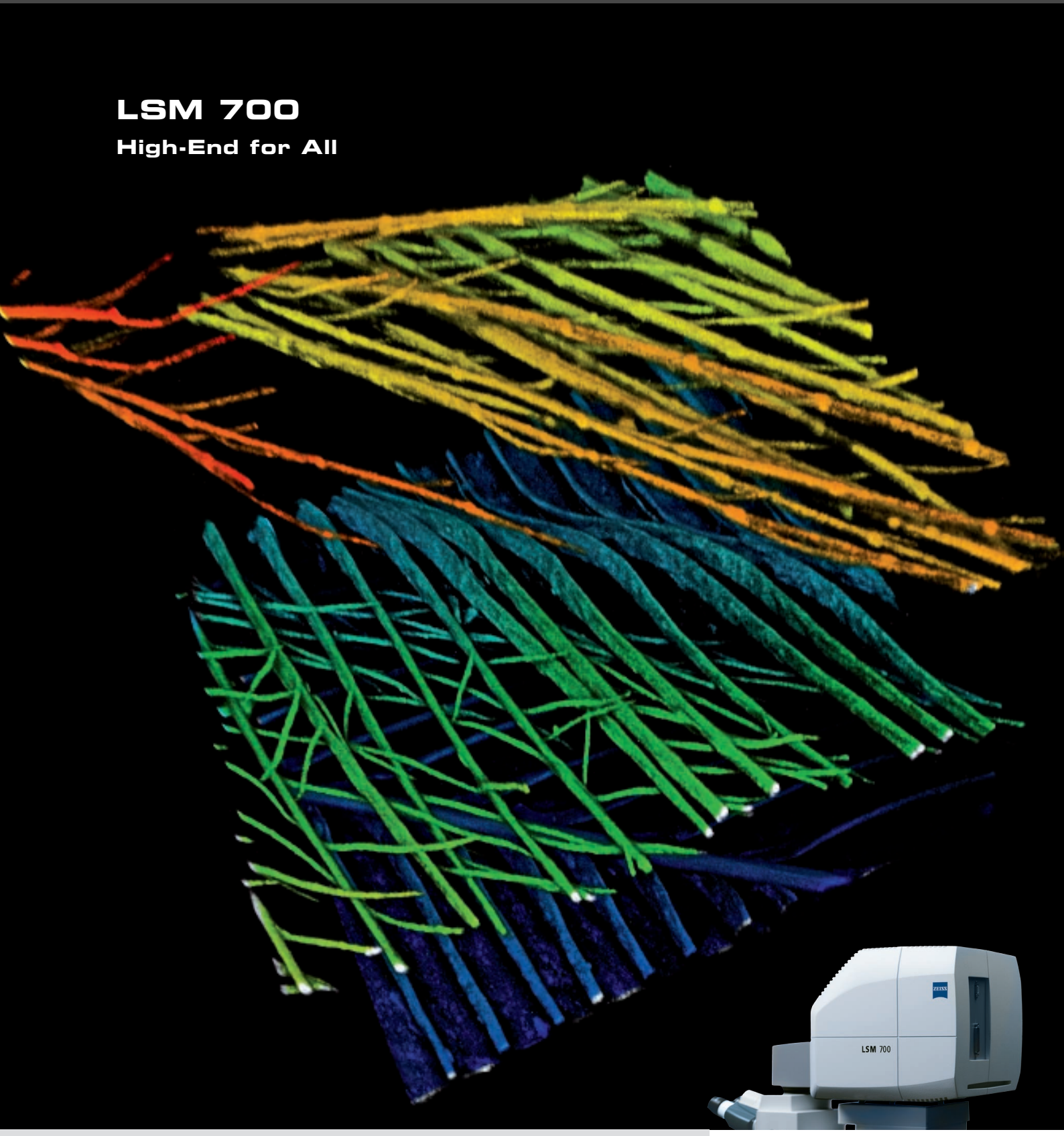
# LSM 700

## High-End for All

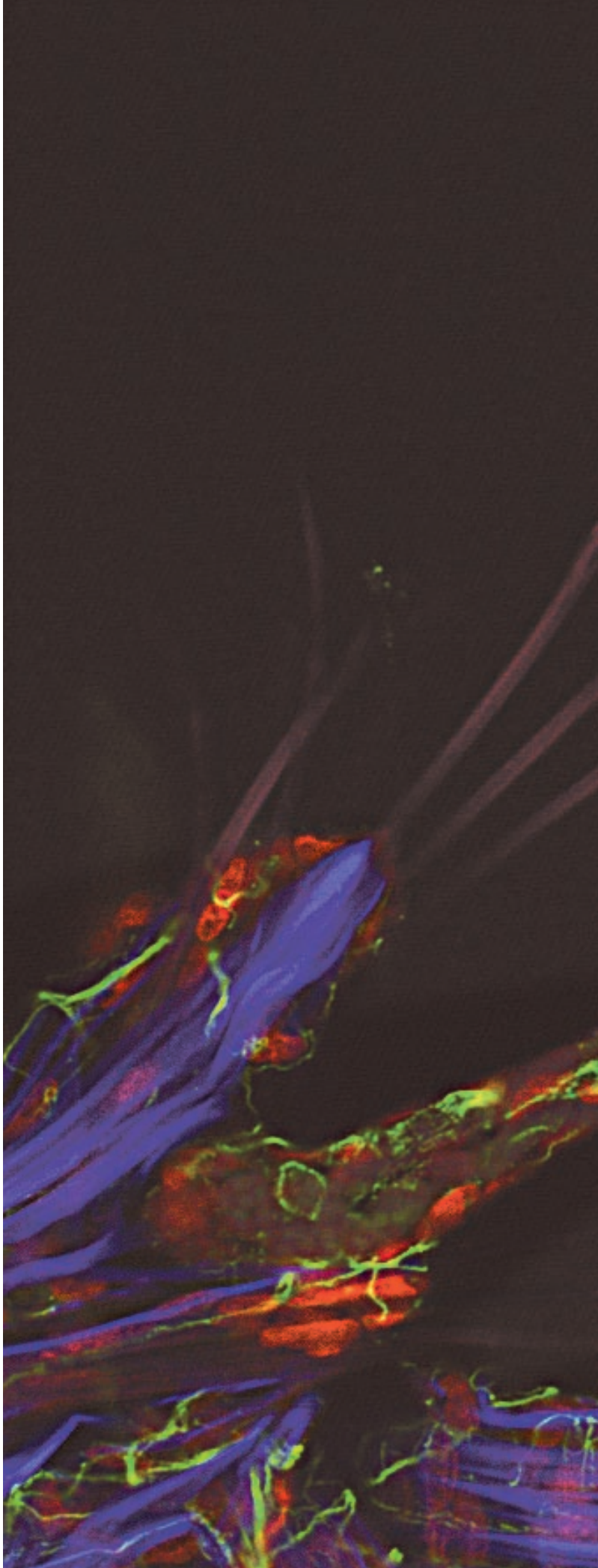



**Confocal Laser Scanning Microscopy**
**Uncompromised Quality and Operating Convenience**

ZEISS

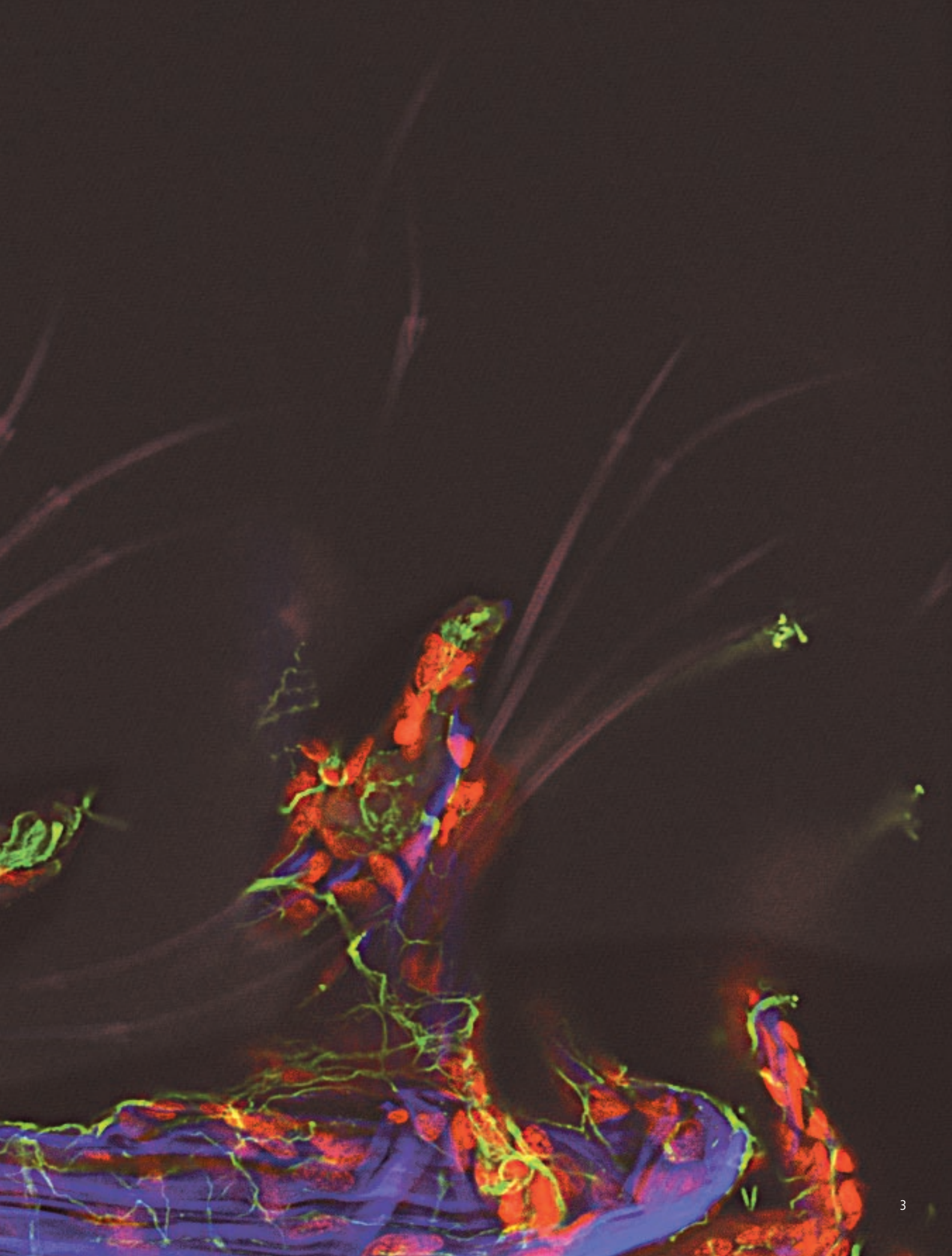
We make it visible.

