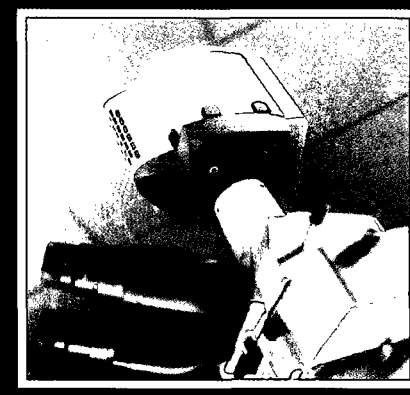
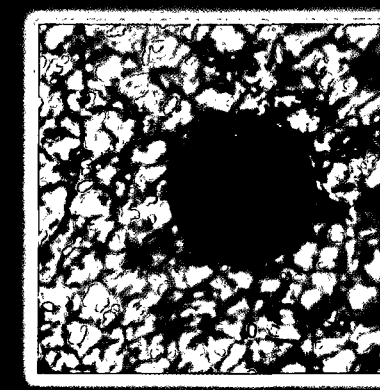
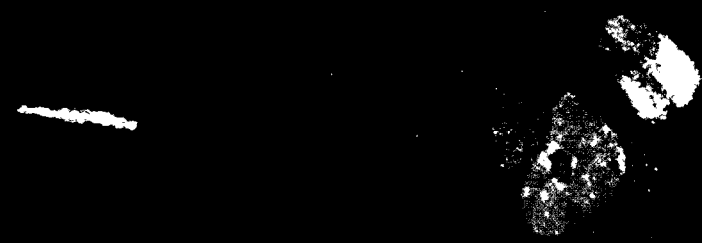
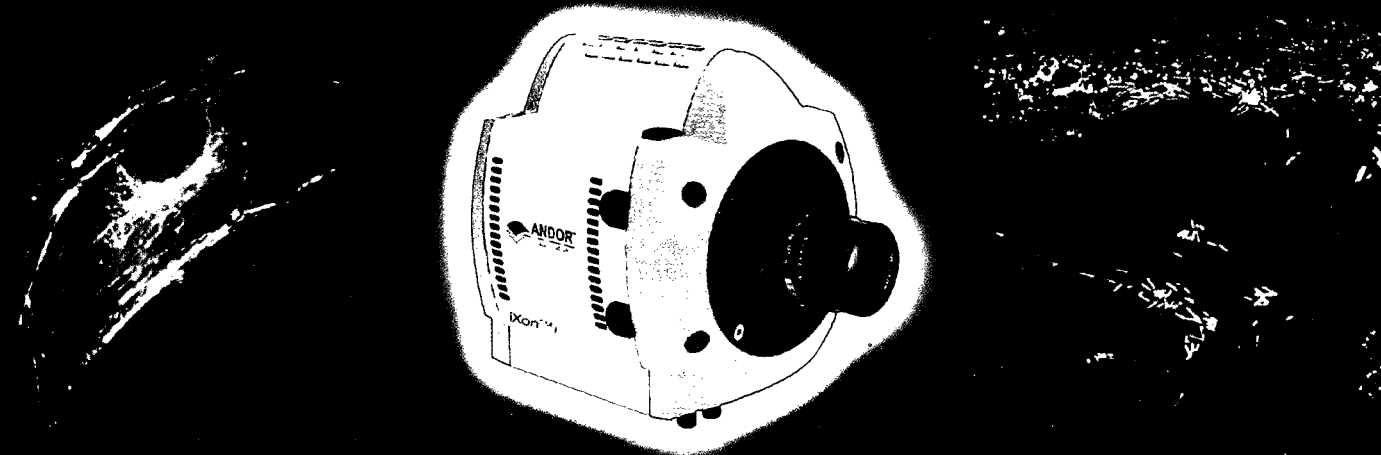


iXon^{EM}+ 885 EMCCD

'High-end, versatile EMCCD performance.. at a distinctly affordable price'







iXon^{EM}+ 885 EMCCD – *'a remarkable all-rounder, at a distinctly affordable price!'*

