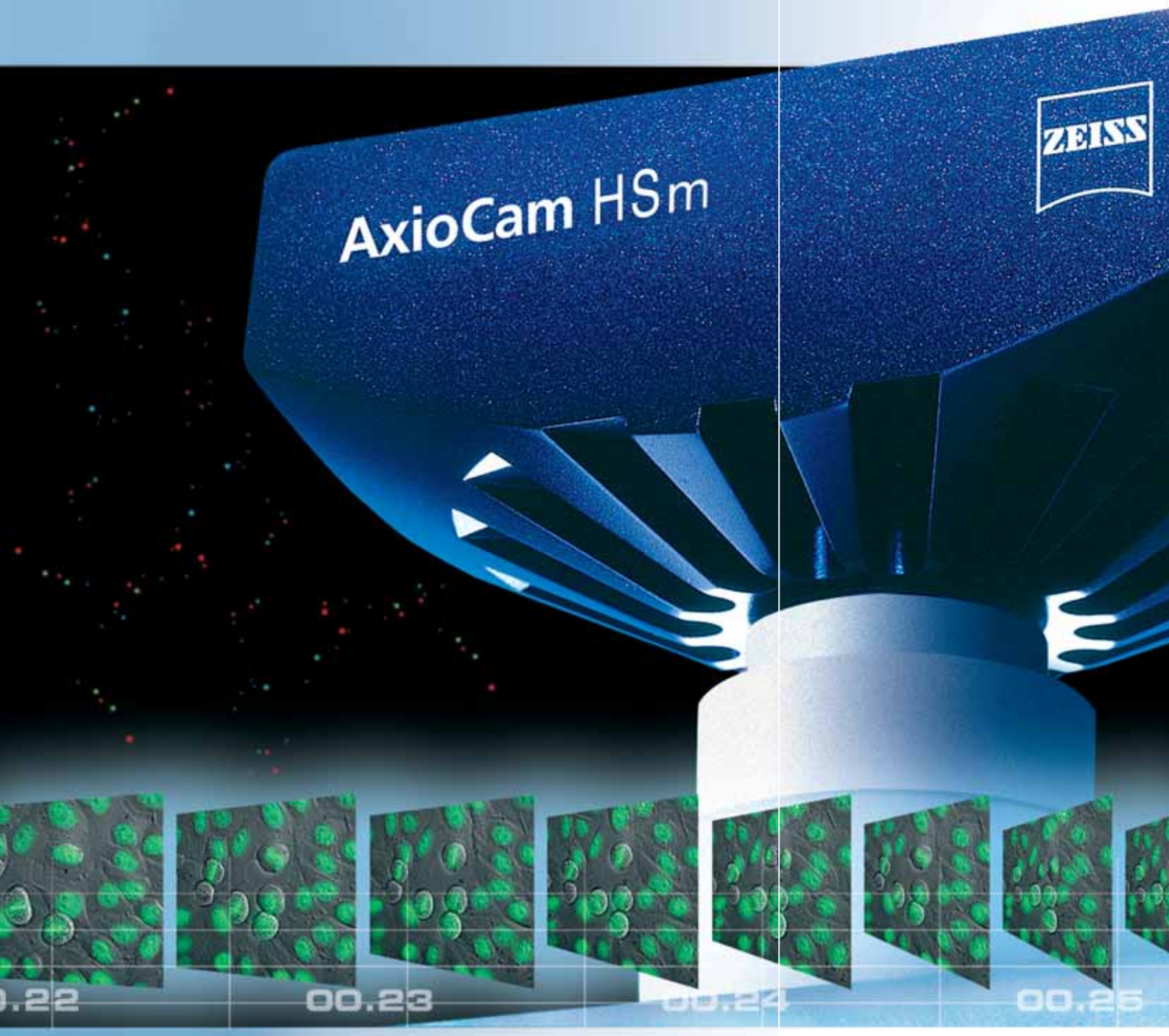
AxioCam HS

Fast. Precise. Live.