The LSM 700 is a member of the seventh generation of confocal microscopes from Carl Zeiss – a product family that is characterized throughout by a wealth of genuinely innovative ideas and technologies.
Top-grade system components ensure superior performance.
The LSM 700 concept combines ZEISS quality, exceptional ease of operation and an attractive price level, resulting in an excellent price/performance ratio, which is evident in many details.



*Title:*
*Feather of an owl. Autofluorescence, depth coding*

*Right:*
*Bristle worm (Platynereis dumerilii)*
*Staining: Nervous system (Alexa 555), muscles (Alexa 488), nuclei (Draq5TM)*



In combination with four different microscope stands, the LSM 700 is ready for a vast range of applications.


ZEISS
Motors
off

# The LSM 700 from Carl Zeiss ...

From a specialists' system to the high-end microscope for all –
the LSM 700 represents the next big step in the evolution of confocal microscopy.

**Tried-and-tested ZEISS quality for basic applications and complex requirements**

Designed for complex tasks while being easy to operate, the LSM 700 meets every challenge, whether in a single- or multiple-user environment. It fits on many different microscope stands to suit a wide range of personal or application requirements.

The system features outstanding sensitivity, thanks to its mature, highly corrected optics and the efficiency of its detectors and electronic components. The system makes up a package that is suitable for classical confocal microscopy and special applications alike, such as live cell and spectral imaging.

The LSM 700 is ideal for multi-user facilities, where it can complement larger systems and relieve their workload. For many users in biomedical research it will provide an entry to high-end applications.

With frame rates of up to five fps (512 x 512 pixels), a freely 360° rotatable scanning field and freely definable regions of interest (ROIs), the LSM 700 provides the experimental freedom required for many applications.

*With its compact design, small footprint, and high quality optics the LSM 700 is ideal for imaging facilities where laboratory space is at premium. Further, the automated maintenance protocols ensure that imaging performance can be verified by users. The training is largely facilitated with the new ZEN environment where all functions are in a single window.*

*Dr. Spencer Shorte*
*Imaging Facility Manager, Institute Pasteur, France*

*With "Smart Setup" acquisition protocols are designed by selecting fluorophore spectra from a database. Users can then choose the best compromise between speed and good spectral detection, simply by telling the ZEN software what overall performance criteria they wish to achieve and "Smart Setup" does the rest. With this feature training new users could not have been made any simpler.*

*Dr. Emanuelle Perret*
*Scientific Staff, Institute Pasteur, France*

# ... Facilitates Your Research

Sophisticated and yet robust technologies make the LSM 700 the genuine workhorse of a research team.

**The LSM 700 is especially suitable for...**

**...service providers who want to make one LSM system available to several users:**

- Calibration objective and System Maintenance Tool permit quick and easy calibration by every system manager.
- The intuitive ZEN software not only shortens the training period for novices but also saves the workstation settings of each user.
- The Laser Life Extender helps save costs.
- Thanks to its small size, the LSM 700 can easily be accommodated even in a cramped lab environment.

**...users who plan ambitious experiments and need an absolutely precise LSM system:**

- The fully automatic pinhole ensures precision in multiple fluorescence work.
- The system's sensitivity permits fast scanning.

**...users who want fast results without in-depth study of laser scanning microscopy:**

- The intuitive ZEN software almost explains itself and the system capabilities.
- The Smart Setup concept allows straightforward configuration.

*The optics design of the LSM 700 enables a wide variety of confocal applications. Sophisticated tasks, like spectral acquisition, are achieved very easily; all with excellent image quality and rapid scan speed. Molecular parameters such as diffusion can be acquired using Imaging Correlation Spectroscopy. The LSM 700 provides much of the functionality and performance usually restricted to higher priced systems.*

*Dr. Pascal Roux*
*Scientific Staff, Institute Pasteur, France*

*This is the most compact Laser Scanning Microscope system I have ever seen, the image quality has not been compromised. Moreover the footprint of the system is so small it could fit into any lab.*

*Dr. Dave Spiller*
*Principal Experimental Officer, University of Liverpool, UK*

*The LSM 700 surpassed my expectations of a "basic" LSM. I found it extremely competent and able to perform most applications with ease. The real bonus is that the system is extremely sensitive and capable of imaging almost any probe. From a multiuser perspective, with the ZEN software my users would not need to be trained on the basic operations and can easily move between systems.*

*Dr. Peter O'Toole*
*Head of Imaging Department, University of York, UK*

# Fresh Impetus to Your Research

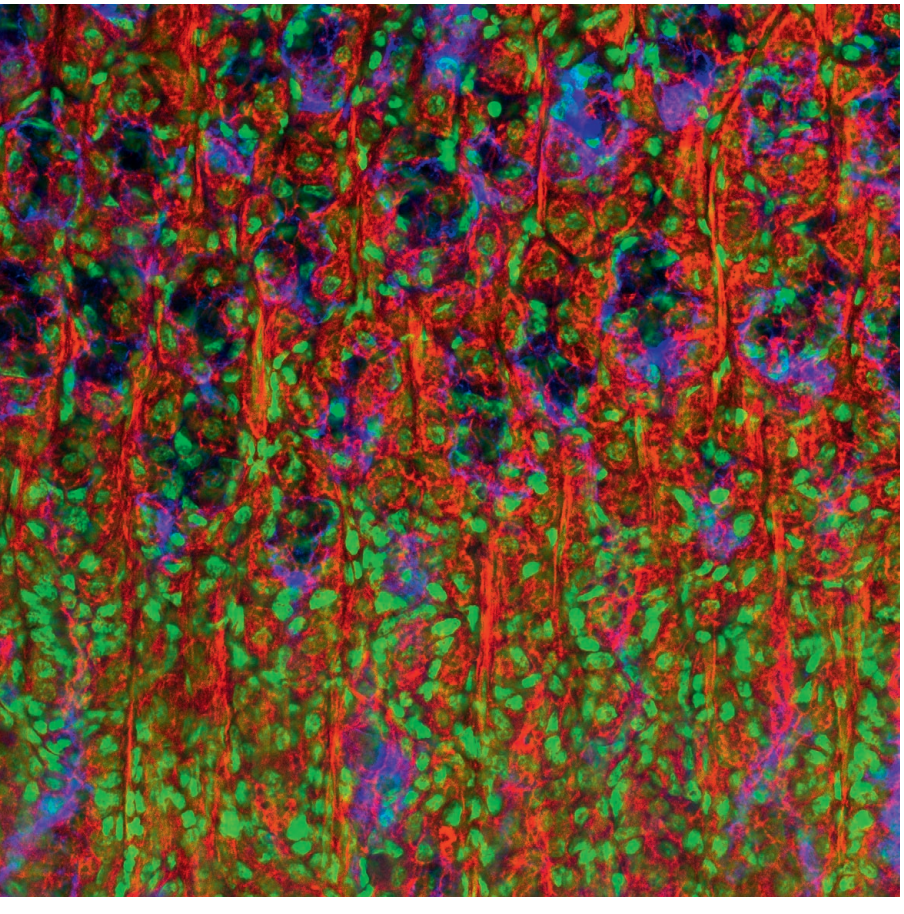
The LSM 700 fits many applications that are extraordinary for its price bracket. Spectral Imaging and Linear Unmixing are but two examples of techniques that demand a system of top quality.

**3D imaging**

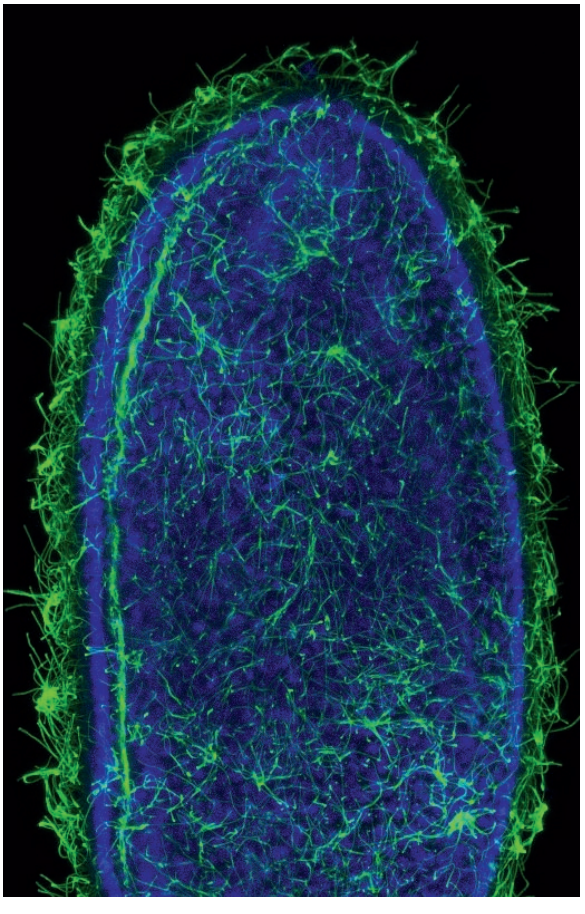
3D imaging is the standard application of a laser scanning microscope. Brilliant 3D images require excellent optical quality and precisely controlled image acquisition.

