



TELEDYNE PRINCETON INSTRUMENTS

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ProEM®-HS:512BX3



The ProEM-HS: 512BX3 is the most advanced EMCCD camera on the market. It features Princeton Instruments' patented eXcelon®3 technology which delivers the best combination of sensitivity, fringe suppression and high speed. The high speed 20 MHz, > 60 fps EM mode captures low light, fast kinetics, while a slow scan CCD mode with very low read noise is suited for precision photometry applications. ProEM-HS:512BX3 also features ultra-fast custom CCD readout for >10,000 fps at reduced resolution and linear, absolute EM gain. This camera can be cooled to below -90° C, and the all-metal, hermetic vacuum seals are guaranteed for life – the only such warranty in the industry. ProEM-HS:512BX3 features the latest Gigabit Ethernet (GigE) interface to allow remote operation over a single cable without the need for custom frame grabbers.

FEATURES	BENEFITS
Patented eXcelon®3 technology	Enhanced QE and fringe suppression versus standard back illuminated sensors.
20 MHz/16-bit readout	61 fps rate at full-frame resolution. Use ROI/binning for hundreds of frames per second.
All-metal, hermetic vacuum design	Lifetime vacuum guarantee and deep cooling. No epoxies used. Lowest dark current.
OptiCAL	Linear, absolute EM gain calibration using built in precision light source. EM and Non-EM modes for the lowest noise and the best linearity.
BASE	Baseline Active Stability Engine - stable reference for quantitative measurements.
High speed CCD readout	>1000 fps with reduced ROI size, >10,000 fps in spectroscopy mode.
100 kHz/16-bit readout	Noise performance of a slow scan camera for precise photometry applications.
Single optical window	Vacuum window is the only optical surface between incident light and the CCD surface; Advanced AR coatings for the highest throughput.
Built-in shutter	Conveniently capture dark reference frames and protect camera from dust when not in use.
Flexible lens mounts	C-mount (standard), Canon mount and adjustable C-to-Spectroscope mount - easily attaches to microscopes, standard lenses, telescopes or other optical instruments.
Gigabit Ethernet (GigE) interface	Industry standard for fast data transfer over long distances, up to 50m. Extenders available for even greater distance.
Optional: LightField® (for Windows 8/7, 64-bit) Or WinView/Spec (for Windows 8/7/XP, 32-bit)	Flexible software packages for data acquisition, display and analysis; LightField offers intuitive, cutting edge user interface, IntelliCal® and more.
PICAM (64-bit) / PVCAM (32-bit) software development kits (SDKs)	Compatible with Windows 8/7/XP, and Linux; Universal programming interfaces for easy custom programming.
LabVIEW™	Easy integration of camera into complex experiments.

ProEM-HS: 512 shown with lens, sold separately.

Applications:

Single molecule detection, spectroscopy, chemiluminescence, astronomy, adaptive optics, hyperspectral imaging, phosphor imaging and tomography

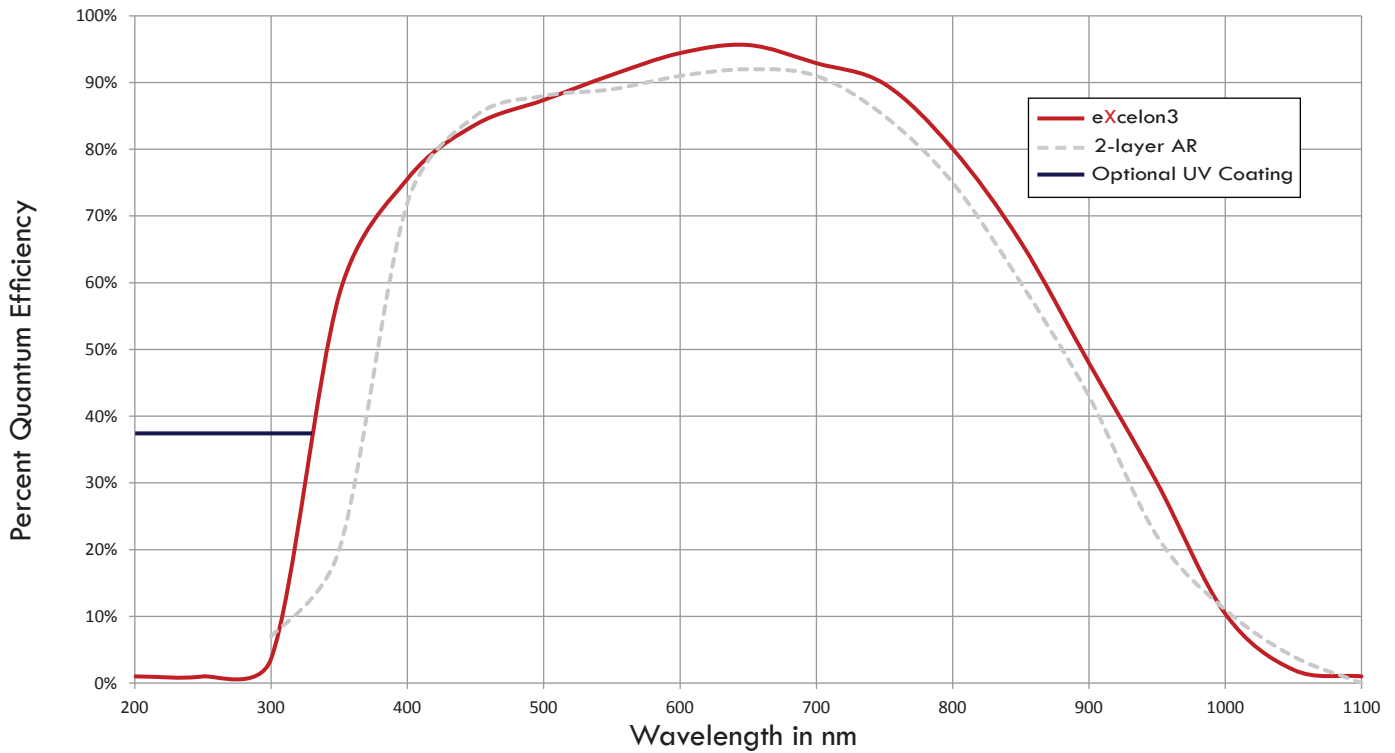
SPECIFICATIONS

	ProEM-HS: 512BX3	
Sensor Format	Back-illuminated 512 x 512 eXcelon3 EMCCD, 16 x 16 μm pixels, 8.2 x 8.2 mm imaging area	
Shutter	25 mm shutter included	
	EM mode	Normal CCD mode
Read noise	25 e ⁻ rms @ 5 MHz 50 e ⁻ rms @ 10 MHz 120 e ⁻ rms @ 20 MHz Read noise effectively reduced to <1 e ⁻ rms with on-chip multiplication gain enabled	3 e ⁻ rms @ 100 kHz 4.9 e ⁻ rms @ 1 MHz
Non-Linearity	<2%	<1%
Analog gain	12, 6, 3 e ⁻ /ADU	3.2, 1.6, 0.8 e ⁻ /ADU
Full well EM mode only EM and Normal CCD modes	800 ke ⁻ (output amplifier) 200 ke ⁻ (single pixel)	
Deepest cooling temperature* (@ +20° C ambient; 10 MHz ADC)	-70° C +/- 0.05° C (guaranteed) Maximum Cooling: -80° C (air), -85° C (+20° C liquid), -90° C (+10° C liquid)	
Dark current	0.001 e ⁻ /p/sec (typical), 0.02 e ⁻ /p/sec (maximum)	
Clock induced charge (CIC) <i>Measured at 1000x EM Gain</i>	0.002 e ⁻ /pixel/frame	
Electron multiplication (EM) gain	1 to 1000x, controlled in linear, absolute steps	
Digitization	16 bits @ 20 MHz, 10 MHz, 5 MHz, 1 MHz and 100 kHz	
Vertical shift rate	300 nsec/row - 5 μsec /row (variable)	
Operating systems supported	Windows 8/7 (64-bit) and Linux (64-bit), Windows 8/7/XP (32-bit)	
I/O signals	Exposure, Readout, Trigger In, Image Shift, Waiting for Trigger	
Operating environment	0 to 30° C ambient, 0 to 80% relative humidity, non-condensing	
Certification	CE	
Dimensions Weight	8.02 inches (20.37 cm) x 5.8 inches (14.73 cm) x 5.8 inches (14.73 cm) L x W x H Approximately 9.2 lbs (4.2 kg)	

* Due to increased thermal dissipation, a higher sensor temperature control point must be set at 20 MHz or in high speed readout modes speed readout modes

NOTE: All specifications are subject to change. Measured at -70° C, 10 MHz ADC setting unless specified.

QUANTUM EFFICIENCY CURVE



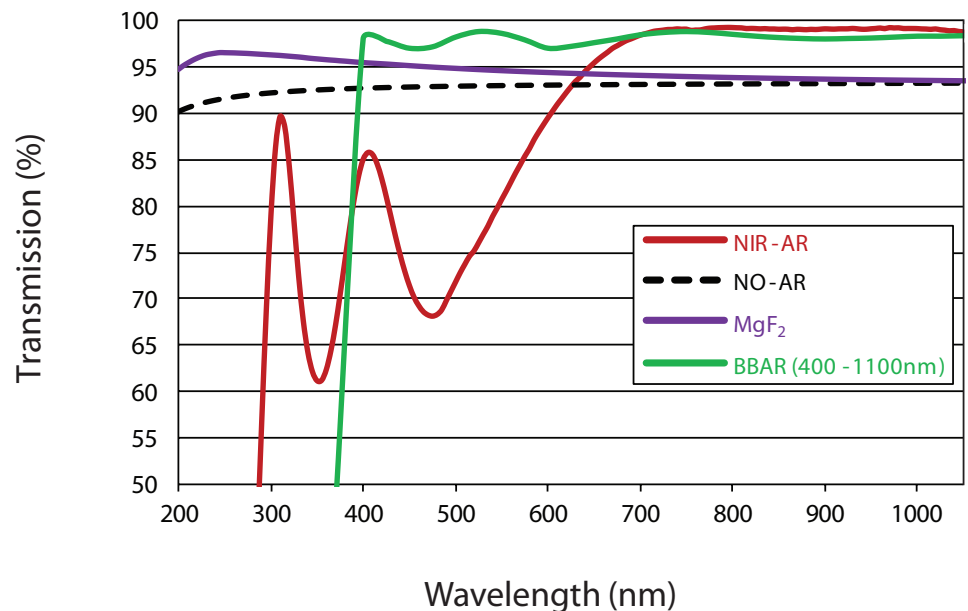
NOTE: Graph shows typical Quantum Efficiency (QE) data measured at + 25° C. Quantum Efficiency is a function of temperature and actual results will depend upon CCD temperature.

