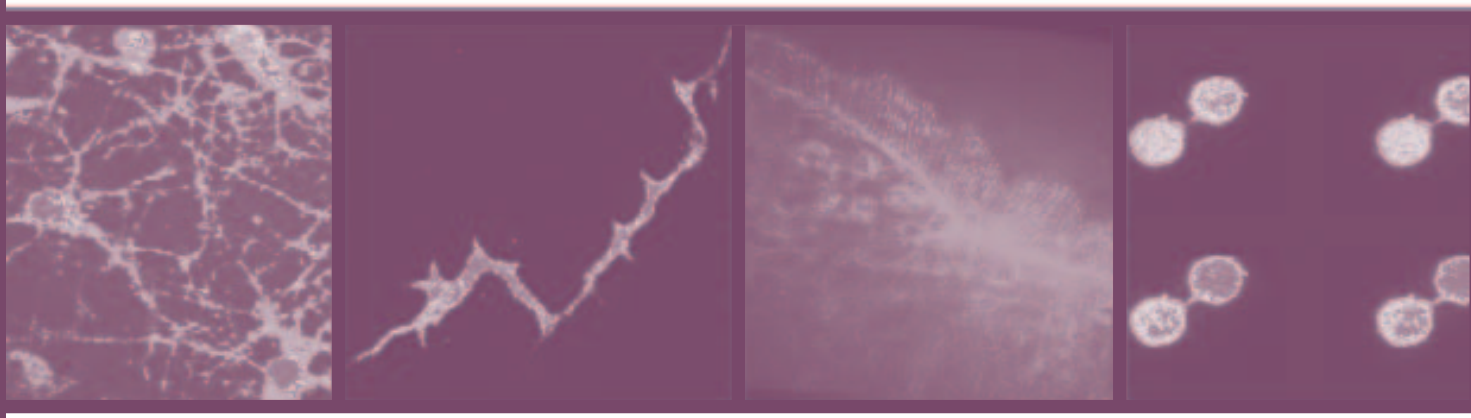
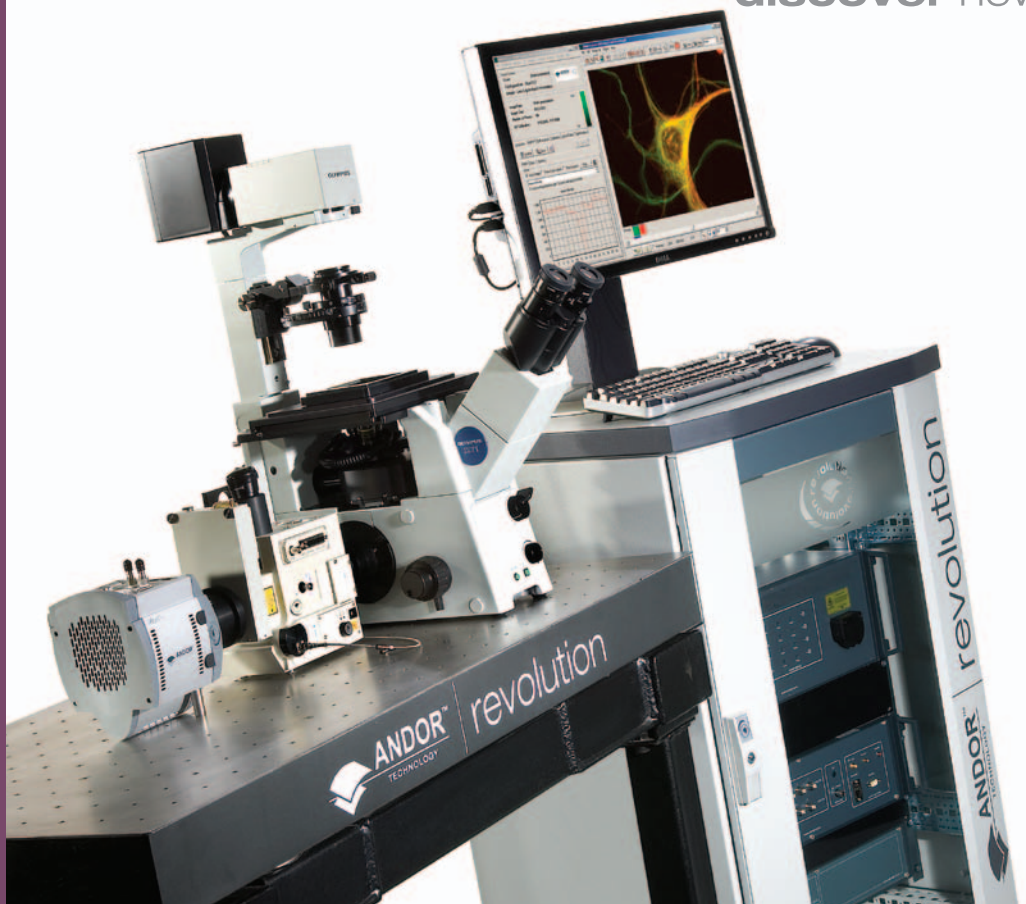
ANDOR™
TECHNOLOGY

