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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 MATLABI®	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-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 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

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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) * Effective read noise with on chip multiplication gain enabled.	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⁻)*
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) *Measured at 1000x EM Gain*	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.

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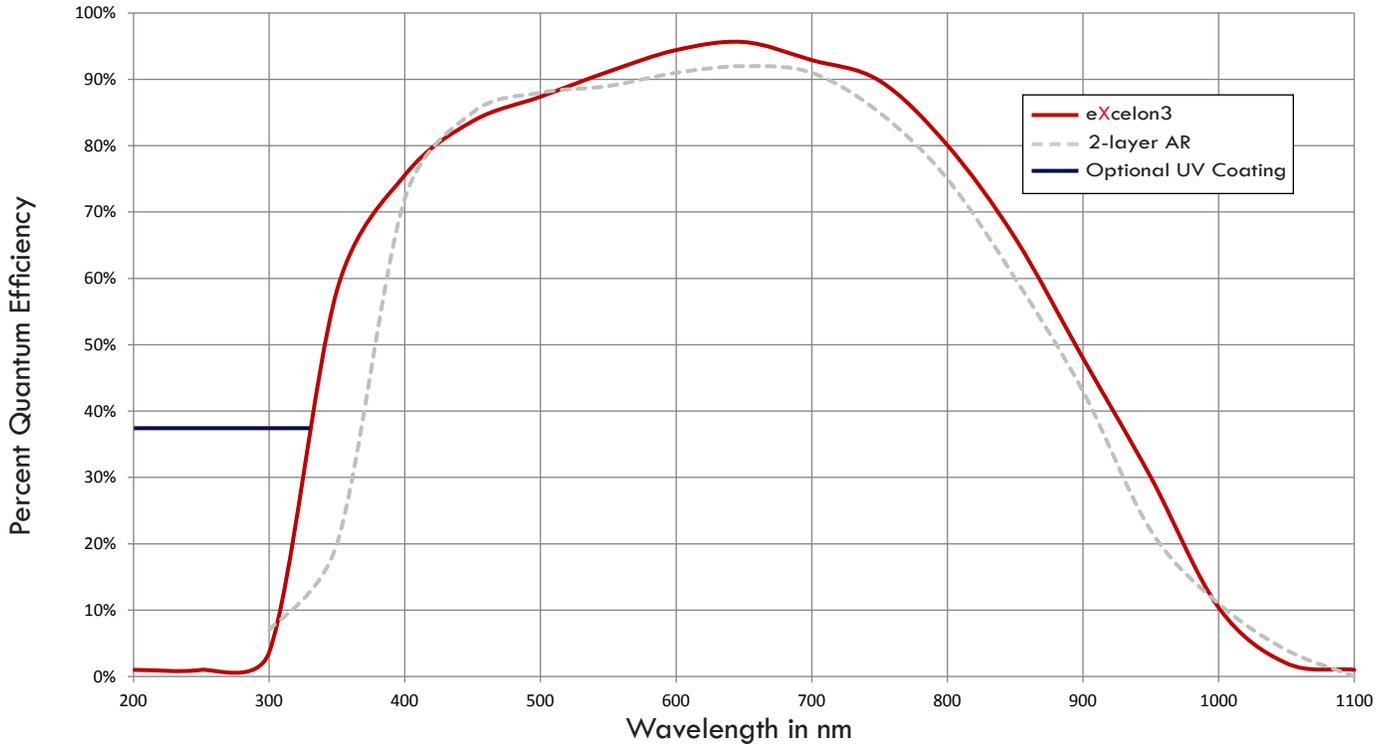
NOTE: Graph shows typical Quantum Efficiency (QE) data measured at + 25° C. Quantum Efficiency is a function of temperature and actual results will depend upon CCD temperature.

