

# Dragonfly

## High-Speed Confocal with 3D Super-Resolution

### Key Specifications

- ✓ Instant confocal: up to 400 fps
- ✓ Borealis® uniform illumination
- ✓ 3D SMLM: resolution to 10-20 nm
- ✓ Live cell super-resolution: SRRF-Stream+
- ✓ Unique easy-to-use TIRF: B-TIRF
- ✓ Broad wavelength range: UV-Vis to NIR
- ✓ Greater productivity: large field of view

### Key Applications

- ✓ Developmental, cell & neurobiology
- ✓ Cancer & oncobiology
- ✓ Microbiology & virology
- ✓ Organoids & large model organisms
- ✓ Spatial genomics & proteomics
- ✓ Multiplex & Expansion microscopy
- ✓ Plant biology



# It's More than Confocal...

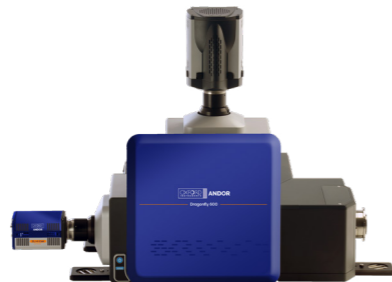
Dragonfly is a **high-contrast multi-dimensional imaging** platform capable of four key imaging modalities.

At its core is a multi-point confocal for high-speed and high-sensitivity imaging. Capturing at speeds at least 10x faster than conventional confocal technology, with dramatically improved sensitivity from 400-800 nm. Dragonfly is the optimal solution for live cell imaging, providing low phototoxicity and photobleaching, or perfect for fast volume acquisition of fixed samples.

We have two models of Dragonfly available, the 200 and 600.



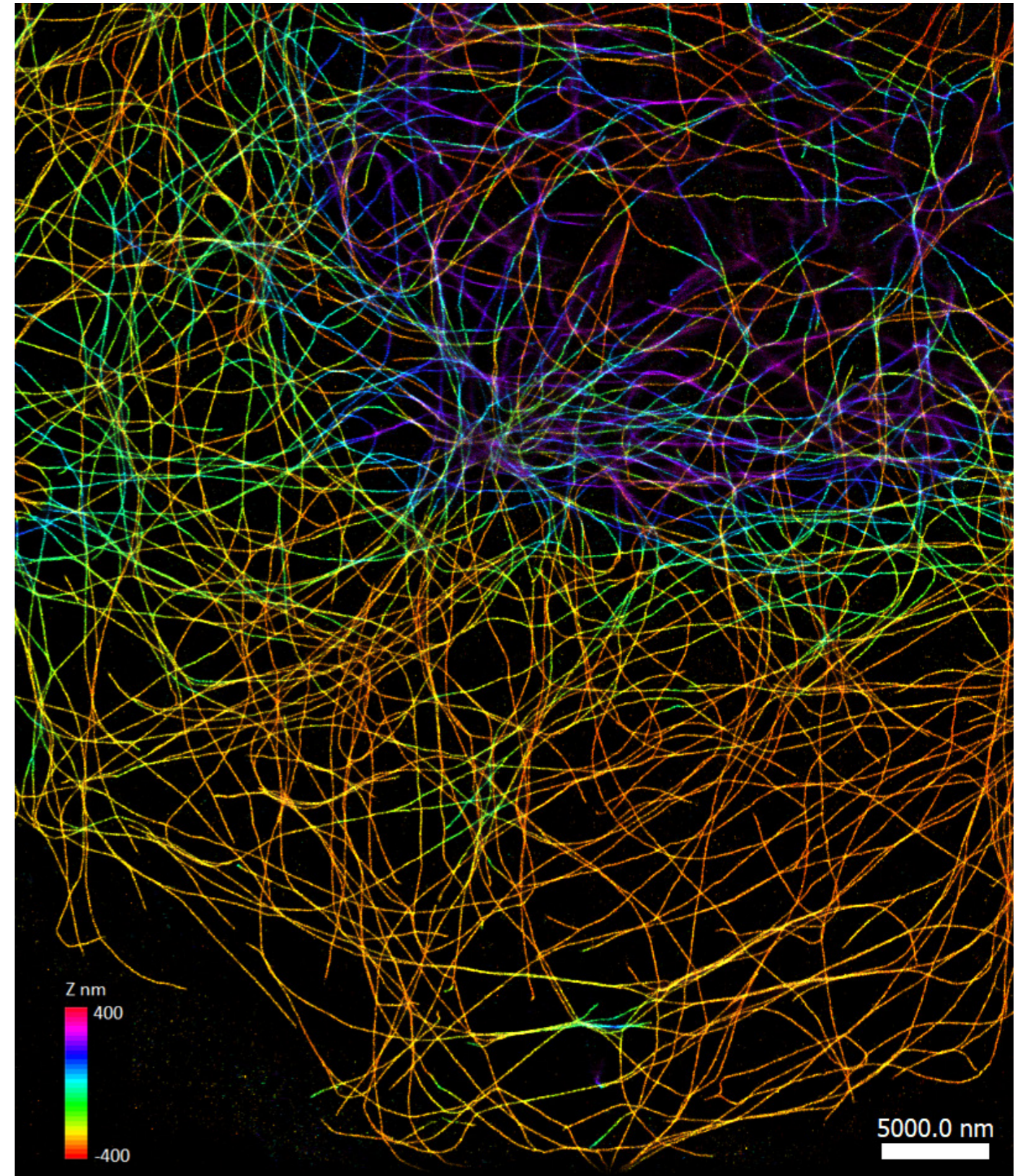
**Dragonfly 200**  
Multi-modal confocal system



**Dragonfly 600**  
Multi-modal confocal system with 3D SMLM capabilities & B-TIRF

|  |   |
|--|---|
| Up to 2 cameras  |   |
| High power or integrated laser engine (HLE or ILE)   |   |
| Single or dual pinhole   | Dual pinhole  |
| <ul style="list-style-type: none"> <li>Confocal</li> <li>Laser based widefield</li> <li>Transmitted light</li> <li>SRRF-Stream+</li> </ul> | <ul style="list-style-type: none"> <li>Confocal</li> <li>Laser based widefield</li> <li>Transmitted light</li> <li>SRRF-Stream+</li> <li><b>SMLM</b></li> <li><b>3D Super-resolution module</b></li> <li><b>B-TIRF</b></li> <li><b>Zoom illumination</b></li> </ul> |

HLE - High power laser engine  
 ILE - Integrated laser engine  
 SMLM - Single molecule localisation microscopy  
 3D Super-resolution module - optics for 3D SMLM  
 B-TIRF - Borealis® total internal reflection microscopy  
 SRRF - Super-resolution radial fluctuations



Super-resolution image of microtubules with B-TIRF. Image credit: F. Rivera-Molina, Yale University.

# Imaging Modalities

## ✓ Confocal

Capturing at speeds at least 10x faster than conventional confocal technology. Dragonfly is the optimal solution for live cell imaging, providing low phototoxicity and photobleaching, or for fast volume acquisition of large fixed samples.

## ✓ B-TIRF

Andor's proprietary Borealis® Total Internal Reflection Fluorescence (B-TIRF) with multimodal illumination avoids the common artefacts observed in conventional TIRF systems. With a unique broad excitation wavelength range from 400 - 800 nm and an exceptionally simple imaging set up, the B-TIRF module is available on Dragonfly 600.

## Super-Resolution - Single Molecule Localization Microscopy (SMLM)

The HLE delivers the required laser power for dSTORM and DNA-PAINT applications. 3D SMLM uses an astigmatic module (3D Super-resolution module) compatible with all imaging modalities: widefield, TIRF and confocal.

## ✓ SRRF-Stream+

SRRF (Super-Resolution Radial Fluctuations) offers a highly effective and flexible software-based approach to super-resolution. Read our [SRRF-Stream+ technical note](#) to find out more.

