NEW WAYS TO DISCOVER
Our portfolio - of over 80 products - enhances scientists' understanding of fields as diverse as drug discovery, astronomy, medical diagnostics, materials characterization and cancer research.

Andor pioneered EMCCD technology, and our iKon cameras are the best selling and highest-performance EMCCD products on the market. The iKon revolutionized cell analysis, allowing faster analysis at lower light levels and speeds that were previously unobtainable.

The iKon Ultra, now with a 60% speed boost, is the camera of choice in the super-resolution microscopy field. This innovative camera benefits researchers in TIRF, FRET, single-molecule detection and live-cell confocal microscopy.

Andor also made EMCCD technology affordable to every laboratory with the launch of the Luca EMCCD camera. A cost-effective yet powerful camera capable of single-photon sensitivity. In addition to widespread use in cell microscopy, the LucaEM is ideal for high-throughput photothermal inspection.

Andor offers the scientific researcher the advantage of choice with a comprehensive sCMOS portfolio. In 2010, Andor introduced the first sCMOS camera, the flagship Neo 5.5. Following this in 2012, Zyla 5.5 was launched offering the customer a cost-effective option (Zyla 5.5 3-Tap) or the fastest sustainable frame rate available from sCMOS (Zyla 5.5 10-Tap). The most recent addition to Andor’s sCMOS portfolio is the Zyla 4.2 which offers the highest QE (72%) available from sCMOS technology. Overall sCMOS technology offers an advanced set of performance features that renders it ideal to high fidelity, quantitative scientific imaging. sCMOS technology can be considered unique in its ability simultaneously deliver on many key performance parameters, overcoming the trade-offs associated with other scientific imaging technology standards and furthermore eradicating the performance drawbacks traditionally associated with CMOS imagers.

With the Clara, Andor delivers the highest sensitivity achievable from a high-resolution interline CCD camera, which coupled with Andor’s IQ live cell imaging software produces superb high-resolution live cell images. The multi-megapixel Mono Slow Scan CCD – with thermoelectric cooling to -100°C – is ideal for long exposure deep-space astronomy and has helped discover many new exoplanets (planets outside our solar system). The iKon CCD is also widely used in the analysis of single super-cooled atoms in Bose-Einstein condensation experiments.

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For spectroscopy applications, Newton®, the world’s first Spectroscopic EMCCD, provides single photon sensitivity at rapid spectral rates, making it ideal for Raman / Luminescence / Chemical Imaging. Those immersed in the study of Atomic Spectroscopy will find the iStar ICCD and Michelle spectrograph the perfect combination, reducing experimental time while simultaneously offering high bandpass and spectral resolution.

Our systems and component-oriented microscopy business allow us to meet scientists’ requirements in cell and live-cell applications. Our confocal and widefield solutions are optimized for applications such as optogenetics and optophysiology, photomanipulation (e.g. activation and ablation), calcium and ion imaging in confocal sections, and fluorescent protein dynamics. Andor components are designed to be compatible with our own software and various third-party products.

The Revolution WD and XD is a family of laser microscopy systems providing high-speed multi-point confocal, FRAPPA™ and TIRF modalities. Ideal in conjunction with Andor’s unique solid state laser combiner (ALC) and Multiport switch, this can deliver a co-linear beam from up to six solid state lasers between three optical pathways.

The Revolution DSD is a high-performance confocal microscopy system, using a white light source. This novel technology offers a simple cost-effective device to upgrade a fluorescence microscope into a confocal microscope. It is proven to work well across a broad range of sample types.

We develop and manufacture our cameras, spectrometers and microscopy systems in a purpose-built 50,000 m² (4,650 m³) factory, which includes state-of-the-art optical, electronic and mechanical workshops, 2,325 ft² (215 m²) class 1,000 and class 100 facility, and vacuum and electronic processing facilities. These provide the best environment for camera-head assembly and exhaustive QC testing of every unit before shipment.

Andor has also implemented 6-sigma manufacturing processes to guarantee the highest possible product-performance and quality.

Since 1998, we have operated a quality management system that currently complies with the requirements of BS EN ISO9001:2008 and has also obtained the ISO14001. Our expertise and facilities are ideally suited to the development of both bespoke and volume-manufacture products, providing the highest performance research and OEM systems.
Much has changed since we developed the world's first non-controller-based scientific camera in 1989. We now have over 400 people in 16 offices worldwide, distributing products to over 10,000 customers in 55 countries. But we are still innovating. We want to keep taking our industry further, to exceed the limits of light-measurement by developing the highest-performing technology possible.
### SENSOR TYPES

We offer a range of different sensor types to assist you, as outlined in the table below:

<table>
<thead>
<tr>
<th>Sensor Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>FI</td>
<td>Front Illuminated CCD</td>
</tr>
<tr>
<td>UV</td>
<td>Front Illuminated CCD with UV coating</td>
</tr>
<tr>
<td>VP</td>
<td>Front Illuminated Virtual Phase EMCCD, optimized for 600 - 1000 nm</td>
</tr>
<tr>
<td>OE</td>
<td>Open Electrode CCD</td>
</tr>
<tr>
<td>BV</td>
<td>Back Illuminated CCD / EMCCD, Vis optimized</td>
</tr>
<tr>
<td>BVF</td>
<td>Back Illuminated CCD / EMCCD, Vis optimized with fringe suppression</td>
</tr>
<tr>
<td>EX2</td>
<td>Back Illuminated EMCCD, dual AR coated</td>
</tr>
<tr>
<td>BN</td>
<td>Back Illuminated CCD, uncoated</td>
</tr>
<tr>
<td>BU</td>
<td>Back Illuminated CCD, Blue optimized AR coating for Spectroscopy</td>
</tr>
<tr>
<td>BU2</td>
<td>Back Illuminated CCD, AR coated for optimized performance in the 250 nm region</td>
</tr>
<tr>
<td>UVB</td>
<td>Back Illuminated CCD / EMCCD with UV coating</td>
</tr>
<tr>
<td>BE1K-DD</td>
<td>Back Illuminated, Deep Depletion CCD with fringe suppression and dual AR coating</td>
</tr>
<tr>
<td>BR-DD</td>
<td>Back Illuminated, Deep Depletion CCD with fringe suppression, optimized for 750 - 1100 nm</td>
</tr>
<tr>
<td>TIL</td>
<td>EMCCD Interline</td>
</tr>
<tr>
<td>S1L</td>
<td>CCD Intensifier frame transfer</td>
</tr>
<tr>
<td>InGaAs</td>
<td>Indium Gallium Arsenide linear detector array providing performance to 2.2 μm</td>
</tr>
<tr>
<td>sCMOS</td>
<td>Scientific Complementary Metal Oxide Semiconductor</td>
</tr>
</tbody>
</table>

### SYSTEM CONSIDERATIONS

In selecting a digital camera, there are certain parameters that should be assessed to ensure the camera can offer the best possible performance for your application(s). These include:

- Sensor readout optimization options
- Cooling options
- Synchronization signals
- Computer interfacing options
- Sensor format and pixel size
- Time resolution

### SENSOR READOUT OPTIMIZATION

To allow the camera to be optimized for the widest range of applications, it is important to have options for the camera readout. These include:

- Sensor pre-amplifier gain
- Variable pixel readout rate
- Variable vertical shift speed
- Binning and sub-imaging

### THE POPULAR CHARGE-COUPLED DEVICE (CCD) CAMERA

For all CCD detectors, a silicon diode photosensor (called a pixel) is coupled to a charge storage region that is in turn connected to an amplifier that reads out the quantity of accumulated charge. Incident photons generate electronic charges, which are stored in the charge storage region. This storage charge can be measured, giving rise to an observable signal.

For sCMOS, the sensor features a split readout scheme in which the top and bottom halves of the sensor are read out independently. Each column within each half of the sensor is equipped with dual column level amplifiers and dual analog-to-digital converters (ADC).

### THE ELECTRON MULTIPLYING CHARGE-COUPLED DEVICE (EMCCD) CAMERA

EMCCD technology, sometimes known as ‘on-chip multiplication’, is an innovation first introduced to the digital scientific imaging community by Andor in 2001, with the launch of our dedicated, high-end iXon range of ultra-sensitive cameras. Essentially, the EMCCD is an image sensor that is capable of detecting single photon events without an image intensifier. This is achieved by way of a unique electron multiplying structure built into the chip.

### THE INTENSIFIED CCD CAMERA (ICCD)

Andor first introduced an Intensified CCD (ICCD) camera into its range in 1995. Andor was the first company to offer a fully integrated ICCD that included a high performance delay generator, a high voltage gating unit in the camera head. Gating and amplification occur in an image intensifier tube similar to those used for night vision applications and allow isolation of phenomena as short as 2 ns.

### THE SCIENTIFIC CMOS (sCMOS) CAMERA

sCMOS is a breakthrough imaging technology innovation, introduced by Andor in 2010 with the launch of the flagship Neo 5.5 camera, offering an advanced set of performance features that renders it ideal to high fidelity, quantitative scientific imaging. sCMOS technology can be considered unique in its ability to simultaneously deliver on many key performance parameters, overcoming the ‘trade-offs’ associated with other scientific imaging technology standards and furthermore eradicating the performance drawbacks traditionally associated with CMOS imagers.
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<td>TYPICAL APPLICATIONS</td>
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Andor manufactures an extensive portfolio of high performance ultra sensitive imaging cameras, each widely considered to be ‘best in class’. Andor’s Electron Multiplying CCD (EMCCD), scientific CMOS (sCMOS) and CCD imaging detectors are defined not only by superior sensitivity and speed, but also by an outstanding reputation for quality and reliability.

The pioneers of single photon sensitive scientific EMCCD camera technology, Andor have consistently led this field with a solid track record of performance innovation. The recently launched iXon Ultra represents the latest advancements in EMCCD, offering superior speed, low noise sensitivity, application flexibility and user accessibility.

Based on breakthrough sCMOS technology, Andor’s Neo and Zyla cameras are uniquely capable of simultaneously offering ultra-low noise, fast frame rates, wide dynamic range, large field of view and high resolution, and are fast gaining a reputation as the new gold standard ‘workhorse’ imaging cameras of the ‘mid-range’ price bracket.
iXon Ultra 888 EMCCD

The world’s fastest megapixel back-illuminated EMCCD

The iXon Ultra 888 has been fundamentally re-engineered to facilitate 3x overclocking of the pixel readout speed to an unprecedented 30 MHz, whilst maintaining quantitative stability, accelerating the full frame performance to video rate. Furthermore, Andor’s unique ‘Crop Mode’ can be employed to further boost frame rates from a user defined sub-region, for example pushing a 512 x 512 sub-array to 93 fps and a 128 x 128 area to 697 fps.

With a 1024 x 1024 sensor format and 1.3 μm pixel size, the resolving power, field of view and unparalleled speed of the iXon Ultra 888 render it the most attractive and versatile EMCCD option for demanding applications such as single molecule detection, super-resolution microscopy, live cell imaging and high time resolution astronomy.

Additional features of the iXon Ultra 888 include high bandwidth USB 3.0 connectivity, a lower noise CCD mode and an additional Camera Link output, offering a unique ability to directly intercept data for ‘on-the-fly’ processing, ideally suited to applications such as adaptive optics. Simultaneously, the iXon Ultra maintains all the advanced performance attributes and rich customer requested feature set that have defined the iXon range to date, such as deep vacuum cooling to -95°C, extremely low spurious noise and EM Gain calibration.

Features
- 30 MHz readout delivering 26 fps at 1024 x 1024
  > 2.6x larger Field of View than ‘897’ model
- Optically Centered Crop Mode – Live Cell Super Resolution at 697 fps
- Single Photon Sensitivity
- EX2 Technology for wider QE response
- TE Cooling to -95°C

Zyla 5.5 and 4.2 sCMOS

Imaging without compromise

Andor’s Zyla sCMOS cameras offer high performance, high sensitivity imaging performance in a remarkably light and compact, TE cooled design. Zyla is ideally suited to many cutting-edge applications that push the boundaries of speed, offering sustained frame rate performance of up to 100 fps, faster with ROI.

