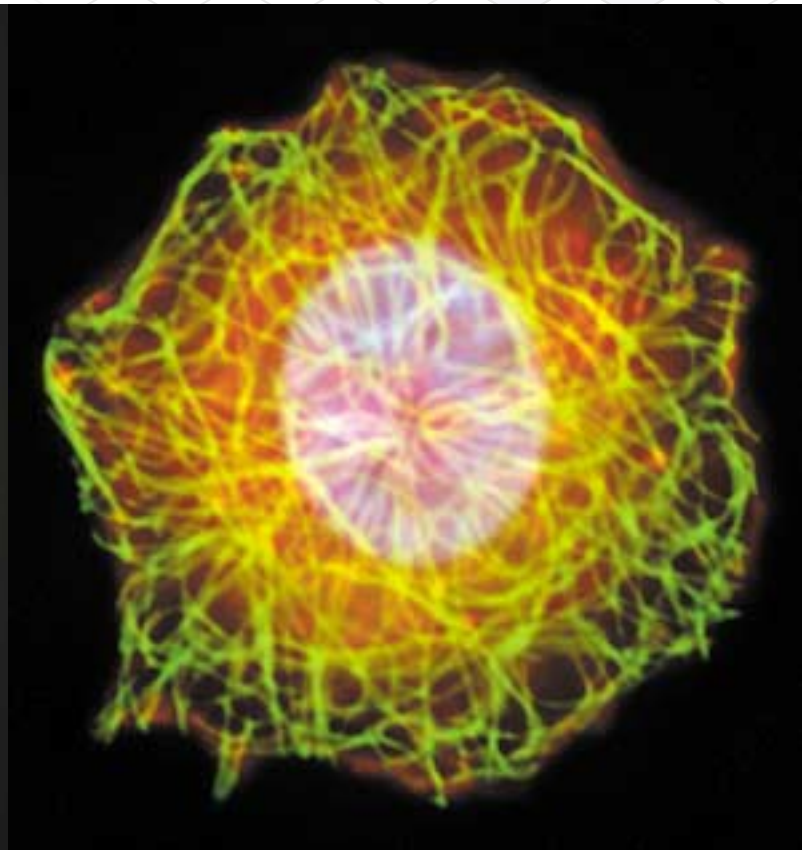
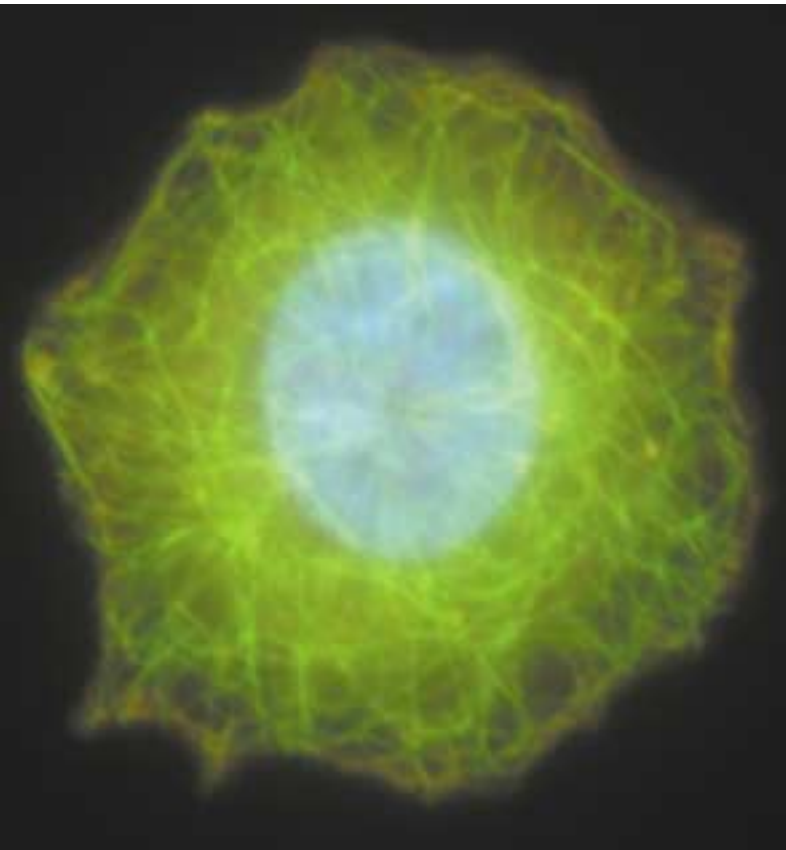




