ZEISS LSM 880 with Airyscan
Your New Standard for Fast and Gentle Confocal Imaging
To get ahead in your research you may want to image the smallest structures, catch the faintest signal or track the fastest processes – or do all of that at once. When it comes to getting accurate data from live cells or other weakly-labeled samples, there is no such thing as too much sensitivity, resolution or speed. Each photon of emission light is precious.

With Airyscan you collect all precious emission light without compromise and get a unique combination of gentle superresolution imaging and high speed. Use multicolor samples with any label and get image quality like you’ve never seen before. You get a perfect optical section and resolve structures of 120 nm (in X, Y) and 350 nm (in Z) even in thick samples. Plus, Airyscan gives you an instant 4–8x improvement of signal-to-noise (SNR).

Decide for this novel detector design for your confocal or multiphoton experiments and get more sensitivity, resolution and speed. The choice is yours.
Airyscan: Enter a New World of Confocal Performance

Imagine a true confocal that will give you high sensitivity and improved resolution in x, y and z, and then combine this with high speed – all in a single system. With Airyscan you will be increasing the resolution in 2D and 3D, far beyond that of a classic confocal point scanning microscope. You can resolve 120 nm laterally and 350 nm axially, at 488 nm – without sacrificing sensitivity. Airyscan in Fast mode gives you the high acquisition speed, sensitivity and superresolution you need to answer your scientific questions.

Perform Quantitative Imaging

Scientific results depend on unbiased data. LSM 880 guarantees gentle imaging of your sample through homogeneous illumination, combining linear scanning with a sensitive detection infrastructure. Working with identical pixel times and continuous scanner monitoring, you can perform quantitative imaging at all speeds and scan modes. Get robust and reliable results, even from your most demanding single molecule imaging and analysis.

Increase Your Productivity

Save time on investigations into localization and interaction of proteins that require multiple fluorescent labels. LSM 880 collects all these signals in one go, with high speed and high sensitivity. You perform simultaneous spectral detection in a single scan with the highest number of descanned or non-descanned channels – featuring GaAsP technology, too. LSM 880 lets you take full advantage of large fields of view and the highest speed of any linear scanning confocal – up to 13 fps.

Drosophila embryo. Color coded maximum intensity projection of the central nervous system. Courtesy of J. Sellin, AG Hoch, LIMES Institute, Bonn, Germany

Mitochondria, RK 13 TOMM20 labeled with Cerulean 3; comparing confocal GaAsP and Airyscan detection. Sample: courtesy of M. Davidson, The Florida State University, Tallahassee, USA
A survey among 250 researchers working with confocal microscopes revealed that their imaging would benefit most from an increase in sensitivity, resolution and speed. Airyscan extends exactly those parameters for your experiments and high speed acquisition combined with increased resolution and signal-to-noise-ratio (SNR).
Your Insight into the Technology Behind It

The Airyscan Principle

Airyscan is a detector that draws on the fact that a fluorescence microscope will image a point-like source as an extended Airy disk (Airy pattern). In a standard confocal microscope the out-of-focus emission light is rejected at a pinhole, the size of which determines how much of the Airy pattern reaches the detector. When you increasingly close the pinhole to reject out-of-focus light, you get a sharper image, but it’s also dimmer since a great deal of light is lost. Lost light translates into irreversible loss of resolution, sensitivity and speed.

Airyscan solves this conundrum between resolution and light efficiency by imaging the Airy disk onto a concentrically-arranged hexagonal detector array. Its detection area consists of 32 single detector elements, each of which acts like a very small pinhole. The confocal pinhole itself remains open and doesn’t block light – thus all photons of the whole Airy disk are collected. The signals from all detector elements are then reassigned to their correct position, producing an image with increased SNR and resolution. Because it capitalizes on the scanning and optical sectioning capabilities of a confocal, Airyscan works with standard samples and standard dyes, and even with your thicker samples such as tissue sections or whole animal mounts that need a higher penetration depth.

An area detector consisting of multiple detector elements allows unparalleled flexibility to take further steps in improving LSM imaging. The additional information about the Airy disk now delivers a perfect optical section at highest sensitivity. Instead of closing the pinhole and universally blocking light, each photon from the z-section is kept. In the additional Fast mode, you profit from yet another advantage of the area detector. The excitation beam is elongated in y and the Airyscan detector, with just one horizontal scanner movement, acquires four lines of image information instead of only one. This parallelization delivers a unique combination of high speed, high resolution and high sensitivity. Both in single and multiphoton excitation, it’s up to you whether to use the advantages of Airyscan and the Fast module to get better signal-to-noise, superresolution or speed.


Mitosis of HeLa Kyoto cells. Red: H2B labelled with mCherry, green: microtubule end-binding protein labelled with GFP. Courtesy of J. Ellenberg, EMBL, Heidelberg, Germany
Your Insight into the Technology Behind It

Beam path of LSM 880 with Airyscan
Emission light travels through the Twin Gate main dichroic beam splitter with its very efficient laser suppression to deliver supreme contrast. Then, at the secondary beam splitter, all emission light either travels via the recycling loop to the internal spectral detection unit (Quasar) with 3, 6 or 34 channels. Or, light is sent to the revolutionary Airyscan detector with GaAsP technology.