A highly cost-effective USB 3.0 version is available offering 40 fps and 1.2 e- rms read noise, representing an ideal low light ‘workhorse’ upgrade camera solution for both microscopy and physical science applications, in either research or OEM environments.

Rolling and Global (Snapshot) shutter readout inherent to Zyla 5.5 ensures maximum application flexibility. Global shutter in particular provides an important freeze frame exposure mechanism that emulates that of an interline CCD, overcoming the transient readout nature of Rolling shutter mode.

Features
- Compact and light
- Engineered for max speed - 100 fps sustained
- Rolling and Global shutter modes
- Industry fastest USB 2.0 frame rates
- Ideal for research and OEM applications

Zyla 4.2 Features
- Engineered for max speed - 100 fps sustained
- > 72% Quantum Efficiency
- Industry fastest USB 2.0 frame rates
- Very low fan vibration
- Ideal for research and OEM applications
- LightScan PLUS mode

Neo 5.5 sCMOS

Imaging without compromise

The newest addition to the Andor sCMOS camera portfolio, the Zyla 4.2 utilizes a high Quantum Efficiency (QE), low noise sensor variant, yielding frame rates up to 100 fps (faster from region of interest). A new, industry fastest USB 3.0 version delivers an amazing 53 fps. The Zyla 4.2 is ideal for applications that benefit from optimal sensitivity and speed, such as calcium imaging, light sheet microscopy and super-resolution microscopy.

In addition, LightScan PLUS with FlexiScan and CycleMax is available on Zyla 4.2 designed to maximize signal and controllability in applications such as Scanned Light Sheet Microscopy and Line Scanning Confocal Microscopy.

Features
- The ONLY vacuum cooled sCMOS on the market
- 1 e- read noise
- UltraVac™ cooling to -60°C
- High dynamic range

Neo 5.5 sCMOS

Ultra Sensitive Imaging Cameras
iKon CCD Series

Large area, high QE, low noise, -100°C cooled CCD

The iKon slow scan CCDs offer industry-leading low-noise performance, alongside unparalleled thermoelectric cooling to -100°C, enabling better signal-to-noise at longer exposure times than other cameras on the market. The iKon series offers up to 5 MHz readout for rapid frame rate acquisition or fast focusing, along with direct USB 2.0 connectivity to PC.

The iKon platform includes a 1 megapixel NIR-enhanced Deep Depletion model, ideal for Bose-Einstein Condensation. The new ‘BEX2-DD’ deep depletion sensor from Sony®, the Clara is ideally suited to high-resolution cell microscopy.

Based around the popular ICX285 sensitivity interline CCD on the market, the Clara Interline CCD has been designed specifically for Photovoltic Inspection. The Clara Interline CCD is a revolutionary 4 megapixel, high-sensitivity interline CCD platform, delivering outstanding coverage available, from UV through to NIR.

The iKon-L is a revolutionary deep depletion version (standard and ‘BEX2-DD’) deep depletion near-IR version (standard and new extended ‘BEX2-DD’ deep depletion) range. The iKon-L is also available along with standard deep depletion and new field of view, resolution and dynamic range. The iKon-L is also available with standard deep depletion and new extended ‘BEX2-DD’ deep depletion sensor options. This platform is used widely across Astronomy and Bio-Imaging OEM applications.

Clara Interline CCD

Pushing interline further

Andor’s expertise in scientific camera performance optimization has been harnessed to deliver the highest sensitivity interline CCD on the market. Based around the popular ICC285 sensor from Sony®, the Clara is ideally suited to high resolution cell microscopy and OEM applications.

Specifications Overview

<table>
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<tr>
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<th>iKon Ultra B97</th>
<th>iKon S B60</th>
<th>Zyla 4.2 sCMOS</th>
<th>Zyla 5.5 sCMOS</th>
<th>Res 5.5 sCMOS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Active pixels (W x V)</strong></td>
<td>1392 x 1040</td>
<td>1392 x 1040</td>
<td>1288 x 1284</td>
<td>2048 x 2048</td>
<td>3502 x 2560</td>
</tr>
<tr>
<td><strong>Pixel size (W x H; μm)</strong></td>
<td>6.45 x 6.45</td>
<td>6.45 x 6.45</td>
<td>6.5 x 6.5</td>
<td>6.5 x 6.5</td>
<td>6.5 x 6.5</td>
</tr>
<tr>
<td><strong>Sensor area (mm)</strong></td>
<td>8.98 x 6.71</td>
<td>8.98 x 6.71</td>
<td>12.3 x 13.3</td>
<td>12.3 x 13.3</td>
<td>27.6 x 27.6</td>
</tr>
<tr>
<td><strong>Pixel well depth (e-, typical)</strong></td>
<td>18,000</td>
<td>18,000</td>
<td>100,000</td>
<td>100,000</td>
<td>100,000</td>
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<tr>
<td><strong>Maximum full frame rate (fps)</strong></td>
<td>11</td>
<td>11</td>
<td>3.0 @ 50 kHz</td>
<td>3.0 @ 50 kHz</td>
<td>2.9 @ 50 kHz</td>
</tr>
<tr>
<td><strong>Read noise (e-, typical)</strong></td>
<td>0.0003</td>
<td>0.0005</td>
<td>0.500 μV</td>
<td>0.0004 @ -100°C</td>
<td>0.000398</td>
</tr>
<tr>
<td><strong>Dark current (e- / pix / sec)</strong></td>
<td>6.5</td>
<td>6.5</td>
<td>11.4 @ 45°C</td>
<td>38 x 76</td>
<td>-</td>
</tr>
<tr>
<td><strong>Minimum sensor temp (°C)</strong></td>
<td>-55</td>
<td>-55</td>
<td>-100</td>
<td>100 (sustained)</td>
<td>100 (sustained)</td>
</tr>
<tr>
<td><strong>Digitalization</strong></td>
<td>14 x 16 bit</td>
<td>14 x 16 bit</td>
<td>3 @ 1 MHz</td>
<td>120 (burst)</td>
<td>16 bit (burst)</td>
</tr>
<tr>
<td><strong>Pixel readout rates (MHz)</strong></td>
<td>20, 10, 1</td>
<td>20, 10, 1</td>
<td>5 MHz</td>
<td>10 MHz</td>
<td>2.9 (at 50 kHz)</td>
</tr>
<tr>
<td><strong>PC interface</strong></td>
<td>USB 2.0</td>
<td>USB 2.0</td>
<td>Camera Link or USB 3.0</td>
<td>Camera Link or USB 3.0</td>
<td>Camera Link</td>
</tr>
<tr>
<td><strong>Sensor QE options</strong></td>
<td>SQ, B, VI, U5B, U6V, sCMOS</td>
<td>SQ, B, VI, U5B, U6V, sCMOS</td>
<td>SQ, B, VI, U5B, U6V</td>
<td>SQ, B, VI, U5B, U6V</td>
<td>SQ, B, VI, U5B, U6V</td>
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</table>
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<th>Neo sCMOS</th>
<th>Clara</th>
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<th>iKon-L</th>
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<tr>
<td>Live Cell Multi-Dimensional Microscopy</td>
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<tr>
<td>Super-Resolution Microscopy</td>
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<tr>
<td>Spinning Disk Confocal Microscopy</td>
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<td>•</td>
<td>•</td>
<td>•</td>
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<tr>
<td>Selective Plane illumination Microscopy (SPIM)</td>
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<td></td>
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<td>•</td>
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<td></td>
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<tr>
<td>Bioluminescence / Chemiluminescence</td>
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<td>Total Internal Reflection Fluorescence (TIRF)</td>
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</table>

**NOTE:** The applications listed above are those most commonly associated with the device shown. Should you have a particular application that is not listed, please consult with your Andor sales representative who can assist you in selecting the equipment best suited to your needs.
Scientific User’s References

Correlated cryo-fluorescence and cryo-electron microscopy with high spatial precision and improved sensitivity
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Ultrastructural Analysis of Nanogold-Labelled Cell Surface Molecules in Liquid by Atmospheric Scanning Electron Microscopy and Their Relevance in Cell Adhesion

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Extracellular Monomeric Tau is Sufficient to Initiate the Spread of Tau Pathology

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The SNARE complex from yeast is partially unstructured on the membrane
Su et al., Structure 16, 1138-1146

Quantum Efficiency Curves

Quantum Efficiency (QE) curves for iKon Ultra

Quantum Efficiency (QE) curves for iKon Ultra and iKon M

Quantum Efficiency (QE) curves for Neo and iKon eCMOS

Quantum Efficiency (QE) curves for Clara

Quantum Efficiency (QE) curves for Neo and Zyla eCMOS
High Energy Detection

We have taken our extensive range of high performance camera platforms and optimized them to suit the detection of high energy photons, thus maintaining our lead in this field by continually pushing the boundaries of detection. Our in-depth knowledge base enables us to tailor solutions from standard flanges to ‘one off’ bespoke solutions, all designed and built with Andor quality and reliability to deliver high camera performance as standard.

In this configuration, the sensor is directly exposed to incoming radiation. This ensures the highest Quantum Efficiency with enhanced spatial and energy resolution compared to indirect detection or X-ray film detection methods.

Direct Detection Cameras

Indirect Detection Cameras

Suitable for High Energy Detection through fibre-optic coupling interface.

‘Open Fronted’ Systems

‘Stand Alone’ Systems

‘Fiber Fronted’ System
**Direct Detection Cameras**

**Open Front’ Systems**

For interfacing directly to vacuum chambers

**Features**
- -100°C TE cooling
- Ultra low noise readout, multi-MHz readout platform
- Large area 2048 x 2048 pixel sensor on iKon-L 936
- High dynamic range and resolution
- Dual output on iKon-L 936 (high sensitivity or high capacity mode)
- Cropped sensor mode for rapid data acquisition
- Enhanced baseline clamp
- O-ring or knife-edge sealing options
- Deep Depletion option for enhanced hard X-ray detection
- Optional filter holder available
- USB 2.0 plug and play connectivity

**iKon SO Systems**

High energy imaging cameras
Andor’s iKon-M SO 934 and 4 megapixel iKon-L SO 936 CCD are ideal systems to interface directly to vacuum chambers for X-ray detection. The systems incorporate high-QE back-illuminated sensor options, optimized for direct X-ray detection.

**Newton SO Systems**

High energy Spectroscopy cameras
Andor’s spectroscopic Newton 920 and 940 CCD cameras are ideal systems to interface VUV spectrographs. The systems incorporate high-QE back-illuminated sensor options, optimized for direct X-ray detection.

**Stand Alone’ Systems**

Incorporate visible photon input window

The ‘Stand Alone’ cameras windows are designed to block visible light wavelengths and allow through X-rays, while maintain the Ultravac™ permanent vacuum performance.

These industry leading platforms cameras have been designed to maximize soft X-ray detection without compromise on our ground breaking platforms performance. The range has direct USB 2.0 connectivity for ease of use flexibility.

**Features**
- Soft X-ray detection
- High spatial resolution
- 200 µm Beryllium window to block visible and low energy photons
- Ultravac™ Technology
- Single photon energy resolution
- Deep Cooling -100°C
- Indirect variants available on request

**Indirect Detection Cameras**

Suitable for High Energy Detection through fiber-optic coupling scintillator interface

Andor’s fiber optic fronted cameras couple to scintillator screen modules for hard X-ray detection. The iKon-L HF allows access to a large field of view, while the new Zyla HF offers the highest resolution, fastest acquisition rate platform.

**Features**
- High frame rate, high resolution iCMOS options (Zyla iCMOS)
- Single photon sensitivity even with highly demanding tapers (iXon Ultra technology available)
- Custom relay tapers available on request
- Range of scintillators / phosphors available
- Detection coverage to beyond the Hard X-ray region

**NEW**

High energy Spectroscopy cameras
Andor’s iKon-M SO 934 and 4 megapixel iKon-L SO 936 CCD are ideal systems to interface directly to vacuum chambers for X-ray detection. The systems incorporate high-QE back-illuminated sensor options, optimized for direct X-ray detection.

