Stray light and second-order effects

Stray-light is radiation of undesired wavelengths that activates a signal at a detector element. Sources of stray-light can be:

- *Ambient light*
- *Scattering light from imperfect optical components, or reflections of non-optical components*
- *Order overlap*

Avantes symmetrical Czerny-Turner optical bench designs favor stray-light rejection relative to crossed designs. Additionally, Avantes Ultra-Low Stray-light (AvaSpec-ULS) spectrometers have a number of internal measures to reduce stray-light from zero order and backscattering.

When working at the detection limit of the spectrometer system, the stray-light level from the optical bench, grating and focusing mirrors will determine the ultimate limit of detection. Most gratings used are holographic gratings, known for their low level of stray-light. Stray-light measurements are conducted using a halogen light source and long-pass or band-pass filters.

Typical stray-light performance for the AvaSpec-ULS and a B-type grating is <0.06% at 250-500 nm. Second order effects, which can play an important role for gratings with low groove frequency, and therefore a wide wavelength range, are usually caused by the 2nd order diffracted beam of the grating. The effects of these higher orders sometimes need to be addressed using filtering. The strategy is to limit the light to the region of the spectra, where order overlap is not possible.

Second order effects can be filtered out, using a permanently installed long-pass optical filter in the SMA entrance connector or an order-sorting coating on a window in front of the detector. The order-sorting coatings on the window typically have one long-pass filter (600 nm) or 2 long-pass filters (350 nm and 600 nm), depending on the type and range of the selected grating. In the broadband ULS configurations, Linear Variable Filters are used for even better suppression of the second order effects.

In Table 6, a wide range of optical filters for installation in the optical bench can be found. The filter types that are 3 mm thick give a much better 2nd order reduction than the 1 mm filters. The use of following long-pass filters is recommended: OSF-475 for grating NB and NC, OSF-515 / 550 for grating NB and OSF-600 for grating IB. For backthinned detectors, such as the 2048XL and 1024x58/122 we recommend an OSF-305 Filter, when the starting wavelength is 300 nm and higher.

Order-Sorting Window in holder

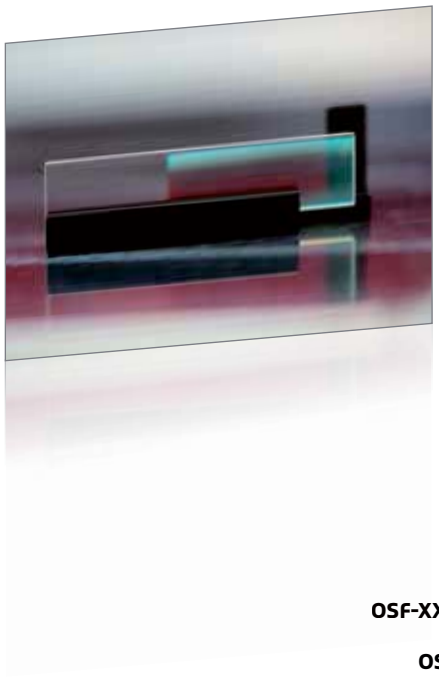

Table 6 Filters installed in AvaSpec spectrometer series

OSF-XXX	Permanently installed order-sorting filter @ XXX nm (XXX= 305, 395, 475, 515, 550, 600, 850)
OSC	Order-sorting coating with 600 nm long-pass filter for BB (>350 nm) and VB gratings
OSC-UA	Order-sorting coating with 350 and 600 nm long-pass filter for UA/VA gratings. Linear Variable Filter for ULS benches
OSC-UB	Order-sorting coating with 350 and 600 nm long-pass filter for UB or BB (<350 nm) gratings
OSC-UC	Order-sorting coating with 300 nm long-pass filter for UC gratings
OSC-HS500	Order-sorting coating with 350 and 600 nm long-pass filter for HS500 gratings in AvaSpec-HS
OSC-HS900	Order-sorting coating with 600 nm long-pass filter for HS900 gratings in AvaSpec-HS
OSC-HS1000	Order-sorting coating with 350 nm long-pass filter for HS1000 gratings in AvaSpec-HS
OSC-HSC300	Order-sorting coating for use with grating HSC0300-xx
OSC-HSC600	Order-sorting coating for use with grating HSC0600-xx
OSC-NIR	Order-sorting coating with 1400 nm long-pass filter for NIR100-2.5 and NIR150-2.0 gratings in AvaSpec-NIR256/512-2.5TEC