كلية المستقبل الجامعة
قسم الفيزياء الطبية
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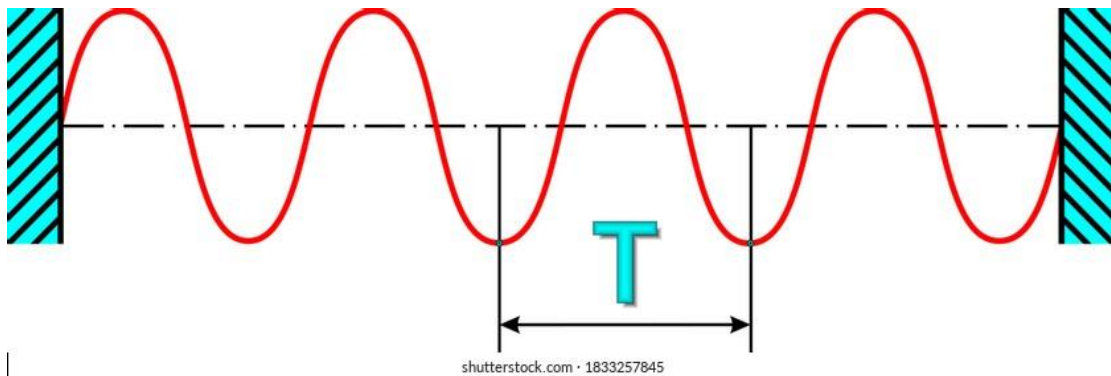# Medical Physics

Optics

Lecture 10

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Types of Coherence:

Coherent sources can be classified into following categories :

1- Temporal Coherence :

- Temporal coherence is a measure of the relationship between the value of a wave and itself creating a delay of T at any wide combination of times.

- Measurement of how monochromatic a particular source is carried out using temporal coherence. This includes determining how well a wave can interfere with itself at a distinct time .

- The delay by a phase or amplitude which ought to be by a substantial amount is known as the coherence time .
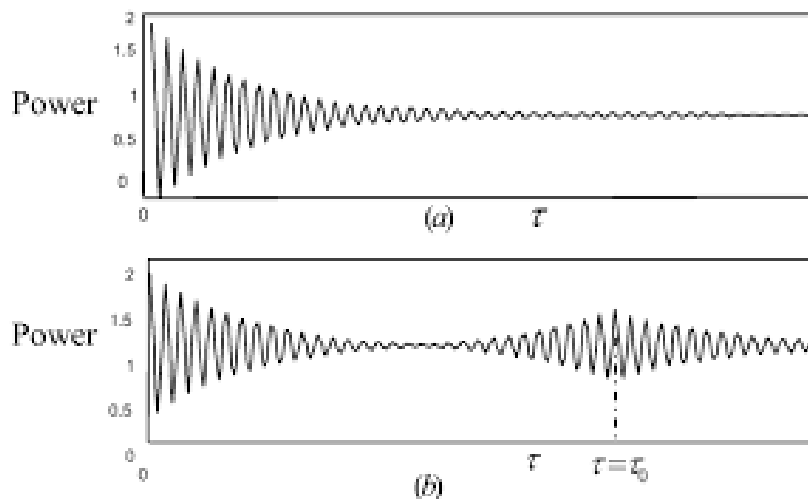
2- Spatial Coherence :

- In case of systems like optics or water waves, the dimension of the wave extends from one or two spaces .