African green monkey kidney: TOMM20 (Alexa 568, red), Tubulin (Alexa 488, green) and nucleus (DAPI, blue). Sample: courtesy of M. Davidson, The Florida State University, Tallahassee, USA
Your Insight into the Technology Behind It

**Fast and Linear Scanning – Your Powerful Combination**

To fully resolve the movement of labeled proteins in dynamic cellular and subcellular processes you often need to image at around 10 frames per second. Now, with LSM 880, you can achieve up to 13 frames per second at 512 × 512 pixels. Add Airyscan with the Fast module to image with up to 27 frames per second and twice the pixel time at 480 × 480 pixels.

While you’re performing unidirectional or bidirectional scanning, LSM 880 is constantly monitoring and calibrating the scanner position. This guarantees a stable field of view and equal pixel integration times over the whole field of view. Linear scanning is an essential prerequisite for your quantitative and correlative imaging. It gives you a constant signal-to-noise level and uniform exposure to the illuminating laser throughout the scanned area, including manipulated regions of interest. Unlike traditional sine scanning confocals, LSM 880 uses more than 80% of the scanning time for data acquisition. That means you will enjoy a 29% improvement of signal-to-noise ratio because of longer pixel integration times at a defined frame rate.

You can’t always influence the orientation of your structure of interest as regards to the detection optics, but with LSM 880 you can always adapt the scanfield and rotate it freely to best suit your sample.
Your Insight into the Technology Behind It

Benefit from the Most Spectral Confocal

It takes multiple labels to analyze interactions between different cellular or subcellular structures, and the number of suitable labels is constantly growing. With the spectral freedom of the 3, 6 or 34 channels of LSM 880’s Quasar detector, you easily capture your dye combination of choice. Plus, you can acquire the transmitted light channel simultaneously to gain additional information without more light exposure of your sample. The unique light path of LSM 880 gives you flexibility and highest sensitivity. You always image your samples gently, with the high quantum efficiency of sensitive GaAsP detectors. Use the photon counting mode to collect even the weakest labels or for single molecule techniques such as fluorescence correlation spectroscopy (FCS) and cross correlation spectroscopy.

If your research requires fast and gentle acquisition of spectral information, you can capture 32 spectral channels in a single scan – with 5 fps at 512 x 512 pixels.

Whichever experiments you are planning: LSM 880 provides the best detectors for gentle imaging. You get highest light efficiency for your demanding multiphoton experiments with up to 12 non-descanned detectors. Highly sensitive GaAsP detectors combine high sensitivity, photon counting for FCS experiments, and FLIM applications.

In Brief

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Typical Sensitivity of Detectors

Typical spectral quantum efficiency (QE) of PMT and GaAsP detectors

Spectral detection unit of LSM 880

Choanoflagellate rosette colony. Blue: nuclei stained with Hoechst; magenta: tubulin of the flagella and cell body; green: actin microvilli collars stained with phalloidin. Courtesy of H. Aaron, UC Berkeley, USA.
Expand Your Possibilities

Experiment Designer: Your Smart Automation Module for Enhanced Productivity

Sometimes your applications require complex acquisition strategies. Especially for statistical analysis, repetitive imaging of a large number of samples with different imaging set ups comes into play. Experiment Designer is an easy-to-use module for ZEN imaging software that sets up your imaging for multiple positions, using the large number of imaging modalities of LSM 880. It is complemented by a number of hardware and software options so your sample always stays in focus, even during the most demanding long-term time lapse experiments.

With the ZEN software module Experiment Designer you can set up complex imaging routines consisting of freely defined and repeatable experiment blocks with multi-position tile scans of multichannel Z-stacks.
Expand Your Possibilities

Multiphoton Microscopy

Multiphoton microscopy lets you acquire optical sections of deep tissue layers. This imaging method makes use of these basic principles:

- The longer the wavelength of light, the less it is scattered when entering tissue. Light of a wavelength between 600 and 1300 nm experiences the lowest absorption in tissue, making it nearly transparent in this spectral range.
- A fluorescent dye with an excitation maximum at 500 nm can be excited with one photon of this wavelength or with two photons of the doubled wavelength –1000 nm – that arrive simultaneously.
- A powerful pulsed tunable laser of 700-to-1300 nm makes sure that enough photons arrive simultaneously to excite the fluorescent dye. Outside the focal plane, the laser intensity drops exponentially and produces no emission light.

Emission light, created by multiphoton excitation, can be captured efficiently with non-descanned detectors. Using Airyscan detection with multi-photon excitation combines deep tissue penetration with increased sensitivity, resolution and speed.

You can make use of these Airyscan advantages for functional imaging experiments, large volume imaging and screening applications.

Even non-stained structures can be visualized with multiphoton high intensity excitation by the non-linear effect of frequency doubling. This second harmonic generation (SHG) on non-centrosymmetric molecules with predominantly periodic alignment occurs, for example, in striated muscle and collagen.