3D Deconvolution

Look Ahead to Get Ahead



Greater brilliance and resolution - More convenient and precise than ever before



Smart and Convenient

Carl Zeiss Deconvolution

The challenge

You're well familiar with the common problem in fluorescence microscopy: Light scattered from the areas above and below the focal plane diffuses and distorts the image. In extreme cases, you can't recognize any structures at all. And you certainly can't afford to run this risk in modern research, where precision, reliability and speed are of the essence.

The solution

The 3D Deconvolution module from Carl Zeiss! This innovative solution mathematically deconvolves the distorted structure by calculating the stray light back to the focal plane and assigning it to its planes of origin. The result is a top-quality image – with substantially less noise, better definition and higher resolution. And the 3D Deconvolution from Carl Zeiss offers you even more – a wide range of features that are advantageous to your everyday work.

The advantages

To put it in a nutshell: Never before has deconvolution been as easy, convenient and reliable as it is with the new software from Carl Zeiss.

- **Easy and highly precise** – Image acquisition in 6 dimensions
- **Retrievable any time** – Automatically saved imaging parameters – from geometric scaling to the fluorescence wavelengths
- **Powerful and efficient** – Advanced algorithms for higher resolution and enhanced images
- **Focused on the essentials** – Define frames and calculate their deconvolution with the Region-of-Interest function
- **Time-saving and practical** – Sequential calculation of all channels and points of time – all at once or individually
- **Perfect for comparison** – Convenient switching between the original and the deconvolved image
- **Accurate from edge to edge** – Integrated method for artifact-free borders
- **Integrated throughout** – The 3D Deconvolution module fits all Carl Zeiss software products – AxioVision Digital Imaging as well as Confocal Microscopy



The Do-All Concept

Image Acquisition



All parameters needed for deconvolution are automatically read from an AxioVision Z-stack.



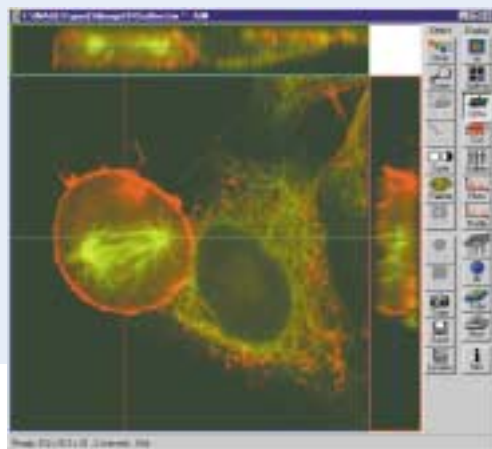
Documentation in new dimensions

The 3D Deconvolution from Carl Zeiss contains everything you can expect from advanced digital imaging today.

- **Z-stack** – Reproducibly controlled with nanometer precision
- **Multichannel** – Stored in up to eight independent channels
- **Time-series** – Dynamic processes of live specimens recorded in "movie" fashion
- **Mark&Find** – Retrieve the correct position - quickly and precisely

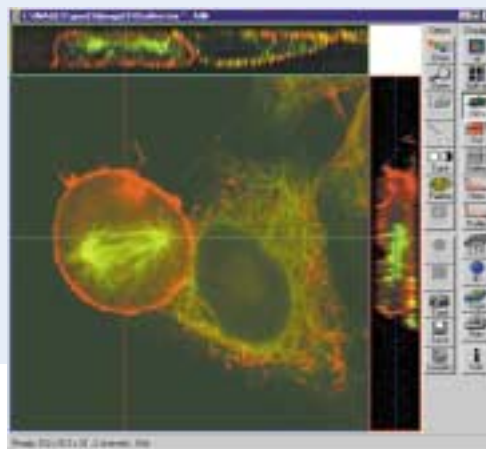
And here's another essential consideration in your daily research work: All functions can be learned and mastered in a very short time.

