

# Add a new dimension to live imaging



## **ZEISS Dynamics Profiler**

Your Easy Access to Underlying Molecular Dynamics in Living Samples

[zeiss.com/dynamics-profiler](http://zeiss.com/dynamics-profiler)



Seeing beyond

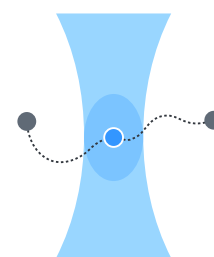
# ZEISS Dynamics Profiler

## Strengthen Your Live Imaging Analyses with Molecular Insights

ZEISS Dynamics Profiler gives you easy access to molecular concentration and dynamics in living samples. Information collected with the ZEISS Airyscan detector lets you characterize heterogenous diffusion behavior, ideal to investigate cellular condensates. Flow measurements determine the speed and direction of active movement in liquids and provide unique new data related to microfluidics and organs-on-a-chip. Explore even your most delicate samples without excessive light exposure or prolonged experiment time and expand your data collection to enhance your research.

Molecular data offers new, and often overlooked, insights about living samples. Fluorescence Correlation Spectroscopy (FCS) is an established method to investigate molecular characteristics. While a precise and very sensitive method, traditionally it is limited to extremely low expression levels or molecule concentrations that can be well below the experimental expression levels in live research samples.

ZEISS Airyscan uniquely employs all its detector elements to collect 32 individual FCS intensity traces per measurement. The mean value of the inner 19 elements provides robust and reliable measurements on molecular concentration and dynamics, even for bright samples. Moreover, the area detector allows a variety of spatial cross-correlation analyses by using combinations of single detector elements.



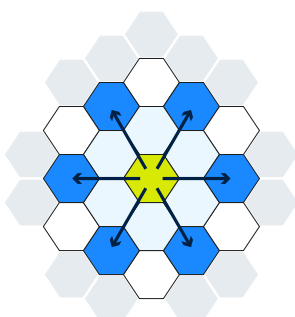
*FCS principle*



*Dynamics Profiler principle*

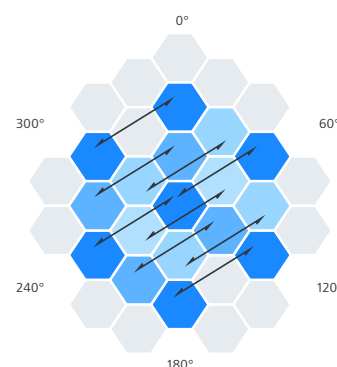
### Asymmetric Diffusion Measurement

Asymmetric diffusion analysis is calculated by cross-correlating the center element of the detector with the elements of the outer rings, uncovering heterogenous characteristics within one excitation volume, perfect to investigate samples such as cellular condensates.



### Flow Measurement

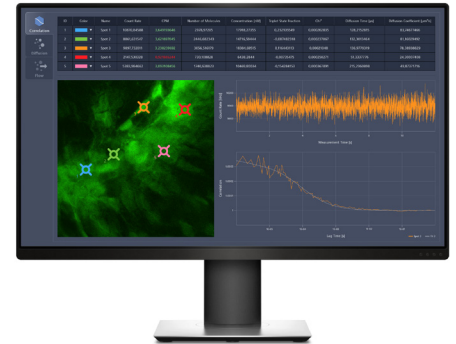
Cross-correlation of detector pairs that are grouped and aligned in multiple directions along the excitation volume can measure speed and direction of actively moved molecules, such as fluorophores in microfluidic systems or within the bloodstream.