Zebra fish. Color coded maximum intensity projection of a 100 µm z-stack with 200 slices. Courtesy of C. Oldfield, UC Berkeley, US

Energy diagram of 2 Photon Microscopy
Expand Your Possibilities

Superresolution Microscopy

LSM 880 is the only confocal laser scanning microscope that can be combined with three complementary superresolution techniques in one system, delivering true multimodal imaging of your samples. Your LSM 880 with Airyscan can deliver resolutions down to 120 nm laterally and 350 nm axially even in thicker and denser samples, both with 2D and 3D acquisition. Acquire even smaller structures by combining it with ELYRA, the dedicated superresolution system for structured illumination (SR-SIM) and photoactivated localization microscopy (PALM). SR-SIM works best with thinner, less scattering samples and delivers large fields of view. PALM uses photo-switchable fluorescent molecules, recording them over time and then superimposing these data. This lets you achieve resolutions down to 20 nm laterally and 50 nm axially.
Clearing Methods
Tissue clearing opens up a new dimension of optical penetration depth into biological samples such as tissue sections, mouse brains, embryos, organs, spheroids or biopsies.

With Axio Examiner and special objectives such as Clr Plan-Apochromat 10x/0.5 nd=1.38, Clr Plan-Apochromat 20x/1.0 Corr nd=1.38 or Clr Plan-Neofluar 20x/1.0 Corr nd=1.45, you can look deep into tissue that has been treated with a respective clearing agent such as Focus Clear or Scale including modified versions thereof. Thus the tissue gets almost transparent and the objectives provide the matching refractive index to the immersion medium. Image up to six times deeper than with a multiphoton microscope and up to 60 times deeper than with a conventional laser scanning microscope.

Get ready to be impressed by the quality of structural information you retrieve from the deepest layers: expect a big push forward, especially in basic neurobiological research and mapping of neuron networks.

Maximum intensity projection, brain of 7-week old YFP-H mouse, fixed and cleared with Scale clearing technique (Hama et al, Nat Neurosci. 2011). Courtesy of H. Hama, F. Ishidate, A. Miyawaki, RIKEN BSI, Wako, Japan
Expand Your Possibilities

As your needs grow, LSM 880 grows with you, forming the basis for a number of enhancements. Like every system from ZEISS, open interfaces and a modular architecture guarantee the seamless interaction of all components now and in the future. These include:

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Combine Axio Observer 7 with integrated incubation modules, e.g. Incubator XL, to get the best tool for long term live cell imaging with stable temperature conditions.

The upright fixed stage microscope Axio Examiner.Z1 gives you ample specimen space and room for micromanipulation. This stable stand is ideally suited for multiphoton experiments with LSM 880. Combine the system with Airyscan or incubation for your demanding experiments with living specimens.

Use BiG.2 with its two GaAsP detectors for FCS, photon counting experiments and FLIM on your LSM 880.

The upright research microscope Axio Imager.Z2 can be combined with LSM 880, Airyscan and incubation, too.

Airyscan can be added to any of the LSM 880 system configurations, including the version with BiG.2 detector.

BiG.2 works perfectly as a non-descanned detector, also providing a highly sensitive direct coupled detector for FLIM.
Expand Your Possibilities

As your needs grow, LSM 880 grows with you, forming the basis for a number of enhancements. Like every system from ZEISS, open interfaces and a modular architecture guarantee the seamless interaction of all components now and in the future. These include:

- The two channel GaAsP NDD with flexible filter settings completes the ensemble of non-descanned detectors for Axio Examiner.Z1.
- You can add a choice of cameras from the Axiocam series to LSM 880 for widefield imaging experiments.
- With the highly sensitive and stable GaAsP detectors of LSM 880 you easily perform Fluorescence Correlation Spectroscopy (FCS). You get information about the kinetics of single molecules.
- Förster Resonance Energy Transfer (FRET) and Fluorescence Recovery After Photobleaching (FRAP) are methods to study molecule interaction and motion.
- You get contrast and better signal to noise – even in your most challenging samples.
- With Autocorr objectives and ZEN imaging software it’s easy to adjust your microscope optics to your sample.
- You can add a choice of cameras from the Axiocam series to LSM 880 for widefield imaging experiments.
- With the Number&Brightness analysis tool you evaluate the connection between the intensity in your sample and the number of molecules responsible for this signal intensity.
Enhance your Airyscan detector with the Fast module. It allows for highest imaging speed, combined with the superresolution and high SNR. Use this option for gentle live cell imaging of dynamic and functional processes.

Definite Focus 2 compensates Z-drift and stabilizes the focal position of your sample. You can now perform long-term multi-position and tiling experiments that can last for multiple days.

Collect all labels simultaneously with the numerous channels of LSM 880 and accelerate the deconvolution process significantly with the CUDA enabled GPUs. Add enhanced resolution and signal to noise to the multi-channel flexibility of imaging with LSM 880.

