Andor Spectroscopy
Product Portfolio

Engineered from the outset with ease-of-use in mind, every Andor spectroscopy system features a combination of market leading detectors and spectral instruments, seamlessly controlled through Andor’s dedicated and intuitive Solis software platform. From configuration of these pre-aligned, pre-calibrated instruments to integration into each unique laboratory set-up, Andor spectroscopy solutions allow researchers around the world to focus quickly on their own challenges: achieving high quality results and breakthrough discoveries.

1. Detectors
Market leading CCDs, InGaAs PDAs, Intensified CCDs and Electron-Multiplying CCDs for VUV to NIR spectroscopy. Unsurpassed combination of cutting-edge TE cooling, proprietary vacuum technology and ultra-low-noise electronics to extract the very best performance from every Andor camera.

2. Spectrographs
Complete family of rugged, pre-aligned and pre-calibrated Czerny-Turner, Echelle and transmission spectographs, for applications ranging from high-resolution UV plasma studies to NIR photonics/kinescence. The ideal partner for Andor’s high-performance detectors and accessories for ultimate low-light detection.

3. Accessories
From gratings to fiber optics, sample chambers and filter wheels, each accessory allows seamless optimization of Andor detection system performance and easy integration into researchers complex experimental setups. Andor also offers a range of single point detectors including PMTs, Si photodiode, InSb, PbS, InGaAs and MCT for extension into the Short and Long-Wave IR.

4. Microspectroscopy
Modular, seamlessly upgradable microspectroscopy solutions. Large range of microscope coupling accessories including direct C-mount and ‘cage’ system, microscope height matching feet sets and spectrograph wide-aperture slit for large field imaging of sample and spectroscopy analysis through the same optical path.

5. Software
Solis Spectroscopy and Solis Scanning offer interactive and dedicated graphical interfaces for simultaneous multichannel or single point detector data acquisition, as well as spectrographs and motorized accessories control.

1. Detectors
2. Spectrographs
3. Accessories
4. Microspectroscopy
5. Software

NEW 6. Kymera 328i
Andor’s new intelligent highly modular imaging spectograph with Adaptive Focus and Truflex™ technology, ideal for a wide range of applications (e.g. material/nano-material science, chemical processes, life science/medical or plasma studies).

NEW 7. iStar sCMOS
Andor’s new intelligent highly modular imaging spectograph with Adaptive Focus and Truflex™ technology, ideal for a wide range of applications (e.g. material/nano-material science, chemical processes, life science/medical or plasma studies)

NEW 8. Zyla sCMOS
Achieving up to 27,000 spectra/s with ultra low readout noise, the Zyla offers unique platform to study fast transient spectral phenomena, fast hyperspectral imaging or multi-track spectroscopy while maintaining high dynamic range.
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 28 years, with thousands of detectors in the field and a proud history of remarkable advances in a wide variety of research areas, truly helping scientists all over the world to discover new ways of seeing.

A Charge Coupled Device, or CCD, is a 2D matrix of silicon diode photo-sensors referred to as “pixels”. Incident photons with sufficient energy are absorbed in the silicon bulk and liberate an electron, which can be stored and detected as part of a readout sequence. Photons with wavelength >1.1 μm do not have enough energy to create a free electron and therefore set the upper detection limit of silicon CCDs.

The probability of detecting a photon at a particular wavelength is known as Quantum Efficiency (QE). QE will vary with depletion depth of the silicon, quality of the CCD structural layers and clocking electrodes “transparency”.

At the end of an exposure, the CCD pixel charges are transferred sequentially under a masked area known as the shift register. This serial register connects to an amplifier that digitizes the signal and allows a quantitative readout of the amount of electrons per pixel.

Unless protected, cooled CCD, EMCCDs or InGaAs sensors will condense moisture, hydrocarbons and other gas contaminants. Exposed to such outgassed contaminants when cooled, the Quantum Efficiency of sensors will decline proportionally. Andor’s Ultravac™ offers the following benefits:

- Maintenance-free operation in laboratory or in-field over extended periods of time, unlike liquid nitrogen (LN2) cooled platforms that require hazardous and regular manual Dewar refills.
- Operating temperatures of the chip can be reduced significantly. Better cooling with an enhanced thermoelectric (TE) Peltier design translates into substantially lower darkcurrent and fewer “hot” blemishes.
- No peak QE and sensor cooling performance degradation over many years operation. Andor Ultravac™ technology offers an MTBF (mean time between failure) of more than 100 years.

CCD Basics

A camera Signal-to-Noise Ratio (commonly abbreviated to S/N or SNR) is the true comparison basis between detectors and detector technologies. It takes into account both the photon capture capability of the detector and the different noise sources along the detection path that can impact on the integrity of the useful signal. The sources of this noise are the following:

- Readout noise
- Inherent sensor electron-to-voltage conversion and amplification noise
- Thermal noise
- Originating from sensor, blackbody radiation (SWIR region) or image intensifier photocathode
- Photon noise / Shot noise
- Statistical incoming photon variation
- Spurious Charge / Clocking Induced Charge (CIC)
- Result of impact ionization during charge transfer

\[
\text{Noise}_{\text{total}} = \sqrt{ \text{Noise}_{\text{readout}}^2 + F^2 \cdot G^2 \cdot (\text{Noise}_{\text{shot}}^2 + \text{Noise}_{\text{photo}^2} + \text{Noise}_{\text{therm}}^2)}
\]

F = amplification noise factor
G = amplification gain

Making sense of sensitivity: signal-to-noise ratio considerations

- CCD Sensitivity is shot noise and readout noise limited - typically used at slow digitization speeds
- EMCCD Sensitivity is shot noise and CIC limited – typically used for photon-starved and ultrafast spectroscopy
- ICCD Sensitivity is shot noise and photocathode thermal noise (EBI) limited – typically used for ns time-resolution

Benefits of Ultravac™ technology for research-grade cooled detectors

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Andor has been taking pride in helping researchers around the world achieve breakthrough discoveries for the last 28 years. By keeping at the forefront of detector technology, Andor is able to offer a range of market leading high-performance, ultra sensitive spectroscopy detectors. Our CCDs, ICCDs, EMCCDs, sCMOS and InGaAs arrays can operate from the VUV to Near-Infrared spectral regions with a unique combination of high sensitivity (down to single photon in the case of EMCCD technology) and ultrafast acquisition speeds.

### CCD

**Workhorse Broadband Platform Newton CCD, iDus CCD**

A two dimensional silicon-based semiconductor matrix of photosensors, with sensitivity ranging from soft X-ray to NIR (1.1 μm). Spectroscopy CCDs are traditionally a rectangular format with a maximum width of 30 mm and a height up to 13 mm, i.e., matching the focal plane size of the majority of high-end spectrographs.

**Electron Multiplying CCD**

**Newton EM**

**iXon Ultra EMCCD**

Identical architecture to standard CCD sensors, with the addition of an on-chip amplification channel prior to the digitization node, designed to overcome the readout noise limitation of slow-scan CCDs. This technology opens the door to ultra-sensitive and ultra-fast spectroscopy.

### Intensified Detectors

**Newton**

**iStor ICCD**

Combination of a CCD or sCMOS matrix with a fiber coupled Image Intensifier, which provides optical shuttering capabilities and time-resolution down to the nanosecond regime while also offering a signal amplification up to x1,000.

### InGaAs

**Indium Gallium Arsenide (InGaAs)** is a photo-sensitive material used for detection up to 2.2 μm. The typical sensor architecture for spectroscopy applications is a single row array of up to 25.6 mm.

### sCMOS

**Scientific CMOS (sCMOS)** provides a unique combination of high resolution pixels, high spectral rates up to 26,000 sps, low noise and high dynamic range simultaneously. This technology is perfectly suited for fast transient phenomena or data extended multi-track analysis.

