CSR Biotech
Transforming Tools Changing Lives

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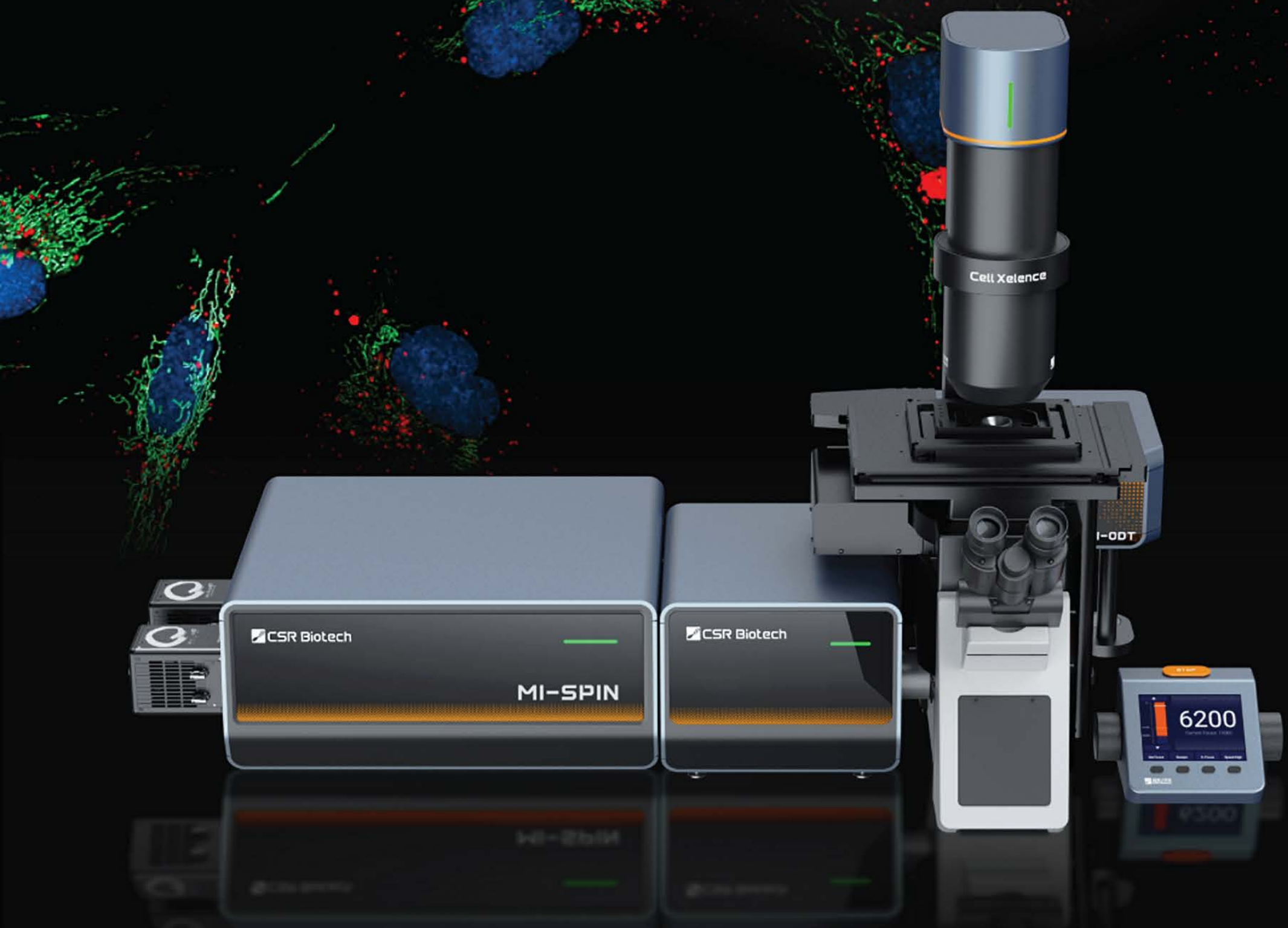
Cell Xelence 256

Spinning Disk + Label-Free Dual Modality Microscope

Spin + ODT · Super-Resolution Optical Sectioning
High Speed Volumetric Imaging · Label-free AI-Assisted Imaging