**Features**
- -100°C TE cooling
- Ultra low noise readout, multi-MHz readout platform
- Large area 2048 x 2048 pixel sensor on iKon-L 936
- High dynamic range and resolution
- Dual output on iKon-L 936 (high sensitivity or high capacity mode)
- Cropped sensor mode for rapid data acquisition
- Enhanced baseline clamp
- O-ring or knife-edge sealing options
- Deep Depletion option for enhanced hard X-ray detection
- Optional filter holder available
- USB 2.0 plug and play connectivity
### Specifications Overview

<table>
<thead>
<tr>
<th>Model</th>
<th>Active pixels (H x V)</th>
<th>Pixel Size (W x H; μm)</th>
<th>Sensor area (mm)</th>
<th>Pixel well depth (μm, typical)</th>
<th>Maximum full frame rate (fps)</th>
<th>Read noise (e−, typical)</th>
<th>Dark current (e−, typical)</th>
<th>Vertical clock speeds (μs)</th>
<th>Minimum sensor temperature (°C)</th>
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<td>iKon-M 934 (SO)</td>
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<td>13.5 x 13.5</td>
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<td>0.500</td>
<td>10</td>
<td>0.00005</td>
<td>0.00009</td>
<td>12.8 to 14</td>
<td>-20</td>
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<td>Zyla S 5 (HF)</td>
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<td>0.00005</td>
<td>0.00009</td>
<td>12.8 to 14</td>
<td>-20</td>
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### Scientific User’s References

- **2013**
  - Optical control of hard X-ray polarization by electron injection in a laser wakefield accelerator
  - Tabletop Nanometer Extreme Ultraviolet Imaging in an Extended Reflection Mode using Coherent Fresnel Ptychography
  - Direct Detection S
  - Medusa⟩ and L
  - ‘Open Front’
  - Newton
  - Zyla 5 Series
  - HF Series
  - Soft X-ray Imaging
  - Hard X-ray Imaging
  - X-ray Diffraction (XRD)
  - X-ray Fluorescence (XRF)
  - Plasma Diagnostics
  - Lithography EUV (DHI)
  - Crystallography
  - X-ray Tomography / Tomography
  - Image Relay Systems (e.g., slit scanners, streak tubes)
  - Laser X Development

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### Quantum Efficiency Curves

- Quantum Efficiency (QE) curves for direct detection high energy cameras

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### Typical Applications Matrix

<table>
<thead>
<tr>
<th>DIRECT DETECTION</th>
<th>INDIRECT DETECTION</th>
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<tr>
<td>‘Open Front’</td>
<td>‘Filter-Optic’</td>
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- Soft X-ray Imaging
- Hard X-ray Imaging
- X-ray Diffraction (XRD)
- X-ray Fluorescence (XRF)
- Plasma Diagnostics
- Lithography EUV (DHI)
- Crystallography
- X-ray Tomography / Tomography
- Image Relay Systems (e.g., slit scanners, streak tubes)
- Laser X Development
The following diagram can be used as a guide to Andor’s broad capabilities in the area of high energy photon detection, demonstrating our ability to adapt our various high-performance camera platforms to meet a broad gamut of specific application and set-up requirements. Many of the camera types represented are available as standard products but please use Andor’s Customer Special Request (CSR) service to discuss other options within this diagram.
The iStar is Andor’s flagship intensified CCD platform for fast-gated, nanosecond, time-resolved imaging and spectroscopy, offering a feature-rich and yet robust tool to the research and industrial communities.

The iStar extracts the very best from CCD sensor and gated image intensifier technologies, achieving a superior combination of rapid acquisition rates, exceptional sensitivity down to a single photon and high timing and shuttering accuracy with a unique software-controlled, ultra-low jitter on-board Digital Delay Generator (DDG™).

The iZyla scientific CMOS-based platform combines nanosecond gating capabilities with ultra-high frame rates to tackle the challenges of fast Plasma imaging or Combustion studies.
### iStar

**Features**
- USB 2.0 connectivity
- 5 MHz readout platform
- Crop and Fast Kinetics ultrafast modes
- High-resolution sensors
- VUV-IR high QE, high-resolution Gen 2 and 3 Image Intensifiers
- True optical gating < 2 ns
- Low jitter, on-board Digital Delay Generator (DDG)
- Insertion delay as low as 19 ns
- Intelligate for > 1:108 On/Off ratios in UV
- 500 kHz sustained photocathode gating
- Thermo-Electric deep cooling to -40°C
- Ruggedized design for high shock and vibration sustaining conditions

**Features**
- Unrivalled capabilities for complex experiment control and ultra-precise synchronization.

Combined with Andor Mechelle spectrograph, the iStar 334T provides a unique detection solution for broadband, high-resolution LIBS spectroscopy.

### iZyla

**Features**
- Rapid frame rates - 120 fps full frame sustained
- 1.2 e- read noise - Lower detection limit than any CCD or interline-based ICCD
- 6.5 µm pixels - Extremely high resolution over a 16.6 x 14 mm field of view
- High-resolution Gen 2 and 3 Image Intensifiers
- Photocathode gating rate up to 30 kHz
- Minimum photocathode gating ≤ 3 ns
- C-mount coupling - two cameras-in-one - seamless switch between ns time-resolved imaging and non-gated low-light imaging
- PIV Mode - as low as 300 ns interframe
- Dynamic Baseline Clamp - ensures quantitative stability

**Features**
- Market leading high speed, high resolution and large field-of-view scientific CMOS
- Nanosecond time resolution with compact, high throughput, high resolution gated image intensifier units
- Maximizing signal-to-noise: high QE Gen2 and Gen3 photocathodes, low read noise floor and high repetition rate photocathode
- Ideal for fast Plasma Imaging, Combustion studies including LIF/PLIF and Particle Image Velocimetry (PIV)
## iStar Specifications Gen 2 and Gen 3 Image Intensifiers

### Gen 2

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<td>30 μm</td>
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<td>30 μm</td>
<td>30 μm</td>
<td>30 μm</td>
<td>30 μm</td>
</tr>
<tr>
<td>Phosphor type (decay time to 10%)</td>
<td>P43 (2 ms)</td>
<td>P43 (2 ms)</td>
<td>P43 (2 ms)</td>
<td>P43 (2 ms)</td>
<td>P43 (2 ms)</td>
<td>P43 (2 ms)</td>
</tr>
<tr>
<td>Relative intensifier gain</td>
<td>&lt; 200</td>
<td>&lt; 200</td>
<td>&lt; 200</td>
<td>&lt; 200</td>
<td>&lt; 200</td>
<td>&lt; 200</td>
</tr>
<tr>
<td>Maximum photocathode repetition rate (with intelligate™ OFF)</td>
<td>500 kHz</td>
<td>500 kHz</td>
<td>500 kHz</td>
<td>500 kHz</td>
<td>500 kHz</td>
<td>500 kHz</td>
</tr>
<tr>
<td>Maximum photocathode repetition rate (with intelligate™ ON)</td>
<td>500 kHz</td>
<td>500 kHz</td>
<td>500 kHz</td>
<td>500 kHz</td>
<td>500 kHz</td>
<td>500 kHz</td>
</tr>
<tr>
<td>Equivalent Background Illuminance (EBI)</td>
<td>&lt; 2 e-/pix/sec</td>
<td>&lt; 2 e-/pix/sec</td>
<td>&lt; 2 e-/pix/sec</td>
<td>&lt; 2 e-/pix/sec</td>
<td>&lt; 2 e-/pix/sec</td>
<td>&lt; 2 e-/pix/sec</td>
</tr>
</tbody>
</table>

### iStar Quantum Efficiency Curves

**Photocathode Quantum Efficiency (QE) curves for iStar Gen 2 models**

![Photocathode QE Curve](image1)

**Photocathode Quantum Efficiency (QE) curves for iStar Gen 3 models**

![Photocathode QE Curve](image2)
iZyla Specifications - Image Intensifier Units

<table>
<thead>
<tr>
<th>Photocathode Type</th>
<th>Wavelength Range (nm)</th>
<th>Photocathode QE (%)</th>
<th>Quantum Efficiency (QE) Curves for Gen 2 image intensifiers</th>
</tr>
</thead>
<tbody>
<tr>
<td>170-850</td>
<td>Gen 2 WE photocathode</td>
<td>≥ 47.5</td>
<td>Gen 2 W Photocathode</td>
</tr>
<tr>
<td>300-850</td>
<td>Gen 3 HVS photocathode</td>
<td>≥ 47.5</td>
<td>Gen 3 W Photocathode</td>
</tr>
</tbody>
</table>

iZyla Sensor Active Area

- Sensor active area: 2560 x 2160 pixels [16.6 x 3.5 mm]
- Effective aperture: Ø 17 mm
- Zyla Sensor: 2560 x 2160 pixels

Scientific User’s References

- Jeffrey M. Heavrin et al., Journal of Aerosol Science, volume 58
- Maria Slovag et al., Spectrochimica Acta Part B: Atomic Spectroscopy, volume 87
- Luisa Caneve et al., Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment

Typical Applications Matrix

<table>
<thead>
<tr>
<th>DH312T (USB 2.0)</th>
<th>DH320T (USB 2.0)</th>
<th>DH341T (USB 2.0)</th>
<th>DH340T (USB 2.0)</th>
<th>Zyla (Camera Link)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plasma Studies</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>Laser Induced Fluorescence (LIF, PLIF)</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>Time-Resolved Luminescence and Photoluminescence</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>Laser Induced Breakdown Spectroscopy (LIBS)</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>Transient Absorption</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>Particle Image Velocimetry</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>Laser Flash Photolysis</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>Time-Resolved Resonance Raman Spectroscopy (TRR)</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
</tbody>
</table>

- Should you have a particular application that is not listed, please consult with your Andor sales representative who can assist you in selecting the equipment best suited to your needs.
Our experience has enabled us to bring together the latest cutting-edge technology in the fields of sensors, electronics, optics, vacuum technology and software to deliver world-class, market-leading scientific Spectroscopy detection systems.

Andor's experience in manufacturing high-performance Spectroscopy systems spans over 20 years, with thousands of detectors in the field and a proud history of remarkable advances in a wide variety of research fields, truly helping scientists all over the world to "Discover new ways of seeing".

Spectroscopy Solutions

Newton and NewtonEM

Idus

Idus InGaAs

Hyperspectral

FAST MULTITRACK SPECTROSCOPY

PLASMA STIMULUS

HOLOSPHERE

Raman Spectroscopy

Absorption · Transmission · Reflection

Luminescence · Fluorescence · Photoluminescence

Laser Induced Breakdown Spectroscopy

Shamrock Spectroscopy Solutions

Spectroscopy Solutions Cameras
Newton and Newton<sup>EM</sup>

### Ground-breaking technology for Spectroscopy

Andor’s Newton cameras are ideally suited to high performance spectroscopic applications. They feature high-resolution spectroscopy sensors with up to 95% QE, USB 2.0 connectivity, multi-MHz low-noise electronics, TE cooling and Ultraloc™. Also available with Electron Multiplying CCD (EMCCD) technology for unsurpassed sensitivity.