3Dx! Viewer – powered by arivis – is the new visualization module for ZEN imaging software. Render even large, super-resolution data sets acquired with LSM 880 and Airyscan. Create impressive 3D animations or fly-through videos to study your sample efficiently from all sides. (Sample courtesy of T. Ruff, Max Planck Institute of Neurobiology, Martinsried, Germany).

Shuttle & Find is your gateway to correlative light and electron imaging (CLEM). Combine the specificity of functional fluorescence imaging with ultrastructural information.
## Tailored Precisely to Your Applications

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<th>Typical Applications, Typical Samples</th>
<th>Task</th>
<th>ZEISS LSM 880 Offers</th>
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<tr>
<td>Antibody stained tissue slices</td>
<td>Document morphological relations of structures with a resolution of 120 nm (XY) / 350 nm (Z) at 488 nm excitation</td>
<td>Airyscan with GaAsP detector for superresolution imaging</td>
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<tr>
<td>Cleared tissue</td>
<td>Image cleared tissue with up to 5.6 mm in Z</td>
<td>Special objective corrected for immersion medium of refractive index 1.38 or 1.45 working with confocal or multiphoton imaging on Axio Examiner</td>
</tr>
<tr>
<td>Live cell culture</td>
<td>Study the motility of vesicles and organelles</td>
<td>Airyscan in Fast mode for gentle imaging with high frame rates</td>
</tr>
<tr>
<td></td>
<td>Document the kinetics of endo- and exocytosis</td>
<td>Mixed mode imaging with LSM and superresolution based on photoactivated localization</td>
</tr>
<tr>
<td></td>
<td>Screen and document cells expressing the desired fluorescent label in response to pharmacological treatment</td>
<td>Widefield imaging using Axiocam</td>
</tr>
<tr>
<td>Live cell culture with two labels</td>
<td>Study the motility of subcellular structures</td>
<td>Airyscan with GaAsP detector to image 2 colors with time lapse imaging in 2D or 3D at 2.5 frames per second and 9.6 frames per second with Fast mode.</td>
</tr>
<tr>
<td></td>
<td>Explore the interaction of two proteins with fluorescent lifetime microscopy</td>
<td>BiG.2 as detector for FLIM and third party electronics and software</td>
</tr>
<tr>
<td></td>
<td>Explore the interaction of two proteins exploiting the Förster Resonance Energy Transfer effect</td>
<td>FRET analysis tool</td>
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<tr>
<td>Live cells with multiple labels</td>
<td>Image over long time in an automated way</td>
<td>Experiment Designer software tool combined with spectral imaging</td>
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<tr>
<td>Fixed cell culture specimens</td>
<td>Document cellular structures in superresolution in 3D with about 2x the resolution of a confocal</td>
<td>Structured illumination with ELYRA</td>
</tr>
<tr>
<td>Live or fixed cells with multiple labels and overlapping emission signals</td>
<td>Examine the interplay of multiple proteins</td>
<td>Parallel acquisition of all signals with spectral imaging at 5 full frames per second and online or post processed unmixing</td>
</tr>
<tr>
<td>Cellular structures with weak labels</td>
<td>Image subcellular structures at physiological expression levels</td>
<td>Airyscan with GaAsP detector or LSM 880 with GaAsP detector</td>
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<tr>
<td>Living organisms/animals</td>
<td>See the interaction of cells within living tissue Imaging of live tissue with cells expressing multiple different fluorescent proteins</td>
<td>Multiphoton extension of LSM 880 Extension of LSM 880 NLO with second laser line for NLO*</td>
</tr>
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(*) available upon request
Tailored Precisely to Your Applications

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<th>Typical Applications, Typical Samples</th>
<th>Task</th>
<th>ZEISS LSM 880 Offers</th>
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<tr>
<td>Plant roots</td>
<td>Follow the changes of subcellular structures over time with a high resolution</td>
<td>Airyscan with GaAsP detector for superresolution imaging beyond 40 µm deep into tissue with up to 19 full frames per second (512 × 512 pixel) in Fast mode</td>
</tr>
<tr>
<td>Model organisms, e.g. Zebrafish, Drosophila or C. elegans</td>
<td>See fine details of the organisation and dynamics of endogenously expressed FP proteins</td>
<td>Airyscan with GaAsP detector for superresolution imaging beyond 40 µm deep into tissue</td>
</tr>
<tr>
<td>Live samples with varying labelling intensities over the field of view</td>
<td>Collect all image information and decide on the way to present the best image in contrast later</td>
<td>Airyscan with GaAsP detector for imaging with 3 Airy units and the ability to virtually close the pinhole post-acquisition</td>
</tr>
</tbody>
</table>
Drosophila embryo, depth coded maximum intensity projection. Microtubules labelled with GFP. Z-stack with 72 slices imaged for 11.5 h at 15 min interval. Airyscan in Fast mode. Courtesy of B. Erdi, Max F. Perutz Laboratories, University of Vienna, Austria
ZEISS LSM 880 at Work

Human RPE cells, ZO1 (tight junction marker) in blue, photoreceptor outer segments stained with FITC in green, EEA1 (endosomal marker) in red. Courtesy of S. Almewadar, CRTD, TU Dresden, Germany

Fixed tumor cells, tubulin labelled with Alexa 555, Airyscan SR mode. Sample: courtesy of P. O’Toole and P. Pryor, University of York, UK

Skin tissue from pig labelled with Ethyleneblue. The unfixed sample was excited with 1100 nm using an OPO (optical parametric oscillator). Fluorescent lifetime measurement was performed using the detector module BiG.2 connected to the TCSPC electronics from Becker&Hickl. The color coded image shows the variation in lifetime within different types of skin cells.