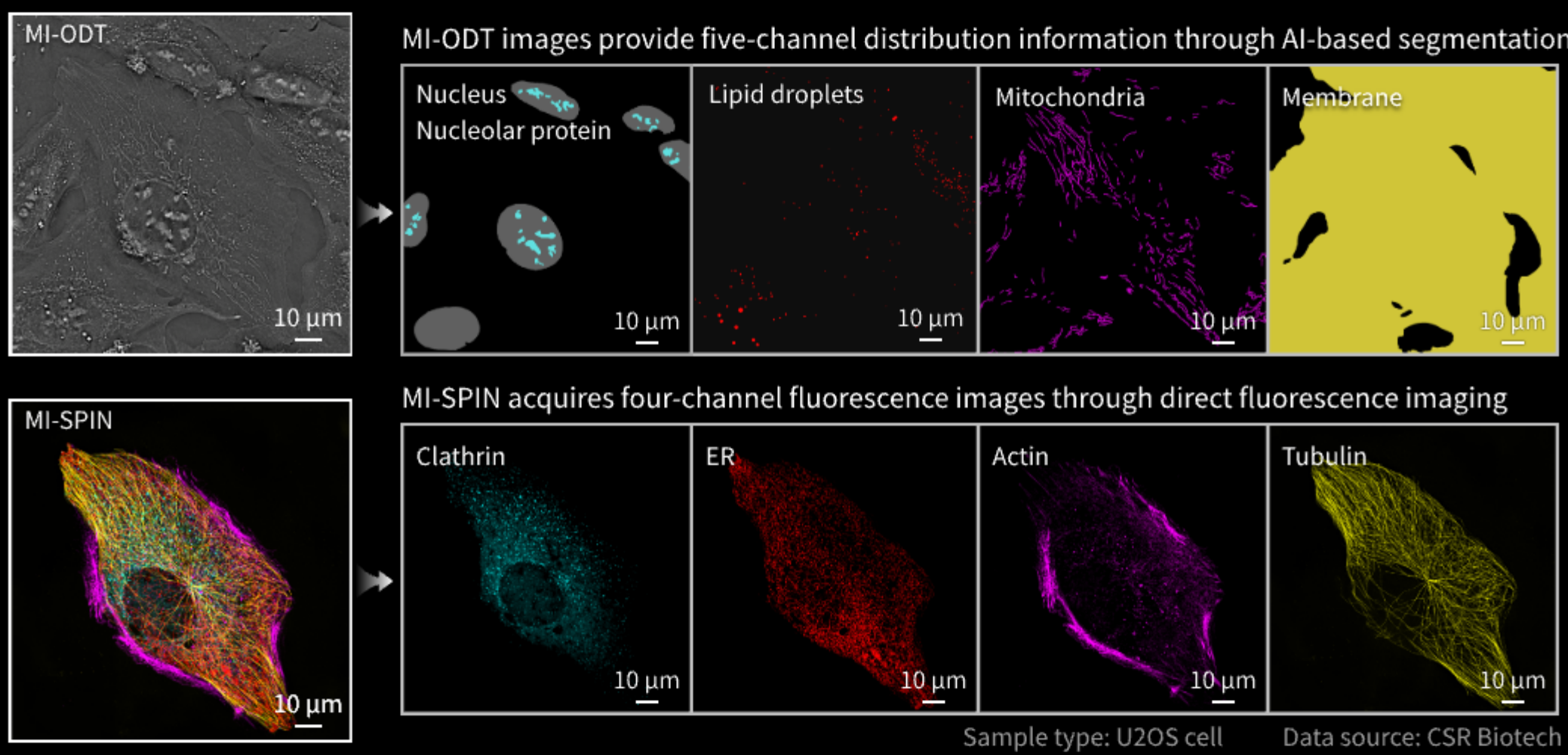
Label-free AI-assisted imaging

MI-ODT provides label-free panoramic cellular morphology, AI-driven multi-channel extraction, and low-phototoxicity long-term live-cell monitoring. These capabilities enable fluorescence imaging assistance for:

- Extending observation via reduced phototoxicity and photobleaching
- Expanding information beyond limited fluorescence channels
- Monitoring and tracking specific cellular structures and features
- Detecting and recognizing critical cellular events

