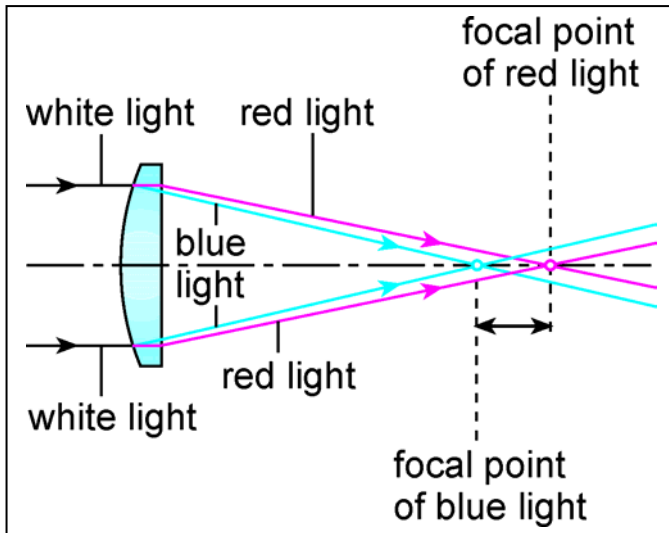


Microscope techniques

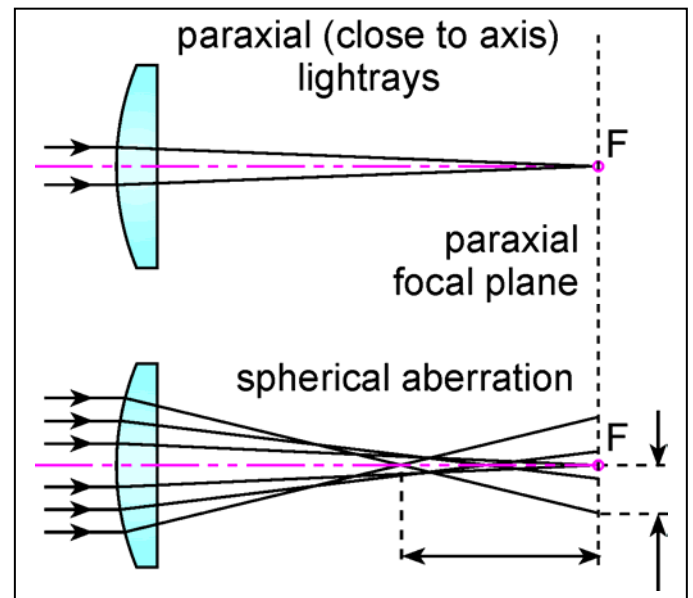
(see the MICROSCOPE, SPECIAL MICROSCOPES in the Manual)

