ENGINEERING PHYSICS

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ENGINEERING PHYSICS

Unit I : Review of concepts leading to Quantum Mechanics

- Double slit experiment revisited
- Double slit experiment with single particles
- Linear Superposition of wave functions

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Unit I : Review of concepts leading to Quantum Mechanics

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➢ *Suggested Reading*

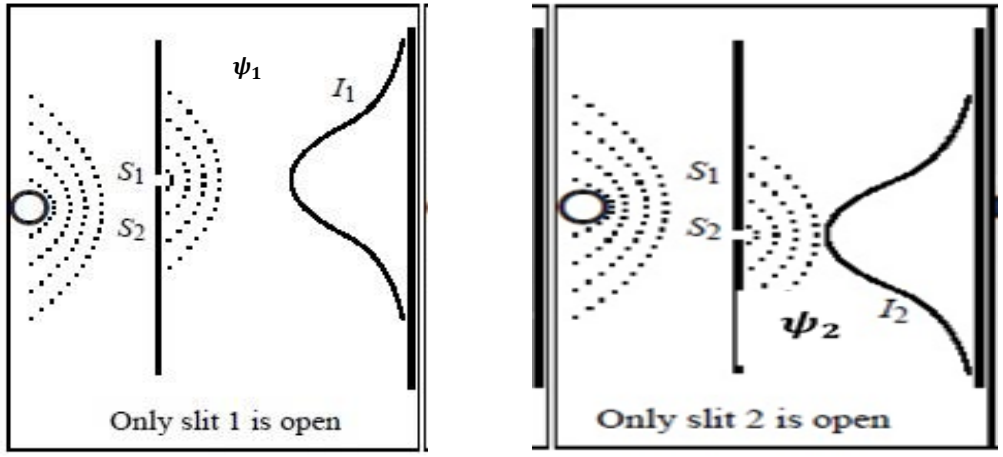
1. *Concepts of Modern Physics, Arthur Beiser, Chapter 3.10*
2. *Learning Material prepared by the Department of Physics*

➢ *Reference Videos*

1. *Video lectures : MIT 8.04 Quantum Physics I*

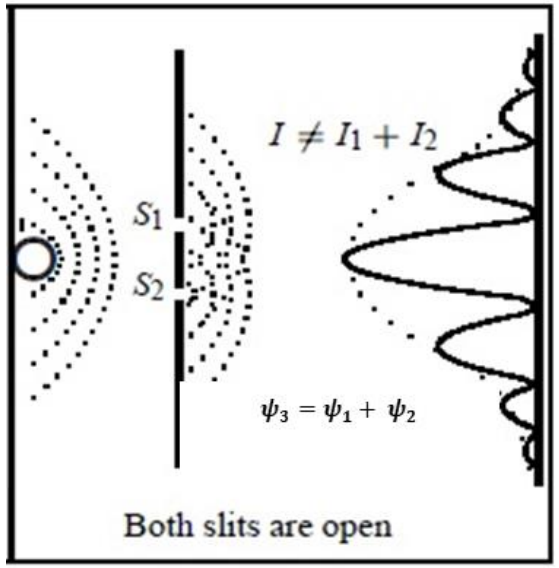
Double slit experiment revisited

- I_1 *is the intensity (probability) distribution of the waves from slit 1 reaching the screen.*
- I_2 *is the intensity (probability) distribution of the waves from slit 2 reaching the screen.*



Young's Double slit experiment

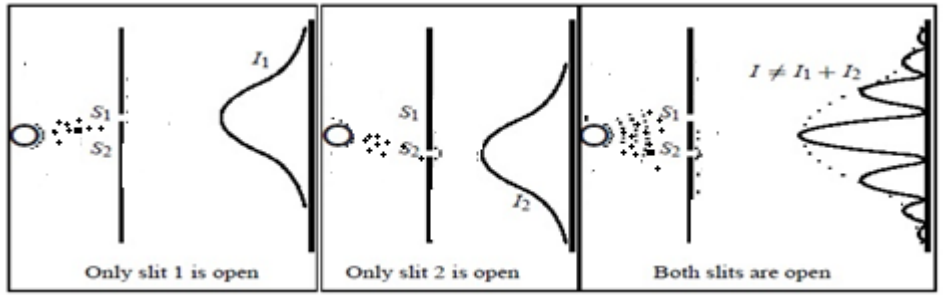
- *The Young's double slit experiment (1801) is a classical experiment to prove the wave nature of waves*
- *Monochromatic waves of wavelength* λ *from a source is diffracted by a pair of slits and secondary wave fronts which interfere on a screen to produce an interference pattern*
- *The fringe width is given by* $w = \frac{\lambda D}{d}$ *where* D *is the distance of the screen from the slits and* d *is the distance between the slits*



Single particle diffraction at a Double slit experiment

- *If the source is replaced by a laser which emits a single photon at a time, the result is the same - an interference pattern is observed if the experiment is allowed to conducted for a sufficiently long time.*

- *The interference pattern disappears once a detector is placed at any one of the slits and the intensity distribution is the algebraic sum of the individual intensities* $I = I_1 + I_2$



Single particle diffraction at a Double slit experiment

- *Electrons also can be diffracted in the same way as photons by a properly designed double slit*
- *Electron diffraction at a wire by Hitachi*
  https://youtu.be/j3Vk4Tu_uMo
- *Single particle diffraction at a double slit explicitly show quantum behavior (very different from classical ideas)*
- *Any attempt to detect the particles approaching the slits result in a collapse of the "quantum" behavior*

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Class #7 …….. Quiz….

1. Double slit experiment conclusively proves the wave nature of matter
2. The probability distribution of a double slit experiment is the superposition of the probability density of waves from the single slit operation
3. Single particles cannot be diffracted at the double slit

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THANK YOU

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