The high-speed camera for digital documentation of dynamic processes

ZEISS

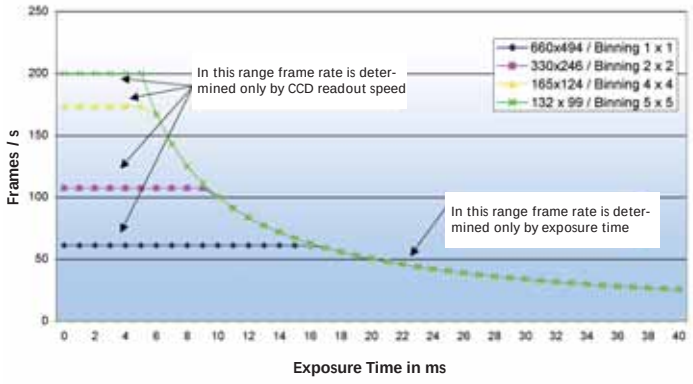
We make it visible.

Fast processes need a fast camera

Demands in the field of Live Cell Imaging call for imaging and microscope systems that stretch technology to its limits. This requires camera technology that can be used to acquire rapidly changing processes in living objects precisely and with high temporal resolution. With the AxioCam HS, Carl Zeiss is launching a high-performance camera that transfers moving images to the hard drive in real time. With up to 200 images per second*.

- **Precise imaging with extremely high temporal resolution**
- **Flexible to use and easy to operate**
- **Monochrome and color models suite many applications**

Image rates according to readout and exposure time**



The observation of dynamic processes at molecular level is now immediately available to a greater spectrum of users.

The AxioCam HS from Carl Zeiss: making advanced technology a standard in research and analysis. And at an excellent price/performance ratio.

A leap forward in performance: moving images in Live Cell Imaging

Speed is crucial in Live Cell Imaging: scientists working in the fields of neurobiology, cell biology and developmental biology, as well as virology and zoology, have to capture movements and changes of 0.1 µm/s to > 1 µm/s. The AxioCam HS is the fastest "Zeiss Blue" and, depending on the resolution setting, achieves a maximum image rate of between 60 and 200 images per second – with superb image quality. Mostly the frame rates are determined by the used exposure time. As the high sensor sensitivity supports short exposure times, high frame rates can be achieved. The FireWire connection transfers the live image to your computer in real time. This represents enormous step forward for biological research: rapidly changing processes at molecular level can be documented and analyzed digitally as moving image sequences.

**5 x 5 binning, full camera field of view*

***Continuous Mode readout*

Ciliate, Interference Contrast, 63x/1.4 Oil.

Rapid time lapses: high-speed imaging stretches feasibility to its limits

Here the AxioCam HS offers a wide range of functions.

- With binning, light sensitivity can be increased by up to 25x and exposure time reduced significantly (monochrome version). As a result, the AxioCam HS achieves image rates of up to 200 images/s even with very weak fluorescence signals.
- Additional adjustment of the frame (ROI) enables the acquisition speed to be increased even more (see table).
- The overlapping of readout and exposure in Continuous Mode enables reliable, precise imaging of very rapid time lapses, e.g., when observing interactions in the living cells of microorganisms.

Superb image quality even with weak signals

Very high acquisition speeds and short exposure times do not have to mean putting up with poor image quality. With 660 x 494 pixels, the AxioCam HS offers adequate resolution for applications in Live Cell Imaging with higher magnification objectives.

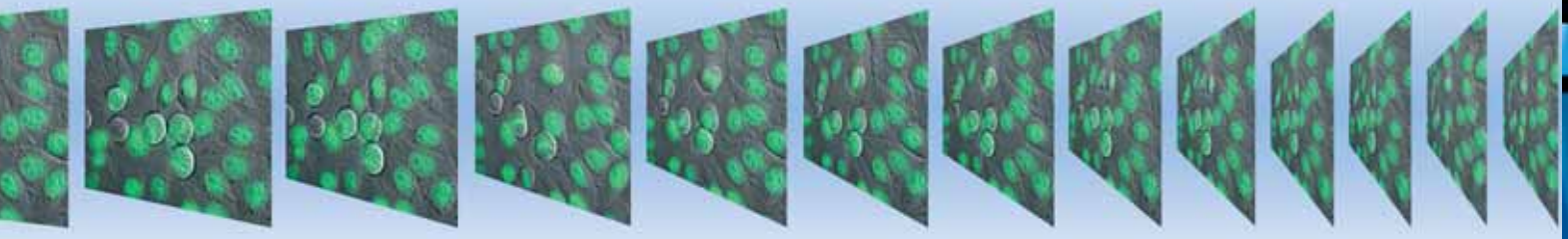
- 9.9 µm x 9.9 µm pixels enable the acquisition even of weak signals, which can be digitized by a 12-bit AD converter with high dynamic range. The high signal quality with a dynamic range of 1:1800 makes it possible to subsequently intensify weak signals and bring out the differences in contrast.
- The additional Peltier cooling minimizes dark current and background noise and also enables long exposure times.
- The AxioCam HS has no cooling fans, and therefore works vibration free.

