

Hands-On Wave Particle Duality

Perimeter Explorations 02



CERN HST2019

Black Box

Building and Revising
Scientific Models



Double Slit with Classical Particles (POE)

Sketch your prediction and provide **three (3) phrases** describing why you think this will happen.

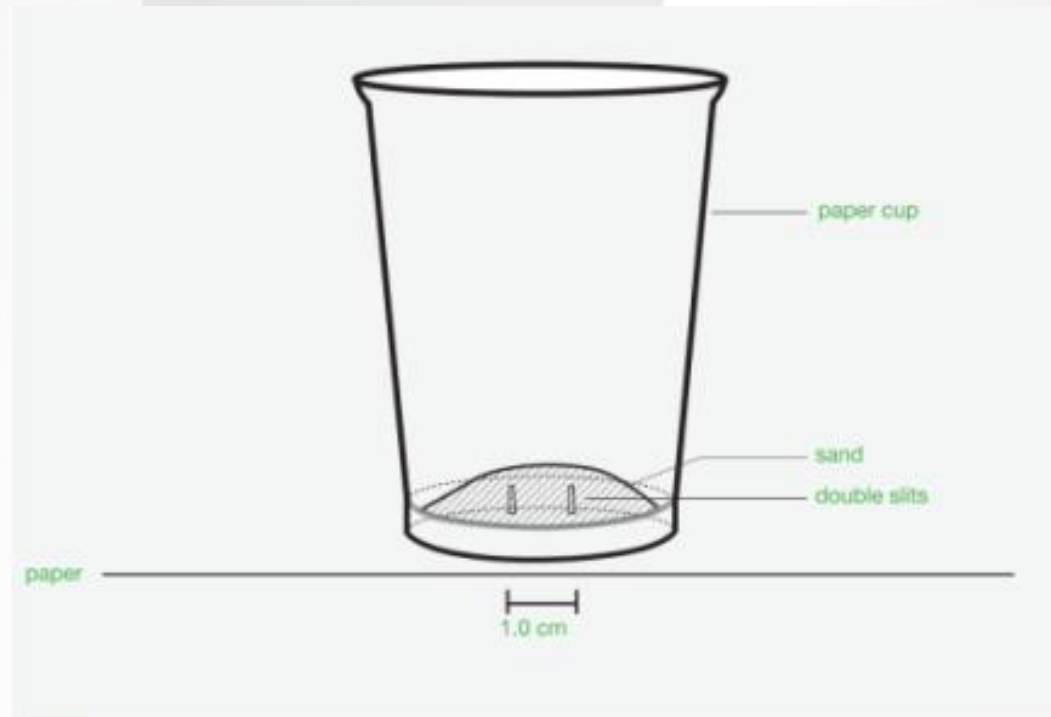


Figure 1 Be sure to keep the cup still and on the tabletop when pouring the sand through the slits.

Double Slit with Classical Particles (POE)

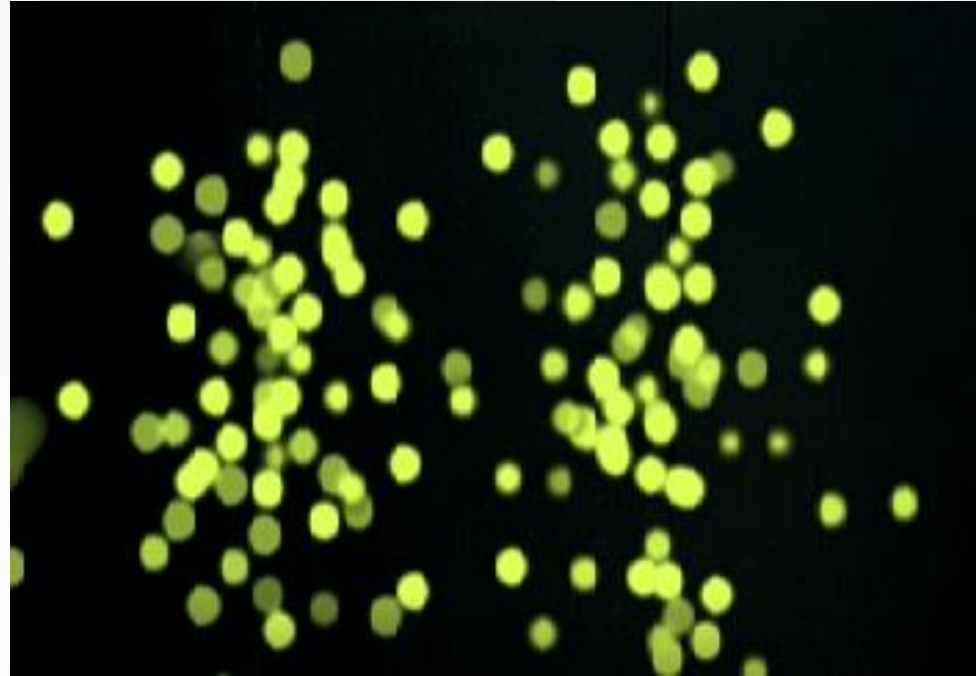


Classical particles...
collide
localized

Particle Model of Nature

What is a particle?