Fluorescent 1 µm ringbeads imaged at 488 nm
ZEISS LSM 880 at Work

Fixed tumor cells, tubulin labelled with Alexa 555, Airyscan SR mode. Sample: courtesy of P. O’Toole and P. Pryor, University of York, UK

Slice of mouse brain, CNPase-antibody staining, imaged with 10x objective. Courtesy of C. Dornblut, Leibniz Institute for Age Research (FLI), Jena, Germany
IMR90 human diploid lung fibroblasts. DNA has been stained with DAPI, the telomeric G strand (leading strand) in green with a Peptide Nucleic Acid probe and Alexa 488 and the telomeric C strand (lagging strand) in red with a Peptide Nucleic Acid probe and Alexa 546. Prior to their harvest the cells have been treated with siRNAs targeting RTEL1. RTEL1 is a helicase that is essential for telomere replication, and lack of the protein leads to stalled forks at telomeres and telomere breakage. This can be seen by individual telomeres that appear as more than one dot, as highlighted in the images. Airyscan resolves multiple telomere dots, thereby allowing an accurate quantification of telomere replication problems. Sample: Courtesy of J. Karlseder, Molecular and Cell Biology Laboratory; J. Fitzpatrick, Waitt Advanced Biophotonics Core, Salk Institute for Biological Studies, La Jolla, USA.
ZEISS LSM 880 at Work

Arabidopsis root. Green: endoplasmatic reticulum labelled with GFP, magenta: Golgi labelled with RFP. Left: confocal GaAsP detection, right: Airyscan in Fast mode. Courtesy of C. Hawes, Oxford Brookes University, UK

Drosophila embryo, maximum intensity projection. Microtubules labelled with GFP. Left: z-stack with 55 slices. Imaged for 203 min at 3 min interval. Right: same embryo imaged at higher magnification. Z-stack with 117 slices, imaged for 75 min at 3 min interval. Courtesy of B. Erdi, Max F. Perutz Laboratories, University of Vienna, Austria

TOMM 20 of the outer membrane of the mitochondria is labelled by Alexa 568 in this series of images, depicting single optical slices. Confocal image, Airyscan 3D processing, Airyscan 2D Superresolution processing. Sample: courtesy of M. W. Davidson, The Florida State University, Tallahassee, USA
**ZEISS LSM 880 at Work**

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**C. elegans embryo. Adherens junction protein labelled with GFP. Maximum intensity projection of a z-stack with 100 slices. Imaged for 120 min at 5 min interval. Courtesy of L. Cochella, Research Institute of Molecular Pathology (IMP), Vienna, Austria**

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**Calcium imaging of Zebrafish spine. GCaMP5, 920 nm excitation, 9 z-slices over 18 µm. Airyscan in Fast NLO mode. Sample: courtesy of D. Friedmann, UC Berkeley, USA**

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**Calcium sparks labeled with Fluo 4 imaged in Cardiomyocytes with 50 frames per second. Airyscan in Fast mode. Courtesy of P. Robison, B. Prosser, University of Pennsylvania, USA**
ZEISS LSM 880: Your Flexible Choice of Components

1 Microscope
- Inverted stand: Axio Observer
- Upright stand: Axio Examiner, Axio Imager
- Port for coupling of Elyra
- Camera port
- Manual or motorized stages
- Incubation solutions
- Fast Z piezo inserts
- Definite Focus

2 Objectives
- C-APOCHROMAT
- Plan-APOCHROMAT
- W Plan-APOCHROMAT, Clr Plan-APOCHROMAT, Clr Plan-NEOFLUAR
- LCI Plan-APOCHROMAT

3 Illumination
- UV laser: 355 nm, 405 nm
- VIS laser: 440 nm, 458 nm, 488 nm, 514 nm, 543 nm, 561 nm, 594 nm, 633 nm
- NIR laser for multiphoton imaging: Ti:Sa, QPO*, InSight DeepSee*, Discovery*

4 Detection
- 3, 6, or 34 descanned spectral channels (GaAsP and multialkali PMT)
- Airyscan detector with optional Fast module
- 2 additional GaAsP channels (BiG.2)
- Up to 6 non-descanned GaAsP detectors
- Up to 12 non-descanned GaAsP or PMT detectors total
- Transmitted light detector (T-PMT)

5 Software
- ZEN, recommended modules: Tiles & Positions, Experiment Designer, FRAP, FRET, RICS, FCS, Deconvolution, 3DxI Viewer – powered by arvis®

(* available upon request)
ZEISS LSM 880: System Overview

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LSM 880 Equipped with Two Photon Laser (NLO) for Single Stand.