Image rates with combination of binning and sensor subareas:

	Sensor subarea (ROI)				
Binning	660 x 494	420 x 420	256 x 256	128 x 128	64 x 64
1x1	60	71	110	197	323
2x2	108	120	184	307	459
3x3	143	158	241	392	548
4x4	174	185	276	472	581
5x5	198	211	320	477	-

Constraints:

AxioCam HSm, 1 ms exposure time, without image display, ROI in middle of sensor, direct storage of raw data on hard drive, optimum PC configuration.




AxioCam HS
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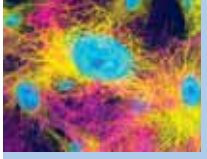
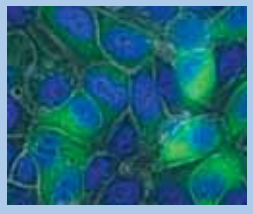


Carl Zeiss: FluoresScience

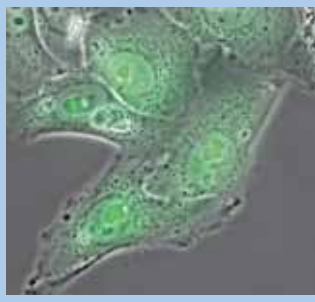
Fluorescence is the basis of a number of modern methods in the field of Life Sciences. Today, new and differentiated fluorescence applications are constantly being developed to enable us to monitor the molecular relationships inside cells. The demands on the corresponding microscope systems are increasing.

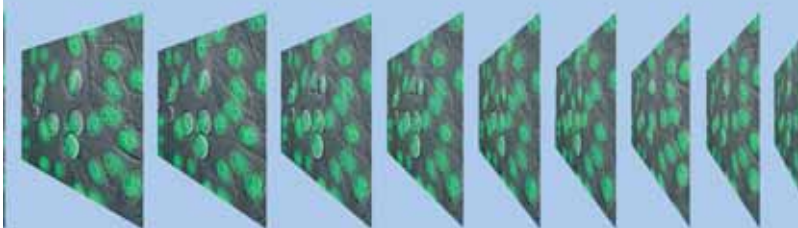
Their development is a science in itself. And a task to which we at Carl Zeiss are devoting all of our commitment and know-how. After all, when you are working at the limits of visibility, only the very best tools count: those that offer optimum efficiency and the most innovative technologies, the most powerful imaging systems, and ultra-quick cameras for Live Cell Imaging that set the standard with regard to technical feasibility. Our focus on the key method used for research into life has been given a name – Carl Zeiss: FluoresScience.

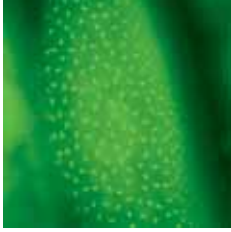


Human Hela cervical carcinoma cell line. Kamyar Hadian and Dr. Ruth Brack, GSF Institute of Molecular Virology, Munich.

Human astrocytoma cell line (phase contrast and GFP fluorescence). Dr. Horst Wolff, GSF Institute of Molecular Virology, Munich.







Cell divisions in Drosophila embryo.
GFP fluorescence.
Objective: EC Plan-Neofluar 20x/0.5.

High-end research demands flexibility

The AxioCam HS has been designed specifically for the demands of Live Cell Imaging. It is flexible and easy to use in many applications. From a single image to complex and rapid time lapses, this camera offers a wide range of possible imaging techniques. A high degree of automation and precise synchronization with other components provide the highest performance. Flexibility and precision in conjunction with optimized acquisition speed guarantee reliable, reproducible results every time.