### Intensified Detectors

<table>
<thead>
<tr>
<th>Applications</th>
<th>Newton CCD</th>
<th>Newton EMCCD</th>
<th>iXon Ultra EMCCD</th>
<th>iDus CCD</th>
<th>InGaAs CCD</th>
<th>iStor ICCD</th>
<th>Zyla sCMOS</th>
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<tr>
<td>Absorption - Transmission - Reflection</td>
<td>UV-NIR†</td>
<td>UV-NIR</td>
<td>UV-NIR</td>
<td>UV-NIR</td>
<td>NR-NIR</td>
<td>UV-NIR</td>
<td>VIS-NIR</td>
</tr>
<tr>
<td>Photoluminescence - Fluorescence</td>
<td>UV-NIR</td>
<td>UV-NIR</td>
<td>UV-NIR</td>
<td>UV-NIR</td>
<td>NR-NIR</td>
<td>UV-NIR</td>
<td>VIS-NIR</td>
</tr>
<tr>
<td>Raman (SERS, SORS, CARS, Stimulated)</td>
<td>244-430 nm</td>
<td>244-430 nm</td>
<td>244-490 nm</td>
<td>1064 nm</td>
<td>244-430 nm</td>
<td>450-830 nm</td>
<td>VIS-NIR</td>
</tr>
<tr>
<td>Micro-Raman and Micro-fluorescence</td>
<td>UV-NIR</td>
<td>UV-NIR</td>
<td>UV-NIR</td>
<td>UV-NIR</td>
<td>NR-NIR</td>
<td>UV-NIR</td>
<td>VIS-NIR</td>
</tr>
<tr>
<td>Photon Counting</td>
<td>UV-NIR</td>
<td>UV-NIR</td>
<td>UV-NIR</td>
<td>UV-NIR</td>
<td>NR-NIR</td>
<td>UV-NIR</td>
<td>VIS-NIR</td>
</tr>
<tr>
<td>Single Molecule Spectroscopy</td>
<td>UV-NIR</td>
<td>UV-NIR</td>
<td>UV-NIR</td>
<td>UV-NIR</td>
<td>NR-NIR</td>
<td>UV-NIR</td>
<td>VIS-NIR</td>
</tr>
<tr>
<td>Hyper-Spectral Imaging</td>
<td>UV-NIR</td>
<td>UV-NIR</td>
<td>UV-NIR</td>
<td>UV-NIR</td>
<td>NR-NIR</td>
<td>UV-NIR</td>
<td>VIS-NIR</td>
</tr>
<tr>
<td>LIBS</td>
<td>UV-NIR</td>
<td>UV-NIR</td>
<td>UV-NIR</td>
<td>UV-NIR</td>
<td>NR-NIR</td>
<td>UV-NIR</td>
<td>VIS-NIR</td>
</tr>
</tbody>
</table>

**λ Optimum**

### Applications

- **Absorption - Transmission - Reflection**
- **Photoluminescence - Fluorescence**
- **Raman (SERS, SORS, CARS, Stimulated)**
- **Micro-Raman and Micro-fluorescence**
- **Photon Counting**
- **Single Molecule Spectroscopy**
- **Hyper-Spectral Imaging**
- **LIBS**
- **Plasma Studies**
The iDus is Andor’s most popular platform for the spectroscopy research and OEM communities, suitable for everyday spectroscopy measurements, as well as more advanced, low light detection applications.

### Comprehensive Sensor Range
CCD matrix sizes include 1024 x 127, 1024 x 256 and high resolution 2000 x 256 formats with UV and NIR optimized options. Dual AR coating (BEX2-DD) offers the best broadband detection performance and versatility.

### High Sensitivity
Best detection capabilities for experiments requiring long exposure times. The iDus range boasts sensor QE option up to 95%, TE cooling down to -100°C and state-of-the-art Ultravac™ for long-lasting performance. New Low Dark Current Deep-Depletion (LDC-DD) technology offers the best detection capabilities in the near infrared.

### Key Applications
- Absorption
- Transmission
- Reflection
- Raman (244, 532, 785 and 833 nm)
- Fluorescence
- Luminescence
- Photoluminescence
- Plasma studies
- Non-linear spectroscopies

### Features
- Peak QE of 95%
- TE cooling to -100 ºC
- Ultravac™ – Guaranteed hermetic vacuum seal
- 26 or 15 µm pixels
- Fringe suppression technology for back-thinned and back-illuminated Deep-Depletion option
- Deep-Depletion sensor options
  - New Low Dark Current Deep-Depletion (LDC-DD) technology
- Simple opto-mechanical coupling interface
- Simple USB 2.0 connection
- Ultra-vac technology and long-lasting detection performance

### Benefits
- High detector sensitivity options both in VIS and NIR regions
- Negligible dark current without the inconvenience of LN$_2$
- Permanent vacuum integrity, critical for deep cooling and best sensor performance
- Choice of high dynamic range (401 and 420 models) or high resolution (416 model)
- Greatly reduces etaloning effect above 650 nm
- High NIR QE, low etaloning – ideal for NIR Raman or photoluminescence. Superior broadband detection with Dual-AR technology option (BEX2-DD). Low dark-current (LDC technology (416 model)) – ideal for challenging low light NIR spectroscopy without the need for LN$_2$ cooling
- Readily integrate with Andor Kymera and Shamrock spectrograph series
- User friendly plug and play connection directly to the back of the camera

### Model Specifications

<table>
<thead>
<tr>
<th>Model</th>
<th>Active pixels (µm)</th>
<th>Pixel size (µm)</th>
<th>Deepest cooling</th>
<th>Sensor options</th>
</tr>
</thead>
<tbody>
<tr>
<td>DU416</td>
<td>1024 x 256</td>
<td>15 x 15</td>
<td>-90°C</td>
<td>LDC-DD</td>
</tr>
<tr>
<td>DU416</td>
<td>1024 x 256</td>
<td>15 x 15</td>
<td>-70°C</td>
<td>LDC-DD</td>
</tr>
<tr>
<td>DU401</td>
<td>1024 x 127</td>
<td>26 x 26</td>
<td>-100°C</td>
<td>BU, BV, BVF</td>
</tr>
<tr>
<td>DU401-BR-DD</td>
<td>1024 x 128</td>
<td>26 x 26</td>
<td>-100°C</td>
<td>BDD, BEX2-DD</td>
</tr>
<tr>
<td>DU420</td>
<td>1024 x 255</td>
<td>26 x 26</td>
<td>-100°C</td>
<td>BU, BV, BVF</td>
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<tr>
<td>DU420-Bx-DD</td>
<td>1024 x 256</td>
<td>26 x 26</td>
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| DV420   | 1024 x 255         | 26 x 26         | -70°C           | BU, BV, BVF    

### More information at andor.com/learning

- **Webinar**: Investigating Molecular Properties of Live Cells and Tissues
- **Technical Notes**: LDC-DD technology for high sensitivity NIR spectroscopy
- **Ultravac technology and long-lasting detection performance**

### Quantum Efficiency

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<th>Quantum Efficiency (%)</th>
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<tr>
<td>200</td>
<td>50</td>
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<tr>
<td>300</td>
<td>70</td>
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<tr>
<td>400</td>
<td>80</td>
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<td>500</td>
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<tr>
<td>1200</td>
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</table>

### Webinar

- ‘Investigating Molecular Properties of Live Cells and Tissues’

### Technical Notes

- ’LDC-DD technology for high sensitivity NIR spectroscopy’
- Ultravac technology and long-lasting detection performance

### Sensor options

- BU, BV, BVF
- BDD, BEX2-DD
- BU, BV, BVF
- LDC-DD
- BDD
- BEX2-DD
- BU, BV, BVF
The iDus InGaAs range is a perfect complement to Andor’s UV-VIS-NIR CCD camera family, extending spectral detection capabilities beyond 1.1 μm and up to 2.2 μm.

Choice of Resolution and Bandpass
Both 1.7 and 2.2 μm cut-off option offer high resolution and high capacity pixel sizes (25 and 50 μm respectively) and large band-pass option (1024 pixels / 25.6 mm width) for extended spectral information simultaneous collection.

TE cooling - No need for inconvenient use of LN₂
The Thermo-Electrically cooled, in-vacuum sensors reach cooling temperatures of -90°C where the best signal-to-noise ratio can be achieved for the majority of the applications in this spectral region. Beyond this cooling point blackbody radiation from any elements facing the sensor will dominate the dark signal, and since Quantum Efficiency will be impacted with decreasing cooling temperature, TE cooling will allow access to optimum SNR performance.