## ✓ Widefield Fluorescence

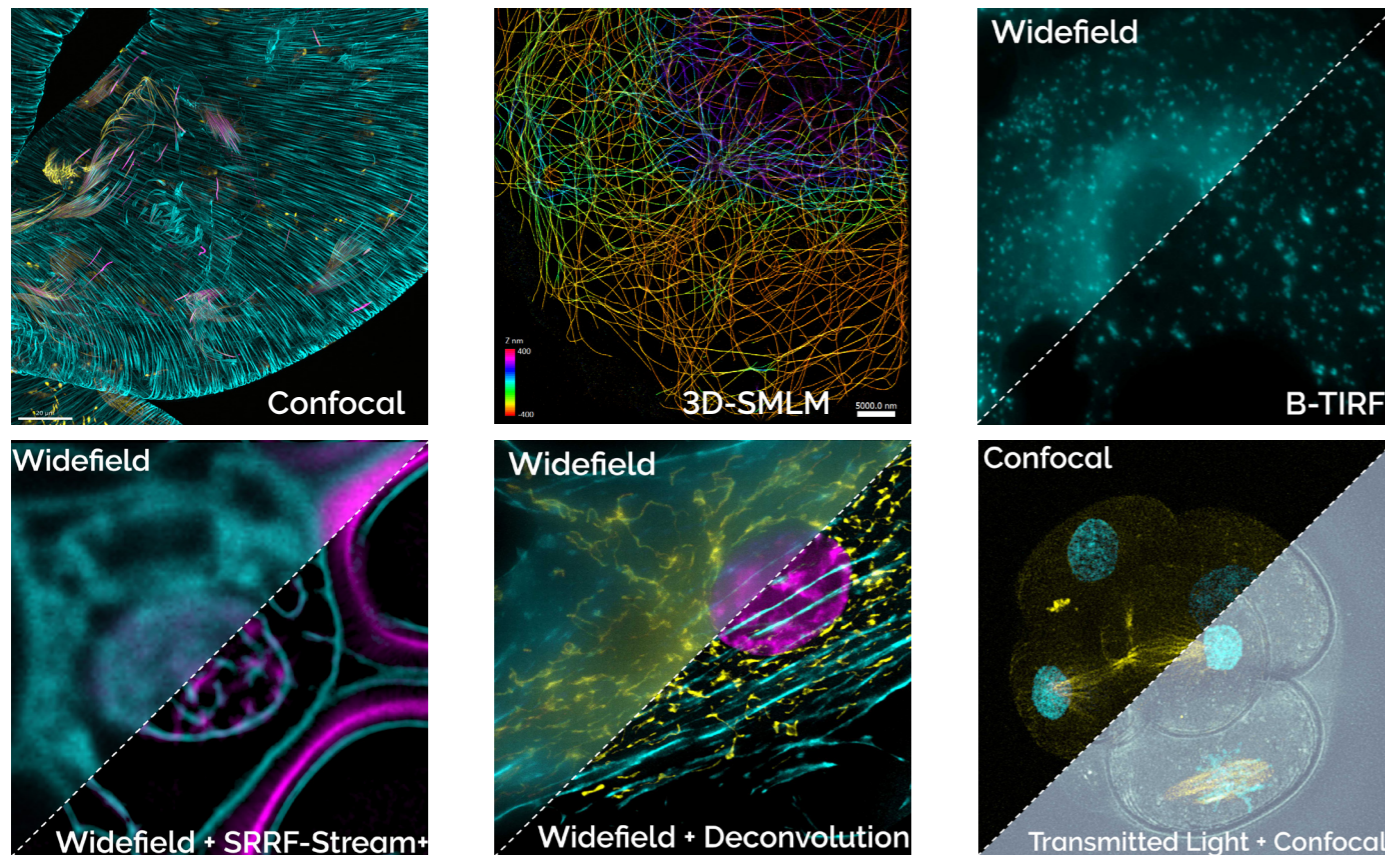
Widefield is ideal for yeast or very thin samples, or applications that require high laser power, like SMLM. In widefield cameras and lasers are shared between modes to avoid switching microscope ports and turrets.

## ✓ Deconvolution

Apply integrated GPU-accelerated deconvolution with confocal, widefield & TIRF, to increase the signal to noise ratio, and boost resolution.

## ✓ Transmitted Light Microscopy (DIC, Phase Contrast & Brightfield)

All imaging modalities can be combined with transmitted light techniques (DIC or phase contrast) providing a reference channel, allowing correlative or context setting.



## From Nanometers to Millimeters

|  | Widefield      | Confocal   | ClearView-GPU™ Deconvolution    | SRRF-Stream+                    | SMLM with WF             | SDC-PAINT              | B-TIRF with/without deconvolution | SMLM with B-TIRF         |
|--|----------------|------------|---------------------------------|---------------------------------|--------------------------|------------------------|-----------------------------------|--------------------------|
| <b>Dragonfly Model</b>                     | All models     | All models | All models                      | Option (All models)             | 600 series               | 600 series             | 600 only                          | 600 only                 |
| <b>SRRF-Stream+ Compatible</b>             | Yes            | Yes        | No                              | NA                              | No                       | No                     | Yes                               | No                       |
| <b>Lateral Resolution (nm)</b>             | 245            | 220        | 200 (widefield); 140 (confocal) | 100 - 150                       | 20                       | 20                     | 140/200                           | 10-20                    |
| <b>Axial Resolution (typical FWHM)</b>     | 570 nm         | 520 nm     | 500 (widefield); 280 (confocal) | 570 (widefield); 520 (confocal) | 30-50 (3D ~1µm range)    | 30-50 (3D ~10µm range) | 220/250                           | 30-50 (3D ~5µm range)    |
| <b>Special probes / sample preparation</b> | No             | No         | No                              | No                              | Yes                      | Yes                    | No                                | Yes                      |
| <b>Image Acquisition</b>                   | Fusion         |            |                                 |                                 |                          |                        |                                   |                          |
| <b>Image Processing</b>                    | Fusion, Imaris |            |                                 |                                 | Fusion, Imaris & Picasso |                        | Fusion, Imaris                    | Fusion, Imaris & Picasso |
| <b>Live Cell Imaging Compatible</b>        | Yes            | Yes        | Yes                             | Yes                             | No                       | No                     | Yes                               | No                       |

SMLM with B-TIRF – single molecule localisation microscopy prepared samples imaged using B-TIRF.

SDC-PAINT – single molecule localisation microscopy sample (DNA-PAINT) imaged using spinning disk confocal.

Fusion and Imaris software from Andor provide seamless transitions from image acquisition to deconvolution, visualisation to analysis.

Picasso - Free third party software tool for PAINT and super-resolution images.

# Neuroscience

## Super-Resolve Synapses in 3D down to 30 nm

Neuroscience researchers need to image both live and fixed samples across multiple size regimes: capturing structures from nanometers to millimeters. Dragonfly is the instrument of choice - whether imaging glial cells, axonal transport, large tissue sections, expanded samples (ExM), or dendritic spines with super-resolution (SMLM).

Dragonfly's large field of view combined with rapid confocal imaging (400 fps), means it is 10 X more productive than point scanners. Further, the 3D super-resolution module is compatible with all imaging modalities: widefield, B-TIRF and confocal for maximum flexibility.

## Localise synaptic zones & understand functional states with SMLM

- ✓ Super resolve synapses in 3D (down to 30 nm axially) with the super-resolution module.
- ✓ Resolve tethered synaptic vesicles using SMLM with lateral resolution down to 10 nm.
- ✓ Visualise the receptors at the membrane and increase signal to noise with B-TIRF.
- ✓ Super resolve structures deep inside neuronal cells with confocal (Z ~ 10  $\mu$ m).

## Create brain atlases with spatial transcriptomics

- ✓ Map gene expression at the cellular level taking advantage of faster acquisition speeds with HLE compared to ILE.
- ✓ Quantify gene expression accurately with Borealis® uniform illumination.
- ✓ Increase productivity taking advantage of the large field of view and fast confocal imaging.

## Image live neuronal samples

- ✓ Image dynamic events such as calcium signalling with fast confocal imaging (400 fps).
- ✓ Image sensitive samples such as brain slices and retina explants with gentle illumination delivered by the HLE or ILE.
- ✓ Capture all signals with short exposure times and highly sensitive detectors.

## Image deeper into live thick brain tissue with NIR wavelengths

- ✓ Increased sample penetration.
- ✓ Increased sample viability due to less energetic radiation.

Mus musculus neuronal staining. Sample from the " BRAIN Initiative® (nih.gov)". Image courtesy of Dr Hong Wei Dong, Department of Neurobiology, UCLA.

# Cell Biology

## Image cell division for hours or days

Whether imaging a cell population, intracellular organelles, Expansion microscopy (ExM) or super-resolution microscopy there is always a suitable imaging modality. Dragonfly delivers imaging with outstanding quality for cell biologists including: confocal, B-TIRF, widefield, super-resolution (SMLM) or super-resolution compatible with live cell imaging (SRRF-Stream+).

## Resolve the ultrastructure of centrioles or 3D nuclear pore complexes

- ✓ Reveal Chromatin & epigenetics organization down to 10 nm in XY using the HLE.
- ✓ Investigate the mitochondrial membrane structures with 30 nm axial resolution using the 3D super-resolution module.
- ✓ Visualise the receptors at the cell membrane and identify biomolecules involved in signalling by combining the 3D super-resolution module, HLE and B-TIRF.

## Image organelle dynamics with minimal phototoxicity or photobleaching

- ✓ Image live samples for days with high sensitivity detectors.
- ✓ Image microtubule growing tips or cilia beating with fast acquisition speeds (400 fps in confocal).