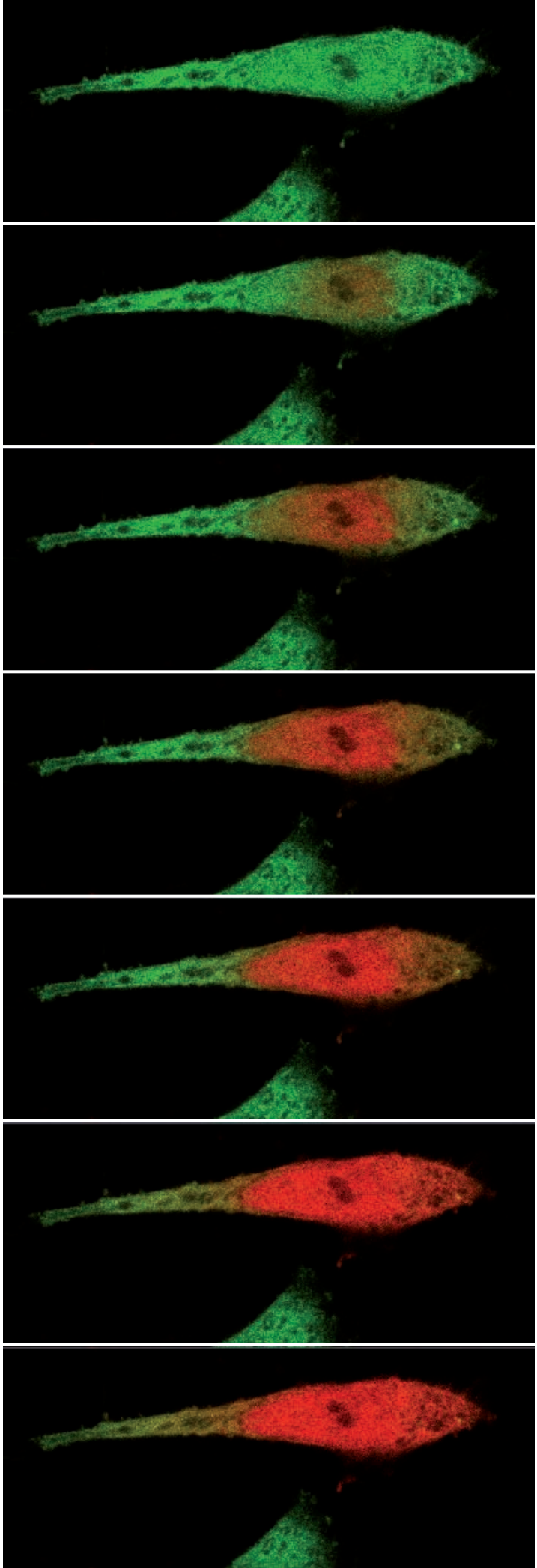
The LSM 700 assists you in configuring the acquisition parameters, from choosing the pixel resolution, setting the diameter of the confocal pinhole, and to the Z spacing of the optical sections.

*Section of a mouse stomach.*
*Blue: Plasma membrane, stained with Alexa Fluor 350 WGA (wheat germ agglutinin). Red: Actin, stained with Alexa 488. Green: Nuclei, stained with Sytox Green*



*Amphioxus B. floridae, neurula stage embryo*
*Staining: DAPI (chromatin), Alexa 488 (anti-tubulin, cilia)*
*Author: Jr-Kai Sky Yu, Institute of Cellular and Organismic Biology, Academia Sinica, Taipei, Taiwan*





**Multiple fluorescence and colocalization analyses**

In multicolor fluorescence imaging, the use of several fluorophores permits the observation of spatial relations between several cell constituents. 2 fluorescence detectors in the LSM 700 detect up to four color signals in a (quasi-)simultaneous mode, at frame rates of up to 5 fps for 512 x 512 pixels. Efficient separation of the fluorescence signals by selective laser excitation, and efficient splitting by means of the VSD (Variable Secondary Dichroic) beamsplitter prevent crosstalk.

**Emission Fingerprinting**

Spectral imaging and subsequent linear unmixing precisely separate fluorescent signals even of greatly overlapping color signals – such as GFP or broad-band autofluorescence.

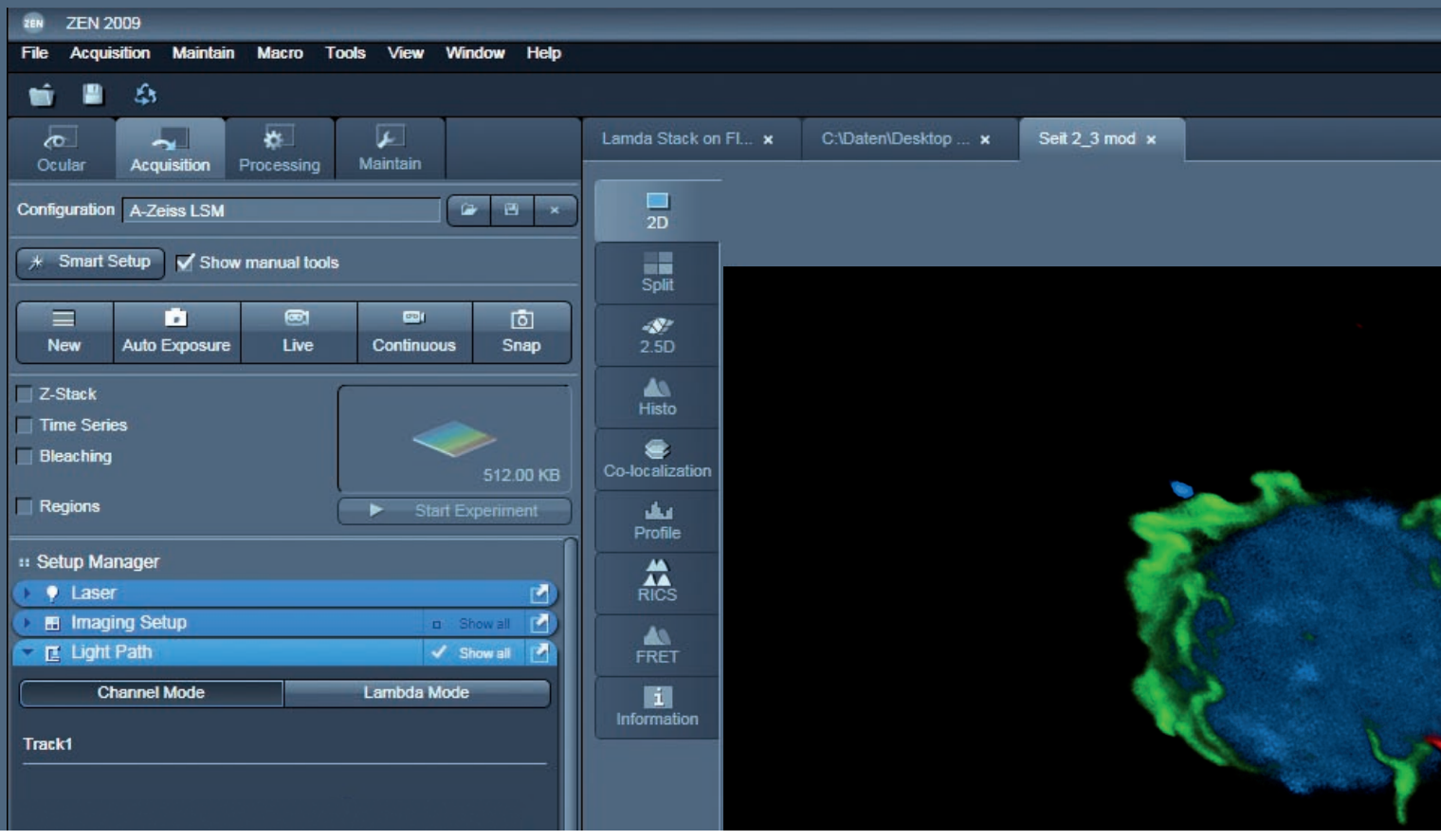
The integration of the VSD beamsplitter into the Emission Fingerprinting concept of the LSM 700 provides an innovative, highly efficient method of spectral image acquisition. Unlike conventional sequential methods, all parts of the spectrum emitted by the specimen are utilized for determining each spectral data point.

**Live Cell Imaging**

High light intensities and long irradiation lead to phototoxic reactions in living cells and tissues. The high sensitivity of the LSM 700, combined with pixel-precise control of illumination, preserves your specimens and permits you to observe fast biological processes over long periods of time.

**FRAP, FLIP, photoactivation and photoconversion**

Transport processes in live cells and organisms can be observed by means of targeted localized photobleaching, or by means of photoactivation or color conversion of fluorophores such as PA-GFP or Kaede. Thanks to precise real-time control of the excitation laser light and scanning mirror movements in the LSM 700, pixel-precise local illumination in up to 99 regions of interest is possible, as is the change between manipulation and imaging modes within milliseconds.