VACUUM WINDOW AR COATINGS

NOTES:

- Standard anti-reflection (AR) coating options shown on graph
- Designed by Acton Optics, our BBAR coating offers unmatched performance for 400 nm - 1100 nm
- Custom wedge window options and other AR coatings are also available

Contact your local sales engineer for more information



FRAME RATES

Frame Rates (Standard Mode)

Binning	512 x 512	256 x 256	128 x 128	64 x 64	32 x 32
1 x 1	61	120	228	416	711
2 x 2	120	228	416	711	1099
4 x 4	228	416	711	1099	1506
8 x 8	416	711	1099	1506	1851

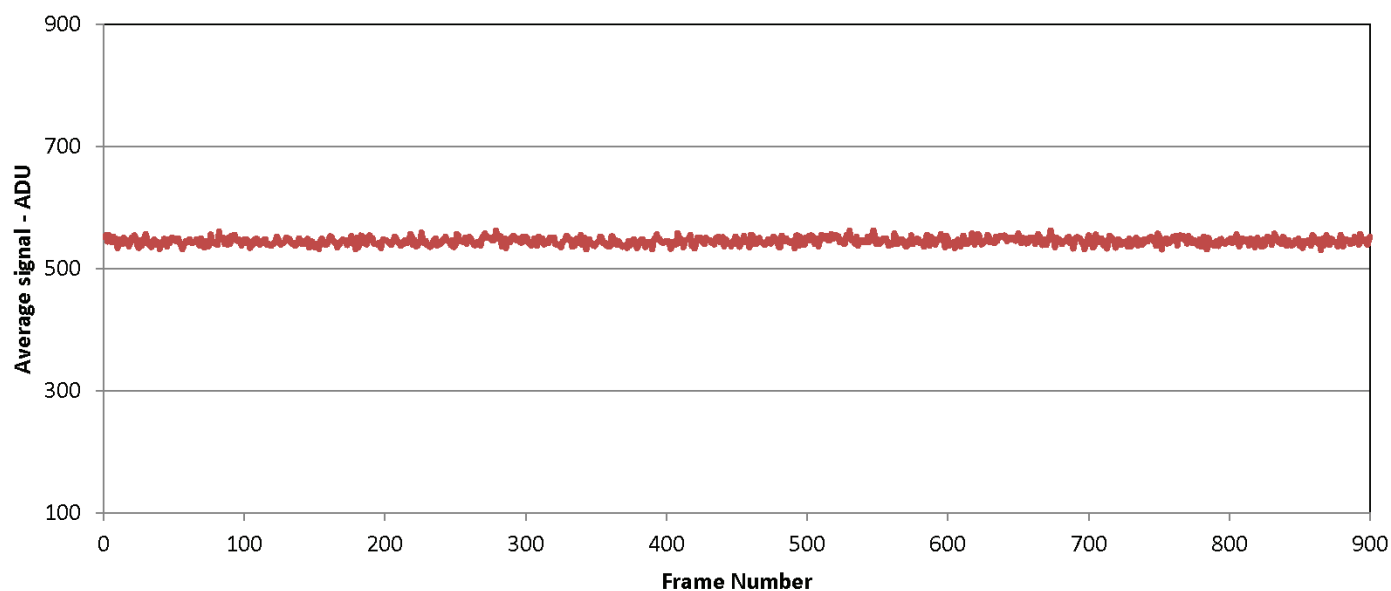
Frame Rates (High Speed CCD Readout Mode)

(High Speed Spectroscopy Readout Mode)

Binning	512 x 512	256 x 172	92 x 101	64 x 62	32 x 30	Binning	512 x 100	512 x 32	512 x 1
1 x 1	61	201.6	865	1529	3472	1 x 100	13850		
2 x 2	120	381	1557	2652	5617	1 x 32		19305	
4 x 4	228	682	2645	4132	7490	1 x 1			23529
8 x 8	416	1131	3968	5899	9708				

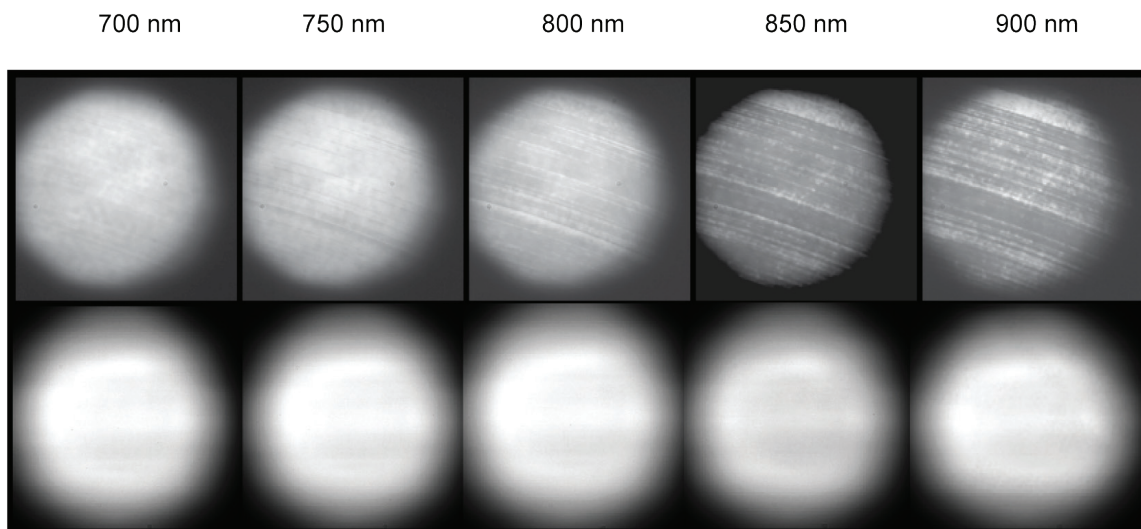
Frame rates are measured with 20 MHz ADC rate and 300 ns vertical shift rate

Baseline Stability at Maximum EM Gain, Measured at 20 MHz and 300 ns

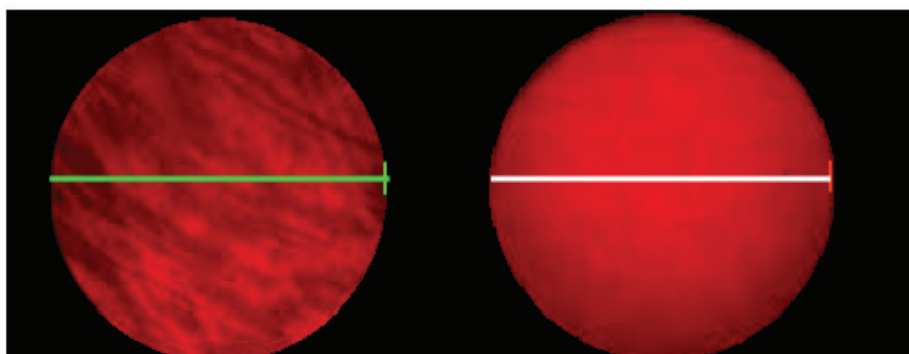


eXcelon3 PERFORMANCE

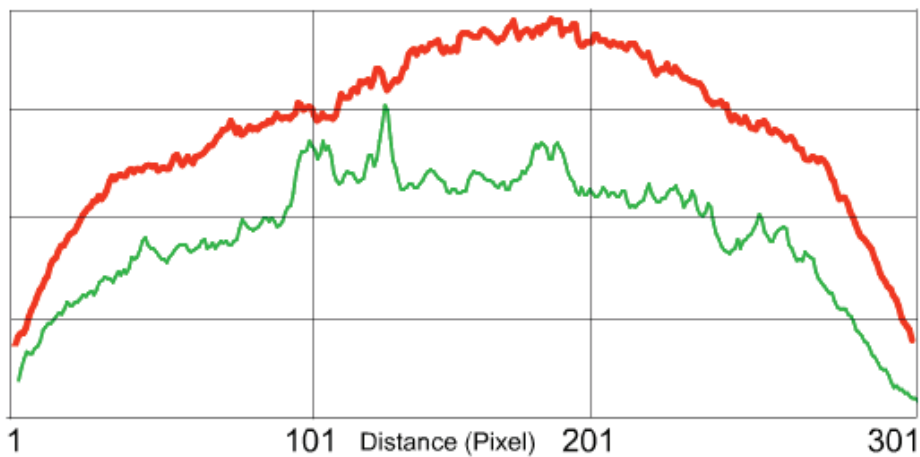
Standard
Back-Illuminated
EMCCD



Data taken with white light source through a monochromator comparing fringe suppression of eXcelon vs. conventional back-illuminated EMCCDs.



Reduced etaloning: CCD PIXIS etaloning-
Comparison of Standard Back-Illuminated
CCD vs. eXcelon BI CCD



EMCCD etaloning: Comparison of Competition vs. eXcelon3 Back-Illuminated EMCCD



Image shows the reduction in etaloning provided by eXcelon3 back-illuminated EMCCDs (right) compared to less-sophisticated back-illuminated EMCCD designs (left).

