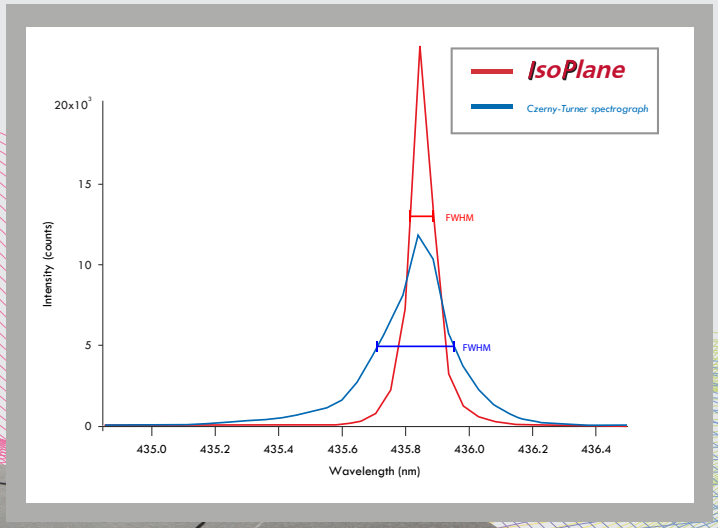
IsoPlane®

Imaging Spectrograph

Spectroscopy and Imaging Reimagined!



Reduced optical aberrations =
Improved imaging and spectroscopy

IsoPlane SCT-320 is pictured with a Princeton Instruments camera, optical fiber, and coupling – each sold separately.

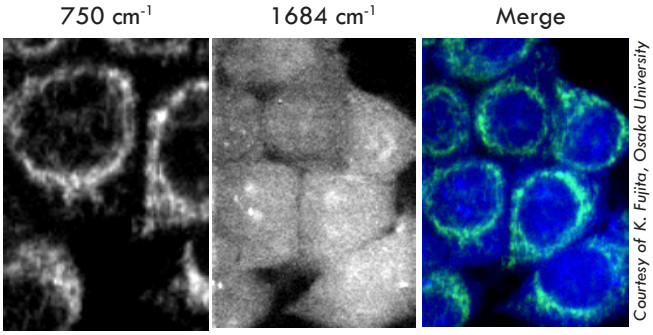
WINNER OF: R&D 100 2013 | PRISM AWARDS WINNER | CLEO/LASER FOCUS WORLD INNOVATION AWARD 2013 Honorable Mention

Princeton Instruments

Princeton Instruments IsoPlane

Imagine - A Spectrograph with Unparalleled Performance

The IsoPlane SCT-320 Schmidt-Czerny-Turner spectrograph overcomes the limitations of traditional Czerny-Turner (CT) instruments by eliminating astigmatism and greatly reducing coma. The result is a spectrograph with high fluence, a measure of the number of photons that strike a unit area. A high-fluence spectrograph has more photons hitting fewer pixels, giving crisp, clean images and spectra with higher resolution and signal-to-noise ratios (SNR).



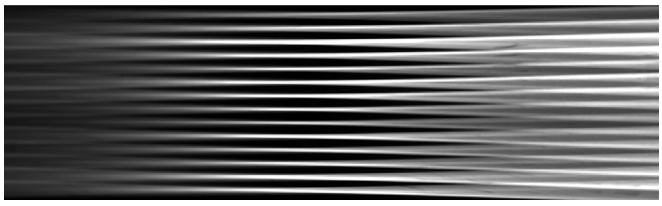
Courtesy of K. Fujita, Osaka University

Raman hyperspectral images of HeLa cells taken with Princeton Instruments IsoPlane.

> "The IsoPlane... combines high-resolution spectra with near-diffraction-limited image quality. It is an ideal choice for 2D imaging spectroscopy and for microscope-coupled systems."
>
> – *Rashid Zia, Assistant Professor, Brown University*

Zero Astigmatism = Outstanding Imaging!