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

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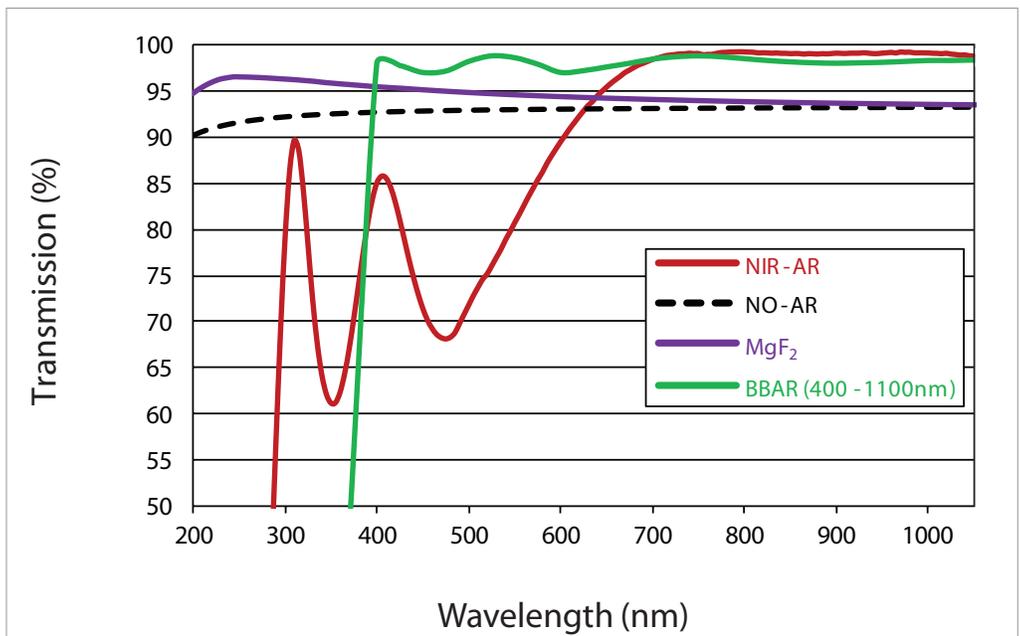
Resolution Comparison – 10 μm pixel vs. 13 μm pixel
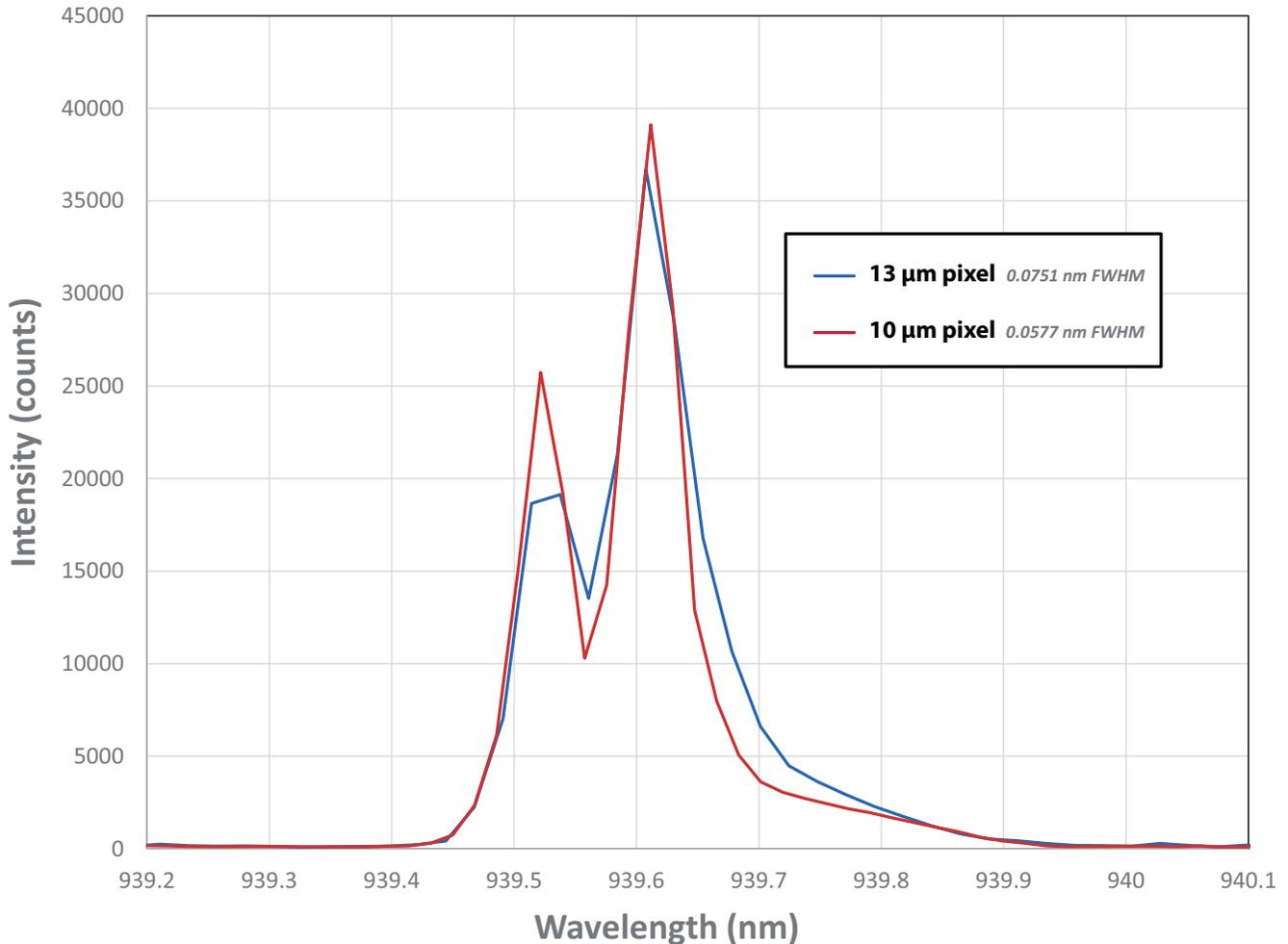
Experimental conditions:

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:1KBX3-10μm camera features 10x10μm pixels for improved spatial and spectral resolution. For spectroscopic applications, the IsoPlane-320 is the only spectrograph that can take full advantage of 10μm pixel resolution due to totally aberration-free design. The graph above shows a comparison of spectra taken with 13x13μm pixels vs. smaller pixels in the ProEM-HS:1KBX3-10μm camera. With 10μm pixel camera, the IsoPlane-320 achieved a 23% improvement in spectral resolution. The ProEM-HS:1KBX3-10μm and IsoPlane spectrographs are ideal for microspectroscopy applications.

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
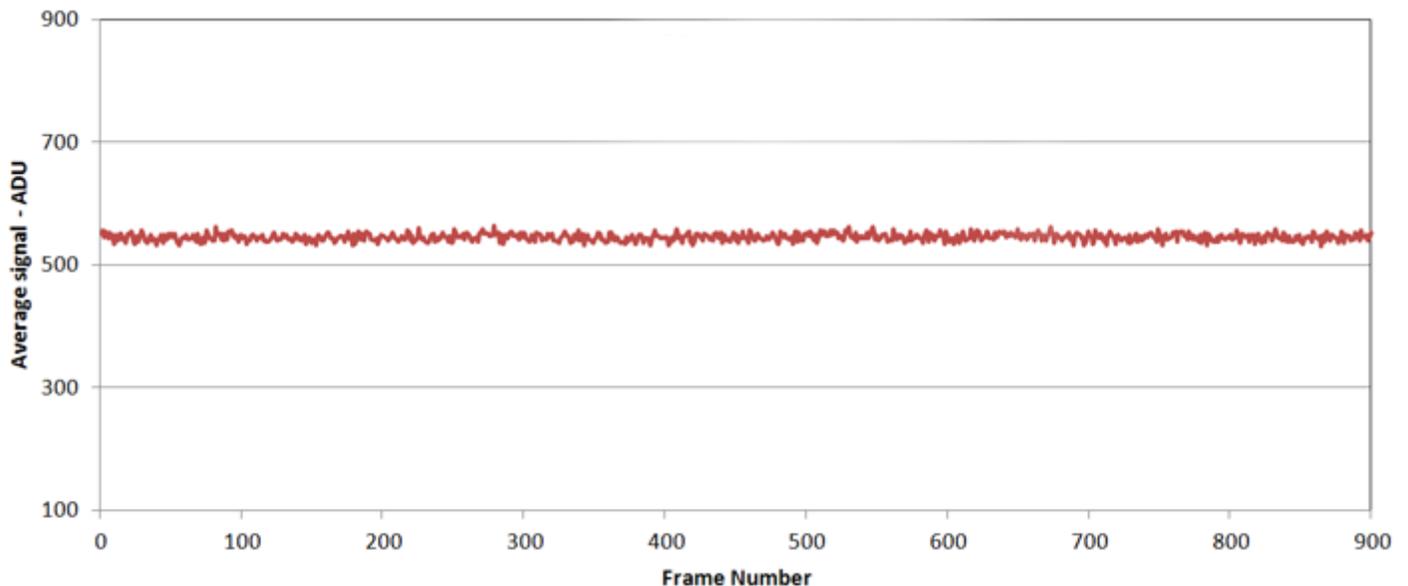
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Frame Rates - Standard Mode (fps)