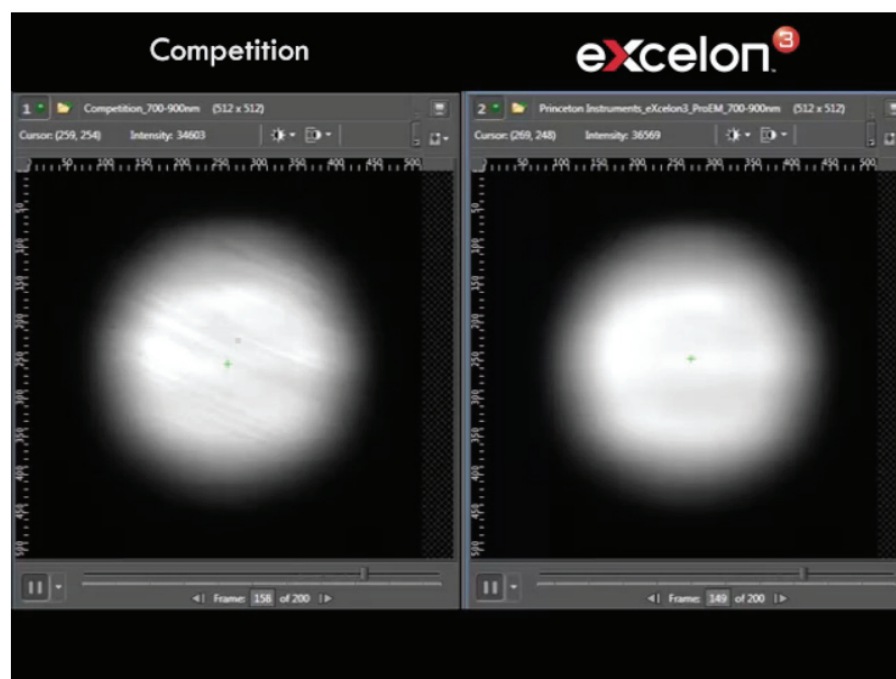
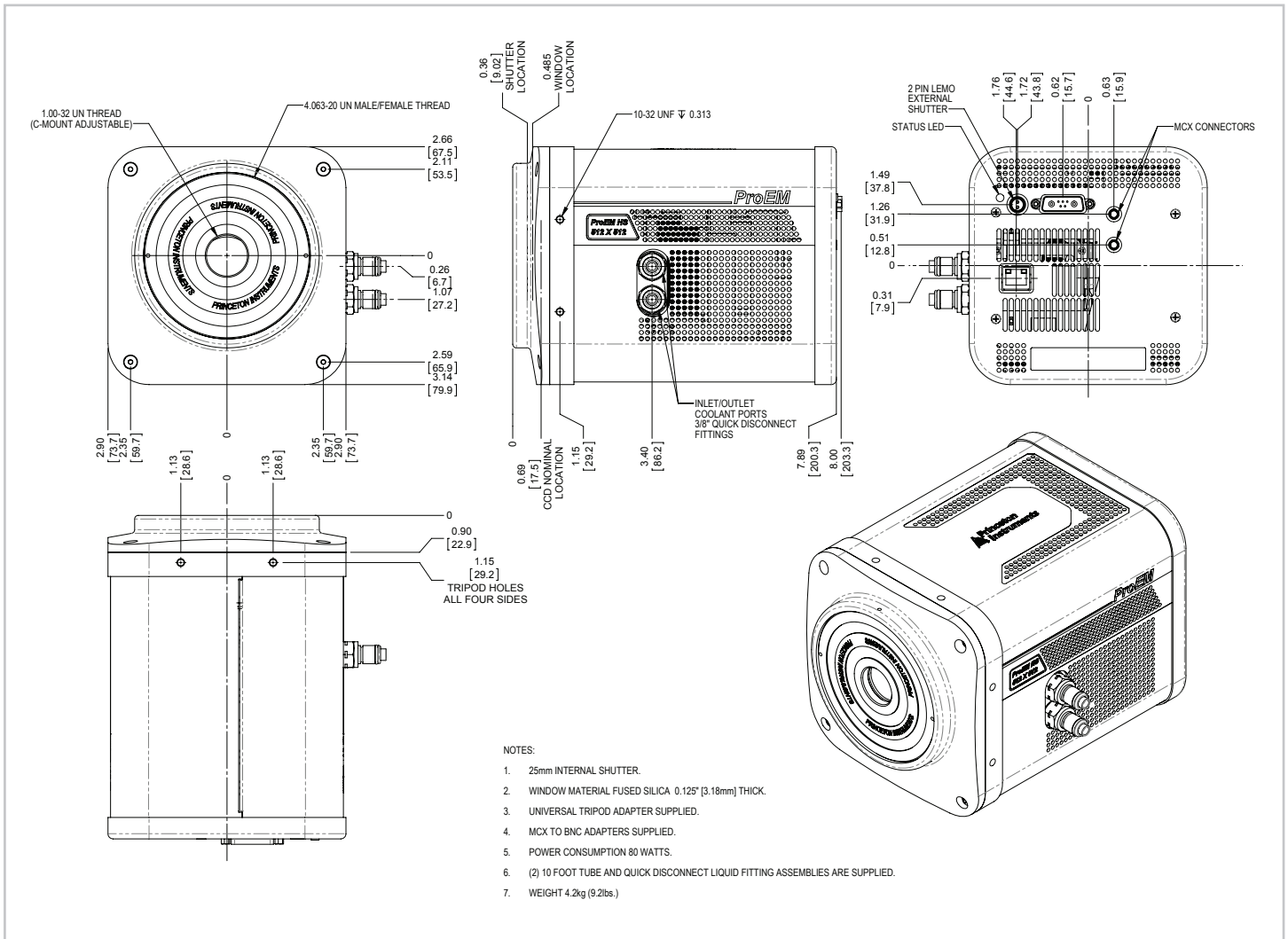
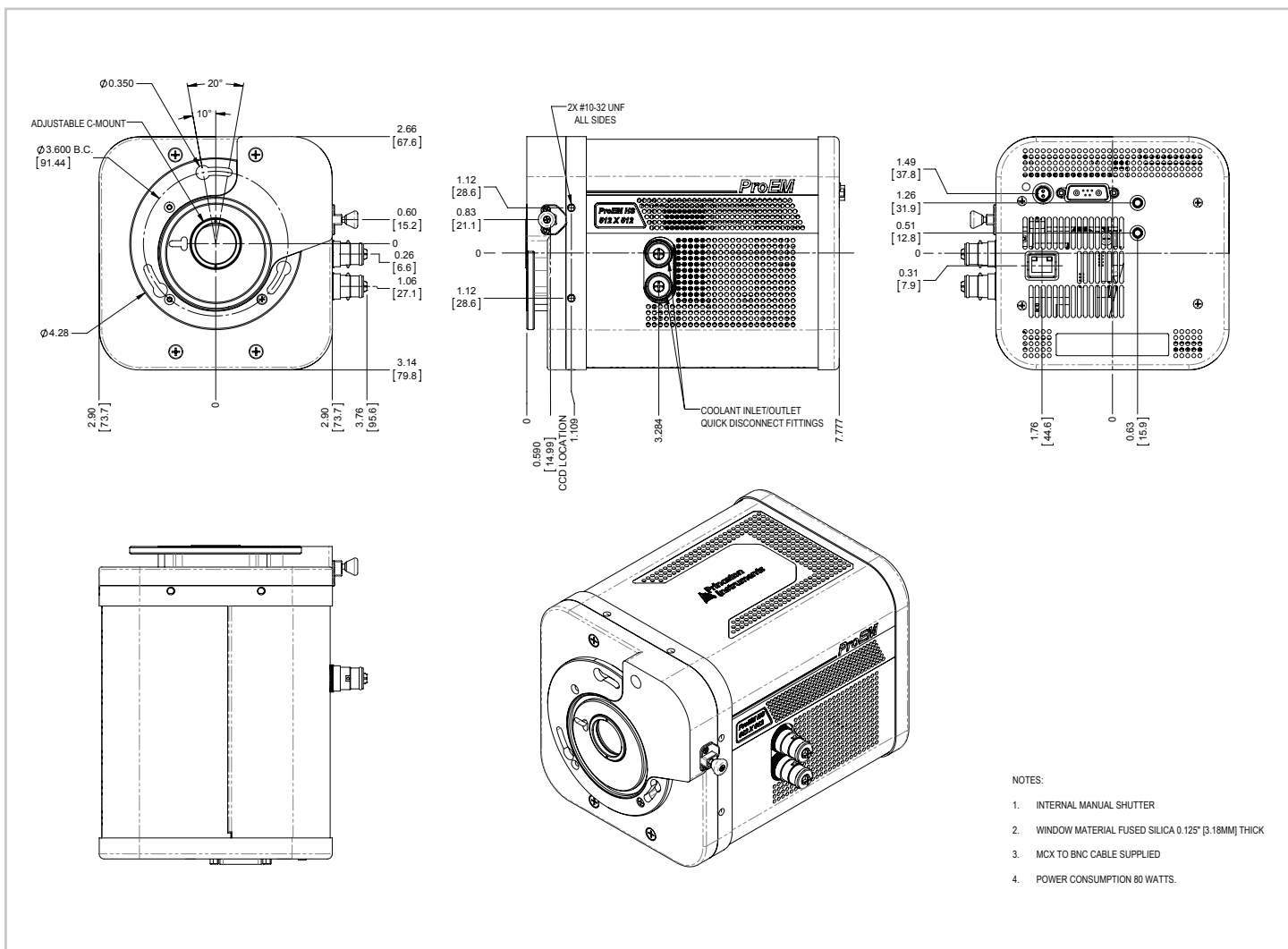


Image shows the reduction in etaloning provided by eXcelon3 back-illuminated EMCCDs (right) compared to less-sophisticated back-illuminated EMCCD designs (left).

OUTLINE DRAWING WITH C MOUNT



OUTLINE DRAWING FOR SPECTROSCOPY





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ProEM®-HS:1024BX3

The ProEM-HS: 1024BX3 is the most advanced EMCCD camera on the market utilizing the latest low-noise readout electronics and a 1024 x 1024 EMCCD. This camera delivers single photon sensitivity and the best fringe suppression with patented eXcelon3 technology. This true 2-in-1 camera features **30 MHz readout speed** with the EM gain mode to deliver **25 fps**, a slow scan normal CCD readout mode with very low read noise for precision photometry applications, as well as other advanced features including solid baseline stability and linear EM gain control. The ultra-fast custom CCD readout mode is specially designed to deliver **greater than 4,400 fps** with reduced ROI, whereas the **special spectra kinetics mode delivers > 300,000 spectra / sec**. The ProEM-HS:1024BX3 camera is **cooled to below -65°C**, and the all-metal, hermetic vacuum seals have a lifetime warranty – the only such guarantee in the industry. For the first time, this camera also features the latest Gigabit Ethernet (GigE) interface allowing remote operation over a single cable, without the need for custom frame grabbers. High QE and ultra-low-noise electronics make the ProEM-HS: 1024BX3 camera ideal for demanding, low-light level applications such as astronomy and Bose-Einstein Condensate (BEC) imaging.

FEATURES	BENEFITS
Patented eXcelon®3 technology	Enhanced QE and fringe suppression versus standard back illuminated and standard fringe suppression AR coated sensors.
30 MHz/16-bit readout	25 fps rate at full-frame resolution. Use ROI/binning for thousands of frames per second.
All-metal, hermetic vacuum design	Lifetime vacuum guarantee and deep cooling. No epoxies used. Lowest dark current.
OptiCAL	Linear, absolute EM gain calibration using built in precision light source; EM and Non-EM modes for the lowest noise and the best linearity.
BASE	Baseline Active Stability Engine - stable reference for quantitative measurements.
100 kHz/16-bit readout	Noise performance of a slow scan camera for precise photometry applications.
High speed, custom camera modes	Imaging mode: Delivers > 4,400 fps with 32 x 27 pixels ROI Spectroscopy mode: Delivers > 20,000 sps with 1024 x 1 row
Multiple readout modes	Full frame, Frame transfer and Kinetics modes Spectra kinetics mode - optional - (> 300,000 sps in burst mode)
Single optical window	Vacuum window is the only optical surface between incident light and the CCD surface; Advanced AR coatings for the highest throughput.
Built-in shutter	Conveniently capture dark reference frames and protect camera from dust when not in use.
Flexible lens mounts	C-mount (standard), Canon mount and adjustable C-to-Spectroscope mount - easily attaches to microscopes, standard lenses, telescopes or other optical instruments.
Gigabit Ethernet (GigE) interface	Industry standard for fast data transfer over long distances, up to 50m. Extenders available for even greater distance.
Optional: LightField® (for Windows 8/7, 64-bit) Or WinView/Spec (for Windows 8/7/XP, 32-bit)	Flexible software packages for data acquisition, display and analysis; LightField offers intuitive, cutting edge user interface, IntelliCal® and more.
PICAM (64-bit) / PVCAM (32-bit) software development kits (SDKs)	Compatible with Windows 8/7/XP, and Linux; Universal programming interfaces for easy custom programming.
LabVIEW® and MATLAB®	Easy integration of camera into complex experiments.

ProEM-HS:1024BX3 shown with lens, sold separately.