Czerny-Turner spectrograph



IsoPlane

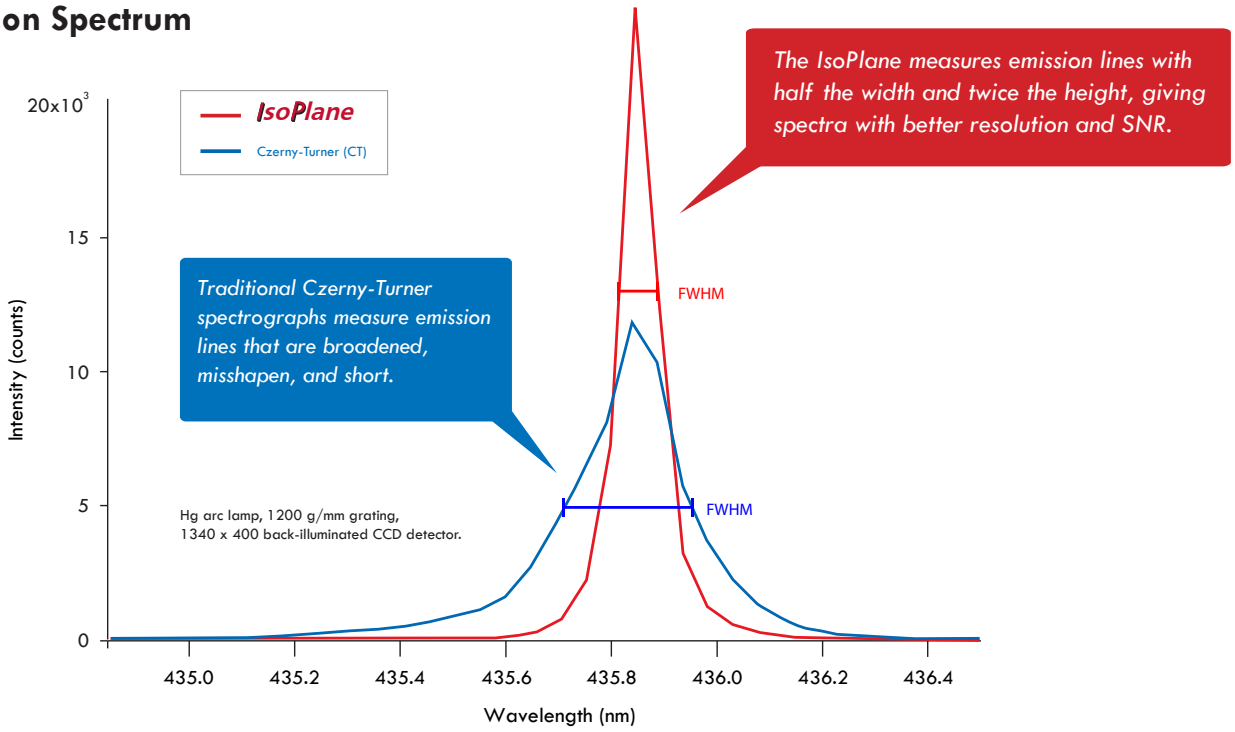
Images acquired with fourteen 100 µm fibers, white light source, 1340 x 400 CCD, 1200 g/mm grating blazed at 500 nm, first order.

Astigmatism occurs when lenses or mirrors are used to image a source off axis and causes vertical elongation of an image. Above left is an image of a fiberoptic bundle illuminated with a white light source and measured with a traditional CT spectrograph. Astigmatism causes the images to broaden, look like a bowtie, and merge at the edges of the focal plane.