- Localized object
- Only in one place at a time
- Can bounce off other particles



Double Slit with Classical Waves (POE)

Sketch your prediction and provide **three (3) phrases** describing why you think this will happen.

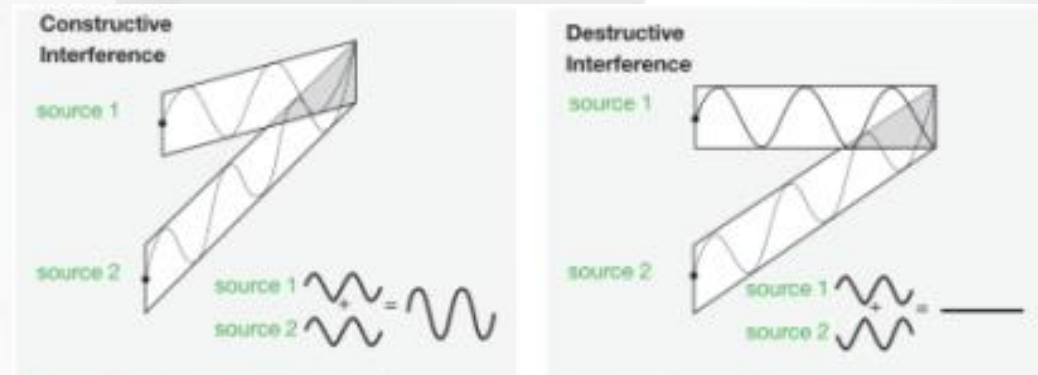


Figure 2 Recall the constructive interference and destructive interference of classical waves.

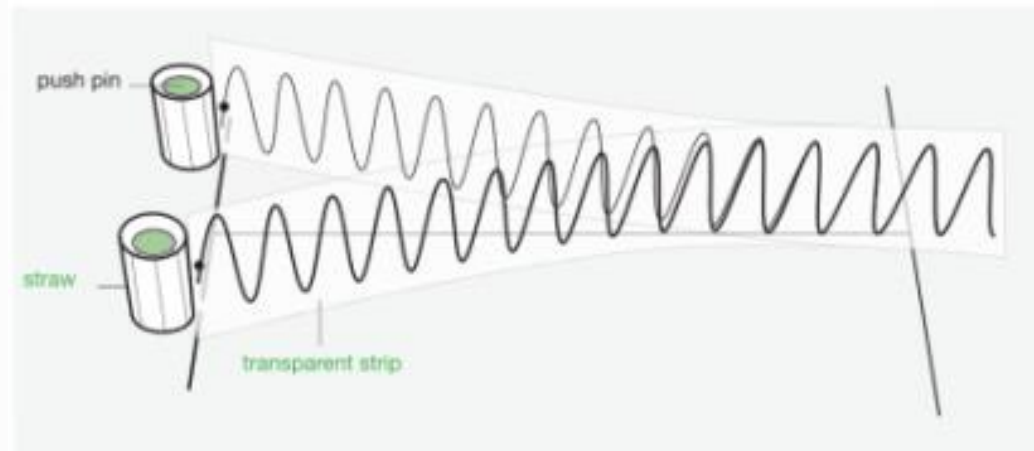
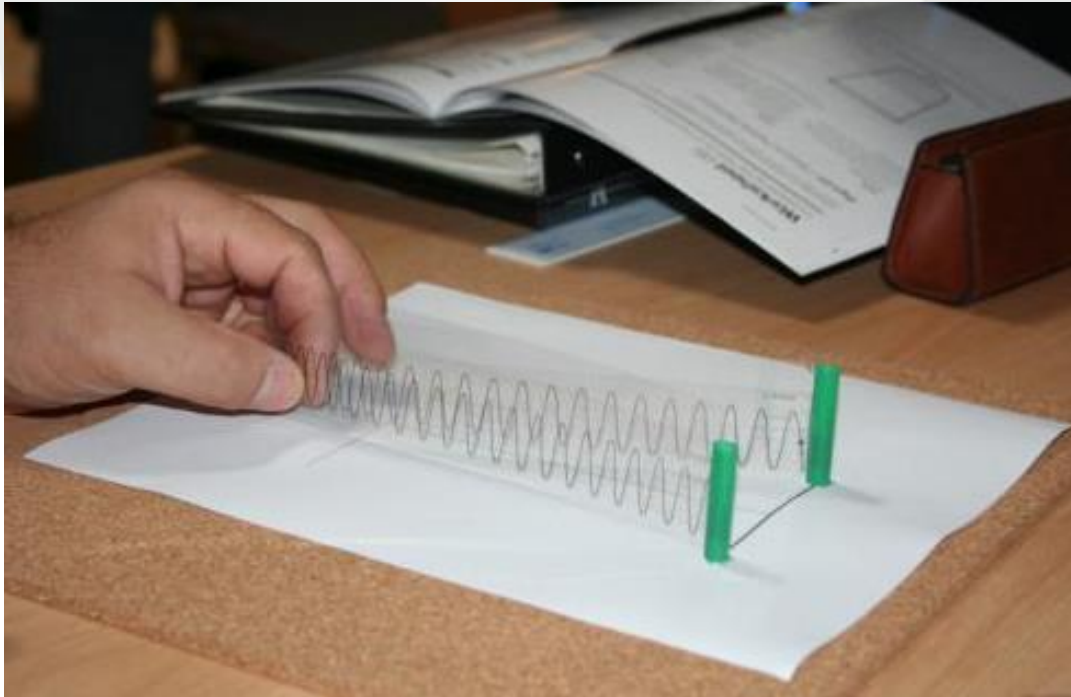