Features
- High Quantum Efficiency
- Typical attainable TE cooling to -90°C
- Minimum exposure time of 1.4 μsec

Benefits
- Maximum sensitivity in the SWIR
- Ensures best sensor performance and protection in time
- Allows study of fast transient phenomena
- Optimized for high dynamic range and high resolution
- Choice of High Dynamic Range (HDR) or High Sensitivity (HS)
- Readily integrates with Andor Kymera and Shamrock spectrograph series
- User-friendly plug and play connection directly to the back of the camera

More information at andor.com/learning
Application Note ‘Raman and Photoluminescence measurements on laser lithographically written structures in Si’
Webinar ‘A TE Cooling Approach to SWIR spectroscopy’
Newton CCD

The world’s fastest spectroscopy CCD

When it comes to access simultaneously the best spectral resolution, acquisition rates and detection range flexibility, the Newton CCD cameras always come first.

Fast spectral acquisitions
The Newton MHz readout platform allows spectral rates up to 1,600 spectra per second with crop mode, ideal for fast microspectroscopy chemical mapping or microfluidics analysis.

High resolution and high dynamic range spectroscopy
13.5 µm pixel option allows access to the highest spectral resolution, while 26 µm pixel matrix boasts larger photoelectrons storage capacity and greater dynamic range.

Key Applications
Absorption - Transmission - Reflection
Raman (244, 532, 785 and 833 nm)
Fluorescence - Luminescence - Photoluminescence
Plasma studies
Plasmonics
Fast Transient phenomena study

Features
Multi-megahertz readout
TE cooling to -100°C
UltraVac™ - guaranteed hermetic vacuum seal technology
Down to 13.5 x 13.5 µm pixel size
Crop mode operation
Deep-cyanation sensor options
Software-selectable output amplifiers (DU940)
Simple opto-mechanical coupling interface
Simple USB 2.0 connection

Benefits
High repetition rates achievable with low noise electronics - ideal for transient phenomena study
Negligible dark current without the inconvenience of LN₂
Permanent vacuum integrity, critical for deep cooling and best sensor performance access
Achieve the highest possible spectral rates of over 1,600 spectra per second
High NIR QE, virtually etalon-free - ideal for NIR Raman
Superior broadband detection with Dual-AR technology option (BEX2-DD)
Choice of High Dynamic Range (HDR) or High Sensitivity (HS)
Readyly integrate with Andor Kymera and Shamrock spectrograph series
User friendly plug and play connection directly to the back of the camera

Model | Active pixels (µm) | Pixels size (µm) | Sensor options
--- | --- | --- | ---
DU920 | 1024 x 255 | 26 x 26 | BU, BU2, BV, OE, BVF
DU920-BX-DD | 1024 x 256 | 26 x 26 | BR-DD, BEX2-DD
DU940 | 2048 x 512 | 13.5 x 13.5 | BU, BU2, BV, OE, BVF

More information at andor.com/learning
Application Note “Fiber Probe Based Raman spectroscopy Bio-sensor for Surgical Robotics”

Quantum efficiency (%) vs Wavelength (nm)

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<tr>
<td>900</td>
<td>20</td>
<td>15</td>
</tr>
<tr>
<td>1000</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>1100</td>
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<td>0</td>
</tr>
<tr>
<td>1200</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
**iXon Ultra and Newton EMCCD**

**Speed and sensitivity with no compromise**

From the pioneers of EMCCD technology, the newly expanded iXon Ultra and Newton™ series have brought low-light spectroscopy to a new level of performance. These cameras offer the absolute combination of sensitivity and acquisition speed for the most demanding photon-starved applications.

### Highest sensitivity

EMCCDs operate by amplification of weak signal events (down to single photons) to a signal level that is well clear of the read noise floor of the camera at any readout speed. This ‘on-chip’ amplification process is realized without sacrificing the photon collection capability of the sensor. Back-illuminated architecture boosts QE up to 95%, while Andor’s market leading TE cooling to -100°C offers unmatched dark noise performance.

### Highest spectral rates

The supercharged iXon Ultra and Newton™ allow access to the highest spectral rates without loss of sensitivity thanks to the EM amplification architecture. The iXon Ultra 888 achieves over 11,990 spectra per second (Crop Mode), while the Newton 970 allows spectral rates in excess of 1,515 spectra per second (Crop Mode) with larger simultaneous bandpass capture capabilities.

---

**Key Applications**

- Absorption
- Transmission
- Reflection
- Raman (244, 532, 633 nm)
- Raman (785 and 833 nm – VP and FI only)
- Fluorescence
- Luminescence
- Plasma studies
- Photon counting
- Single molecule spectroscopy

---

**Features**

- <1 e⁻ readout noise and up to 95% QE
- Industry benchmark for fast frame and spectral rate
- Cropped mode option
- Ultravac™ technology and TE cooling down to -100°C
- Software-selectable output amplifiers
- Spectroscopy and Imaging sensor formats available
- Seamless integration with Andor spectrographs
- Simple USB 2.0 connection

**Benefits**

- ‘Silent’ noise floor perfectly complements high QE performance for extremely low-light detection
- Full vertical binning up to 650 spectra per second or imaging frame rate up to 56 full-frames per second
- Boost spectral rates in excess of few thousand of spectra per second
- Permanent vacuum integrity, critical for deep cooling and best sensor performance access
- Choice of High Sensitivity (low light applications) or Electron Multiplication (ultra-low light applications down to single photon)
- 25 mm wide option for maximum spectral information collection, or up to 13 mm tall option for larger vertical field of view, ideally suited for microspectroscopy.
- Fringe suppression options available for minimizing optical etaloning above 650 nm
- Simple opto-mechanical coupling to Andor Kymera and Shamrock spectrograph series, with all-integrated dedicated software control
- User friendly plug and play connection directly to the back of the camera

---

**Table: Model Specifications**

<table>
<thead>
<tr>
<th>Model</th>
<th>Active pixel matrix</th>
<th>Pixel size (μm)</th>
<th>Fastest spectral rate</th>
<th>Data transfer interface</th>
<th>Sensor options</th>
</tr>
</thead>
<tbody>
<tr>
<td>Newton 970</td>
<td>1600 x 200</td>
<td>16 x 16</td>
<td>11,990 sps</td>
<td>USB 2.0</td>
<td>BV, FI, UV, UVB, BVP</td>
</tr>
<tr>
<td>Newton 971</td>
<td>1600 x 400</td>
<td>16 x 16</td>
<td>11,990 sps</td>
<td>USB 2.0</td>
<td>BV, FI, UV, UVB</td>
</tr>
<tr>
<td>iXon Ultra 888</td>
<td>1024 x 1024</td>
<td>13 x 13</td>
<td>11,990 sps</td>
<td>USB 3.0</td>
<td>BV, UVB, EXP, EX</td>
</tr>
<tr>
<td>iXon Ultra 897</td>
<td>512 X 512</td>
<td>16 x 16</td>
<td>9,991 sps</td>
<td>USB 2.0</td>
<td>BV, UVB, EXP, EX, BVP</td>
</tr>
</tbody>
</table>

---

**More information at** andor.com/learning

**Webinar**

*EMCCDs for spectroscopy*

**Application note**

*Spectral Flow Cytometry*

---

Professor Michael Morris

Professor of Chemistry, University of Michigan

“In our lab the Andor Newton™ EMCCD has enabled millisecond Raman spectroscopy and hyperspectral Raman imaging in times as short as a minute or two. And the 1600 x 400 format is just right for spectroscopy.”

---

[Image of camera and technical diagram]
The Zyla scientific CMOS (sCMOS) platform offers Physical and Life Science spectroscopists seamless access to a unique combination of superfast spectral rates, high sensitivity, high resolution and high dynamic range.

**Highest spectral rates**
Market leading spectral rates up to 27,057, ideally suited for high resolution transient spectroscopy applications with 10’s of μs time-resolution. Multi-track mod provides rates up to 6,000 acquisitions/second for hyperspectral imaging and dual-track kilohertz transient absorption spectroscopy.

**High dynamic range**
The Zyla sCMOS offers user-configurable, ready-to-analyze binned single spectra or multiple (multi-track) spectra. A unique 32-bit data transmission mode allows the preservation of the signal dynamic range in these extensive spectroscopy binning scenarios.