<table>
<thead>
<tr>
<th>Features</th>
<th>iDus InGaAs</th>
<th>iVac</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak QE of 95%</td>
<td>Peak QE &gt; 85% (1.7 µm version) and &gt; 70% (2.2 µm version)</td>
<td>Low dark current, deep depletion, high resolution 15 µm pixel array, 30 mm wide sensor (416 model only)</td>
</tr>
<tr>
<td>Multi-megahertz Readout</td>
<td>Minimum operating temp of -100°C with TE cooling</td>
<td>Dual-AR technology - broadband UV-NIR, virtually etalon-free spectroscopy (420 model only)</td>
</tr>
<tr>
<td>Minimum operating temp of -100°C with TE cooling</td>
<td>Dual-AR technology - broadband UV-NIR, virtually etalon-free spectroscopy (420 model only)</td>
<td>16-bit digitization</td>
</tr>
<tr>
<td>Ultraloc™ guaranteed hermetic vacuum seal technology</td>
<td>USB 2.0 plug and play connectivity</td>
<td>USB 2.0 plug and play connectivity</td>
</tr>
<tr>
<td>High-resolution sensor matrix - 13.5 and 16 µm pixel options</td>
<td>Anti-fringing back-illuminated, back-thinned options (970 and 920 models only)</td>
<td>Anti-fringing back-illuminated, back-thinned options</td>
</tr>
<tr>
<td>EM sensor (970 and 971) models</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crop Mode operation for ultra-fast spectral acquisition</td>
<td></td>
<td></td>
</tr>
<tr>
<td>UltraVac™ guaranteed hermetic vacuum seal technology</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Features

- Peak QE of 95%
- Multi-megahertz Readout
- Minimum operating temp of -100°C with TE cooling
- Ultraloc™ guaranteed hermetic vacuum seal technology
- High-resolution sensor matrix - 13.5 and 16 µm pixel options
- EM sensor (970 and 971) models
- Crop Mode operation for ultra-fast spectral acquisition
- Dual output amplifiers (940 models) providing ‘High Sensitivity’ or ‘High Capacity’ modes
- Front and Back-illuminated sensors including Deep-Depletion option for enhanced NIR detection (920 model only)
- Dual-AR technology - broadband UV-NIR, virtually etalon-free spectroscopy (920 model only)
- 16-bit digitisation
- USB 2.0 plug and play connectivity
- Anti-fringing back-illuminated, back-thinned options (910 and 920 models only)
- Peak QE of 95%
- Multi-megahertz Readout
- Minimum operating temp of -100°C with TE cooling
- Ultraloc™ guaranteed hermetic vacuum seal technology
- High-resolution sensor matrix - 13.5 and 16 µm pixel options
- EM sensor (970 and 971) models
- Crop Mode operation for ultra-fast spectral acquisition
- Low dark current, deep depletion, high resolution 15 µm pixel array, 30 mm wide sensor (416 model only)
- Dual-AR technology - broadband UV-NIR, virtually etalon-free spectroscopy (420 model only)
- USB 2.0 plug and play connectivity
- Software selectable pre-amplifier gain
- Anti-fringing back-illuminated, back-thinned options

### iDus InGaAs

**InGaAs detector array for Spectroscopy**

Andor’s iDus InGaAs detector array systems feature USB 2.0 connectivity, low noise and high QE in the NIR wavelength region, with a detection limit of 1.7 or 2.2 µm. The TE-cooled, in-vacuum sensors reach cooling temperatures of -90°C, where best Signal-to-Noise ratio can be achieved.

<table>
<thead>
<tr>
<th>Features</th>
<th>iDus InGaAs</th>
<th>iVac</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak QE &gt; 85% (1.7 µm version) and &gt; 70% (2.2 µm version)</td>
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<td>Low dark current, deep depletion, high resolution 15 µm pixel array, 30 mm wide sensor (416 model only)</td>
</tr>
<tr>
<td>Low noise and high QE in the NIR wavelength region, with a detection limit of 1.7 or 2.2 µm</td>
<td>Dual-AR technology - broadband UV-NIR, virtually etalon-free spectroscopy (420 model only)</td>
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</tr>
<tr>
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<td>USB 2.0 plug and play connectivity</td>
<td>16-bit digitization</td>
</tr>
<tr>
<td>16-bit digitisation</td>
<td></td>
<td>USB 2.0 plug and play connectivity</td>
</tr>
<tr>
<td>Software selectable output amplifiers</td>
<td></td>
<td>Anti-fringing back-illuminated, back-thinned options</td>
</tr>
<tr>
<td>USB 2.0 plug and play connectivity</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Features**

- Peak QE > 85% (1.7 µm version)
- Minimum operating temp of -90°C with TE cooling
- Ultraloc™ guaranteed hermetic vacuum seal technology
- 16-bit digitization
- Software selectable output amplifiers
- USB 2.0 plug and play connectivity
- Exposure times as low as 1.4 µs
- Lowest propagation delay of 2.95 µs

### iVac

**Compact, research-grade OEM Spectroscopy platform**

Andor’s iVac combines NIR enhanced front and back-illuminated sensors, high resolution sensor matrix, Andor’s renowned Ultraloc™, TE cooling interface, and USB 2.0 connectivity to ensure high performance and reliability over time.

<table>
<thead>
<tr>
<th>Features</th>
<th>iVac</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak QE of 95%</td>
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<td>USB 2.0 plug and play connectivity</td>
<td></td>
</tr>
<tr>
<td>Software selectable pre-amplifier gain</td>
<td></td>
</tr>
<tr>
<td>Anti-fringing back-illuminated, back-thinned options</td>
<td></td>
</tr>
</tbody>
</table>

**Features**

- NIR enhanced front-illuminated and back-illuminated deep-depletion sensor
- NIR peak QE of up to 65% (front-illuminated) and 95% (back-illuminated)
- Ultraloc™ guaranteed hermetic vacuum seal technology
- 16-bit digitization
- USB 2.0 plug and play connectivity

- 60°C air cooled performance
- Ruggedized shake-proof connectors
- USB 2.0 plug and play connectivity
- 16-bit digitization
- Software selectable output amplifiers
- USB 2.0 plug and play connectivity
### Specifications Overview

#### Active pixels
- **Newton CCD DU917P**: 1024 x 1024
- **Newton EMCCD DU917P**: 1024 x 1024
- **iDus**: 1024 x 1024
- **iDus InGaAs**: 1024 x 1024

#### Pixel size (W x H: μm)
- **Newton CCD DU917P**: 13.5 x 13.5
- **Newton EMCCD DU917P**: 13.5 x 13.5
- **iDus**: 13.5 x 13.5
- **iDus InGaAs**: 13.5 x 13.5

#### Sensor area (mm²)
- **Newton CCD DU917P**: 16 x 16
- **Newton EMCCD DU917P**: 16 x 16
- **iDus**: 16 x 16
- **iDus InGaAs**: 16 x 16

#### Read noise (e-, typical)
- **Newton CCD DU917P**: ≤0.002
- **Newton EMCCD DU917P**: ≤0.002
- **iDus**: ≤0.002
- **iDus InGaAs**: ≤0.002

#### EM gain (typical highest)
- **Newton CCD DU917P**: ≤0.0003
- **Newton EMCCD DU917P**: ≤0.0003
- **iDus**: ≤0.0003
- **iDus InGaAs**: ≤0.0003

#### Spectral sensitivity (μm)
- **Newton CCD DU917P**: 1.7 μm
- **Newton EMCCD DU917P**: 1.7 μm
- **iDus**: 1.7 μm
- **iDus InGaAs**: 1.7 μm

### Specifications Overview

#### Active pixels
- **Newton CCD DU917P**: 1024 x 1024
- **Newton EMCCD DU917P**: 1024 x 1024
- **iDus**: 1024 x 1024
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- **Newton CCD DU917P**: 1.7 μm
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- **iDus**: 1.7 μm
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### Quantum Efficiency Curves

#### Quantum Efficiency (QE) curves for Newton and iDus cameras

![Quantum Efficiency Curve](image_url)

#### Quantum Efficiency (QE) curve for iDus InGaAs

![Quantum Efficiency Curve for iDus InGaAs](image_url)
ANDOR TECHNICAL KNOW-HOW EXTENDS FAR BEYOND MARKET-LEADING PERFORMANCE DETECTORS WITH A COMPREHENSIVE RANGE OF HIGH-END SPECTROGRAPHS.


These instruments can be seamlessly integrated with Andor’s world-class range of CCDs, Electron-Multiplying CCDs, Intensified CCDs, InGaAs cameras and single point detectors to offer both versatility and by far the most sensitive modular solutions on the market. Andor Solis software offers the most user-friendly and state-of-the-art, real-time control of detectors, spectrograph and motorized accessories at the touch of a button.

Spectroscopy Solutions Spectrographs

Shamrock 163

Shamrock 193i

Shamrock 303i

Shamrock 500i

Shamrock 750

HoloSpec

Mechelle 5000
Mechelle 5000

High bandpass Echelle spectrograph for LIBS

Andor’s Mechelle spectrograph provides simultaneous recording of a wide wavelength range (200 - 975 nm) with high spectral resolution in one acquisition. Based on the echelle grating principal, its patented optical design provides extremely low crosstalk. It is designed to operate with both Andor’s DU934 iKon camera and the DH334T iStar intensified camera in applications such as LIBS and plasma studies.

Features
- Pre-aligned, pre-calibrated instrument
- Compact and rugged design
- Astigmatism-corrected optical design
- High repetition rate shutter
- Pre-aligned, pre-calibrated optics

Shamrock 163

Versatile compact benchtop spectrograph

The Shamrock 163 is the most compact research-grade Czerny-Turner spectrograph on the market. Its 163 mm focal length, high F/0.6 aperture and wide range of seamlessly interchangeable gratings, slits and light coupling accessories make it the ideal tool for general benchtop spectroscopy measurements.

Features
- Compact and rugged design with horizontal and vertical mounting positions
- Seamless connection to microscopes
- Seamless connection to microscopes
- High throughput optical design
- Wide range of interchangeable gratings for optimization of wavelength range and resolution
- Auto-temperature correction
- Varieties of fixed slits for optimization of resolution
- Large choice of light coupling interfaces
- Silver-protected coated optics options

HoloSpec

On-axis high throughput imaging spectrograph

High throughput spectrograph with superb high-density multi-track spectroscopy capabilities. Robust and compact design based on low stray-light transmission virtual phase holographic (VPH) grating.

Features
- High throughput optical design
- High collection efficiency ultrafast F/1.8 aperture
- Low scattered light
- Compact and rugged design
- Easily interchangeable accessories
- Specialized Raman grating options
- Optional integrated Rayleigh filtering unit

Shamrock 303i, 500i and 750

High-resolution, research-grade spectrograph series

The longer focal length Shamrock series is designed for working with demanding low-light applications, but equally suited to day-to-day routine measurements. It offers highly versatile platforms with multiple input/output ports and seamless interfacing to microscopes for modular micro-spectroscopy setups integration.

Features
- Adaptive Focus (patent pending)
- Dual-grating turret with RFID technology
- Astigmatism-corrected optical design
- Dual detector outputs
- USB interface
- Silver-protected coated optics options

Shamrock 193i

Intelligent, modular and compact imaging spectrograph

Andor’s compact imaging spectrograph boasts Active Focus technology, fully motorized, RFID-tagged dual grating turret, dual detector output ports and seamless interfacing to microscopes for modular micro-spectroscopy setups integration.

Features
- Pre-aligned, pre-calibrated spectrograph systems
- Image astigmatism correction with toroidal optics (303i and 500i)
- All-in-one interactive and dedicated Solis software
- USB 2.0 interface
- Single Point Detectors for scanning applications up to 15 µm (Shamrock 500i & 750i)

HoloSpec

On-axis high throughput imaging spectrograph

High throughput spectrograph with superb high-density multi-track spectroscopy capabilities. Robust and compact design based on low stray-light transmission virtual phase holographic (VPH) grating.

Features
- High collection efficiency ultrafast F/1.8 aperture
- On-axis imaging-corrected design
- High throughput optical design
- Low scattered light
- Compact and rugged design
- Easily interchangeable accessories
- Specialized Raman grating options
- Optional integrated Rayleigh filtering unit

Mechelle 5000

High bandpass Echelle spectrograph for LIBS

Andor’s Mechelle spectrograph provides simultaneous recording of a wide wavelength range (200 - 975 nm) with high spectral resolution in one acquisition. Based on the echelle grating principal, its patented optical design provides extremely low crosstalk. It is designed to operate with both Andor’s DU934 iKon camera and the DH334T iStar intensified camera in applications such as LIBS and plasma studies.

Features
- Pre-aligned, pre-calibrated instrument
- Seamless connection to microscopes
- Compact and rugged design
- Astigmatism-corrected optical design
- High repetition rate shutter
- Monochromator capabilities

Shamrock Motorized Spectrographs

NEW

Shamrock 163

Versatile compact benchtop spectrograph

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Shamrock 303i, 500i and 750

High-resolution, research-grade spectrograph series

The longer focal length Shamrock series is designed for working with demanding low-light applications, but equally suited to day-to-day routine measurements. It offers highly versatile platforms with multiple input/output ports, large range of field-replaceable and motorised accessories configurable at the touch of a button.