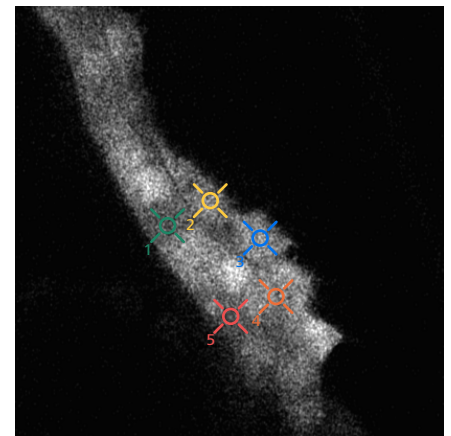
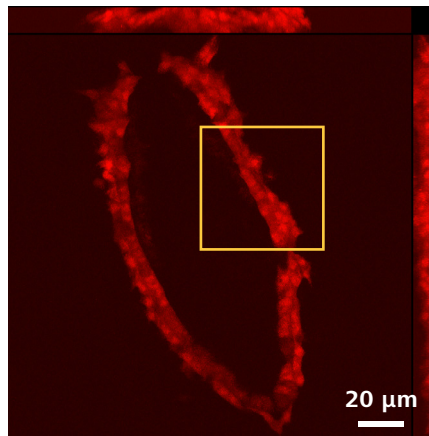
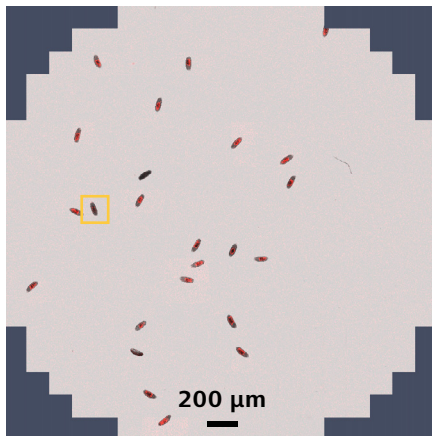
# Remarkably Easy Access to Molecular Dynamics

## Wizard-Guided Measurements with Built-in Quality Control

Molecular dynamics experiments are often limited by lack of necessary equipment or the highly trained personnel. Now, with the Dynamics Profiler function that can be easily added to a ZEISS confocal with the Airyscan detector, any proficient confocal microscopy user can go beyond traditional confocal imaging to collect molecular concentration and dynamics information about a protein of interest. The wizard-guided workflow ensures precise acquisition settings and simple data quality control. Reference images aid in sample context and measurement position documentation. Comprehensible data visualization enables intuitive access to the information obtained. Adding molecular dynamics measurements to any of your current live sample experiments has never been easier.



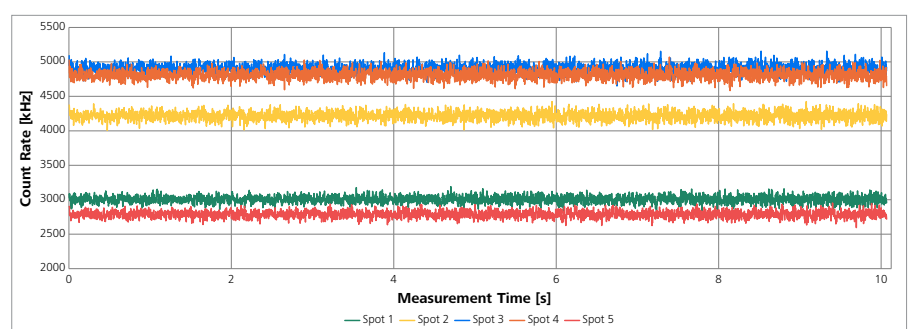
### Add information about molecular dynamics to live imaging experiments with complex and bright samples



Conventional fluorescence image acquisition: Overview image acquired with ZEISS LSM Plus and a 10× objective (left); Z stacks of the *Drosophila* heart acquired with ZEISS LSM 980 with Airyscan 2 and a 40×/1.2 W autocorr objective (right).

Subsequent Dynamics Profiler measurements within the same embryo at the same system

Fluorescent protein dynamics and concentration measurements can effortlessly be added to a confocal experiment. The sample shows a *Drosophila melanogaster* embryo expressing mCherry under control of the hand cardiac and hematopoietic enhancer (Han and Olson, 2005), located in the third intron. The expression of the reporter mimics endogenous hand expression in the heart and is maintained throughout embryogenesis in cardioblasts as well as in pericardial cells. Even with bright samples like this, Dynamics Profiler allows to get robust FCS data and compare concentrations of molecules in different cells.



	Concentration [nM]	Diffusion Coefficient [ $\mu\text{m}^2/\text{s}$ ]
Spot 1	17918,27355	83,74677466
Spot 2	14716,59444	81,16029492
Spot 3	18384,69515	78,38938829
Spot 4	14063,53361	92,30007408
Spot 5	10469,80034	49,87371716

Sample courtesy of Prof. Dr. Achim Paululat and Dr. Christian Meyer, Osnabrück University, Department of Zoology and Developmental Biology, Germany