Applications:

Single molecule detection, spectroscopy, chemiluminescence, astronomy, BEC
adaptive optics, hyperspectral imaging, phosphor imaging and tomography



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ProEM®-HS:1KBX3-10μm

The ProEM-HS:1KBX3-10μm is the fastest EMCCD camera on the market utilizing the latest low-noise readout electronics and a 1024 x 1024 EMCCD. This camera delivers single photon sensitivity and the best fringe suppression with patented eXcelon3 technology. This high speed, high resolution camera features **36.67 MHz readout speed** with the EM gain mode to deliver **30 fps** at full resolution and <1 e- rms effective read noise, as well as other advanced features including solid baseline stability and linear EM gain control for precision photometry applications. The ultra-fast custom CCD readout mode is specially designed to deliver **greater than 4,800 fps** with reduced ROI, whereas the **special spectra kinetics mode delivers > 119,000 spectra/sec**. The ProEM-HS:1KBX3-10μm camera is **cooled to below -70°C**, and the all-metal, hermetic vacuum seals have a lifetime warranty – the only such guarantee in the industry. This camera also features the latest Gigabit Ethernet (GigE) interface allowing remote operation, without the need for custom frame grabbers. High QE and ultra-low-noise electronics make the ProEM-HS:1KBX3-10um camera ideal for demanding, low-light level applications such as astronomy and Bose-Einstein Condensate (BEC) imaging.

FEATURES	BENEFITS
Patented eXcelon®3 technology	Enhanced QE and fringe suppression versus standard back illuminated and standard fringe suppression AR coated sensors.
36.67 MHz/16-bit readout	30 fps rate at full-frame resolution. Use ROI/binning for thousands of frames per second.
All metal, hermetic vacuum design	Lifetime vacuum guarantee and deep cooling. No epoxies used. Lowest dark current.
OptiCAL	Linear, absolute EM gain calibration using built in precision light source;
BASE	Baseline Active Stability Engine - stable reference for quantitative measurements.
10 μm x 10 μm pixel size	Ideal for high resolution imaging and spectroscopy.
High speed, custom camera modes	Imaging mode: Delivers > 4,800 fps ROI Spectroscopy mode: Delivers > 22,000 sps
Multiple readout modes	Full frame, Frame transfer and Kinetics modes Spectra kinetics mode - optional - (> 119,000 sps in burst mode)
Single optical window	Vacuum window is the only optical surface between incident light and the CCD surface; Advanced AR coatings for the highest throughput.
Built-in shutter	Conveniently capture dark reference frames and protect camera from dust when not in use.
Flexible lens mounts	C-mount (standard), Canon mount and adjustable C-to-Spectroscopy mount - easily attaches to microscopes, standard lenses, telescopes or other optical instruments.
Gigabit Ethernet (GigE) interface	Industry standard for fast data transfer over long distances, up to 50m. Extenders available for even greater distance.
Optional: LightField® (for Windows 10/8/7, 64-bit)	Flexible software packages for data acquisition, display and analysis with built in math engine; LightField offers intuitive, cutting edge user interface, IntelliCal® and more.
PICAM (64-bit) software development kits (SDKs)	Compatible with Windows 10/8/7, and Linux (contact factory for an update); Universal programming interfaces for easy custom programming.
LabVIEW® and MATLAB	Easy integration of camera into complex experiments.

ProEM-HS shown with lens, sold separately.

Applications:

Single Molecule Detection | Spectroscopy | Chemiluminescence | Astronomy | BEC | Adaptive Optics | Hyperspectral Imaging
Phosphor Imaging | Tomography

SPECIFICATIONS

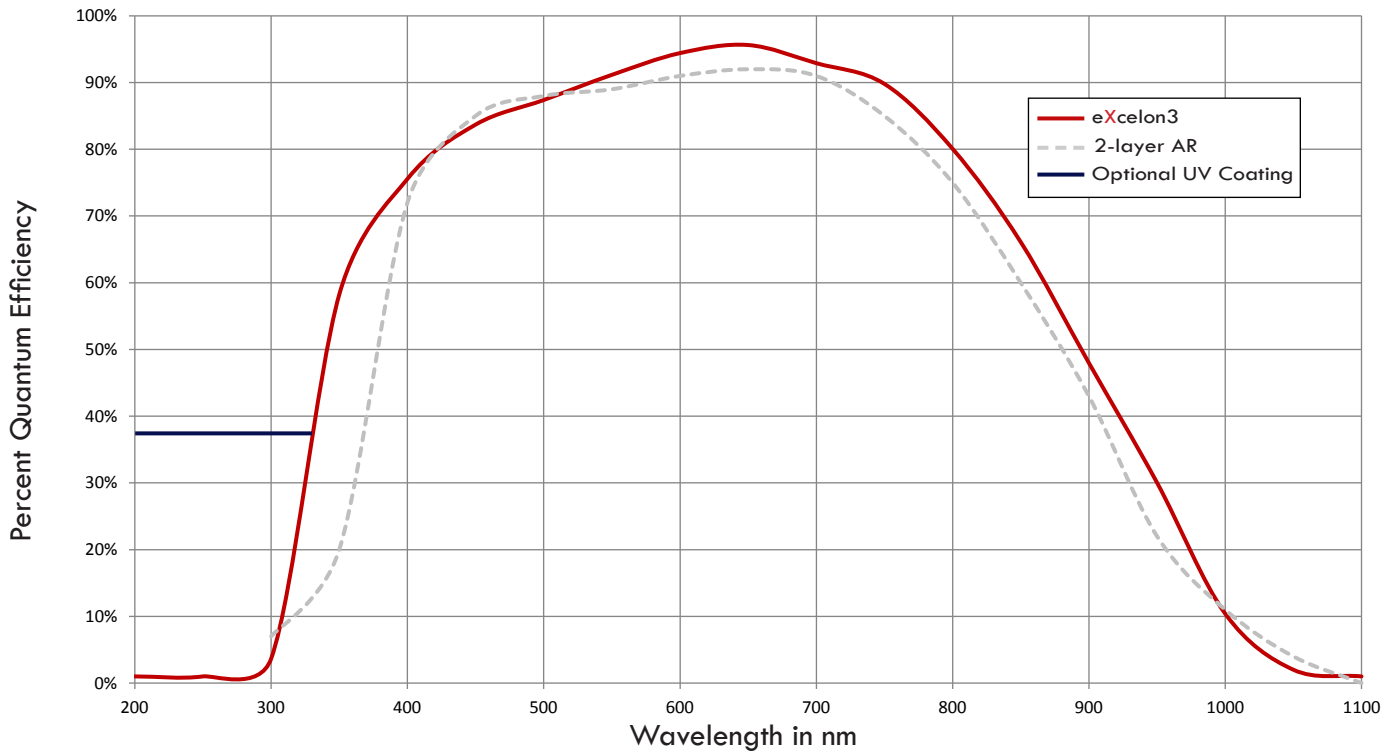
Model	ProEM-HS: 1KBX3-10µm	ProEM-HS:1024BX3
Sensor	Back-illuminated 1024 x 1024 eXcelon3 EMCCD, 10 x 10 µm pixels, 10.2 x 10.2 mm imaging area	Back-illuminated 1024 x 1024 eXcelon3 EMCCD, 13 x 13 µm pixels, 13.3 x 13.3 mm imaging area
Shutter	25 mm shutter included	25 mm shutter included
ADC Speed	5, 10, 20, 30 & 36.67 MHz (EM mode)	5, 10, 20, & 30 MHz (EM mode) 1 MHz & 100 KHz (Normal CCD mode)
Read noise - EM mode (e ⁻ rms)	5 MHz 20 e ⁻ (< 1 e ⁻)* 10 MHz 26 e ⁻ (< 1 e ⁻)* 20 MHz 40 e ⁻ (< 1 e ⁻)* 30 MHz 80 e ⁻ (< 1 e ⁻)*	5 MHz 30 e ⁻ (< 1 e ⁻)* 10 MHz 40 e ⁻ (< 1 e ⁻)* 20 MHz 80 e ⁻ (< 1 e ⁻)* 30 MHz 130 e ⁻ (< 1 e ⁻)*
* Effective read noise with on chip multiplication gain enabled.		
Read noise - Normal CCD mode (e ⁻ rms)	n/a	100 KHz 3.5 e ⁻ 1 MHz 4.0 e ⁻
Frame Rate	30 fps at 1Kx1K; >4,800 fps @ High Speed mode; >119,000 sps Spectra-Kinetics mode	25 fps at 1Kx1K; >4,800 fps @ High Speed mode; >300,000 sps Spectra-Kinetics mode
Linear full well - EM mode only	>150 ke ⁻ (output amplifier)	>500 ke ⁻ (output amplifier)
Linear full well EM and normal CCD modes	30 ke ⁻ (single pixel)	80 ke ⁻ (single pixel)
Deepest cooling temperature*	-70°C +/- 0.05°C @ +20°C ambient; 5 MHz ADC	-55°C +/- 0.05°C (guaranteed) @ +20°C ambient; 10MHz ADC Maximum Cooling: -65°C (air), -65°C (+20°C liquid)
Dark current	0.002 e ⁻ /p/sec (typical) @ -70°C	0.002 e ⁻ /p/sec (typical), 0.04 e ⁻ /p/sec (maximum) @ -55°C
Vertical shift rate	800 nsec/row (variable)	700 nsec/row - 5 µsec/row (variable)

Clock induced charge (CIC) <i>Measured at 1000x EM Gain</i>	0.02 e ⁻ /pixel/frame
Electron multiplication (EM) gain	1 to 1000x, controlled in linear, absolute steps
Trigger modes	External Trigger, Bulb Mode, Shift per Trigger, Single Trigger
I/O signals	Exposure, Readout, Trigger In, Image Shift, Waiting for Trigger
Operating environment	0 to 30°C ambient, 0 to 80% relative humidity, non-condensing
Certification	CE
Dimensions / Weight	8.02 inches (20.37 cm) x 6.79 inches (17.24 cm) x 5.8 inches (14.73 cm) L x W x H Approximately 9.2 lbs (4.2 kg)

* Due to increased thermal dissipation, a higher sensor temperature control point must be set at 36.67 MHz and 30 MHz or in high speed readout modes.

NOTE: All specifications are typical and are subject to change without notice.

QUANTUM EFFICIENCY CURVE



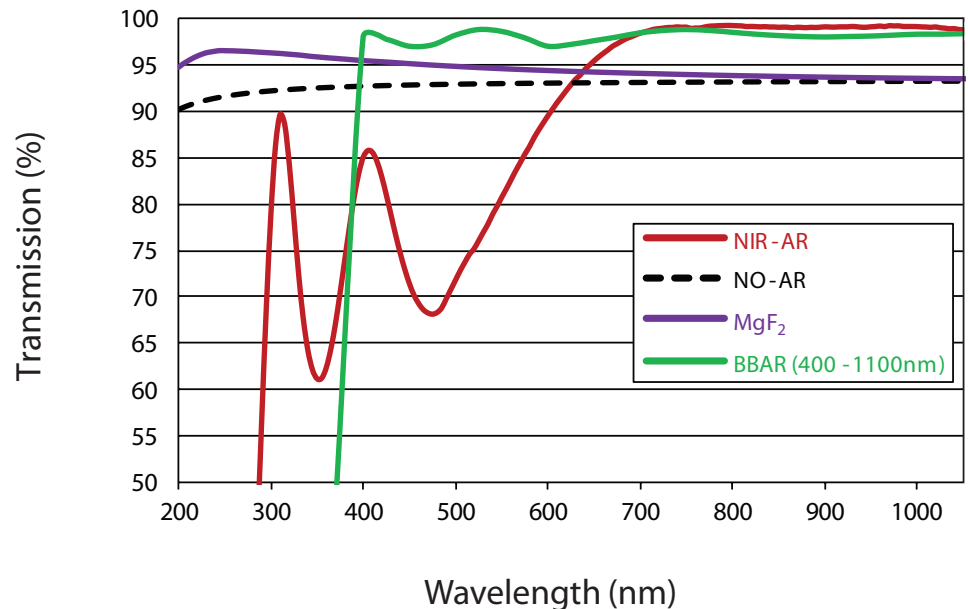
NOTE: Graph shows typical Quantum Efficiency (QE) data measured at + 25° C. Quantum Efficiency is a function of temperature and actual results will depend upon CCD temperature.