- Spatial coherence is known as the ability of two points denoted by x1 and x2 within the area of a wave that may interfere .
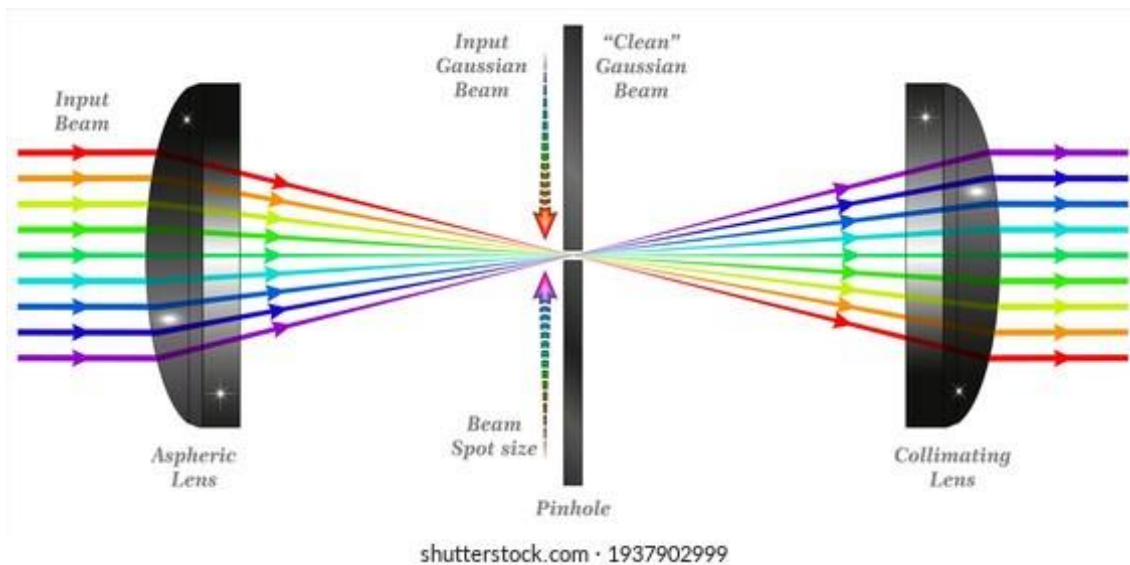
- Thus in simple words, it can be defined as cross-relation between two points during a wave at any given time .

- When a wave possesses a single amplitude value over an infinite length, we can say that it has a perfect spatial coherence.

Examples of Coherent sources :

1- Sound waves generated from speakers are driven by electrical signals and have a constant frequency .

2- Lasers are normally used as coherent sources as it makes use of a mechanism known as stimulated emission to get extremely coherent light.

3- Small sources of sunshine are partially coherent due to which we can observe interference patterns on soap bubbles and appreciate the brightness of butterfly wings .

Incoherent Sources :

Incoherent light is a type of light source where there is a frequent and random change in the phase between the photons. For example, conventional light sources such as night bulbs, fluorescent tubes and metal filament lamps produce incoherent lightweight waves. All standard sources are incoherent sources.
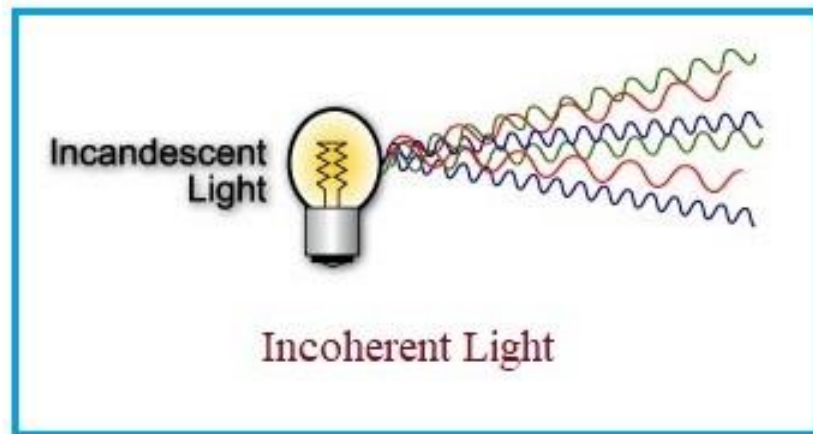
We don't get an interference pattern with incoherent sources of Consider two waves that are emitted from two sources of .waves intensities I1 and I2. The intensity of these two waves is, I = I1 + I2 .
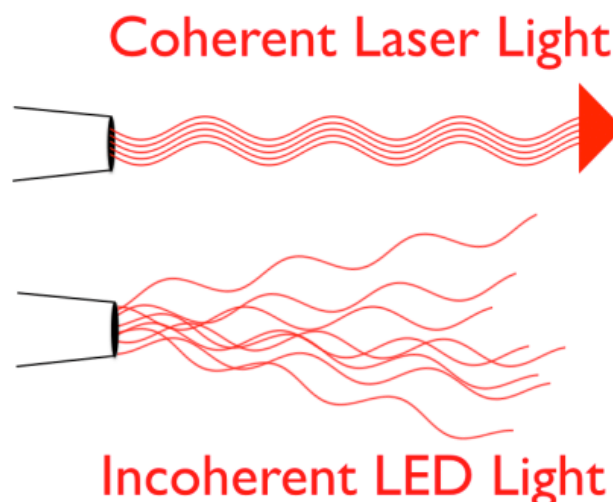
Difference Between Coherent and Incoherent :

1- Coherent light waves are usually stronger compared to the incoherent source of light waves .

2- Furthermore, coherent light waves are unidirectional and Incoherent light waves are Omni-directional .