Label-free AI segmentation: Expanding the channel capacity of live-cell imaging

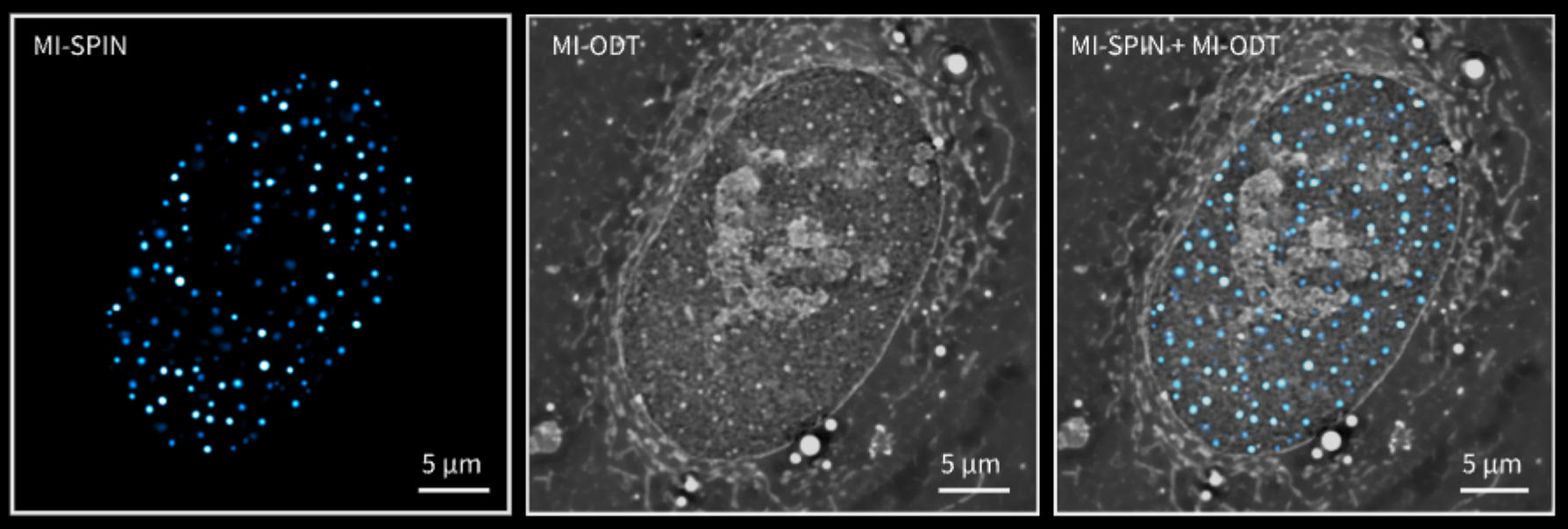
- MI-ODT maps cellular refractive index (RI) distribution and uses AI-driven label-free segmentation to reveal organelles and subcellular structures. Meanwhile, MI-SPIN captures high-resolution fluorescence of labeled organelles, proteins, and biomolecules across multiple channels.
- Cell Xelence integrates label-free ODT and fluorescence spinning disk imaging to deliver deeper biological insights and complementary cellular information within a single live-cell experiment.



Sample type: U2OS cell Data source: CSR Biotech

Label-free intelligent tracking: Studying FUS protein phase separation

- Cell movement during long-term live-cell imaging can cause focal drift and field-of-view shifts, losing target structures.
- Cell Xelence performs AI-driven tracking on ODT images to keep target cells in focus and within the imaging field throughout acquisition.
- IIn this study, MI-SPIN captured FUS proteins (blue) while MI-ODT provided panoramic imaging and real-time 3D nucleus tracking in U2OS cells, enabling stable long-term observation of FUS phase separation dynamics.



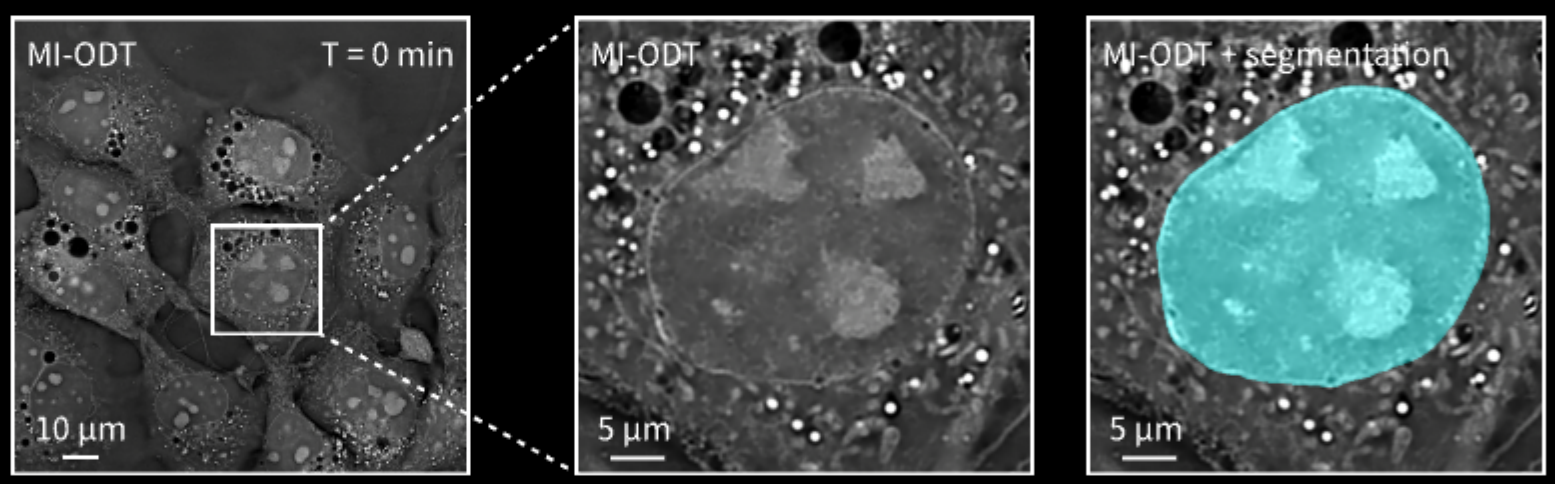
Sample type: U2OS cell
Data source: CSR Biotech