VACUUM WINDOW AR COATINGS

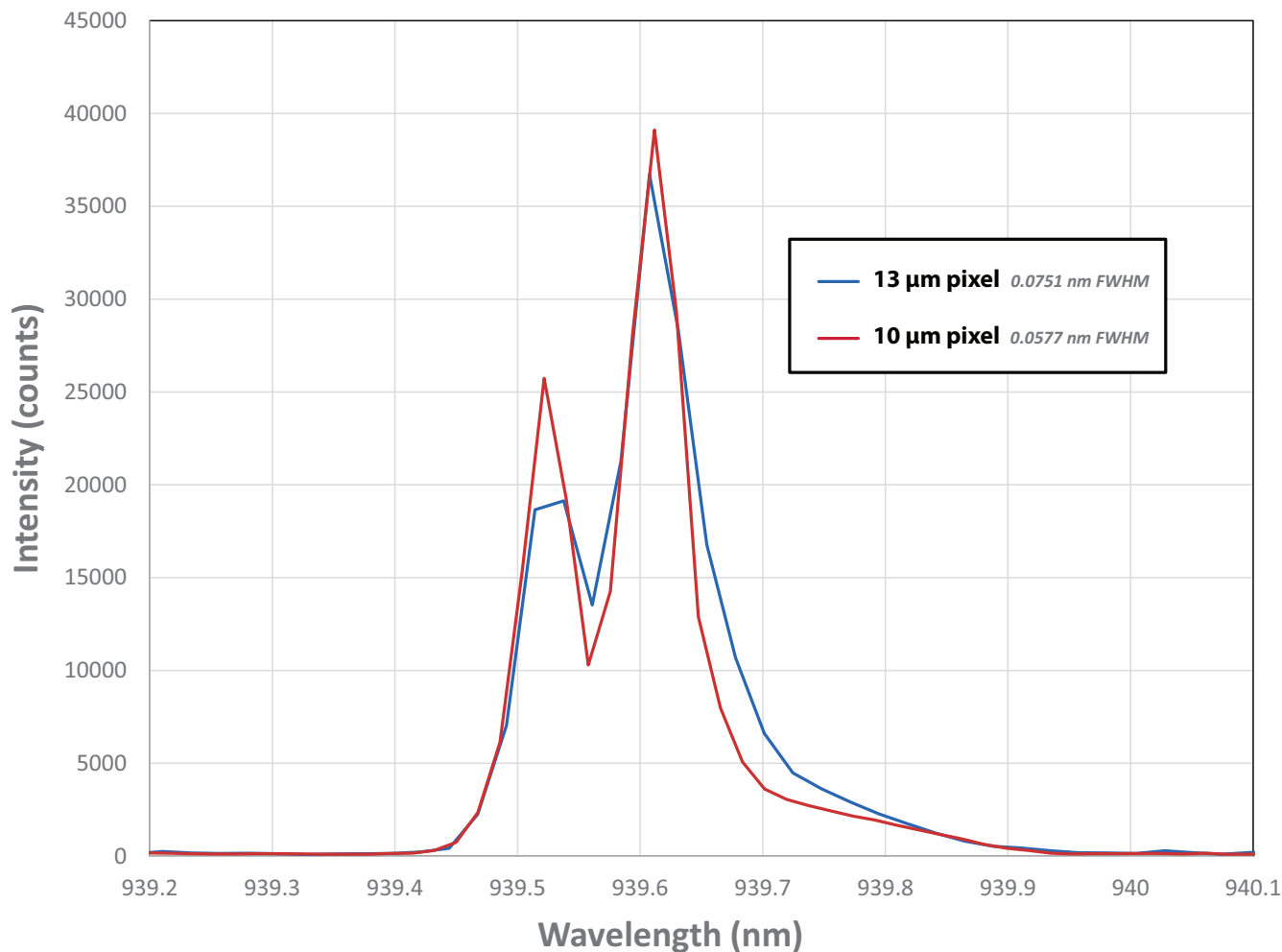
NOTES:

- Standard anti-reflection (AR) coating options shown on graph
- Designed by Acton Optics, our BBAR coating offers unmatched performance for 400 nm - 1100 nm
- Custom wedge window options and other AR coatings are also available

Contact your local sales engineer for more information

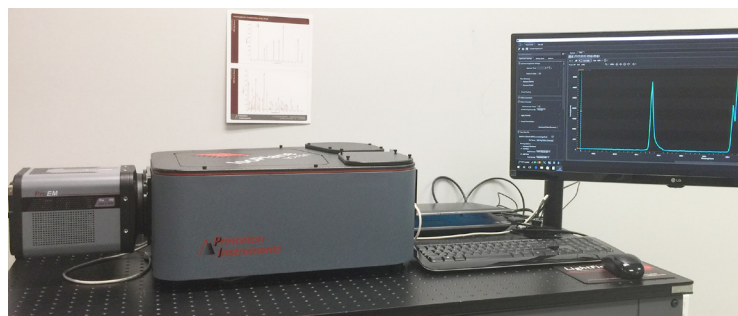


Resolution Comparison – 10 μm pixel vs. 13 μm pixel



Experimental conditions:

Atomic emission lines were acquired using the Princeton Instruments IsoPlane-320 imaging spectrograph with 10 μm wide slits and a 1200 gr/mm grating.



The ProEM-HS:1KBX3-10 μm camera features 10x10 μm pixels for improved spatial and spectral resolution. For spectroscopic applications, the IsoPlane-320 is the only spectrograph that can take full advantage of 10 μm pixel resolution due to totally aberration-free design. The graph above shows a comparison of spectra taken with 13x13 μm pixels vs. smaller pixels in the ProEM-HS:1KBX3-10 μm camera. With 10 μm pixel camera, the IsoPlane-320 achieved a 23% improvement in spectral resolution. The ProEM-HS:1KBX3-10 μm and IsoPlane spectrographs are ideal for microspectroscopy applications.

PROEM-HS:1KBX3-10μM FRAME RATES

Frame Rates - Standard Mode (fps)

Binning	1024 x 1024	512 x 512	256 x 256	128 x 128	64 x 64	1024 x 100	1024 x 32	1024 x 1
	fps	fps	fps	fps	fps	fps	fps	fps
1 x 1	30	56	103	175	268	207	366	546
2 x 2	56	103	175	268	366	303	446	
4 x 4	103	176	268	366	446	398	502	

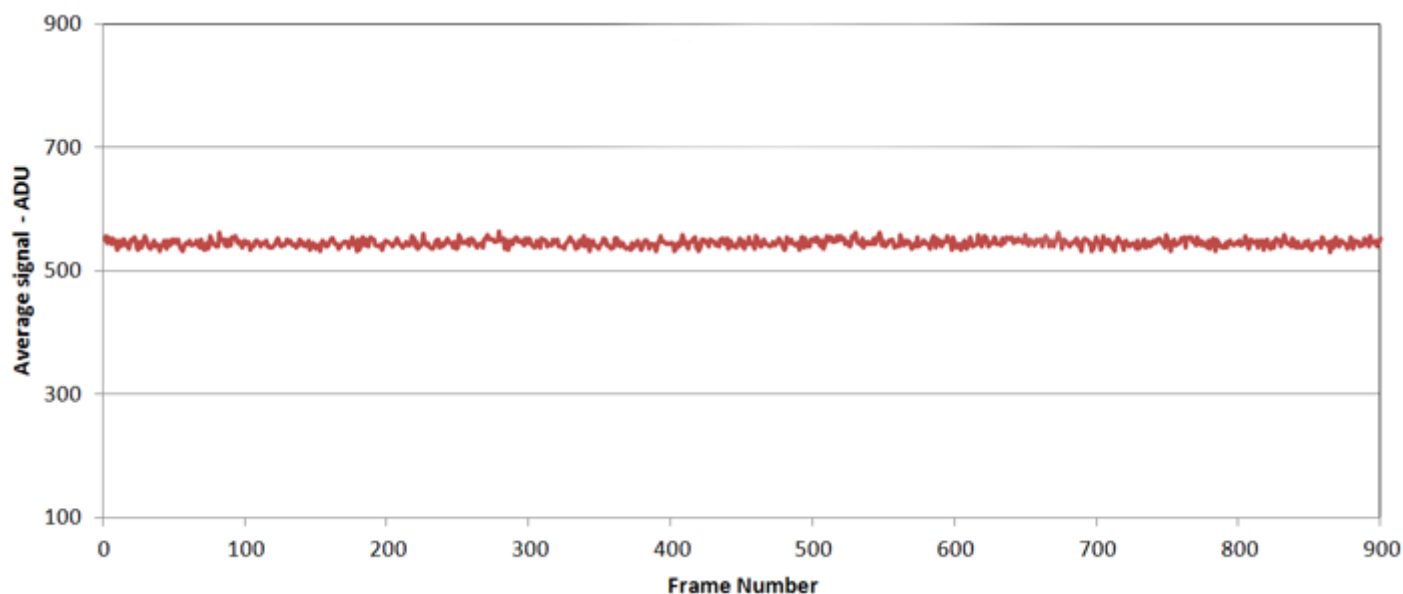
Frame rates are measured with 36.67 MHz ADC rate and 800 ns vertical shift rate and 1 ms exposure time

Frame Rates - High Speed Camera Mode (Bias correction and continuous cleans OFF)

Binning	536 x 343	260 x 204	120 x 103	32 x 30		Binning	1024 x 100	1024 x 32	1024 x 1
	fps	fps	fps	fps			Spectra/s	Spectra/s	Spectra/s
1 x 1	159	450	1272	4830		1 x 100	8196		
2 x 2	290	763	1953	5970		1 x 10		19531	
4 x 4	495	1176	2631	6779		1 x 1			22727

Frame rates are measured with 36.67 MHz ADC rate, 800 ns vertical shift rate and 1 μs exposure time

Baseline Stability at Maximum EM Gain, Measured at 10 MHz and 1.2 μsec



PROEM-HS:1024BX3 FRAME RATES

Frame Rates - Standard Mode (fps)