Magnification, resolution, contrast

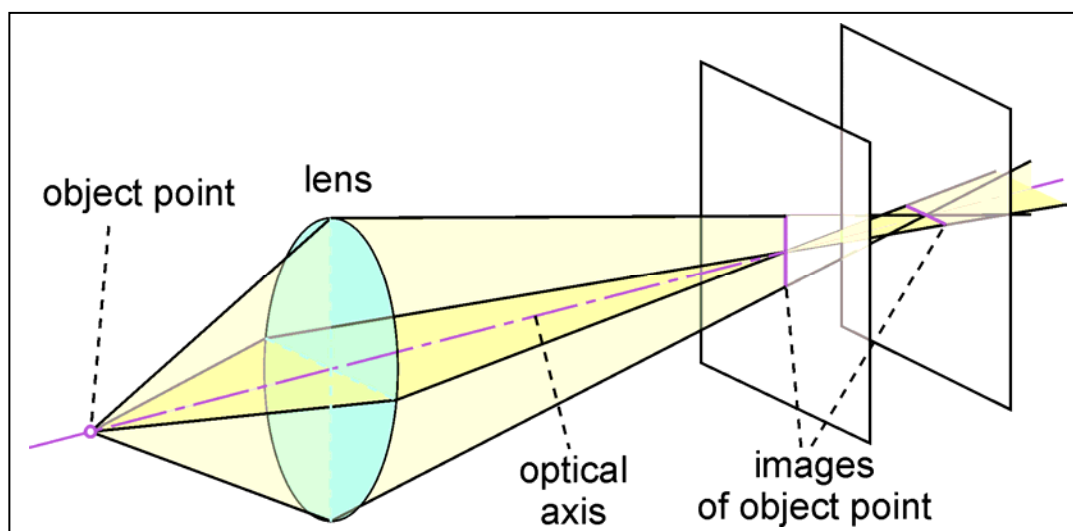
Errors of imaging



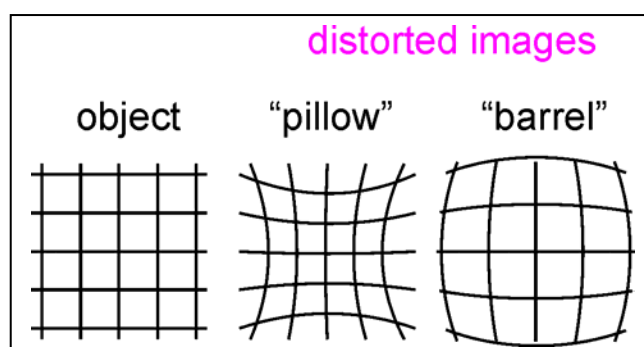
Chromatic aberration



Spherical aberration



Astigmatism

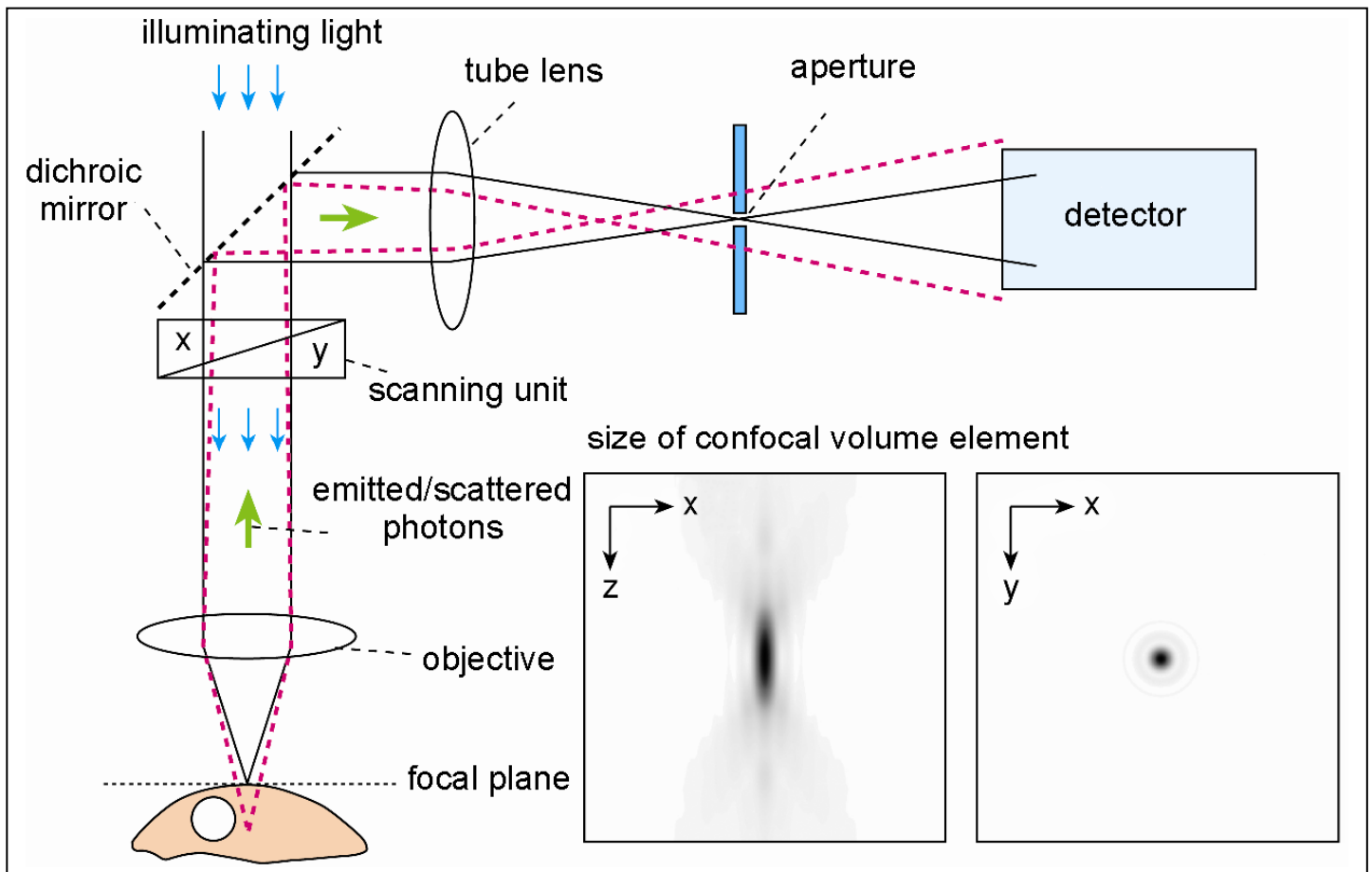


"Pillow" and "barrel" types of torsions

Special optical microscopes

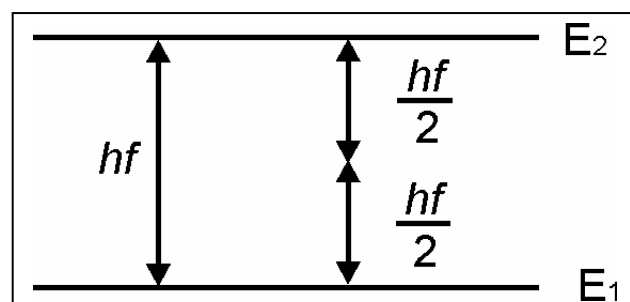
Stereo microscope; Ultramicroscope; Fluorescence microscope; Polarization microscope; Phase-contrast microscope;