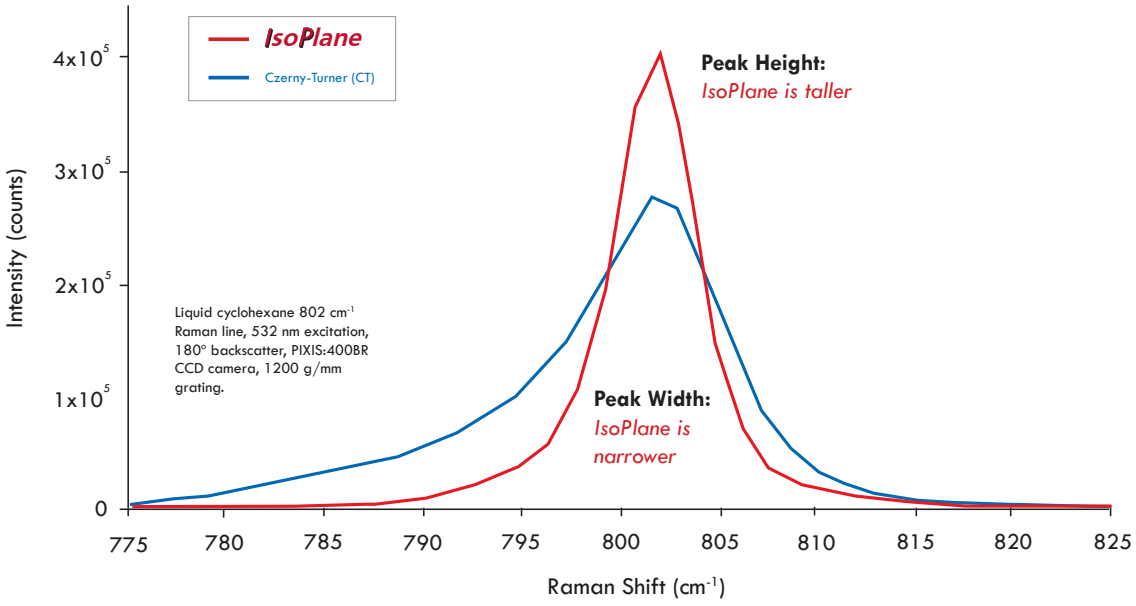
An image of the same optical fiber bundle measured with the IsoPlane is seen above right. Because the IsoPlane has zero astigmatism at all wavelengths and across the entire focal plane, it gives sharp images even at the sensor edges and has negligible crosstalk between optical channels.

Spectroscopy Reimagined – Spectra with Improved Resolution AND Signal-to-Noise Ratios

Emission Spectrum



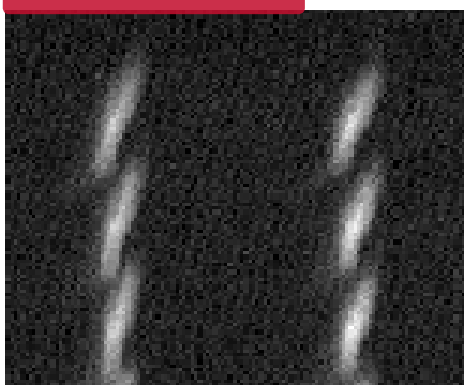
Raman Spectrum



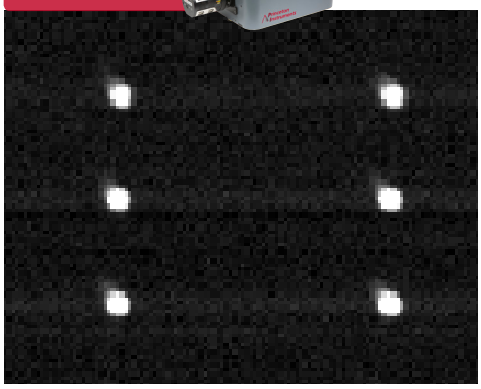
By eliminating field astigmatism at all wavelengths and greatly reducing coma, the IsoPlane gives Raman spectra with improved resolution AND signal-to-noise ratios. Finally, spectroscopy without compromise!

