

PH160 LAB 7

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AIM :

1. To study the effect of detection of wave nature of particle in presence and absence of detector.
2. To visualize and analyze the intensity pattern for different matter waves.
3. To study the effect of slit width and vertical separation on the interference pattern from Young's Double slit experiment.

THEORY :

Quantum physics is the study of matter and energy at its most fundamental level. A central tenet of quantum physics is that energy comes in the form of individual packets called "QUANTA".

Interference is the phenomenon in which two waves superpose to form a resultant wave of greater, lower or the same amplitude. Constructive or destructive interference result from the interaction of waves that are correlated or coherent with each other because they come from the same source or because they have the same or nearly the same frequency. Interference can be observed in all types of waves, for example, light, radio, acoustic, surface water waves, gravity waves or matter waves. The light intensity produced by the slits increases with increased width of the slit. The screen thus develops brighter fringes as the slit width

Increases.

Due to the presence of the detector in slit , the detector gathers clues of the particles - including their speed, mass and charge. This device detects the presence of electromagnetic waves.

Interference is not observed in any case when the detector is used, irrespective of material / waves used. Detectors basically absorb or deviate the path of the particles as a result of which interference pattern is not observed.

EFFECTS OF WAVELENGTH ON INTERFERENCE PATTERN :

Change in wavelength of the source will alter the number of lines in the pattern and alter the proximity or closeness of the lines.

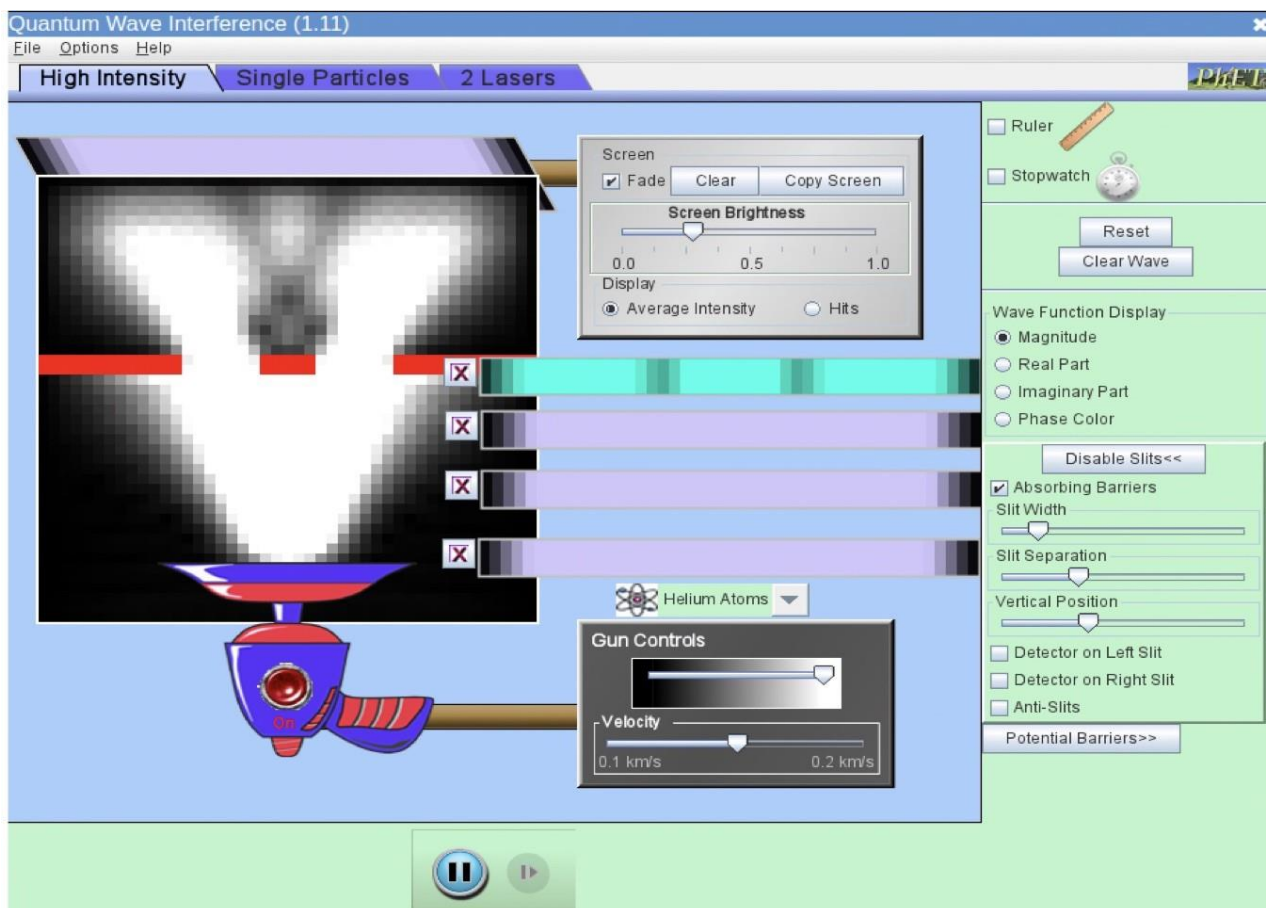
EFFECTS OF FREQUENCY ON INTERFERENCE PATTERN :

