



The EMU-120/65 VIS/NIR/SWIR is based upon the same echelle design as the 190-1100nm model, except it uses a prism with much higher dispersion. This prism separates the spectral orders nearly 4x wider apart using the same gratings. Higher dispersion allows taller slits to be used for much better throughput (or étendue) at the same resolving power as compared to the 190-1100nm instrument. The étendue of the VIS/NIR/SWIR will be approximately 4x higher than the 190-1100nm instrument, plus it will have extremely low cross-talk between adjacent spectral orders because of the higher dispersion.

There are two possible wavelength ranges depending upon the optical adjustments:

350nm to 1100nm wavelength range  
400nm to 1700nm wavelength range

Cameras with CCD, EMCCD and CMOS detectors will cover 350nm to 1100nm. Above 1100nm, a SWIR camera is required.

The same interchangeable grating cassettes and aperture stops are available with both models of the EMU-120/65. The maximum resolving power across the VIS/NIR/SWIR spectrum can exceed 60,000 ( $\lambda / \text{FWHM}$ ) with the IX series cassettes.

The high étendue, low stray light and high resolving power make the instrument ideal for LIBS, Raman, photoluminescence, and absorption spectroscopy. The low stray light and limited cross-talk offer performance in the VIS/NIR/SWIR range that is more comparable to double monochromators than other echelle instruments.

*The EMU-120/65 is designed, manufactured and marketed by Catalina Scientific Instruments, LLC, and it is protected under US Patents 7,936,454 and 7,936,455.*

## EMU-120/65 VIS/NIR/SWIR

### High Resolution High Throughput Very Low Stray Light Echelle Spectrograph

- EMU is the **Echelle Multiplex Unit**
- High étendue (numerical aperture x slit area) allows for high throughput.
- Covers the VIS-NIR-SWIR range and acquires completely linearized spectra in units of wavelength or Raman shift.
- Can be used with a variety of EMCCD, CCD, ICCD, CMOS, SWIR cameras.
- A variety of user interchangeable grating cassettes, aperture stops, and entrance slits to optimize applications.
- Highest resolving power up to 60,000 with the IX series grating cassettes.
- Proprietary algorithms to correct stray light and order cross-talk can provide the highest quality spectra.

#### Interchangeable Grating Cassettes



grating

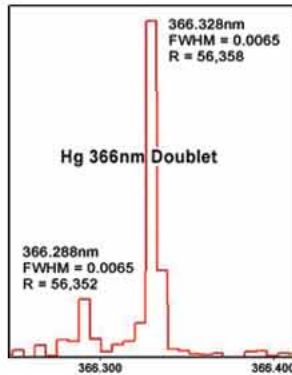
<b>HT Series:</b>	up to R = 9,500
<b>HR Series:</b>	up to R = 12,000
<b>UV Series:</b>	up to R = 30,000
<b>IS Series:</b>	up to R = 40,000
<b>IX Series:</b>	up to R = 60,000

*The grating cassettes for the EMU-120/65 are user interchangeable. The above values for R ( $\lambda / \text{FWHM}$ ) are based upon  $8 \times 8 \mu$  pixel size and  $10\text{-}14 \mu$  wide entrance slit.*

## Resolving Power

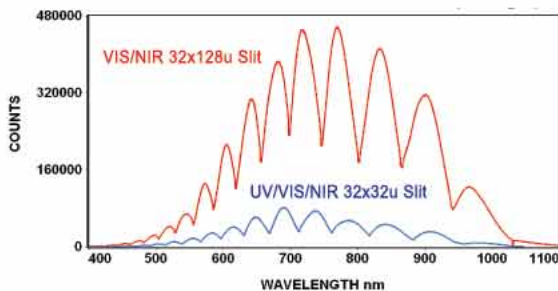
The EMU-120/65 optical design can yield *single pixel* resolving power with high throughput.

The Hg 366.288nm and 366.328nm doublet is clearly resolved using the IX series cassette. Each peak is one CCD pixel wide (8 microns) using an entrance slit 10 microns wide. Each peak has 0.0065nm FWHM resolution, for a resolving power of about 56,350. The IX cassettes have the highest resolving power.