Imaging Reimagined – Sharp Images Even at the Edges of the Focal Plane

Czerny-Turner spectrograph



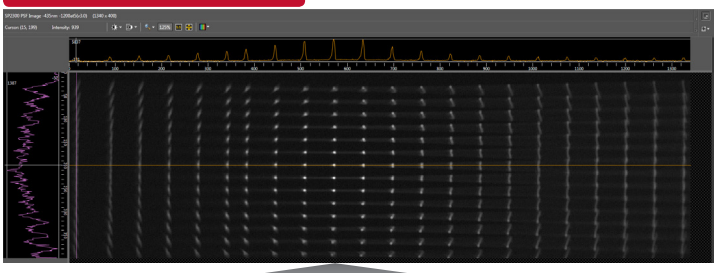
IsoPlane



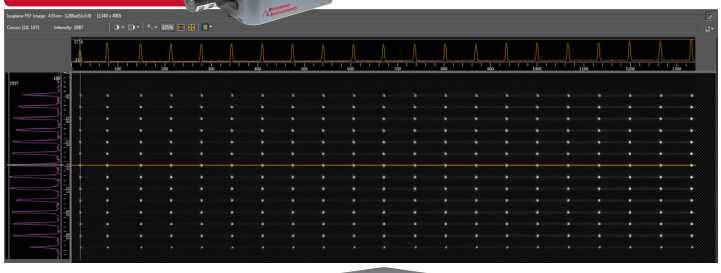
These two optical fiber images are from the upper left corner of a CCD camera. Because optical aberrations are large at the focal plane edges of a traditional CT spectrograph, the fiber images seen at left are elongated smears. With the IsoPlane, optical aberrations are negligible even at the focal plane edges. The image at right is sharp and correctly shows that the fibers are round.