BEFORE



LSM Software: Orthogonal cut visualization of an image stack before deconvolution.

AFTER



Improvements, especially in the orthogonal cuts after deconvolution applying the iterative Maximum Likelihood algorithm.

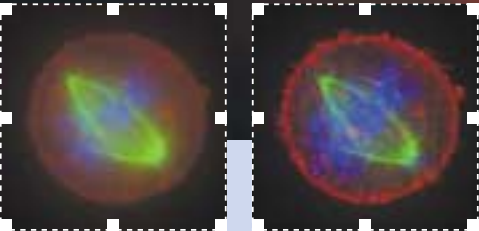
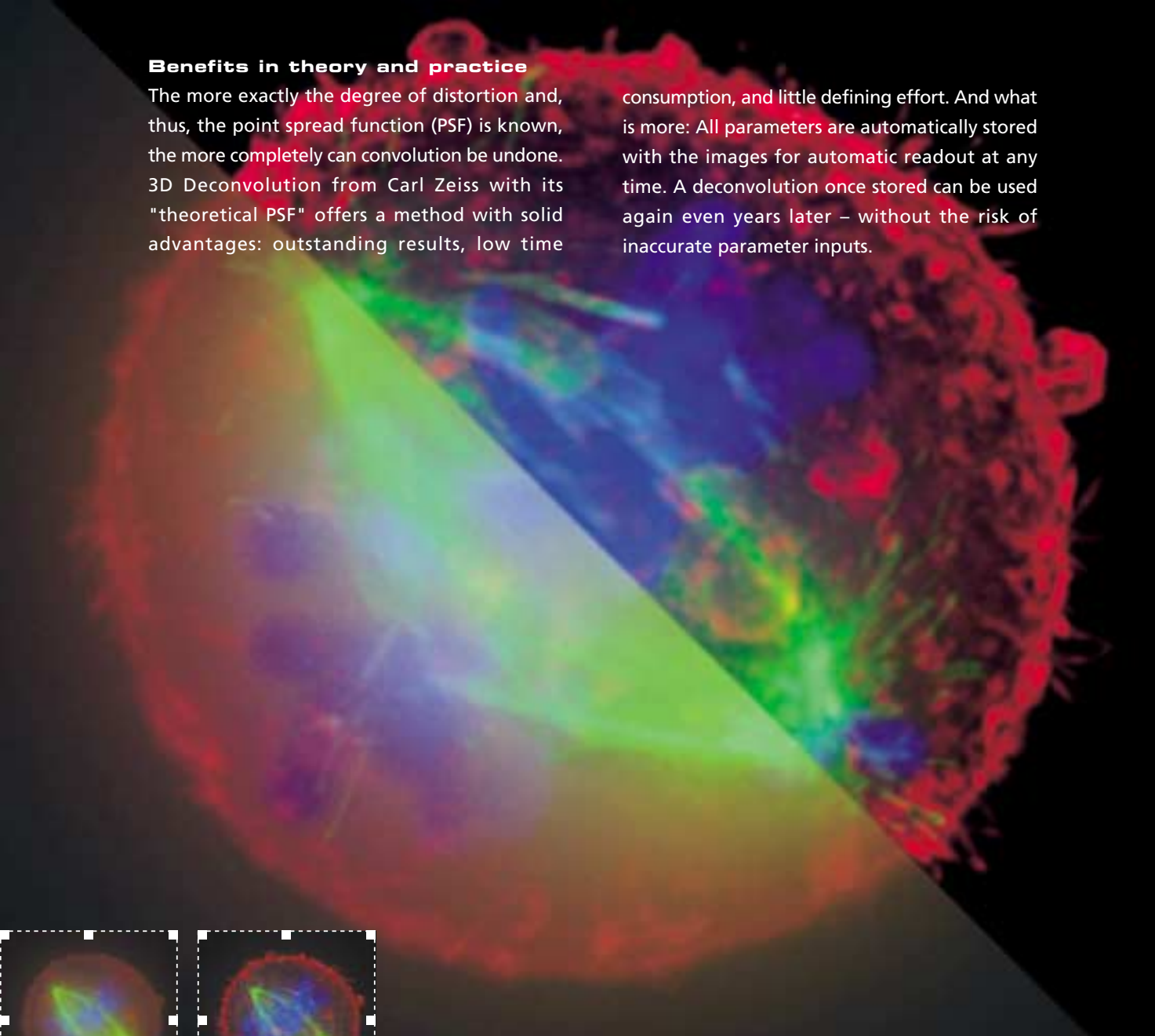
PSF Calculation