Figure 3 Use waves drawn on transparencies to observe interference.

Double Slit with Classical Waves (POE)

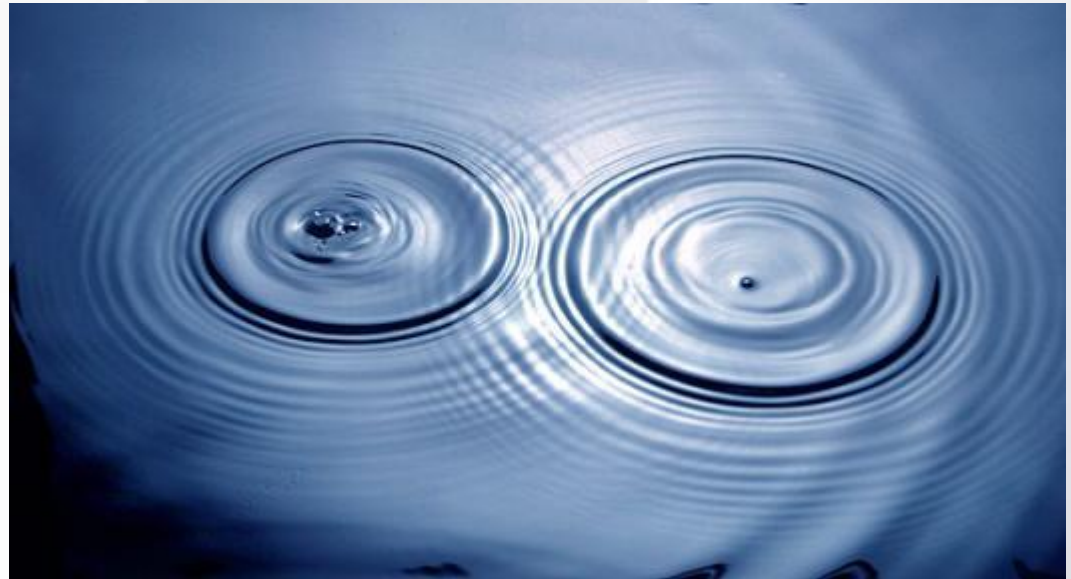


Classical waves...
interfere
non-localized

Wave Model of Nature

What is a wave?

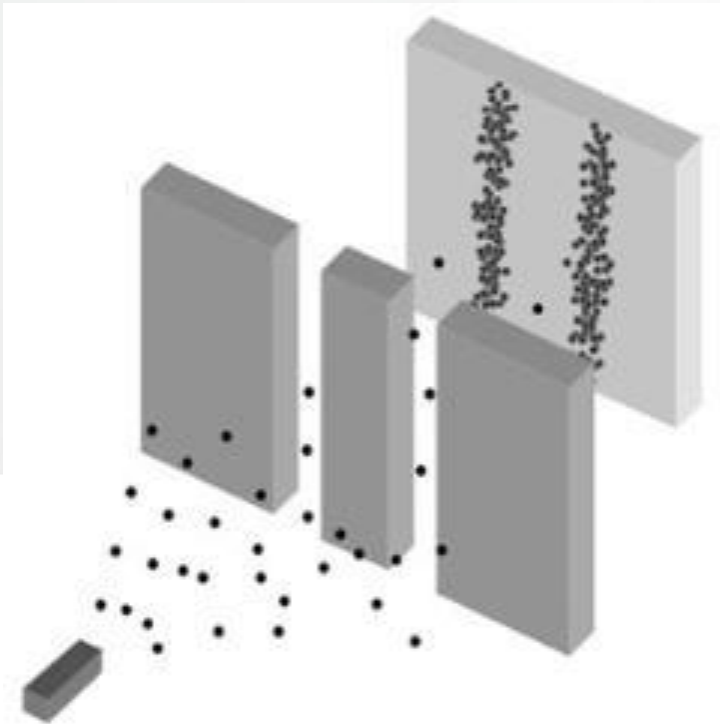
- Non-localized
- Spread out
- Add together to produce interference