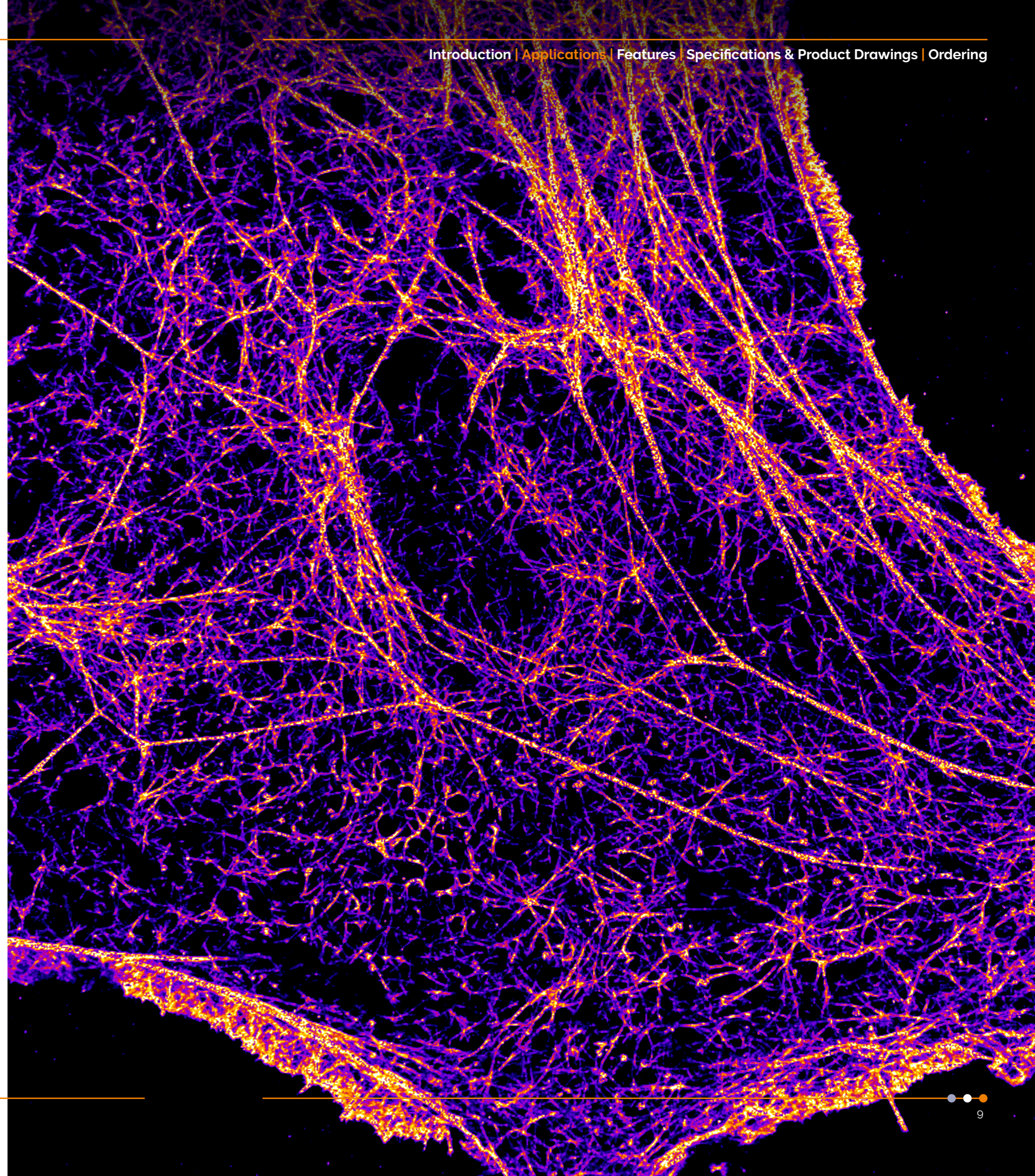
## Image live membrane fusion events and receptor signalling

- ✓ Get more information from one image with Borealis® uniform illumination.
- ✓ Image vesicle trafficking live with outstanding quality using B-TIRF with 30% more uniformity than conventional TIRF.
- ✓ Increase productivity and get the optimal image using B-TIRF optical feedback.

## Image cell biology using Expansion microscopy (ExM)

- ✓ Image large and Expanded (ExM) samples.
- ✓ Capture more images faster through large field of view, high sensitivity detectors and high power lasers.
- ✓ Quantify, use and interpret more data in the image due to Borealis® uniform illumination.
- ✓ Acquire information from multiple probes, taking advantage of the wide excitation spectrum of the HLE.

Actin network of a U2OS cultured cell, imaged by PAINT SMLM protocol with Dragonfly 600. Actin is transiently labelled with LifeAct-Cy3B and imaged at 560 nm in B-TIRF. A 10k frame time-series was acquired with 20 ms exposure and Sona 4B6 BSI sCMOS detector. Reconstructed with Picasso. *Image courtesy of Florian Schueder, Yale University.*

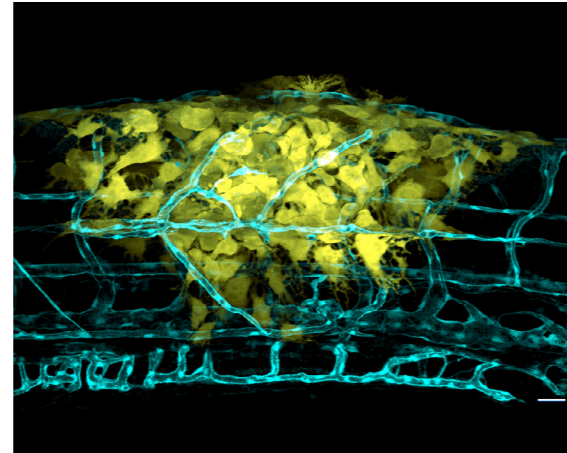


# Application Focus

## Cancer Research

Visualise deep into tissue and metastasis formation due to optimized pinholes & disk

Cancer research needs a holistic approach to biology requiring insights into gene expression, tumour microenvironment, in vitro/in vivo assays and malignancy. Dragonfly allows researchers to study cancer cell behaviour interactions with the environment and spatial distribution of the tumour in either fixed or live cells. Capture all the information in one experiment using multicolour imaging of multiple signals from cancers with the wide spectrum of the ILE or HLE. Gentle imaging delivers live images of cancer tissues over hours or days. The speed of acquisition and optimised pinhole spacing allow imaging fast and deep into thick tissues or organoids.



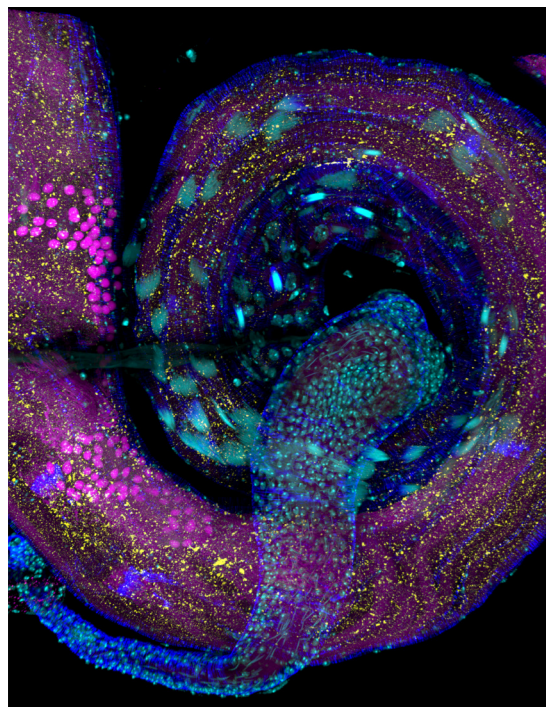
Angiogenesis in Zebrafish with cancer. Image courtesy of Dr Julien Rességuier at NorMIC University of Oslo.

## Developmental Biology

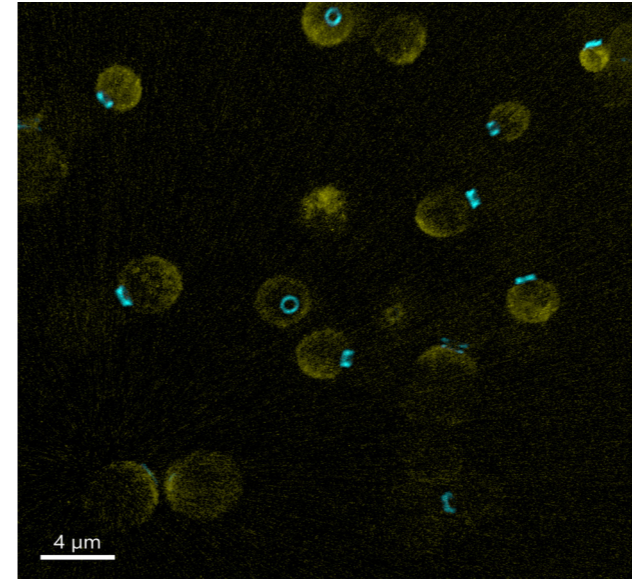
Image blood flow or cilia beating with instant confocal

Developmental biology requires imaging of thick samples. Image very deep into thick organisms up to the millimetre range using Dragonfly due to its optimised pinhole size and spacing.