Features
- Pre-aligned, pre-calibrated spectrograph systems
- Image astigmatism correction with toroidal optics (303i and 500i)
- All-in-one interactive and dedicated Solis software
- USB 2.0 interface
- Single Point Detectors for scanning applications up to 15 µm (Shamrock 500i & 750i)
Typical Applications Matrix

<table>
<thead>
<tr>
<th>Shamrock 163</th>
<th>Shamrock 193</th>
<th>Shamrock 303i, 500i and 750</th>
<th>Heliospec</th>
<th>Michelles 5000</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Absorption</strong></td>
<td><strong>Transmission</strong></td>
<td><strong>Reflection</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Raman</strong> (Stimulated, Resonance, CARS, SERS, SORS, TERI)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Luminescence</strong> / Fluorescence / Photoluminescence</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Micro-Fluorescence and Micro-Raman</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Single Molecule Spectroscopy</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Multi-track Spectroscopy</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Laser Induced Breakdown Spectroscopy (LIBS)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

NOTE: The applications listed above are those most commonly associated with the device shown. Should you have a particular application that is not listed, please consult with your Andor sales representative who can assist you in selecting the equipment best suited to your needs. * With lens-based correction accessories for Shamrock 163 and 750.

Shamrock Spectrograph Grating Efficiency Curves *

Specifications Overview

<table>
<thead>
<tr>
<th>Shamrock 163</th>
<th>Shamrock 193i</th>
<th>Shamrock 303i</th>
<th>Shamrock 500i</th>
<th>Shamrock 750</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Focal length (mm)</strong></td>
<td>163</td>
<td>193</td>
<td>303</td>
<td>500</td>
</tr>
<tr>
<td><strong>Aperture</strong></td>
<td>f/4.6</td>
<td>f/4.6</td>
<td>f/4.6</td>
<td>f/4.6</td>
</tr>
<tr>
<td><strong>Field plane size (W x H)</strong></td>
<td>30 x 30</td>
<td>30 x 30</td>
<td>30 x 30</td>
<td>30 x 30</td>
</tr>
<tr>
<td><strong>Multi-track capabilities</strong></td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Resolution (nm)</strong> *</td>
<td>0.25</td>
<td>0.25</td>
<td>0.21</td>
<td>0.10</td>
</tr>
<tr>
<td><strong>Slit sizes</strong></td>
<td>10 µm - 200 µm</td>
<td>10 µm - 200 µm</td>
<td>10 µm - 200 µm</td>
<td>10 µm - 200 µm</td>
</tr>
<tr>
<td><strong>Grating types</strong></td>
<td>Single grating (interchangeable)</td>
<td>Dual grating (interchangeable)</td>
<td>Triple grating (interchangeable)</td>
<td>Triple grating (interchangeable)</td>
</tr>
<tr>
<td><strong>Communication</strong></td>
<td>Manual</td>
<td>Manual</td>
<td>USB 2.0</td>
<td>USB 2.0</td>
</tr>
<tr>
<td><strong>Bandpass (nm)</strong> *</td>
<td>4.7 x 10^5</td>
<td>4.7 x 10^5</td>
<td>4.7 x 10^5</td>
<td>4.7 x 10^5</td>
</tr>
<tr>
<td><strong>Shutter speed (Hz)</strong></td>
<td>2 Hz</td>
<td>2 Hz</td>
<td>2 Hz</td>
<td>2 Hz</td>
</tr>
</tbody>
</table>

* Please note other gratings are available on request.

* With lens-based correction accessories for Shamrock 163 and 750.

* With high dispersion “532 nm Stokes / Anti-Stokes” grating.

* With 27.6 mm wide CCD e.g. Newton DU940.

* With 50 µm input slit and 13.5 µm pixel CCD e.g. Newton DU940.

* With “785 nm low frequency” grating

* With “532 nm low frequency” grating.

* With “785 nm low frequency” grating.

* With high dispersion “532 nm Stokes / Anti-Stokes” grating.
MODULAR APPROACH TO COMBINED MICROSCOPY AND SPECTROSCOPY

Adding structural and chemical spectral analysis to microscopy images of bio-samples such as cells and proteins, or materials such as polymers or semi-conductors, is in ever increasing demand amongst the research community. Andor’s range of modular interfaces features cage systems couplers, allowing endlessly configurable connections between Andor Shamrock spectrographs and a wide range of market leading microscopes such as Nikon, Olympus and Zeiss inverted series. The Shamrock “wide-aperture” slit opens the door to a single setup with a single detector to image the sample, whilst allowing spectral information collection through the same optical path from the microscope.

![Shamrock 193i, 303i, 500i, 750](https://example.com/shamrock.png)

**Features**

- C-mount interfaces
  - Shamrock spectrograph integration to market leading upright and inverted microscopes
- Microscope feet
  - Precisely match Shamrock spectrograph optical height for accurate opto-mechanical coupling
- Wide aperture slit
  - Allows high-quality sample image relay through Shamrock imaging spectrographs, and collection of spectral information through the same optical channel
- Cage System Compatibility
  - Thorlabs or Linos ‘cage systems’ compatible interfaces
- EMCCD compatible
  - Andor NewtonEM and iXon Ultra enable a unique combination of single photon sensitivity and high spectral rate and frame rate for challenging low-light Spectroscopy

**Accessory Tree**

Shamrock 193i, 303i, 500i, 750

- C-mount adapter
- Optical cage system adapter
- Cage system - microscope flange
- Fixed FC fiber adapter
- Fixed SMA fiber adapter
- SMA single fiber
- FC single fiber
- 12 mm Aperture
- 50 µm Aperture
Scanning Monochromator Accessories

This addition to the Andor Spectroscopy portfolio provides a perfect complement to Andor’s extensive range of market leading CCD, InGaAs ICCD and EMCCD detectors.

Shamrock spectrograph dual detector output configurations allow a combination of multiple detectors for acquisition from 180 nm to 12 μm in one single setup. Soils scanning software is a dedicated single interface for seamless setup and synchronization of single point detectors, spectrographs, monochromators data acquisition unit and lock-in amplifiers, with an intuitive interface for complex experiment acquisition sequences.

### Features
- Extended detection to LWIR region - up to 12 μm sensitivity
- Comprehensive software experiment builder - pre-acquisition programming of complex wavelength scanning sequences including synchronization of gratings and filters, shutters and up to two detectors and monochromators
- Dedicated software for scanning monochromators application
- Time main software acquisition modes - scanning, photon counting and time-resolved / lifetime analysis

### Specifications Summary

<table>
<thead>
<tr>
<th>Detector Type</th>
<th>Wavelength Coverage</th>
<th>Active Area (mm)</th>
<th>Cooling</th>
<th>Function</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>MCT*</td>
<td>2 - 12 μm</td>
<td>1 x 1</td>
<td>LN2</td>
<td>HPV power supply for PMT</td>
<td>Software-controlled lock-in amplifier and chopper options</td>
</tr>
<tr>
<td>InGaAs**</td>
<td>185 - 900 nm</td>
<td>Ø 11.28</td>
<td>Uncooled</td>
<td>Photon counting unit for PMT</td>
<td>Monochromator IR optics coatings - optional silver coated mirrors and gratings for maximum efficiency in the near-infrared and infrared region</td>
</tr>
<tr>
<td>PbS</td>
<td>0.8 - 2.9 μm</td>
<td>Ø 3</td>
<td>LN2 TE</td>
<td>Software-selectable discrimination thresholds</td>
<td></td>
</tr>
<tr>
<td>InSb*</td>
<td>0.8 - 2.9 μm</td>
<td>Ø 3</td>
<td>Uncooled</td>
<td>LN2</td>
<td>Standard gold-plated focusing optics for MCT and InGaAs</td>
</tr>
<tr>
<td>MCT</td>
<td>2 - 12 μm</td>
<td>1 x 1</td>
<td>LN2</td>
<td>Data acquisition unit</td>
<td>** Including gold coated focusing mirror for maximum collection efficiency</td>
</tr>
<tr>
<td>InGaAs**</td>
<td>185 - 900 nm</td>
<td>Ø 11.28</td>
<td>Uncooled</td>
<td>USB 2.0 interface, 2x SPD acquisition channels, 2x analog output for PMT, HV power supply control and connections to lock in amplifier**</td>
<td></td>
</tr>
<tr>
<td>PbS</td>
<td>0.8 - 2.9 μm</td>
<td>Ø 3</td>
<td>Uncooled</td>
<td>Software-controlled, 0 to 1.5 kV</td>
<td></td>
</tr>
<tr>
<td>InSb*</td>
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<td>Ø 3</td>
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<td>Software-controlled, 0 to 1.5 kV</td>
<td></td>
</tr>
</tbody>
</table>

### Scientific User’s References

- **Prototype instrument development for non-destructive detection of pesticide residue in apple surface using Raman technology**

- **Metal-organic coordination using one of nature’s tricks to control soft material mechanics**

- **Photophysical Properties of the Excited States of Bacteriochlorophyll F1 in Solvents and in Chlorosomes**

- **A combined Raman-fluorescence spectrometric probe for tissue diagnostics applications**
  - Riccardo Zicca et al., Proc. SPIE 7998, Clinical and Biomedical Spectroscopy and Imaging VI, doi:10.1117/12.2031370

- **Anatomical variability of in vivo Raman spectra of normal oral cavity and its effect on oral tissue classification**
  - M. Ariana et al., Biomedical Spectroscopy and Imaging 210, doi:10.1039/C3TB21374A

- **Effect of the laser and light-emitting diode (LED) phototherapy on midpalatal suture bone formation after rapid maxilla expansion: a Raman spectroscopy analysis**

- **Method for Assessing the Reliability of Molecular Diagnostics Based on Multiplexed SERS-Coded Nanoparticles**

- **Monitoring angiogenesis using a human comparable calibration for broadband near-infrared spectroscopy**

- **Ophthalmic Raman sensor for simultaneous detection of the toxicity and quality of alcoholic beverages**

- **Raman spectroscopy and imaging to detect contaminants for food safety applications**
  - A. Chen et al., Proc. SPIE 8721, Sensing for Agriculture and Food Quality and Safety X, doi:10.1117/12.2005679

- **Single-nanoparticle detection and spectroscopy in cells using a hyperspectral darkfield imaging technique**

- **The influence of surface properties on the plasma dynamics in radio-frequency driven oxygen plasma: Measurements and simulations**

- **Rational Assembly of Optoelectronic Helium/Ion nanoparticle Arrays with Tunable Photonic–Plasmonic Resonances**

**Note:** Referenced articles are from 2013 to 2014.
Our microscopy systems business is focused on providing best-in-class performance within a modular architecture. We design and manufacture Andor products to integrate with our own and third-party software, and in combination with high quality products from other manufacturers.

Solutions include laser-based spinning disk confocal microscopy for live cell imaging, a simple laser-free confocal solution and devices for photo-bleaching, activation, conversion and ablation. We also support techniques such as TIRF, calcium ratio imaging, FRET, anisotropy and bioluminescence.

A dedicated "specials" engineering team will develop custom configurations and components to address your specific requirements, and our field support infrastructure now has a global presence.

**Microscopy Systems**

- Revolution WDi
- Revolution XD Family
- Custom Imaging Systems

**Revolution WDi**

The versatile laser cell confocal solution

**Revolution XD Family**

The Andor Revolution XD is a family of flexible system solutions focused on multidimensional live cell imaging

**Custom Imaging Systems**

Configure systems for a range of applications with our component-oriented approach

**Active Illumination Devices**

- MicroPoint
- Mosaic3
- FRAPPA

**UV / Vis Light Sources**

- AMH-200 Series (Metal Halide)
- XLED1
- 405 nm Highpower Laser
- DG-4

**Microscopy Systems Components**

- iXon Ultra and iXon3 EMCCD
- Neo and Zyla sCMOS
- CSU-W1
- CSU-X1
- Borealis upgrade for CSU10, 21/22 & X
- DSD2
- Laser Combiner and Multi-Port Unit
- Precision Controller Unit
- iQ3 and Imaris Workstation
- Camera port adapters
- Filter wheels and splitters
- Motorized XYZ Control
- Stage Incubator

**Revolution DSD2**

The personal confocal imaging unit
Different tools are required to answer different questions. Now you can answer more questions about a sample during the same experiment. The multi-modal Diskovery platform combines options for imaging the same areas in your samples:

- Multi-point confocal
- Dual color TIRF
- Widefield imaging
- Single molecule imaging

...with Borealis illumination.