More information at andor.com/learning

**Features**
- 5.5 and 4.2 megapixel sensor formats and 6.5 μm pixels
- ~ 1 e- Read Noise
- Up to 27,000 sps
- 12-bit and 16-bit modes
- Selectable bit-depth up to 32-bit
- 82% peak QE
- Zero etaloning in the NIR

**Benefits**
- Extremely sharp resolution over a 22 mm (Zyla 5.5) and 19 mm (Zyla 4.2 PLUS) diagonal field of view. Ideal for extended multi-track spectroscopy
- Noise floor down to 0.9 e-. Lower detection limit than any CCD
- Excellent time resolution capabilities for study of transient phenomena through user-definable Region of Interest
- 12-bit mode for smaller file size and absolute fastest frame rates through USB 3.0; 16-bit mode for full dynamic range
- Preserve dynamic range in extensive on-head binning scenarios. User-selectable data bit depth to be transmitted over the camera interface, up to 32-bit
- Highest available photon capture efficiency across visible/NIR
- Front-illuminated sensor architecture, no unwanted signal modulation in the NIR compared to back-illuminated devices
- Unparalleled quantitative measurement accuracy across the full dynamic range (> 99.9% for low light range)
iStar Intensified CCD and sCMOS

Industry gold standard for high-resolution, high-speed nanosecond time-resolved spectroscopy

With over 16 years of Excellence in the development of world-class, fast-gated intensified CCD and sCMOS cameras, Andor’s iStar detectors are at the forefront of rapid, nanosecond time-resolved spectroscopy. They extract the very best from CCD/sCMOS sensors and gated image intensifier technologies, achieving a superior combination of rapid acquisitions rates and exceptional sensitivity down to single photon.

Nanosecond time-resolution
Software-controlled, ultra-low-jitter onboard Digital Delay Generator (DDG™) and high-voltage, high-speed gating electronics offer < 2 ns time resolution and ultra-precise synchronisation.

Highest spectral rates
The iStar’s 5 MHz platforms and intelligent Crop and Fast Kinetics modes offer spectral rates in excess of 3,500 sps and, 9,525 sps respectively. The iStar’s 5 MHz platforms and highest spectral rates offer spectral rates in intelligent Crop and Fast Kinetics mode.

The iStar’s 5 MHz platforms and highest spectral rates offer spectral rates in intelligent Crop and Fast Kinetics mode.

More information at andor.com/learning

Key Applications
- Laser Induced Breakdown Spectroscopy (LIBS)
- Time-resolved fluorescence - luminescence
- Raman scattering spectroscopy
- Single molecule spectroscopy
- Time-Resolved Raman and Resonance Raman spectroscopy (TFR)

Application Notes
- ‘Stand-off LIBS - A detection technique for explosive residues’
- ‘High sensitivity imaging of Thomson scattering signal’

Features
- USB 2.0 connectivity
- Industry-standard plug and play, lockable and rugged interface
- Seamless multi-camera control from single PC or laptop
- Intelligent and accurate MCP gating for better than 1:10^8 shuttering efficiency in the UV
- Software-controlled 3x triggering outputs with 10 ps setup accuracy
- Lowest delay from signal generation to photocathode triggering
- Comprehensive triggering interface
- Software-controlled 3x triggering outputs with 10 ps setup accuracy
- True optical gating < 2 ns
- Highest gating timing accuracy with lowest propagation delay
- Comprehensive triggering interface
- Software-controlled 3x triggering outputs with 10 ps setup accuracy
- Intelligent and accurate MCP gating for better than 1:10^8 shuttering efficiency in the UV
- 500 kHz sustained photocathode gating
- Maximizes signal-to-noise in high repetition rate laser-based applications
- TE-coding to -40°C
- Efficient minimization of CCD dark current and pixel blemishes
- Real-time control interface
- On-the-fly software control of intensifier gain, gating and 3x outputs trigger parameters for real-time detection optimization

- Photo-cathode
- Type
- Coverage
- Peak QE (typical)
- Minimum gating speed
- Coverages
- Peak QE (typical)
- Minimum gating speed

- -03
- 180-850 nm
- 18% < 2 ns
- -83
- 180-850 nm
- 25% < 100 ns
- -04
- 180-850 nm
- 18% < 2 ns
- -93
- 380-1,100 nm
- 4% < 3 ns
- -05
- 180-850 nm
- 16% < 5 ns
- -A3
- 280-810 nm
- 40% < 2 ns
- -13
- 180-920 nm
- 13.5% < 50 ns
- -C3
- 180-910 nm
- 17% < 3 ns
- -B3
- 280-760 nm
- 48% < 2 ns
- -E3
- 180-850 nm
- 22% < 2 ns
- -73
- 280-910 nm
- 26% < 2 ns

- Photo-cathode
- Type
- Coverage
- Peak QE (typical)
- Minimum gating speed

- DH320T
- 1024 x 256
- 26 x 26
- Q16 mm [1:1]
- 0.155 mm [1:1]
- 1024 x 2048
- 13.5 x 13.5
- Q18 mm [1:1]
- 0.165 mm [1:1]
- 2048 x 512
- 13.5 x 13.5
- Q18 mm [1:1]
- 0.165 mm [1:1]
- 2560 x 2160
- 6.5 x 6.5
- Q18 mm [1:1]
- 0.165 mm [1:1]
Andor’s technical know-how extends far beyond market-leading performance detectors with a comprehensive range of high-end spectrographs. At the heart of this portfolio are the new Kymera and Shamrock platforms, which offer ultimate flexibility and performance with their “out-of-the-box”, pre-aligned and pre-calibrated approach and seamless combination with our highly sensitive spectroscopy cameras. The Mechelle 5000 is Andor’s dedicated detection solution for broadband and high-resolution LIBS, while HoloSpec F/1.8 offers maximum light throughput with high-density multi-track capabilities.

**Spectrographs**

**Kymera 193i**
Intelligent, modular and compact imaging spectrograph with Active Focus technology (patented), fully motorized, RFP-Sagged dual grating turret, dual detector output ports and seamless interfacing to microscopes for modular micro-Raman or micro-fluorescence setups.

**Kymera 328i**
Intelligent and highly configurable, motorized imaging spectrograph with RFP-Sagged Dual Turret (on-axis rotation), Active Focus technology (patented), user-controlled TrueFocus spectral resolution enhancement, dual input and output ports for ease of integration into complex experiments or microspectroscopy systems.

**Shamrock 500i**
Ideal combination of high spectral resolution, imaging capabilities for multi-track acquisitions and monochromator capabilities with single point detectors sensitive up to 12 µm and plug and play, fully motorized platform.

**Shamrock 163**
Rugged, compact 163 mm focal length manual spectrograph, highly configurable for general, everyday lab spectroscopy.

**Shamrock 750**
Ideal combination of high spectral resolution, imaging capabilities for multi-track acquisitions and monochromator capabilities with single point detector use for detection up to 12 µm. Convenient USB interface, fully motorized platform and accessory range.

**Mechelle 5000**
Patented optical echelle design with band-pass ranging from 205 nm to 975 nm and resolution power $\lambda/\Delta \lambda$ of 5,000 across the full wavelength range, all accessible in a single acquisition without the need for moving components.

**HoloSpec F/1.8**
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.

**Applications**

<table>
<thead>
<tr>
<th>Kymera 193i</th>
<th>Kymera 328i</th>
<th>Shamrock 500i</th>
<th>Shamrock 750</th>
<th>Shamrock 163</th>
<th>HoloSpec F/1.8</th>
<th>Mechelle 5000</th>
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<tr>
<td><strong>NEW</strong></td>
<td><strong>NEW</strong></td>
<td></td>
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<tr>
<td>Kymera series</td>
<td>Shamrock series</td>
<td>HoloSpec F/1.8</td>
<td>Mechelle 5000</td>
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<tr>
<td>193i</td>
<td>328i</td>
<td>163</td>
<td>500i</td>
<td>750</td>
<td>F/1.8</td>
<td>5000</td>
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<tr>
<td>Absorption - transmission - reflection</td>
<td>★</td>
<td>★</td>
<td>★</td>
<td>★</td>
<td>★</td>
<td>★</td>
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<tr>
<td>Photoluminescence - fluorescence</td>
<td>★</td>
<td>★</td>
<td>★</td>
<td>★</td>
<td>★</td>
<td>★</td>
</tr>
<tr>
<td>Raman (SERS, SORS, CARS, Stimulated)</td>
<td>★</td>
<td>★</td>
<td>★</td>
<td>★</td>
<td>★</td>
<td>★</td>
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<tr>
<td>Micro-Raman</td>
<td>★</td>
<td>★</td>
<td>★</td>
<td>★</td>
<td>★</td>
<td>★</td>
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<tr>
<td>Micro-fluorescence</td>
<td>★</td>
<td>★</td>
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<td>★</td>
<td>★</td>
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<tr>
<td>Photon counting</td>
<td>★</td>
<td>★</td>
<td>★</td>
<td>★</td>
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<td>Single molecule spectroscopy</td>
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<td>LIBS</td>
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<td>★</td>
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<tr>
<td>Multi-track spectroscopy</td>
<td>★</td>
<td>★</td>
<td>★</td>
<td>★</td>
<td>★</td>
<td>★</td>
</tr>
</tbody>
</table>

★ Suitable ★ Optimum
**Versatile, intelligent and compact imaging spectrograph**

The Kymera 193i is a compact imaging spectrograph with F/3.6 aperture which, when combined with Andor’s world-class range of ultra-sensitive UV-NIR and SWIR detectors, offers a ‘workhorse’ spectroscopy platform with superb photon collection efficiency.