Monochrome and color

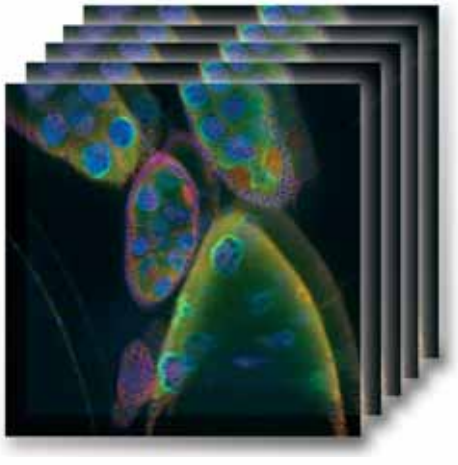
The AxioCam HSm monochrome, with separate acquisition of the fluorescence channels, low level of noise, optimum resolution and high sensitivity with weak fluorescence signals is perfect for fluorescence imaging. For users mainly studying living microorganisms without the use of fluorochromes, the AxioCam HSc for color images is the camera of choice.

From a single image to rapid multidimensional time lapses

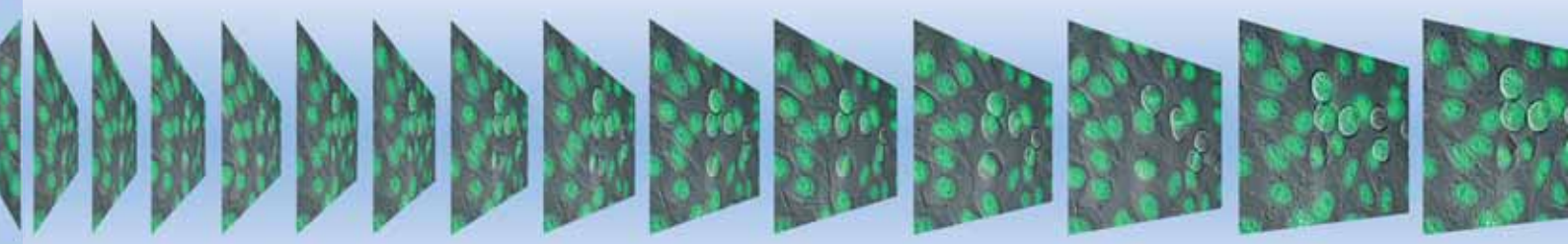
The AxioCam HS covers a wide range of applications. For the acquisition of weakly fluorescing fixed specimens, the exposure time can be adjusted to several seconds. Digitization is performed in 12 bit. For complex imaging, such as rapid multidimensional multichannel time lapses, e.g., growth processes over time, wavelength and location are documented with very short exposure times. In changing acquisition conditions, the AxioCam HS switches to the corresponding exposure time without major time loss by quickly adjusting acquisition parameters.

Adjustable data volume

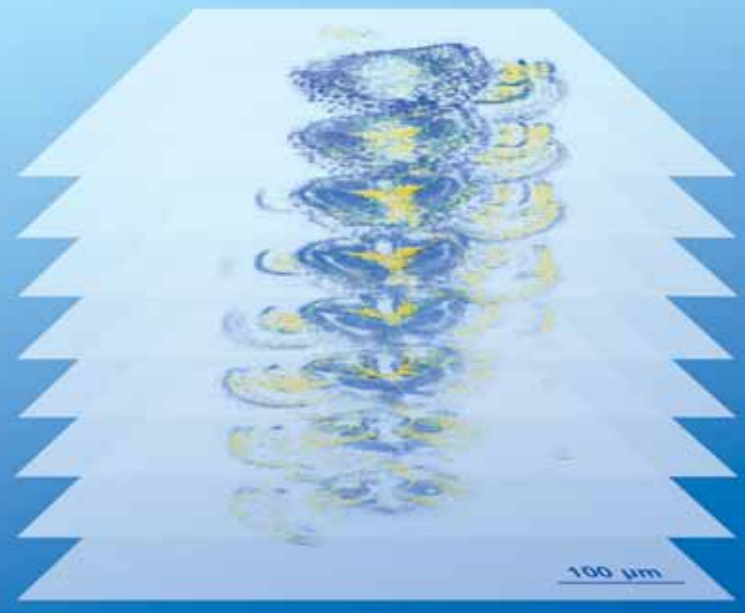
Enormous volumes of data can be accumulated, particularly with long time lapse images. This data, once digitized, can be stored as either 8 or 12 bit. Depending on the application, a decision can be made between high image quality or easier handling of large data. You can select between higher image quality or easier to handle quantities of data, depending on what you need for your application.



Drosophila oocytes.
3x fluorescence.
Optical section using ApoTome.
Objective: Plan-Apochromat 20x/0.75.