LSM 880 Equipped with Two Photon Laser (NLO) for Dual Stand.
# Technical Specifications

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<th>Width (cm)</th>
<th>Height (cm)</th>
<th>Weight (kg)</th>
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<td>Small passively damped system table</td>
<td>90</td>
<td>75</td>
<td>77</td>
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<tr>
<td>Small actively damped system table</td>
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<td>Large actively damped system table</td>
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<td>77</td>
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<td>Active anti-vibration table (NLO) for Mai Tai Laser or Chameleon</td>
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<td>150</td>
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<td>Active anti-vibration table (NLO) for two-microscope configuration</td>
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<td>150</td>
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<td>Scanning Module LSM 880</td>
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<td>Microscope</td>
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<td>Electronic rack with laser units</td>
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<tr>
<td>Plug-in unit external laser</td>
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<tr>
<td>Laser module UV</td>
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<tr>
<td>Airyscan</td>
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<tr>
<td>Fiber optic cable, UV</td>
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<tr>
<td>Fiber optic cable, VIS</td>
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<tr>
<td>Cables</td>
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## Microscopes

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<td>Inverse: Axio Observer 7 with side port or rear port</td>
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<tr>
<th>Z Drive</th>
<th>Smallest increment Axio Imager.Z2: &lt;25 nm; Axio Observer 7: &lt;25 nm; Axio Examiner: &lt;30 nm; fast piezo objective or stage focus available; Definite Focus for Axio Observer 7</th>
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</table>

| XY Stage (optional)                        | Motorized XY scanning stage, for Mark & Find function (XYZ) as well as Tile Scan (Mosaic Scan); smallest increment of 0.25 µm (Axio Observer 7), 0.2 µm (Axio Imager.Z2) or 0.25 µm (Axio Examiner.Z1) |

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**Technical Specifications**

- **Physical Dimensions**
- **Length (cm)**
- **Width (cm)**
- **Height (cm)**
- **Weight (kg)**

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**Microscopes**

- **Stands**
- **Up: Axio Imager.Z2, Axio Examiner.Z1**
- **Inverse: Axio Observer 7 with side port or rear port**

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**Z Drive**

- Smallest increment Axio Imager.Z2: <25 nm; Axio Observer 7: <25 nm; Axio Examiner: <30 nm; fast piezo objective or stage focus available; Definite Focus for Axio Observer 7

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**XY Stage (optional)**

- Motorized XY scanning stage, for Mark & Find function (XYZ) as well as Tile Scan (Mosaic Scan); smallest increment of 0.25 µm (Axio Observer 7), 0.2 µm (Axio Imager.Z2) or 0.25 µm (Axio Examiner.Z1)
# Technical Specifications

## Scanning Module

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scanner</td>
<td>Two independent, galvanometric scanning mirrors with ultrashort line and frame flyback</td>
</tr>
<tr>
<td>Scanning Resolution</td>
<td>4 × 1 to 8192 × 8192 pixels, also for multiple channels, continuously adjustable</td>
</tr>
<tr>
<td>Scanning Speed</td>
<td>19 × 2 speed levels; up to 13 images/sec. with 512 × 512 pixels (max. 430 images/sec. 512 × 16), up to 6875 lines/sec. In Fast Airyscan mode: 13x2 speed levels, up to 19 images/sec. with 512x512 (max. 27 images/sec. 480x480, or 6 images/sec. 1024x1024)</td>
</tr>
<tr>
<td>Scanning Zoom</td>
<td>0.6 × to 40 ×; digitally adjustable in increments of 0.1 (Axio Examiner: 0.67 × to 40 ×)</td>
</tr>
<tr>
<td>Scanning Rotation</td>
<td>Can be rotated freely (360 degrees), adjustable in increments of one degree, freely adjustable XY offset</td>
</tr>
<tr>
<td>Scanning Field</td>
<td>20 mm field diagonal (max. 18 mm for Axio Examiner) in the intermediate image plane, with full pupil illumination</td>
</tr>
<tr>
<td>Pinholes</td>
<td>Master pinhole with preset size and position; can be adjusted as desired for multitracking and short wavelengths (such as 405 nm)</td>
</tr>
<tr>
<td>Beam Path</td>
<td>Exchangeable Twin Gate beamsplitter with up to 100 combinations of excitation wavelengths and outstanding laser line suppression; manual interface port for external detection modules (such as BiG.2, Airyscan, third party detectors, internal detection with spectral signal separation and signal recycling loop for compensation of polarization effects)</td>
</tr>
</tbody>
</table>