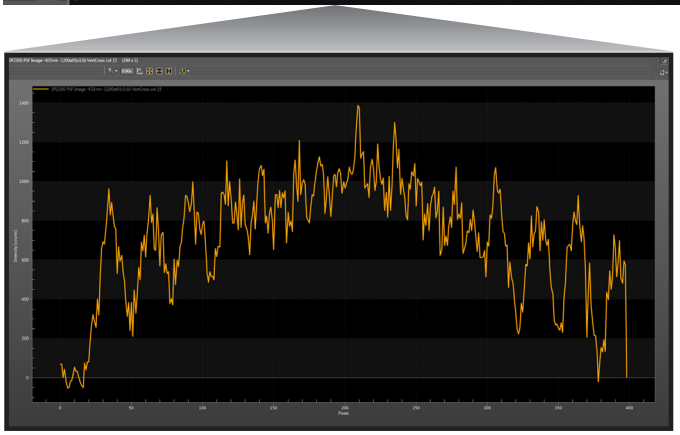
Cross Sections Tell the Story

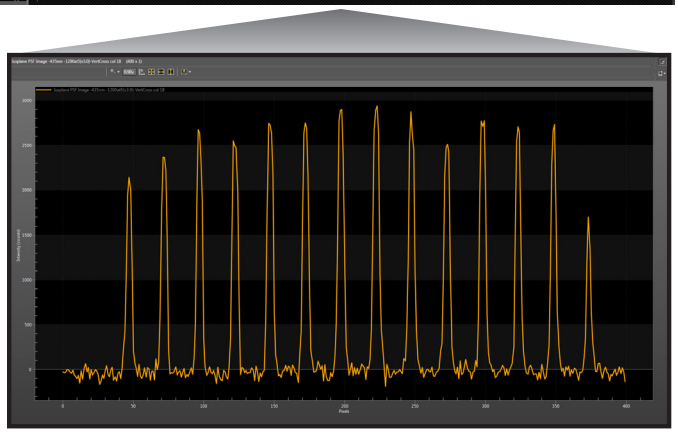
Czerny-Turner spectrograph



IsoPlane



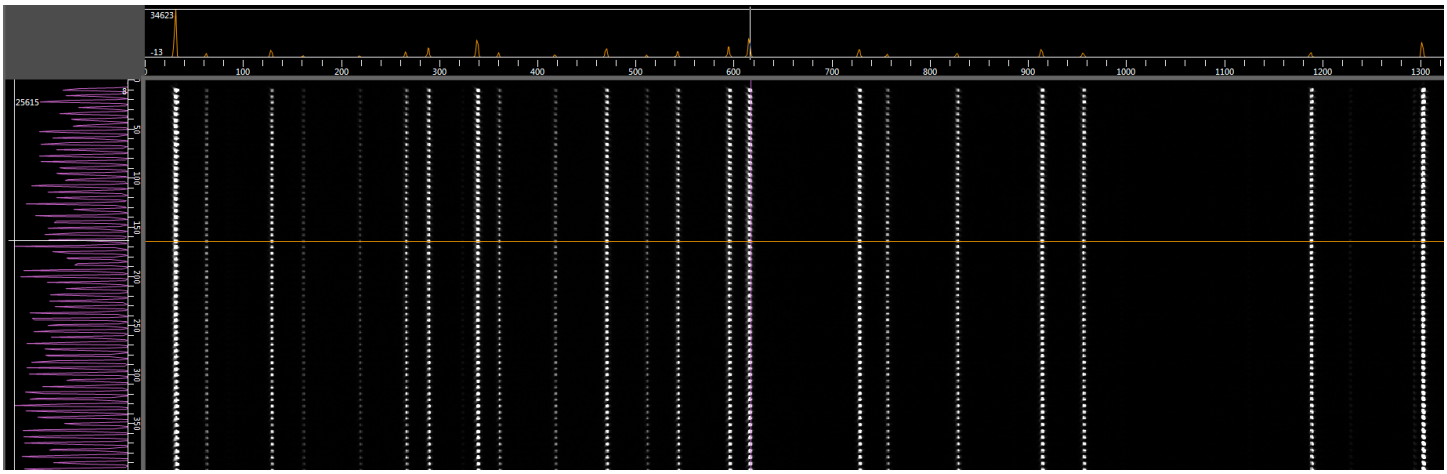




Top left: Images of a 14-fiber bundle measured with a CT spectrograph. An ideal vertical cross section through these images would show 14 baseline-resolved peaks of equal intensity. Below: A vertical cross section from the CT image. Optical aberrations cause individual channels to merge and distort peak heights.

Top right: Same image as measured on an IsoPlane. There are 14 easily distinguishable baseline-resolved peaks. All the peaks are nearly the same height. Reduced optical aberrations give a cross section much closer to ideal than the one measured with a CT spectrograph. This means the IsoPlane is ideal for imaging multiple optical fibers.

Imagine – Dozens of Optical Fibers Crisply Imaged



63 x 50 µm fibers, 8 mm sensor height, 26.8 mm sensor width, neon arc lamp, center wavelength of 644 nm, 600 g/mm grating

This figure shows greater than sixty 50 µm diameter optical fibers imaged with the IsoPlane. There is excellent spatial resolution and minimal crosstalk. This high spatial resolution is attainable over sensor sizes as large as 22 mm tall by 27 mm wide. This figure shows the IsoPlane is excellent for hyperspectral imaging and multi-stripe spectroscopy.

Microscopic Spectroscopy and Imaging

Traditional CT microspectroscopy images are plagued by distortions. The IsoPlane microspectroscopy interface enables researchers to perform high-quality imaging and spectroscopy of microscopic samples by coupling the camera port on an inverted microscope to an IsoPlane SCT-320 spectrograph. Finally, images and spectra of small samples without compromise!

IsoPlane spectrograph shown interfaced to Olympus IX-71 inverted microscope with the IsoPlane microspectroscopy interface (spectrograph, microscope, camera, and interface all sold separately).

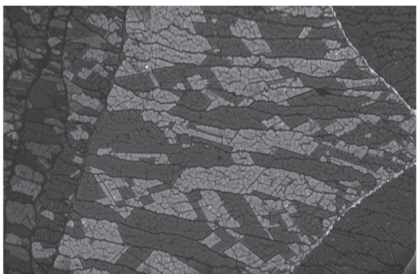


Image of the details of a polymer sample taken with the witness camera on a microscope.