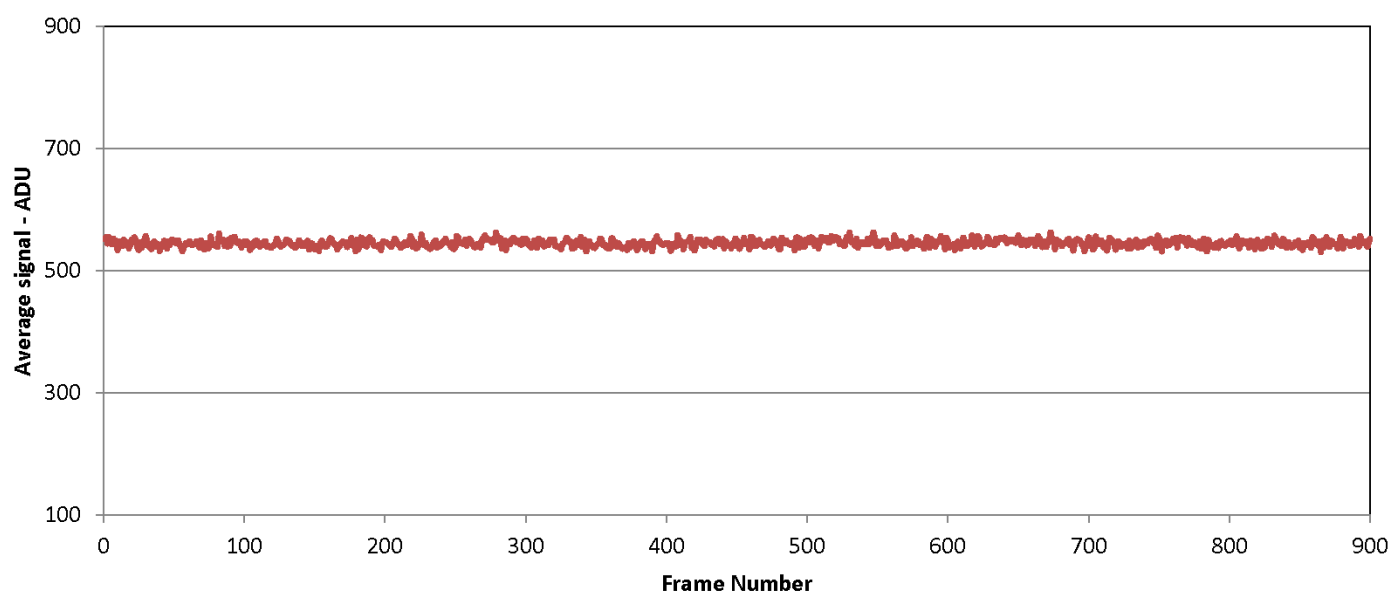
Binning	1024 x 1024	512 x 512	256 x 256	128 x 128	64 x 64	1024 x 100	1024 x 32	1024 x 1
1 x 1	25	48	89	154	244	215	481	1117
2 x 2	48	89	154	244	345	358	675	
4 x 4	89	154	244	346	435	536	847	

Frame rates are measured with 30 MHz ADC rate and 700 ns vertical shift rate

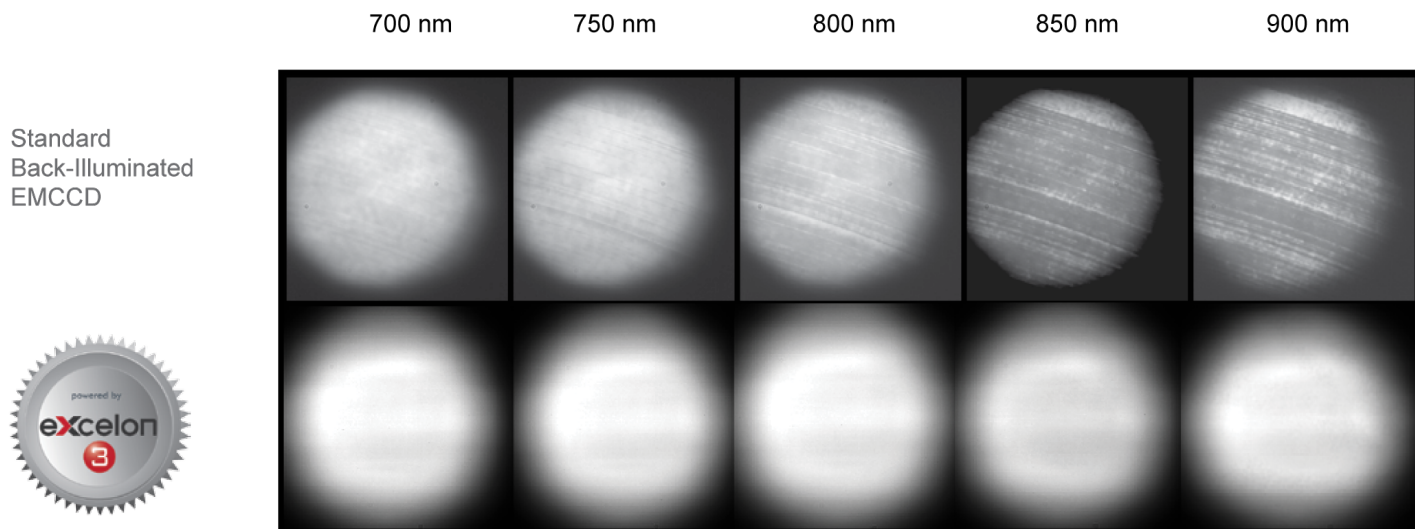
Frame Rates - High Speed Camera Mode (fps)

Binning	504 x 343	236 x 203	100 x 106	32 x 27	Binning	1024 x 100	1024 x 10	1024 x 1
1 x 1	138	403	1162	4444	1 x 100	8474		
2 x 2	256	694	1818	5747	1 x 10		18315	
4 x 4	446	1123	2564	6756	1 x 1			20745

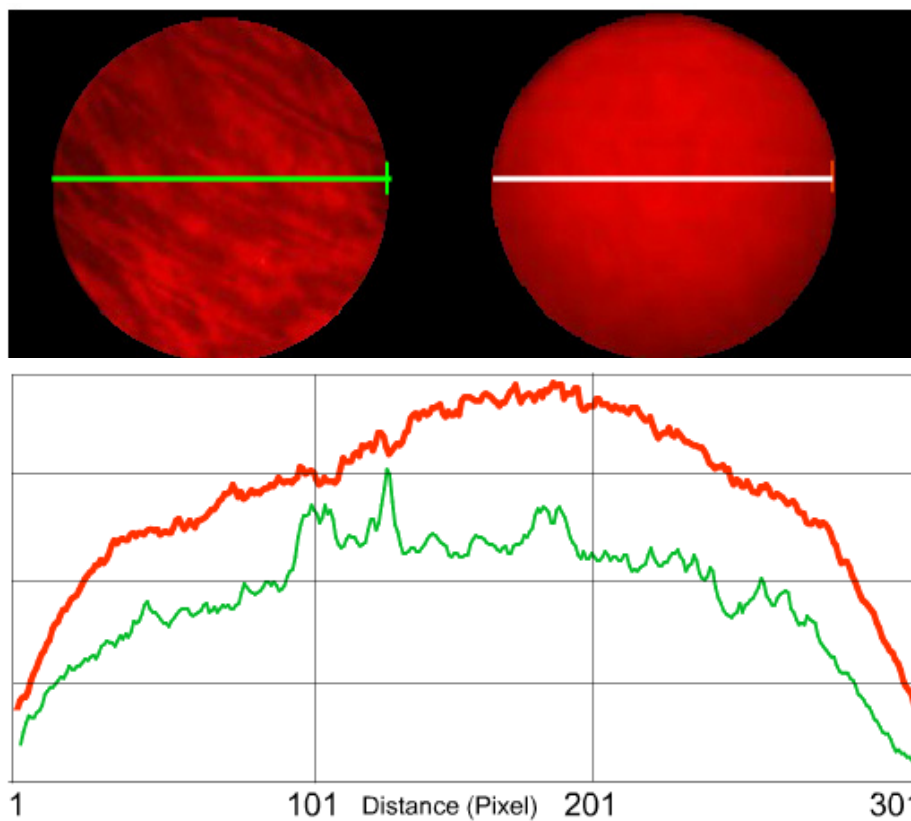
Baseline Stability at Maximum EM Gain, Measured at 10 MHz and 1.2 μ sec



eXcelon3 PERFORMANCE



Data taken with white light source through a monochromator comparing fringe suppression of eXcelon vs. conventional back-illuminated EMCCDs.



EMCCD etaloning: Comparison of Competition vs. eXcelon3 Back-Illuminated EMCCD



Image shows the reduction in etaloning provided by eXcelon3 back-illuminated EMCCDs (right) compared to less-sophisticated back-illuminated EMCCD designs (left).

