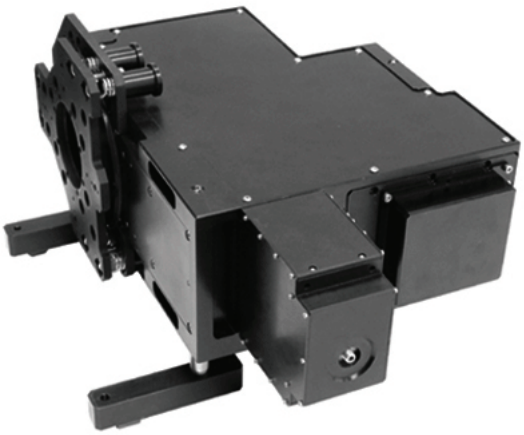
kestrel™ spectroscopy systems

Catalina Scientific

EMU-120/65 UV/VIS/NIR

High Resolution High Throughput Ultra-Low Stray Light Echelle Spectrograph



The resolution, portability and broad wavelength coverage of the EMU-120/65 is suitable for many isotopic and other applications requiring a high resolution spectrograph. The average resolving power across the spectrum can exceed 50,000 (λ/FWHM) with our IX dispersion cassettes.

The input optics of the 120mm focal length collimating mirror can be as fast as F/4. The 120mm collimator is better matched with the most commonly used input optics, which can improve overall resolution and throughput.

The 65mm camera focusing optics can be as fast as F/2. The collimating mirror combined with the camera focusing optics can reduce the slit image size by 0.54x at the focal plane, which can improve alignment of the optics and increase resolution. The throughput of the EMU-120/65 can be 10x to 20x higher than other broadband echelle instruments, which are typically ~F/10.

Because of its high étendue and resolving power, the EMU-120/65 is an echelle spectrograph that is versatile enough for both LIBS (laser-induced breakdown spectroscopy) and Raman applications. Its low stray light offers performance more comparable to double monochromators than other echelle-type spectrographs.

The EMU-120/65 is designed to take advantage of the characteristics of EMCCD cameras. These cameras have higher quantum efficiency, resolution, and frame rate than ICCD cameras. EMCCDs are more compact and less expensive than ICCDs. An EMCCD is more robust than intensified cameras because they cannot be damaged by over exposure to light.

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.

- High étendue (numerical aperature x slit area).
- Covers the entire wavelength range of the detector (UV-VIS-NIR) and acquires completely linearized spectra in units of wavelength or Raman shift.
- Can be used with a variety of CCD, EMCCD, ICCD and CMOS cameras.
- A variety of user interchangeable dispersion cassettes, aperture stops, entrance slits to optimize applications.
- Highest resolving power over 50,000 with the IX series dispersion cassettes.
- As an option, a 65mm collimator can be used instead of the 120mm collimator. It depends upon which collimating optics are a better match to the user's input optics for optimizing throughput.

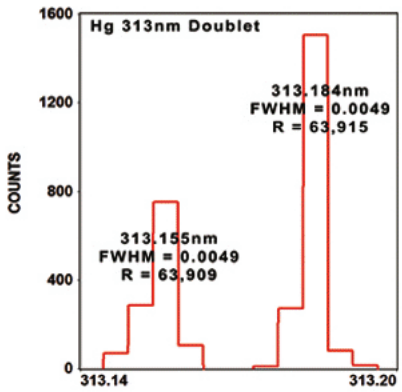
Interchangeable Dispersion Cassettes

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

The custom dispersion cassettes on the EMU-120/65 are interchangeable. The above values for R (λ / FWHM) are based upon 8x8μ pixel size and 8μ wide entrance slit.

Resolving Power

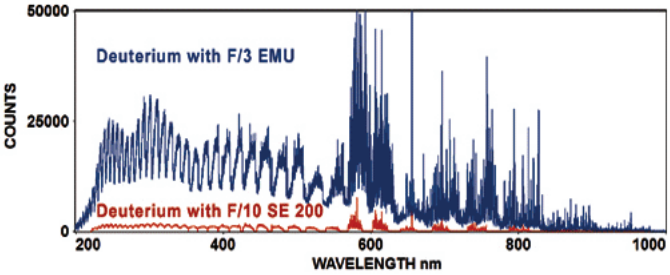
The EMU-120/65 optical design can yield ***single pixel*** resolving power with high throughput.



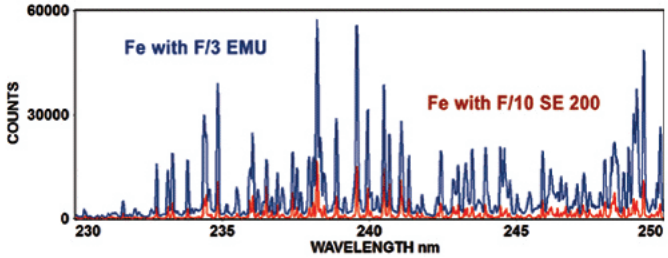
The Hg 313.155nm and 313.184nm doublet is clearly resolved using the IX series cassette. Each peak is one CCD pixel wide (8 microns) using an entrance slit 8 microns wide. Each peak has 0.0049nm FWHM resolution, for a resolving power of about 63,900. The IX series has the highest resolving power.

Throughput/Etendue Comparisons

The deuterium/tungsten spectra below compare the throughput of an EMU (blue) with an SE 200 (red) echelle spectrograph. The EMU is F/3 and the SE 200 is F/10. Both systems had the same grating, camera and slit size.

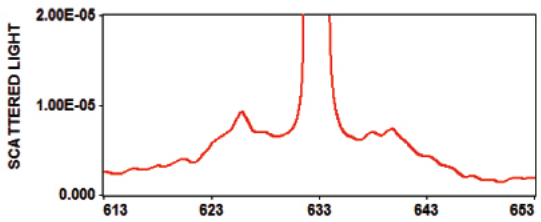


The iron LIBS spectra below compare the throughput of the EMU and EMCCD system (blue) with an SE 200 and ICCD system (red). Both echelle spectrographs used similar sized slits and exposures, and both used 10 laser shots.



Stray and Scattered Light

The overexposed HeNe laser line below shows the small angle scattering caused mostly by the grating. Scattered light is measured as a fraction of the HeNe peak intensity, and it drops below the CCD dynamic range limit at a fraction of a nm from the peak. The EMU-120/65 is designed to minimize stray light beyond the region affected by the scattering.



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^{-1} 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: F/4 to F/16
- At the detector: F/2 to F/8
- Focal Length (collimator): 120mm
- Focal Length (camera focusing optics): 65mm
- Magnification: ~ 0.54x
- Wavelength Coverage: 190 - 1100nm
- Scattered Light: 2.0E-05 at 1nm from the HeNe 633nm peak with an HR2 cassette
- Stray Light: ~2.0E-06
- Unit Volume: 6227 cm^3 (380 cubic inches)
  Fits into a 385 x 250 x 110 mm box (15 x 10 x 4.5 inches) excluding camera, adapters and base
- Weight: 6 kg (13 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
- Dispersion Cassettes: user interchangeable gratings with blaze angles from 32° to 76°

Computer System Requirements

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

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