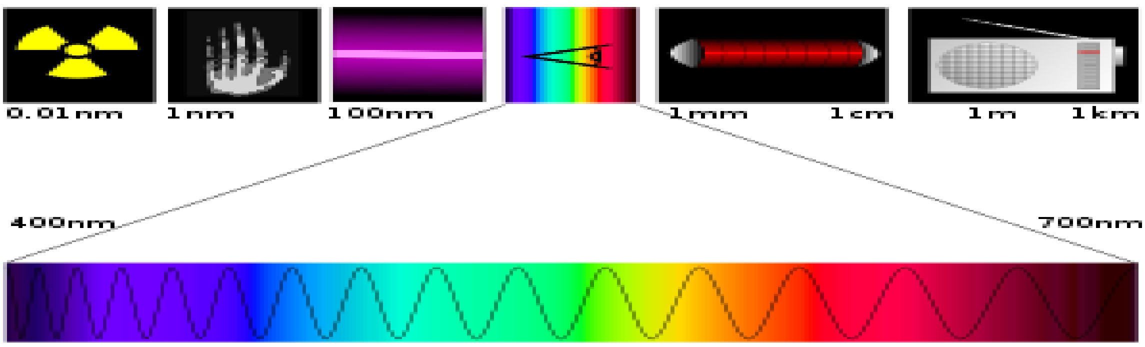
Light Amplification by Stimulated Emission of Radiation (LASER Videography)

Light Amplification by Stimulated Emission of Radiation, **LASER** (**laser**), is a mechanism for emitting light within the electromagnetic radiation region of the spectrum, via the process of stimulated emission. The emitted **laser light** is (usually) a spatially coherent, narrow low-divergence beam, the light can be manipulated with lenses. In laser technology, “coherent light” denotes a light source that produces (emits) light of in-step waves of identical frequency and phase. The laser’s beam of coherent light differentiates it from light sources that emit *incoherent* light beams, of random phase varying with time and position; whereas the laser light is a narrow-wavelength electromagnetic spectrum monochromatic light; yet, there are lasers that emit a broad spectrum light, or simultaneously, at different wavelengths.

The word **laser** originally was the upper-case **LASER**, the acronym from *Light Amplification by Stimulated Emission of Radiation*, wherein *light* broadly denotes electromagnetic radiation of any frequency, not only the visible spectrum; hence infrared laser, ultraviolet laser, X-ray laser, et cetera. Because the microwave predecessor of the laser, the **maser**, was developed first, devices that emit microwave and radio frequencies are denoted “masers”.



Electromagnetic spectrum of light

DIFFERENT KINDS OF LASERS:

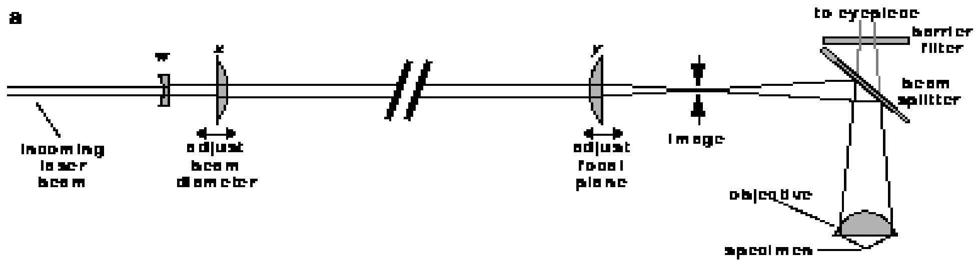
(1) Free electron lasers (2) Dye lasers (3) Semiconductor lasers

(4) Photonic crystal lasers (5) Fiber-hosted lasers (6) Solid-state lasers

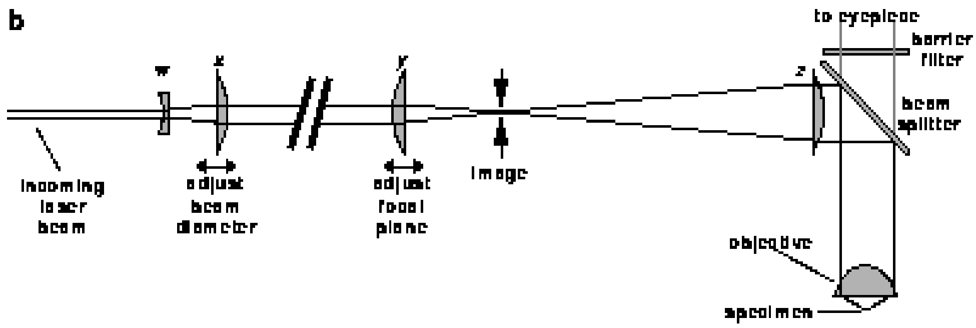
(7) Excimer lasers (8) Chemical lasers (9) Gas lasers