join a **microscopy** revolution

microscopy systems



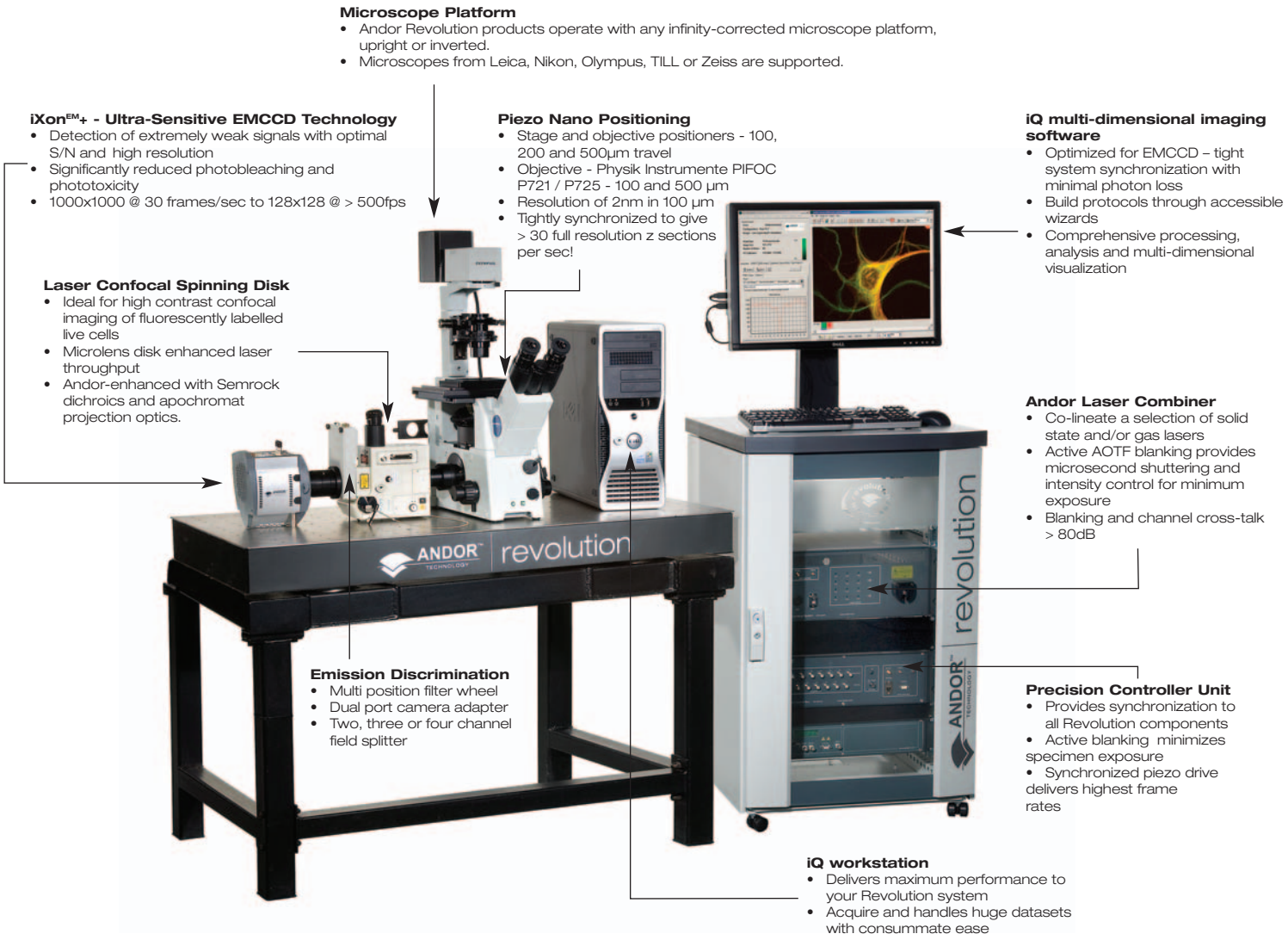
discover new ways of seeing ™



revolution **laser microscopy:**

Andor Revolution - A Family of Products

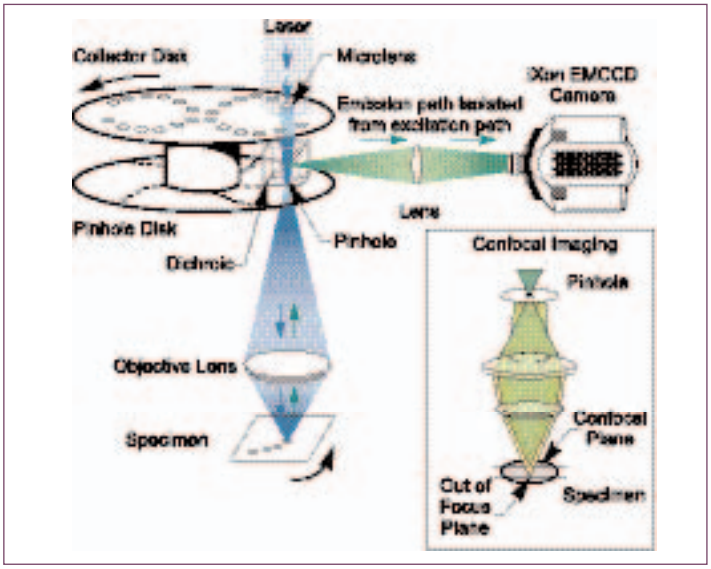
Andor Revolution provides a framework for our range of laser-illuminated microscopy solutions, including spinning disk confocal, TIRFM and photo-bleach and activation modalities. Our spinning disk, live cell confocal instrument, illustrated below, combines Andor's award winning iXon EMCCD cameras, solid-state laser combiner and the renowned Yokogawa CSU confocal scanner "inside". Andor has established a global distribution agreement with Yokogawa Electric Corporation and harnessed our opto-electronics engineering and manufacturing knowledge to create powerful live cell confocal solutions. Andor's direct market presence and unique solutions bring you unrivalled performance, product understanding and support.



Revolution encompasses a range of components, both hardware and software that fit seamlessly together creating a complete laser microscopy solutions. An open flexible component focus also allows us to provide key pieces of hardware stand-alone. We want to tailor solutions matched to your needs.
At the core of Revolution systems is Andor iQ, a multi-dimensional imaging software which synchronizes iXon EMCCD cameras with the CSU confocal spinning disk and other key hardware components such as Piezo Z100 z-stage and our Laser Combiner with AOTF for rapid laser line selection.

revolutionary **technology:**

Confocal Dual Spinning Disk



Confocal Dual Spinning Disk

Revolution's confocal dual spinning disk technology provides an ideal platform for high speed, high SNR imaging, with low bleach rate and low photoxicity.

