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Technical note TN-0017

Problem	Spectral flattening filter at VNIR (400-1000nm) and SWIR (1000-2500nm) range.	**Date**	8 February 2007
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1. Introduction

When using spectral cameras and spectrographs the usual behaviour of system is that it is working better at certain part of the wavelength range and the SNR tend to decrease at some other regions of the wavelength range. Due to the light source radiance, detector response and systems instrument function it is sometimes worth of even necessary to use filters to balance the system in order to increase the SNR at some wavelength bands and improve the use of dynamic range of the detector.

Usually the dominant element is the light source. The most often used light source is simulating blackbody radiator with different colour temperatures (T_C). The next figures illustrates the difference between Sun radiance (T_C= 6500K) and normal halogen light radiance (T_C= 3000K) at VNIR an SWIR range.

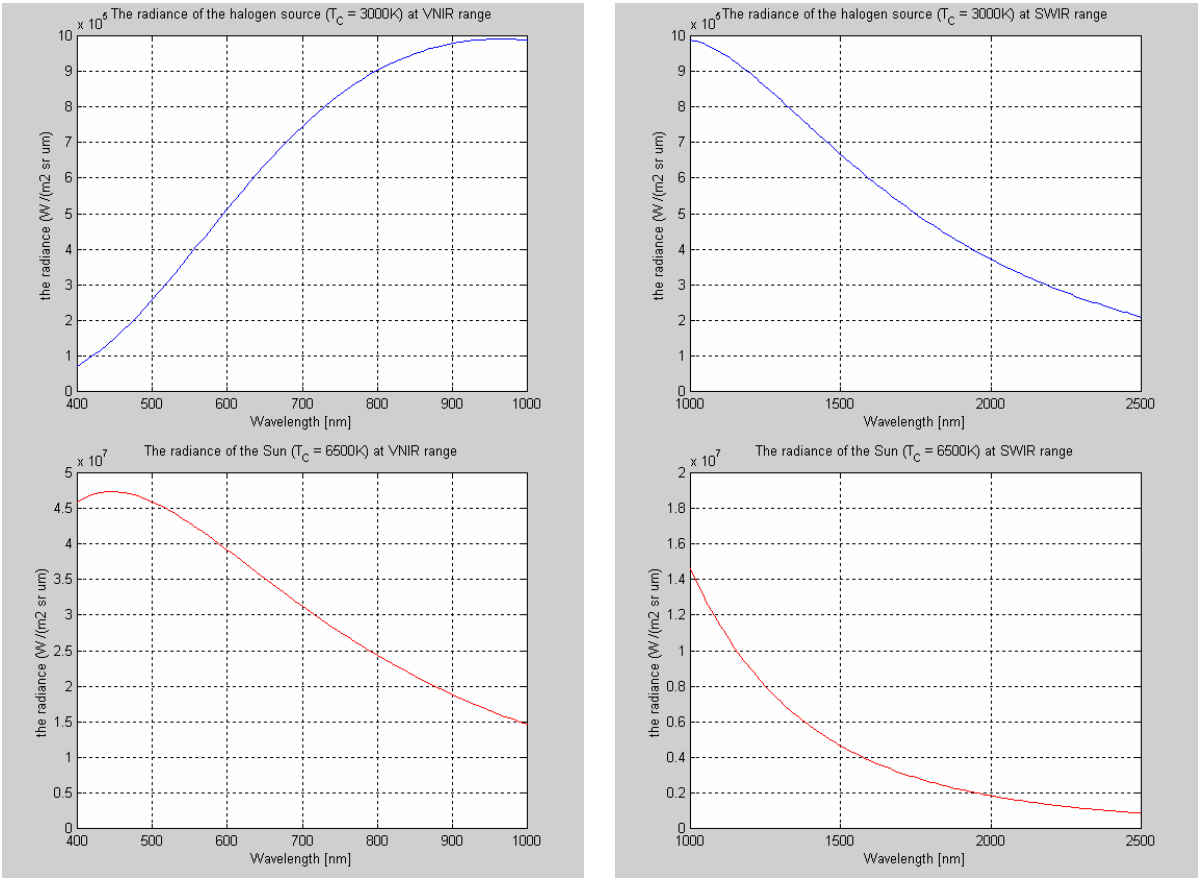

Figure 1 Often used light sources at VNIR and SWIR range.

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2. Problem solution

(a) VNIR range

The most used light source in VNIR range is Halogen light because most of the measurements are done in laboratory. In this case the problem is the blue end of the spectrum where the signal of the source gets low. For this purpose we recommend a blue or violet filters like,

- **Hoya LB-100 known as 80B**
- **Hoya LB-120 known as 80A**
- **Hebo Spezialglas SSB 130**
- **Hoya M-30 (violet)**

The filters listed above are blue ones and they transmit the blue part of the spectrum and absorb the red end and short infrared. The violet Hoya M-30 balances the effect of spectrograph efficiency and detector response which are both highest at wavelengths 500-600nm. The transmittance of the filters is showed in the next figure.