Confocal Laser Scanning Microscopy, CLSM



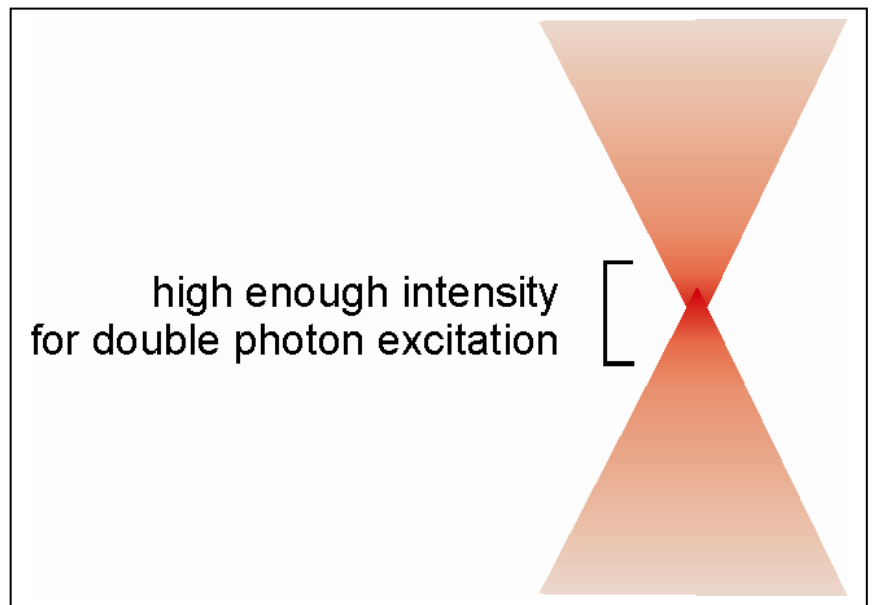
Study of the cell's interior without having to actually dissect it.
The rear focal plane is **conjugate** to the objective
(hence the name of the method – **conjugate focality**)

Multi-photon excitation



Since the probability of the absorption of two photons is much less, than the absorption of a single one, we need much higher photon density or intensity.