- Isolated detection channel with extremely low background - optimal for EMCCD technology
- Efficient illumination coupling via a microlens array (~60%)
- Low peak power by parallel illumination of ~1000 scanning laser points
- Efficient parallel detection with highest QE - 90% peak
- True broadband operation - excitation 400-650nm - detection 420-750nm
- CSU optimization includes:
  - Apochromatic detector channel optics
  - Focusing single and dual camera adapters
  - Semrock dichroic filters optimized for selected laser lines

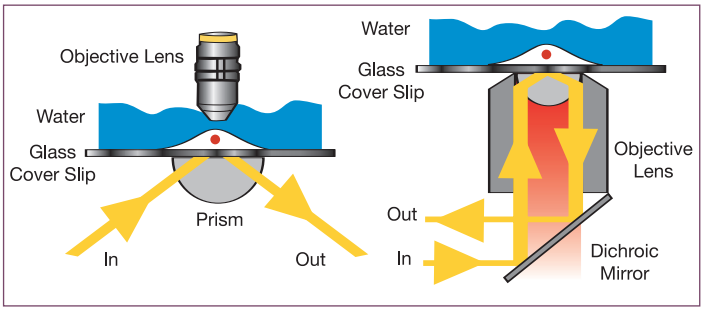
Also Available from Andor

Live Cell Confocal Upgrades

Andor's Revolution range includes our laser spinning disk live cell confocal microscopy systems utilizing the Yokogawa CSU. We have created a range of upgrade solutions for Perkin Elmer UltraView and Visitech system users to bring a new lease of life to legacy systems.

TIRF and Photo-bleaching

Andor Revolution technology is ideally suited to use in other modalities of fluorescence imaging, including TIRFM and photo-bleaching/activation. The Andor laser combiner (ALC) offers unique functionality for creation of multi-modal imaging systems.



Prism-type TIRFM (LHS) and objective-type TIRFM (RHS)

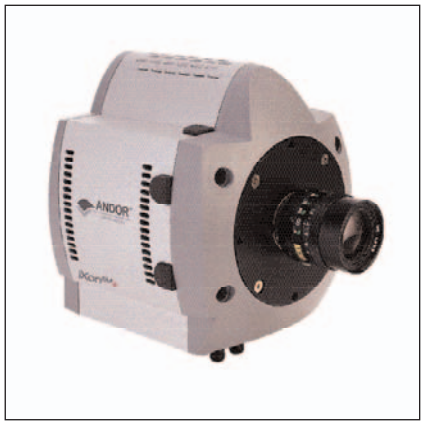
TIRFM is a well-established technique for live cell imaging making use of total internal reflection (TIR). The electromagnetic field of the TIR light (the evanescent field) extends into the sample beyond the interface by some one to two hundred nanometers into the medium of lower refractive index. Since the field decreases exponentially along the z-axis, only a very thin section of the specimen undergoes fluorescence excitation. TIRFM produces extremely high contrast, low background images, ideal for detection with our iXon EMCCD cameras and is a valuable tool in the study of e.g. cellular membrane traffic, surface receptor activity and cytoskeleton dynamics as well as in single molecule and molecular machine studies.

Andor Revolution components provide:

- Matched illuminator and detector for maximum performance
- Flexible fiber-coupled 400-650 nm excitation compatible with all TIRF platforms.
- Multiple fiber outputs for confocal, TIRF and Photobleach.
- Integral AOTF – microsecond wavelength, shuttering and intensity control
- Active blanking - precise synchronization and > 80 dB isolation.

microscopy **products:**

iXon^{EM+} providing single photon sensitivity



Model	Features
• DU-680	128 x 128 pixels; 24 x 24µm; QE >90% for high speed applications e.g Ca^{2+} flux
• DU-885	1002 x 1004 pixels; 8 x 8µm; QE >60%, 35 MHz readout, high resolution intra-cellular imaging
• DU-897	512 x 512 pixels; 16 x 16µm; QE >90%, the ultimate combination of sensitivity and speed
• DU-888	1024 x 1024 pixels; 13 x 13µm; QE >90%, resolution and exceptional sensitivity combined