Z-stack image of embryonal stage of the North American slipper snail Crepidula. The cell nuclei are shown in blue with DAPI and the skeleton in yellow with YFP. Embryology Course, Woods Hole.



Compact format

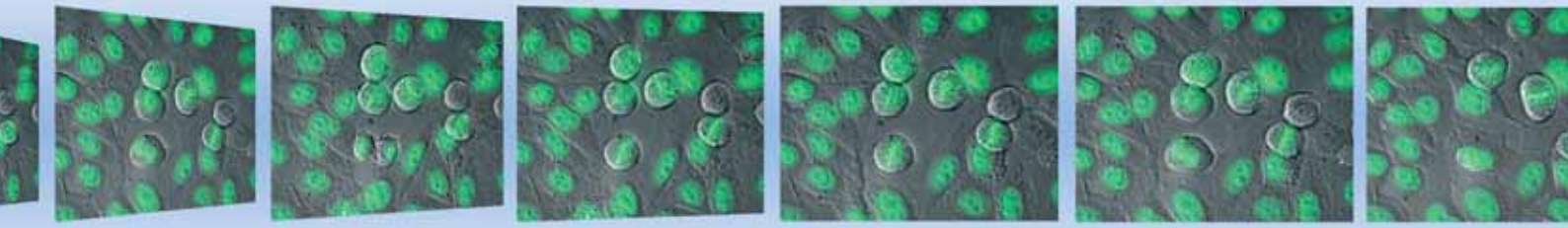
Whether we are talking about entry-level imaging systems or complex configurations utilizing voluminous incubators, the AxioCam HS is quick and easy to install in any environment, thanks to its very small dimensions and the fact that there is no external power supply to get in the way.

Real-time recording without image compression

A lengthy acquisition process produces a very large volume of data. In many cases this data have to be compressed to make it easier to handle. This generates compression artefacts and reduces the meaningfulness of the image data. With the AxioCam HS and its ability to acquire and store original data directly on the hard drive in real time, this problem is resolved. Up to 100 gigabytes per hour are transferred directly to the hard drive in real-time quality. You see digitally what the microscope sees, with absolutely no loss, and in scientifically utilizable quality for image analysis.

Optimum precision and rapid synchronization

The high precision of the AxioCam HS has two components. First one is the possibility of overlapping image exposure and readout in Continuous Mode. The speed of the camera is determined only by the required exposure time and is not hampered by the readout time of the sensor. This enables rapid time lapse imaging of movements, diffusion processes or growth processes at perfectly even and closely staggered intervals for extremely precise documentation and analysis. The second component that makes the imaging of the AxioCam HS so precise is rapid synchronization. External devices are synchronized perfectly with image acquisition via trigger signals. For the multidimensional imaging of dynamic processes in living cells, for example, the switching of the excitation wavelength of external fluorescence light sources or the movement of the z-positions is tailored perfectly to image acquisition via the triggers. This achieves precise, high-frequency image scanning, even in several dimensions.



A high-speed camera needs a high-end microscope system

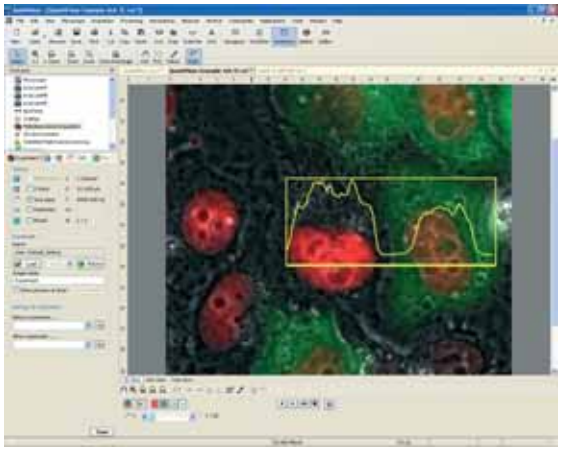
Carl Zeiss offers a wide range of system components, all with one thing in common: optimum support for the user's applications. From external fluorescence light sources with various excitation wavelengths to fast focusing and image processing and analysis with the AxioVision software, they are tailored perfectly to one another in the system as a High Speed Cell Observer®.