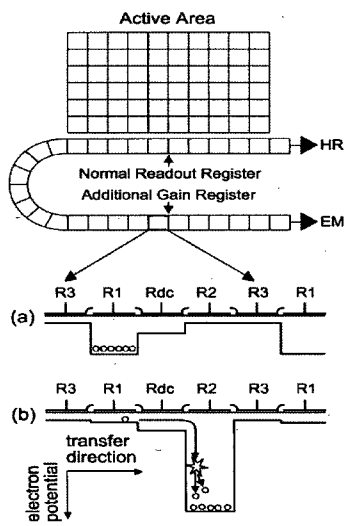
A proud member of the iXon^{EM}+ EMCCD family, the 885 benefits from the unique innovations and high-end performance specifications that have characterized this camera range as the industry's leading high-performance EMCCD.

The Megapixel sensor format and 8 x 8µm pixel size of the 885 presents an ideal combination of field of view and resolution. When more light is available from the sample, the EMCCD gain can be completely switched off and the camera operated as a 'traditional' CCD camera. However if the camera is used in low-light conditions, the EMCCD gain can be applied to render it single photon sensitive, while maintaining a full resolution frame rate of 31 frames/sec.

With single photon sensitivity, great resolution, high 'virtual phase' QE, clean uniform backgrounds, stable baseline technology, exceptionally low darkcurrent, UltraVac™ hermetic vacuum and fast frame rates - all at an affordable price tag – the iXon^{EM}+ 885 deserves serious consideration as a worthy addition to your laboratory.

The EMCCD advantage...

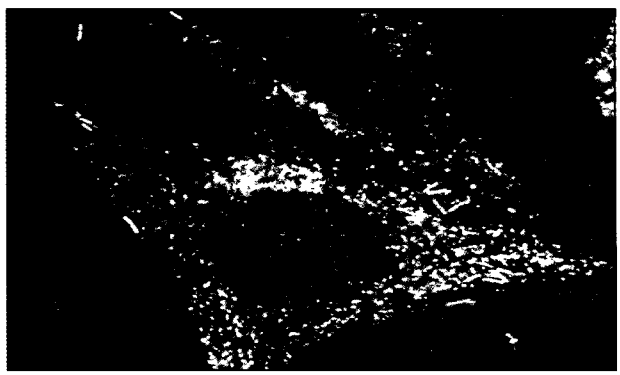
Current trends in photon measurement are placing unprecedented demands on detector technology to perform at significantly higher levels of sensitivity and speed. Electron Multiplying CCD (EMCCD) technology has been designed to respond to this growing need, unlocking new and innovative experimental prospects.
EMCCDs operate by amplifying weak signal events (down to single photons) to a signal level that is well clear of the read noise floor of the camera, at any readout speed.
Importantly, this 'on-chip' amplification process is realized without sacrificing the photon collection capability of the sensor, the iXon^{EM}+ 885 offering an unrestrained 65% $QE_{max.}$



Why upgrade to the iXon^{EM}+ 885?

Quite simply, the 885 sets a new benchmark for the camera performance that you can acquire from your budget, redefining the *'workhorse camera'* price category. The 885 offers an impressive combination of fundamental high-end performance specifications:

EMCCD technology – Outstandingly sensitive single photon detection (even at high speed) and high QE.
Versatility – Uniquely harnessed in the 885 for optimal performance across all light levels.
RealGain™ - Select absolute EM gain direct from a linear and directly quantitative software gain scale. No more arbitrary EM gain units. The EM you ask for is the EM you get!
Small pixel resolution – Run at full pixel resolution for over-sampling. Flexible binning for higher photon capture and S/N.
Vacuum TE cooling performance – unparalleled -85 °C as standard (-95 °C optional).
Fast speed readout – 35MHz readout speed delivers 31 frames/sec at full Megapixel resolution; 60 frames/sec when binned to 16µm pixel size!
Enhanced Quantitative Reliability – Andor's pioneering Baseline Clamp technology provides quantitative reliability throughout and between measurements.
Negligible EM Gain ageing – no requirement for gain recalibration.
Single input window – UltraVac™ process facilitates use of one single input window that is anti-reflectance coated on each side.
Extended-dynamic range capability – With EMCCD technology, the *effective* dynamic range of a measurement can be readily extended through sofware accumulation of rapidly acquired images, *with minimal impact on read noise floor!*
3rd party excellence – Latest advances in comprehensive software and hardware triggering options enable high-speed synchronization with a range of acquisition protocols.
Price/Performance – the new standard in workhorse cameras, making for an ideal upgrade option.