**Features**
- 193 mm focal length
- F/3.6 aperture
- USB 2.0 and i2c interface
- Dual output port
- Motorized dual grating turret with eXpressID™ RFID-based technology
- Astigmatism-corrected optical design
- Silver-protected coated optics options
- Compact and rugged design
- μManager software control
- 10 Hz shutter with 40 Hz burst mode

**Benefits**
- Provides typical resolution of 0.21 nm with a 1200 l/mm @ 500 nm and up to 0.1 nm with a 2400 l/mm grating @ 300 nm
- High throughput design suitable for photon starved applications such as single molecule microspectroscopy
- Easy control of both spectrograph and Andor USB detectors through laptops
- Maximum detection flexibility to cover the widest wavelength range by combining UV-Vis-NIR CCDs with SWIR InGaAs sensor
- Precise indexing design and easy/hack access for rapid in-field upgrade
- User-friendly software controlled with automatic RFID-based grating turret details upload
- Extremely high fidelity image relay of a microscope sample image through the new 15 mm wide aperture slit – imaging and spectroscopic analysis can be performed through one single optical path
- Seamless control of a large range of microscopes and accessories alongside Andor Kymera and Shamrock spectrographs and spectroscopy detectors in one single software platform
- Simple setup of complex microspectroscopy acquisition sequences, e.g. chemical mapping.
- Ideal for rapid background series acquisition and fast imaging or multi-track applications.
- Extended lifetime > 1 million cycles

**Key Specifications**

<table>
<thead>
<tr>
<th>Feature</th>
<th>Kymera 193i</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aperture (F/#)</td>
<td>F/3.6</td>
</tr>
<tr>
<td>Focal length</td>
<td>193 mm</td>
</tr>
<tr>
<td>Imaging corrected optics</td>
<td>Vis (Multi-track capabilities)</td>
</tr>
<tr>
<td>Resolution</td>
<td>1304 nm</td>
</tr>
<tr>
<td>Bandpass</td>
<td>98 nm</td>
</tr>
<tr>
<td>Grating turret</td>
<td>Dual grating, motorized, interchangeable, RFID</td>
</tr>
<tr>
<td>Slit options</td>
<td>Adjustable (manual): 10 μm to 2.5 mm Adjustable (motorized): 10 μm to 2.5 mm Wide aperture: Motorized 10 μm to 2.5 mm, manual to 15 mm</td>
</tr>
<tr>
<td>Operation</td>
<td>Motorized, USB2.0 and i2c</td>
</tr>
</tbody>
</table>

† Nominal values using 1200 l/mm grating, 13.5 μm pixel and 27.6 mm wide sensor, 500 nm central wavelength.

**Adaptive Focus Technology (patented)**

‘Intelligent’ motorized adaptive focus allows access to the very best spectral resolution performance in any configuration with un-matched repeatability.

**Ease of use**

The RFID-based technology eXpressID™, indexed dual-grating turret, dual output port and extensive accessories range provide a highly configurable, yet compact platform to best match Academic and OEMs specific performance requirements.

**Key Applications**

- Absorption - Transmission - Reflection (UV-NIR and SWIR)
- Raman (442, 514, 633, and 1064 nm)
- Fluorescence - Luminescence (UV-NIR and SWIR)
- Micro-Fluorescence
- Photon counting
- Single molecule spectroscopy

**Versatile, intelligent and compact imaging spectrograph**

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<tbody>
<tr>
<td>Aperture (F/#)</td>
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</tr>
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<td>Focal length</td>
<td>193 mm</td>
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<td>Grating turret</td>
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</tr>
<tr>
<td>Operation</td>
<td>Motorized, USB2.0 and i2c</td>
</tr>
</tbody>
</table>

† Nominal values using 1200 l/mm grating, 13.5 μm pixel and 27.6 mm wide sensor, 500 nm central wavelength.

**Looking for a manually-controlled, compact, general benchtop spectroscopy platform?**

The Shamrock 163 is a manually controlled, single grating spectrophotograph designed for setups with lower integration and automatization/motorization constraints. More details can be found at andor.com/163.
The Kymera 328 mm focal length imaging spectrograph offers a highly configurable platform, with advanced user controls to always access the very best spectral performance for routine measurements and more demanding optical setups.

**Quad Turret**
Combines up to 4 gratings for greater flexibility in one single setup – more choice of resolution or blaze options at the touch of a button without grating turret swapping.

eXpressID™, RFID-based technology ensures seamless recognition and upload of all important turret parameters automatically to the spectrograph.

**TruRes™**
Intelligent spectral resolution enhancement at the touch of a button, which greatly expands your spectrograph performance capabilities and range. This provides a unique ability to precisely tune the resolution needed for your applications without the need for multiple grating sets.

**Key Applications**
- Absorption - Transmission - Reflection (UV-NIR and SWIR)
- Raman (384, 532, 785, 833 and 1064 nm)
- Fluorescence - Luminescence (UV-NIR and SWIR)
- Micro-Raman and Micro-fluorescence
- Plasma studies and LIBS

**Features**
- 328 mm focal length, F/4.1 aperture
- Adaptive Focus (patented)
- Motorized quad-grating turret with eXpressID™ RFID technology
- TruRes™
- Astigmatism-corrected optical design
- Dual input and output ports
- Robust on-axis wavelength drive
- Protected silver coated optics options
- μ-Manager software integration

**Benefits**
- Ideal combination for a wide range of applications ranging from luminescence/photoluminescence spectroscopy to more demanding, higher resolution Raman spectroscopy or plasma studies
- Intelligent and user-friendly interface for uncompromised high spectral resolution performance
- Seamless field-upgradability with precise indexing interface and user-friendly hatch access.
- Automatic gratings recognition and setup with embedded RFID tags - minimum user interaction.
- True spectral resolution enhancement at the touch of a button. Fully user-controlled feature to extract the very best spectral performance for a wide range of applications without the need for multiple grating sets
- Toroidal optics enable multi-track fiber detection and excellent sample image relay from a microscope at the grating ‘0’ order.
- Greater setup flexibility for complex, multi-modal optical setups.
- Extended wavelength coverage when combining Andor UV-NIR CCD, EMCCD, ICCD and InGaAs cameras. slit option for microchromatograph operation
- High accuracy direct-drive delivers superb single-grating and grating-to-grating center wavelength repeatability down to 4 and 10 pm respectively
- Most efficient for NIR/SWIR detection when used in conjunction with Andor InGaAs cameras.
- Simultaneous control of Andor cameras, spectrographs and a wide range of microscopes and accessories through 1 single software platform. Dedicated, user-friendly spectrum handling interface. Simple setup of complex microspectroscopy acquisition sequences, e.g. chemical mapping.

