كلية المستقبل الجامعة
قسم الفيزياء الطبية
المرحلة الثانية

Medical Physics

Optics

Lecture 9

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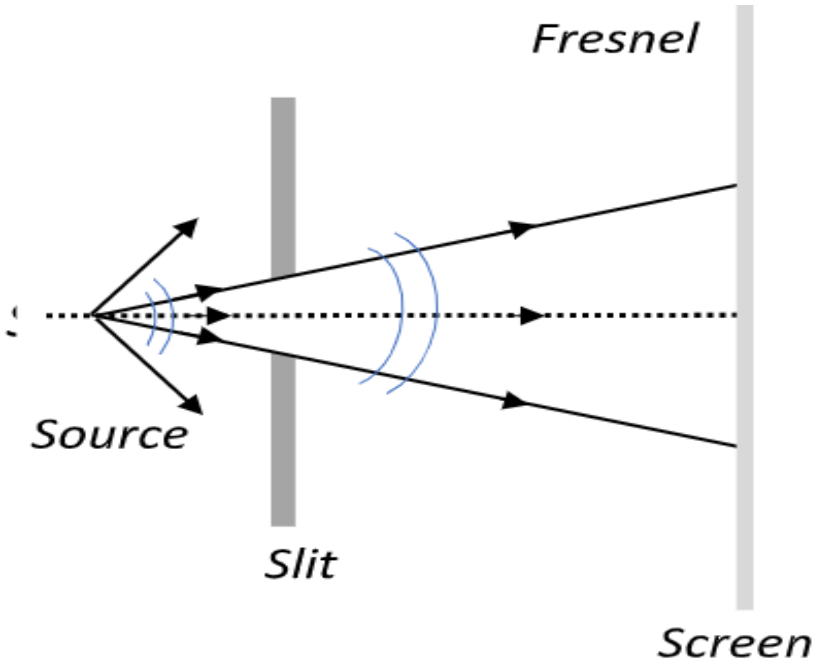
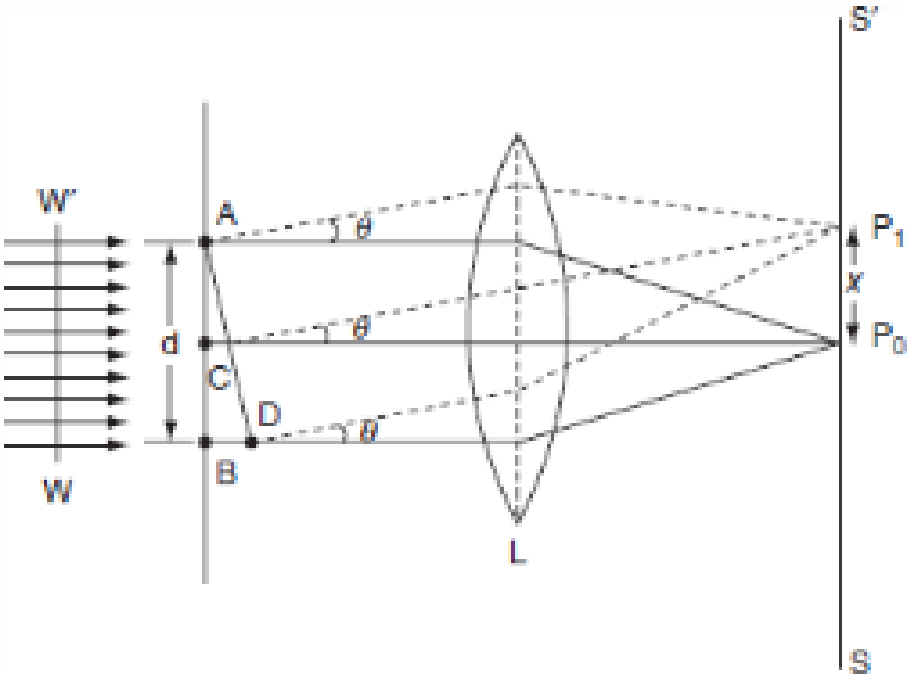
Types Of Diffraction :

1- Fresnel diffraction: When the light from the point source reaches the obstacle, the waves produced are spherical and the pattern of the image of the object is a fringed image.



2- Fraunhofer diffraction: When the waves from the light source are in the form of wave fronts, and they are infinite .



Fresnel and Fraunhofer Diffraction :

The basic difference between fresnel and Fraunhofer diffraction is that in Fresnel diffraction the source of light and screen is at a finite distance from the obstacle, while in Fraunhofer diffraction if the source of light and screen is at an infinite distance from the obstacle .