- ✓ Visualise the entire organism at high resolution. Acquire all the images at high magnification and seamlessly stitch as if they were a single snapshot using Borealis uniform illumination.
- ✓ Image embryonic mouse development or other delicate processes for hours or days, with exceptional sensitivity.
- ✓ Image blood flow or cilia beating deep into developing tissues with fast confocal imaging speeds.



Adult drosophila testis showing different stages of sperm individualization. Image courtesy of Alina Kolpakova, Eli Arama group, Weizmann Institute of Science.

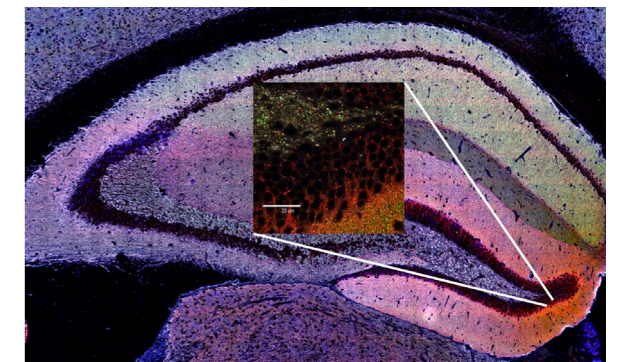


Budding Yeast sample. In Cyan Cdc3-GFP (septin marker) and yellow Gic2PBD-tdTomato (Cdc42 marker) in yellow. Image is a maximum intensity projection of 67 Z stacks, acquired in confocal mode with the 40 μm pinhole. Sample courtesy of Dr. Satoshi Okada, Medical Biochemistry, Kyushu University Faculty of Medical Science.

## Transcriptomics & Proteomics

Increase Productivity in Omics data with High Power Laser Engine

Understanding the molecular basis of development, brain function, neurodegenerative diseases, cancer, and behaviour is an enormous task. The Omics-related sciences gather information about  $X^n$  biological molecules to characterize and quantify the entire pool of molecules. Dragonfly is perfect for such applications because of its highly sensitive detectors, exceptionally high background rejection, speed of acquisition, uniform illumination and automation capabilities. Omics research has applications in multiple areas of life sciences, such as predicting disease progression based on gene expression maps, accessing tumour microenvironment and cancer severity.



Large tissue section scanned for synaptic protein density mapping Dragonfly high speed confocal. Image credits: S. Grant, University of Edinburgh.

# Features and Benefits

| Feature   | Benefits   | 200 Series                    | 600 Series           |
|---|--|-------------------------------|----------------------|
| High speed confocal (micro-lens dual disk)                | <ul style="list-style-type: none"> <li>Up to 400 fps for fast cell dynamics</li> <li>At least 10x faster than conventional confocal</li> </ul>   | ✓                             | ✓                    |
| Large field of view (16.6 x 14.0 mm)                      | <ul style="list-style-type: none"> <li>Capture more in a single image</li> <li>Matches large sCMOS sensors</li> </ul>  | ✓                             | ✓                    |
| Borealis® Uniform Illumination                            | <ul style="list-style-type: none"> <li>Provides stable light throughput, uniform illumination, and extended wavelength range (405 to 785 nm)</li> </ul>  | ✓                             | ✓                    |
| Borealis® - TIRF or B-TIRF                                | <ul style="list-style-type: none"> <li>Andor's proprietary TIRF module supplied for 60x and 100x TIRF objective lenses</li> <li>Easy to set up - with optical feedback</li> <li>Highly-uniform TIRF and oblique imaging</li> <li>Enables broad spectrum TIRF 400 - 800 nm</li> </ul> | -                             | ✓                    |
| 16-bit dynamic range                                      | <ul style="list-style-type: none"> <li>Capture both weak and bright signals without saturation</li> </ul>  | ✓                             | ✓                    |
| Motorized 4 position emission-splitting dichroic cassette | <ul style="list-style-type: none"> <li>Optimal flexibility for simultaneous dual colour imaging (e.g. single camera bypass + 3 chromatic splitters)</li> </ul>   | ✓                             | ✓                    |
| Active blanking   | <ul style="list-style-type: none"> <li>Laser illumination synchronised with camera exposure to minimize phototoxicity and photobleaching</li> </ul>  | ✓                             | ✓                    |
| Exchangeable emission filter wheels                       | <ul style="list-style-type: none"> <li>To comprehensively image multiple fluorophores when using up to 8 laser lines for excitation (UV to NIR)</li> <li>RFID-tagged for filter update in user interface</li> </ul>  | ✓                             | ✓                    |
| Camera magnification (1x, 1.5x & 2x)                      | <ul style="list-style-type: none"> <li>For flexible higher resolution imaging and pixel scaling to achieve Nyquist sampling over a wide range of objectives and pixel sizes</li> </ul>   | 2-position motorized (option) | 3-position motorized |
| 2 pinhole diameters (25 µm and 40 µm)                     | <ul style="list-style-type: none"> <li>High contrast imaging at low and high magnification for large samples to subcellular imaging</li> </ul>   | Option                        | ✓                    |
| Laser-illuminated widefield mode                          | <ul style="list-style-type: none"> <li>For imaging thin specimens and single molecules</li> </ul>  | ✓                             | ✓                    |
| Sensitive & fast detectors                                | <ul style="list-style-type: none"> <li>EMCCD for extreme sensitivity</li> <li>sCMOS for resolution &amp; speed with &gt;95% QE</li> </ul>  | ✓                             | ✓                    |

| Feature                      | Benefits  | 200 Series | 600 Series |
|------------------------------|---|------------|------------|
| Illumination zoom*1          | <ul style="list-style-type: none"> <li>Delivers higher illumination power density for applications such as localisation microscopy</li> </ul>   | -          | ✓          |
| 3D super-resolution module*1 | <ul style="list-style-type: none"> <li>3D astigmatic module for 3D single molecule localisation imaging in a volume</li> <li>Compatible with all imaging modalities allowing spinning-disk, Widefield and TIRF DNA PAINT.</li> </ul>                      | -          | Option     |
| Laser engines (HLE or ILE)   | <ul style="list-style-type: none"> <li>Extended spectral range (400 - 800)</li> <li>High laser power capabilities for SMLM</li> <li>2 to 6X faster with HLE vs ILE*</li> <li>Multimode fibre - more robust to damage and longer term stability</li> </ul> | ✓          | ✓          |

\*6X faster testing based on setting an acquisition with 31% laser power for 488 lines in both ILE and HLE. The exposure time for each acquisition was set so that the image delivers the same grey levels: 200 ms for ILE and 10 ms for HLE. Results are given by a finite burst acquisition of 200 frames. (On the laser engine: 100% laser power is 150 mW and 1500 mW for ILE and HLE respectively).

| Software               |   | 200 Series | 600 Series |
|------------------------|---|------------|------------|
| Real-time 3D rendering | <ul style="list-style-type: none"> <li>Immediate visual feedback on experimental progress to evaluate data and make appropriate decisions in real-time</li> </ul>   | ✓          | ✓          |
| 3D Montage & Stitching | <ul style="list-style-type: none"> <li>Activate Stitching in a protocol</li> </ul>  | ✓          | ✓          |
| ClearView-GPU®         | <ul style="list-style-type: none"> <li>Up to 50x faster processing than non-GPU based deconvolution solutions</li> <li>Activate Deconvolution in a protocol</li> <li>Choose an algorithm to balance speed and quality according to your image properties</li> </ul> | ✓          | ✓          |
| High content screening | <ul style="list-style-type: none"> <li>Supports multiple well plates, dishes and slides</li> <li>Supports multiwell + montage acquisitions</li> </ul>   | ✓          | ✓          |
| Imaris file format     | <ul style="list-style-type: none"> <li>Easy transfer of data to Imaris for comprehensive downstream multi-dimensional analysis</li> </ul>   | ✓          | ✓          |

✓ = Feature available as standard  
 Option = Feature available as an option  
 - = Feature not available

# Technical Features Explained

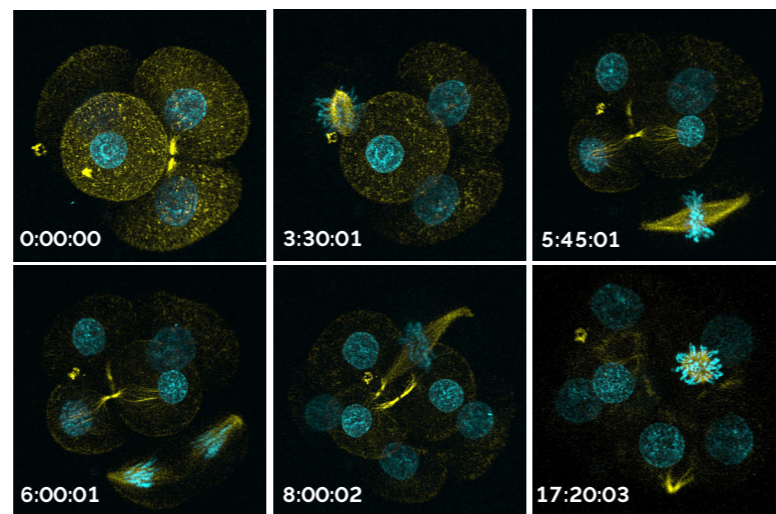


## 1 Dual Microlens Spinning Disk

In spinning disk confocal microscopy, multiple points of the sample are simultaneously illuminated by a disk with multiple pinholes. The emitted light from the sample is re-imaged through the pinhole to reject out-of-focus light before it reaches the detector (camera). Therefore, it reduces the laser power needed to achieve an excellent confocal image. Thereby reducing the background and consequently allowing imaging deeper into the sample.