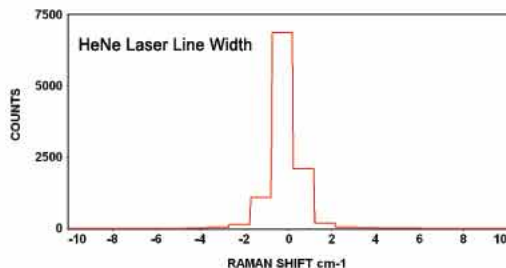
## Throughput/Etendue Comparisons

The tungsten spectra below compare the throughput of the VIS/NIR model (red) with the UV/VIS/NIR model (blue) of the EMU-120/65. Both systems used the same grating, camera and aperture stop. The resolving power of the two models is the same. The high dispersion prism in the VIS/NIR model allows 4x taller entrance slits to be used than the UV/VIS/NIR model, allowing for greater throughput.

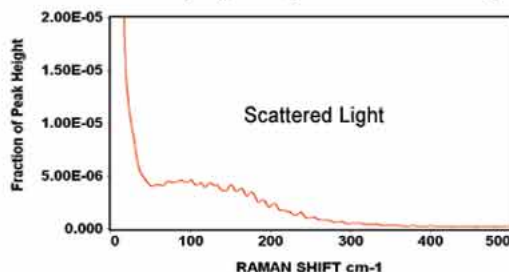


## Stray and Scattered Light

The resolution for the HeNe 633nm laser line shown below is 1 cm<sup>-1</sup> FWHM using the HR2 grating cassette.



The HeNe laser line below is over exposed by ~6000x to show the small angle scattering caused primarily by the grating. Scattered light is measured as a fraction of the HeNe peak intensity. It drops below the CCD dynamic range limit at a fraction of a nm from the peak. The VIS/NIR/SWIR model minimizes stray light beyond the scattering region.



## KestrelSpec™ Software

Industry-standard KestrelSpec™ software controls the EMU-120/65 system, with complete real-time camera control and spectra acquisition. Our unique "3-point calibration" to calibrate the EMU spectrograph is performed quickly and easily with high accuracy. Spectral diffraction orders are automatically linked, linearized and plotted as the data is acquired in either nm or cm<sup>-1</sup> units. Image and spectral data can be easily exported in various formats. An Element Identification tool with a user-editable reference library can identify the elements in atomic emission spectra. A Windows DLL (dynamic link library) is available for control of the EMU spectrograph by third party developers' applications.

## EMU-120/65 Specifications

- At the collimator: maximum F/4 input optics
- At the detector: max. F/2.2 camera focusing optics
- Focal Length (collimator): 120mm
- Focal Length (camera focusing optics): 65mm
- Magnification: ~ 0.54x
- Wavelength Coverage: 350 - 1100nm; 400 - 1700nm
- Scattered Light: 2.0E-05 at 1nm from the HeNe 633nm peak with an HR2 cassette
- Stray Light: ~1.0E-07
- Unit Volume: 6445 cm<sup>3</sup> (394 cubic inches)  
Fits into a 400 x 255 x 165mm box (15.7 x 10.0 x 6.5 inches) excluding camera, adapters and base
- Weight: 7 kg (15 lb) without camera, base, adapters
- Fiber Optic Input: SMA connector
- Entrance Slits: user interchangeable in varied sizes 8 to 128μ wide; 12 to 128μ tall
- Aperture Stops: user interchangeable in varied sizes 12 to 30mm in diameter
- Grating Cassettes: user-interchangeable gratings with blaze angles from 32° to 76°

## Computer System Requirements

- Windows™ XP/Vista/7/8/10 (32-bit or 64-bit)
- Appropriate driver to interface with the detector

For more information please contact:

**Catalina Scientific Instruments, LLC**  
1870 West Prince Road, Suite 21  
Tucson, Arizona 85705 USA

Tel: 520 571 8000  
Fax: 520 571 0120  
Web: [www.catalinasci.com](http://www.catalinasci.com)  
Email: [info@catalinasci.com](mailto:info@catalinasci.com)