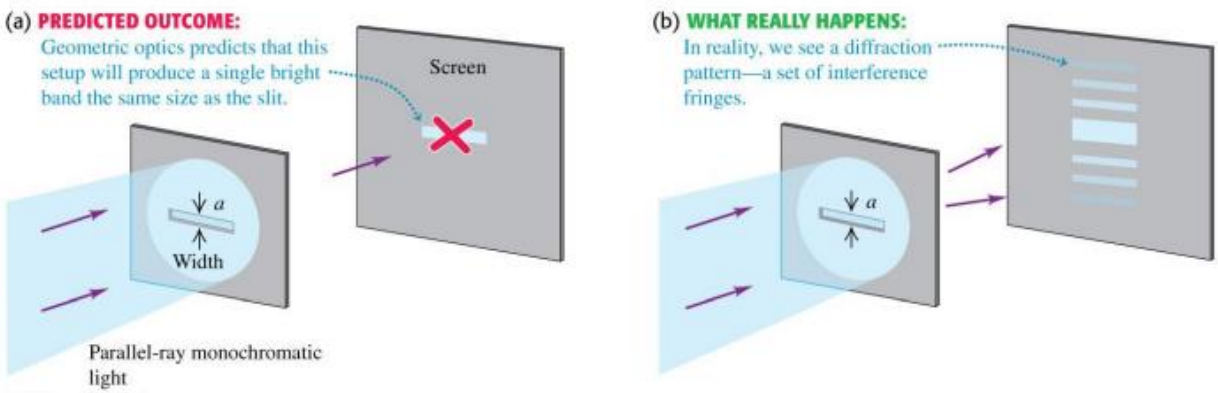
Fraunhofer diffraction	Fresnel diffraction
Source and the screen are far away from each other.	Source and screen are not far away from each other.
Incident wave fronts on the diffracting obstacle are plane.	Incident wave fronts are spherical.
Diffracting obstacle give rise to wave fronts which are also plane.	Wave fronts leaving the obstacles are also spherical.
Plane diffracting wave fronts are converged by means of a convex lens to produce diffraction pattern.	No Convex lens is needed to converge the spherical wave fronts.

Single Slit Diffraction (Fraunhofer Diffraction) :

1- As we have already hinted at, and seen, waves don't behave as we might have expected from our study of geometric optics .

2- We can see interference fringes even when we only have a single slit .

3- To understand this phenomena, we have to go back to Huygens' Principle and phasor diagrams .



Newton's Rings :

Newton's rings is a phenomenon in which an interference pattern is created by the reflection of light between two surfaces; a spherical surface and an adjacent touching flat surface. It is named after Isaac Newton, who investigated the effect in 1666. When viewed with monochromatic light, Newton's rings appear as a series of concentric, alternating bright and dark rings centered at the point of contact between the two surfaces.

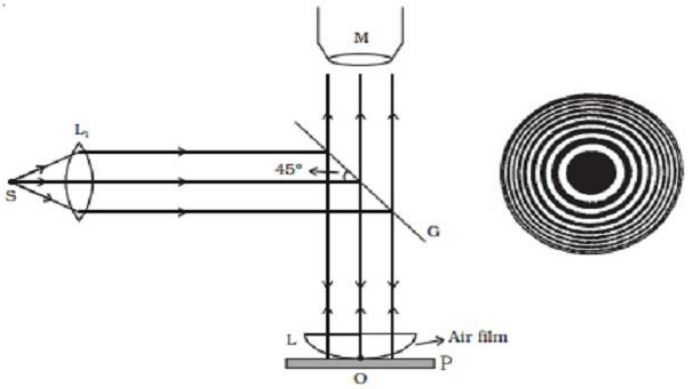
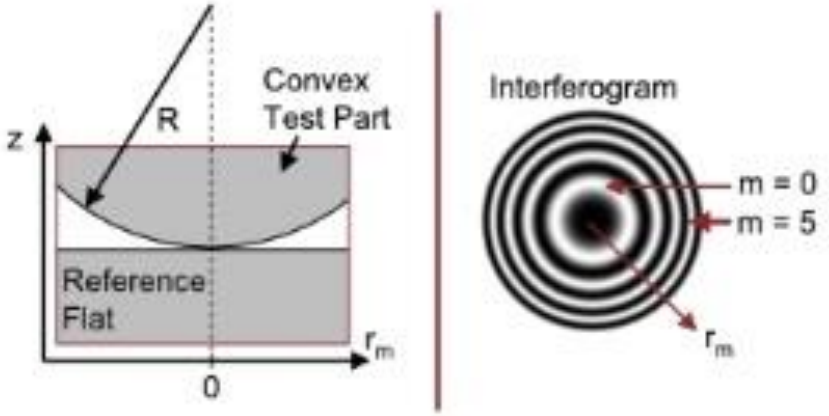