GFP-tagged Listeria HeLa cells expressing the clathrin light chain tagged with fluorescent protein (Tomato). Full resolution, 100ms exposure images, taken with the iXon^{EM}+ 885 integrated into the Andor Revolution confocal spinning disk system, courtesy of Dr. Esteban Veiga, Institute Pasteur, Paris.

Upgrade your lab with more than one 885, or a mix of Andor camera types. Contact Andor to discuss attractive bundle options to suit your lab's needs.

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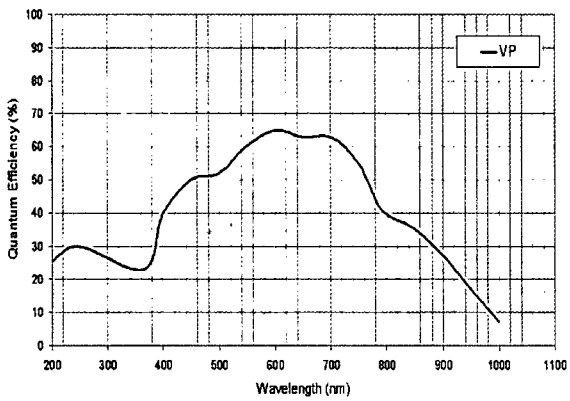
iXon^{EM}+ 885 for the cell microscopist...

Since its pioneering introduction in 2000, Andor's quantitative EMCCD technology has been widely and highly successfully employed by microscopists throughout the world, resulting in an outstanding level of representation in high-profile publications.

The iXon^{EM}+ 885 presents a unique mix of performance features that characterize it as an extremely powerful and versatile camera for fluorescence microscopy. The 8 µm pixels provide for Nyquist over-sampling across a range of objectives, as well as impressive photon collection (> 50% more photon collection area than a 6.45µm pixel size).
The Megapixel frame transfer architecture is read out at up to 35MHz, facilitating readout rates of up to 31 full frames/sec, significantly faster under conditions of sub-array/binning.
The deep-cooled, high QE EMCCD sensor delivers ultra-sensitive detection capability in live cell fluorescence microscopy, facilitating use of lower excitation powers (thereby reducing photobleaching and phototoxicity) and lower dye concentrations. If not operating under ultra-low light or dynamic conditions, the EMCCD gain can be completely switched off, the readout slowed down and the 885 becomes a low noise CCD. No other camera type offers this level of application flexibility.
The comprehensive software and hardware triggering options enable high-speed synchronization with a range of acquisition protocols.

The iXon^{EM}+ 885 is particularly ideal for applications such as live cell microscopy (including confocal), ion signaling, transport/motile imaging and immunofluorescence microscopy.

The unique price, performance and versatility of the iXon^{EM}+ 885 makes it a highly attractive choice of Megapixel 'workhorse' laboratory camera with which to upgrade existing set-ups.