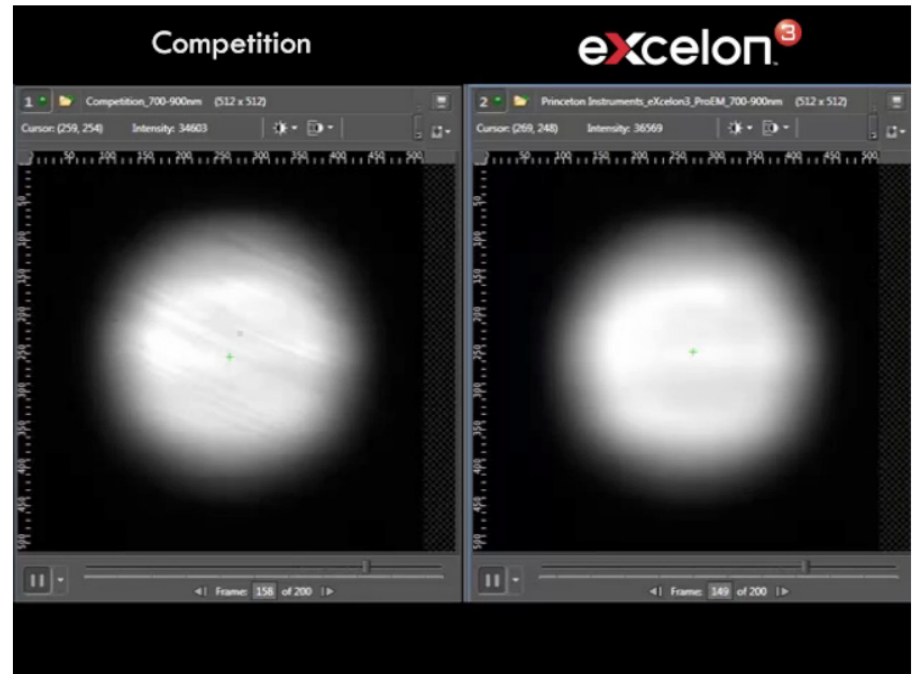
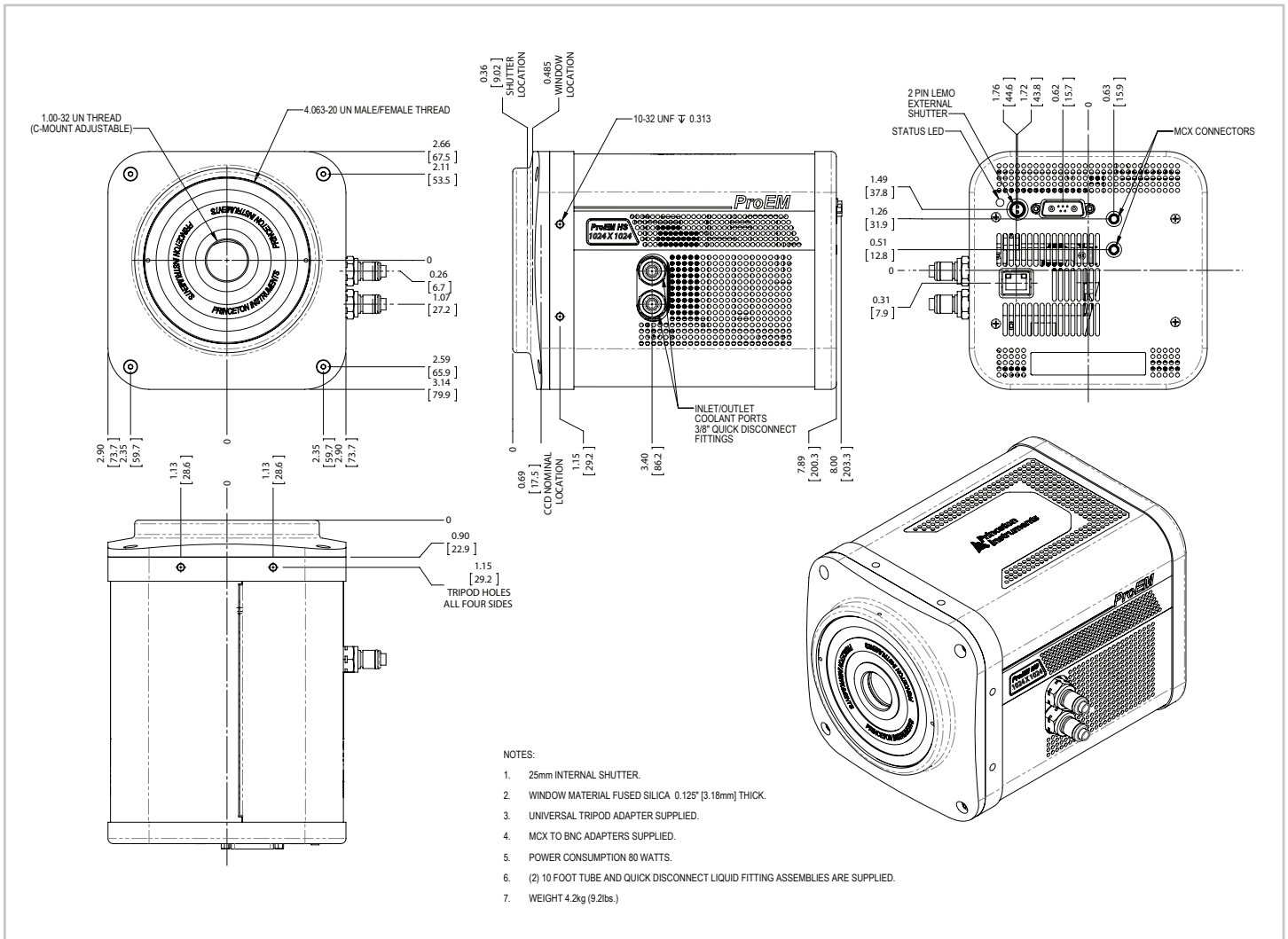
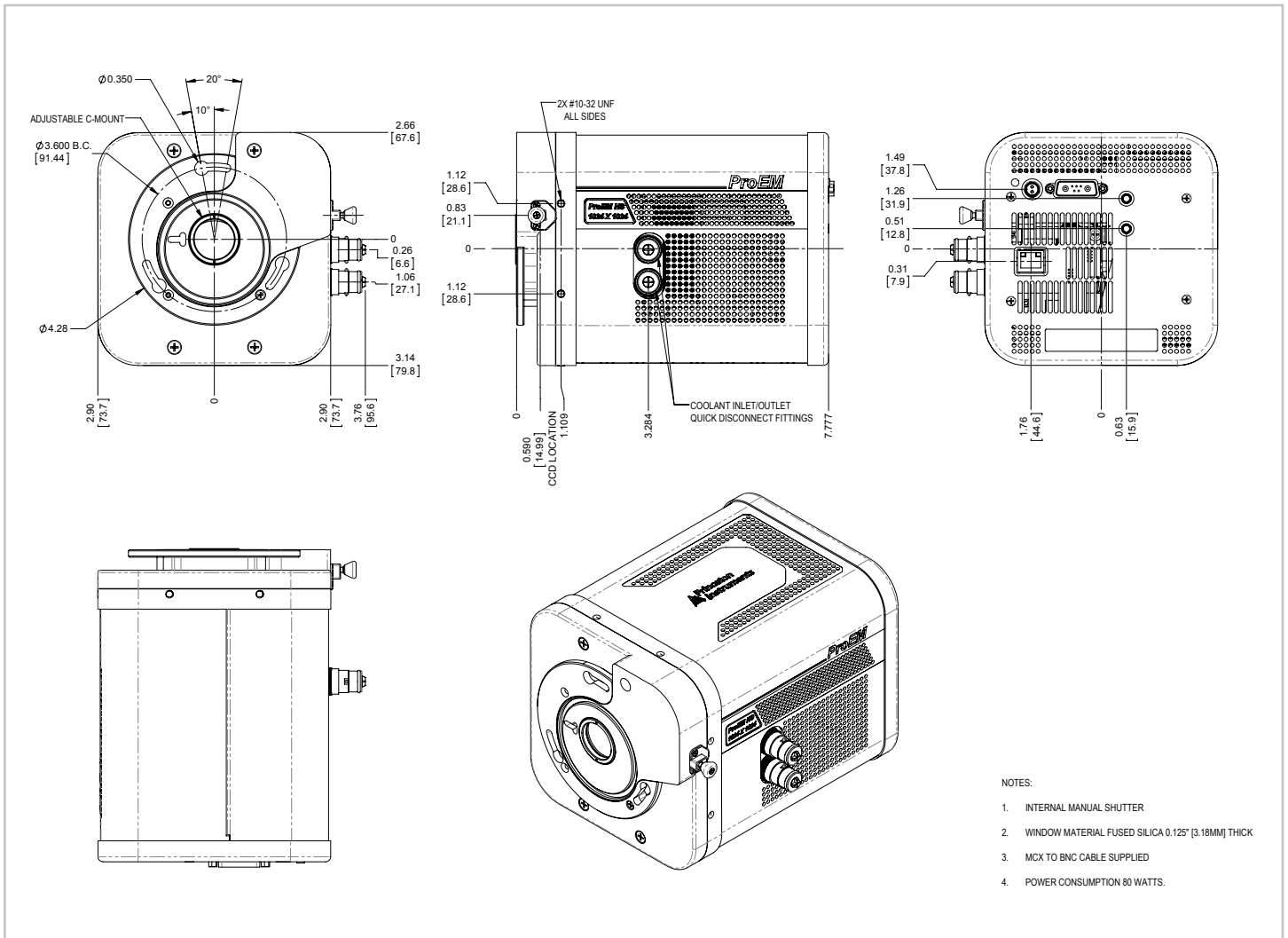


Image shows the reduction in etaloning provided by eXcelon3 back-illuminated EMCCDs (right) compared to less-sophisticated back-illuminated EMCCD designs (left).

OUTLINE DRAWING WITH C MOUNT



OUTLINE DRAWING FOR SPECTROSCOPY





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ProEM®+:1600



The ProEM+: 1600 EMCCD cameras from Princeton Instruments are the most advanced spectroscopy EMCCD cameras on the market. **The 1600 x 200 and 1600 x 400 format sensors, featuring PI's exclusive eXcelon®3 technology, provide the lowest etaloning in the NIR, and enhanced QE in blue and red.** These cameras feature a high speed Electron Multiplying (EM) mode to capture fast kinetics as well as a normal CCD mode with very low read noise for precision photometry. The ProEM+: 1600²/1600⁴ cameras are deep cooled using either air or liquid, while the all metal, hermetic vacuum seals are warranted for life – the only such guarantee in the industry. Both models feature the latest Gigabit Ethernet (GigE) interface to allow remote operation over a single cable without the need for custom frame grabbers.

FEATURES	BENEFITS
eXcelon3 technology	Higher QE in the UV and near IR regions; extremely low etaloning
1600 x 200 and 1600 x 400 format	16 µm pixels for high spectral resolution
Electron multiplication (EM) gain	Amplify weak signals above the read noise floor
OptiCAL	Linear, absolute EM gain calibration using built in precision light source
Improved BASE correction routine	Baseline Active Stability Engine: Bias correction ensures a flat and highly stable baseline for quantitative measurements
Deep thermoelectric cooling with air or liquid recirculation	Minimizes dark current, allowing long exposure times. Use convenient forced-air cooling or liquid cooling for vibration-sensitive environments
Single fused silica vacuum window	Minimizes reflection losses from the UV to the NIR; Optional AR coating and wedge windows are available
Dual readout modes	Individually optimized signal chains for a true 2-in-1 camera configuration, for high speed (EM mode) or long integration (normal CCD mode) applications
Readout rates of 1, 4 and 8 MHz in EM mode	Acquire spectral data at over 4000 frames per second
100 kHz readout	Low noise register provides conventional CCD readout when EM gain is not needed
Ultralow binned read noise	Negligibly increases noise, unlike in CMOS detectors
Gigabit Ethernet (GigE)	Reliable data transmission over 50 m for remote operation
Standard spectroscopy flange mount	Easily mounts to IsoPlane, Acton Series, and many other spectrometers
Optional: LightField® (for Windows 8/7, 64-bit) Or WinView/Spec (for Windows 8/7/XP, 32-bit)	Flexible software packages for data acquisition, display and analysis; LightField offers intuitive, cutting edge user interface, IntelliCal® and more.
PICAM (64-bit) / PVCAM (32-bit) software development kits (SDKs)	Compatible with Windows 8/7/XP, and Linux; Universal programming interfaces for easy custom programming.
LabVIEW® and MATLAB®	Easy integration of camera into complex experiments.
Ultra-low correlated noise	Strategic circuit design minimizes non-random noise in spectra and images

Applications:

Scanning Confocal Spectroscopy, Hyperspectral Imaging and Single Molecule Spectroscopy