Fig Newton's rings

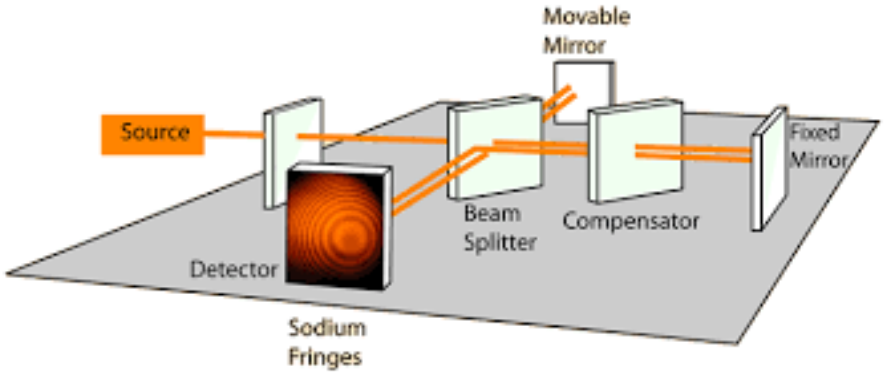
When viewed with white light, it forms a concentric ring pattern of rainbow colors, because the different wavelengths of light interfere at different thicknesses of the air layer between the surfaces .



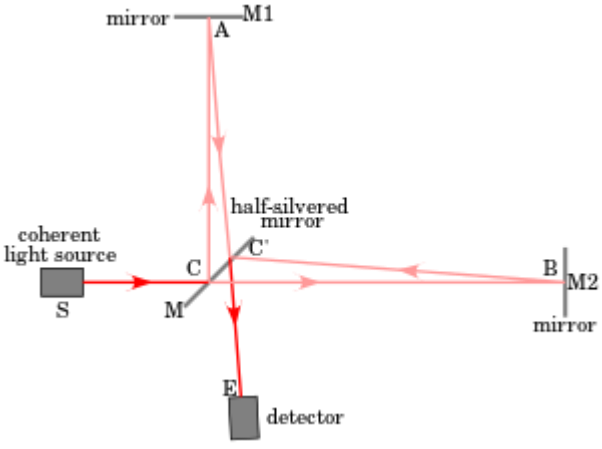
$$R = \frac{r_m^2}{\lambda\left(m + \frac{1}{2}\right)}$$

Michelson interferometer :

The Michelson interferometer is a common configuration for optical interferometry and was invented American physicist Albert Abraham Michelson. Using a beam splitter, a light source is split into two arms.



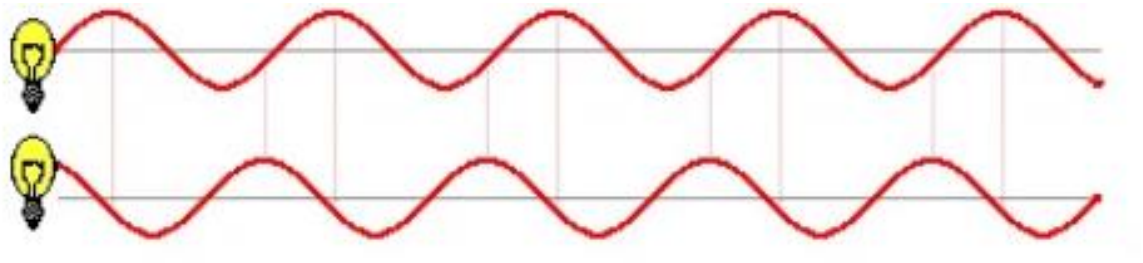
Each of those light beams is reflected back toward the beamsplitter which then combines their amplitudes using the superposition principle. The resulting interference pattern that is not directed back toward the source is typically directed to some type of photoelectric detector or camera.



For different applications of the interferometer, the two light paths can be with different lengths or incorporate optical elements or even materials under test .

Coherent Light Waves :

Coherent light is light where the beam occurs for all the photons at the same time. There will be no sudden change in the phase within the beam. For example, the light produced by the laser is both coherent and monochromatic .Coherence can be defined as a set relationship between the phases of waves during a beam of radiation of one frequency.



Two light beams can be called coherent if the phase distinction between their waves is constant; they're noncoherent if there's a random or dynamic phase relationship. Radiation from coherent sources are responsible for stable interference patterns which are produced when a single beam of light gets separated into two or more beams of light .

Characteristics of Coherent Sources :

1- The waves generated have a constant phase distinction .

2- The waves are of one frequency.

3- The waves ought to have identical amplitude .