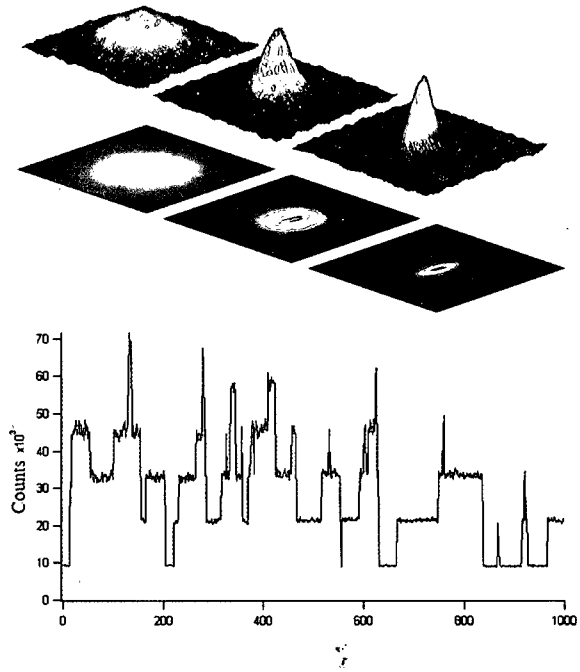
The 'Virtual Phase' architecture of the 885 sensor renders significantly higher QE performance than a standard front-illuminated sensor.

iXon^{EM}+ 885 for the physical scientist...

The unique high-performance specifications of the optimized iXon^{EM}+ have been serving the physical scientist and astronomer in scenarios that demand more than simply an EM sensor in a camera!

For example, the iXon^{EM}+ 885 represents, for many reasons, an outstanding detection solution for **Bose Einstein condensation / Ion-trapping** experiments. In addition to EMCCD sensitivity and rapid frame rates, the 885 excels in the following capabilities:

- **Rapid charge 'purging':** useful to eradicate unwanted bright signal, e.g. from magneto- optical traps, prior to absorption or fluorescence measurements
- **External Trigger Modes:** capture synchronous with introduction of probe laser – includes **'External Exposure'** mode, where exposure time is fully controlled by the external trigger input.
- **'Fast Kinetics' Mode:** sub-microsecond temporal resolution from industry fastest parallel shifts. Extensive on-chip storage capability.
- **Zero fringing:** The 885 provides NIR sensitivity without etaloning effects encountered by some back-illuminated systems.



Top: *Surface plots of the transition from a thermal gas (left) to a Bose-Einstein condensate. The sharp, bimodal peak in the right figure is a signature of a BEC.* ***Bottom plot:*** *Fluorescence from a few-atom MOT vs time, showing the discrete steps characteristic of single atoms entering and leaving the trap. Courtesy of Michael Chapman's research group at the School of Physics, Georgia Institute of Technology, Georgia, USA.*

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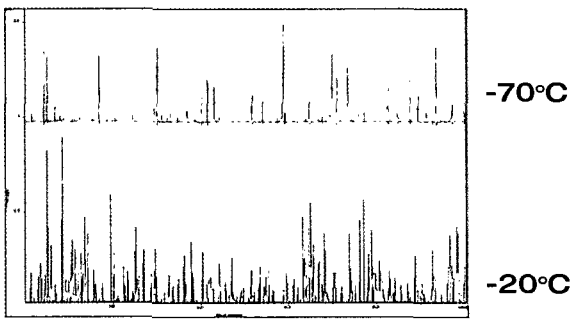
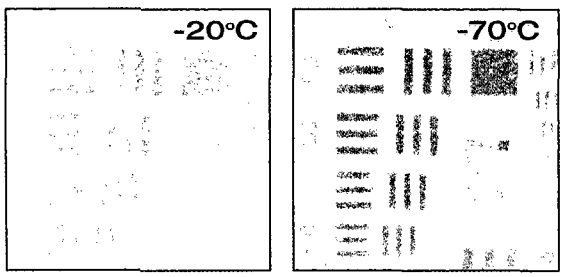
Deep Thermoelectric Cooling and CIC

Single thermal electrons are amplified by the EMCCD gain mechanism. Similarly, clock induced charge (CIC) electrons show up as spurious spikes, boosted well clear of the read noise floor. When using the EMCCD in optical configurations that are designed to minimize the extent of background photons, such as confocal or TIRF microscopy, there is heightened emphasis on minimizing the darkcurrent and CIC contribution to the background.
The iXon^{EM}+ 885 offers outstanding vacuum cooling performance of -70 °C air / -85 °C water (an optional -80 °C air / -95 °C water version is available). The CIC of the iXon^{EM}+ 885 is the lowest available for this sensor, benefiting from Andor's unique finesse clocking parameters and the fastest vertical shift speeds in the industry.