- Highly uniform illumination
- Optimized for low photo-toxicity
- Dual-camera ready
- Field-of-view optimized for both EMCCD and sCMOS

Stable and reliable illumination sources and detectors are the backbone of all imaging systems. Diskovery is available with up to seven lasers ranging from the blue to the near infrared, selected from a broad range of Lasers to meet the needs of any application. Diskovery’s dual camera functionality offers up to 14 x 14 mm field of view, enabling optimized use of high resolution large area sCMOS detectors or ultra high sensitivity EMCCDs.

Multi-point confocal imaging is not limited to fast 2D confocal imaging of photo sensitive samples. When implemented properly, multi point confocal is capable of highly confocal, quantitative imaging in a wide range of samples producing superb 2D images and stunning 3D sectioning while still exhibiting the hallmark sensitivity required for 4D analysis of live samples.

Features
- Two pinhole sizes and patterns per disk
- 4 different sized fields of illumination
- Motorized widefield bandpass
- Confocal imaging up to 1000 fps
- Borealis quality illumination with < 10% variation across image
- Any laser combinations possible with no excitation dichroic
- Dual-camera ready
- 14mm diagonal field-of-view optimized for EMCCD and sCMOS
- Low laser power at sample
- Low phototoxicity
- Easily removable and interchangeable disk assemblies

Total Internal Reflection Fluorescence
Discover the dynamic world of activity 100 nm from your coverslip with Diskovery’s multi-channel TIRF functionality.

What is TIRF?
Total Internal Reflection Fluorescence microscopy is a well-established tool for examining molecular activity at the cell membranes / coverslip interface giving very high contrast and 100 nm resolution. As it is often necessary to study these molecules in the context of their surrounding environment the Diskovery system combines its unique methods of Borealis widefield Illumination with its multicolor TIRF imaging mode with only 3 ms switch times. This provides a virtually instantaneous representation of TIRF imaging overlaid with the high quality Borealis widefield illumination.

Unique TIRF Features
- Single fiber and one pathway for imaging multiple wavelengths without changing alignment
- Patented control of TIRF penetration depth without moving the fiber
- One command places all wavelengths at the same TIRF penetration depth for simultaneous or sequential imaging
- Precise alignment and control with superb repeatability
- Reflected laser excitation is captured to reduce stray light and reduce noise
- Supports polarized excitation and emission separation
- TIRF performance optimized from excitation to emission
- Does not require specialized TIRF filter cubes
- System designed with all TIRF applications in mind

Key Applications
- 3D/4D confocal imaging
- Deconvolution microscopy
- FRET microscopy
- Quantitative FRAP
- Image-based correlative spectroscopy
- Multi-wavelength photoactivation
- Optogenetics

Image showing Widefield imaging (top) and TIRF imaging (bottom) from the same sample, system switchover between widefield and tirf modalities is at the push of a button.

Mouse embryos imaged using Diskovery with an Andor iXon EMCCD. The image on the left was further rendered using Imaris software from Bitplane.
**Borealis**  
**Critical Illumination Solution**

Exclusive to Andor, Borealis is revolutionizing laser illumination for a broad range of imaging techniques including spinning disk confocal, TIRF, and super-resolution. Critically, Borealis is delivering a highly uniform field of illumination across a broad spectrum range into the near infra-red, previously unseen in the aforementioned techniques.

<table>
<thead>
<tr>
<th>Features</th>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uniformity improvements of up to 10x</td>
<td>Best in class image quality</td>
</tr>
<tr>
<td>Throughput improvements up to 3x (for some CSU models)</td>
<td>Better performance for quantitative analysis and image manipulation</td>
</tr>
<tr>
<td>Improved optical sectioning</td>
<td>Improved signal to noise for higher contrast images</td>
</tr>
<tr>
<td>Broader range of magnification</td>
<td>Deeper imaging</td>
</tr>
<tr>
<td>Extended wavelength range</td>
<td>Broader choice of fluorescence probes</td>
</tr>
<tr>
<td>400-750 nm excitation</td>
<td>Avoid autofluorescence</td>
</tr>
<tr>
<td>Flexible bellows coupling</td>
<td>Lower laser powers required</td>
</tr>
<tr>
<td>Optimal, strain-free alignment and vibration isolation (e.g. for AFM)</td>
<td>More power for high power applications</td>
</tr>
</tbody>
</table>

**Features**

- Uniformity improvements of up to 10x
- Throughput improvements up to 3x (for some CSU models)
- Improved optical sectioning
- Broader range of magnification
- Extended wavelength range
- 400-750 nm excitation
- Flexible bellows coupling
- Optimal, strain-free alignment and vibration isolation (e.g. for AFM)

**Benefits**

- Best in class image quality
- Better performance for quantitative analysis and image manipulation
- Improved signal to noise for higher contrast images
- Deeper imaging
- Broader choice of fluorescence probes
- Avoid autofluorescence
- Lower laser powers required
- More power for high power applications
- Vibration isolation for image stability (e.g. for AFM)

The benefit of a highly uniform illumination is a significant improvement in image analysis across the entire field of view. It is also critical to algorithm-based techniques such as super-resolution and accurate interpretation of the entire image. Qualitatively, Borealis delivers superior image quality in terms of full field visualization and montage imaging of large samples.

**New**

The benefit of Borealis on intensity and illumination uniformity. The intensity profile across the field of view with a standard CSU is clearly uneven; Borealis delivers uniform image illumination with higher intensity. As the wavelength increases, so does the degree of non-uniformity seen with a conventional CSU. Borealis remains consistently uniform across the spectrum.

**Backwards Compatibility**

Borealis can be retrospectively fitted to Revolution WD and XD, and third party systems using Yokogawa's CSU-W1, CSU-10, 21, 22 and X1.

Upgrade your system to extend its capabilities and enhance your research. Capture clearer images, image deeper, and use more of the spectrum.
Revolution XD Family

The Andor Revolution XD is a family of flexible system solutions focused on high-speed, high-sensitivity imaging.

The Revolution XD is the ultimate solution for high speed, high sensitivity live cell confocal imaging at high magnifications. Perfect for applications such as ion imaging, vesicle tracking and other detailed fast cellular dynamics. The inclusion of Borealis illumination further enhances image quality and more choice over experimental design.

Andor’s award winning iXon EMCCD cameras and our own laser combiners are the perfect partners to the Revolution series, delivering outstanding sensitivity and speed. When you need the highest resolution available, then choose one of our Zyla sCMOS cameras. In manufacturing the core components we can ensure optimum performance and reliability.

Experience tells us that almost every customer is unique in their application requirements. We pride ourselves in flexible hardware configurations in order to deliver the best system solutions.

Revolution WD

The Andor Revolution WD is the ultimate solution for the diverse range of samples used in live cell imaging. Equipped with Andor’s Borealis illumination, the Revolution WD offers more than the standard Yokogawa® unit, delivering better imaging results for your research.

The Revolution WD is the ultimate solution for high speed, high sensitivity live cell confocal imaging at high magnifications. Perfect for applications such as ion imaging, vesicle tracking and other detailed fast cellular dynamics. The inclusion of Borealis illumination further enhances image quality and more choice over experimental design.

Andor’s award winning iXon EMCCD cameras and our own laser combiners are the perfect partners to the Revolution series, delivering outstanding sensitivity and speed. When you need the highest resolution available, then choose one of our Zyla sCMOS cameras. In manufacturing the core components we can ensure optimum performance and reliability.

Experience tells us that almost every customer is unique in their application requirements. We pride ourselves in flexible hardware configurations in order to deliver the best system solutions.

Revolution XDh

Combine full system choice with an upright microscope.

Features
- Highest speed and/or resolution with iXon Ultra and Neo sCMOS
- Ultimate sensitivity with iXon EMCCD and Yokogawa® CSU-X1 spinning disk
- Study live specimens with reduced fluorophore concentrations or expression levels
- Minimal perturbation of physiological events
- Fast multi-dimensional image capture
- Dual-camera and optical splitters for simultaneous multi-channel imaging and anisotropy
- Micro-plate, multi-field and montage imaging
- Ultimate multi-dimensional visualization and analysis with Imaris from Bitplane

Key Applications
- Cell Division
- Cell Motility
- Ion Imaging
- Neurophysiology
- Cell Signaling

Revolution WD

The Revolution WD is the ultimate solution for the diverse range of samples used in live cell imaging. Equipped with Andor’s Borealis illumination, the Revolution WD offers more than the standard Yokogawa® unit, delivering better imaging results for your research.

Versatility
With 4x the field of view of the Revolution XD, and optimized pinholes, the Revolution WD delivers outstanding performance and versatility. It is the perfect solution for imaging large as well as small samples, and capturing deep into your specimens. The Revolution WD is the perfect match for core facilities that handle a broad range of samples from the researchers they serve.

Diversity
With a choice of pinhole size, the Revolution WD now delivers confocal imaging at low magnifications as well as high. This benefit means that we can offer stunning image performance in research fields such as developmental biology, stem cell research, embryology and neuroscience. These fields often require low power objectives due to the size of sample, and need to image deep whilst maintaining high contrast confocal images.

The Revolution WD can rival the more traditional point scanners for deep imaging, whilst delivering higher dynamic range and faster imaging speeds. This is truly a new confocal experience for your research.

Features
- Fast confocal imaging for live cell studies
- 4x field of view for larger sampling
- Confocal imaging at low and high magnification
- High contrast imaging of thick samples
- Simple bypass mode for brightfield or widefield imaging
- Variable aperture to match field of illumination to camera
- Minimal perturbation of physiological events due to low illumination powers required
- NIR imaging port for deeper imaging and far red fluorophores
- Photo-bleaching and activation - study diffusion and transport of labelled molecules
- Photo-ablation of cells, organelles and filaments - perturb and observe

Key Applications
- Developmental Biology
- Stem Cell Research
- Neuroscience
- Embryology
- Intra-vital Imaging

Regenerating cholinergic motorneurons in the nematode C.elegans.
Left Image - Dual labelled nematode. Right Image - Shows axons cut using an Andor MicroPoint pulsed dye laser.
Collaboration with T. Edwards, Hammarlund Laboratory, Yale School of Medicine.

Andor Technology, Inc. 3281 Central Park Blvd. Germantown, MD 20876 USA
Phone: +1 301-442-8900 | Fax: +1 301-293-6295 | Email: info@andro.com | Website: www.andor.com
Andor Technology Europe, 376 Oldfield Road, Egham, Surrey, TW20 9AW, United Kingdom
Phone: +44 1784 410 410 | Fax: +44 1784 410 411 | Email: info@andro.co.uk | Website: www.andor.co.uk
Andor Technology Australia, Unit 1/187-217 Altona North Road, Altona North, Victoria 3025, Australia
Phone: +61 3 9390 1599 | Fax: +61 3 9390 1598 | Email: info@andro.com.au | Website: www.andor.com.au

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**Revolution DSD2**

The **Revolution DSD2** is an innovative hybrid of spinning disk technology and structured illumination. This unique approach is laser-free and delivers a budget-friendly confocal solution to your lab, offering less dependency on laser-based solutions that are often restricted to core facilities.

A simple device, which can even be added to your existing fluorescence microscope in your lab, the Revolution DSD2 will benefit your research by delivering confocal images as a routine technique in your work.

Whilst laser-free, the Revolution DSD2 can still achieve the optical sectioning and image quality you expect of a complex laser scanning confocal system, but with lower maintenance costs. Furthermore, it does not need an expert to run it!

Andor has designed the Revolution DSD2 system with our best-in-class sCMOS camera, Zyla, the AMH 200 W DC-stabilized metal halide source and Andor iQ workstation with optional Piezo Z stages. These components are integrated seamlessly to perform 5D and 6D imaging, and the system can be fitted to most makes and models of inverted and upright microscopes.

