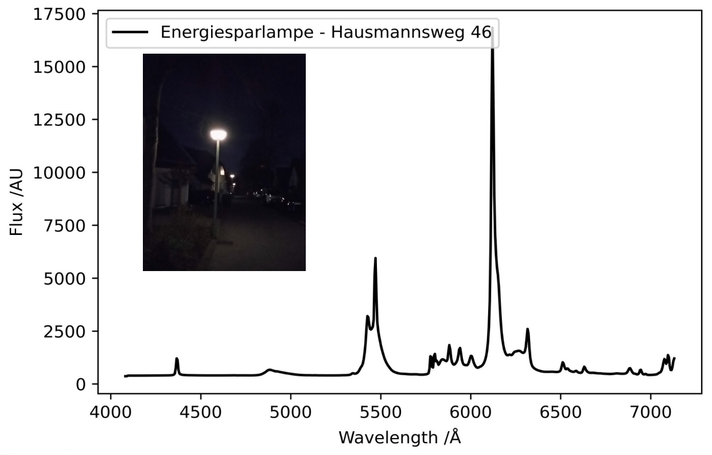

Fig. 4: Energy saving bulb 2x 11 W / 840 Dulux S (Osram).

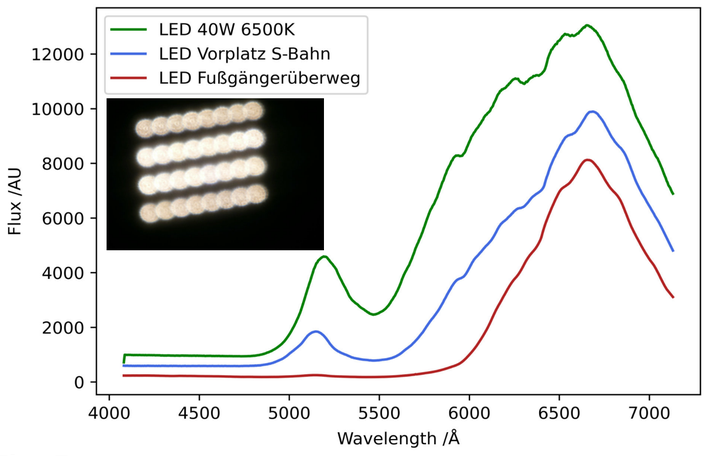

Fig. 5: 15W LED Modul 8NS 178 519-40/AB (Hella/Lunux).

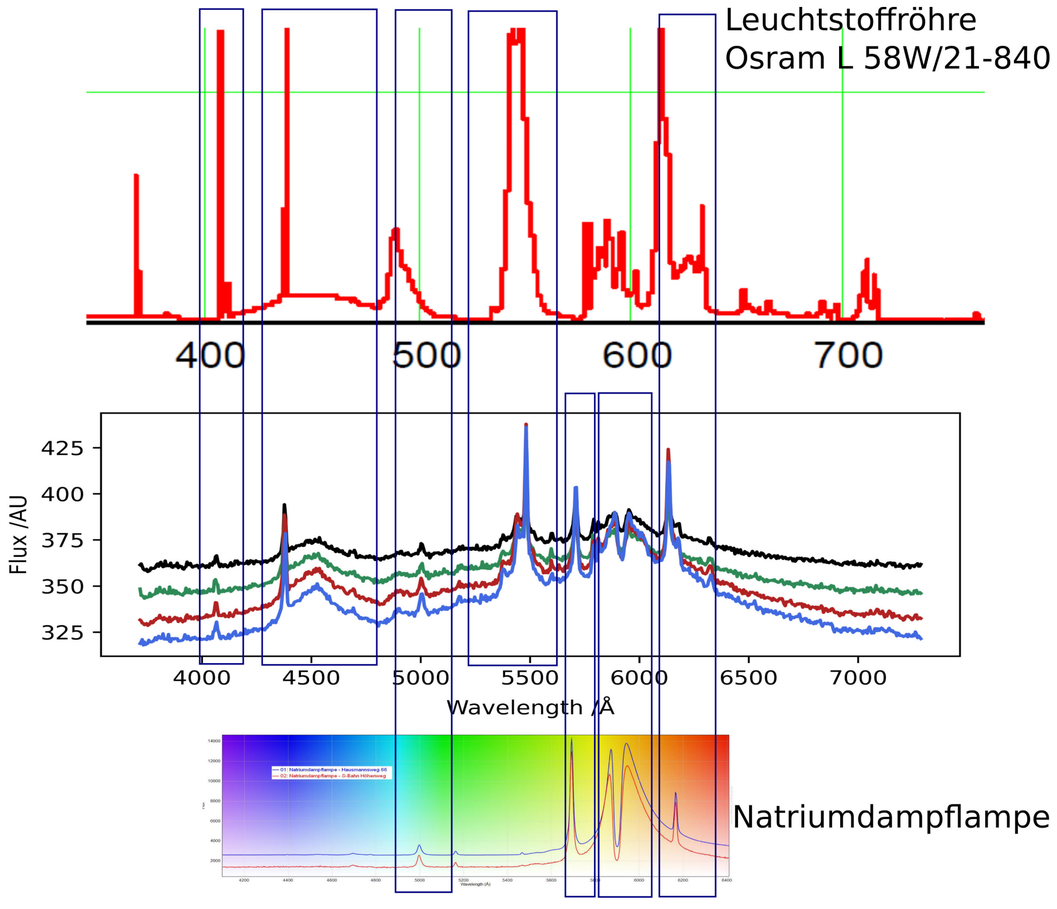

Fig. 6: Identification of sources in the spectra.