# Super-resolution imaging across scales



## ZEISS Lattice SIM Family

Full Access to Super-Resolution Imaging
for all Research Areas

Seeing beyond
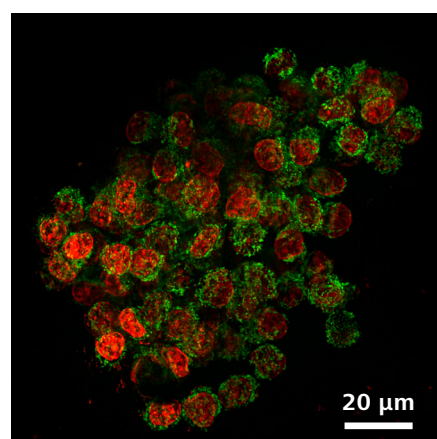
# ZEISS Lattice SIM Family
## Full Access to Super-Resolution Imaging for all Research Areas

Using microscopy to visualize biological structures provides insights into function. When imaging fixed structures, acquisition settings can be optimized for spatial resolution. However, when capturing dynamic events in living samples, higher acquisition speeds and low-light conditions must be balanced with resolution. The ZEISS Lattice SIM family balances sample size, imaging speed, and super-resolution capabilities based on your application – from outstanding optical sectioning of tissues and developing organisms to high-speed imaging of living cells to resolution excellence at the molecular level.
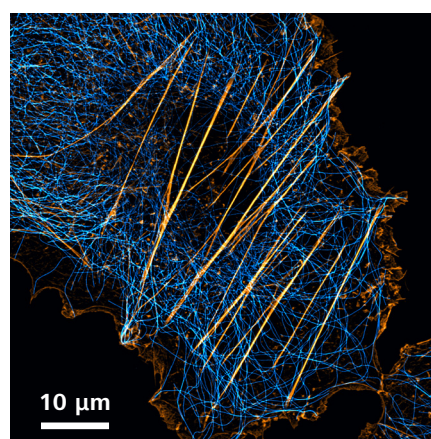
**ZEISS Lattice SIM 3**
Your fast optical sectioning solution for studying developing organisms and tissue microstructures

**ZEISS Lattice SIM 5**
Your live imaging system for uniform super-resolution in all spatial dimensions

**ZEISS Elyra 7 with Lattice SIM**
Your complete super-resolution system with unprecedented resolution down to molecular details

*Spheroid stained for mitochondria (MitoTracker Green) and nuclei (NucRed Live 647)*

*Cos-7 cells stained for microtubules (anti-tubulin Alexa Fluor 488, cyan) and actin (Phalloidin Alexa Fluor 561, orange)*
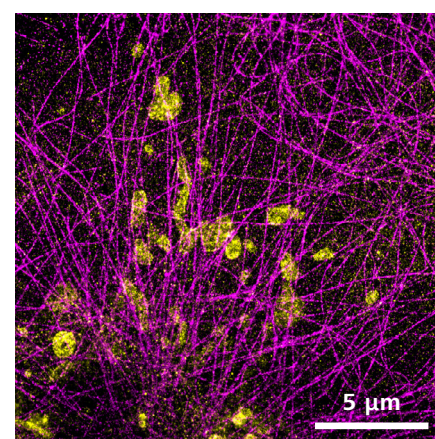
*Dual-color 2D STORM of Cos-7 cells stained for microtubules (anti-tubulin-Alexa Fluor 647, magenta) and mitochondria (anti-TOMM20-CF568, yellow)*

# ZEISS Lattice SIM 3
## Reveal Cellular Behavior and Inter-Cellular Dynamics

ZEISS Lattice SIM 3 is designed to meet the requirements of multicellular samples, such as: developing organisms, organoids, 3D cell cultures, and tissue sections. Optimized for use with objectives from 10× to 40×, ZEISS Lattice SIM 3 exploits the full potential of the SIM Apotome technology: fast optical sectioning at superior quality, large fields of view with access to smaller regions of interest, near-isotropic resolution, and the gentlest super-resolution imaging possible. Additionally, Lattice SIM imaging and SIM² image reconstruction give you super-resolution imaging down to 140 nm.



