

# QUANTUM WAVE INTERFERENCE SIMULATION

Recreating strange results from Dr. Quantum Video in the double slit experiment.

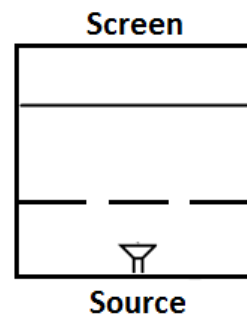
PhET Quantum Wave Interference Simulation:

<https://phet.colorado.edu/en/simulation/quantum-wave-interference>

Set up instructions for simulation:

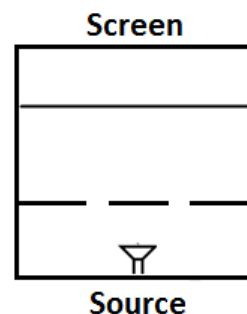
- Click the play button on the simulation.
  - Click RUN CHEERPJ BROWSER-COMPATIBLE VERSION option.
1. Recreate the claim that shooting particles at the double slit can create an interference pattern. Time stamp (2:13-2:45) in Dr. Quantum video.

- Click on the “High Intensity” tab at the top left of the simulation.
- Click on “Double Slits” on the right toolbar.
- Select “Electrons” in the drop-down menu for the particle that will be fired.
- Click on the red button on the gun to turn it on.
- Adjust the “Screen Brightness,” “Slit Width,” “Slit Separation,” and “Vertical Position,” bars to create an interference pattern with the electrons.
- Record a description of what you did to the controls and a sketch of the interference pattern.



2. Recreate the claim that shooting particles at the double slit one particle at a time can still create an interference pattern. Time stamp (2:45-3:42) in Dr. Quantum video.

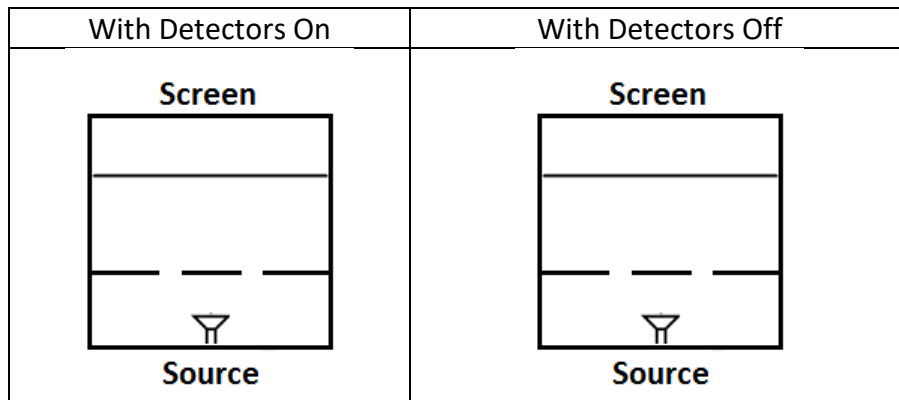
- Click on the “Single Particles” tab at the top left of the simulation.
- Click on “Double Slits” on the right toolbar.
- Select “Electrons” in the drop-down menu for the particle that will be fired.
- Check the box for “Auto-repeat” firing in “Gun Controls.”
- Adjust the “Screen Brightness,” “Slit Width,” “Slit Separation,” and “Vertical Position,” bars to create an interference pattern with the electrons.
- Click on the red button on the gun to turn it on and wait for 2-3 minutes to see if you have created an interference pattern. If there is not an interference pattern, adjust the controls and try it again. Look at the wave path to help predict if an interference pattern is created.
- Record a description of what you did to the controls and a sketch of the interference pattern.



Firing photons through one at a time came up with a really weird result, which did not match the classical view of the world. Scientists wanted more information, and so they decided to put

detectors at the slits so that they could know which slit each photon was passing through on its way to the screen.

3. Recreate the claim that shooting particles at the double slit one particle at a time can still create an interference pattern, but that adding a detector in front of the slit makes the interference pattern disappear. The detector stops wave behavior, and it reverts to particle behavior. Time stamp (3:42-4:36) in Dr. Quantum video.
  - Click on the “High Intensity” tab at the top left of the simulation.
  - Click on “Double Slits” on the right toolbar.
  - Select “Electrons” in the drop-down menu for the particle that will be fired.
  - Click on the red button on the gun to turn it on.
  - Adjust the “Screen Brightness,” “Slit Width,” “Slit Separation,” and “Vertical Position,” bars to create an interference pattern with the electrons.
  - Add a detector, and the interference pattern should disappear. You may need to lower the screen brightness, but once you have it set up right, adding a detector removes the interference pattern and removing the detector brings the interference pattern back.
  - Record a description of what you did to the controls and a sketch of the interference pattern.



### What Did I Learn Today?

On the back of this paper, take five minutes to write out some of the key ideas covered in class and include a list of when an interference pattern will and will not form when using a double slit.