- Cooling down to -85 °C (-95 °C optional)
- Lowest EM-amplified darkcurrent
- Fewer pixel blemishes (hot pixels)
- Low power consumption
- Industry-lowest CIC



Line intensity profile generated from iXon^{EM}+ 885 dark images, taken with x1000 EM gain and 50ms exposure time at two different cooling temperatures. -20 °C shows elevated levels of EM-amplified dark-current noise. -70 °C shows significantly fewer noise events.



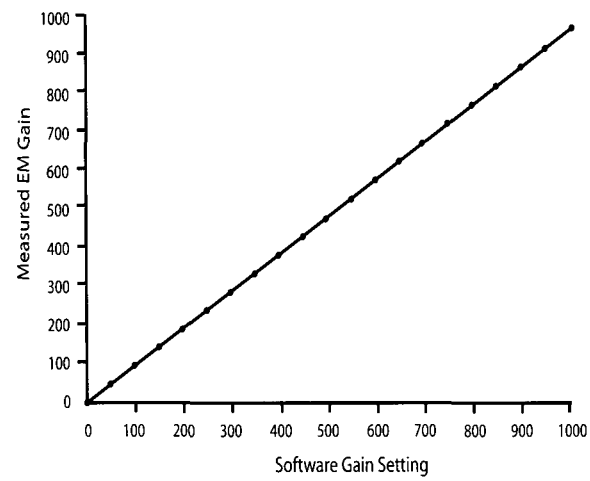
iXon^{EM}+ 885 images from an extremely weak LED illuminating a resolution chart in a light-tight environment, taken in each case with x1000 EM gain, 15s exposure time at 2 different cooling temperatures. -20 °C shows significantly poorer contrast (and hence resolution) due to elevated levels of EM-amplified darkcurrent in the 'dark' regions. Note that with EM gain off, this signal level is completely absorbed in the read noise floor.

The iXon^{EM}+ 885 offers faster vertical shift speeds than other EMCCD cameras employing the same sensor. This yields faster frame rates - particularly under commonly employed conditions of binning/sub-array - reduced vertical smearing during frame transfer and minimized Clock Induced Charge (CIC) noise.

RealGain™

With the launch of the iXon^{EM}+ in early 2006, Andor once again raised the bar by introducing some significant new technology innovations. One of these breakthroughs was RealGain™, and is a standard feature of the quantitative iXon^{EM}+ 885 camera.

- RealGain™ – Select absolute EM gain direct from a linear and directly quantitative software scale, x1 to x1000. No more arbitrary EM gain units. The EM gain you ask for is the EM gain you get!



***RealGain™** calibration in the iXon^{EM}+.
Temperature-compensated: The same linear relationship holds across all cooling temperatures.*

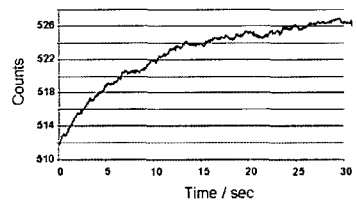
Does the iXon^{EM}+ 885 suffer from the gain ageing effect?

The iXon^{EM}+ 885 range contain exclusively Impactron™ sensors from Texas Instruments. It is important and fair to note that EMCCD cameras containing Impactron™ sensors have shown rates of EMCCD saturation-induced ageing that are orders of magnitude slower than those utilizing E2V sensors (i.e. all back-illuminated EMCCDs rely on E2V sensors), exposed to comparable light intensity and EM gain levels. In fact the EMCAL™ technology that Andor have developed to recalibrate EMCCDs that have aged is not even necessary on the 885 camera. *Note also that the Andor Luca^{EM} models also contain exclusively sensors from Texas Instruments.*

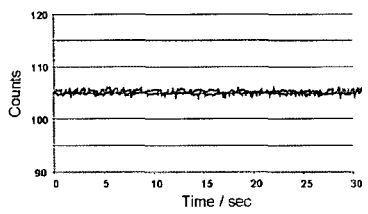
Enhanced Quantitative Stability

The iXon[EM]+ range is well regulated in terms of both Baseline (bias offset) rigidity and EM Gain Stability, lending for enhanced quantitative reliability throughout and between measurements. A feature of Andor's EMCCD technology since 2002!