**Key Specifications**

<table>
<thead>
<tr>
<th>Feature</th>
<th>Kymera 328i</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aperture (F/A)</td>
<td>F/4.1</td>
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<tr>
<td>Focal length</td>
<td>328 mm</td>
</tr>
<tr>
<td>Imaging corrected optics</td>
<td>Yes (multi-track capabilities)</td>
</tr>
<tr>
<td>Resolution†</td>
<td>0.10 nm – &gt; 0.07 nm **</td>
</tr>
<tr>
<td>Bandpass†</td>
<td>0.1 nm</td>
</tr>
<tr>
<td>Grating turret</td>
<td>Quad grating, motorized, interchangeable, RH1, 328 mm</td>
</tr>
<tr>
<td>Slit options</td>
<td>Adjustable (manual): 10 μm to 2.5 mm, Wide aperture: Motorized 10 μm to 2.5 mm, manual to 15 mm</td>
</tr>
</tbody>
</table>

† Nominal values using 1200 l/mm grating, 13.5 μm pixel and 27.6 mm wide sensor, 500 nm central wavelength.

**With TruRes™ option**
Shamrock 500i and 750

Research grade modular high resolution spectrographs

The Shamrock 500i and 750 imaging spectrographs are research-grade, high performance, motorized and rugged platforms designed for working with demanding low-light applications, but equally suited to routine measurements.

Versatility

The Shamrock series offers a choice of high resolution, highly modular multi-input and output platforms with a wide range of field-upgradable accessories, including indexed triple grating turrets, motorized slits and filter wheels, shutters, multi-way (multi-track) fiber optics, IR single point detectors, scanning accessories and microscope coupling interfaces.

The right resolution for your experiment

With focal lengths of 500 and 750 mm, researchers have access to a wide range of spectral resolution performance, down to 0.02 nm for plasma spectroscopy or up to a few nanometers for broadband luminescence / photoluminescence spectroscopy. Each Shamrock comes with a choice of three software-selectable gratings (or flat mirror) that offers maximum flexibility with both broadband and high resolution options available.

Key Applications

- Absorption - Transmission - Reflection (UV-NIR and SWIR)
- Raman (514, 635, 785, 833 and 1064 nm)
- Fluorescence - Luminescence (UV-NIR and SWIR)
- Micro- Raman and Micro-fluorescence
- Photon counting
- Single molecule spectroscopy
- Plasma studies

Features

- Pre-aligned, pre-calibrated detector and spectrograph systems
- Image astigmatism correction with toroidal optics (500i)
- USB 2.0 interface
- Triple exchangeable grating turret
- Double detector outputs

Benefits

- Motorized, individually factory-calibrated systems - “out-of-the-box” operation and seamless integration to experimental set-ups
- Maximum light throughput with multitrack capabilities
- Plug and play connectivity, ideal for laptop operation alongside multi-USB camera control
- Precision kinematic mount for precise in-field upgrade
- For extended wavelength coverage when combining Andor UV-VIS-NIR CCD and InGaAs cameras
- The ultimate in modular set-up and in-field upgradability, including:
  - Motorized slits and filter wheel
  - Microscope interfaces
  - Shutters
  - Fiber-optic and lens couplers
  - Multi-way (multi-track) fiber-optic bundles
  - Light sources and optics
- Extract best optical resolution while allowing use of single point detectors with sensitivity up to 12 μm
- Most efficient for NIR detection when used in conjunction with Andor InGaAs cameras and single point detectors

Spectrograph Specifications Comparison*

<table>
<thead>
<tr>
<th></th>
<th>Kymera 328i</th>
<th>500i</th>
<th>750</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aperture ratio (F/#)</td>
<td>F/4.1</td>
<td>F/6.5</td>
<td>F/9.9</td>
</tr>
<tr>
<td>Focal length (mm)</td>
<td>328</td>
<td>500</td>
<td>750</td>
</tr>
<tr>
<td>Wavelength Resolution (nm)</td>
<td>0.1 - 0.07**</td>
<td>0.06</td>
<td>0.04</td>
</tr>
<tr>
<td>Band pass (nm)</td>
<td>61</td>
<td>40</td>
<td>38</td>
</tr>
<tr>
<td>Multi-track capability</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
</tbody>
</table>

* Nominal values using 1200 l/mm grating, 13.5 μm pixel and 27.6 mm wide sensor, 500 nm central wavelength.
** With TruRes™ option

More information at andor.com/learning

Accessory Tree
Please refer to p37

Application Note
'Spectral characterization of quantum light from an engineered Type-II sum-frequency generation process'

Resolution Calculator
andor.com/calculators
HoloSpec F/1.8 and F/1.8i

High throughput imaging spectrograph

The Andor HoloSpec is the ideal platform for collecting more light and achieving better and faster signal-to-noise ratio. Its rugged and compact design makes it an ideal tool for challenging industrial or in-the-field applications, while still offering research-grade performance suitable for academic research.

Superior light gathering power - when every photon counts

The Andor HoloSpec spectrograph series is designed for very high light collection efficiency with a large F/2 aperture and high throughput optical design based on Volume Phase Holographic technology. It provides a perfect match to Andor's low noise CCD, EMCCD and ICCD detectors, offering the most sensitive and versatile detection solution on the market for Visible or Near-Infrared spectroscopy.

High density multitrack spectroscopy

The on-axis transmission design greatly minimizes scattered light and channel crosstalk when working with high density multi-track fiber optic assemblies, allowing simultaneous acquisition of over 200x individual channels at a time with large area CCDs.

Key Applications
- Raman, Luminescence and Plasmonics microscopy mapping - e.g. bio-samples, carbon nanostructures, light harvesting complex or organic light emitting diode (OLEDs)
- Photoluminescence - e.g. Quantum dots
- Ultra-low excitation threshold - e.g. Raman scattering
- Pre-aligned and pre-calibrated, "out-of-the-box" operation, excellent thermal stability and easily transportable
- Optimized for Stokes/Anti-Stokes, 'low frequency' or 'high frequency' Stokes operation, 514.5 to 830 nm laser options

More information at andor.com/learning

Application Notes
- 'Spectral Flow Cytometry expanded to Visible and Near Infrared Fluorescence spectroscopy'
- 'Hyphenated Raman - OCT Clinical Diagnosis of Skin Cancers'

Resolution and Bandpass

<table>
<thead>
<tr>
<th>Features</th>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>High collection efficiency ultrabright F/1.8 aperture</td>
<td>Up to 6.5 times better light collection efficiency than traditional 1/3&quot; in Czerny-Turner designs</td>
</tr>
<tr>
<td>On-axis imaging-corrected design</td>
<td>100% light collection from NA=0.22 fiber optics</td>
</tr>
<tr>
<td>High throughput optical design</td>
<td>Superior optical aberration correction across a large focal plane for superior spatial resolution and high density, low crosstalk multi-track (multi-fibers) acquisitions</td>
</tr>
<tr>
<td>Low scattered light</td>
<td>Gather more photons per pixel for superior signal-to-noise ratio</td>
</tr>
<tr>
<td>Compact and rugged design</td>
<td>High transmission volume phase holographic (VPH) gratings with state-of-the art optics - maximum optical efficiency for visible or near-infrared range</td>
</tr>
<tr>
<td>Easily interchangeable accessories</td>
<td>Smooth, sinusoidal refractive index VPH gratings profile greatly minimizes stray light - maximizes detection dynamic range and signal-to-noise</td>
</tr>
<tr>
<td>Specialized Raman grating options</td>
<td>Pre-aligned and pre-calibrated, &quot;out-of-the-box&quot; operation, excellent thermal stability and easily transportable</td>
</tr>
<tr>
<td>Specialized Raman grating options</td>
<td>Optimized for Stokes/Anti Stokes, &quot;low frequency&quot; or &quot;high frequency&quot; Stokes operation, 514.5 to 830 nm laser options</td>
</tr>
<tr>
<td>Optional integrated Rayleigh filtering unit</td>
<td>Fully-enclosed SuperNotch Plus Kaiser filter compartment with user-friendly external adjustment</td>
</tr>
</tbody>
</table>

Image and cross-section of a high density 19 x 100 μm core (125 μm clad) fiber optics bundle at the output focal plane of a HoloSpec F/1.8 "visible" model. Source is a broadband Deuterium-Tungsten captured from 532 - 609 nm with a Newton EMCCD DU971P-BV.