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 µsec

700 nm	750 nm	800 nm	850 nm	900 nm

**Standard Back-Illuminated EMCCD**
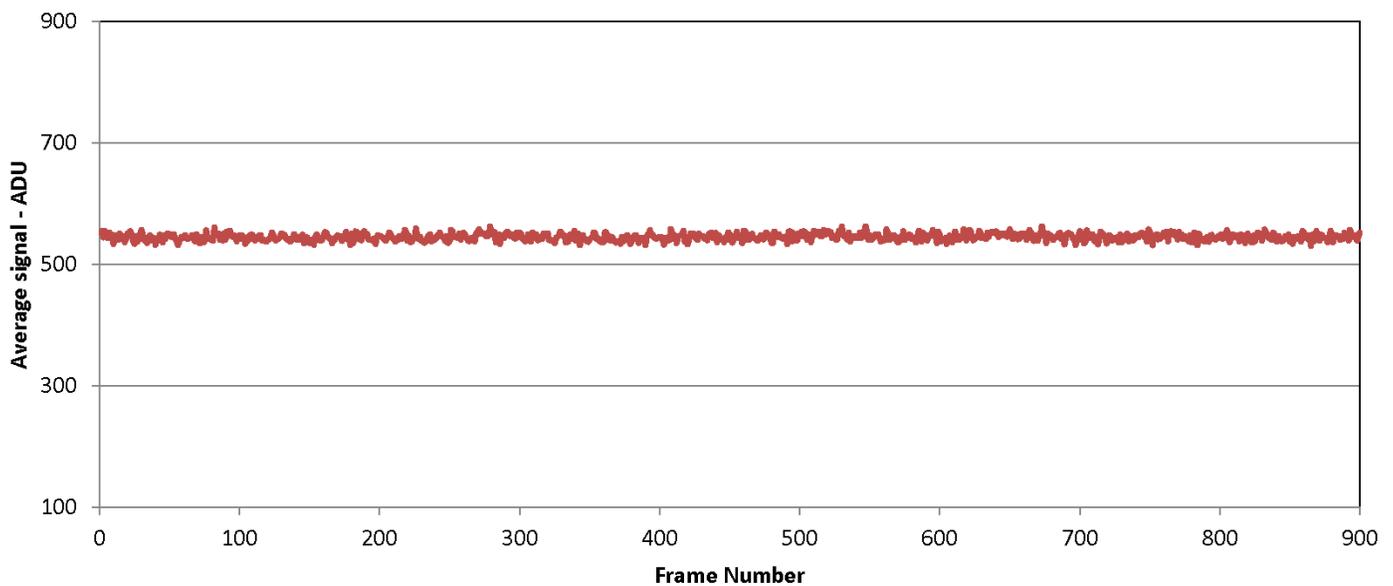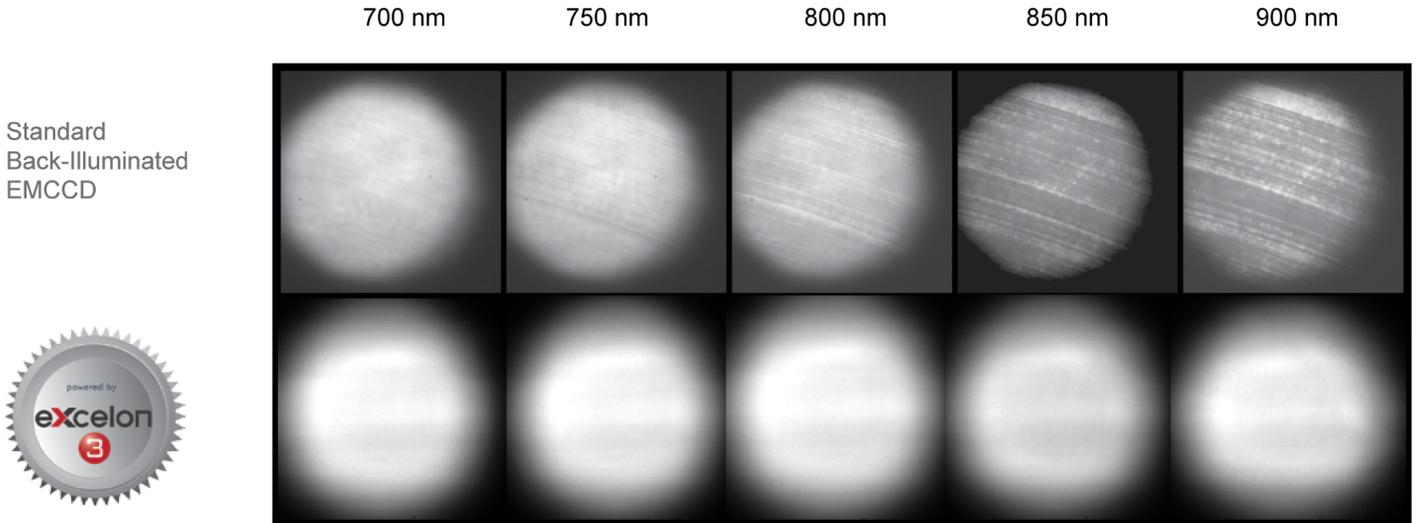
Data taken with white light source through a monochromator comparing fringe supression of eXcelon vs. conventional back-illuminated EMCCDs.