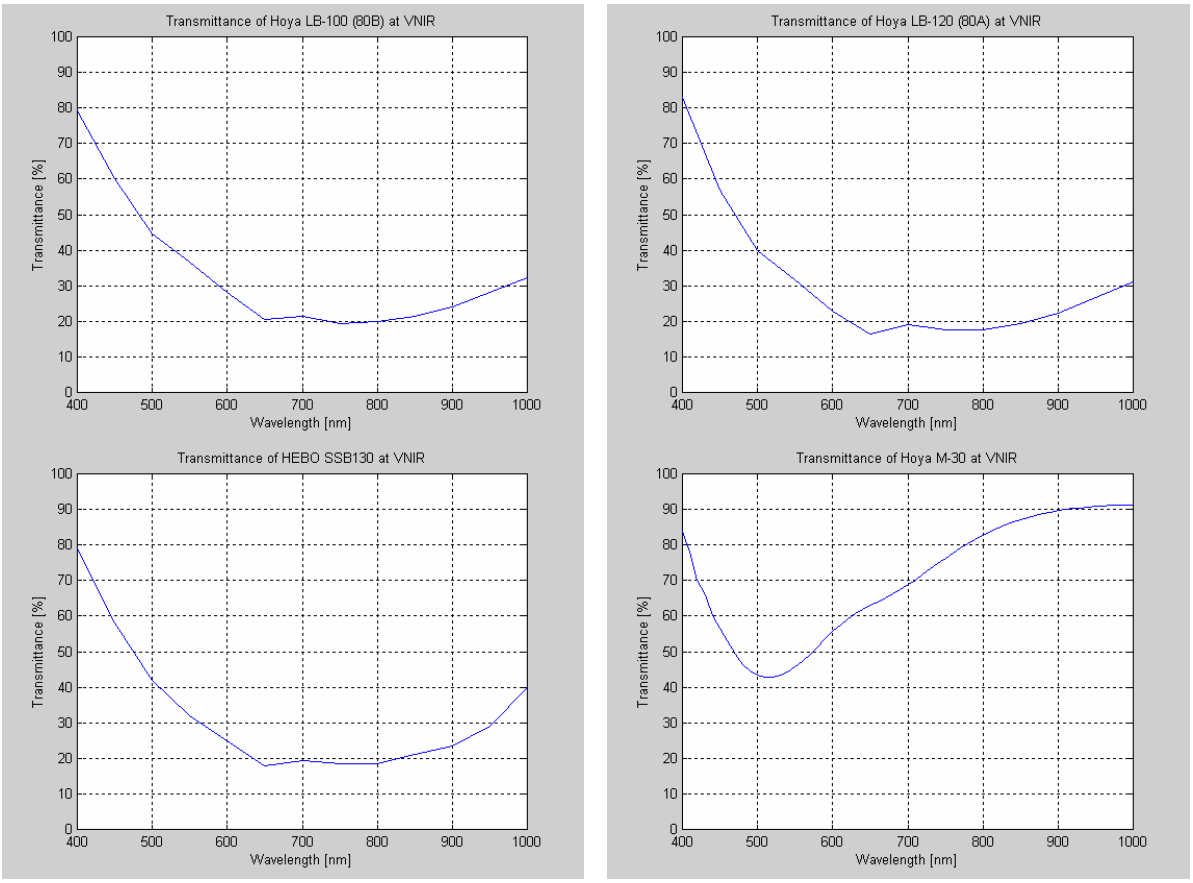

Figure 2 The recommended spectral flattening filters for VNIR range when using halogen light source.

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(b) SWIR range

The most used light source in SWIR range is halogen light because most of the measurements are done in laboratory. In this case the problem is the long end of the spectrum where the signal of the source gets low. When using the Sun light the situation is exactly the same. For this purpose we recommend the same blue filters like in VNIR range. They are

- Hoya LB-100 known as 80B
- Hoya LB-120 known as 80A
- Hebo Spezialglas SSB 130.

With the filters listed above the transmittance increases when approaching the 2500nm. The transmittance of the filter is showed in the next figure.