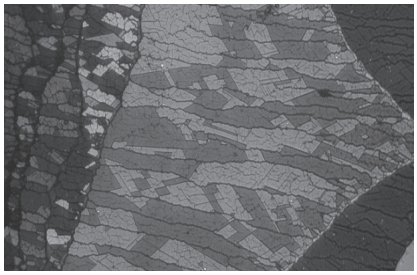
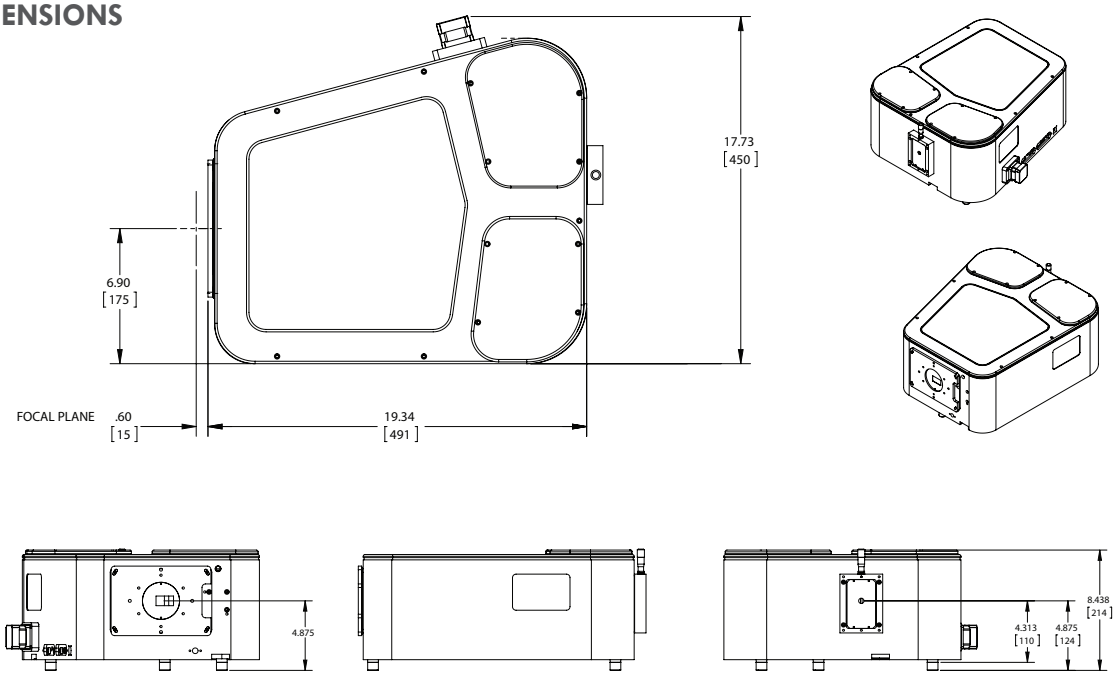


Image of the same sample taken with the IsoPlane in zero order shows excellent fidelity to the microscope image. These images show that when using an IsoPlane, a witness camera is no longer needed.

FEATURES	BENEFITS
Astigmatism-free patent pending design	Spectra are free of astigmatism at all wavelengths across the entire focal plane. Can resolve >100 optical fiber channels with minimal crosstalk. Excellent spatial and spectral resolution with CCD cameras with heights of up to 22 mm*. No other mirror-based scanning spectrograph offers comparable performance.
Outstanding imaging performance	Greatly reduced coma results in spectral linewidths of ~1.5 20 µm pixels across the entire focal plane. The IsoPlane offers the resolution of a 500 mm instrument with twice the light-gathering power.
High fluence	Reduction or elimination of all major aberrations gives high fluence (i.e., photons are concentrated in the peaks of spectral lines rather than in the wings). Peak heights for narrow lines can be 2x or better than with competing instruments. High resolution is maintained when binning over a single row or the entire sensor.
Fixed-position camera mount with micrometer focus adjustment	Easy camera mounting with improved hardware. Fine adjustment for razor-sharp focus.
Kinematic torque-limiting turret mount	Improves reproducibility when changing grating turrets. Up to three triple-grating turrets are supported.
High-efficiency optical coatings	Acton #1900 mirror coating gives highest reflectivity from UV to NIR. Optional silver, gold, or dielectric coatings are available with reflectivities of 98% or better.
Compatible with wide variety of cameras	Princeton Instruments PIXIS, PyLoN, Spec-10/LN, PyLoN-IR, ProEM 1600, PI-MAX3/4 and NIRvana cameras with spectroscopy mount and without electronic shutter are supported.
Wide range of optional accessories	Including fiber bundles, adapters, shutters, filter wheels, purge ports, and light sources such as the IntelliCal™ spectrograph wavelength and intensity calibration system. Accessories sold separately.
Optional: LightField® (for Windows® 7/8, 64-bit) or WinSpec (for Windows XP®/7/8, 32-bit)	 Flexible software packages for data acquisition, display, and analysis. LightField offers intuitive, cutting-edge user interface, IntelliCal, hardware time stamping, and more. Software sold separately.