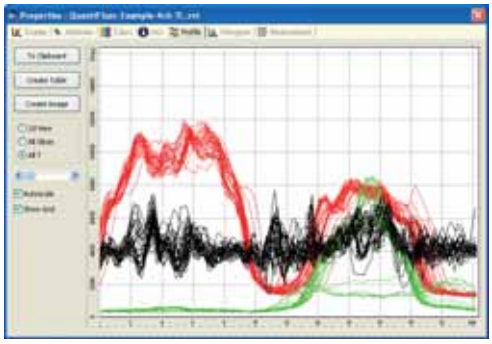
Digital intelligence: AxioVision

AxioVision from Carl Zeiss is the software platform for all digital imaging requirements, from image acquisition and processing to image analysis and archiving. AxioVision is practice-oriented, intuitive in terms of operation and easily adapted to your individual requirements. It offers a wide range of modules tailored to fluorescence and Live Cell Imaging.

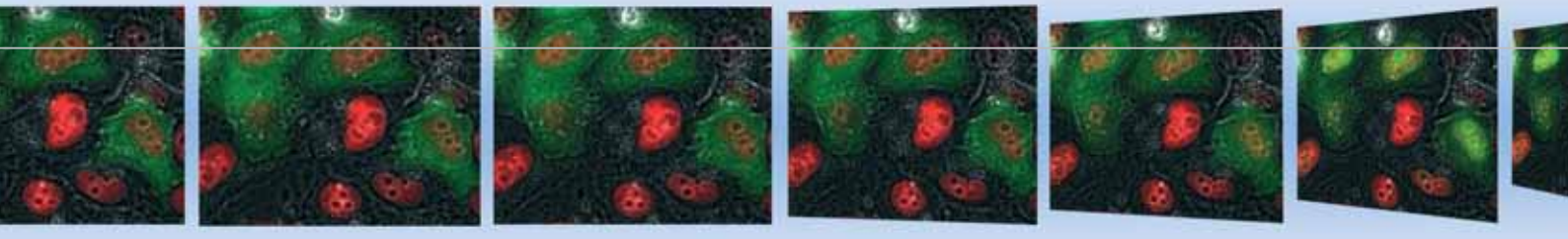
- Z-stack images: accurate to the nanometer and perfectly reproducible
- Multichannel fluorescence: with storage possibilities in more than 8 channels
- Time lapse images: for documenting dynamic processes of living samples
- Inside4D: for spatial visualization and presentation
- 3D Deconvolution: for mathematical restoration of optical sections
- IntMess: interactive measurement, e.g., of gray value intensities over time

AxioVision





This figure shows a measurement of fluorescence intensity with the help of a line profile. The profile clearly shows the concentration of the histone H2B protein, which has been linked to the fluorescent protein DsRed.



AxioCam HS system interfaces: trigger and FireWire (IEEE 1394 a) plug, encapsulated CCD sensor with C-Mount adapter.