# New Insights from Your Living Samples

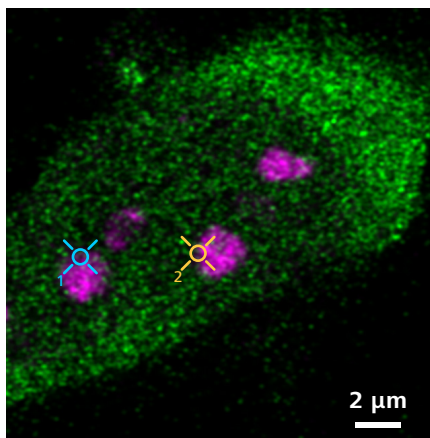
## Add Dynamics Measurements to Your Current Experiments

Previously, confocal users applied techniques like Fluorescence Recovery after Photobleaching (FRAP) to measure molecular dynamics despite limitations, including that each sample can be measured only once and phototoxic levels of light exposure. Traditional Fluorescence Correlation Spectroscopy (FCS) could be used to precisely measure fluorescent protein concentrations, but required additional equipment and could be challenging, even to experienced users. Dynamics Profiler is the first tool with an intuitive and easy-to-use interface to provide effortless access to these data simultaneously during confocal imaging experiments with low time and light investment. Developed from FCS, it uniquely allows these measurements even in bright and challenging samples.



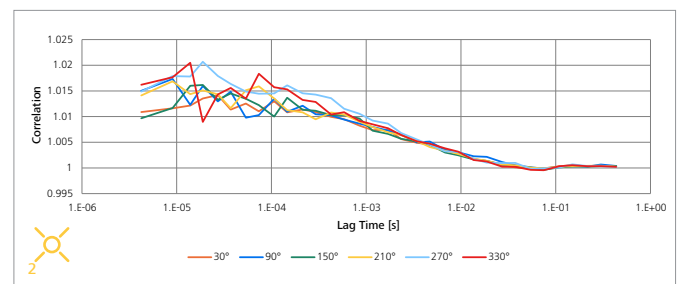
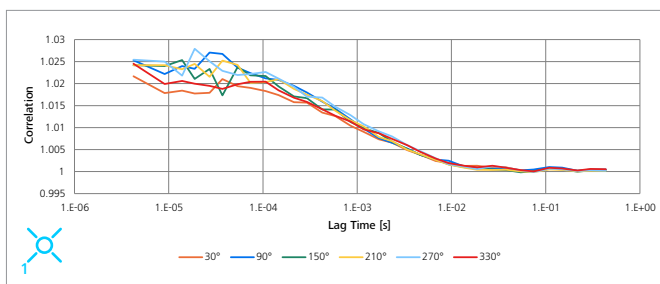
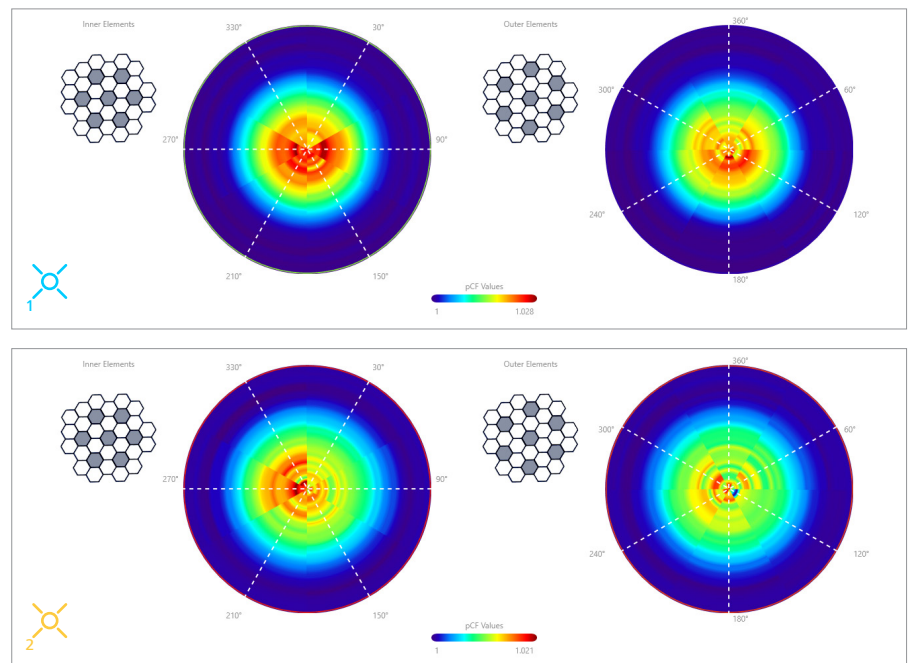
### Determine dynamic changes at the border of nucleoli

Live U-2 OS cells transiently co-expressing tetrameric EGFP and the nucleolar protein Fibrillarin tagged with monomeric Red Fluorescent Protein were subjected to Dynamics Profiler measurements at the border of the nucleoli as indicated in the confocal overview image. Samples kindly provided by P. Hemmerich and T. Ulbricht (Core Facility Imaging, Leibniz Institute on Aging, Jena, Germany).