The immediate benefits for the user are:

- ✓ Gentle imaging allows to image live samples without phototoxicity or photobleaching
- ✓ Fast confocal imaging
- ✓ Image live very fast events
- ✓ Increase productivity when imaging deep thick samples
- ✓ Increase the signal-to-noise ratio

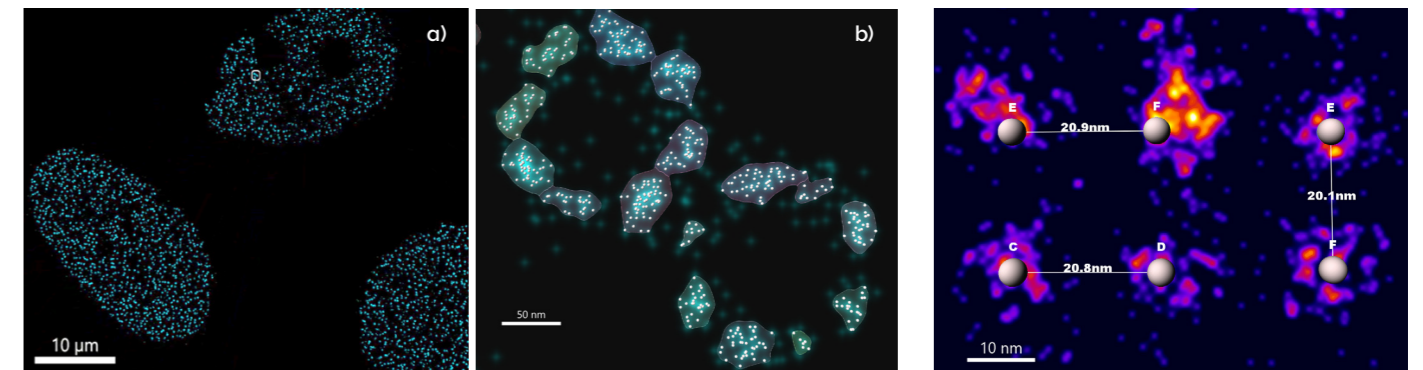


Mouse fertilized egg early development. Samples were imaged with Andor Dragonfly soon after fertilization. Early development was followed by imaging every 15 minutes for 24 hours. At each time point, 50 stacks per channel were acquired. In yellow microtubules, in cyan DNA. *Sample courtesy of Dr. Yoshiteru Kai, Yamashita Shonan Yume Clinic.*

## 2 3D Single molecule imaging

The Dragonfly 600 has all the necessary tools for single-molecule localisation microscopy. It will deliver images with nanometre localisation precisions and corresponding resolution down to 10 nm. Significantly, Single Molecule Localisation Microscopy (SMLM) can be done using the 3D super resolution module, which is compatible with all imaging modalities: Widefield, TIRF and confocal. A single plane image through the 3D Super-resolution module delivers axial information over an  $\sim 1 \mu\text{m}$  range with a corresponding resolution down to 30 nm.

The 3D Super-resolution module in widefield allows collection of axial SMLM data. In combination with B-TIRF this increases the signal to noise of the super-resolution data close to the coverslip. When the 3D super-resolution module is combined with confocal spinning disk, super resolution can be achieved in thicker specimens ( $\sim 10 \mu\text{m}$  range) by sequential acquisition of optical sections.



Dragonfly allows correlative/cross scale microscopy. a) image of 3 cell nuclei in which the nuclear pores were transiently labelled for NUP96 (nuclear pore protein). b) The same data set, zoomed around white highlight in a) to show DNA-PAINT resolution of  $<20 \text{ nm}$ , revealing the 8-fold symmetry of the nuclear pore complex.

DNA-origami  $3 \times 4$  grid with  $\sim 20 \text{ nm}$  Cy3B fluorophore separation, imaged with a similar B-TIRF protocol shows resolution  $<10 \text{ nm}$ .

## 3 Sensitive Detectors

Sensitivity is a fundamental parameter of all microscope imaging systems. It determines the minimum detectable signal for a given excitation intensity. Dragonfly benefits from Andor's market-leading sCMOS and EMCCD detectors.

For the faintest of signals, iXon EMCCD detectors capture as low as 1.9 photons per pixel, with high signal to noise ratio.

Our latest generation of sCMOS detectors offer an outstanding balance of sensitivity and speed; with quantum efficiencies up to 95% and speeds greater than 44 frames per second (sustained), at full field of view.

Read more in our camera specifications:

- ✓ [iXon Back Illuminated EMCCD Specifications](#)
- ✓ [Sona Back Illuminated sCMOS Specifications](#)
- ✓ [ZL41 Cell sCMOS Specifications](#)

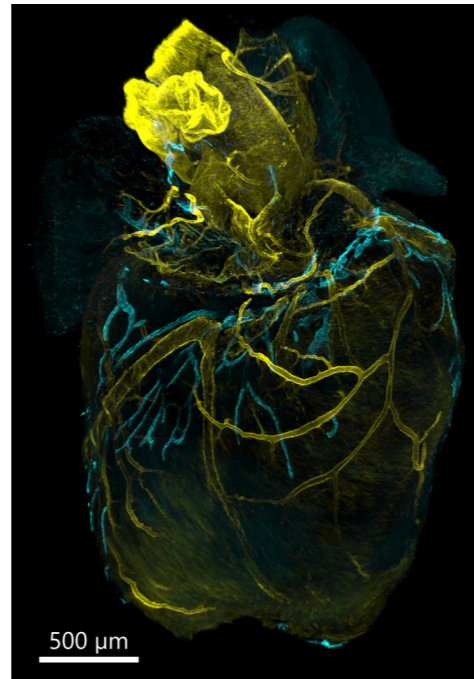


## 4 Borealis® Uniform Illumination

Andor's patented Borealis® Uniform Illumination delivers premier uniform illumination in the full field of view. It minimizes roll-off in excitation uniformity ( $\leq 5\%$ ) and significantly improves resulting image quality. This reduces errors in analysis across a field of view and reduces stitching artefacts in tiled or montage imaging. Borealis® patented technology is also available with B-TIRF.

B-TIRF illuminates the objective back focal plane with a multimode pupil function and produces a uniform illumination pattern at the specimen. The multimode illumination avoids the common artefacts often observed in TIRF: interference and streaking.

Regardless of the imaging modality: confocal, widefield, TIRF or single molecule imaging, Dragonfly delivers excellent uniformity across the full field of view allowing for seamless stitching and consistent quantification of image intensity.



Mouse heart lymphatic vessels, showing Lyve-1 in cyan and SMA in yellow. The image is a stitch of 9 tiles and was imaged over a 720  $\mu\text{m}$  Z range. Sample courtesy of Claire Bouvard, Laboratoire BioSanté U. Grenoble, France.

## 5 TIRF and B-TIRF

Borealis® Total Internal Reflection Fluorescence (B-TIRF) is Andor's proprietary TIRF module. The Borealis® uniform illumination of B-TIRF avoids interference and streaking artefacts found in standard TIRF imaging and consequently delivers superior image quality. Significantly B-TIRF is extremely easy to use, reducing the expertise needed to acquire TIRF images. B-TIRF can be used for regular TIRF applications, such as live imaging events at the edge of the cell membrane (e.g. endo/exocytosis, focal adhesion and cell movement, viral infection dynamics, etc).

Further, in Dragonfly, B-TIRF can be combined with illumination zoom, or the HLE, to perform single-molecule localization experiments with significantly increased signal to noise ratios.

## 6 Integrated and High Power Laser Engines

Select laser illumination between the ILE (Integrated Laser Engine) or the HLE (High Power Laser Engine), both laser engines offer multimode fibre. Multimode fibres support and transmit longer wavelengths than single mode fibres. Further, they require less maintenance and can match and fill the square sensor of the detector perfectly.

Both ILE and HLE are suitable for live cell imaging of delicate samples, as they provide strictly controlled and gentle illumination. Both the ILE and HLE are compatible with the new B-TIRF imaging modality.