Fermat's principle :

in optics, statement that light traveling between two points seeks a path such that the number of waves (the optical length between the points) is equal, in the first approximation, to that in neighbouring paths.

Another way of stating this principle is that the path taken by a ray of light in traveling between two points requires either a minimum or a maximum time.

Thus, two beams of light diverging from a distant object point and converged by a lens to an image point will have identical optical path lengths. Fermat's principle was first enunciated in 1658 by Pierre de Fermat, a French mathematician. It is useful in the study of optical devices .
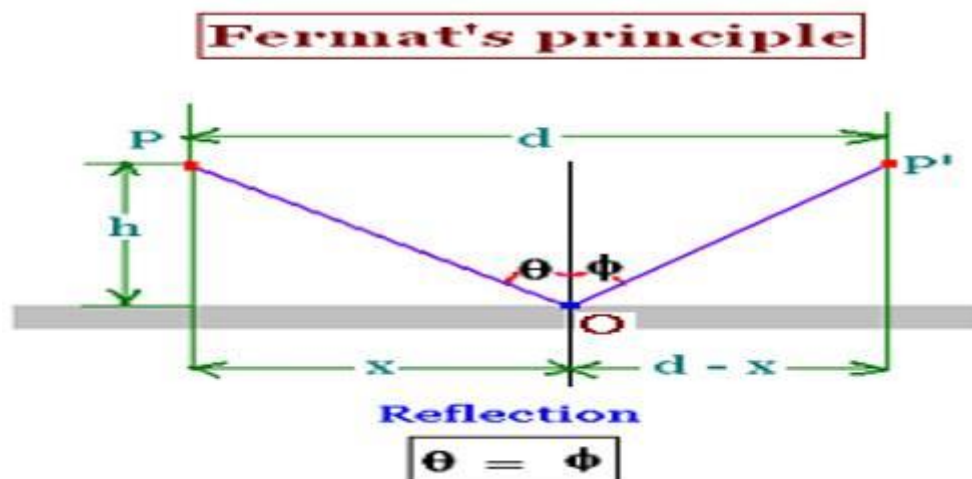
Optical path (OP) :

Optical path is the trajectory that a light ray follows as it propagates through an optical medium. The geometrical optical-path length or simply geometrical path length (GPD) is the length of a segment in a given OP, the Euclidean distance integrated along a ray between any two points. The mechanical length of an optical device can be reduced to less than the GPD by using folded optics. The optical path length in a homogeneous medium is the GPD multiplied by the refractive index of the medium .
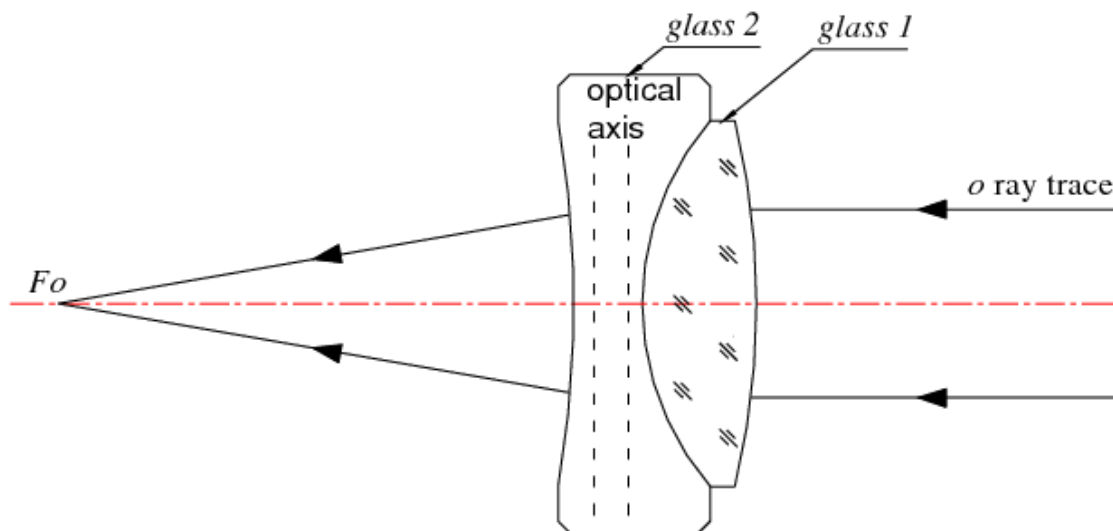
Factors affecting optical path :

Path of light in medium, or between two media is affected by the following :

1- Reflection .

2- Total internal reflection .

3- Dispersion of light .

4- Absorption .