50 µm
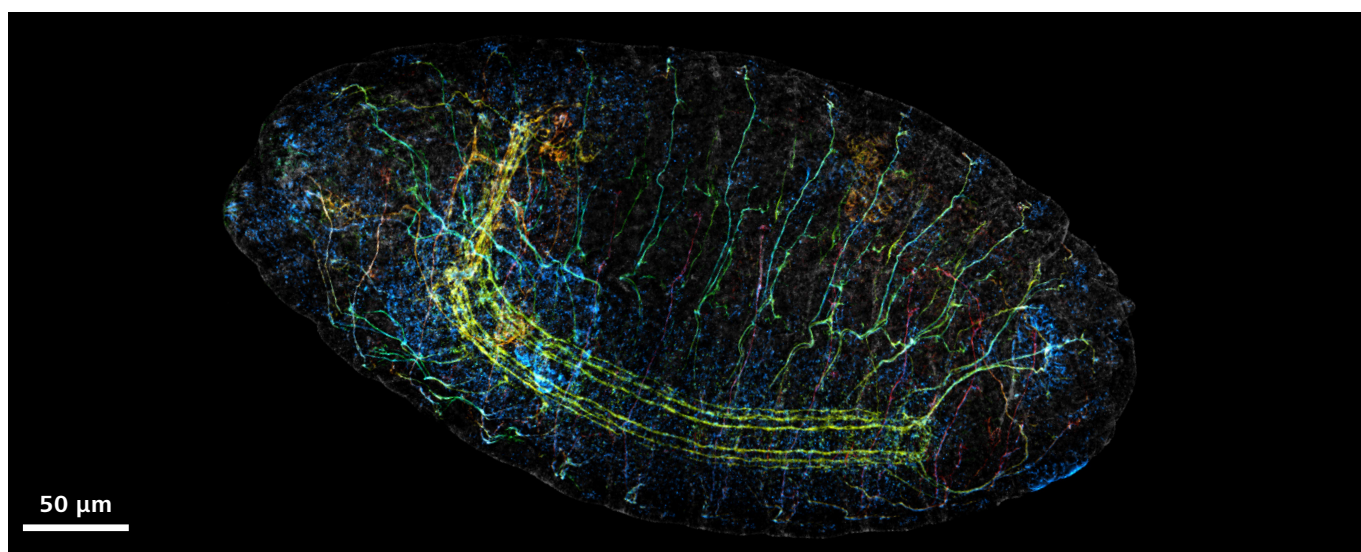
*Drosophila embryo stained for Fasciclin II (color-coded depth projection) and HRP (cyan) labelling the nervous system, imaged in SIM Apotome mode, Objective: Plan-Apochromat 20×/0.8 air. Image courtesy of Ines Hahn, University of York, UK.*

### Capture entire model organisms and tissue sections

ZEISS Lattice SIM 3 fully leverages SIM Apotome technology, to provide the most outstanding optical sectioning at large fields of view with near-isotropic resolution. ZEISS Lattice SIM 3 is your system of choice for fast imaging of larger volumes, such as 3D model organisms, embryos, organoids, or tissue sections. Whether you work with living or fixed samples, ZEISS Lattice SIM 3 provides access to structured illumination microscopy of multicellular organisms with superior penetration depth.

### Acquire super-resolution images as fast and gentle as widefield images

Choose between the standard SIM Apotome imaging mode for the highest available resolution (5 phase images required) or the imaging mode with reduced phases for slightly lower resolution but significantly increased speed and gentleness (only 3 phase images required). Combine SIM Apotome with the Leap mode to significantly speed up super-resolution acquisition. SIM Apotome makes even lossless acquisition possible, meaning for every reconstructed image just one raw image is needed.

### Go from a large-field overview to the super-resolution details

For large sample experiments, ZEISS Lattice SIM 3 offers the most advantageous combination of a large field of view and super-resolution imaging. SIM Apotome mode in combination with SIM² image reconstruction enables lateral super-resolution down to 140 nm with superior optical sectioning and sensitivity. Additionally, imaging in Lattice SIM mode with a ZEISS 25× multi-immersion objective and subsequent SIM² processing provides similar lateral resolutions with larger fields of view and more flexible adaptation to the refractive index of your sample.

# ZEISS Lattice SIM 5
## Reveal the Vibrant Sub-Organelle Network of Life

ZEISS Lattice SIM 5 has been optimized for single cell imaging as well as capturing subcellular structures and their dynamics. Powered by the Lattice SIM technology and the SIM² image reconstruction algorithm, ZEISS Lattice SIM 5 provides you with outstanding super-resolution capabilities down to 60 nm in both living and fixed cells. Additionally, you can choose SIM Apotome imaging mode and a low-magnification objective to achieve fast overview images of your sample before zooming into super-resolution details.