This phenomenon solves the problem of depth-resolution without confocal optics.



The penetration depth of light in the IR range is much larger than in the visible range, allowing easy examination of the deeper lying cells and layers even in the case of thicker tissue.

Photobleaching only in a small volume

4Pi Microscopy

Two objectives of high NA (numerical aperture) are placed facing each other and directed at a thin sample so that their frontal focal planes coincide, and both are used both for illumination and detection, then their NA's add up.

The photon collecting capacity is doubled since emitted photons are detected from a maximal aperture angle of nearly 4π –hence the name of the method.

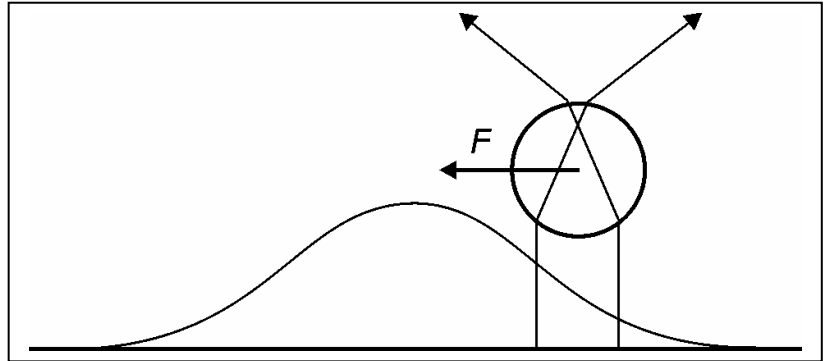
Optical tweezers

A single cell can be lifted without causing any perceivable damage, and placed virtually anywhere while performing measurements with the optical and spectroscopic techniques.

Change of momentum of photons

$$p = \frac{h}{\lambda}$$

F (forces)



Atomic Force Microscopy (AFM)