For LASER videography: For LASER videography we use coupling optics. The coupling optics do two things. First, they shape the beam so that it enters the specimen from the full available range of angles, and comes to a focus at a point in the image plane. Second, they allow beam location and angle to be adjusted by moving lenses and mirrors, rather than **the**

microscope (in case of microscopy) and laser. Lenses and mirrors can be mounted in optical positioning equipment that allows fine, stable, continuous adjustment. Since there are six separate adjustments necessary to make the laser system operate properly, easy, stable adjustment is important. In fact, the design of the coupling optics is the single most important factor determining how convenient the laser system will be to use. In addition, since the coupling optics is far less expensive than the laser and microscope, you can lavish attention on this part of your system without much increasing the overall cost. The below figures show the lenses used to shape and focus the beam.



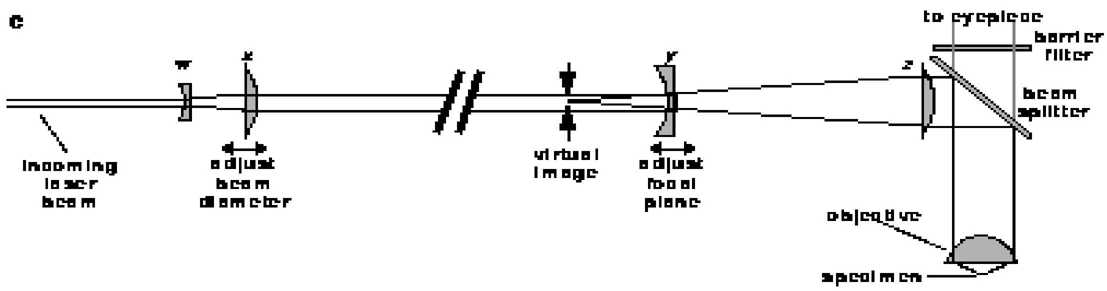
Lens y focuses the beam to a point within the image, so that it will focus to a corresponding point within the specimen. Lens y can be moved along the beam axis to adjust the focus of the laser so that it corresponds to the image you see. If it is moved toward the laser, the focus will move upward in the specimen. The laser light cannot be focused to a point in the image, because no image is formed. In this case one uses an additional lens (z in the figure) to form an image.



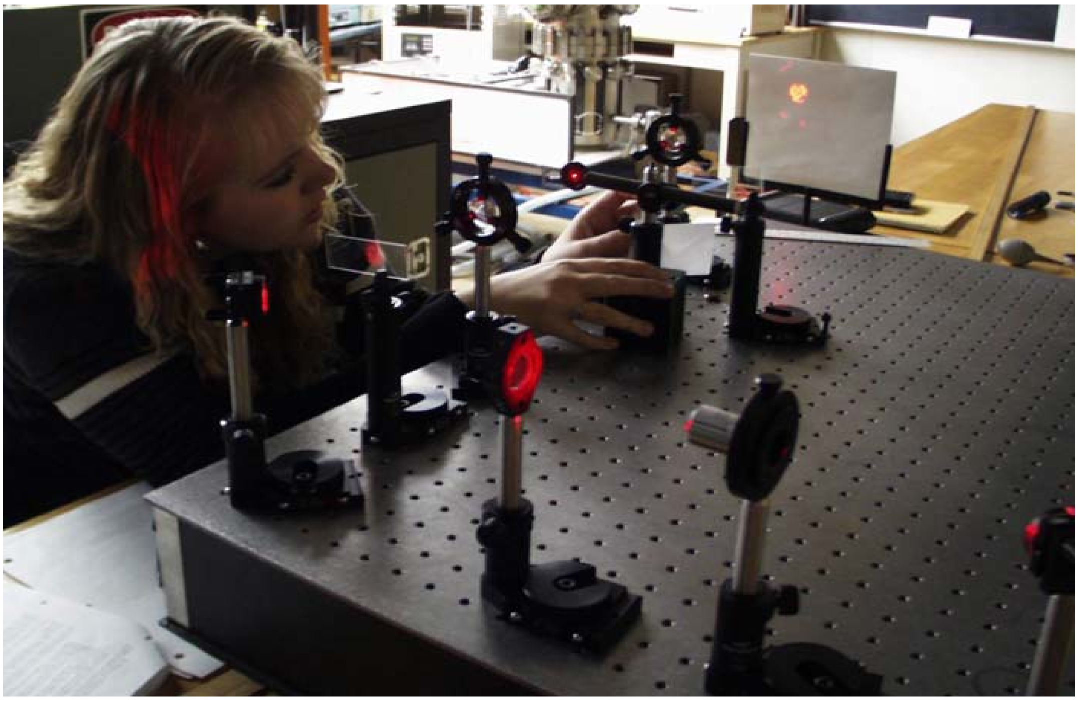
How to form the image and where?