And decrease in frequency will result in fewer lines per centimeter and a greater distance each consecutive line.

INTERFERENCE PATTERN OF PHOTON : The experiment is sufficiently sensitive, the interference pattern appears grainy. Single photons travel as though they are interfering with other photons but are themselves individual.

INTERFERENCE PATTERN OF ELECTRON : No interference pattern was observed.

INTERFERENCE PATTERN OF NEUTRON : No interference pattern was observed.



OBSERVATION TABLE :

Analysis of interference pattern of photon, electron, helium atom and neutron atom.

INTERFERENCE PATTERN OF HELIUM ATOM : No interference pattern was observed.

PHOTON			
S. No.	Slit Width(nm)	Vertical Separation(nm)	Distance between 2 maxima(nm)
1.	300	1700	1100
2.	300	1400	900
3.	400	1400	900
4.	400	1100	700

NEUTRON

S. No.	Slit Width(nm)	Vertical Separation(nm)	Distance between 2 maxima(nm)
1.	0.5	3	1.5
2.	0.5	2.5	1.3
3.	0.7	1.9	0.7
4.	0.7	2.3	0.9
5.	0.5	1.2	0.5

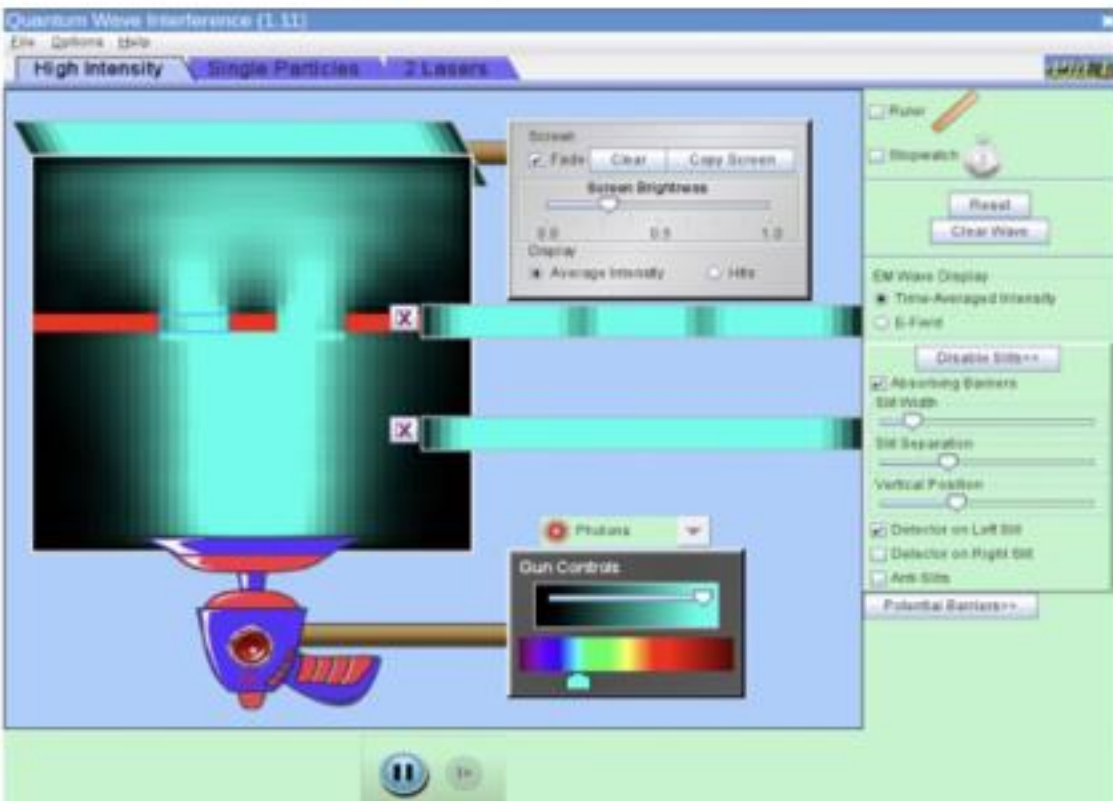
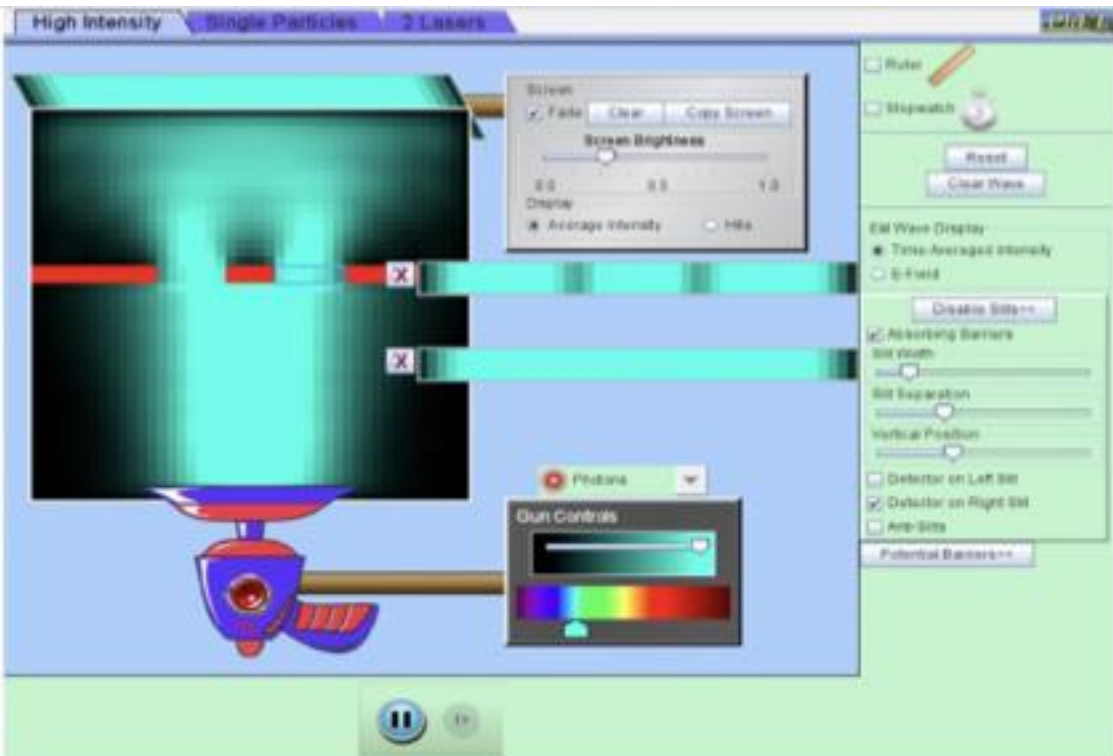
ELECTRON