**Features**
- Real-time control and viewing
- Full spectrum, laser-free (380-650 nm)
- Excellent confocality
- High dynamic range
- Cost effective
- Suitable for live and fixed tissues, cells and embryos
- Integrates with most microscopes
- Zyla sCMOS – best-in-class camera
- Mosaic3 – macroscope compatible

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**Active Illumination Devices**

**FRAPPA**

**Photo-Bleach and Activate**

Andor’s **FRAPPA** uses a dual galvanometer scan head to provide a computer-controlled laser beam delivery system. By utilizing the ALC’s range of lasers the FRAPPA provides unrivalled Fluorescence Recovery After Photo-bleach (FRAP) and Photo-activation (PA) flexibility. The FRAPPA provides diffraction limited performance and can be configured in-line with a CSU or on other ports.

**Features**
- All ALC laser lines available for FRAP and PA actions
- <10 ms switch over from Imaging to FRAP
- Arbitrary multi-region scanning of points, rectangles and polygons
- Integration with flexible protocols for 3D FRAPPA localization and analysis

**MicroPoint**

**Laser Illumination and Ablation**

**MicroPoint** is a pulsed laser delivery, which utilizes a pulsed N2 laser to pump a dye cell resonator, yielding pulsed laser output at more than 20 user-exchangeable wavelengths ranging from 365 to 656 nm.

**Features**
- Simultaneous laser delivery and image acquisition
- Ablation, uncaging, activation and bleaching
- 365 - 656 nm - adapt to specific targets
- Incremental control of pulse energy

**Mosaic3**

**Simultaneous multi-region light targeting**

The Mosaic3 active illumination system utilizes digital mirror device (DMD) technology to control the illumination field of a fluorescence microscope. Using a choice of illumination sources, Mosaic3 achieves real time and near diffraction limited resolution.

Unlike traditional galvoscanning systems, where pixels are addressed sequentially, Mosaic3 can simultaneously and precisely excite multiple regions of interest with complex geometries and allow simultaneous imaging.

Operating from 365-830 nm, Mosaic3 is unique yet flexible. Mosaic3 SDK offers access to software independent high speed pattern sequencing, ideal for applications such as optogenetics that mimic high speed cell signaling. Greyscale is also available for detailed pattern illumination such as required in photolithography.

**Features**
- Unlimited flexibility in shape and complexity of illumination mask
- No scanning - simultaneous illumination of multiple regions of interest
- Create complex pattern sequences with software independent recall (e.g., TTL)
- High speed pattern recall (up to 5,000 fps)
- Greyscale capability
- Applications include channelrhodopsin, glutamate uncaging and photoactivation
- Available with 475 mW 405 nm laser

**Microscopy Systems**
Microscopy Systems Components

iXon Ultra EMCCD

The market leading back-illuminated EMCCD (Supercharged)

Facilitated by a fundamental redesign, the iXon Ultra platform takes the principal back-illuminated, single photon sensitive EMCCD sensors and delivers readout up to an amazing 30 MHz, whilst maintaining quantitative stability.

The ‘897’ model pushes the popular 512 x 512 sensor to 56 fps. iXon Ultra include USB connectivity and direct raw data access for ‘on the fly’ processing. EMCCD and conventional CCD readout modes provide heightened application flexibility, with a new ‘low and slow’ noise performance in CCD mode.

Features
- 56 fps @ 30 MHz (888)
- 56 fps @ 17 MHz (897)
- Unique Ultrafast Optimally Centred Crop Mode (697 fps with 128 x 128 ROI (888))
- EX2 Technology offers extended QE response
- Direct Data Access for ‘on the fly’ processing
- USB 3.0 (888) & USB 2.0 (897)
- Fringe Suppression reduces etaloning in NIR
- UltraVac™ cooling to -100ºC
- OptAcquire one-click optimization
- Count Convert calibrates in electrons or photons
- Lower noise CCD amplifier

Clara Interline CCD

Pushing interline further

Andor’s expertise in scientific camera performance optimization has been harnessed to deliver the highest sensitivity interline CCD on the market. Based around the popular ICX285 sensor from Sony®, the Clara is ideally suited to high-resolution cell microscopy and OEM applications.

Features
- 26 fps @ 30 MHz (888)
- 56 fps @ 17 MHz (897)
- Unique Ultrafast Optimally Centred Crop Mode (697 fps with 128 x 128 ROI (888))
- EX2 Technology offers extended QE response
- Direct Data Access for ‘on the fly’ processing
- USB 3.0 (888) & USB 2.0 (897)
- UltraVac™ cooling to -100ºC
- OptAcquire one-click optimization
- Count Convert calibrates in electrons or photons
- Lower noise CCD amplifier

Zyla 5.5 and 4.2 sCMOS

Imaging without compromise

Andor’s 2.3 micromega pixel sensors offer high speed, high sensitivity imaging performance in a remarkably light and compact, TE cooled design. Zyla is ideally suited to many cutting-edge applications that push the boundaries of speed, offering sustained frame rate performance of up to 100 fps, faster with ROI’s.

A highly cost-effective USB 3.0 version is available offering 40 fps and 1.2 e- rms read noise, representing an ideal low light ‘workhorse’ upgrade camera solution for both microscopy and physical science applications, in either research or OEM environments.

Rolling and Global (Snapshot) shutters, with 1 e- read noise, represent an ideal low-light ‘workhorse’ upgrade camera solution for both microscopy and physical science applications, in either research or OEM environments.

Features
- UltraVac™ cooling to -100ºC
- Quantum Efficiency performance.
- EX2 Technology offers extended QE response
- USB 3.0 (888) & USB 2.0 (897)
- UltraVac™ cooling to -100ºC
- OptAcquire one-click optimization
- Count Convert calibrates in electrons or photons
- Lower noise CCD amplifier

Neo 5.5 sCMOS

Imaging without compromise

In a -40ºC vacuum cooled platform, with 1 e- read noise, very low dark current, Rolling and Global Shutter, and loaded with FPGA intelligence, Andor’s Neo sCMOS camera is designed to drive optimal performance from this exciting and innovative new technology development.

The Neo 5.5 model is based around a large 5.5 megapixel sensor with 6.5 µm pixels and a 22mm diameter, ideal for applications such as cell microscopy, astronomy, digital pathology and high content screening. The Neo 5.5 can deliver 30 fps sustained or up to 100 fps burst to internal 4GB memory. Extremely low dark current means Neo 5.5 is suited to a range of exposure conditions.

The Rolling and Global shutter flexibility further enhances application flexibility with Global shutter in particular offering an ideal means to simply and efficiently synchronize the Neo with other ‘moving’ devices such as stages or light switching sources and eliminating the possibility of spatial distortion when imaging fast moving objects.

Features
- The ONLY vacuum cooled sCMOS on the market
- 1 e- read noise
- UltraVac™ cooling to -40ºC
- High dynamic range

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**Laser Combiner and Multi-Port Unit**

Compact, flexible robust

The new ALC-601 introduces a number of improvements and feature additions to meet the demands of a developing market. The ALC can house up to six solid state laser lines from 405 - 640 nm, and the optional Multi-Port Unit facilitates fast switching between up to three channels permitting use of the laser combiner with confocal imaging, FRAPPA and TIRF.

- **Features**
  - Hardware blanking minimizes specimen exposure
  - Long life solid state lasers with excellent stability (typical ± 0.5% peak to peak)
  - Up to six solid state lasers (from 405, 445, 488, 491, 515, 532, 594, 640 nm)
  - Powers from 50 - 250 mW depending on wavelength
  - Individual on/off power control of lasers to maximize laser life if not being used.
  - Up to three output ports for multiple devices
  - Direct TTL control available for selected wavelengths
  - Compact 19” rack mount enclosure

**Camera Port Adapters**

Andor couplers are designed to ensure optimal 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.

- **Features**
  - Single Port Coupler Features
    - Magnification X = 1.0, 1.2, 1.5, 2.0 (others by request)
    - Compatible with filter wheel or CSU + filter wheel
    - Achromatic 450-650 nm
    - AR-coated
    - Transmission > 98%
  - adjustable XY centering
  - Sliding barrel focus control
  - Bypass mode built-in

**Stage Incubator**

The CO2 Microscope Stage Incubator (MSI) is a very compact solution to create a suitable environment for cell cultures right on the microscope stage, allowing cells to proliferate as well as they do in a regular bench-top incubator. Humidifying and preheating options prevent medium evaporation and avoid condensation.

- **Features**
  - Available for Piezo inserts
  - Electric, water, and cryo options
  - Options include heating and cooling between 10 to 50°C and regulation down to ±0.1°C
  - CO2 range adjustable between 0% and 100%
APZ-X00
Piezo Z-Stage

Specifically designed for researchers utilizing deconvolution and 3D imaging, the APZ-X00 offers 100 μm, 200 μm, 250 μm and 500 μm travel models. The APZ-X00 provides rapid and precise movement of the specimen container. The 250 μm and 500 μm versions can accept a micro-plate insert for multi-well scanning.

Features
- 100 μm, 200 μm, 250 μm and 500 μm travel range
- Accuracy / Linearity of 0.5% of travel
- Stage control via Analog (± 10 VDC), USB and RS232
- Setting time of 0.04 s
- Inserts for slides, Petri dishes and microtiter plates
- Output-Position Signal 0.0 - 10.0 V

Piezo Objective Control

Motorized XY Control

UV / Vis Light Sources

XLED1

LED light source for fluorescence microscopes

The XLED1 light source from Lumen Dynamics is the perfect solution for live cell applications. With high speed on/off cycling, fine intensity control and the ability to synchronize with other image capture devices for multiparameter imaging, you can be sure of protecting your live samples from phototoxicity and bleaching.

The XLED1 is the ideal partner for the Andor Mosaic device used for applications such as optogenetics, photoactivation, switching/conversion.

Features
- Wavelength range 360 – 750 nm
- Switching time: TTL 10 μs; USB 1 ms
- Intensity control 0-100% - 1% resolution
- Optional touch screen controller
- Easy switch LED/Dichroic for additional wavelengths

DG-4

Fast switching filter-based Xenon source

The Lambda DG-4/DG-5 is a complete illumination system offering speed and versatility for experiments requiring rapid wavelength switching. The instrument retains all the advantages of interference filter-based systems, yet eliminates temporal constraints imposed by traditional filter changing devices like filter wheels.

Switching between any two wavelengths is achieved in less than 1.2 ms. This facilitates the ability to follow fast changes in ion concentrations in dual wavelength ratio imaging applications and to monitor changes in the studied system at additional wavelengths.

Features
- Wavelength range 340 - 700 nm (Xenon 150 or 300 W)
- 1.2 ms switching time and 500 μs shutter
- Synchronized operation with Fast L2 imaging
- Liquid Light Guide coupling
- Choice for fast Calcium ion imaging
- Compatible with DSS2
- TTL, RS232, Parallel control interfaces

UV / Vis Light Sources

MICROSCOPY SYSTEMS

Features
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- Easy switch LED/Dichroic for additional wavelengths

Piezo PIFOC®
P721 - 100 μm travel
PI PIFOC® P725 - 400 μm travel
Setting time can be tuned to < 10 ms
1.25 nm resolution
Analogue or digital control
Oil and water objectives

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1.25 nm resolution
Analogue or digital control
Oil and water objectives
Microscopes

Diverse Compatibility

Andor products are compatible with modern infinity corrected microscopes from Leica, Nikon, Olympus or Zeiss to meet your preferred configuration. If you require environmental control we recommend temperature and CO2 control incubators from Okolab.

Focus drift can severely affect time-lapse movies and is especially important in confocal and TIRF imaging, where focus and illumination are tightly constrained. Andor IQ software supports all manufacturers focus drift correction (FDC) solutions, providing long-term drift-free imaging of live cell samples.

Although microscope manufacturers produce quality solutions, it is possible to improve speed and convenience of some features with third-party devices. One example is the transmitted light source, which is traditionally a quartz halogen (WH) incandescent lamp.

WH lamps produce heat, so they affect thermal stability as well as transmit extreme wavelengths harmful to cell health. In addition, they have slow shutters and short life spans. We recommend replacing these with an LED (white or narrow band), which can be switched on and off in microseconds without any vibration.