Label-free event trigger: 3D mitotic dynamic imaging

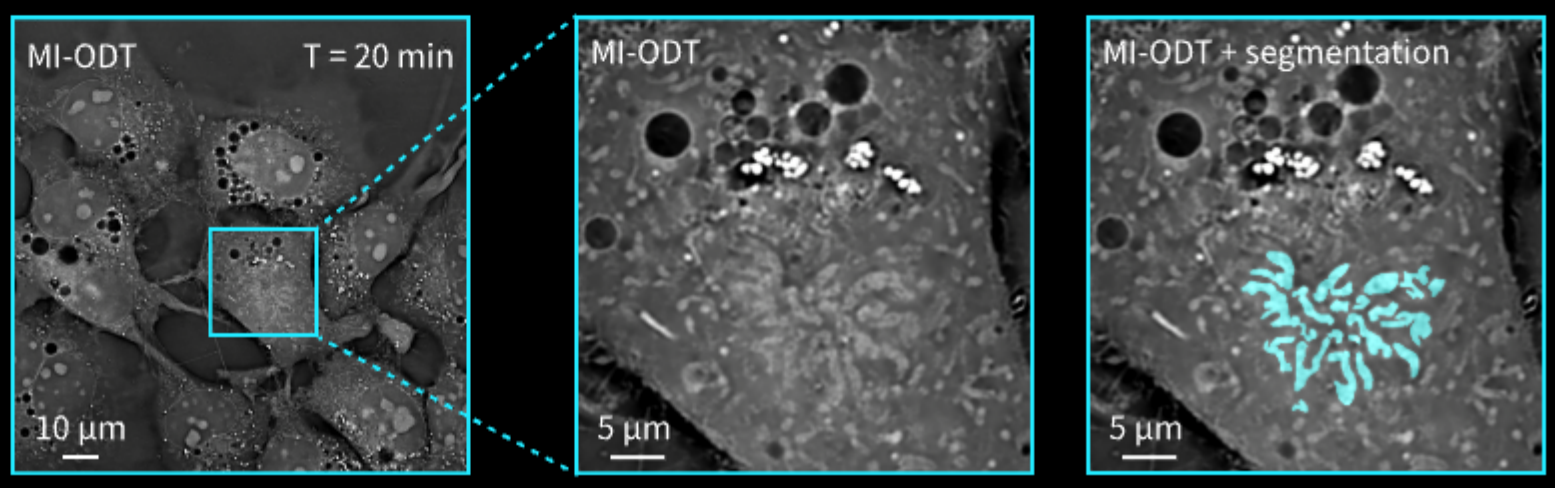
- Conventional long-term imaging cannot automatically switch to high-resolution acquisition at critical moments, causing transient dynamics to be missed, while prolonged fluorescence exposure risks phototoxic damage to live cells.
- Cell Xelence combines continuous low-phototoxicity MI-ODT monitoring with AI-powered event recognition to automatically trigger high-resolution MI-SPIN imaging when predefined cellular events occur.
- Mitotic imaging workflow: MI-ODT continuous live-cell monitoring → OIA real-time recognition of chromatin condensation → Automatic triggering of MI-SPIN high-resolution 3D imaging → Complete capture of chromosome segregation and mitochondrial dynamics.

Monitoring Phase:

Continuous panoramic imaging with MI-ODT



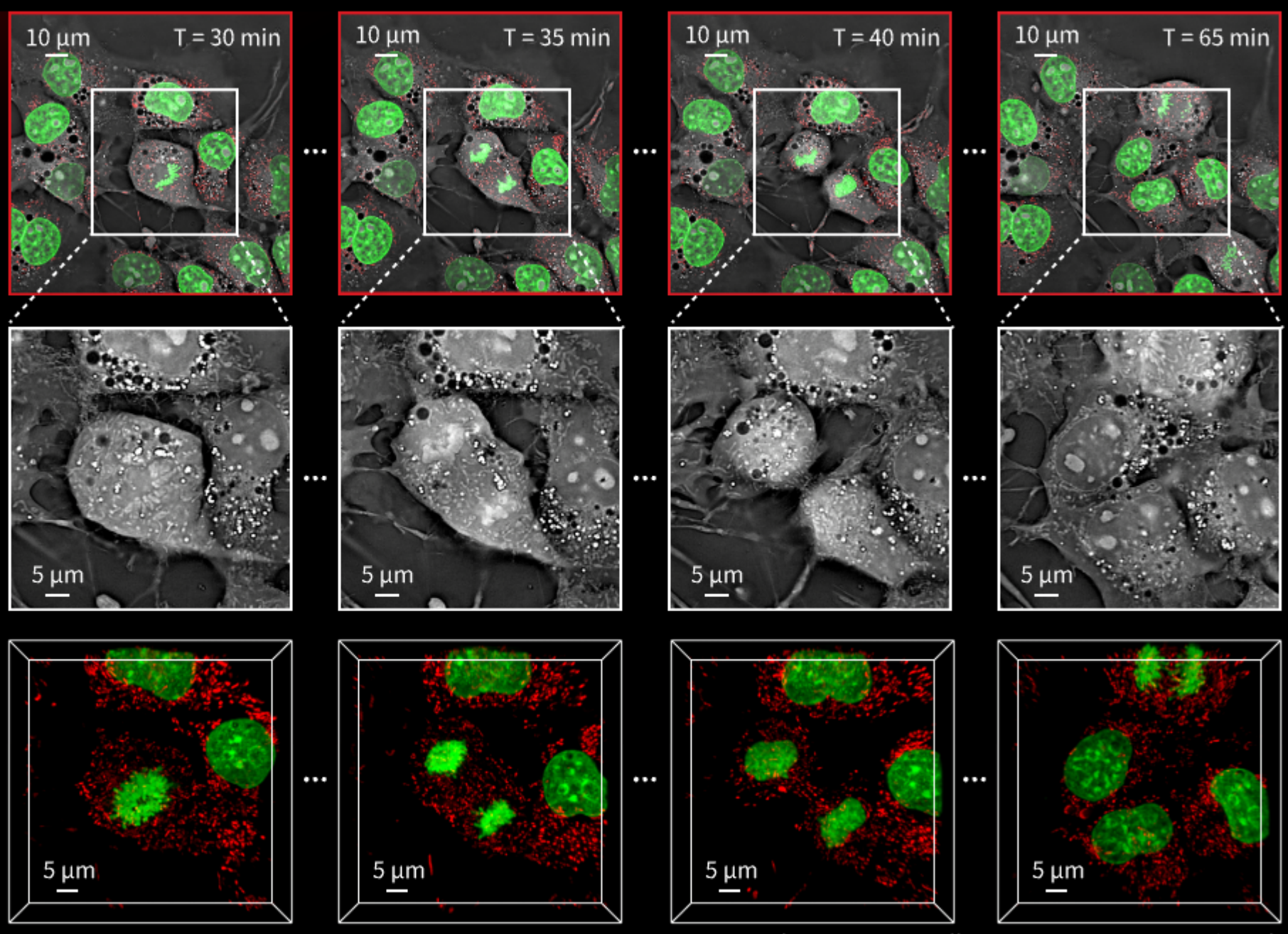
Trigger Event



When OIA detects chromatin condensation into chromosome structures within the nucleus, the system automatically triggers MI-SPIN imaging of mitochondria and chromosomes.

Imaging Task Phase:

Simultaneous MI-SPIN dual-channel imaging and MI-ODT acquisition



MI-ODT monitors the dynamic process of cell mitosis

MI-SPIN visualizes chromosome and mitochondrial dynamic

Sample type: COS7 cell

Data source: CSR Biotech

[1] OIA (Online Image Analysis): Dynamic feature analysis based on label-free segmented images, enabling detection of cellular phenotypic changes and intracellular organelle dynamics for intelligent cell-state and event recognition.

Cell Xelence 256: Dual-modality spinning disk & label-free microscope

Cell Xelence is a cutting-edge, AI-assisted microscope that seamlessly combines label-free and spinning disk confocal super-resolution imaging, designed for imaging complex dynamic live samples with unparalleled clarity. By integrating MI-ODT label-free super-resolution with MI-SPIN high-speed spinning disk confocal, the system unites these complementary modalities in a single platform. Together, they deliver exceptional spatial and temporal resolution, offering detailed insights into both labeled and unlabeled cellular structures. With AI-driven functions, Cell Xelence enables flexible dual-modality workflows for organelle interaction studies, multi-target live-cell drug screening, cell division and apoptosis analysis, and rapid volumetric imaging of 3D organoids and tumor spheroids.

MI-Spin

- 100 nm resolution in Spin-SACD
- 150 nm resolution with sparse deconvolution
- 8000 rpm dual-disk rotation speed
- 30 mm ultra-large Spin Illumination FOV
- Improved optical sectioning performance
- Integrate FRAP and quantitative FRET molecular measurements

MI-ODT

- 130 nm label-free whole-cell super-resolution
- Extremely low photo stress
- Self-developed long WD high NA air condenser
- Highly precise and stable motorized arm
- Advanced high-speed 2D and 3D ODT options
- Real-time AI segmentation live-view