The HLE additionally offers the high power required for single-molecule imaging and considerably speed up imaging spatial transcriptomics experiments. For more information on laser engines please consult the [laser engines specification sheet](#).

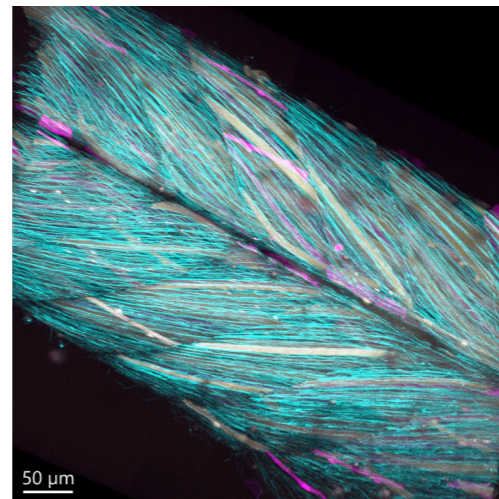


Image right: Skeletal muscle of transgenic Medaka fish. Gaudi strain [Centanin et al., 2014, Development]. Z-stack images of a 290  $\mu\text{m}$  thickness sample were acquired with Andor Dragonfly using a 20x/0.75 water immersion lens. Sample courtesy of Dr. Joe Sakamoto, Dr. Yasuhiro Kamei, and NBRP Medaka, NIBB, Japan.

## 7 Intuitive Software

### Fusion

Fusion has been designed to meet the requirements of today's researchers providing ease of use and immediate visual feedback for data review. Fusion simplifies the control of the Dragonfly system, making high-end microscopy accessible to all users.

- ✓ Real-time 3D visualisation permits powerful insights to your experiments.
- ✓ Stitching and deconvolution can be activated in the protocol delivering the processed image soon after the acquisition is finished.
- ✓ Multi-well acquisition is available through an easy and intuitive user interface supporting up to 384 well plates: perfect for easy and fast screening of samples, organoids and phenotypes.
- ✓ A new burst shutter imaging mode for fast acquisitions can also be combined with Z acquisition.
- ✓ 3D single molecule imaging can be done in whole cells with minimal software interaction.
- ✓ An autofocus system is available in all imaging modalities delivering stable, precise imaging at all points during the entire experiment.

### Imaris®

Imaris for Dragonfly is integral to all Dragonfly models.

Imaris for Dragonfly Super-Resolution is an integral part of the Dragonfly 600.

Imaris for Dragonfly allows the user to:

- ✓ Create 3D/4D volume and surface renderings
- ✓ Make high resolution snapshots
- ✓ Create sophisticated multi-dimensional animations
- ✓ Apply image pre-processing

Imaris MeasurementPro for Dragonfly Super-Resolution adds these features for visualisation and analysis of 3D SMLM data:

- ✓ Object measurements: Count, Volume, Intensity, Surface Area and more
- ✓ Distance measurements: average from nearest neighbour(s), shortest to other structures or to reference points
- ✓ Machine learning object classification
- ✓ Object color-coding based on measurements

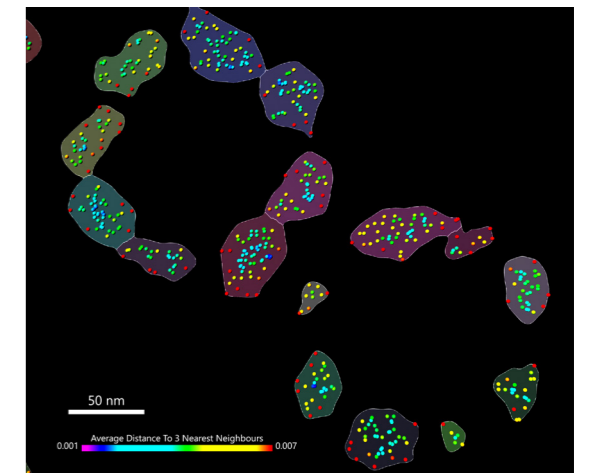
Imaris licence can be transferred to another workstation to ensure enough processing power and allow more time for image visualisation and analysis.

Additional application-specific modules are available on request and include options from packages for cell biology, cell lineage, neuroscience and much more.

See [imaris.oxinst.com](http://imaris.oxinst.com)

### Picasso

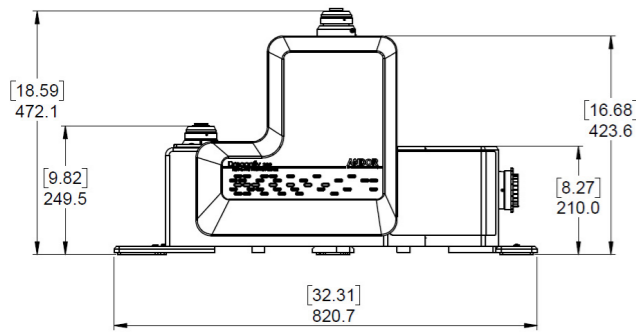
We have worked with Picasso developers to allow Imaris .ims files to be read in Picasso. Users have the flexibility to go to open-source software to retrieve SMLM data and 3D SMLM localizations. 3D rendering and statistical measurements are then delivered in Imaris.



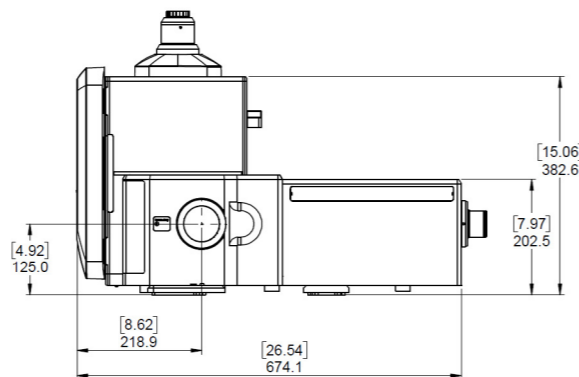
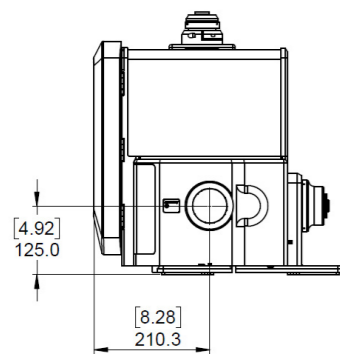
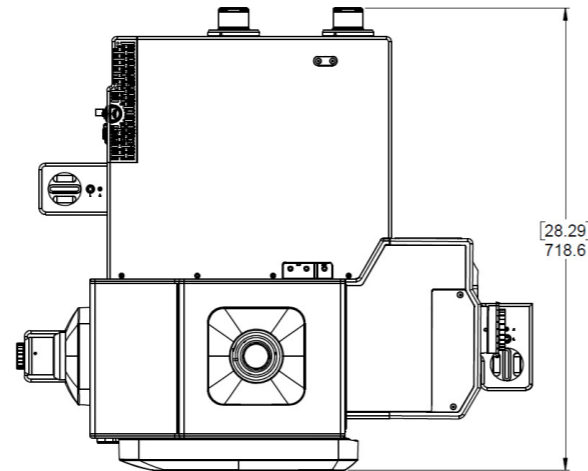
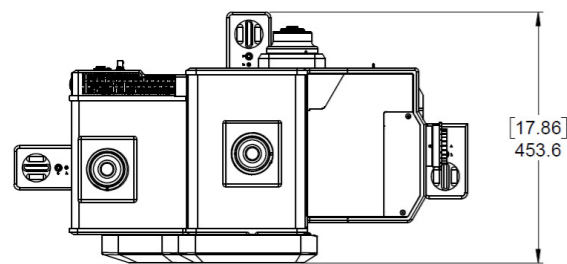
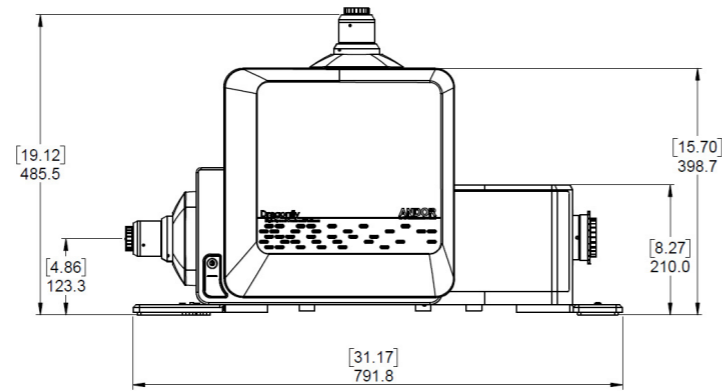
Fusion, Picasso and Imaris operate in harmony: Picasso directly reads Fusion raw data files and localises single molecule events in XY & Z, and exports both localisations and voxels. Imaris loads the voxels as a 3D volume and the localisations as Spots® for visualisation, filtering and analysis of densities (e.g. nearest neighbour measurements). Surfaces can be fitted to the resulting density maps as shown here with the NUP96 complex (page 15)

# Mechanical Drawings

## 200 Series



## 600 Series



|                                | 200 Series   | 600 Series   |
|--------------------------------|--|--|
| Weight                         | 39 kg approx. without cameras/accessories  | 65 kg approx. without cameras/accessories  |
| Dimensions (WxDxH) inches [mm] | 32.3 x 22 x 18.8 [821 x 558 x 477]<br>(with installation handles)<br>See diagram above for without handles | 31.2 x 30.7 x 19.3 [792 x 780 x 489]<br>(with installation handles)<br>See diagram above for without handles |

Note: Addition of camera(s) will add up to 7.4 [189] to height and up to 3.7 kg weight per camera.  
For dimensions of the HLE, please refer to the [HLE & ILE specifications sheet](#).