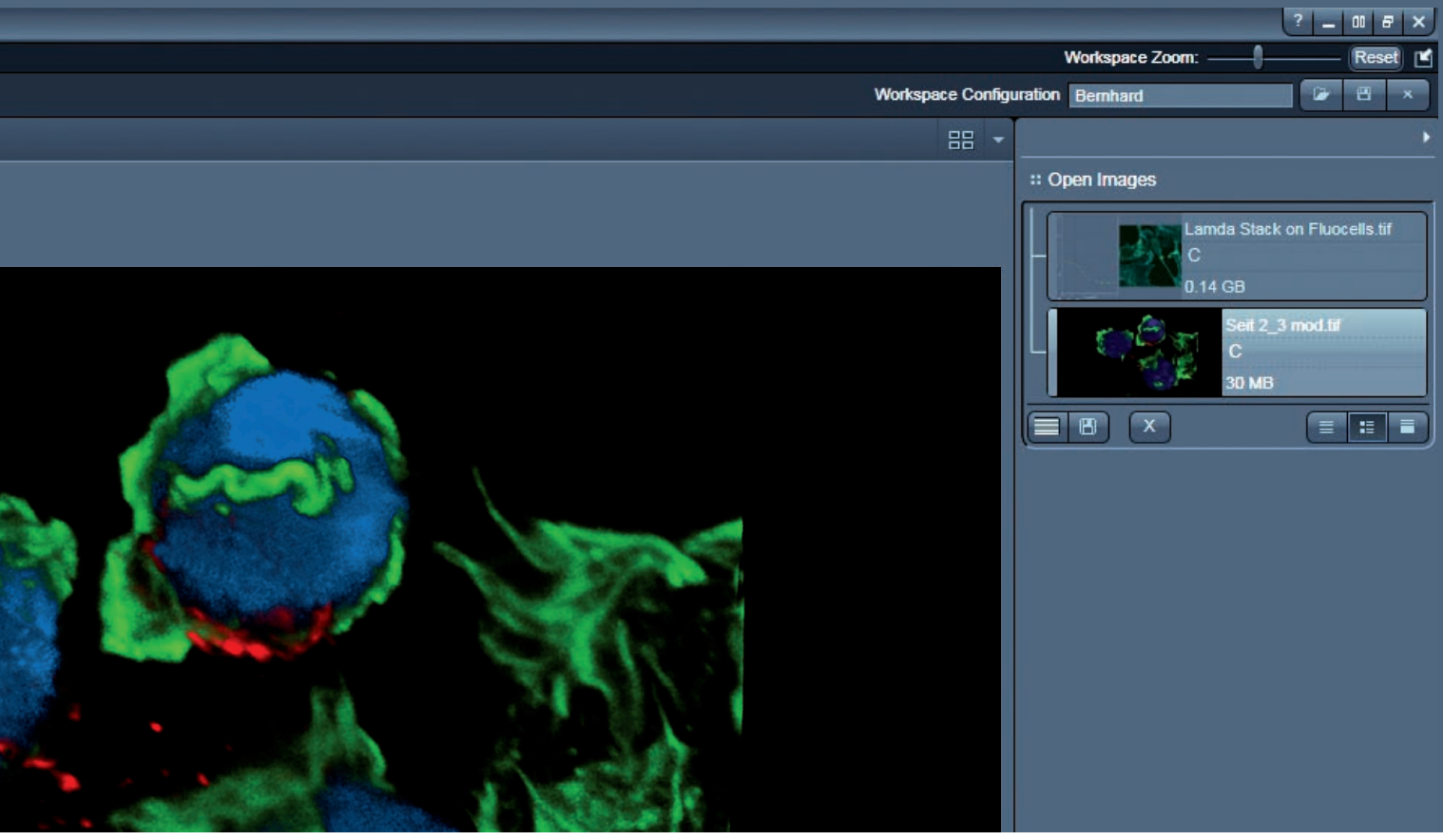

# The Ingenious, but Easy Way: ZEN – the Software for the LSM 700

ZEN makes life with confocal laser scanning microscopy easier for you. After a short period of familiarization with the intuitive user interface you are ready to go.

ZEN Efficient Navigation is the software that now comes with all Carl Zeiss confocal LSM systems. Easy to operate, ZEN offers a wide range of capabilities. It controls highly complex LSM techniques (e.g., FRAP) with the same dependability as it does classical confocal applications. The current ZEN version, specially tailored to the LSM 700, allows you to concentrate on your experiments rather than on the microscope software.

**Navigation the easy way**

The color scheme of the ZEN user interface matches the lighting conditions in a lab environment so as to be easy on the eye. The three-zone layout reflects the typical work process: Left Tool Area with the tools for image acquisition and microscope control, Central Screen Area for image viewing, and Right Tool Area for file management. The software screen area is freely scaleable to improve readability from a distance.




# Made to Measure for Each Individual User

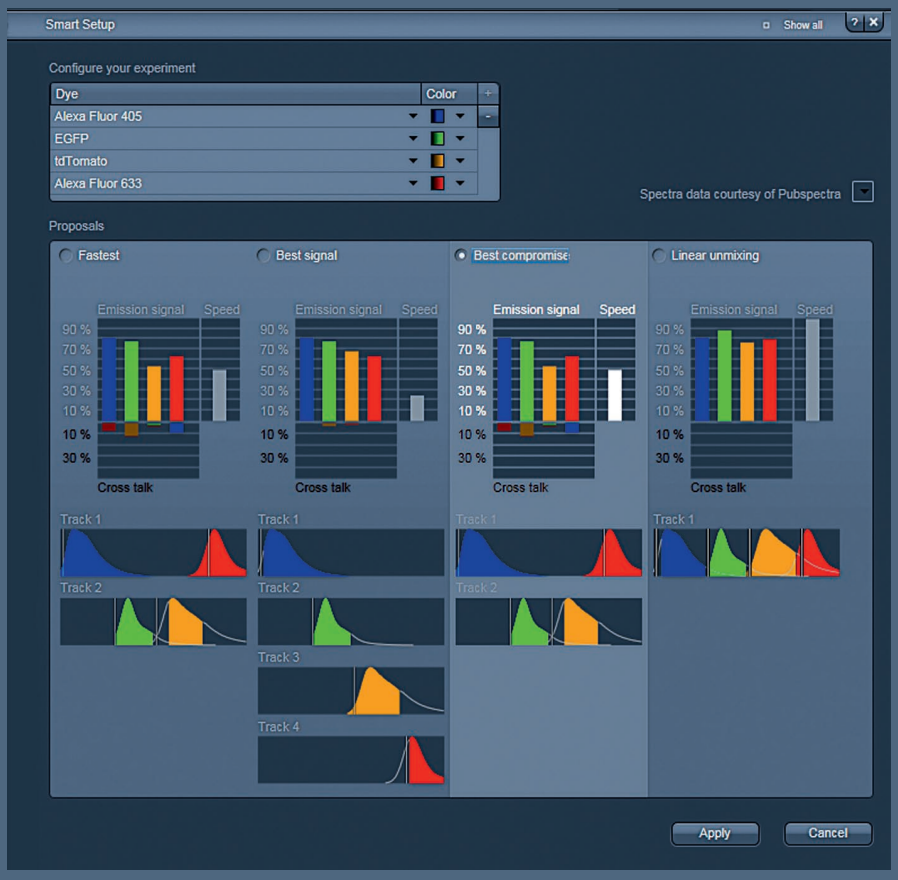
## Configure the user interface of ZEN to suit your personal preferences or a particular experiment.

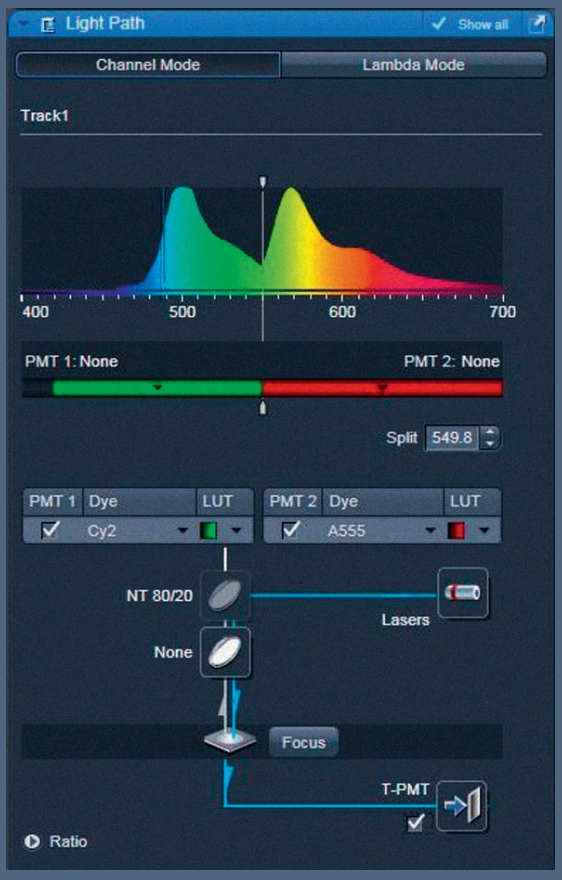
In the Central Screen Area of the ZEN user interface up to three image containers can be opened at any time to compare images side by side. In each container you can separately select between modes of presentation of the acquired data. The tools to do this with are View Control Panels with functions such as 3D, colocalization, 3D section *(Cut View)* or orthogonal section *(Ortho View)*.

In the Exposé Mode all images opened in the image containers are shown side by side like slides. This gives you a clear overview and facilitates navigation among the images opened. The Right Tool Area shows all images opened, together with concise information on size, image type, etc., providing a quick overview of the images acquired; this overview can be switched on or off.

**Flexible tool windows for personalized work**

ZEN has been conceived to allow you to compile your individual set of functions. Thanks to rarely used features being hidden unless you decide to “show all”, your tool windows are never more complex than necessary. You only see the functions you need. Moreover, you can place the tool windows in any position on the monitor screen, and save the software layout required for each individual work procedure. Thus you can start your next session with the identical settings right away – an ideal feature especially if you share the LSM 700 with others.