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

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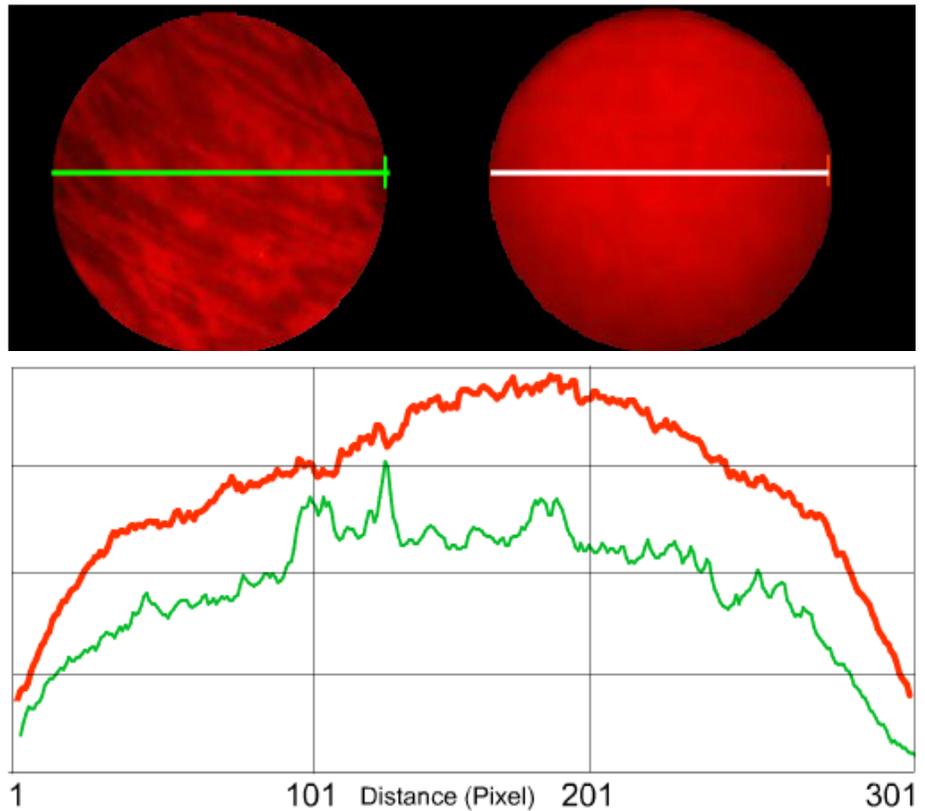
EMCCD etaloning: Comparison of Competition vs. eXcelon3 Back-Illuminated EMCCD
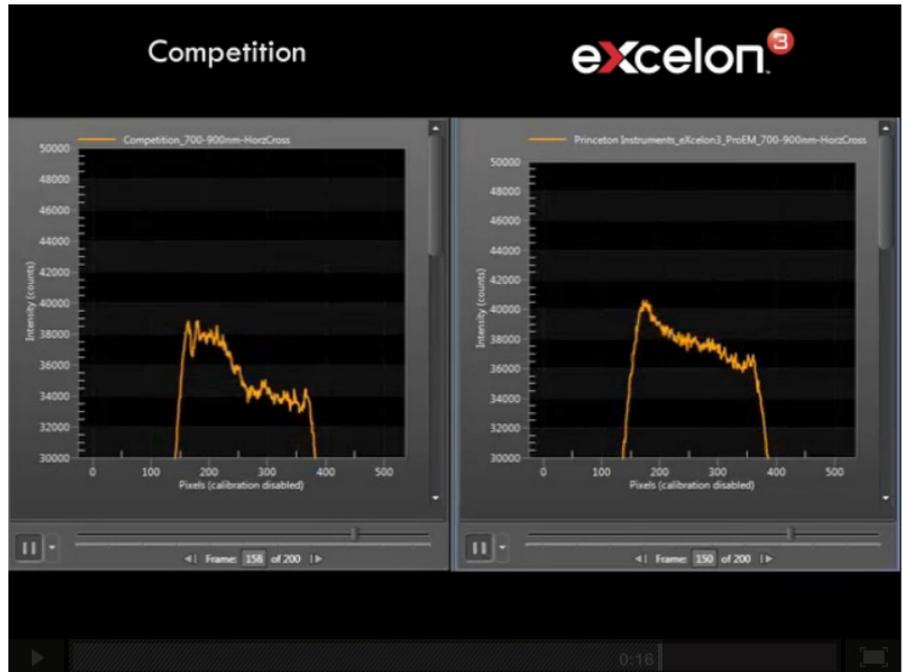
Image shows the reduction in etaloning provided by eXcelon3 back-illuminated EMCCDs (right) compared to less-sophisticated back-illuminated EMCCD designs (left).

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

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NOTES:

1. 25mm INTERNAL SHUTTER.

2. WINDOW MATERIAL FUSED SILICA 0.125" [3.18mm] THICK.

3. UNIVERSAL TRIPOD ADAPTER SUPPLIED.

4. MCX TO BNC ADAPTERS SUPPLIED.

5. POWER CONSUMPTION 80 WATTS.

6. (2) 10 FOOT TUBE AND QUICK DISCONNECT LIQUID FITTING ASSEMBLIES ARE SUPPLIED.

7. WEIGHT 4.2kg (9.2lbs.)

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Ø0.350   20°
10°
ADJUSTABLE C-MOUNT
Ø3.600 B.C. [91.44]
Ø4.28
2.66 [67.6]
0
0.26 [6.6]
1.06 [27.1]
3.14 [79.8]
2.90 [73.7]   2.90 [73.7]   3.76 [95.6]

2X #10-32 UNF ALL SIDES
1.12 [28.6]
0.83 [21.1]
0
1.12 [28.6]
ProEM
COOLANT INLET/OUTLET QUICK DISCONNECT FITTINGS
0
0.590 [14.99]
CCD LOCATION
1.109
3.284
7.777

1.49 [37.8]
1.26 [31.9]
0.51 [12.8]
0
0.31 [7.9]
1.76 [44.6]
0
0.63 [15.9]

NOTES:

1.   INTERNAL MANUAL SHUTTER

2.   WINDOW MATERIAL FUSED SILICA 0.125" [3.18MM] THICK

3.   MCX TO BNC CABLE SUPPLIED

4.   POWER CONSUMPTION 80 WATTS.