Summary

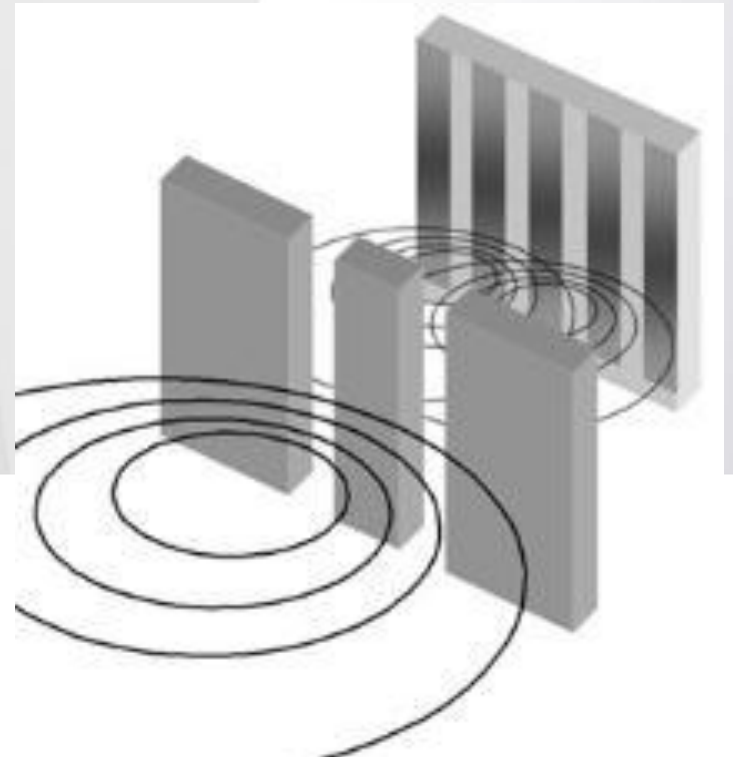
Particles

- Localized
- One place at a time
- Can bounce off other particles



Waves

- Non-Localized
- Spread out
- Add together to produce interference



Electrons Through the Double Slits

What model do you think the electron will most closely follow?

What should happen if we pass electrons through the two slits?

Double Slit with Electrons



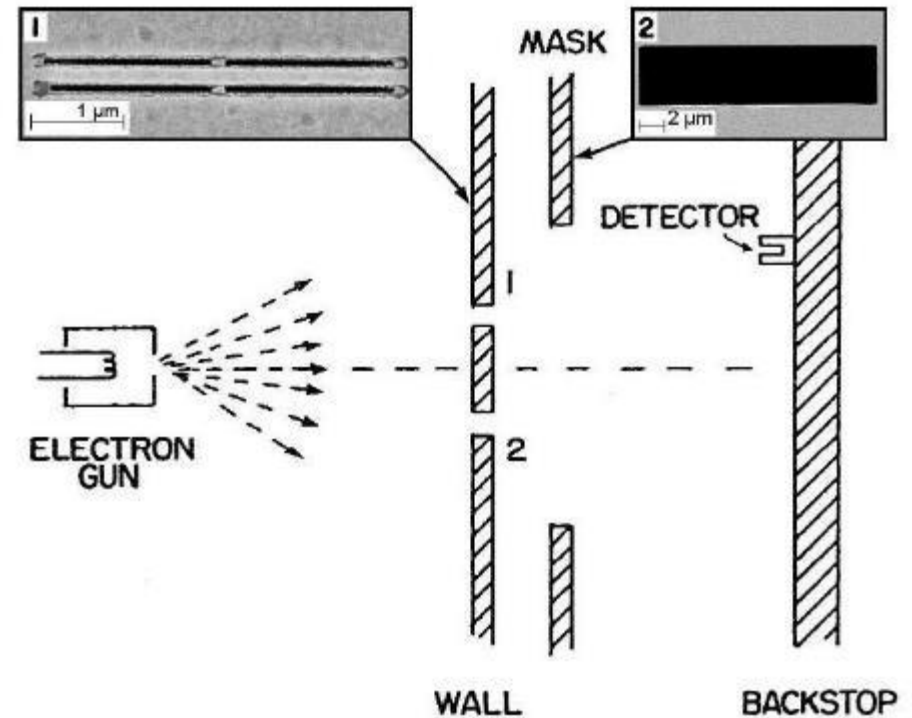
Double Slit with Electrons

Download the Challenge of Quantum Reality resource and video at:

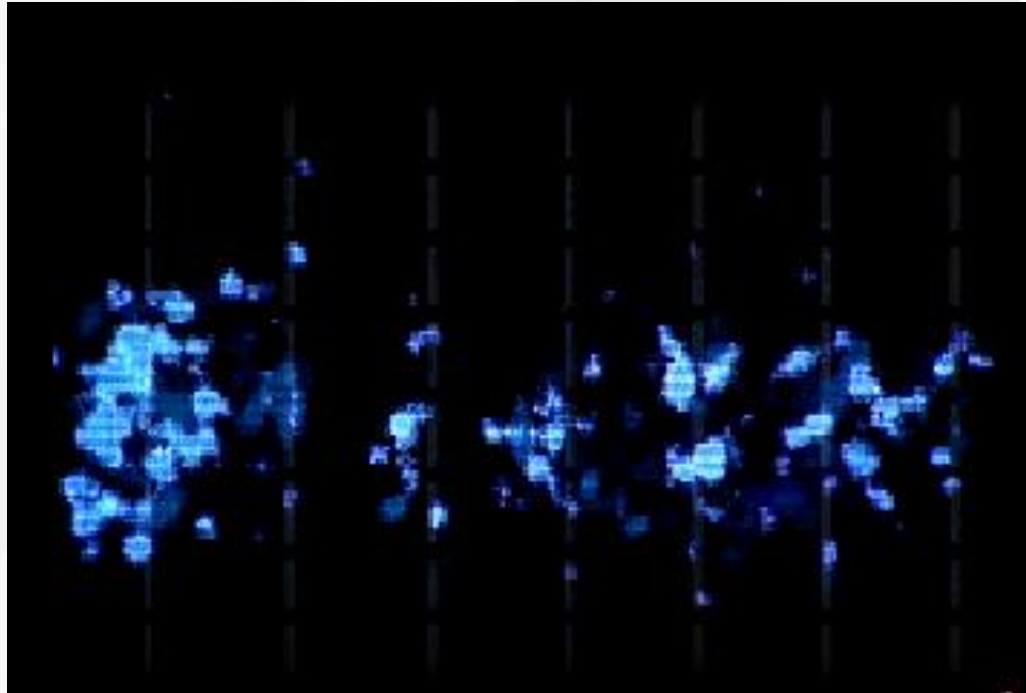
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Electrons Through the Double Slits

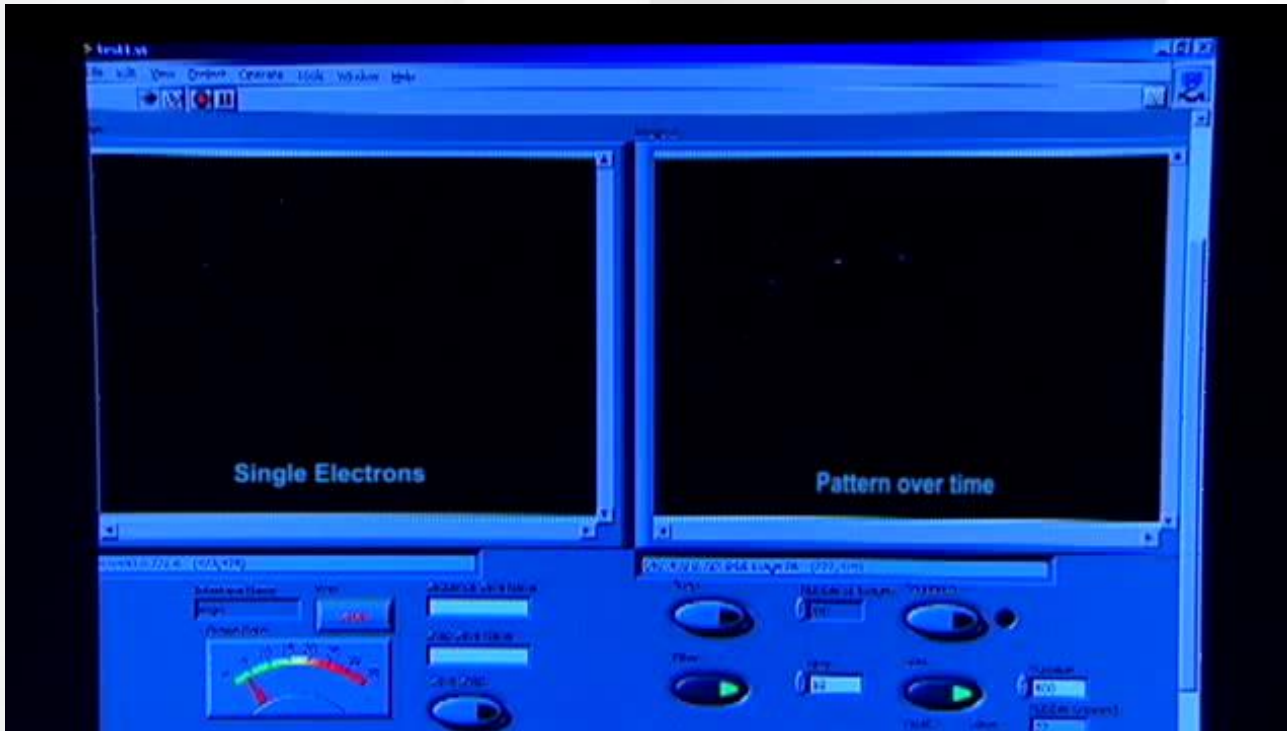
Sketch your prediction and provide **three (3) phrases** describing why you think this will happen.