Top: Reference image with spots for measurement positioned, acquired with Dynamics Profiler on ZEISS LSM 900 with Airyscan 2.

Right: Graphical representation of the Asymmetric Diffusion measurement within spot 1 (top row) and spot 2 (bottom row). Molecular dynamics of EGFP at the nucleolar border were determined.



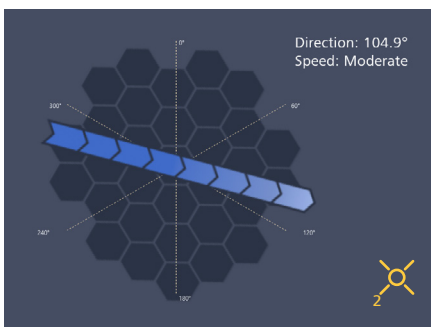
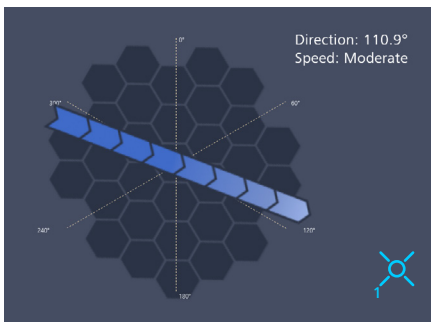
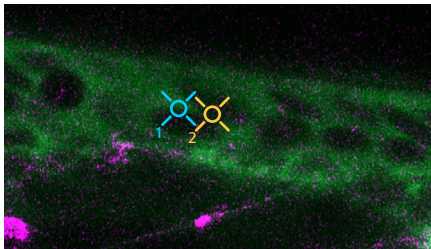
Asymmetric Diffusion measurement by pair correlation of inner Airyscan elements along six angles within spot 1 (left) and spot 2 (right)



# Access to New Molecular Discoveries

## Asymmetric Diffusion and Flow Analyses

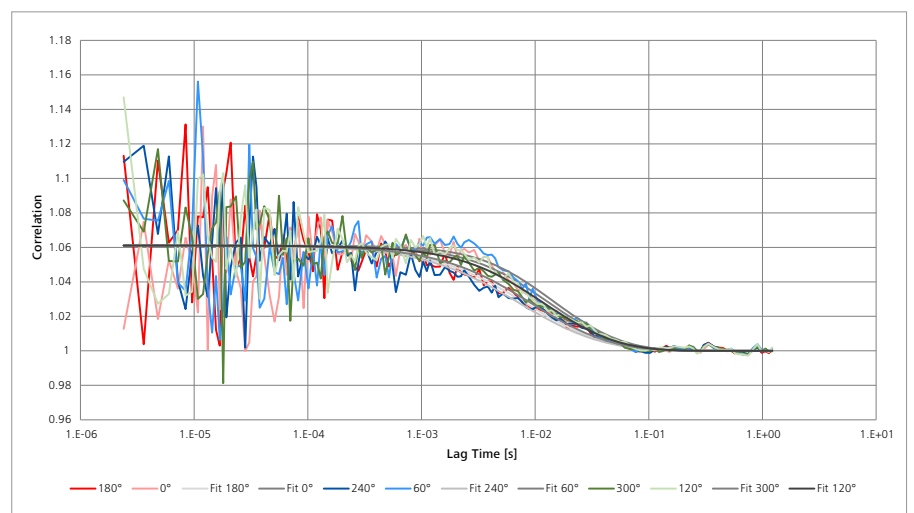
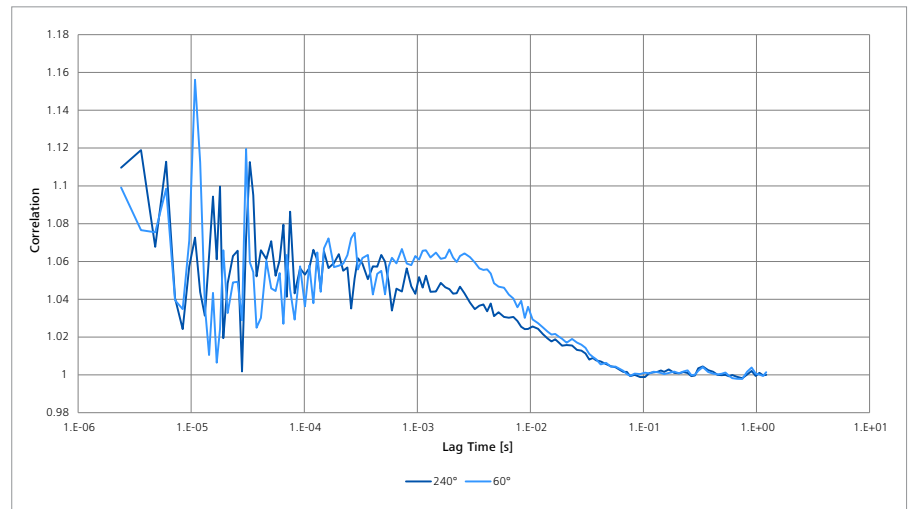
With traditional FCS, molecular measurements are limited to a single excitation volume. By utilizing the Airyscan area detector, Dynamics Profiler adds spatial information, enabling new, in-depth molecular profile analyses in single measurements. The Asymmetric Diffusion Tool can capture asymmetric diffusion behavior within a single point spread function, such as at the interface of the liquid-liquid phase separation leading to cellular condensates. The Flow Analysis Tool measures the speed and direction of fluorescent molecules all within a single excitation volume – perfect for the measurement of active movement of solutions, such as biological processes in the blood stream, or in microfluidic systems, such as organs-on-a-chip. The raw data from each measurement is available for further, customized analyses.