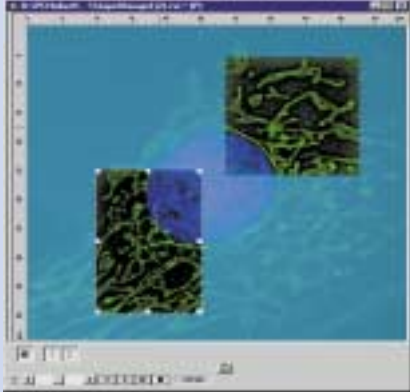
Benefits in theory and practice

The more exactly the degree of distortion and, thus, the point spread function (PSF) is known, the more completely can convolution be undone. 3D Deconvolution from Carl Zeiss with its "theoretical PSF" offers a method with solid advantages: outstanding results, low time

consumption, and little defining effort. And what is more: All parameters are automatically stored with the images for automatic readout at any time. A deconvolution once stored can be used again even years later – without the risk of inaccurate parameter inputs.



With the Region-of-Interest function, one or several frames are deconvolved in next to no time.



Deconvolution

Leading-edge technologies

Optimized for supreme image quality and performance, the algorithms of the 3D Deconvolution software are the latest results of intensive research and engineering. Carl Zeiss 3D Deconvolution offers you three methods perfectly tailored to your requirements.

1. Nearest Neighbor

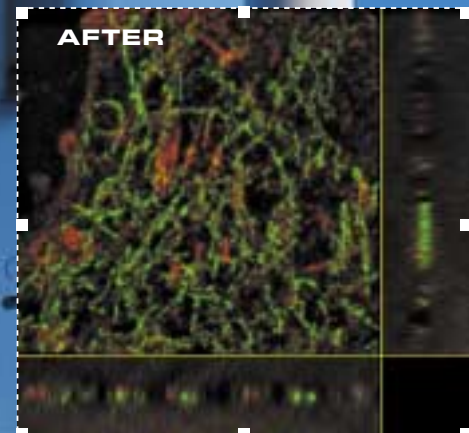
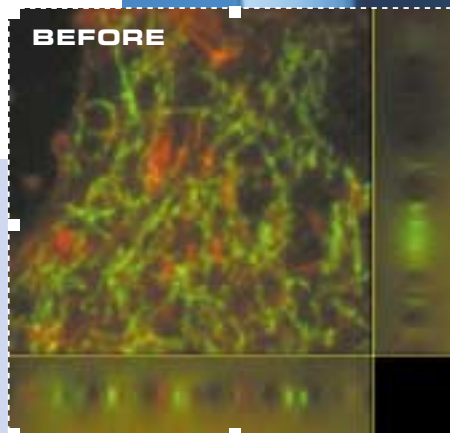
A 2D method applied to the entire 3D stack – the method of choice where results are needed within seconds.

2. Inverse Filter - regularized

A genuine 3D calculation method, ideal for calculating several image stacks and for preselecting images. This method determines the calculation parameters automatically and delivers good results within a short time.

3. Iterative Maximum Likelihood algorithm

The sophisticated method for the ultimate in imaging quality. The only method permitting the calculated image stack to be sliced in any plane and visualized in 3D with mathematical precision.