All iXon detectors benefit from:
a) minimized dark current from unparalleled –90°C TE cooling – especially critical for confocal imaging where experimental backgrounds are minimal,
b) Industry fastest vertical shift rates (< 2µs/row) - Vital to avoid Scan Lines with both CSU 10 and CSU 22 operation

csu confocal spinning disk unit

Features

- 1500-5000 rpm disk, giving 300-1000 fps frame rate
- Easy synchronization of exposure to disk speed
- Manual and motorized filter changer models available
- FWHM Z section <=1.2µm
- Semrock dichroic and emission filter pairing provides optimum SNR
- Filter wheel mounting for fluorescence and DIC analyzer

- High performance custom Semrock dichroic mirrors; quad, triple and dual line combinations
- Custom optics fitted to camera adapters for higher throughput, chromatic aberration and background noise reduction

andor laser combiner solid state & gas laser lines

Solid State Range

- 405 - 50 mW
- 445 - 40 mW
- 488 - 20, 25, 50 mW
- 513 - 20, 50 mW
- 532 - 20, 50, 75 mW
- 561 - 25, 50, 75 mW
- 635 - 25 mW

Note: 400 series model allows up to 4 solid state lasers (5 lines with a gas laser), while the soon to be announced 600 series will support up to 6 solid state lasers

Features

- Compact 4U 19" rack mount enclosure
- Quiet, cool, low power consumption
- Long life solid state lasers with excellent stability (typical +/- 0.4% pk to pk)
- Integral AOTF for laser selection. intensity and blanking control
- Excellent isolation and cross-talk (>80dB)
- ALC allows Gas laser integration e.g. Ar ion or mixed gas

precision controller unit flexible expansion

PCU100

- Provides system synchronization
- Houses AOTF driver for ALC coupling
- 16 bit Analogue output for direct piezo Z control
- 8 digital inputs for sensing external events
- 8 digital outputs for triggering and expansion
- Enables Revolution to slave or master.
- All under iQ software control

PCU NEOS

- Up to 5x 16 bit analogue outputs for external AOTF control
- NEOS or AAEO AOTF support
- Optional active blanking driver for AOTF shuttering
- 8 digital inputs for sensing events
- 8 digital outputs for triggering and expansion
- Information available for third party software support

motorized xy & z control piezo z / motorized xy

XY Stage

- Open and closed loop stages for your preferred microscope
- Typical travel >100x75mm, with 0.02µm resolution
- 30mm/sec travel speed
- Perform multi-field scans for 6D imaging
- Create 4D mosaics using iQ software

Z Stage

- Piezo Z stage with 100, 200 and 400µm ranges
- 1nm repeatability
- 2-8 nm resolution (depends on range)
- Up to 100 Z sections per second
- Slide holder 3"x1"
- 35mm petri dish holder

Z Objective

- PI PIFOC P721-100µm or P725-400µm travel
- Up to 20 Z sections per second
- 1.25nm resolution
- Analogue or digital control
- Oil and water objectives

filter wheels & splitters emission discrimination

TR-FW10

- 10 position, ø25 filterwheel with 40ms switching time
- Matched with CSU or microscope "C"coupler
- Infinity optical path for optimum filter performance
- External controller allows support of Sutter Smartshutter
- Multi-wheel Sutter controllers available

TR-FW06

- 6 position, ø25 filterwheel,with 100 ms switching time
- Matched with CSU or microscope "C" coupler
- Infinity optical path for optimum filter performance
- MAC5000 external controller expandable for other Ludl components e.g. stages

Field Splitter

- Optosplit II uses 25 mm filters
- Field splitting for simultaneous 2 color imaging
- Matched to CSU or microscope "C" coupler
- DualView and QuadView also supported