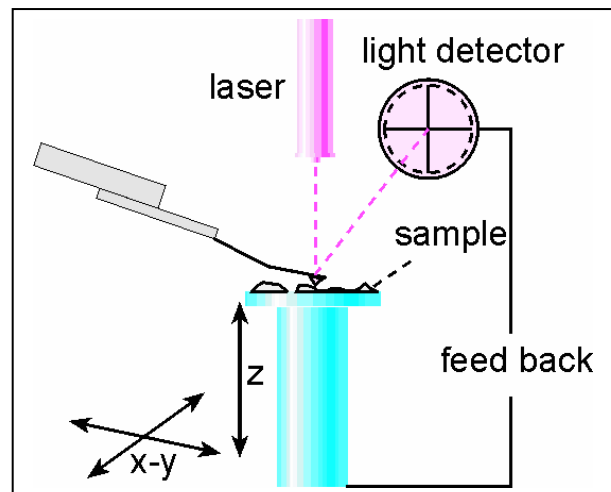
Study of insulators

Surface scanning

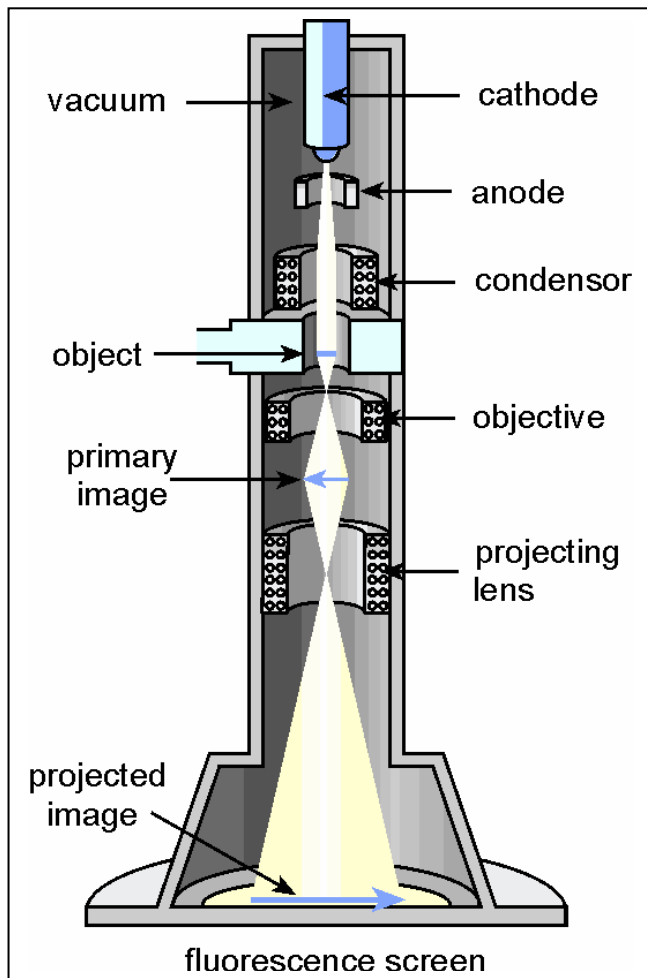
Weak force

Stage

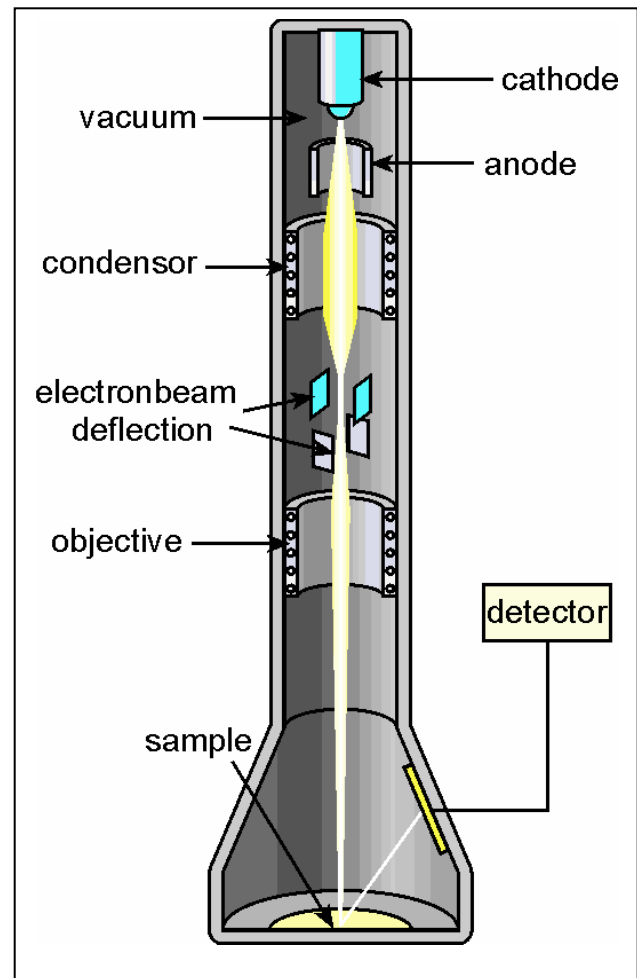
(inverse piezoelectric effect)



Transmission Electron Microscopy (TEM)



Scanning Electron Microscopy (SEM)



$$\lambda = \frac{h}{p}$$

In the transmission mode (TEM), the electron beam functions analogously to an optical microscope.

Electron backscattering detects differences in atomic number. In contrast to the cross-sectional, strictly two-dimensional (summation) image of the transmission method (TEM), it (SEM) provides a plastic, solid representation of the surface of the object. This technique is especially important in biological applications, since by the very nature of the phenomenon, the scattering image is very sensitive to details of the surface to a depth of ca. 10 nm.