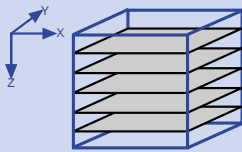


Immuno double labeling of an inhibitory G-protein (green) and Beta1 Integrin (red) in embryonal stem cells before and after deconvolution. Priv.-Doz. Dr. W. Bloch, Dr. Ji Han, Dr. Walther, Prof. Dr. K. Addicks – Institute for Anatomy, University of Cologne, Germany.

Get a Clear Picture Now: The Physics Behind Deconvolution

The elimination of stray light in fluorescence microscopy is an essential condition for three-dimensional processing steps such as 3D restoration or volume calculation.

All these processes are based on a set of digitally recorded three-dimensional data. To obtain it, a number of two-dimensional images are recorded in different focal planes of the specimen. The resulting stack of 2D images contains the entire 3D information about the specimen.



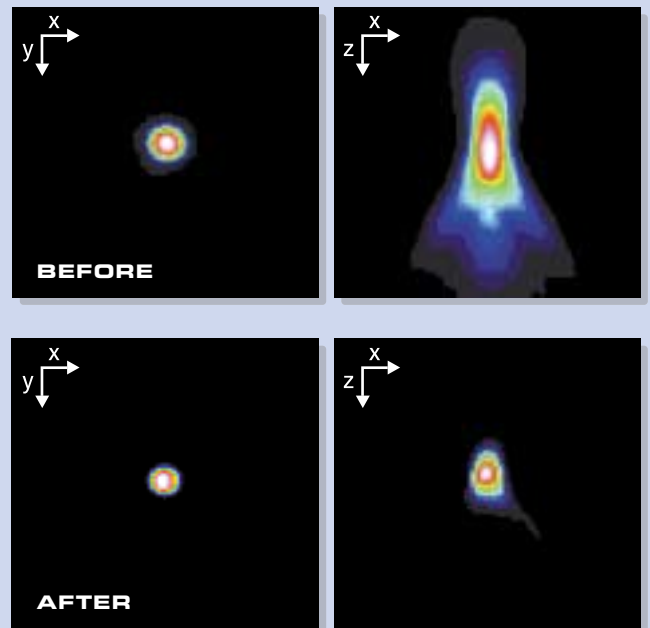
The problem is that the result of depicting a 3D object by slices in various planes does not represent the true shape of the object. While passing through the optical system, the image gets distorted. In terms of physics, this is to say that the object is convolved by what is known as the optical system's point spread function (PSF). This function describes the manner in which the light of a point source is rendered by the optical system.



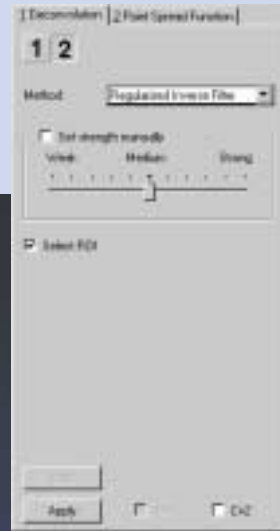
That convolution can be almost completely undone mathematically if the PSF and, therefore, the degree of distortion is known. The image can thus be deconvolved and the original shape of the object restored.