software optimized imaging software & choice

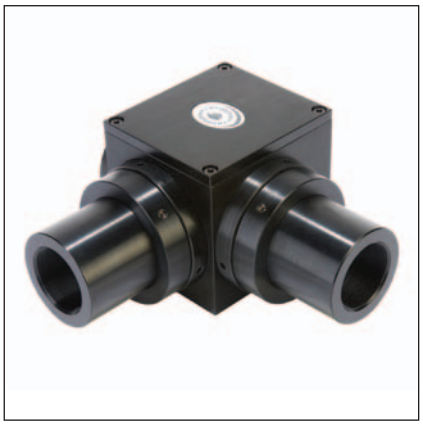
iQ

Andor iQ is our flagship live cell imaging software, designed with flexibility and power in mind. iQ - image and quantify - provides optimized control of Andor's award winning iXon^{EM}+ EMCCD cameras and other hardware for bio-imaging.
Imaris v7.0 and **VisBio** Bio-formats import Andor Multi-TIFF image files.
MatLab - We are a member of Mathworks connections program and provide Revolution data access tools for MatLab users.
Micro-Manager and Image-J - Revolution components will soon be compatible with the Micro-Manager open source device adapter standard.

iQ Workstation

- Dell Precision workstation
- Preconfigured with iQ and Control hardware
- RAID-0 disk configuration
- High performance graphics with OpenGL
- Guaranteed compatibility and maximum frame rate performance

camera port adapters single and dual port



Single Port Coupler

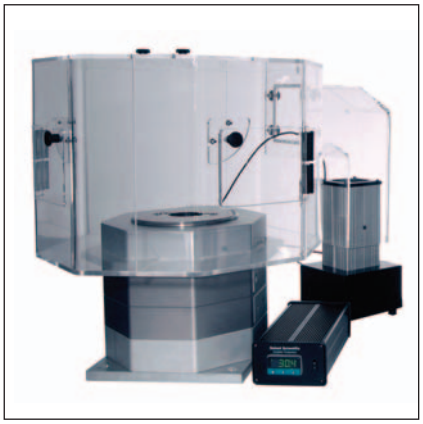
- **Magnification X** = 1.0, 1.2, 1.5, 2.0 - other by request
- Compatible with filter wheel or CSU+filter wheel

Andor couplers are designed to ensure optimum throughput, minimal aberrations, magnification options and flexible detection configurations. Our couplers match our CSU enhancements and can also be configured with a broad range of imaging optics including microscope C-mount, 'C' and 'CS' mount lenses.

Dual Port Coupler

- **Magnification X** = 1.0, 1.2, 1.5, 2.0 - other by request
- Compatible with 'C'/'CS' lenses, C-mount, filter wheel or CSU+filter wheel
- Magnification select in each arm
- Mounting cassettes 'store adjustment' simplifying exchange and minimizing readjustment

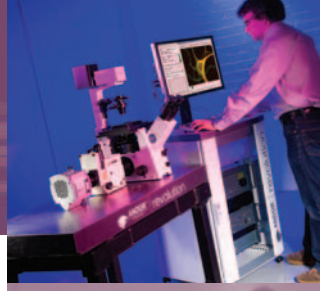
microscopes platforms & auto-focus



Diverse Compatibility

Revolution products are compatible with modern infinity corrected microscopes from Leica, Nikon, Olympus or Zeiss to meet your preferred configuration. NB For laser safety a 100% side port switch is required. We have recently introduced support for TILL's iMIC - modular automated microscope system.
Microscopes need environmental control to maintain living conditions for mammalian cell preparations. We recommend temperature and CO^2 control incubators from LIS (Switzerland). Thermal and mechanical factors in the microscope mechanics or environment can impact the observation of living specimens when image focus is affected by drift or vibration. Therefore we recommend that systems are configured on vibration isolation tables. An important recent innovation in microscope design is focus drift correction (FDC). FDC corrects focus drift, which can severely affect time-lapse movies and is especially important in confocal and TIRF imaging, where focus and illumination are tightly constrained. Nikon and Olympus have introduced FDC solutions, while ASI (Oregon, USA) offer a product they call "CRIFF" which is adaptable to most microscopes. Andor iQ supports the operation of these devices, to provide long-term drift free imaging from Revolution live cell imaging solutions.

microscopy **applications:**



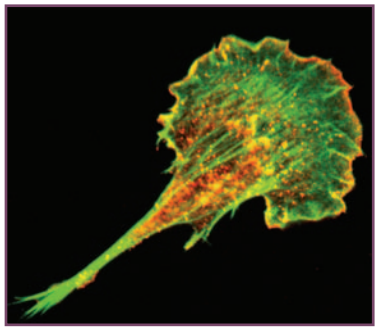
Revolution components and systems benefit from common features across applications. Whether in confocal, photo-bleach/activation or TIRFM imaging this means state of the art performance, flexible component-oriented supply and an open-minded approach to systems and technically demanding solutions. As we continue to provide wide-ranging support for key hardware components, we also try to increase your choice through expanding our software compatibility. We are actively involved in making the bridge from iQ to MatLab, Imaris or Image-J and Micro-Manager as smooth as possible.