Resolution and Bandpass

<table>
<thead>
<tr>
<th>Resolution and Bandpass</th>
<th>F/1.8 VIS§</th>
<th>F/1.8 NIR§</th>
</tr>
</thead>
<tbody>
<tr>
<td>Example Gratings</td>
<td>532 High Dispersion</td>
<td>532 Low Dispersion</td>
</tr>
<tr>
<td>Resolution (nm)¹</td>
<td>0.07</td>
<td>0.17</td>
</tr>
<tr>
<td>Bandpass (nm)²</td>
<td>32</td>
<td>83</td>
</tr>
</tbody>
</table>

¹ For F/1.8 model, typical resolution should be multiplied by 1.2 due to the optical magnification of the system
² With 50 µm input slit and 13.5 µm pixel CCD e.g. Newton DU940
³ With 27.6 mm wide CCD e.g. Newton DU940
Andor’s Mechelle 5000 spectrograph is based on the echelle grating principle with a patented optical design that provides extremely low crosstalk and maximum resolution compared to other spectrographs. It is designed to operate with both Andor’s iKon CCD camera and the iStar DH334T intensified camera in applications including LIBS and plasma studies.

**Simultaneous high bandpass and resolution**

The Echelle spectrograph design allows capture of multiple grating orders in one single acquisition, leading to a spectral coverage of over 750 nm from 200 – 975 nm, while also offering a constant high resolution power up to 6,000 across the entire wavelength range.

**Key Applications**
- Laser Induced Breakdown Spectroscopy (LIBS)
- Plasma studies

**Features**
- Compact and robust design with no moving components
- Patented optical design
- Auto-temperature correction
- N2 purged
- Pre-aligned detector/spectrograph solution
- Low F/number
- Wide range of accessories available

**Benefits**
- Ideal for lab and OEM system integration
- Ensures maximum resolution and extremely low cross-talk
- Corrects for the variation of prisms optical refractive index with temperature
- Enables maximum throughput in the UV region
- Enables fast and efficient experimental set-up
- Highly efficient light collection
- Including fiber optics, slits, aiming laser, collector/collimator and calibration lamps

**Spectrograph Specifications**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wavelength range (nm)</td>
<td>200 - 975</td>
</tr>
<tr>
<td>Focal length (mm)</td>
<td>195</td>
</tr>
<tr>
<td>Aperture</td>
<td>f/7</td>
</tr>
<tr>
<td>Spectral resolution (λ/Δλ)</td>
<td>6,000</td>
</tr>
<tr>
<td>Wavelength accuracy</td>
<td>Better than ± 0.05 nm</td>
</tr>
<tr>
<td>Optical adjacent order cross-talk</td>
<td>Better than 1 x 10^-7</td>
</tr>
<tr>
<td>Stray light</td>
<td>Better than 1.5 x 10^-4</td>
</tr>
</tbody>
</table>

**Echellogramme**

*Example of Mercury-Argon spectrum*
Modularity is Andor’s ethos when it comes to spectroscopy systems, because every researcher’s requirements are unique. This translates into the need for an extensive range of state-of-the-art accessories, from light collection to signal analysis and detection.

Andor combines over 25 years of expertise in the fields of optics, mechanics and electronics, from designing complex interfaces to extract the very best of its market leading detectors and spectrographs, to working alongside key suppliers worldwide. The result is Andor’s ability to offer a comprehensive range of high performance dedicated or extremely versatile accessories, ranging from multi-cord fiber optics to sample chamber, light sources, gratings, slits and third party instruments interfaces including microscopes and VUV monochromators.
Software

Research spectroscopy applications demand powerful software tools that provide everything from seamless configuration of spectrographs and cameras to actual data acquisition optimization. Andor’s Solis software and Software Development Kit (SDK) offer a truly powerful, yet user-friendly modular approach to spectroscopy.
Access to a wide range of detection system configurations is the basis of Andor’s modular approach to spectroscopy. That is why Andor is continuously and dynamically expanding its range of field-upgradable accessories to meet the ever-growing demand from researchers. This now includes enhanced options for combining microscopy and spectroscopy.

Looking for light coupling interfaces to Andor spectrographs?

Get an instant view of all standard accessories and follow the configuration trees to check for compatibility.

Can’t see exactly what you are looking for?

Do you want a grating with a different groove density or a different blaze angle, FC connection instead of SMA or custom light coupling between microscope and spectrograph? Andor’s experienced and dedicated Customer Special Request (CSR) team will be eager to discuss your specific needs.
Fiber optic is one of the most convenient ways to collect and transport light from an experimental set-up to a spectrograph-based detection solution. Andor’s series of “round-to-line”, multi-core fiber optic bundles maximizes the signal collection by positioning the multiple cores alongside the spectrograph entrance slit. Andor works with industry leading manufacturers to deliver solutions which meet any user requirement.

**Fiber Reference**

<table>
<thead>
<tr>
<th>Fiber Reference</th>
<th>Number of legs</th>
<th>Fiber Core Diameter</th>
<th>Optimized Wavelength</th>
<th>Number of fiber cores per leg</th>
<th>a (mm)</th>
<th>b (mm)</th>
<th>c (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SR-OPT-8002</td>
<td>1 way</td>
<td>100 μm</td>
<td>VIS-NIR (LOH)</td>
<td>19</td>
<td>2.38</td>
<td>2.38</td>
<td>-</td>
</tr>
<tr>
<td>SR-OPT-8007</td>
<td>2 way</td>
<td>100 μm</td>
<td>VIS-NIR (LOH)</td>
<td>7</td>
<td>2.35</td>
<td>0.875</td>
<td>1.2</td>
</tr>
<tr>
<td>SR-OPT-8008</td>
<td>4 way</td>
<td>100 μm</td>
<td>VIS-NIR (LOH)</td>
<td>3</td>
<td>5.625</td>
<td>0.375</td>
<td>1.375</td>
</tr>
<tr>
<td>SR-OPT-8009</td>
<td>5 way</td>
<td>100 μm</td>
<td>VIS-NIR (LOH)</td>
<td>3</td>
<td>5.375</td>
<td>0.375</td>
<td>0.875</td>
</tr>
<tr>
<td>SR-OPT-8013</td>
<td>3 way</td>
<td>100 μm</td>
<td>VIS-NIR (LOH)</td>
<td>7</td>
<td>5.625</td>
<td>0.875</td>
<td>1.50</td>
</tr>
<tr>
<td>SR-OPT-8014</td>
<td>1 way</td>
<td>100 μm</td>
<td>UV-VIS (HOH)</td>
<td>7</td>
<td>2.38</td>
<td>2.38</td>
<td>-</td>
</tr>
<tr>
<td>SR-OPT-8015</td>
<td>2 way</td>
<td>100 μm</td>
<td>UV-VIS (HOH)</td>
<td>7</td>
<td>2.35</td>
<td>0.875</td>
<td>1.2</td>
</tr>
<tr>
<td>SR-OPT-8016</td>
<td>3 way</td>
<td>100 μm</td>
<td>UV-VIS (HOH)</td>
<td>7</td>
<td>5.625</td>
<td>0.875</td>
<td>1.5</td>
</tr>
<tr>
<td>SR-OPT-8017</td>
<td>4 way</td>
<td>100 μm</td>
<td>UV-VIS (HOH)</td>
<td>7</td>
<td>5.625</td>
<td>0.375</td>
<td>1.375</td>
</tr>
<tr>
<td>SR-OPT-8018</td>
<td>5 way</td>
<td>100 μm</td>
<td>UV-VIS (HOH)</td>
<td>3</td>
<td>5.375</td>
<td>0.375</td>
<td>0.875</td>
</tr>
<tr>
<td>SR-OPT-8019</td>
<td>1 way</td>
<td>200 μm</td>
<td>VIS-NIR (LOH)</td>
<td>19</td>
<td>4.06</td>
<td>4.06</td>
<td>-</td>
</tr>
<tr>
<td>SR-OPT-8020</td>
<td>2 way</td>
<td>200 μm</td>
<td>VIS-NIR (LOH)</td>
<td>7</td>
<td>9.43</td>
<td>1.745</td>
<td>2.0</td>
</tr>
<tr>
<td>SR-OPT-8021</td>
<td>3 way</td>
<td>200 μm</td>
<td>VIS-NIR (LOH)</td>
<td>3</td>
<td>9.625</td>
<td>0.735</td>
<td>1.715</td>
</tr>
<tr>
<td>SR-OPT-8025</td>
<td>4 way</td>
<td>200 μm</td>
<td>VIS-NIR (LOH)</td>
<td>3</td>
<td>9.88</td>
<td>0.735</td>
<td>1.715</td>
</tr>
<tr>
<td>SR-OPT-8024</td>
<td>1 way</td>
<td>200 μm</td>
<td>UV-VIS (HOH)</td>
<td>19</td>
<td>4.06</td>
<td>4.06</td>
<td>-</td>
</tr>
<tr>
<td>SR-OPT-8025</td>
<td>2 way</td>
<td>200 μm</td>
<td>UV-VIS (HOH)</td>
<td>7</td>
<td>9.43</td>
<td>1.715</td>
<td>2.0</td>
</tr>
<tr>
<td>SR-OPT-8026</td>
<td>3 way</td>
<td>200 μm</td>
<td>UV-VIS (HOH)</td>
<td>3</td>
<td>9.625</td>
<td>0.735</td>
<td>1.715</td>
</tr>
<tr>
<td>SR-OPT-8027</td>
<td>4 way</td>
<td>200 μm</td>
<td>UV-VIS (HOH)</td>
<td>3</td>
<td>9.88</td>
<td>0.735</td>
<td>1.715</td>
</tr>
</tbody>
</table>