Features

- Support for Leica, Nikon, Olympus and Zeiss
- Configurations for inverted and upright instruments
- Specials for fixed stage “physiology” platforms
- Focus drift compensation support – PFS, ZDC, ZDC2
- Control microscope motorization
- Motorized TIRF illumination for multi-channel imaging
- Vibration isolation tables

Supported Microscopes Include

- Leica DM range
- Nikon FE, inverted
- Nikon TE2000, 1300 – legacy inverted
- Nikon F1 fixed stage
- Olympus IX71, 81 inverted
- Olympus IX73, 83 inverted
- Olympus BX51, BX53, BX55
- Olympus BX55WI, BX61WI – upright physiology
- Zeiss AxioObserver – inverted
- Zeiss AxioImage A1 – upright
- Zeiss Axiovert 200MOT – legacy inverted
- Zeiss AxioImager, Axioskop II MOT – legacy upright

iQ3 and Imaris Workstation

Optimized PC Workstation for Live Cell Work

Handling, processing and visualizing multidimensional images is very computer intensive. The Andor iQ3 and Imaris workstation is a high end desktop PC optimized for use with iQ3 and Imaris as well as handling large data sets that arise from experiments employing Andor systems and cameras.

Features

- High speed 4D, 3D and 2D imaging
- Industry leading 3D visualization and analysis
- Acquisition bandwidth for dual camera support
- ImageLink removes dependency on RAM for huge datasets
- Control and analysis of photo-stimulation experiments

Typical Applications

Matrix

<table>
<thead>
<tr>
<th>Resolution WD</th>
<th>Resolution XD</th>
<th>Resolution OS</th>
<th>Andor CIS</th>
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<tbody>
<tr>
<td>Calcium and Ion Imaging (Note: Fura 2 ratio imaging is only possible with Andor CIS)</td>
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<td>Fluorescent Protein Dynamics, e.g. Translocations</td>
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<td>Development e.g. C. elegans, Drosophila</td>
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<td>Cytokeleton and Membrane Dynamics</td>
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<td>Fad Cell Component Tracking (e.g. vesicles)</td>
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<td>Membrane Trafficking, Ends and Eos-Cytoxis</td>
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<tr>
<td>Nuclear Organization and Dynamics</td>
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<td>New Methods With Q Dots and Nano-Particles</td>
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<td>Imaging Combined With Electrophysiology</td>
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<tr>
<td>Viral Infection and Translocation</td>
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<td>Mobility and Chemotaxis Assays</td>
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<td>Bistimunescence</td>
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<td>Immunofluorescence</td>
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<td>Super-Resolution Localization Microscopy, e.g. PALM, STORM</td>
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<td>Stem Cell Research (e.g. colonies and 3D cultures)</td>
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<td>Embryology</td>
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<td>Tissue Store Preparations (e.g. neuronal)</td>
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<td>Infra-Vital Imaging</td>
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<td>Plant Tissue</td>
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Active Illumination Application Matrix

<table>
<thead>
<tr>
<th>FRAP</th>
<th>Micropoint</th>
<th>Mosaic3</th>
</tr>
</thead>
<tbody>
<tr>
<td>FRAP GPP, RFP, YFP</td>
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<tr>
<td>Channel Rhodopsin = 400, 480, 540nm</td>
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<td>Dendra, Rati, EOS = 400nm</td>
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<tr>
<td>Photosensitive GPP</td>
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<tr>
<td>Photoactivating (cAMP, Calcium, FITC)</td>
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<tr>
<td>Ablation = 365nm</td>
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<tr>
<td>DNA Damage</td>
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</tbody>
</table>

Scientific User’s References

- Januschke J. et al., Nature Communications, Volume 2, article 243
- Telley J. et al., Nature Protocols, Volume 8, pages 310-324
- The Role of Active Tumour in Retrangi-Action Neurons: A Pathway in Neuronal Growth Cones
- Gardy K. et al., Science, Volume 340, 1475-1478
- An inverse relationship to germline transcription defines centromeric chromatin in C. Elegans
- Gatsiaro F. et al., Nature (Lett), Volume 484, 534-537
- Drosophila neurotactin relates the daughter centrosome
- Lenoir J. et al., Nature Communications, Volume 2, article 243
Research imaging and spectroscopy applications demand powerful software tools to provide everything from instrument control to acquisition, visualization and analysis of large data volumes. Andor has invested heavily in software over recent years and offers a range of world-class software solutions targeting our core markets of imaging, spectroscopy and multi-dimensional microscopy.
Acquisition and Analysis Software for the Comet Assay - Research and GLP

Komet software allows the capture and analysis of images from the Comet Assay. The Comet Assay permits the quantification of DNA damage and repair in single cell preparations and is applicable to any eukaryotic cell. The assay can be used in both in-vitro and in-vivo testing and has been shown to be a powerful and sensitive predictor of genetic toxicity.


Features
- Software control of wide range of cameras from sCMOS to video, Firewire (IEEE1394) and USB
- Large Field of View options with Andor sCMOS integration - faster scoring option
- "Virtual Camera" - scores live images from any camera you already own
- LED light sources - replace mercury bulbs with safe, efficient, long-life illumination
- Certified Windows 7 compatibility - Windows 8.1 coming soon
- Fast and easy to use - pop-up controls accelerate scoring and minimize fatigue
- Fully automatic or interactive computation of Head Tail %DNA, Tail Length, Olive Tail moment, etc.
- Background correction for every cell scored
- User-friendly, freely distributed Database Viewer (DBV) application
- Datasets include all comet images, parameters and audit trails

Komet 7

Solis 64

Camera control and analysis

Solis 64 is Andor’s camera control and analysis software platform, with versions specifically designed to run Imaging, Spectroscopy and Time-Resolved cameras as well as their associated accessories. All camera parameters can be configured through the straightforward setup dialogues. Solis 64 provides considerable ease of use, state-of-the-art data acquisition, display and processing capabilities with a minimal learning curve. The 64-bit architecture can make use of all available PC RAM for storing image frames. This increases the total number of frames captured to memory by orders of magnitude.

Features
- Real-time image / spectral display, ideal for aligning experiments
- Advanced data spooling direct to hard disk, allowing large data sets to be acquired
- Increase your signal above the read noise floor with RealGain™, EMCCD gain control
- Kinetic series recording and playback
- Comprehensive and real-time multiple ROI analysis, including live stats and plot generation
- Various real-time and playback display options, including 2D, 3D, stacked and overlaid
- Comprehensive data analysis and arithmetic operations
- Extensive export options, including TIF, BMP, AVI, GRAMS, ASCII, FITS
- Intuitive and comprehensive user-defined thresholding and auto-scaling
- Data histogram enabling easy image display data scaling
- Full experiment and camera control within the same package
- Improved signal-to-noise with the "Integrate On Chip" function
- Real-time Photon Counting mode enables observation of data build at very low flux levels
- Intuitive and dedicated GUI for Shamrock spectrophotograph real-time control

Solis Imaging

Solis Imaging is optimized for image capture and analysis and is used in a wide range of scientific fields including fluorescence imaging, Bose-Einstein Condensation, single fluorophore labelling, upper atmosphere studies and X-ray studies.

Solis Spectroscopy

For Raman, LIBS, photoluminescence, plasma diagnosis or other spectroscopic applications, Solis Spectroscopy has been tailored to enable quick configuration of acquisition, including exposure time, number of exposures, readout rates and binning parameters. Data capture, display and processing is all performed through this user-friendly package.

Solis Scanning

Solis Scanning offers a dedicated platform for scanning monochromator applications. Monochromators, detectors, data acquisition unit, lock-in amplifier / chopper and motorized accessories can all be conveniently synchronised through a series of intuitive interfaces.

Solis Time-Resolved

Solis Time-Resolved enables specific control of the iStar camera range. Applications include Laser Induced Breakdown Spectroscopy (LIBS), Laser Induced Fluorescence (LIF), combustion and Time-resolved Resonance Raman Spectroscopy.
**iQ3**

Multi-dimensional imaging with Python IDE

Andor iQ is our flagship live cell imaging software. iQ3 delivers a radical new user interface to simplify the capture of many routine multi-dimensional image capture protocols. The focus is on minimizing the time required to learn iQ as well as being able to navigate and edit experiments as quickly as possible. The latter is a key requirement for live cell imaging and greater productivity.

iQ3 has been designed with core facilities in mind, not just reducing training time, but also providing user accounts for managing user settings, file access and also usage reporting to help with facility financial tracking. For long-standing iQ users, who rely on the powerful flexible protocol structure for complex multi-modal experiments, this is retained with a simple toggle button between the new and traditional user interfaces.

**Features**

- Routine and advanced imaging protocol user interfaces available
- Multi-dimensional at its core – from fast time-lapse to 5D / 6D imaging
- User account management for settings and activity reporting
- Online data charting for ratiometric imaging
- Multi-well and Micro-plate scanning
- Dual camera acquisition - 50 full frames per second (iXon Ultra)
- Integrated Python environment for user programming
- Smooth integration with Imaris for deep analysis

**New iQ3**

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- Smooth integration with Imaris for deep analysis

**Ovariole of Drosophila melanogaster showing germarium and early stage egg chambers. Green: F-actin stained with Alexa Fluor® 488 phalloidin. Blue: DNA stained with DAPI. Courtesy of Dr. Eurico Sá, Molecular Genetics group, IBMC, Porto, Portugal**

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**Imaris**

The ultimate tool for data management, analysis and visualization of multidimensional images.

Imaris offers you a fully integrated workflow from data management and searching to image visualization, analysis and exploration of single / 2D+ / time images. Imaris Arena, Surpass and Vantage - will naturally guide you through the stages of the Scientific Method.

At your disposal you have a fully integrated platform which allows you to organize/explore your data, visualize it, (batch) analyze it, test hypotheses and present your conclusions in the best possible manner. The Arena view is Imaris’ central hub and it keeps track of (and allows you to search for) all images, experiments, plots, image analysis protocols and results.

Surpass is an interactive 3D/4D work environment where you can visualize and analyze your images - thus creating an image analysis protocol. Vantage is a multi-dimensional results plotting and exploration tool - ideal to test hypothesis.

**Features**

- Arena View (tag, search and manage all image data related resources)
- New Imaris Batch
- Imaris Batch fully integrated into the Arena view
- Imaris Administrator Section
- Floating License Opt-In
- Dark Theme GUI
- Context/View dependent menus

**Imaris 8.1**

Freedom to Discover

Imaris 8.1 expands its reach both upstream and downstream from the visualization and analysis of single 2D+ / time images. Imaris Arena, Surpass and Vantage - will naturally guide you through the stages of the Scientific Method.

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Andor has worked with a number of third-party software companies to include support for our cameras and other products in their software. For further information on the latest versions of Andor’s third-party software packages, which are compatible with Andor products please visit andor.com/software/software_support/

Andor also offers drivers for the following popular ‘development environments’:
- National Instruments – LabVIEW
- MathWorks – MATLAB
- Bruxton - SIDX

Third-party compatible software includes:
- Metamorph, MetaFluor and MM NX from MDS (Universal Imaging)
- μManager – open source ImageJ compatible (micro-manager.org)
- Nikon Elements
- Olympus cell ^M / R family
- Leica LAS and MM AF
- ImagePro from Media Cybernetics
- Imaging Workbench from Indec Biosystems
- EPICS
- Slidebook from IIT

The next generation of MetaMorph software streamlines the workflow for all tasks and provides an entirely new user-focused interface. With one-click access to features, integrated hardware setup, and synchronized, unobstructed views of your data, you can become an imaging expert in minutes.

Features
- “Ribbon” interface for convenient access to commonly used options
- Selectable context specific acquisition modes
- Easy installation and configuring of microscope devices
- Multi-threading for software interaction during acquisition
- Live data review and analysis
- Settings recall function from previous experiments
- Improved the speed of acquisitions

Typical Applications

<table>
<thead>
<tr>
<th>Komel 7</th>
<th>IQ</th>
<th>Imaris</th>
<th>Sells</th>
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<tbody>
<tr>
<td>Data Acquisition</td>
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<td>Live Cell Confocal Microscopy</td>
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<td>Physical Sciences Imaging</td>
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<td>Bose-Einstein Condensation (BEC)</td>
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<td>Single Molecule Detection / Tracking</td>
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<td>Advanced Volume / Surface Rendering</td>
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