500 µm

▶ Click here to view this video
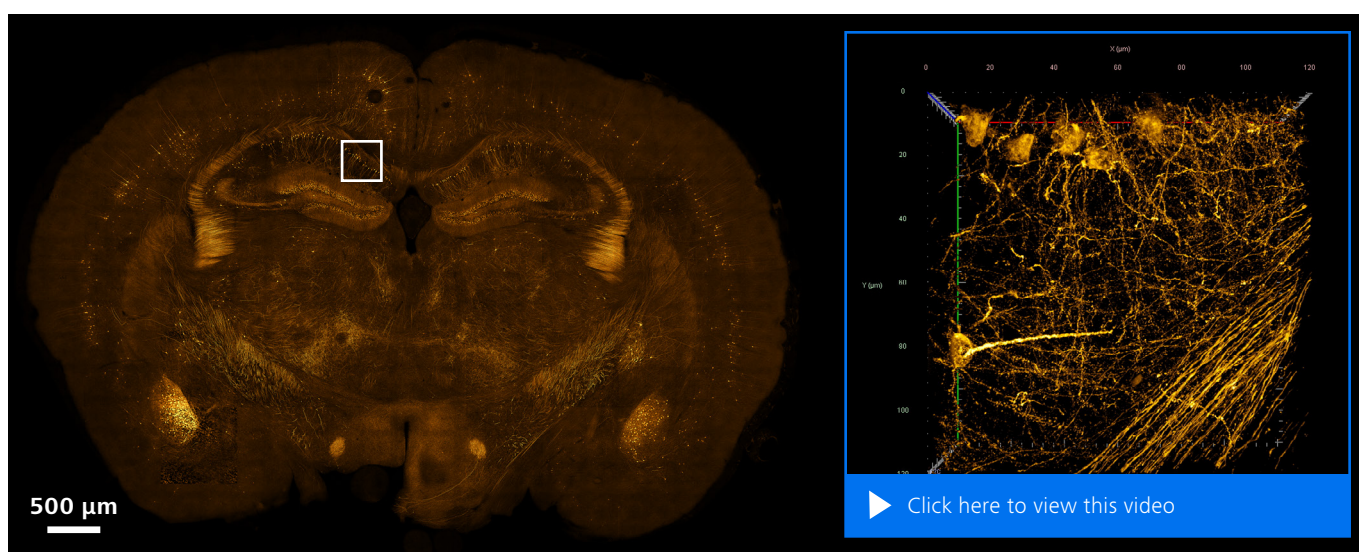
*Murine brain expressing the neuronal marker Thy1-eGFP was imaged in SIM Apotome and Lattice SIM modes over a Z stack range of 170 µm.*
*Objective for overview image (left): Plan-Neofluar 10×. The ZEN Connect project combines data sets recorded with 10× SIM Apotome, 25× SIM Apotome,*
*40× SIM Apotome and 63× Lattice SIM. The volume rendering on the right-hand side shows a subset of the 63× Lattice SIM data set.*
*Objective: Plan-Apochromat 63× / 1.4 Oil. Sample courtesy of Herms Lab (MCN, University of Munich, Germany).*

**Capture highly dynamic processes**
Equipped with Lattice SIM illumination and the SIM² image reconstruction algorithm, ZEISS Lattice SIM 5 raises structured illumination microscopy to a new level. You will always achieve the best possible results, even when using lower light exposures to protect living specimens. Double the conventional SIM resolution and discriminate the finest subcellular structures that are no more than 60 nm apart. The light-efficient Lattice SIM technology provides the gentlest imaging of living and fixed specimens, giving you high temporal resolution with up to 255 fps.

**Optimize to the needs of living samples**
The flexibility of ZEISS Lattice SIM 5 allows you to balance the needs of your experiment by prioritizing resolution, speed, or by finding the right balance in between. Use the photon budget to enhance lateral resolution well below 100 nm or reduce the number of required raw images to boost acquisition speed and gentleness. ZEISS Lattice SIM 5 has a number of options for reducing raw images which allows you to select for the best acquisition settings that target your desired spatial and temporal resolution.

**Get more reliable experiment results**
ZEISS Lattice SIM 5 with SIM² comes with outstanding out-of-focus light suppression, giving you the sharpest sectioning in widefield microscopy, even for highly scattering samples. The SIM² image reconstruction uses a special SIM point spread function to robustly reconstruct all structured-illumination-based acquisition data of your ZEISS Lattice SIM 5 with minimal image artifacts – for both living and fixed samples. Rest assured knowing that you are basing your experimental conclusions on reproducible data generated from a powerful and proven algorithm.