Reference image and Dynamics Profiler data acquired with LSM 980 with Airyscan 2 and a 40x/1.2 W autocorr objective. Direction and speed of molecule flow through the blood vessel were measured at two different spots. The graphs (right) show the correlation curves of the measurement within spot 1: correlation curves of selected angles (top), actual flow speed and direction results out of the 6 cross-correlations along three axis (bottom). Courtesy of V. Hopfenmüller, Leibniz Institute on Aging – Fritz Lipmann Institute (FLI), Germany

### Measure the flow speed in blood vessels of zebrafish larvae

The spatial information provided by the Airyscan detector allows analyses to determine the flow speed of molecules in the blood. Tetramethylrhodamine-labeled Dextran (10 kDa, Dynamics Profiler measurement) and Fluorescein-labeled Dextran (40 kDa, labeling blood vessels) were injected into blood vessels of a 5-day-old zebrafish larvae that was embedded in 1% low melt agarose.



# ZEISS Dynamics Profiler for Your Confocal

## Upgrade Your System to Uncover Hidden Molecular Profiles



### ZEISS LSM 980 with Airyscan 2

Your unique confocal experience for fast and gentle multiplex imaging

→ [zeiss.com/lsm980](https://zeiss.com/lsm980)



### ZEISS LSM 900 with Airyscan 2

Your compact confocal for gentle multiplex imaging and smart analysis

→ [zeiss.com/lsm900](https://zeiss.com/lsm900)

#### ZEISS Dynamics Profiler Features

Wizard-guided workflow	✓
Reference images for orientation	✓
Up to 10 measurement points	✓
Graphical visuals for easy data assessment and quality control	✓
Measurement of bright samples	✓
Pair correlation (Asymmetric Diffusion)	✓
Flow measurement (speed, direction)	✓
Accessible raw data for customized fit models	✓
Export of data, graphs, and images	✓
Diffusion coefficient and molecular concentration without additional calibrations	✓
Automated Airyscan calibration	✓
Time resolution	1.2 $\mu$ s, 0.5 $\mu$ s
FCCS	n/a*
Spectral FCS up to 7 channels	n/a*

#### Compatibility

LSM 980 Airyscan 2	C-Apochromat 40 $\times$ /1.2 W Corr FCS
	LD LCI Plan-Apochromat 40 $\times$ /1.2 Imm Corr DIC FCS
	C-Apochromat 63 $\times$ /1.2 W Corr FCS
	LD LCI Plan-Apochromat 25 $\times$ /0.8 Imm Corr DIC
LSM 800/900 Airyscan 2 Type 40 $\times$	C-Apochromat 40 $\times$ /1.2 W Corr FCS
	LD LCI Plan-Apochromat 40 $\times$ /1.2 Imm Corr DIC FCS
LSM 800/900 Airyscan 2 Type 63 $\times$	C-Apochromat 63 $\times$ /1.2 W Corr FCS

\* Available with LSM 980 FCS

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