Applications include:

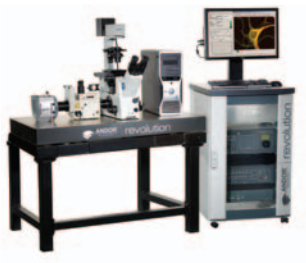
- Calcium Signaling
- Multi-channel GFP Imaging
- Developmental and cell cycle studies
- Fluorescence translocation and Colocalization
- FRET imaging
- Membrane trafficking
- Cytoskeleton dynamics
- Single molecule studies
- Molecular machines

System Features

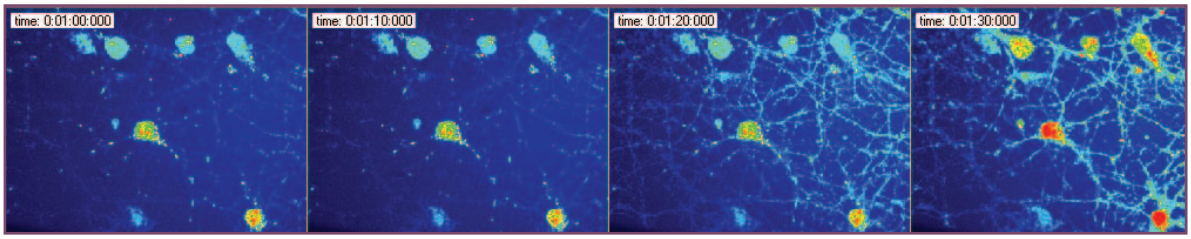
- Ultimate sensitivity from combination of iXon^{EM}+ EMCCD and TIRF illumination or CSU spinning disk.
- Fast frame rates (up to 1000 sec^{-1}) with perfect synchronization.
- Reduced photo bleaching - particularly vital for non-ratiometric dyes.
- Reduced phototoxicity of living cells.
- Study live specimens with reduced fluorophore concentrations or expression levels.
- Minimal perturbation of physiological events.
- Synchronization of electrophysiology and photolysis with the Precision Control unit.



Courtesy Dr James E. Bear, Lineberger Comprehensive Cancer Center, NC. Rat2 fibroblast expressing Pod-GFP (green) stained with phalloidin (red).



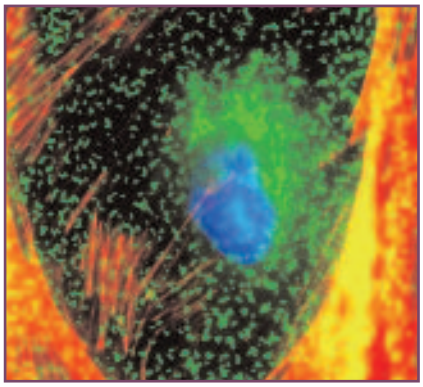
- Rapid optical sectioning with Piezo Z100 for 4D imaging - up to 100 sections sec^{-1}.
- Detection limit down to single GFP molecules in parallel at supra-video frame rates.
- Powerful visualization, image analysis and tracking tools in iQ software.
- Detect and track many individual vesicles in parallel.
- Lower detection limits down to single co-localized pairs, at supra-video frame rates.
- Align and merge optically split images in iQ.
- Powerful and comprehensive FRET analysis and tracking.