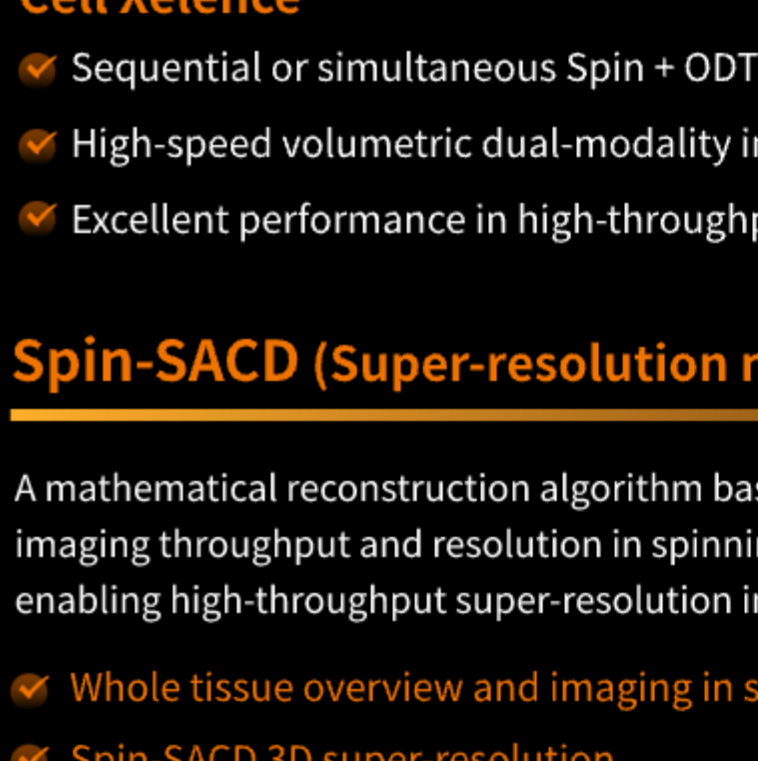
Cell Xelence

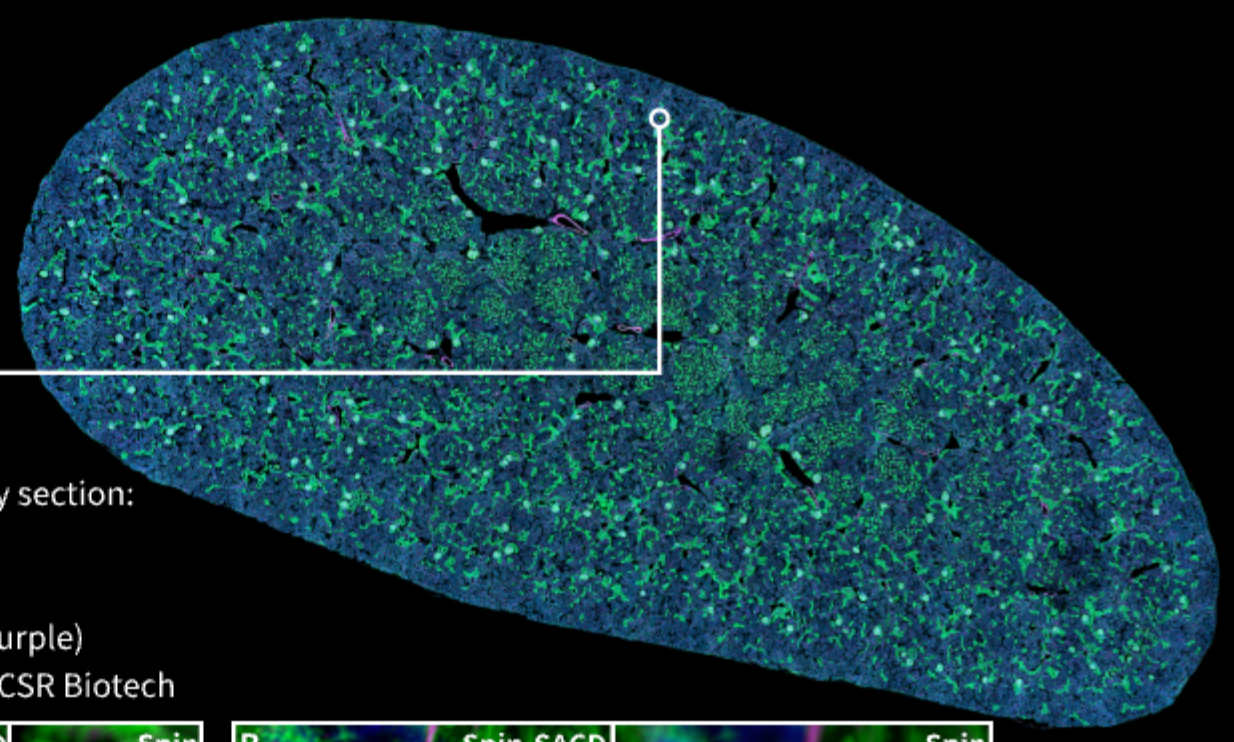
- Sequential or simultaneous Spin + ODT imaging
- High-speed volumetric dual-modality imaging
- Excellent performance in high-throughput applications
- Extract up to 9 channels from live cell imaging experiments
- AI-guided autonomous multi-phase imaging
- Advanced image processing pipeline

Spin-SACD (Super-resolution method based on Auto-Correlation two-step Deconvolution)[1]

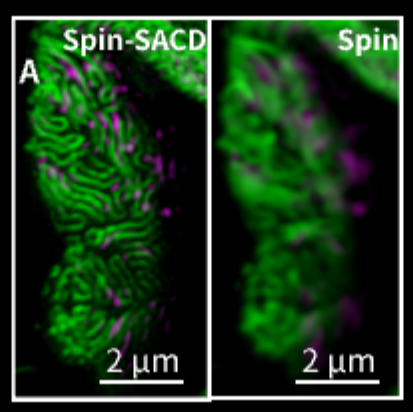
A mathematical reconstruction algorithm based on fluorescence fluctuation analysis breaks the inherent trade-off between imaging throughput and resolution in spinning disk confocal microscopy. Spin-SACD improves imaging resolution to 100 nm, enabling high-throughput super-resolution imaging across multiple sample types and spatial scales.