## Detection Options

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Detectors</td>
<td>1, 4 or 32 GaAsP PMT combined with 2 multalkali PMT spectral detection channels (QE 45 % typical for GaAsP)</td>
</tr>
<tr>
<td></td>
<td>2 additional GaAsP detection channels (BiG.2)</td>
</tr>
<tr>
<td>Airyscan detector</td>
<td>(32 channels GaAsP), delivers resolution up to 120 nm lateral, 350 nm axial; in Fast mode: 145/180 nm lateral, 450 nm axial</td>
</tr>
<tr>
<td></td>
<td>Up to 12 non-descanned detection channels (PMT and/or GaAsP)</td>
</tr>
<tr>
<td></td>
<td>Transmitted light detector (PMT)</td>
</tr>
<tr>
<td>Spectral Detection</td>
<td>3, 6 or 34 simultaneous, confocal reflected-light channels, GaAsP and PMT based</td>
</tr>
<tr>
<td></td>
<td>freely adjustable spectral detection area (resolution down to 3 nm)</td>
</tr>
<tr>
<td>Data Depth</td>
<td>8 bit, 12 bit or 16 bit available; up to 35 channels simultaneously detectable</td>
</tr>
<tr>
<td>Real-Time Electronics</td>
<td>Microscope, laser, scanning module and additional accessory control; data acquisition and synchronization management through real-time electronics; oversampling read-out logic; ability to evaluate data online during image acquisition</td>
</tr>
</tbody>
</table>
### Technical Specifications

<table>
<thead>
<tr>
<th>ZEN Imaging Software</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>System Configurations</strong></td>
</tr>
<tr>
<td><strong>System Self-Test</strong></td>
</tr>
<tr>
<td><strong>Recording Modes, Smart Setup</strong></td>
</tr>
<tr>
<td><strong>Crop Function</strong></td>
</tr>
<tr>
<td><strong>Real ROI Scan, Spline Scan</strong></td>
</tr>
<tr>
<td><strong>ROI Bleaching</strong></td>
</tr>
<tr>
<td><strong>Multitracking</strong></td>
</tr>
<tr>
<td><strong>Fast Acquisition</strong></td>
</tr>
<tr>
<td><strong>Lambda Scan</strong></td>
</tr>
<tr>
<td><strong>Linear Unmixing</strong></td>
</tr>
<tr>
<td><strong>Visualization</strong></td>
</tr>
<tr>
<td><strong>Image Analysis and Operations</strong></td>
</tr>
<tr>
<td><strong>Image Management</strong></td>
</tr>
</tbody>
</table>
# Technical Specifications

## Optional Software

<table>
<thead>
<tr>
<th>Optional Software</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3Dxl Viewer powered by arivis</td>
<td>Rapid 3D and 4D reconstructions and animations (available modes: shadow projections, transparency projection, surface rendering)</td>
</tr>
<tr>
<td>Deconvolution</td>
<td>3D, GPU based Cuda image restoration based on calculated point-spread functions (modes: nearest neighbor, maximum likelihood, constrained iterative)</td>
</tr>
<tr>
<td>ROI-HDR</td>
<td>Imaging mode: High Dynamic Range, intelligent, local improvement of the dynamic signal range, user-selectable gain and laser power</td>
</tr>
<tr>
<td>Physiology</td>
<td>Comprehensive evaluation software for online and offline calibration of ion concentrations</td>
</tr>
<tr>
<td>FRET</td>
<td>Acquisition of FRET (Förster resonance energy transfer) image data with subsequent evaluation; Acceptor Photobleaching and Sensitized Emission methods supported</td>
</tr>
<tr>
<td>FRAP efficiency analysis</td>
<td>Acquisition of FRAP (fluorescence recovery after photobleaching) experiments with subsequent evaluation of intensity kinetics</td>
</tr>
<tr>
<td>RICS Image Correlation</td>
<td>Single molecule imaging and analysis using multialkali or GaAsP PMT detectors (publ. v. Gratton)</td>
</tr>
<tr>
<td>Experiment Designer</td>
<td>Definition of customized imaging configurations and procedures</td>
</tr>
<tr>
<td>Macro Environment</td>
<td>VBA Macro recording and editing</td>
</tr>
</tbody>
</table>
# Technical Specifications

## Lasers

<table>
<thead>
<tr>
<th>Laser Insert RGB (pigtailed; 458, 488, 514, 543, 561, 594, 633 nm)</th>
<th>Single-mode polarization preserving fiber</th>
</tr>
</thead>
</table>
| Laser beam attenuation for all lasers by VIS-AOTF  
Ar laser (458, 488, 514 nm, 25 or 35 mW)  
HeNe laser (543 nm, 1 mW)  
DPSS laser (561 nm, 20 mW)  
HeNe laser (594 nm, 2 mW)  
HeNe laser (633 nm, 5 mW) |  |