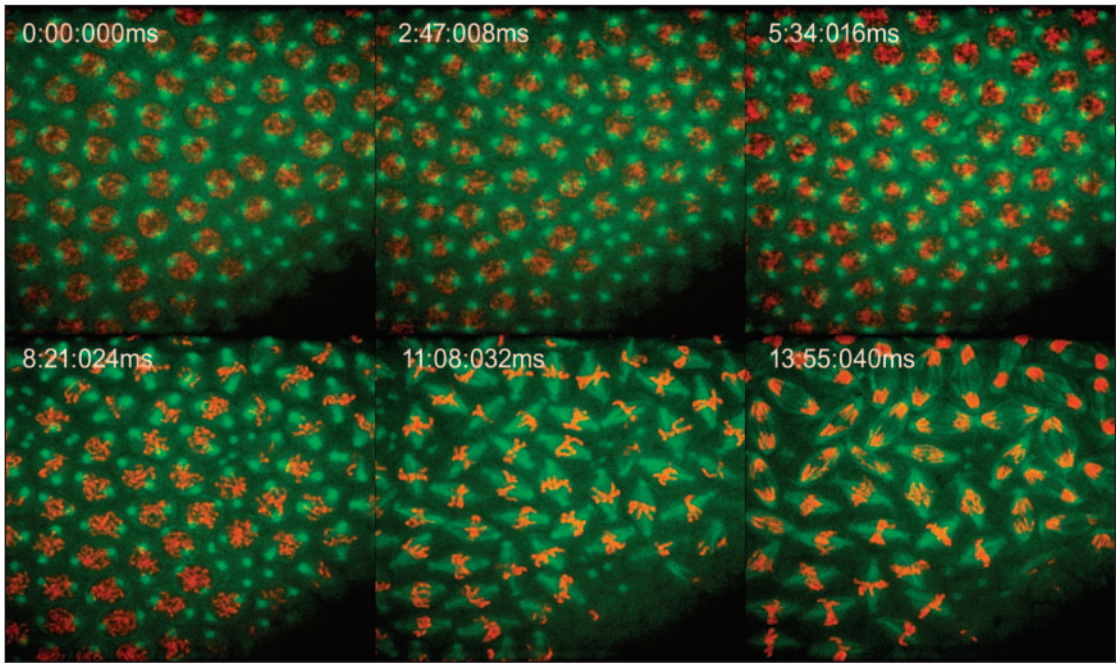


Courtesy Dr Iain Johnson, Invitrogen, Eugene, OR. Cultured neurons were loaded with DiSBAC2(3), a voltage sensitive dye and visualized with the Revolution 488. Exposure time of the iXon 887-BV was 100ms and EM Gain 200. The figure shows a film strip from Andor iQ of maximum intensity projection time series. Time point 4 is taken almost simultaneously with the addition of KCl, which depolarizes the cells and shows a near instantaneous rise in DiSBAC2(3) signal. ΔF of almost 45% is observed in this example. Imaged at the 3D Microscopy of Imaging Cells Course, Vancouver 2005.

"With iXon EMCCD cameras we are seeing a revolution, the revolution is seeing (single molecules in action). The synergy of iXon and Yokogawa CSU technology will open new exciting possibilities in cellular imaging"

Dr Derek K Toomre
Assistant Professor of Cell Biology
Member of Ludwig Institute for Cancer Research
Yale University School of Medicine





Embryo Cell Division using the Andor Revolution XD system.
Courtesy of Paula Sampaio, University of Porto Rua Campo Alegre, Portugal

Andor **overview:**

Andor Technology strives to bring innovative solutions to the demanding needs of researchers and manufacturers. We are a reliable source for the researcher in the lab as well as a trusted supplier to more than half of the top twenty analytical instrumentation companies in the world. We understand their requirements and share an in-depth knowledge of their applications. Whether you require single or multiple components, off-the-shelf or a custom-designed solution, Andor is the logical choice, enabling greater efficiencies, lower costs and better results.

Andor Headquarters, Belfast

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www.**andor**.com

Andor Technology Worldwide: +44 28 9023 7126
Andor Technology USA: (860) 290-9211
Andor Technology Japan: 81-3-3511 0659
Andor Technology China: +86-10-5129-4977

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