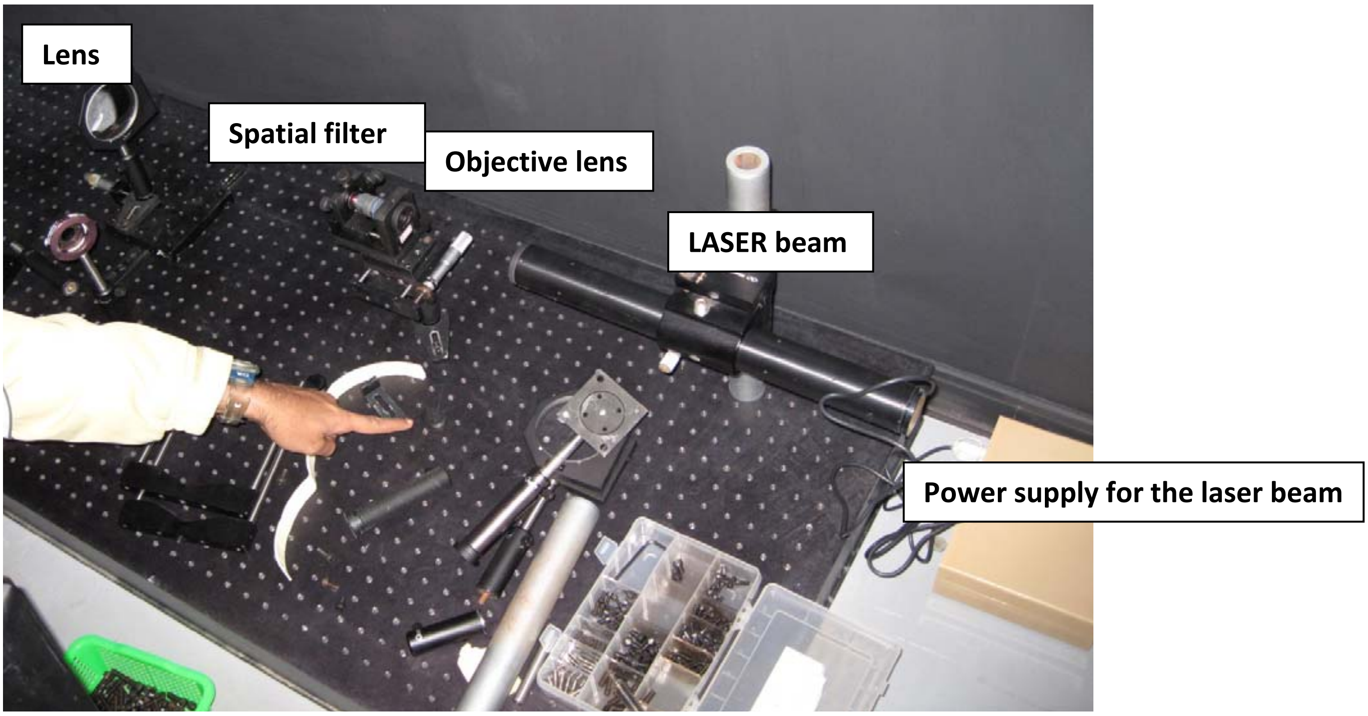
We need to test image formation and need to adjust the LASER light also. It is important that laser light enter the specimen from the widest possible range of angles, which means that beam diameter must be at least large enough to illuminate the entire objective. (You can find out if your beam diameter is large enough by unscrewing the high- power objective from its mount, then comparing the size of the spot of laser light on a card held under the hole to the opening in the back of the objective.) Lenses allows the beam diameter to be adjusted. If lens x is moved slightly towards the laser, the beam will diverge slightly as it leaves the telescope, so that its diameter will be larger at lens y and the objective. If the beam is larger than the objective, only the center will enter. Thus as lens x is moved toward the laser, less of the light enters the objective, so that the illumination becomes weaker, a useful way of adjusting the intensity. It also improves the uniformity of the illumination, since the center of the beam is the most uniform. Intensity can also be adjusted by interposing neutral density filters in the beam, or, for very small changes in intensity, microscope slides.

Of course, unlimited variations on these arrangements are possible. For instance, you can shorten the light path in Figure 1b by using a concave lens instead of a convex lens (see figure). As in this, we place a mirror between y and z to bend the light path so that it can be more conveniently placed on a desktop.



LASER VIDEOGRAPHY SYSTEM ARRANGEMENT IN THE LAB:





Assembly for the Laser light equipment

Fresnel filter to adjust light