Double Slit with Electrons



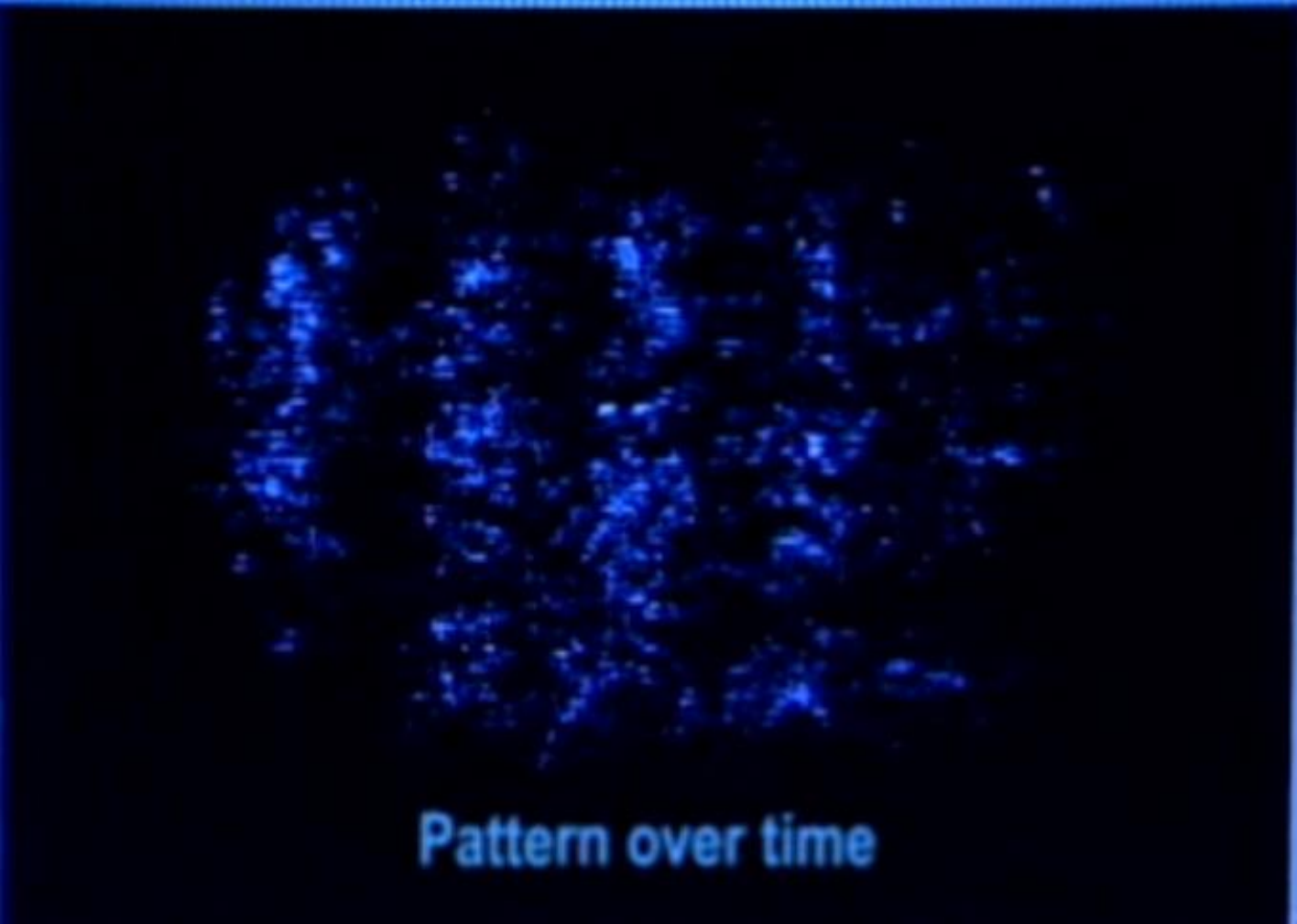
Double Slit with Electrons



Double Slit with Electrons

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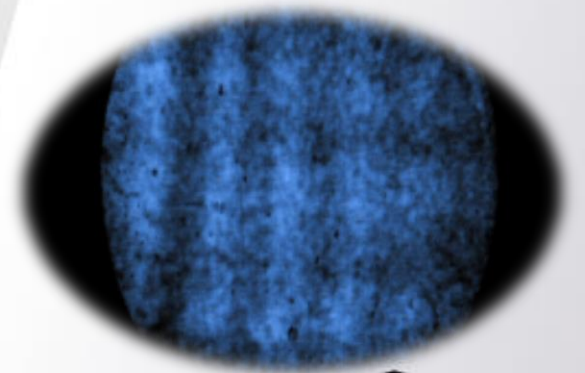
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Wave-Particle Duality