- **Key Specifications**
  - UV-Vis and VIS-NIR optimized options
  - Numerical Aperture = 0.22
  - 100 and 200 μm fiber core options
  - From 1 to 5 leg options as standard
  - Standard SMA connectors to Ø 11 mm Andor ferrule
  - 2 m overall length - setup convenience and minimum transmission losses
  - Re-enforced shield and ruggedized connectors
  - Compatible with Andor Kymera and Shamrock F/number matchers and X-Y adjusters

**Have you found what you are looking for?**

- Need a different fiber core size? A longer overall cable? FC connectors?
- Additional channels or legs?
- Please contact your local Andor representative to discuss your specific needs.
Adding structural and chemical spectral analysis to Microscopy images of bio-samples such as cells and proteins, or materials such as polymers or semiconductors, is of ever increasing demand amongst the research community. Andor’s range of modular interfaces feature cage systems couplers, allowing endlessly configurable connections between Kymera and Shamrock spectrographs and a wide range of market leading microscopes such as Nikon, Olympus, Leica and Zeiss. The “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.

Key Applications
- Micro-Raman
- Micro-Luminescence - luminescence
- Micro-LIBS

From sample imaging... to analytical information

<table>
<thead>
<tr>
<th>Features</th>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>C-mount interfaces</td>
<td>Seamless integration of Kymera and Shamrock spectrograph-based systems to market leading upright and inverted microscopes</td>
</tr>
<tr>
<td>Microscope feet</td>
<td>Microscope left or right inverted output options – matches precisely Kymera and Shamrock spectrograph optical height for accurate opto-mechanical coupling</td>
</tr>
<tr>
<td>Wide-aperture slit</td>
<td>Up to 12 mm field of view - Andor’s imaging-optimized spectrographs allow high-quality sample image relay, without compromise in spectral information collection through the same optical channel</td>
</tr>
<tr>
<td>Thorlabs or Linos cage systems compatible interfaces</td>
<td>Fully user-configurable optical setups for Micro-Luminescence and Micro-Raman – compatible with 16, 30 and 60 mm versions</td>
</tr>
<tr>
<td>EMCCD compatible</td>
<td>Andor Newton™ and iXon platforms offer a unique combination of single photon sensitivity and high spectral rate and frame rate for challenging low-light spectroscopy</td>
</tr>
<tr>
<td>Software Development Kit</td>
<td>Enables seamless integration with third-party hardware and SDK under Labview, C/C++ and Visual Basic</td>
</tr>
</tbody>
</table>

Adjustable spectrograph foot set
- Leica DM4000 / 6000B
- Leica DM II
- Nikon Eclipse Ti series
- Nikon TE-2000
- Olympus BX15/B1 (left port)
- Olympus BX3/31
- Zeiss Axiovert 200
- Zeiss Axio Observer

Microscope fixed foot set
- Kymera 193i/328i: SR-A5M-0098
- Shamrock 500i/750: SR-A5M-0082

Microscope to cage system adapter
- TR-LCDM-MNT-150
- TR-DML-MNT-150
- TR-NKT-MNT-150
- TR-OLX-MNT-150
- TR-ZSA-MNT-150
- TR-ZAXO-MNT-150
Scanning Accessories

The perfect complement to Andor’s multi-channel detector portfolio

These accessories provide a perfect complement to Andor’s extensive range of market leading CCD, ICCD, InGaAs and EMCCD detectors. Shamrock and Kymera spectrograph double detector output configurations allow detection from 180 nm to 12 μm with one single setup. A Solis Scanning software platform provides a dedicated single interface for seamless setup and synchronizing of single point detectors, spectrographs, data acquisition unit and lock-in amplifiers, with an intuitive interface for complex experiment acquisition sequences.

More information at andor.com/learning
Specification sheets andor.com/spectroscopy

Part reference | Detector type | Wavelength coverage | Active area (mm) | Cooling
--- | --- | --- | --- | ---
ACC-SR-ASM-0042 | MCT | 2-12 μm | 1 x 1 | LN
ACC-SR-ASM-0043 | InSb | 1.5-5.5 μm | Ø2 | LN
ACC-SR-ASM-0044 | InGaAs | 0.8-2.3 μm | Ø3 | LN
ACC-SR-ASM-0045 | PbS | 0.8-1.9 μm | Ø3 | 4ºC TE cooling
ACC-SR-ASM-0046 | Si | 190-1100 nm | Ø11.28 | Room temperature
ACC-SR-ASM-0047 | PMT (R928) | 185-900 nm | 8 x 24 | Room temperature
ACC-SR-ASM-0048 | PMT (R1527P) | 165-480 nm | 8 x 24 | Room temperature

Part reference | Function | Features
--- | --- | ---
ACC-SR-ASZ-0053 | HV power supply for PMT | 0 to 1.5 kV software-controlled range for PMT gain adjustment
ACC-SR-ASZ-0054 | Photon counting unit for PMT | Software-selectable discrimination thresholds
ACC-SR-ASZ-0055 | Data acquisition unit | USB 2.0 interface, includes 2x SPD acquisition channels, 2x analog outputs for PMT HV power supply control and connections to lock-in amplifiers **

** Recommended models include SRS SR430 with associated SRS40 chopper

More information at andor.com/learning
Specification sheets andor.com/spectroscopy
With over 50,000 users worldwide Andor products are represented in all the major universities, helping researchers to achieve key advances and discoveries by offering cutting-edge spectroscopy systems based on the latest technologies available. The result is a great breadth of exciting applications, collaborations and testimonials across researchers’ publications, which Andor is extremely proud to share with the scientific community.

Visit the Learning Center now to discover more at andor.com/learning.

Innovative techniques and cutting edge research:

- TERS - Label-free chemical analysis of nanostructures in biofilms
- Stand-off LIBS: a detection technique for explosive residues
- Development of a Raman detector for hyphenation with high-temperature liquid chromatography and isotope ratio mass spectrometry
- Magneto-PL unveils photoluminescence in Si nanocrystals
- Novel enabling detector technology

Have you found what you are looking for?

Can’t see your publications referenced when your work involved Andor equipment? Are you interested to put forward some of your key innovations and results? Do you have spectacular images, movies or posters you would be keen to share and are interested in collaboration work around a particular application? Our team of application specialists will be eager to discuss your ideas.
Customer Support

Andor products are regularly used in critical applications and we can provide a variety of customer support services to maximise the return on your investment and ensure that your product continues to operate at its optimum performance.

Andor has customer support teams located across North America, Asia and Europe, allowing us to provide local technical assistance and advice. Requests for support can be made at any time by contacting our technical support team at andor.com/support.

Andor offers a variety of support under the following format:

- On-site product specialists can assist you with the installation and commissioning of your chosen product
- Training services can be provided on-site or remotely via the Internet
- A testing service to confirm the integrity and optimize the performance of existing equipment in the field is also available on request.

A range of extended warranty packages are available for Andor products giving you the flexibility to choose one appropriate for your needs. These warranties allow you to obtain additional levels of service and include both on-site and remote support options, and may be purchased on a multi-year basis allowing users to fix their support costs over the operating life cycle of the products.