## General Specifications •<sup>1</sup>

|                                     |   |
|-------------------------------------|---|
| Confocal/Widefield wavelength range | Excitation range: 400-800 nm<br>Emission range: 420-850 nm  |
| Confocal scan rate                  | 400 scans per second  |
| B-TIRF input wavelength range       | 400 - 800 nm  |
| Confocal pinhole diameter           | 25 µm and 40 µm (option)  |
| Disk type                           | Dual disk with matched microlens and pinhole arrays.  |
| Active blanking                     | Laser illumination timed with camera exposure to minimize phototoxicity and photobleaching              |
| Output power                        | See <a href="#">HLE &amp; ILE specifications sheet</a>  |
| Lateral resolution                  | Diffraction limited in 16.6 x 14.0 mm (21.7 mm diagonal rectangular FOV, 19 mm diagonal square FOV)     |
| Illumination uniformity             | Less than ≤5% roll-off • <sup>2</sup>   |
| Compatible Microscopes              | Leica DMI8   Leica DM6 B (200 series only)   Nikon Ti2 (single deck)   Nikon FN1, NiU (200 series only) |

## Frame Rates •<sup>3</sup>

### Maximum Confocal Frame Rate (FPS) •<sup>4</sup>

| Zyla 4.2 / ZL41 Cell<br>Array Size | Frame Rate (sustained / burst)<br>USB 3.0 | iXon 888<br>Array Size | Binning |     |     | Sona<br>Array Size | -6 (sustained / burst)<br>USB 3.0 | -11 (sustained / burst)<br>USB 3.0 |         |
|------------------------------------|---|------------------------|---------|-----|-----|--------------------|-----------------------------------|------------------------------------|---------|
|                                    |   |                        | 1x1     | 2x2 | 4x4 |                    |                                   |                                    |         |
| 2048x2048                          | 43/102                                    | 1024x1024              | 26      | 51  | 95  | 2048x2048          | 44/44                             | 1400x1400                          | 70/71   |
| 2048x1024                          | 87/136                                    | 512x512                | 51      | 96  | 171 | 2048x1024          | 87/87                             | 1400x1024                          | 95/97   |
| 2048x512                           | 400/401                                   | 256x256                | 97      | 174 | 289 | 2048x512           | 174/175                           | 1400x512                           | 191/194 |
| 2048x128                           | 400/401                                   | 128x128                | 174     | 292 | 327 | 2048x128           | 395/397                           | 1400x128                           | 402/407 |

### Maximum Widefield/TIRF Frame Rate (FPS)

| Zyla 4.2 / ZL41 Cell<br>Array Size | Frame Rate (sustained / burst)<br>USB 3.0 | iXon 888<br>Array Size | Binning |     |     | Sona<br>Array Size | -6 (sustained / burst)<br>USB 3.0 | -11 (sustained / burst)<br>USB 3.0 |         |
|------------------------------------|---|------------------------|---------|-----|-----|--------------------|-----------------------------------|------------------------------------|---------|
|                                    |   |                        | 1x1     | 2x2 | 4x4 |                    |                                   |                                    |         |
| 2048x2048                          | 43/102                                    | 1024x1024              | 26      | 51  | 95  | 2048x2048          | 44/44                             | 1400x1400                          | 70/71   |
| 2048x1024                          | 87/136                                    | 512x512                | 51      | 96  | 171 | 2048x1024          | 87/87                             | 1400x1024                          | 95/97   |
| 2048x512                           | 404/406                                   | 256x256                | 97      | 174 | 292 | 2048x512           | 174/175                           | 1400x512                           | 191/194 |
| 2048x128                           | 790/794                                   | 128x128                | 174     | 292 | 439 | 2048x128           | 687/690                           | 1400x128                           | 755/769 |

### Frame rate acquisition conditions

Zyla / ZL41 Cell - Protocol Type = Finite Burst | Repeats = 1000/200 | Acquisition Mode = High Speed | Binning = 1x1 | Exposure time = 2.5 ms (Con) Min (WF) | Overlap = ON | Bit Depth = 12-bit (low noise)

iXon - Protocol Type = Finite Burst | Repeats = 50 | Acquisition Mode = High Speed | Binning = 1x1 | Exposure time = 2.5 ms (Con) Min (WF) | Overlap = ON | Vertical Shift Speed = 0.6 µs

Sona - Protocol Type = Finite Burst | Repeats = 200/50 | Acquisition Mode = High Speed | Binning = 1x1 | Exposure time = 2.5 ms (Con) Min (WF) | Overlap = ON | Bit Depth = 12-bit (fast speed Sona-11) 12-bit (low noise Sona-6)

The reader should note that HLE lasers 561 - 1W and 592 - 1W lasers have mechanical shutters. Therefore, the shutter will always be open for acquisition speeds lower than 50 ms (20 Hz), and disk stripes might be visible at speeds lower than 30 ms.

Dual channel sequential imaging is limited by the 50 ms threshold. This threshold also limits dual-camera simultaneous imaging coordinated with active blanking. This limitation only applies to the 561-1W and 592-1W lasers. For the fastest imaging acquisition using speeds, the user is advised to choose the lower power options 561 - 150 mW and 592 - 100 mW.

# Configuring Dragonfly Solutions

The following sections are designed to give you an overview of the models, features and configurations available and provide a guide to ordering your system. Please contact your local sales representative who will be able to guide you through the ordering process.

## Dragonfly

**Dragonfly 600** - The 600 series introduces a new B-TIRF modality, high power laser engines and a unique design of 3D Super-resolution module which retains parfocality across all imaging modes. These technical innovations combined with cutting edge software extend Dragonfly capabilities to excel at single molecule localisation microscopy with nm precision and deliver even faster imaging for large and deep tissue scanning.

**Dragonfly 200** - The 200 series delivers an exceptional confocal platform for deep, fast, sensitive & gentle imaging.

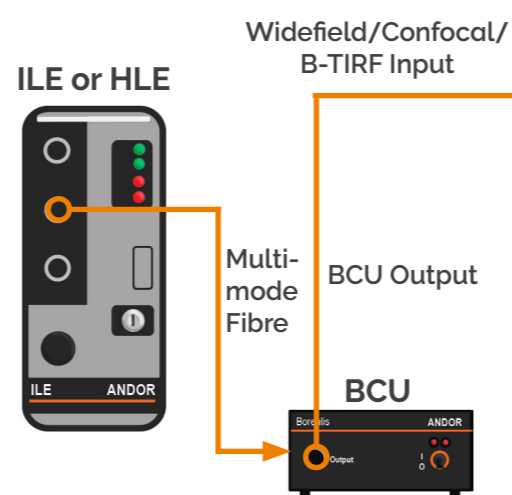
### Laser Engines, Borealis® and the Beam Conditioning Unit (BCU)

**Borealis® illumination:** a multi-mode fibre is directly coupled to a Beam Conditioning Unit (BCU). The BCU homogenises the laser output for outstanding illumination uniformity and integration for all imaging modalities.

**HLE** offers two to seven multimode laser lines in a single chassis and up to ten in dual configuration.

**ILE** is configured for two to four laser lines per chassis and up to eight in a dual configuration.

Want to learn more [HLE & ILE Specifications](#)



### Photostimulation Options

**Mosaic®** is a digital micro mirror based solution for real-time multi-region illumination. Mosaic can be configured with laser and/or LED sources (365-800 nm) for applications including bleaching, photoactivation and optogenetics.

**MicroPoint®** is a tuneable pulsed laser system capable of ablation, bleaching and uncaging. Wavelengths supported: 365 to 656 nm.