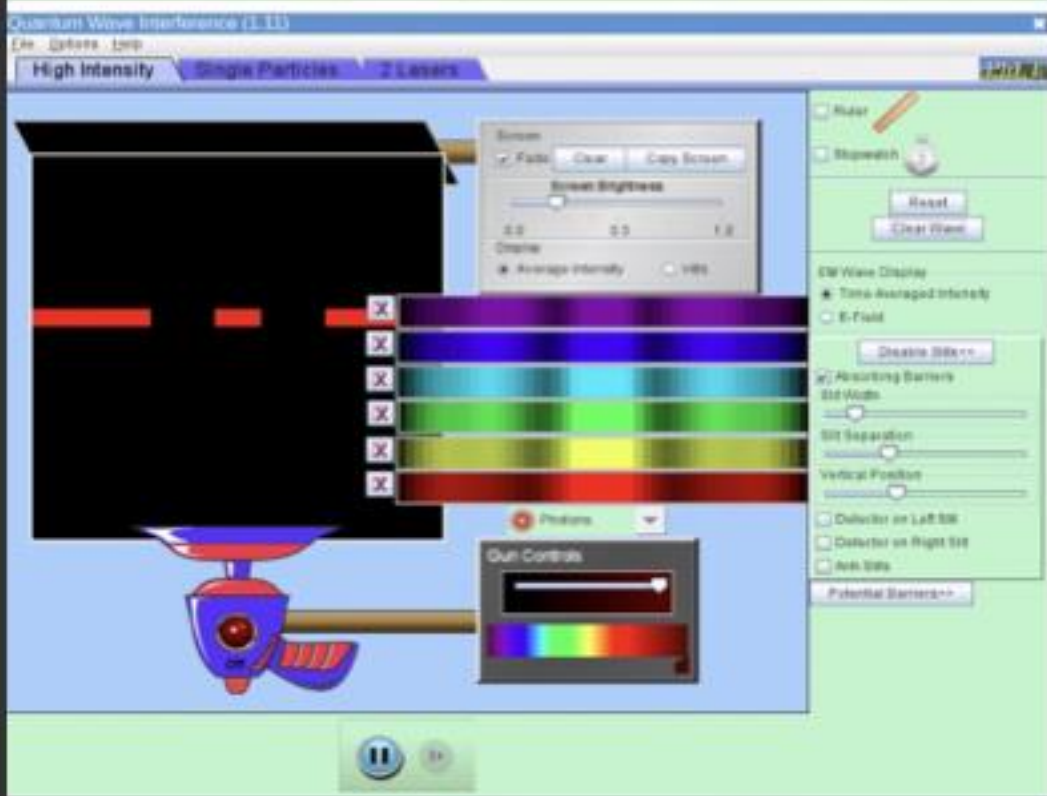
S. No.	Slit Width(nm)	Vertical Separation(nm)	Distance between 2 maxima(nm)
1.	0.5	2.7	1.3
2.	0.7	2.7	1.3
3.	0.7	3.1	1.5
4.	0.7	1.8	0.75
5.	0.5	3	1.5

HELIUM ATOMS

S. No.	Slit Width(nm)	Vertical Separation(nm)	Distance between 2 maxima(nm)
1.	0.5	1.2	0.5
2.	0.7	1.2	0.2
3.	0.5	2.8	1.3
4.	0.5	3.1	1.1
5.	0.7	1.8	0.7







ERROR IN RESULTS :

1. Measurement error while measuring distance between 2 maxima's, slit width and vertical separation because of the least count of the device.

2. % error can be calculated by using this formula :

$$\% \text{ error} = |\text{expected value} - \text{experimental value}|$$

RESULT ANALYSIS :

1. Changing the slit width, decreases the intensity of the maxima obtained on screen.

2. Changing only the slit width, decreases the distance between 2 maxima.

3. No maximas are obtained, if vertical separation between screen and slits is small.

4. No maximas are obtained when slit width is small.

5. No interference pattern was observed in the case of electrons, neutrons and helium atoms.

Thank you