# Special ZEN Functions for the LSM 700 that Make Your Job Easier

## ZEN makes it possible for you to focus entirely on the essential.

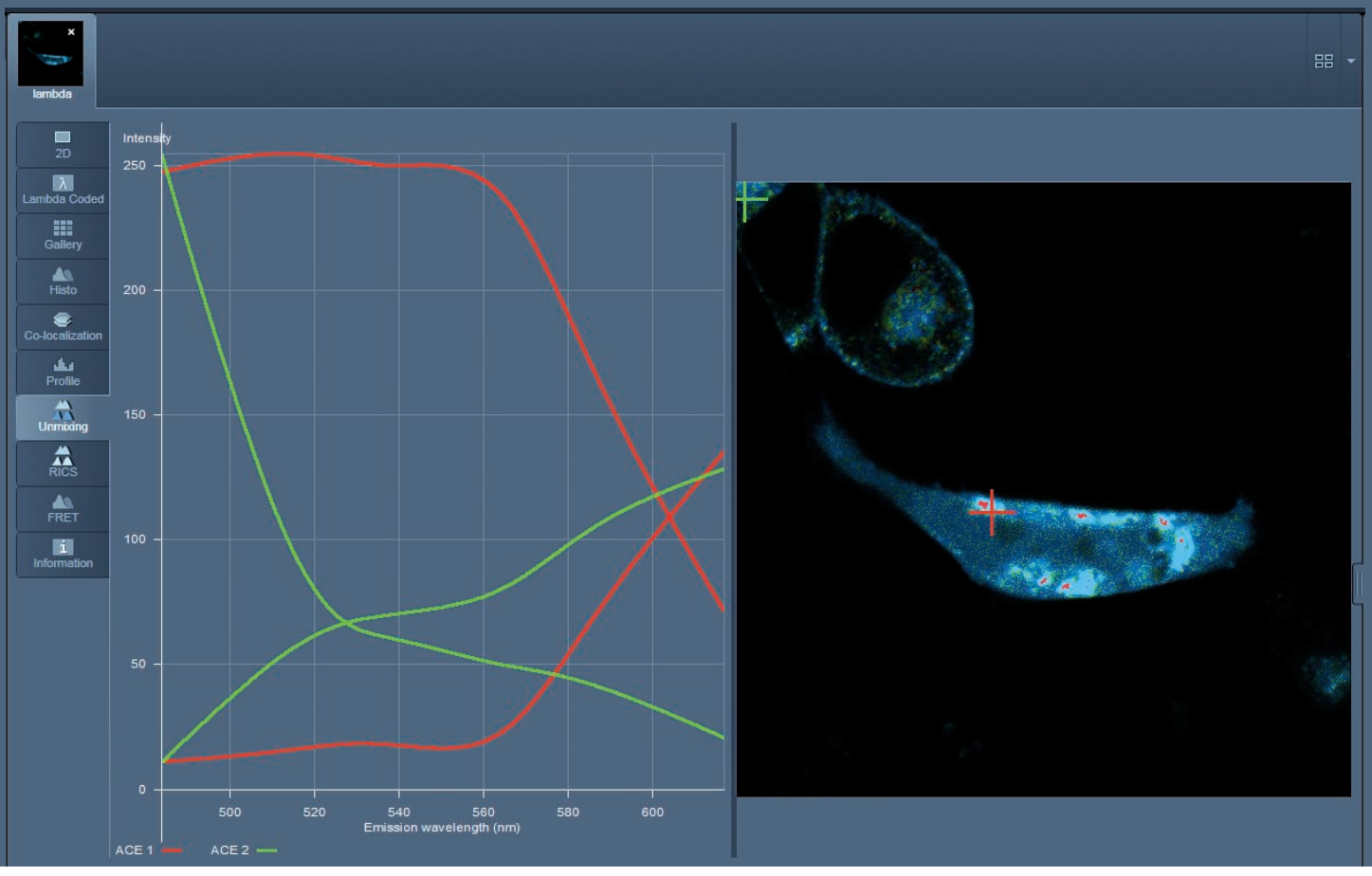
**Choice of control tools**

The software provides easy control of all the technical features of the LSM 700. Via interactive navigation you can also select applications such as colocalization, unmixing, bleaching or time series.

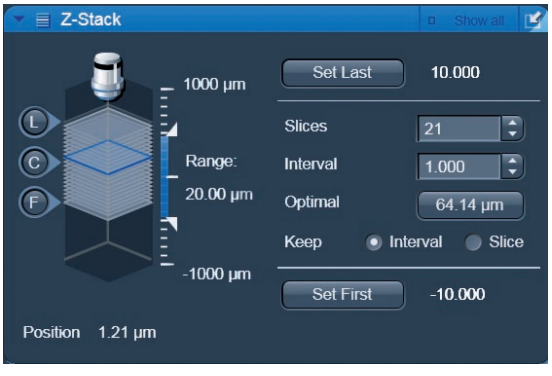
The **Smart Setup** tool is one of the functions that will make your work with the LSM 700 incredibly convenient. Even without in-depth knowledge of LSM, you can use it to set your microscope for optimum image acquisition within the shortest possible time. Simply select the fluorescent dyes in your specimen from a list and choose one of four image acquisition strategies. The system then automatically changes all the required settings of the LSM. Click on the start button, and see the first images.

**Light Path**

With this function you can select the position of the VSD beamsplitter, and thus, the desired detection range. Do this interactively, or automatically with the Smart Setup tool.








**Stage**

A software joystick supports the control of the motorized XY scanning stage.

**Z-Stack**

Use this module to configure the acquisition of image Z-stacks. The software controls the Z movement of the microscope at the correct intervals and synchronizes its movements with image acquisition. Step sizes can be computed automatically or determined interactively.

# Confocal Microscopy – 3D Imaging of Objects

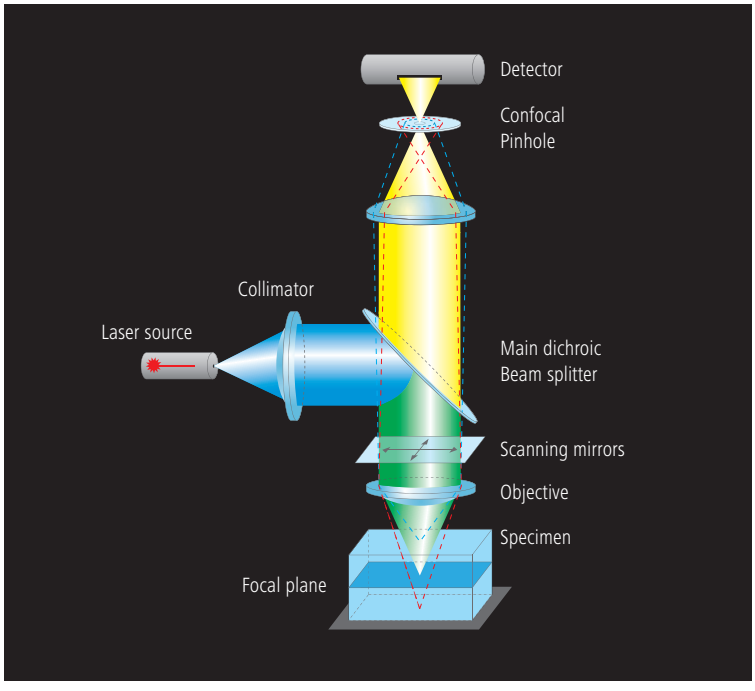
## Confocal Laser Scanning Microscopy: Sharp three-dimensional images – even of thick specimens.

**LSM:**
**Point-size illumination – point-size observation**
Unlike classical microscopes, confocal laser scanning microscopes feature a confocal **pinhole aperture** positioned in the beam path and conjugate with the illumination focus. Its diameter can be varied so as to ensure that the detector receives light exclusively from the focal plane. Light from zones above or below the focal plane is rejected, which increases the definition of the image.

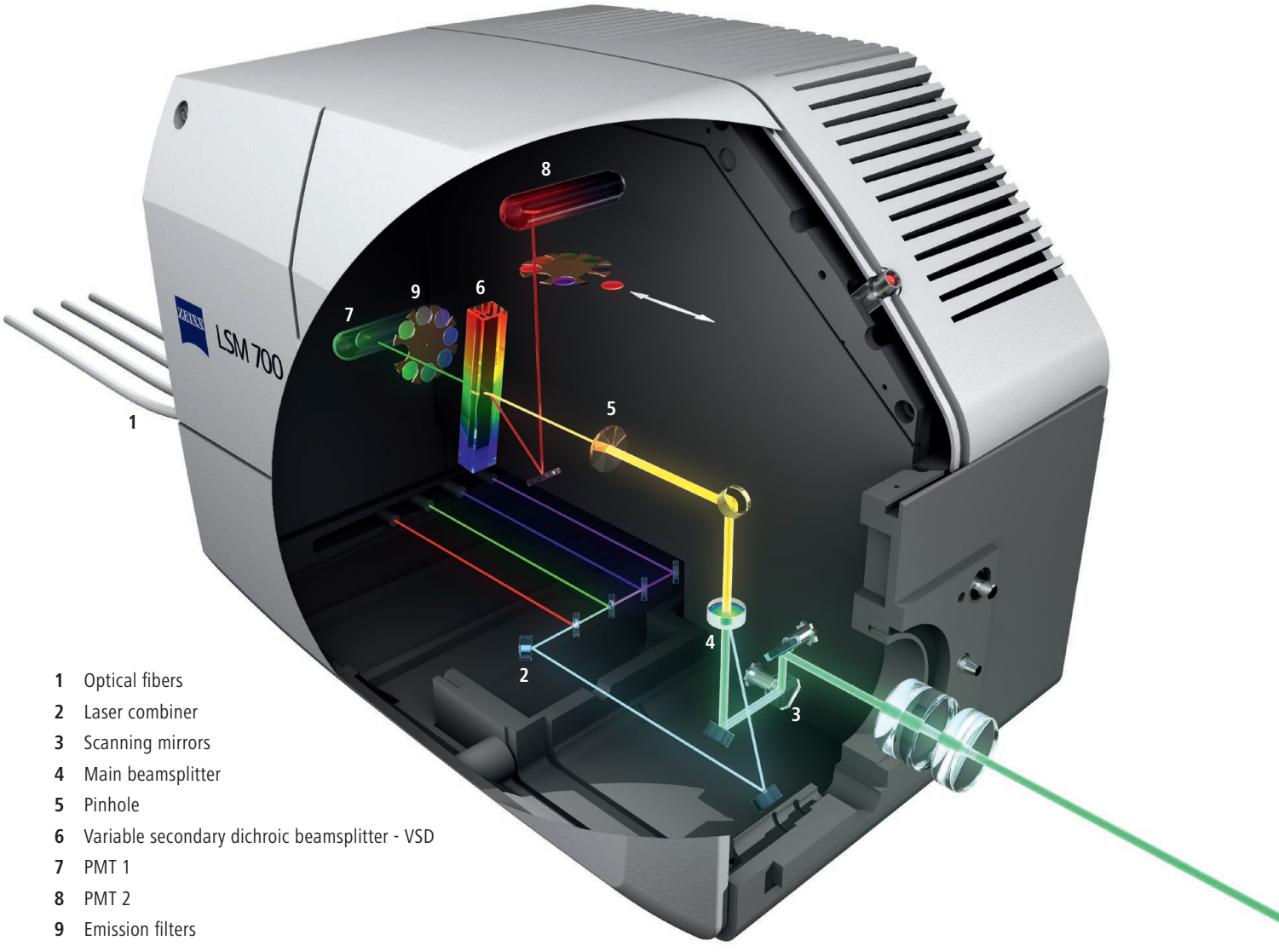
In the conventional light microscope, transformation from the object to the image takes place simultaneously (in parallel) for all object points, whereas the confocal laser scanning microscope scans the specimen in a point-by-point mode. A digital image processing system assembles the image points (voxels), thus creating a 2D image known as an optical section. Several optical sections, taken along the microscope's Z axis, form a Z-stack, which the computer then converts into a 3D image with an extended depth of focus.