Find out more [andor.oxinst.com/products/photostimulation-solutions](http://andor.oxinst.com/products/photostimulation-solutions)

## Cameras

### iXon Back-Illuminated EMCCD Camera Series

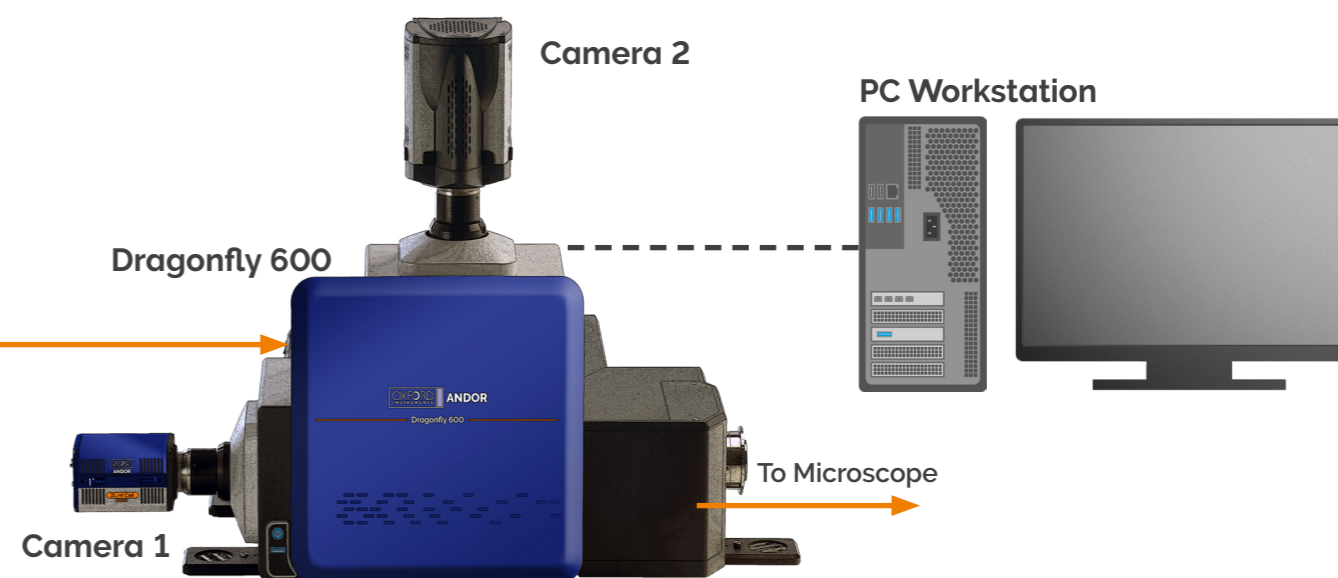
Single photon sensitive. Deep cooled back-illuminated EMCCD sensor technology.  $QE_{max}$  95%. 1024 x 1024 pixels, pixel size 13  $\mu$ m, image area 13.3 x 13.3 mm. SRRF-Stream+ compatible.

### ZL41 Cell sCMOS Cameras

Fast and flexible high-resolution imaging.  $QE_{max}$  82% and down to 0.9 e- read noise. 2048 x 2048 pixels, 6.5  $\mu$ m pixel size and 13.3 x 13.3 mm image area. SRRF-Stream+ compatible.

### Sona Back-Illuminated sCMOS Cameras

The latest back-illuminated sCMOS technology with  $QE_{max}$  95% and down to 1.0 e- read noise. 2048 x 2048 pixels, 6.5  $\mu$ m pixel size and 13.3 x 13.3 mm image area. SRRF-Stream+ compatible.



## PC Workstation

Windows 10 Professional, Dual quad-core Xeon CPUs; SSD fast boot disk; 96 GB ECC RAM (expandable to 192 GB); 4x2 TB SSD RAID0 (8 TB) for images (expandable to 28 TB); 2x Nvidia Quadro RTX4000 8 GB for hardware accelerated, image capture, processing and visualization.

## Software

**Fusion Control Software:** Multi-channel, dual camera simultaneous imaging, multi-dimensional acquisition options (time, XYZ, tile, multi-position), multi-modal imaging (confocal, widefield, SMLM, TIRF, SRRF-Stream+), multi-well acquisition and real-time rendering. Image processing options activated in protocol (stitching and deconvolution). Focus stabilisation.

**Imaris for Dragonfly:** Render 3D/4D images, detect objects, snapshot & animation.

**Imaris Measurement Pro for Dragonfly Super-Resolution:** Multiple statistics measurements. Report and interact with detected object measurements.

Find out more [imaris.oxinst.com/packages](http://imaris.oxinst.com/packages).

# Model Selector Matrix

|  |  | Dragonfly                   |             |               |               |  |             |                |             |
|--|--|-----------------------------|-------------|---------------|---------------|--|-------------|----------------|-------------|
|  |  | 200                         |             |               |               | 600  |             |                |             |
|  |  | Multi-modal confocal system |             |               |               | Multi-modal confocal system with 3D SMLM capabilities & B-TIRF |             |                |             |
| Feature                                      | Feature Description  | DFLY-201-40                 | DFLY-202-40 | DFLY-201-2540 | DFLY-202-2540 | DFLY-602   | DFLY-602-SR | DFLY-610-BTIRF | DFLY-620-SR |
| <b>B-TIRF</b>                                | B-TIRF supplied for 60x and/or 100x TIRF objective lenses.   | -                           | -           | -             | -             | 0  | 0           | ●              | ●           |
| <b>3D Super-resolution module</b>            | For 3D single molecule localization imaging in a volume.   | -                           | -           | -             | -             | 0  | ●           | 0              | ●           |
| <b>iZoom</b>                                 | Higher illumination power density for applications such as localization microscopy.  | -                           | -           | -             | -             | ●  | ●           | ●              | ●           |
| <b>Motorised camera mag</b>                  | 1X, 1.5X, 2.0X   | Up to 2                     | Up to 2     | Up to 2       | Up to 2       | 3  | 3           | 3              | 3           |
| <b>Dual pinhole</b>                          | 25 µm, 40 µm   | -                           | -           | ●             | ●             | ●  | ●           | ●              | ●           |
| <b>Motorised image splitter</b>              | Up to 4 splitters  | -                           | 0           | -             | 0             | ●  | ●           | ●              | ●           |
| <b>Integrated Laser Engine - ILE</b>         | ILE delivers between two and four laser lines per chassis and up to eight lines in a dual chassis configuration.   | Either                      | Either      | Either        | Either        | Either   | -           | Either         | -           |
| <b>High power Laser Engine - HLE</b>         | HLE offers two to seven multimode laser lines in a single chassis and up to ten lines in dual configuration.   |                             |             |               |               |  | ●           |                | ●           |
| <b>Dual camera port</b>                      | Up to two cameras  | -                           | 0           | -             | 0             | 0  | 0           | 0              | 0           |
| <b>Imaris for Dragonfly</b>                  | 3D visualisation and interactive data inspection (rotations, clipping planes), time lapse view, high-res snapshots and animations, microscopy file management. | ●                           | ●           | ●             | ●             | ●  | ●           | ●              | ●           |
| <b>Imaris for Dragonfly Super-resolution</b> | Object measurements, machine learning object classification, object color-coding based on measurements.  | 0                           | 0           | 0             | 0             | 0  | ●           | ●              | ●           |
| <b>Accessories</b>                           | Piezo stages, incubators, extra filter wheels & filters.   | 0                           | 0           | 0             | 0             | 0  | 0           | 0              | 0           |

● - Standard 0 - Optional

# Order Today

Need more information? At Andor we are committed to finding the correct solution for you. With a dedicated team of technical advisors, we are able to offer you one-to-one guidance and technical support on all Andor products.

For a full listing of our local sales offices, please see: [andor.oxinst.com/contact](http://andor.oxinst.com/contact)

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Fax +1 (860) 290 9566

## Japan

Tokyo  
Phone +81 (3) 6732 8968  
Fax +81 (3) 6732 8939

## China

Beijing  
Phone +86 (10) 5884 7900  
Fax +86 (10) 5884 7901



### Items shipped with your Dragonfly

Dragonfly base unit, cables and accessories (model as ordered)  
HLE or ILE (with laser options and accessories as ordered)  
Borealis BCU  
PC Workstation and accessories  
Fusion and Imaris Software  
User guides in electronic format

### Operating & Storage Conditions:

- Operating Temperature: 18°C to +28°C ambient
- Indoor use only
- Operating Altitude: up to 2000 m
- Relative Humidity: <70% (non-condensing)
- Storage Temperature: 0°C to 50°C

### Power Requirements:

- External supply: 100 - 240 VAC, 50 - 60 Hz
- Power consumption  
Dragonfly 600: 65 W/120 W (typ./ max.)  
Dragonfly 200: 45 W/75 W (typ./ max.)

### Footnotes

1. All specifications are typical.
2. Measured for 488 nm with 40 µm pinhole pattern at Dragonfly output port. Illumination at sample may differ due to variation between microscope objectives.
3. Frame rate data shown for three typical camera options.
4. Confocal frame rates require at least 2.5 ms exposure time, synchronized with the confocal scan speed, hence they differ slightly from widefield/TIRF.



The Dragonfly system may be classified under IEC 60825-1 and CDRH 21 CFR 1040.10 as either Class 3B or 4 depending on the system configuration.



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DFLYSS 1023 R1