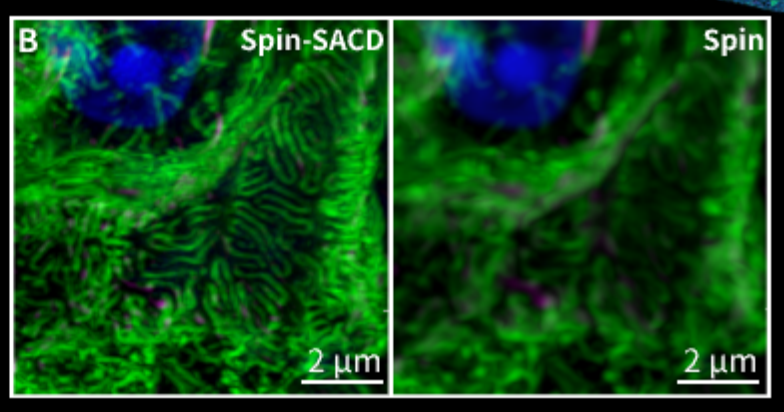
- Whole tissue overview and imaging in spin mode
- Spin-SACD 3D super-resolution





Mouse kidney section:
Nuclei (blue)
WGA (green)
Phalloidin (purple)
Data source: CSR Biotech





[1] Proprietary techonology: Weisong Zhao et al, *Nature Photonics* , 2023. Patented.

High-speed volumetric dual-modality imaging

Advantages of simultaneous dual-modality imaging

1. Complementary dual modalities

- MI-SPIN provides super-resolution fluorescence imaging of labeled organelles, proteins, and biomolecules in live cells.
- MI-ODT delivers super-resolution label-free imaging of live-cell morphology and RI–based subcellular structures.

Together, the two modalities complement each other in imaging contrast, channels, and biological information, enabling simultaneous visualization of both molecular dynamics and global cell morphology.

2. Benefits of simultaneous imaging

- Higher temporal accuracy: Both modalities are acquired at the same time point, enabling accurate capture of dynamic biological events.
- Reliable spatial registration: Simultaneous acquisition ensures natural pixel-to-pixel alignment without concerns about sample drift or deformation.
- Higher imaging efficiency: Dual-modality information is obtained in a single scan without increasing total imaging time.

Cell Xelence delivers richer biological information than conventional SPIN imaging alone, while ODT data further enables intelligent AI-assisted imaging workflows (see application examples on the reverse side).

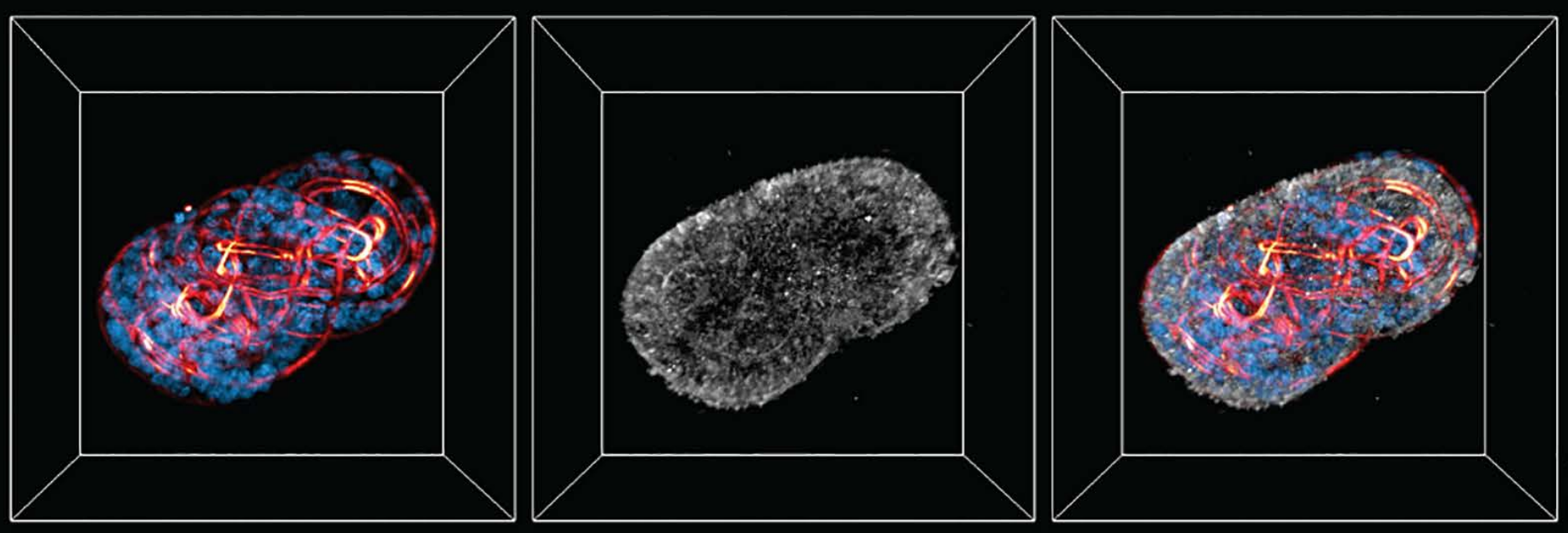
Technical highlights of simultaneous dual-modality imaging