**The advantages at a glance**
Confocal laser scanning microscopy
- captures images of three-dimensional objects with high spatial and temporal resolution
- permits studies of intra- and extracellular molecular movements in live cells
- permits many modern techniques such as pixel-precise photomanipulation for localized bleaching or photoactivation

*Beam path in the confocal microscope*



# Every Photon Counts – the Beam Path




**1** Optical fibers
**2** Laser combiner
**3** Scanning mirrors
**4** Main beamsplitter
**5** Pinhole
**6** Variable secondary dichroic beamsplitter - VSD
**7** PMT 1
**8** PMT 2
**9** Emission filters

High sensitivity of the LSM 700 is guaranteed by the sophisticated, innovative optical design by Carl Zeiss, which conducts the light emitted by the specimen onto the detectors with next to no photon loss.

This is the path of light rays from the source to the detectors in the LSM 700 scanning module: Excitation light from up to four lasers is coupled into the scanning module via optical fibers (1).
It falls on the beam-combining mirror cascade (2), where it is centered and aligned with the optical axis.
Two scanning galvanometer mirrors (3) direct the light onto the specimen, which is scanned by the light beam in a point-by-point mode.

The fluorescent light emitted by the specimen is contaminated by a small amount of reflected laser light; this is efficiently blocked by the FixGate main beamsplitter (4).
The remaining emission light is directed through the fully automatic, high-precision pinhole (5), which exclusively allows fluorescent light originating from the objective's focal plane to pass.
This reaches another beamsplitter (6), where it is split up and directed onto the two detectors PMT1 (7) and PMT2 (8).
From the signals they detect, the computer assembles an electronic 3D image.
Filters (9) may optionally be positioned in the beam path between the VSD beamsplitter and the detectors.

# High Flexibility, Reproducibility and Sensitivity; Excellent Optical Quality

The LSM 700 is characterized by the following technical innovations:
The VSD beamsplitter provides flexibility of detection. The motor-controlled precision pinhole ensures the best possible reproducibility.

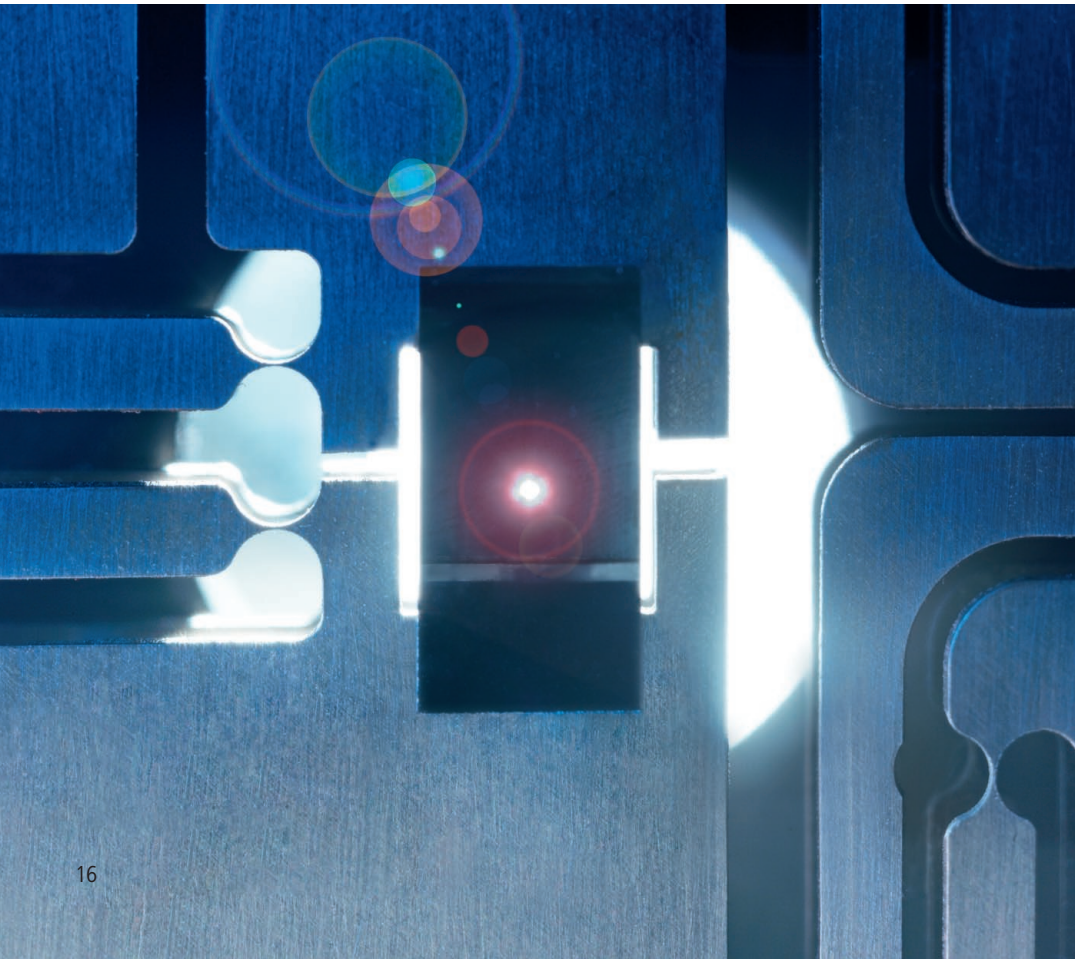
**The precision pinhole**
can continuously vary its aperture and position and automatically adjust it to any of several illumination and detection wavelengths you may work with. Thus, the optical slice thickness in multiple fluorescence experiments is optimally set for each wavelength.

**The VSD beamsplitter:**
**Full flexibility in choosing the detection range**
The VSD beamsplitter is the core of the LSM 700 – an optical element with which the emission light can be split between the system's two detectors.

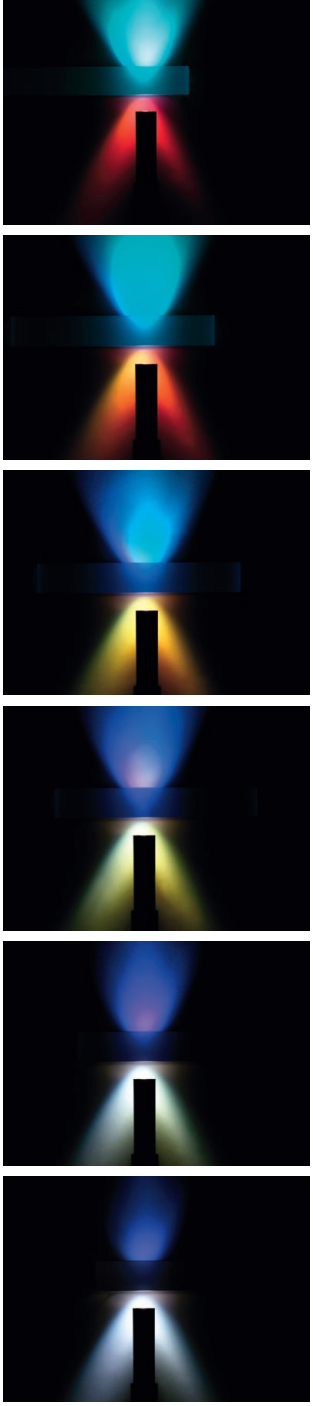
This lets you freely select the detection range. You can flexibly adapt the detection window to your fluorochromes.

The VSD beamsplitter is highly efficient with regard to photon yield. Unlike conventional systems, the VSD directs the incident photons onto one of the two detectors with no loss.

The VSD beamsplitter further permits the acquisition of spectrally resolved image series known as lambda stacks.



*Pinhole*



*The incident emission light is split into variable shares by the VSD.*

*PTC laser concept with precision connectors.*

**Main beamsplitter**

It separates the fluorescent signal from the excitation radiation with great efficiency. The resultant superb laser blocking in the LSM 700 permits imaging of even the faintest fluorescence signals in critical specimens.

**PTC lasers and mirror cascade**

The LSM 700 operates with up to four stable solid-state lasers (405/444, 488, 555 and 639 nm). The mirror cascade in the scanning module directs all excitation wavelengths onto the system's optical axis – precisely and color-corrected. These components are responsible for the excellent optical quality of the LSM 700.

**Further technical features of the LSM 700**

**Laser Life Extender**

If any of the lasers of the LSM 700 is not used for more than 15 minutes, it is switched off automatically. This considerably prolongs the service life of the laser diodes.

**Calibration objective and System Maintenance Tool**

The optional calibration objective and the System Maintenance Tool (SMT) adjust and calibrate the LSM 700 fully automatically. Restore your LSM 700 to its optimum settings within less than 30 minutes.

