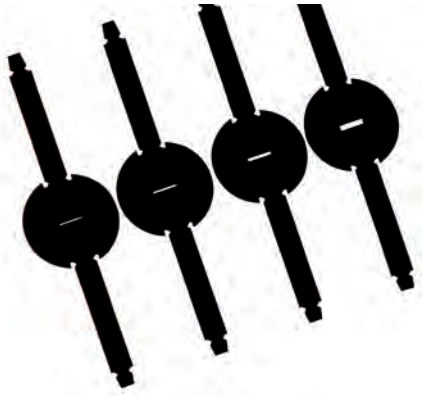
How to select optimal optical resolution

Installed Slit in SMA Adapter



The optical resolution is defined as the minimum difference in wavelength that can be separated by the spectrometer. For separation of two spectral lines it is necessary to project them at least two array-pixels apart.

Because the grating determines how far different wavelengths are separated (dispersed) at the detector array, it is an important variable for the resolution. The other important parameter is the width of the light beam entering the spectrometer. This is basically the installed fixed entrance slit in the spectrometer, or the fiber core when no slit is installed.

For AvaSpec spectrometers the available slit widths are 5, 10, 25, 50, 100, or 200 µm wide x 1000 µm high, or 500 µm wide x 2000 µm high. The slit image on the detector array for a given wavelength will cover a number of pixels. For two spectral lines to be separated, it is necessary that they are dispersed over at least this image size plus one pixel. When large core fibers are used the resolution can be improved by a slit of smaller size than the fiber core. This effectively reduces the width of the light beam entering the spectrometer optical bench.
The influence of the chosen grating and the effective width of the light beam (fiber core or entrance slit) are shown in the tables provided for each AvaSpec spectrometer instrument.

In Table 3 the typical resolution can be found for the AvaSpec-ULS2048CL. Please note that for the higher lines/mm gratings the pixel dispersion varies along the wavelength range and improves towards the longer wavelengths.
The resolution in this table is defined as Full Width Half Maximum (FWHM), which is defined as the width in nm of the peak at 50% of the maximum intensity.

For larger pixel-height detectors (3648, 2048L, 2048CL, 2048XL, 4096CL) in combination with thick fibers (>200 µm) and a larger grating angle the actual FWHM value can be 10-20% higher than the value in the table. For best resolution small core diameter fibers are recommended.

All data in the resolution tables are based on averages of actual measured data (with 200 µm fibers) of our Quality Control System during the production process. A typical standard deviation of 10-25%, depending on the slit diameter and the grating should be taken into account. For 10 µm slits the typical standard deviation is somewhat higher, which is inherent to the laws of physics. The peak may fall exactly within one pixel, but may cover 2 pixels causing, a lower measured resolution.

The replaceable slit feature is available on all ULS and NIR spectrometers.
The spectrometers come with one installed slit and a slit kit which includes 3 other slit sizes, so you can opt for higher resolution (25 µm slit) or higher throughput (200 µm slit) or somewhere in between (50 or 100 µm slits).

Resolution Table (FWHM in nm) for AvaSpec-ULS2048CL-EVO

	Slit size (µm)					
Grating (lines/mm)	**10**	**25**	**50**	**100**	**200**	**500**
300	1.0	1.4	2.5	4.8	9.2	21.3
600	0.40-0.53*	0.7	1.2	2.4	4.6	10.8
830	0.32	0.48	0.93	1.7	3.4	8.5
1200	0.20-0.28*	0.27-0.38*	0.52-0.66*	1.1	2.3	5.4
1800	0.10-0.18*	0.20-0.29*	0.34-0.42*	0.8	1.6	3.6
2400	0.09-0.13*	0.13-0.17*	0.26-0.34*	0.44-0.64*	1.1	2.7
3600	0.06-0.08*	0.10	0.19	0.4	0.8	1.8

* depends on the starting wavelength of the grating; the higher the wavelength, the bigger the dispersion and the better the resolution