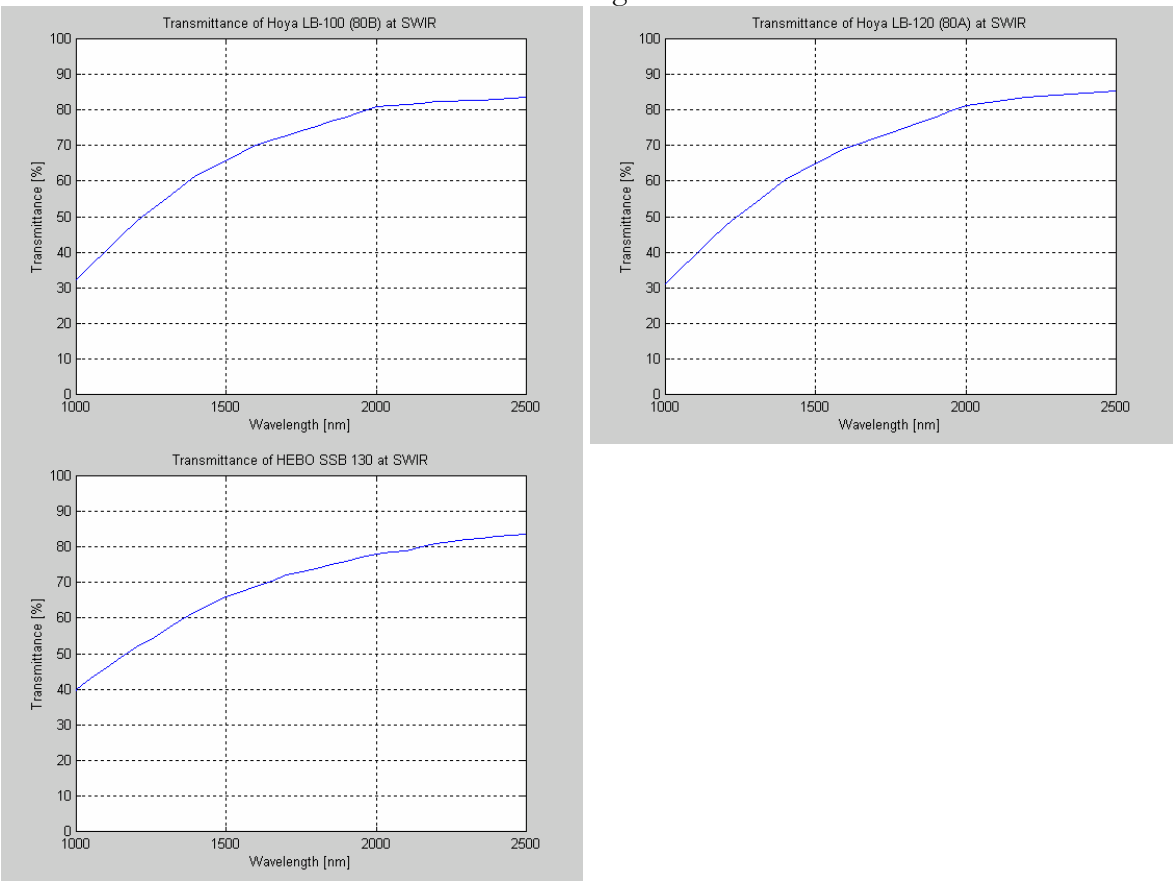

Figure 3 The recommended spectral flattening filters for SWIR range when using either halogen light or the Sun as light source.

Specim provides the SWIR filters with special coating. The filter is coated to block the wavelengths 800-960nm. This special filter is working like blue filter listed above except this blocking range. The reason for this special coating is the fact that SWIR detectors are already sensitive from 800nm on and these wavelengths cannot be filtered by Order Blocking Filter (OBF).

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The difference between measured SWIR signal of the halogen source is showed in next figure.

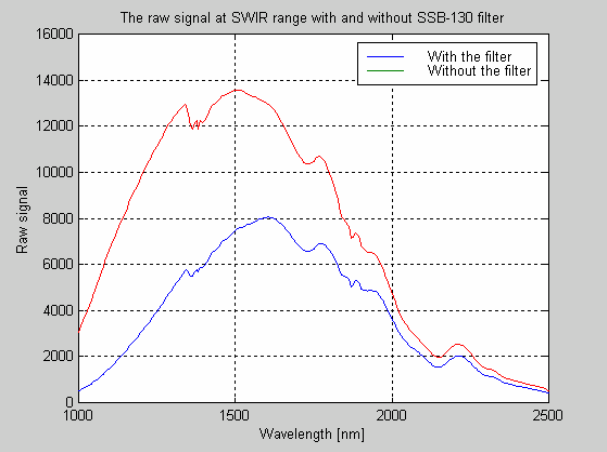

Figure 4 The filtered and unfiltered SWIR measurements

From the previous figure one can see the purpose of the filter. When using the filter one can increase the integration time avoiding saturation in 1500nm and increase the signal in the wavelengths 2000-2500nm. Like this one can improve the SNR at long wavelengths.