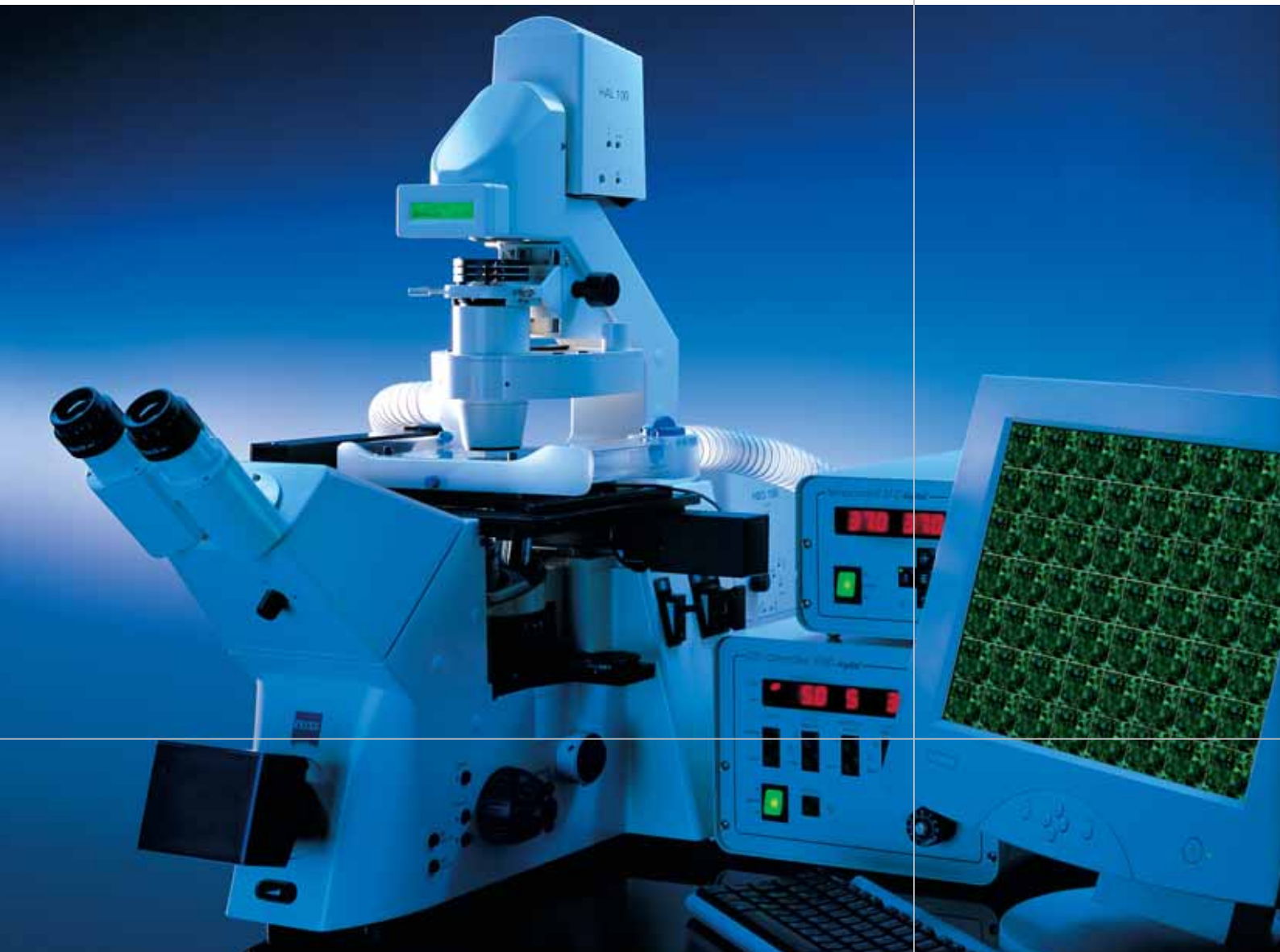
Fast microscopes: Axiovert 200 and Axio Imager

Research microscopes from Carl Zeiss are world leaders in fluorescence microscopy and Live Cell Imaging. The Axiovert 200 inverted and the Axio Imager upright fluorescence microscopes support the acquisition of rapid processes particularly well thanks to the following features:

- quick and reliable automation of numerous processes
- fast, motorized reflector turrets with up to 10 filter positions*
- optimized fluorescence optics: high illumination homogeneity, perfect contrast and brilliant image, even with weak light intensities
- integration of a variety of external components such as high-speed shutters, fast external light sources, quick focusing equipment

The High Speed Cell Observer® is even more powerful with the AxioCam HS. A solid investment for the future, and a quality promise from Carl Zeiss.