<table>
<thead>
<tr>
<th>Laser Insert V (pigtailed; 405, 440 nm)</th>
<th>Single-mode polarization preserving fiber</th>
</tr>
</thead>
</table>
| Diode Laser pulsed/cw (405 nm, 30 mW) | max power ca. 15 mW at fiber out  
range 0.6 – 15 mW w/o attenuator, attenuation by a factor of 25  
pulsed mode  
repetition rate 20 – 80 MHz  
mean power: @20 MHz – ca. 0.2 mW; @50 MHz – ca. 0.5 mW; @80 MHz – ca. 0.8 mW  
peak power: 50 – 300 mW  
pulse width: 50 – 90 ps  
jitter <20 ps |

| Diode Laser pulsed/cw (440 nm, 25 mW) | max power ca. 15 mW at fiber out  
range 0.6 – 15 mW w/o attenuator, attenuation by a factor of 25  
pulsed mode  
repetition rate 20 – 80 MHz  
mean power: @20 MHz – ca. 0.1 mW; @50 MHz – ca. 0.25 mW; @80 MHz – ca. 0.4 mW  
peak power: 50 – 300 mW  
pulse width: 50 – 90 ps  
jitter <20 ps |
### Technical Specifications

#### Power Requirements

LSM 880 has a main power supply cord and plug, either CEE red (3/N/PE 400/230V/16A), or NEMA L 14-30P (2/N/Ground 120/240V/30A), and the matching mains socket outlet. The mains socket outlet must be equipped with a fuse having minimum tripping characteristic C according to IEC/EN 60898.

<table>
<thead>
<tr>
<th>Line Voltage</th>
<th>3/N/PE 400/230 V AC (±10 %)</th>
<th>2/N/Ground 240/120 V AC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Line Frequency</td>
<td>50...60 Hz</td>
<td>50...60 Hz</td>
</tr>
</tbody>
</table>

#### ZEISS LSM 880 incl. VIS Laser

<table>
<thead>
<tr>
<th>Max. Current</th>
<th>3 phases at 16 A</th>
<th>2 phases at 25 A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power</td>
<td>Phase 1 = 600 VA max.</td>
<td>Phase 1 = 800 VA max.</td>
</tr>
<tr>
<td></td>
<td>Phase 2 = 500 VA max.</td>
<td>Phase 2 = 1600 VA max.</td>
</tr>
<tr>
<td></td>
<td>Phase 3 = 1500 VA max.</td>
<td></td>
</tr>
<tr>
<td>Power Consumption</td>
<td>2100 VA max.</td>
<td>2100 VA max.</td>
</tr>
</tbody>
</table>

#### Multiphoton Laser

<table>
<thead>
<tr>
<th>Power Consumption</th>
<th>800 VA max.</th>
<th>800 VA max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ti:Sa laser</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heat emission without Ti:Sa</td>
<td>2000 W max.</td>
<td>2000 W max.</td>
</tr>
</tbody>
</table>

#### EMC test

- according to DIN EN 61326-1 (05/2010)
- Noise emission according to CISPR 11 / DIN EN 55011 (04/2011)
- Noise immunity according to table 2 (industrial sector)
## Technical Specifications

### Environmental Requirements

For operation the system has to be placed in a closed room.

1. Operation, specified performance
   - T = 22 °C ± 3 °C without interruption (24 h a day independently whether system is operated or switched-off)
   - It has to be ensured that the air-flow of the air-conditioning is not directed at the system.
2. Operation, reduced performance
   - T = 15 °C to 35 °C, any conditions different from item 1. and 5.
3. Storage, less than 16 h
   - T = –20 °C to 55 °C
4. Storage, less than 6 h
   - T = –20 °C to 55 °C
5. Temperature gradient
   - ±0.5 °C/h
6. Warm up time
   - 1 h, for high-precision and/or long-term measurements ≥ 3 h
7. Relative humidity
   - <65% at 30 °C
8. Operation altitude
   - max. 2000 m
9. Loss of heat (without Ti:Sa)
   - 2 kW
10. Vibrations under operation conditions
    - (with system table)
      - 5 µm pp at 5 Hz
      - 10 µm pp at 10 Hz
      - 10 µm pp at 20 Hz
11. Shipping shock (LSM 880 box)
    - 10 g

LSM 880 meets the requirements according to IEC 60825-1:2007
Count on Service in the True Sense of the Word

Because the ZEISS microscope system is one of your most important tools, we make sure it is always ready to perform. What’s more, we’ll see to it that you are employing all the options that get the best from your microscope. You can choose from a range of service products, each delivered by highly qualified ZEISS specialists who will support you long beyond the purchase of your system. Our aim is to enable you to experience those special moments that inspire your work.

Attain maximum uptime with your microscope. A ZEISS Protect Service Agreement lets you budget for operating costs, all the while reducing costly downtime and achieving the best results through the improved performance of your system. Choose from service agreements designed to give you a range of options and control levels. We’ll work with you to select the service program that addresses your system needs and usage requirements, in line with your organization’s standard practices.

Our service on-demand also brings you distinct advantages. ZEISS service staff will analyze issues at hand and resolve them – whether using remote maintenance software or working on site.

Enhance Your Microscope System.
Your ZEISS microscope system is designed for a variety of updates: open interfaces allow you to maintain a high technological level at all times. As a result you’ll work more efficiently now, while extending the productive lifetime of your microscope as new update possibilities come on stream.

Profit from the optimized performance of your microscope system with services from ZEISS – now and for years to come.

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