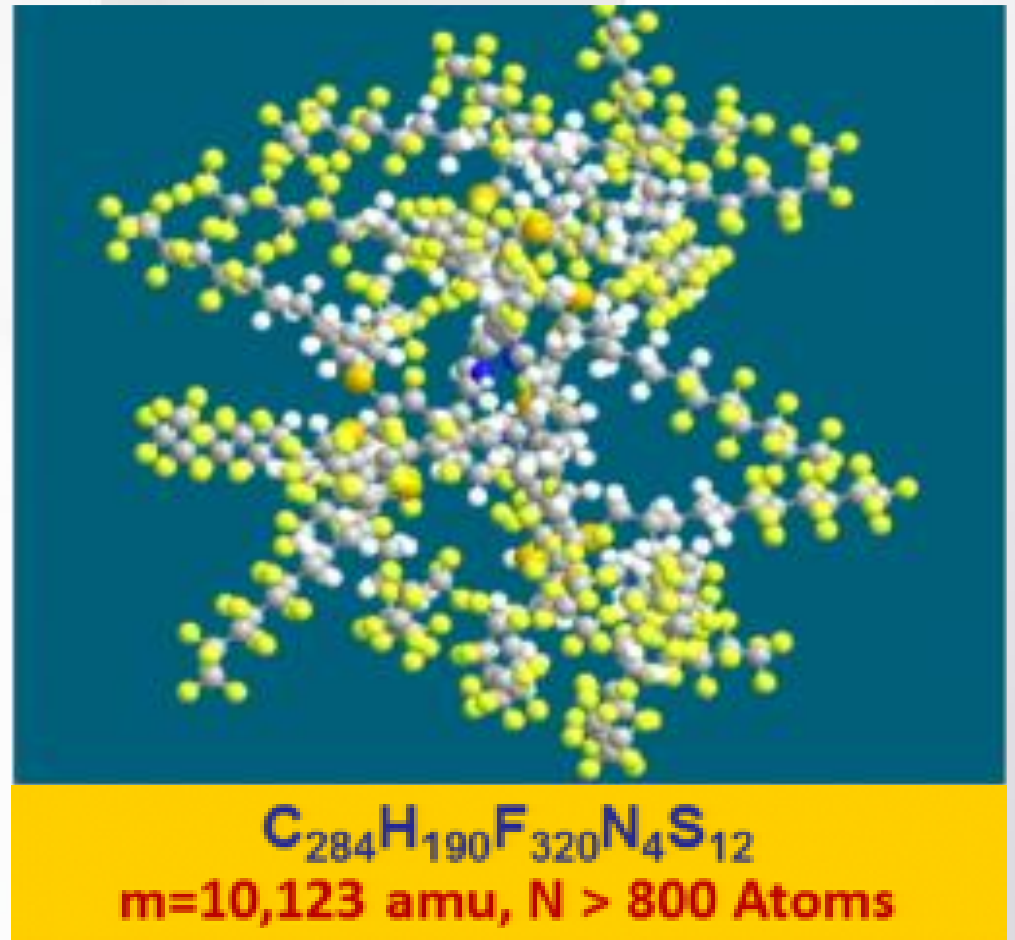
Electrons ...

- leave and arrive individually
- arrive at discrete, random locations
- produce an interference pattern