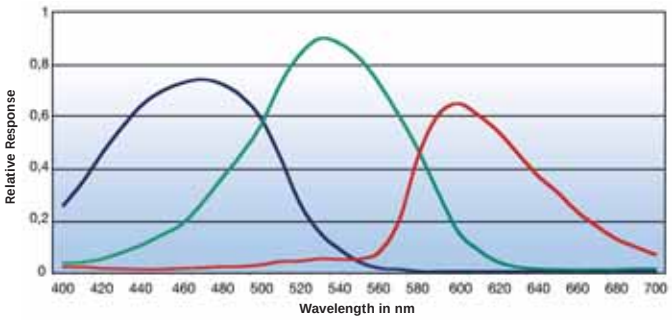
**with Axio Imager.Z1*



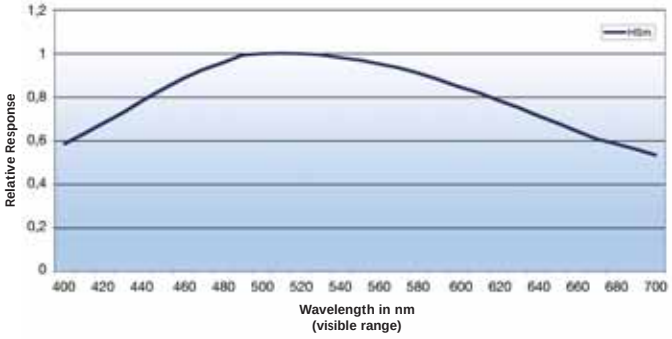
Technical Data of the AxioCam HS

Sensor	Sony ICX 414, progressive readout
CCD basic resolution	660 (H) x 494 (V) = 330 K pixels
Pixel size	9.9 µm (H) x 9.9 µm (V)
Sensor size	6.5 mm x 4.9 mm, equivalent to ½"
Spectral sensitivity	HSc approx. 400 up to 720 nm with BG 40 IR blocking filter HSm approx. 350 up to 1000 nm with BK 7 protective cover glass
Dynamic range	Typical SNR 65 dB = 1 : 1800
Full well capacity	Typical 32 Ke
Readout noise	Typical 17 e
Dark current	Typical 0.7 LSB/s, equivalent to 5.4 e/pixel/s
Readout clock speed	Max. 24.57 MHz
Speed optimized readout mode	Max. time resolution by overlapping exposure and readout for time lapse acquisitions
Frame rates	Approx. 60 frames/s in basic resolution up to approx. 200 frames/s at binning 5 x 5 at 1 ms respectively, higher frame rates with combinations of binning and ROI (see table page 3)
Raw data rate	Max. 28 MB/s or 1.6 GB/minute (appropriate PC main memory capacity required)
Data recording	Inline recording of raw data directly to hard disk at all frame rates (available from 12/2005)
Exposure time	From 0.25 ms up to 60 s
Color optimization	Available for color model, default white point 3200 K
Gain	Analog gain 2x, digital gain 16x
Binning modi	Binning / Resolution (pixel) / Frames/s* 1 x 1 / 660 x 494 / 60 2 x 2 / 328 x 246 / 108 3 x 3 / 216 x 164 / 143 4 x 4 / 160 x 122 / 174 5 x 5 / 124 x 98 / 198 On Chip Binning in two axes (only monochrome version) * Dependant on application software
Sensor subarea readout (ROI)	Freely adjustable
Digitization	12 bit AD converter
Interface	FireWire (IEEE 1394 a), several cameras on one bus possible
Control signals	Trigger In/Out, TTL compatible, programmable polarity, adjustable trigger delay for shutter synchronization
Housing	Aluminum, blue anodized, cooling fins, 11 cm x 8 cm x 4.5 cm, 350 g
Optical interface	C-Mount adapter
Free back focal depth	Max. 5 mm
Protective cover glass	BK 7 for HSm, annealed, IR filter BG 40 for HSc, annealed respectively
CCD cooling	Single stage thermoelectrical cooling (Peltier) for decrease of dark current and thermal decoupling of the CCD sensor, heat dissipation by means of the housing, no fan required
Dark current compensation	Adaptive compensation algorithm in camera driver
Operating system	Microsoft® Windows 2000 Professional, Microsoft® Windows XP Professional
Camera firmware	Firmware download possible
Dual camera operation	Possible
Product types	Monochrome and color
Certificates	CE, cUL
Power supply	10 … 33 V DC / 4 W power supply by the FireWire cable (IEEE 1394 a) from the PC, no external power supply required
Environmental conditions	+5° up to +35° Celsius, max. 80% air humidity, non condensing , free air circulation required

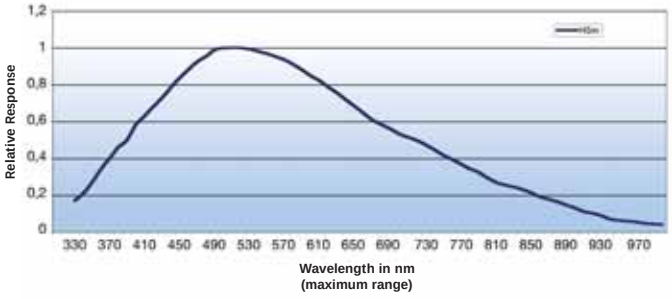
Relative Spectral Sensitivity AxioCam HSc with BG 40 IR-Filter



Relative Spectral Sensitivity AxioCam HSm with BK 7



Relative Spectral Sensitivity AxioCam HSm with BK 7



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