# ZEISS Elyra 7 with Lattice SIM
## Reveal Life Across Scales – Down to Molecular Details

ZEISS Elyra 7 includes a wealth of microscopy techniques to meet your experimental needs across scales, optimally matching resolution, speed, and sensitivity requirements to your demanding samples. Employ SIM Apotome for fast optical sectioning, Lattice SIM for super-resolution imaging, SIM² image reconstruction for resolution excellence down to 60 nm, as well as SMLM and TIRF for investigations at the molecular level. You can combine these techniques to multiply the insights from your specimen and to correlate the acquired data.
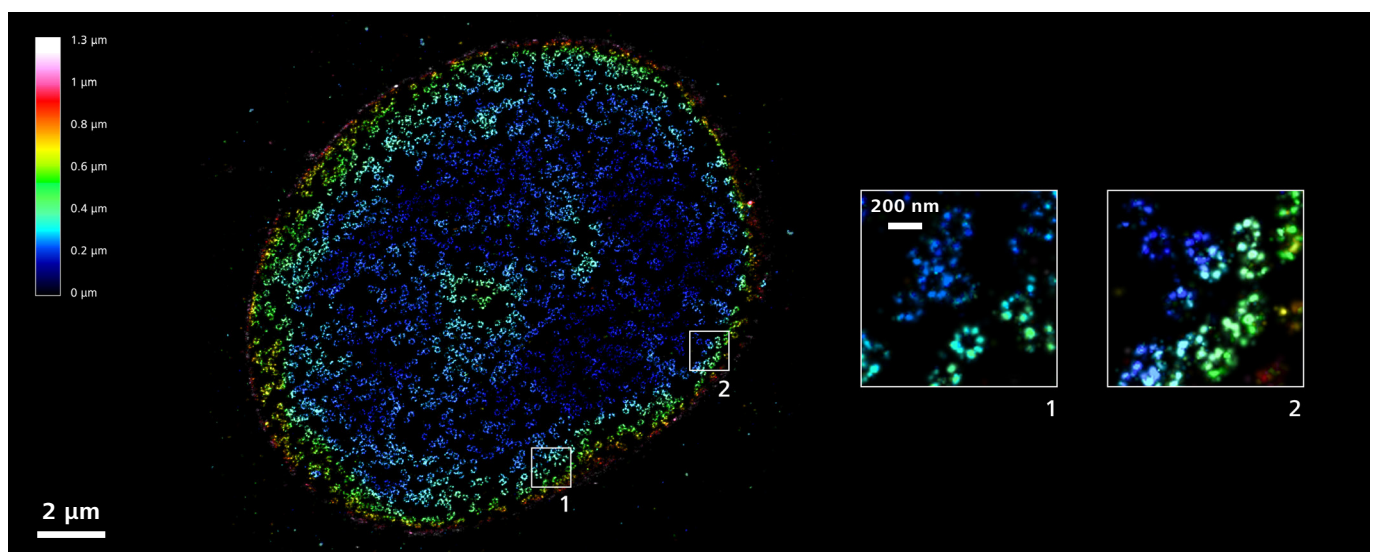


*Single-color 3D STORM of Xenopus laevis A6 cells stained for nuclear pore marker GP210 (Georg Krohne, University of Würzburg) and F(ab)2 Alexa Fluor 647 secondary antibody. Objective: alpha Plan-Apochromat 63×/ 1.46 oil.*

### Observe life's finest details

ZEISS Elyra 7 was designed for the understanding of biological processes that require the observation of living samples in low light and high spatiotemporal resolution. Observe cellular, sub-cellular, and sub-organelle structures in living specimens in 2D and 3D over time. Whether you are interested in cytoskeletal dynamics, mitochondrial fusion and fission, or budding of the endoplasmic reticulum, it gives you both live cell compatibility and super-resolution.

### 3D imaging at molecular resolution

With Elyra 7 you can use single-molecule localization microscopy (SMLM) techniques such as PALM, dSTORM and PAINT to achieve lateral localization precision of 10 – 20 nm. The ZEN software will seamlessly perform the image reconstruction of your data. In addition, Elyra 7 provides you with 3D SMLM mode based on PRILM technology. The PSF is reshaped for encoding the Z position so while acquiring only one plane, you get volume information of 1.4 µm depth at 20 – 40 nm axial resolution. Thus, you can acquire 3D data with consistent molecular precision.