** Special order*

DIMENSIONS



WEIGHT: 55 LBS [25 KG] | **DIMENSIONS:** 20.4" [518 MM] X 17.7" [450 MM] X 8.5" [216 MM] (L x W x H)

IsoPlane SCT-320 Specifications

Focal length	320 mm
Aperture ratio	f/4.6
Scan range*	0 – 1400 nm mechanical range
Usable wavelength range	190 nm to mid-IR with available mirror coatings, gratings, and detectors (to ~150 nm with optional purge capability)
Reciprocal linear dispersion*	2.38 nm/mm
CCD resolution (20 µm pixels)†	0.08 nm at all points on the focal plane
PMT resolution (10 µm slit)†	0.05 nm
Wavelength coverage*	64 nm
Stray light	$< 2 \times 10^{-5}$
Grating mount/size	Interchangeable triple-grating turrets with on-axis grating rotation, , 68 x 68 mm gratings
Focal plane size	27 mm wide x 14 mm high ‡
Astigmatism	Zero (0) at all wavelengths across the entire focal plane
Spatial resolution (MTF)	≥15 line pairs/mm @ 50% modulation, measured at focal plane center
Slits	**Entrance slit:** Standard manual (10 µm – 3 mm), optional motorized (10 µm – 3 mm and 10 µm – 12 mm versions), or kinematic entrance slit available for imaging and microspectroscopy. **Exit slit:** Standard manual (10 µm – 3 mm) or optional motorized (10 µm – 3 mm and 10 µm – 12 mm versions).
Wavelength accuracy*	Mechanical: ± 0.2 nm | With IntelliCal: ± 0.01 nm
Wavelength repeatability*	Mechanical: ± 0.05 nm | With IntelliCal: ± 0.001 nm
Drive step size*	0.005 nm
Reflective surfaces	3 mirrors and 1 grating
Size and weight	20.4” (518 mm) length x 17.7” (450 mm) width x 8.5” (216 mm) height 55 lbs (25 kg) weight
Optical axis height	Adjustable: 5.0” to 5.875”
Computer interface	USB and RS232

** With 1200 groove/mm grating, dispersion of 0.048 nm/pixel*
† With 1200 groove/mm grating @ 435 nm
‡ Up to 22 mm focal plane height can be illuminated (special order)

Specifications are subject to change without notice.

For more information, go to
www.princetoninstruments.com/IsoPlane

About Princeton Instruments

Drawing daily upon a rich heritage that encompasses more than a half-century of spectroscopy expertise, Princeton Instruments designs and manufactures world-renowned monochromators and spectrographs, precision optical coatings, and high-performance light detection systems tailored for spectroscopy, imaging, industrial, and x-ray applications.

Key Princeton Instruments innovations include the first spectroscopy cameras to utilize photodiode arrays and CCDs, as well as the first high-performance, gated, ICCD camera for spectroscopy. The introduction of the IsoPlane imaging spectrograph continues this unrivaled tradition of excellence.

Princeton Instruments

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