# LSM 700
# Technical Data

| Microscopes | |
|---|---|
| **Upright stands** | Axio Imager.Z1, Axio Imager.Z2, Axio Imager.M1, Axio Imager.M2, Axio Examiner, Axio Scope mot for LSM |
| **Inverted stands** | Axio Observer.Z1 (SP), Axiovert 200M (SP) |
| **Z drive, smallest increment** | Axio Imager.Z1, Axio Imager.M1, Axio Observer.Z1: < 25 nm; Axio Examiner: < 30 nm; Definite Focus for Axio Observer.Z1; XY stage, option: motorized XY scanning stage, with Mark & Find function (XYZ) and tile (mosaic) scan |
| **Accessories** | AxioCam digital microscope camera; integration of incubation chambers |

| Scanning module | |
|---|---|
| **Scanning module** | 1 or 2 reflection/fluorescence (R/FL) detection channels, each with highly sensitive PMT detectors, prepared for lasers of wavelengths 405, 445, 488, 555 and 639 nm; option: 1 external transmitted-light channel (DIC-capable) |
| **Scanners** | Two independent galvanometer mirrors with ultrashort line and frame flyback |
| **Scan resolution** | 4×1 up to 2048 x 2048 pixels, also for two channels, continuously variable |
| **Scan speed** | Up to 5 fps of 512 x 512 pixels (and, e.g., 27 fps at 512 x 96 pixels, or 154 fps at 512 x 16 pixels) in two channels, selection of 26 speed levels |
| **Line scan mode** | Scaleable from 4 to 2600 lines/s with 512 x 1 pixels |
| **Scan zoom** | 0.5x to 40x, digitally variable by increments of 0.1 |
| **Scan rotation** | Free 360° rotation, variable by increments of 1°, free XY offset |
| **Scan field** | 18 mm field diagonal (max.) in the intermediate image plane, with full pupil illumination |
| **Pinhole** | Motorized pinhole, continuously variable diameter |
| **Beam conduction** | Main beamsplitter, outstanding laser line suppression |
| **Spectral detection** | Simultaneously in two confocal reflection channels, with high-sensitivity, low-noise PMTs, adjustable (increment 1 nm) |
| **Data depth** | Selectable between 8, 12 and 16 bit |

| Laser modules | |
|---|---|
| **Laser modules (VIS, V)** | Pigtail-coupled solid-state lasers with polarization-preserving single-mode fibers; up to 4 V/VIS lasers directly connectable to the scanning module |
| **Laser lines** | 405 nm 5 mW or 445 nm 5 mW; 488 nm 10 mW; 555 nm 10 mW; 639 nm 5 mW (each at the fiber output end). Fast (pixel-precise), individually variable intensity setting of all laser lines (direct modulation). Automatic power-down of lasers not in use |

## Electronics module

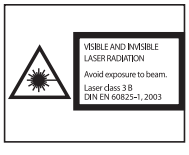
| |
|---|
| Real-time electronics integrated in PC; communication with PC via PCI Express |
| Control of microscope, lasers, scanning module and accessory components; monitoring of data acquisition and synchronization |
| Oversampling read-out logics for best sensitivity and twice the SNR; online data extraction possible already during image acquisition |
| User PC generously equipped with main memory and hard-disk capacity; ergonomic, high-resolution 16:10 TFT flat-panel display |
| Many accessories; Windows VISTA operating system, multi-user capability |
| Ethernet connection to local area network |

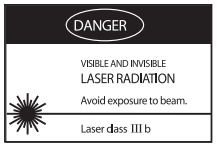
## ZEN Standard software

| |
|---|
| Configuration of all motorized functions of microscope, scanning module and lasers<br>Configurable and savable workspace (user interface)<br>Saving and restitution of application-specific configurations (ReUse) |
| System self-test: Calibrating and testing tool for automatic system checking and adjustment |
| Smart Setup; Automatic setting of the system according to a selection of dyes |
| Acquisition modes: Spot, Line/Spline, Frame, Z-stack, Lambda Stack, Time Series and all combinations (XYZ \| t) |
| Online computation and presentation of ratio images; averaging and summation (linewise, framewise, configurable), Step Scan (for higher frame rates) |
| Crop function: Convenient selection of scan areas (zoom, offset, rotation simultaneously); RealROI Scan, Spline Scan, scan of up to 99 ROIs of any shape, pixel-precise laser blanking; scan along a freely defined line |
| ROI Bleach: Localized bleaching in up to 99 bleaching-ROIs for applications such as FRAP or Uncaging; use of different speeds for bleaching and image acquisition, use of different laser lines for different ROIs. |
| Multitracking: Fast change of excitation lines when acquiring multiple fluorescences, for minimizing signal crosstalk<br>Lambda Scan: Sequential acquisition of image stacks with spectral information for every pixel<br>Linear Unmixing: Generation of crosstalk-free multifluorescence images with simultaneous excitation; online or offline unmixing, automatically or interactively; advanced unmixing logic with reliability statement |
| Presentation: XY, Orthogonal (XY, XZ, YZ), Cut (3D section), 2.5D for time series of line scans |

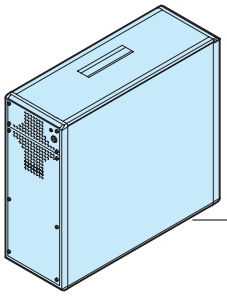
*Certifications:*



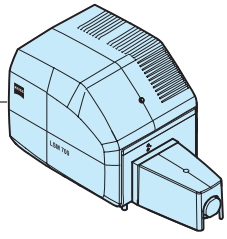



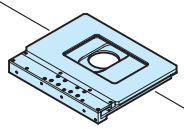
# LSM 700
# System Overview



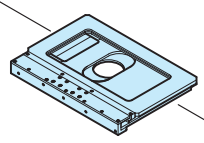
Electronics and laser module
for LSM 700
(4x pigtailed laser 405-639 nm)



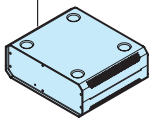
1-2-channel scanning module LSM



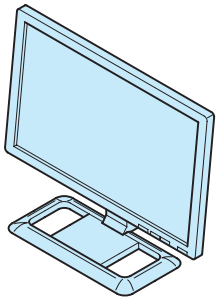
Scanning stage 130x85 PIEZO
for upright stand



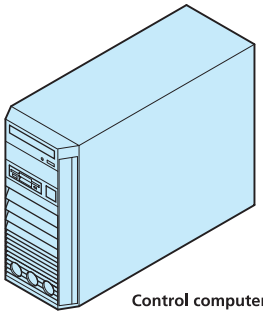
Scanning stage 225x85 PIEZO
for upright stand



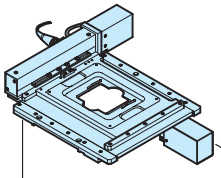
XY-stage controller PIEZO
XY-joystick
for stage controller PIEZO



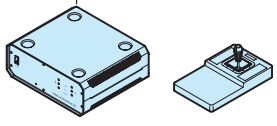
LCD TFT flat screen monitor 30"
16:10 flat screen monitor 24"



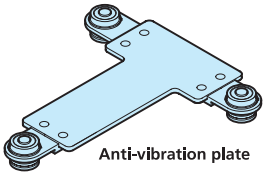
Control computer



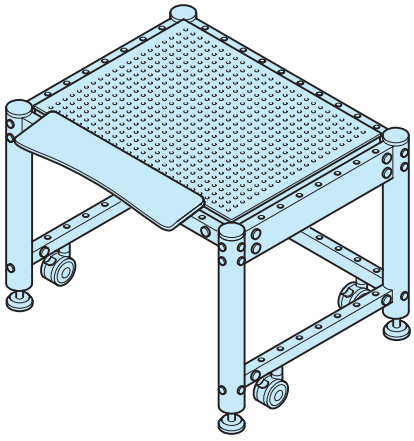
Scanning stage DC 120 x 100
for inverted stand



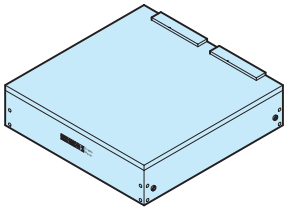
Controller incl. joystick



Anti-vibration plate



System table with breadboard
Wide: 1000x750mm (1200x950 overall)
Narrow: 750x1000mm (950x1200 overall)