### Correlative microscopy within the same system

Correlative microscopy, where the same area of the sample is imaged using different techniques, has become an important tool for biological research. Imaging with Elyra 7 can be combined seamlessly with LSM 980 Airyscan or ZEISS electron microscopy solutions. Nevertheless, Elyra 7 itself contains three different imaging modalities – SIM Apotome, Lattice SIM and SMLM – providing the possibility to combine them when needed for sample scales varying by orders of magnitude.

# ZEISS Lattice SIM Family

## Balance Sample Size, Imaging Speed, and Super-Resolution Capabilities Based on the Needs of Your Application

| | Lattice SIM 3 | Lattice SIM 5 | Elyra 7 with Lattice SIM |
|---|---|---|---|
| Target applications | ■ 3D cell culture models<br>■ Organoid development<br>■ Embryonic development<br>■ Tissue sections | ■ Fast dynamics in living cells<br>■ Organelle and protein interaction<br>■ Structural super-resolution imaging of fixed samples | ■ Ultrastructure of organelles and molecular assemblies<br>■ Single molecule localization microscopy (SMLM)<br>■ Molecule interaction<br>■ Protein localization |
| SIM Apotome module | Two different grating frequencies for best match to objective and wavelength | One grating | One grating |
| Lattice SIM | One grating | Five different grating frequencies for optimal matching of illumination pattern to laser wavelength and objective lens | |
| Multi-tracking | Freely configurable change of gratings (SIM Apotome);<br>One common grating (Lattice SIM) | Freely configurable change of gratings (Lattice SIM); One common grating (SIM Apotome) | |
| Leap mode | ✔ | ✔ | ✔ |
| Burst mode | ✔ | ✔ | ✔ |
| TIRF illumination | | | ✔ |
| 3D-PALM | | | ✔ |
| **Resolution** | | | |
| SIM/SIM² Apotome | XY: down to 320 / 265 nm for 25× | | |
| Lattice SIM/SIM² | XY: down to 210 nm / 140 nm with LD LCI Plan-Apochromat 25× / 0.8 Imm Corr DIC | XY: down to 120 nm / 60 nm with Plan-Apochromat 63× / 1.40 Oil DIC | |
| **Objective lenses** | | | |
| SIM Apotome | Plan-Apochromat 40×/1.4 Oil; C-Apochromat 40×/1.2 W; LD LCI Plan-Apochromat 25×/0.8 Imm Corr DIC; Plan-Apochromat 20×/0.8 Air; EC Plan-Neofluar 10×/0.3 Air | | |
| Lattice SIM | LD LCI Plan-Apochromat 25×/0.8 Imm Corr DIC | Plan-Apochromat 63×/1.40 Oil DIC;<br>C-Apochromat 63×/1.20 W Corr;<br>alpha Plan-Apochromat 63×/1.46 Oil | Plan-Apochromat 63×/1.40 Oil DIC;<br>C-Apochromat 63×/1.20 W Corr;<br>alpha Plan-Apochromat 63×/1.46 Oil;<br>alpha Plan-Apochromat 100×/1.57 Oil-HI DIC Corr |
| SMLM | | | alpha Plan-Apochromat 63×/1.46 Oil (2D/3D PALM);<br>Plan-Apochromat 63×/1.4 Oil DIC (3D PALM);<br>C-Apochromat 63×/1.2 W Corr DIC (3D-PALM);<br>Objectives with NA > = 1.46 suitable for TIRF and HILO illumination |
| TIRF | | | alpha Plan-Apochromat 100×/1.46 Oil DIC;<br>alpha Plan-Apochromat 100×/1.57 Oil-HI DIC Corr (2D-PALM); |
| Camera | Up to two CMOS cameras (ZEISS Axiocam 820 mono) | Up to two CMOS cameras (ZEISS Axiocam 820 mono) or up to two sCMOS cameras (Hamamatsu ORCA-Fusion BT) | Up to two sCMOS cameras (Hamamatsu ORCA-Fusion BT) |
| Multi-color imaging | Detection of up to four different fluorescent labels (sequential detection); simultaneous dual-color detection with Duolink | | |

ZEISS Lattice SIM Family meet the requirements according to IEC 60825-1:2014 and are laser class 1 devices. Interlocks on customer interfaces prevent access to the laser radiation.