Algorithm Innovation	Leveraged a volumetric ODT acquisition and reconstruction scheme to deliver isotropic image quality across all layers, and developed a real-time 2D ODT reconstruction using fewer image frames to enable synchronized high-speed volumetric imaging of Spin and ODT.
System Optimization	Optimized system light source, illumination pathway, and detection optics to resolve spectral overlap between two modalities.
Hardware Control	Developed an integrated FPGA-based high-speed timing control for synchronized dual-modal imaging.
Software Integration	Leveraged a self-assembled workflow framework to enable dual-modal synchronized multi dimensional imaging control and data synchronization.

Applications of simultaneous dual-modality imaging

This technology combination is ideally suited for live-cell studies requiring simultaneous correlation between label-free morphological dynamics and fluorescence-based molecular events, including mitosis, vesicle transport, calcium signaling, and rapid drug responses.

With simultaneous Z scanning, Cell Xelence can image thick samples including organoids, tumor spheroids, and tissue sections, enabling high-speed deep volumetric dual-modality imaging.



Sample type: *C. elegans* egg

Data Source: CSR Biotech

- In this application, long-term dual-modality imaging was used to dynamically monitor the development of a *C. elegans*embryo. High-speed volumetric imaging revealed regulatory mechanisms involved in embryogenesis, cell differentiation, and morphogenesis.
- MI-SPIN visualized nuclei (blue) and microtubules (red), while MI-ODT provided panoramic imaging of the entire embryo.

Cell Xelence 256 System Specifications

Configuration	Core Functions	Specifications	Standard ✓ Optional ○
Imaging Mode	Brightfield (BF)	White LED light source	
	Widefield (WF)	Multi-channel laser light source for widefield imaging	
	Spin	Spinning disk confocal Optical resolution: XY: 230 nm; Z: 450 nm Computational super-resolution: XY: 150 nm; Z: 280 nm [1]	
		Spin-SACD super resolution XY: 100 nm; Z: 280 nm	○
	Label free ODT	Find ODT: real-time ODT preview DS ODT: label-free imaging with adjustable resolution SR ODT: super-resolution ODT imaging All of the above imaging modes support 2D-ODT and 3D-ODT image reconstruction XY: 130 nm; Z: 350 nm [2]	
Hardware Component	Excitation power	High power single-mode laser	
		High power multi-mode laser	✓
	Excitation wavelengths [3]	405 nm, 488 nm, 561 nm, 640 nm	
		445 nm, 515 nm, 532 nm, 594 nm, 750 nm	○
	LED eyepiece	405 nm, 488 nm, 561 nm, 640 nm	
		445 nm, 515 nm	○
	Label-free transmission light source	Highly coherent illumination light source, compatible with simultaneous imaging with fluorescent light sources	
	Spin	Single disk max rotation speed: 18000 rpm Pinhole size: 50 µm; 25 µm	
		Dual disk (microlens array + pinhole array) max rotation speed: 8000 rpm Pinhole size: 50 µm; 25 µm	○
	Multi-channel fluorescence imaging options	Single-camera multi-channel full-frame sequential imaging	
		Single-camera multi-channel high-speed simultaneous imaging	○
		Dual-camera multi-channel full-frame simultaneous imaging	○
		Dual-camera multi-channel full-frame imaging with flexible camera selection	○
	Spin acquicision camera	Two choices of sCMOS cameras: Hamamatsu ORCA-Fusion BT, Teledyne Photometrics Kinetix 29	
	Spin illumination FOV	Max. 30 mm FOV	
	Objectives	Compatible with a wide range of objectives including air, water, oil and silicon oil immersion	
	Microscope stand	Evident IX85 / Evident IX83 / Nikon Ti2-E	
	Advanced intelligent function [4]	Real-time preview and auto-tracking, large-area preview, event-triggered multi-phase and high-speed multi-well plate imaging, large-ROI stitching	
Molecular Functional Quantification	FRET		
	FRAP	Supports multi-channel FRAP Sub-pixel positioning accuracy Time-multiplexed excitation and bleaching with ⩽ 10 ms switching User-defined, segmentation-based, and multi-region ROI	○

[1] Resolution in XY and Z after sparse deconvolution.
[2] XY resolution obtained using 532 nm coherent illumination, followed by reconstruction and deconvolution.
[3] Compatible with common fluorescence excitation wavelengths.
[4] CSR Biotech provides CSR IMAGER (for Cell Xelence control) and MicroscopeX FINER (general image analysis), fully supporting advanced intelligent imaging features.

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