MOD-1M active antivibration system
Table Surface: 40 cm x 40 cm

MOD-1L active antivibration system
Table Surface: 60 cm x 60 cm

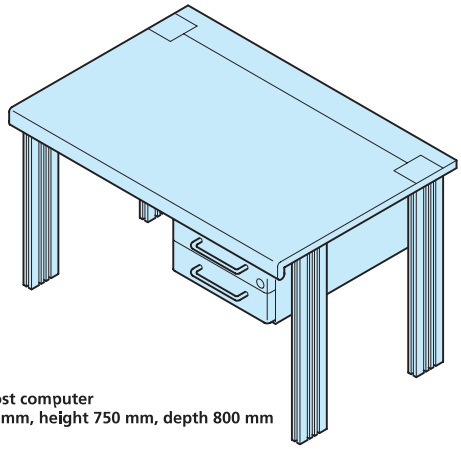
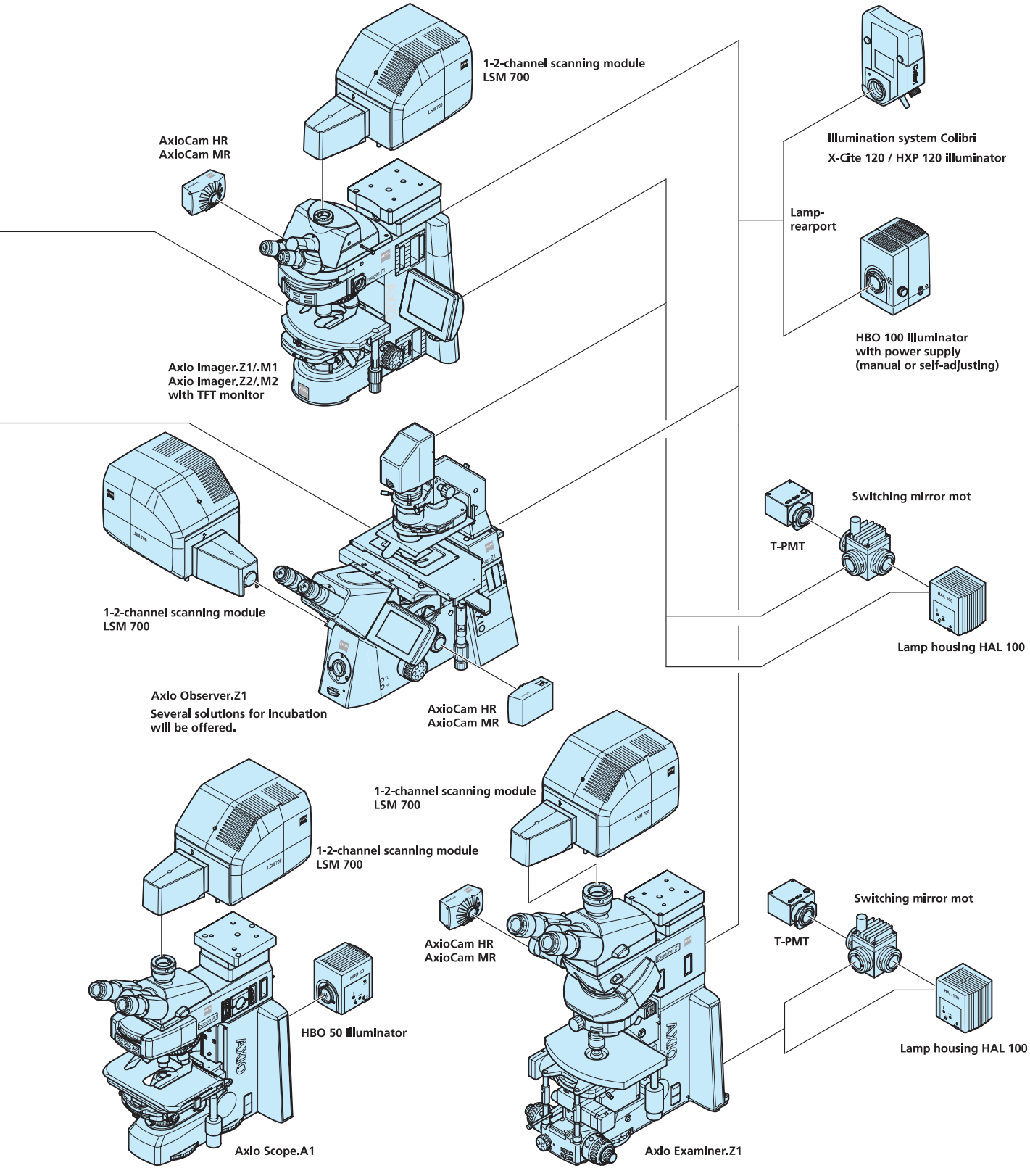


Table for host computer
Width 1200 mm, height 750 mm, depth 800 mm


1-2-channel scanning module
LSM 700
AxioCam HR
AxioCam MR
Illumination system Colibri
X-Cite 120 / HXP 120 illuminator
Lamp-
rearport
HBO 100 Illuminator
with power supply
(manual or self-adjusting)
Axio Imager.Z1/.M1
Axio Imager.Z2/.M2
with TFT monitor
Switching mirror mot
T-PMT
1-2-channel scanning module
LSM 700
Lamp housing HAL 100
Axio Observer.Z1
Several solutions for incubation
will be offered.
AxioCam HR
AxioCam MR
1-2-channel scanning module
LSM 700
1-2-channel scanning module
LSM 700
Switching mirror mot
T-PMT
AxioCam HR
AxioCam MR
HBO 50 Illuminator
Lamp housing HAL 100
Axio Scope.A1
Axio Examiner.Z1

# Wide Variety of LSM 700 Configurations

Combined with tried-and-approved microscope stands from Carl Zeiss, the LSM 700 is ready for a broad spectrum of applications.

Start small, end up great: Upgrade your ZEISS System to suit increasingly demanding requirements.

**The LSM 700 on the upright Axio Imager**
is excellently suited for the examination of tissues.

**The LSM 700 on the inverted Axio Observer**
is the ideal combination for live cell observation and quantitative imaging.

**The LSM 700 on the Axio Scope**
is just perfect for routine applications.

**The LSM 700 on the Axio Examiner**
is the best solution for cell manipulation and physiology.

**The LSM 700 retrofits to the inverted Axiovert 200M.**


**The LSM 700 is ...**

**confocal**
The 1- or 2-channel confocal system is fit for many applications (3D, multiple fluorescence, live cell imaging and many more).

**sensitive**
A new, intelligently constructed beam path ensures maximum sensitivity.

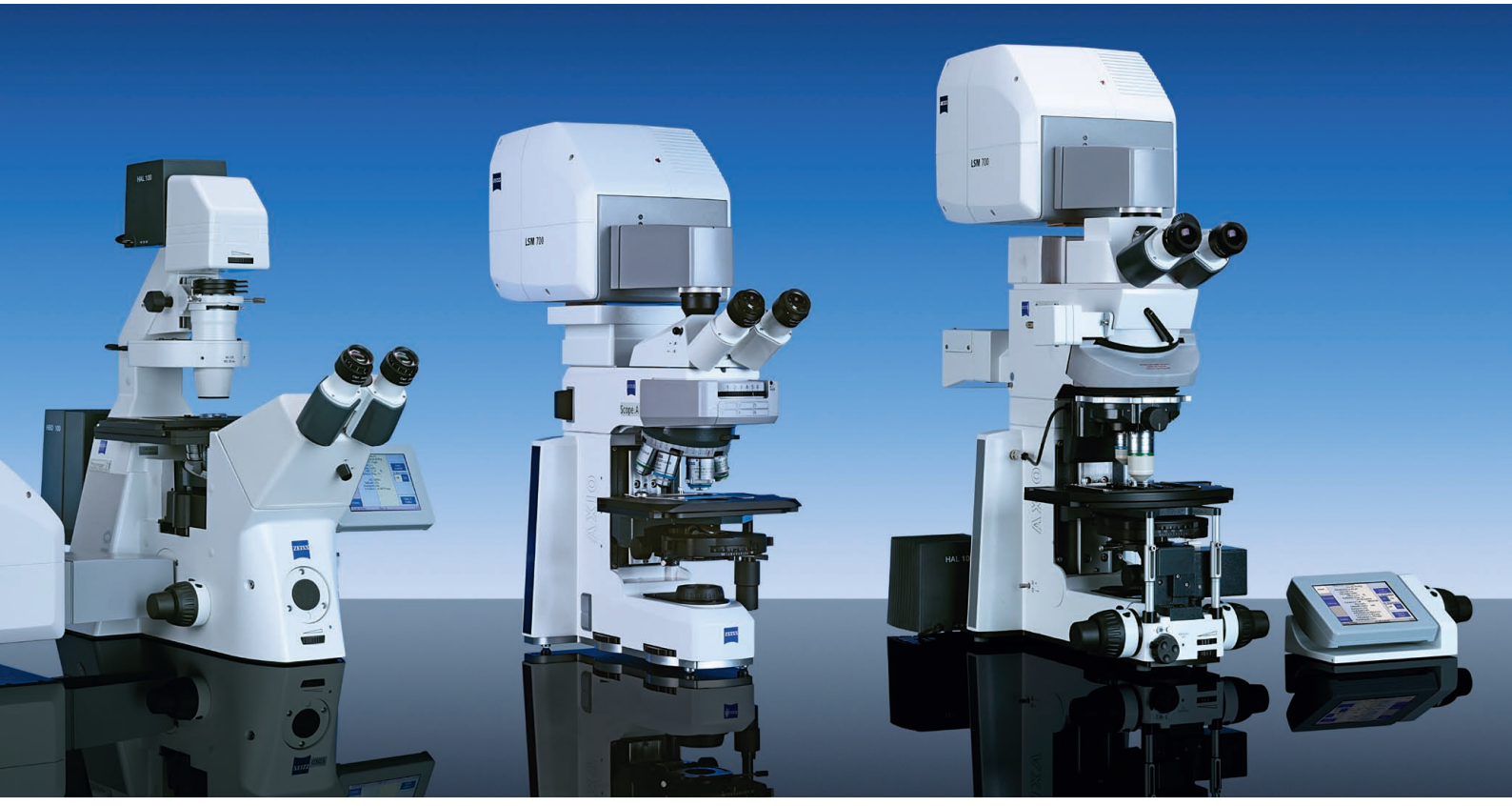
**spectral**
The VSD beamsplitter implements an innovative spectral detection principle.

**flexible**
The VSD beamsplitter is continuously variable, providing flexible selection of detection bands.

**future-oriented**
Integration of up to four solid-state lasers and the Laser Life Extender technology make the LSM 700 a future-oriented investment.

**expandable**
Lasers or a second detection channel can be readily retrofitted, and the LSM 700 fits a variety of microscope stands from Carl Zeiss.

**space-saving**
The compact setup fits onto many standard worktables.



**intuitive**
Easy operation via the ZEN software and the Smart Setup function allow the LSM 700 to be used intuitively after significantly shorter training times.

**modern**
Modern technology features permit the application of new imaging techniques.

**fast**
Thanks to new real-time control, the LSM 700 is a fast system which can be used with flexible scanning strategies.

**Quality**
from Carl Zeiss – at an attractive price/performance ratio.

For patents, see
**www.zeiss.de/micro-patents**


The LSM 700 Laser Scanning Microscope from Carl Zeiss sets a new standard in confocal microscopy.

Based on tried-and-tested technology concepts, it offers innovative solutions for image analyses of extraordinary sensitivity and quality at a very attractive price/performance ratio.

The LSM 700 is distinguished by high flexibility with regard to applications and system configuration. Applications range from simple routine examinations to multidimensional image acquisition in biomedical research.

The system can be combined with many microscope stands and tailored to specific user requirements. This also makes it ideal for users entering confocal microscopy.

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Subject to change. Printed on environmentally friendly paper, bleached without the use of chlorine.
60-1-0022/e – printed 09.09