Baseline Clamp OFF



Baseline Clamp ON



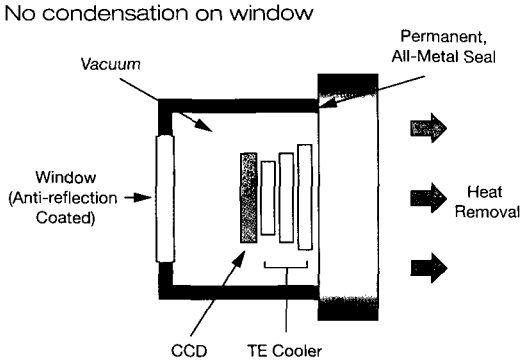
iXon[EM]+ Baseline Clamp ensures stable baseline value across a kinetic series and across different EM Gain settings.

iXon[EM] 885 can be read out at either 35, 27 or 13 MHz speeds, offering extensive flexibility to balance dynamic range vs frame rates.

Permanent Vacuum Head

The iXon[EM]+ range of high-end EMCCD cameras benefit from Andor's proprietary UltraVac™ process, resulting in a hermetically sealed permanent vacuum head with minimized out-gassing. UltraVac™ has a proven track record of field reliability, accumulated over more than 10 years of shipping high-end vacuum cameras. Since the sensor is completely protected in the vacuum head, UltraVac™ also enables use of only one input window (with double AR coating), improving photon-throughput by 8%.

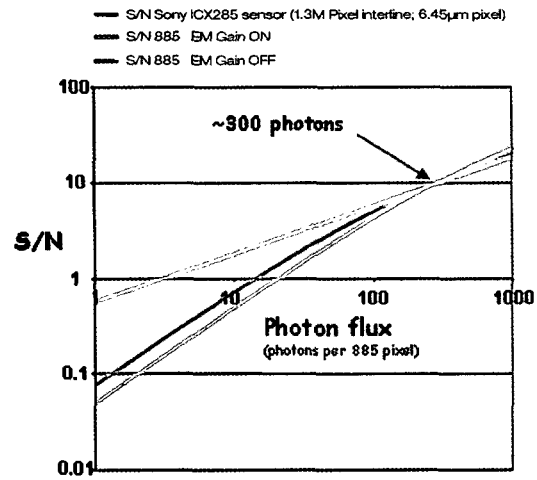
- Sustained deep TE cooling (no re-pumping)
- Complete sensor protection – longevity!
- One input window – photon throughput!
- No condensation on window



Andor's flexible EMCCDs allow EM Gain to be completely turned off under brighter conditions, enabling multiplicative noise to be circumvented and S/N to be optimized for high-speed measurements.

Upgrade to Signal to Noise superiority across the full range of light levels...

The remarkable flexibility of iXon[EM]+ 885 relates also to the ability to deliver signal to noise superiority across a wide range of light levels, hence laboratory uses.



Plot of Signal to Noise vs Photon Flux for the iXon[EM]+ 885 vs a camera containing the Sony ICX285 sensor, assuming 5.5 electrons rms 'typical' read noise for the latter and accounting for both pixel size and QE differences @ 550nm. The 885 shows significantly higher S/N in the low light regime with EM gain applied. In brighter conditions, the EM gain can be completely turned off to maintain the S/N advantage.

iXon[EM] offers the lowest read noise specifications available for the Texas Instruments TC285 EMCCD sensor. Importantly, this translates into a higher S/N when not using EM gain and a higher available dynamic range.