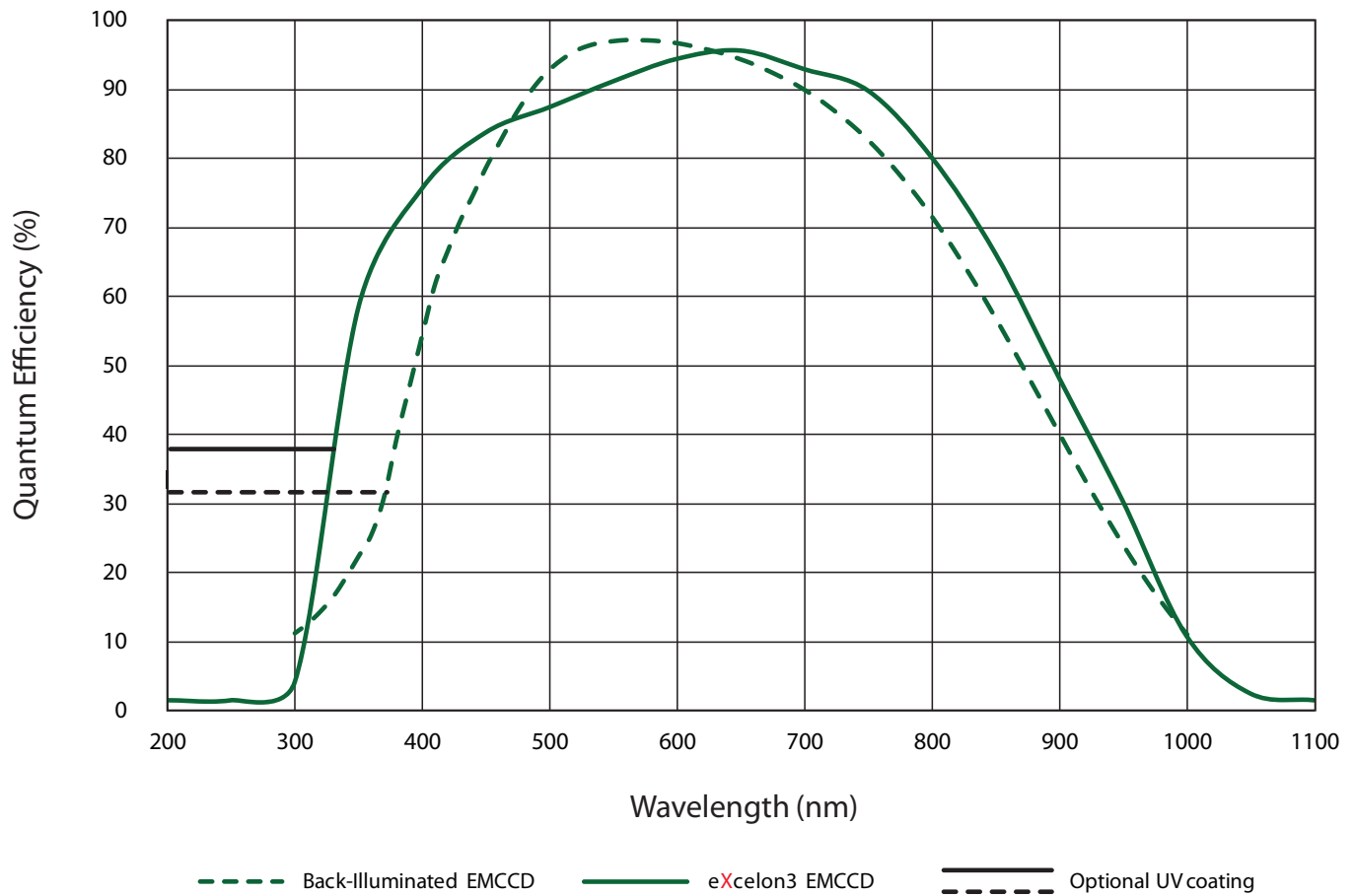
SPECIFICATIONS

	ProEM+: 1600 ² eXcelon3 		ProEM+: 1600 ⁴ eXcelon3 	
Sensor Format	Back-illuminated EMCCD with eXcelon3 technology. 3.2 mm sensor height for high-speed data acquisition.		Back-illuminated EMCCD with eXcelon3 technology. 6.4 mm sensor height for multiple-ROI spectroscopy with fiber bundles.	
CCD format	1600 X 200, 16 µm pixels 25.6 X 3.2 mm (optically centered)		1600 X 400, 16 µm pixels 25.6 X 6.4 mm (optically centered)	
	EM mode		Low noise mode	
Read noise*	15 e- rms @ 1 MHz 27 e- rms @ 4 MHz 75 e- rms @ 8 MHz Read noise effectively reduced to <1 e- rms with on-chip multiplication gain enabled		4 e- rms @ 100 kHz 7 e- rms @ 1 MHz	
Spectrometric well capacity*	350 ke-		200 ke-	
Nonlinearity	<1% (≤ 1 MHz) <2% (4 & 8 MHz)		<1% (≤ 1 MHz)	
Operating temperature (@ +20° C ambient)	-60° C guaranteed (air); -75° C typical (liquid cooling with CoolCube recirculator)			
Dark current*	< 0.01 e/p/s at -60° C			
Clock-induced charge (CIC) (typical)	< 0.02 e/p/frame (2 or 3 µs vertical shift @ 8 MHz ADC)			
Electron multiplication (EM) gain	1 to 1000x, controlled in linear, absolute steps			
Digitization	16 bits			
Vertical shift rate	1600 ² : 2 or 3 µs/row (optimized for EM); 4 or 6 µs/row (optimized for LN) 1600 ⁴ : 3 or 4 µs/row (optimized for EM); 5 or 6 µs/row (optimized for LN)			
Spectral rate @ 8 MHz	1600 ² Full Vertical Bin: 1150 fps Custom chip 20 rows binned: 2150 fps 1600 ⁴ Full Vertical Bin : 600 fps Custom chip 20 rows binned: 2050 fps Single row: 4500 fp			
Binning	Flexible binning in vertical, and 2x to 32x in horizontal			
Operating systems supported	Windows 8/7 (64-bit) and Linux (64-bit), Windows 8/7/XP (32-bit)			
I/O signals	Exposure, Readout, Trigger In, Trigger Out, Waiting for Trigger			
Operating environment	+5 to +30° C ambient, non-condensing atmosphere			
Data interface	Gigabet Ethernet (GigE)			
Dimensions Weight	7.93 inches (20.15 cm) x 6.70 inches (17.02 cm) x 5.8 inches (14.73 cm) L x W x H Approximately 9.2 lbs (4.2 kg)			
Software-selectable gains - Low noise amplifier - Electron multiplication amplifier	High 1 e-/ct 2.5 e-/ct	Medium 2 e-/ct 5 e-/ct	Low 4 e-/ct 10 e-/ct	

All specifications subject to change.

* Typical

QUANTUM EFFICIENCY CURVE

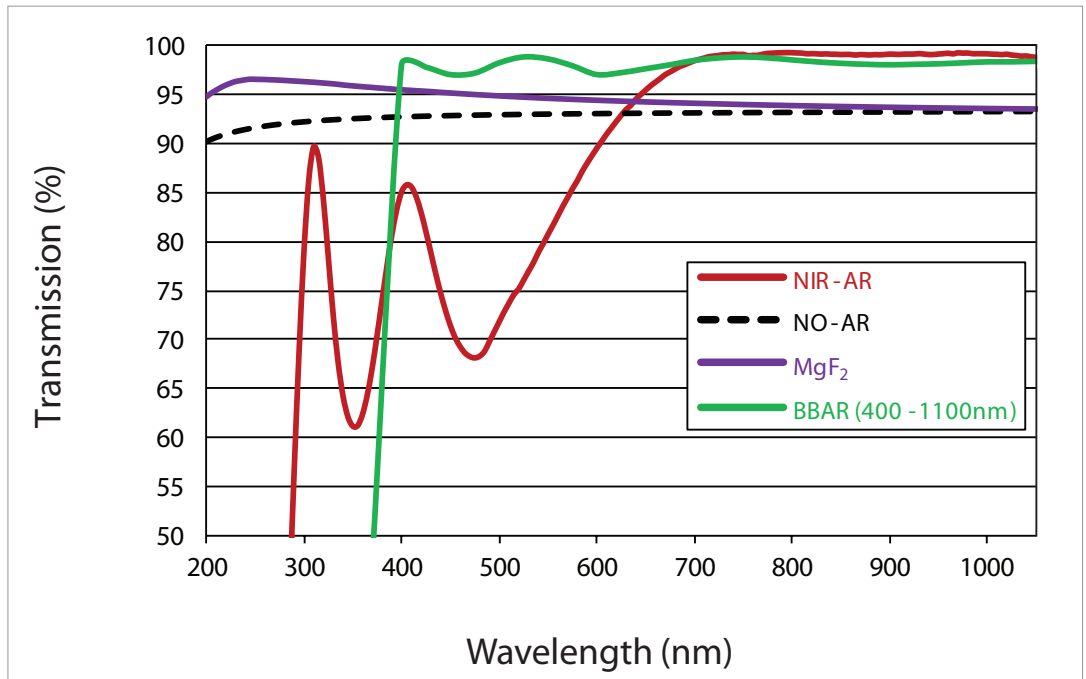


NOTE: Graph shows typical Quantum Efficiency (QE) data measured at + 25°C, representing expected performance at this temperature. QE will be lower at operating temperature. For the best results for your application, please discuss the specific parameters of your experiment with your sales representative.

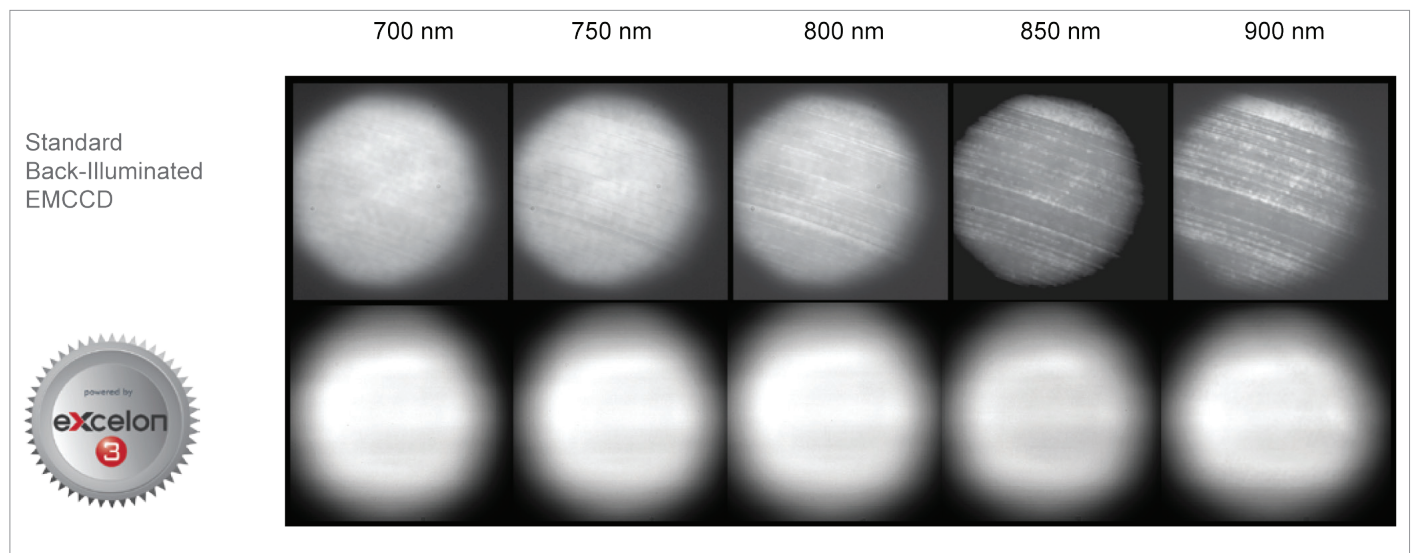
VACUUM WINDOW AR COATINGS

NOTE:

Standard anti-reflection (AR) coatings shown. Custom AR coatings and wedge window options are also available. Contact your local sales representative for more information.



eXcelon PERFORMANCE



Data taken with white light source through a monochromator comparing etaloning performance of eXcelon vs conventional back-illuminated EMCCDs.

OUTLINE DRAWING WITH SPECTROSCOPY MOUNT