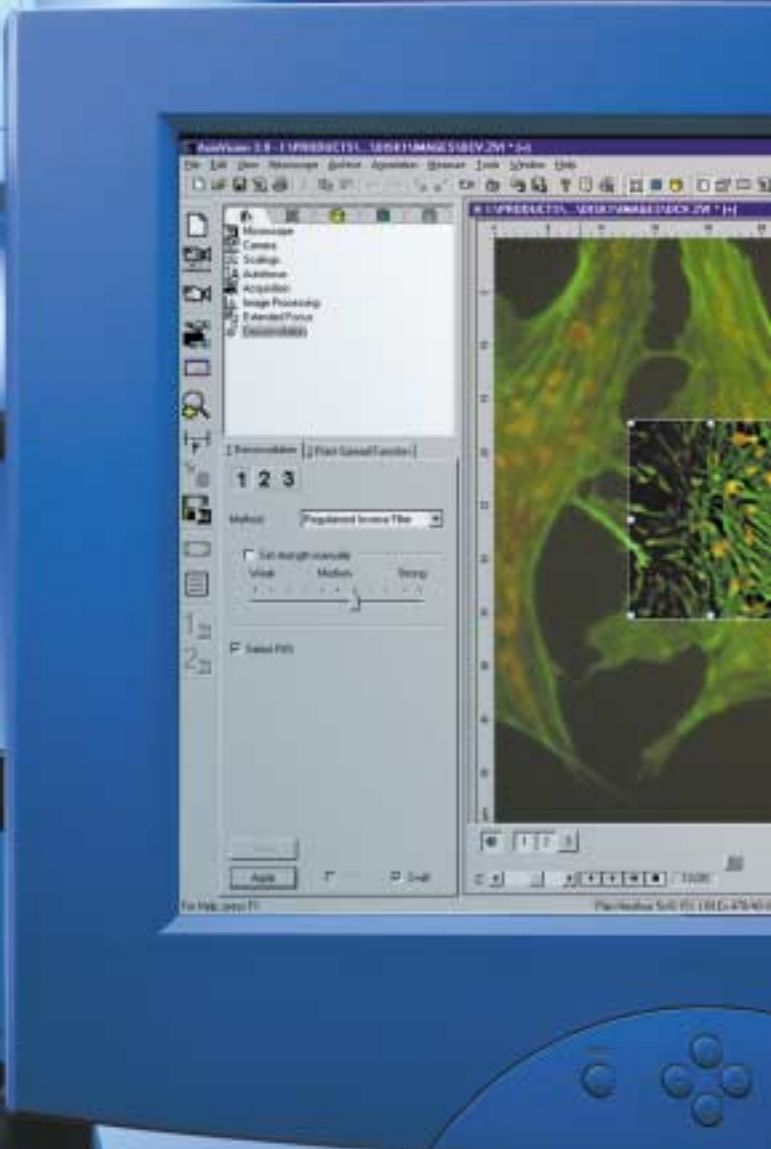
The effect of 3D deconvolution is most impressive with objects of familiar shape, such as fluorescent spheres (beads). The illustration below shows the stack of images of a fluorescent bead in various views prior to and after 3D deconvolution.



The resolving power of an optical system is much lower in Z direction (i.e. along its optical axis) than in the lateral (X,Y) direction. Accordingly, the resolution improvement by deconvolution is greatest in the Z direction.



Property tabs for defining the point spread function and handling the deconvolution process.



Smart Combinations



Carl Zeiss provides you with a comprehensive, perfectly tailored solution to your specific tasks in fluorescence microscopy: microscope, camera and software from a single source. Expert advice and first-rate service are included.



Software

The names of AxioVision and LSM Software stand for sophisticated microscope control, image acquisition, image processing and archiving. Moreover, they represent open, dynamic systems, which are continuously upgraded to meet the increasing requirements of research and routine work. A superb example is the modular concept of AxioVision, which allows individual configurations and subsequent extensions by modules such as *Multichannel*, *Time-lapse*, *Interactive Measurement*, and many more.

Microscopes

Axiovert 200 M, Axioplan 2 imaging MOT, Axioskop 2 MOT, or the laser scanning systems LSM 510 and LSM 5 PASCAL. The motorized high-end microscopes from Carl Zeiss excel on all counts: superior optics, optimized fluorescence, perfect ergonomic design, unsurpassed flexibility, and intelligent details such as the patented Light Trap.

Camera

Optimum integration with the microscope's and user software, finest resolution and highest sensitivity: the Carl Zeiss AxioCam family, monochrome version.

System Requirements

Conventional fluorescence microscopy

- Microscope:** Axioplan 2 imaging MOT, Axiovert 200 M, Axioskop 2 MOT
- Digital Camera:** AxioCam (monochrome)
- Computer:** Min. Pentium III, 900 MHz, 512 MB RAM
- Software:** AxioVision Release 3.x with Z-stack module. Optional modules: *Multichannel*, *Time-lapse*, *Mark&Find*

Confocal microscopy

- System:** LSM 510 or LSM 5 PASCAL, software version 2.8 or later

Carl Zeiss Light Microscopy

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