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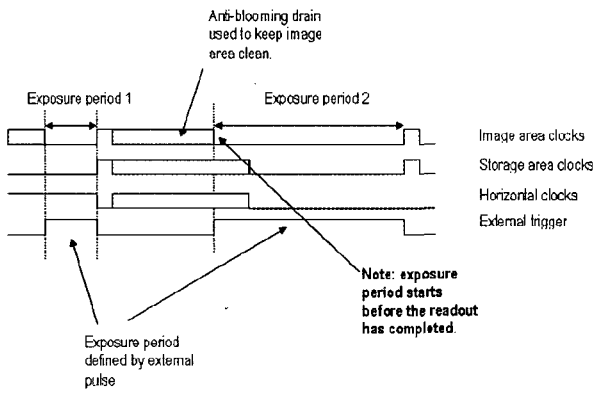
iXon^{EM}+ Trigger Modes

Andor's EMCCDs offer a comprehensive range of internal, software and external trigger modes. Furthermore, software and internal trigger modes avail of cutting-edge firmware and SDK enhancements, delivering enhanced speed performance during complex software acquisition protocols. On-head storage of multiple exposure times facilitates rapid exposure time switching upon receiving a trigger. Such features lend for performance excellence across a range of key 3rd party imaging and microscopy software packages, as well as in Andor's own **iQ** multi-dimensional live cell imaging software.

The iXon^{EM}+ 885 has several different external trigger modes, including *External Trigger*, *Fast External Trigger* (used to achieve fastest frame rates), *External Start* and *External Exposure* (in which the start and end of exposure is defined completely by the trigger pulse). Furthermore, the 885 sensor architecture enables use of the anti-bloom structure to keep the sensor purged of charge when not acquiring, facilitating a rapid transition between keep clean and acquisition upon receiving a trigger event.



Timing diagram for iXon^{EM}+ 885 'External Exposure' trigger mode, using anti-bloom drain for keep clean

Andor Solis Software

Andor Solis (**SOL**utions for **I**maging and **S**pectroscopy) is Andor's camera control and analysis software platform, with versions specifically designed to run imaging. It is easy to install and provides state of the art acquisition, display and processing capabilities.

Andor iQ Software

Andor iQ is our flagship live cell imaging software, designed with flexibility and power in mind. iQ – **i**mage and **Q**uantify – occupies a central role in our Revolution product range and provides optimized control of Andor's award winning iXon^{EM}+ EMCCD cameras and automation hardware for a range of bioimaging applications.

Third Party Software Support

Andor has worked with several 3rd party imaging software companies to include support for the Andor range of cameras.

EMCCD Pioneers

Andor Technology pioneered the world's first scientific EMCCD cameras, shipping the initial cameras back in 2000 and winning the Photonics Circle of Excellence award for our achievements in January 2001.

Andor even coined the term 'Electron Multiplying CCD (EMCCD)', which has now been adopted right across this burgeoning industry! Since then, Andor have consistently set higher and higher EMCCD performance standards with our deep-cooled, vacuum-sealed iXon^{EM} & iXon^{EM}+ quantitative camera range.

For example, we introduced the world's first back-illuminated EMCCDs in January 2002, alongside our unique baseline clamp solution for enhanced quantitative performance. Andor's method for achieving industry-lowest Clock Induced Charge was introduced in early 2003 and our much revered quantitative and linearized EM gain control (RealGain™) was innovated in January 2006.

Human Umbilical Vein Endothelial Cells (HUVEC) was infected with a mutated Cat Scratch Disease bacterium (Bartonella henselae unable to form an invasome). After 2 days of co-incubation human cell was permeabilised and stained for Actin (TRITC-Phalloidin shown here in red channel) whereas bacterial cells were labeled with Cy2 (green). Image taken with the iXon^{EM}+ 885, courtesy of Christophe Dehio and Matthias Truttmann, Infection Biology, Biozentrum, University of Basel, Switzerland.