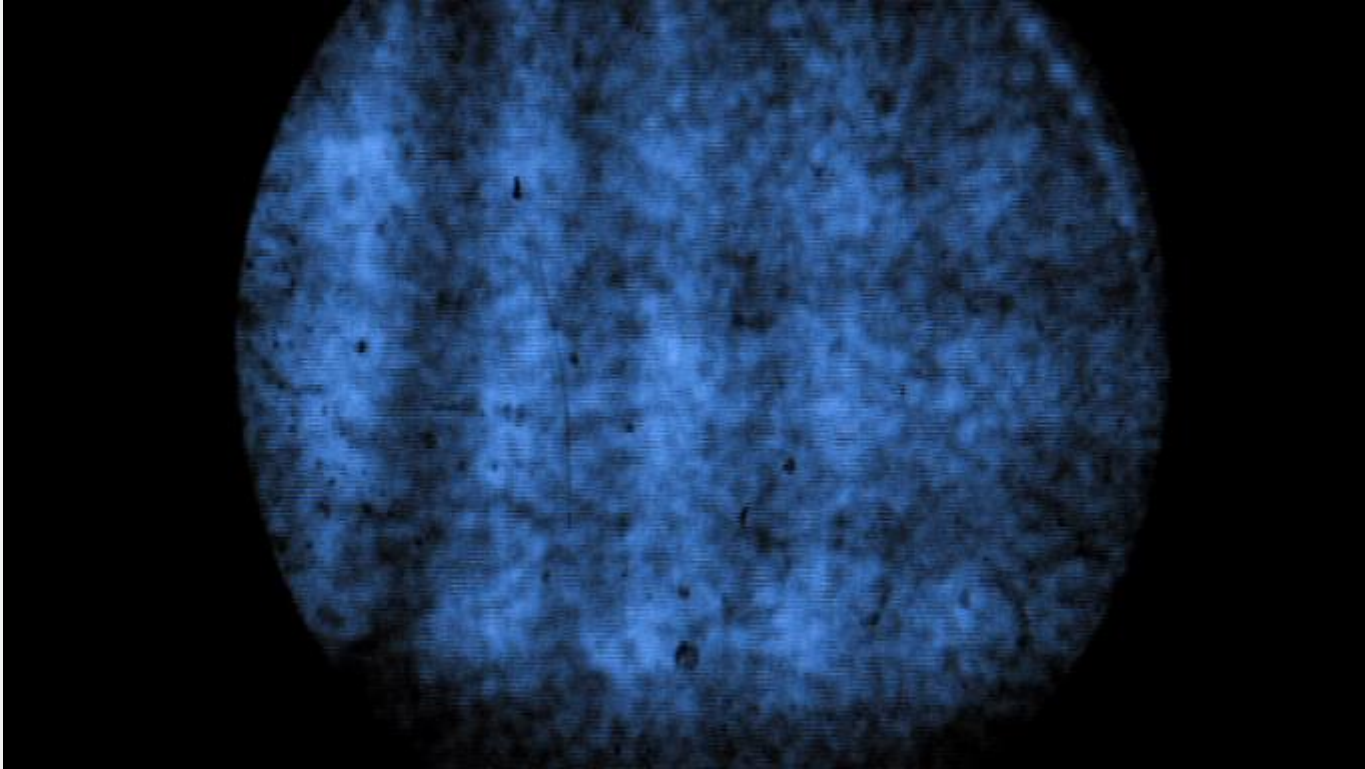


Wave-particle Duality is Universal

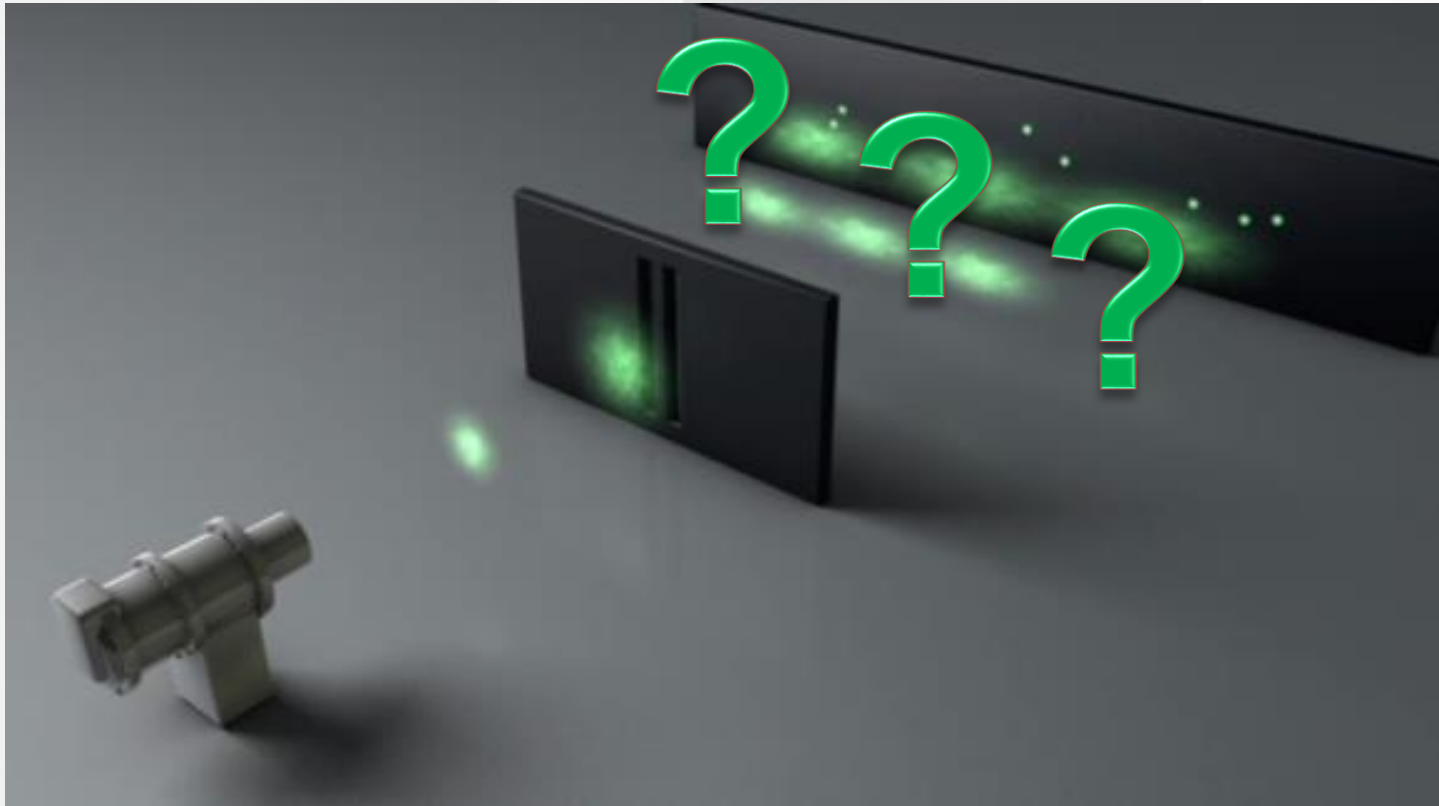
- Protons
- Neutrons
- Light
- Atoms
- Molecules



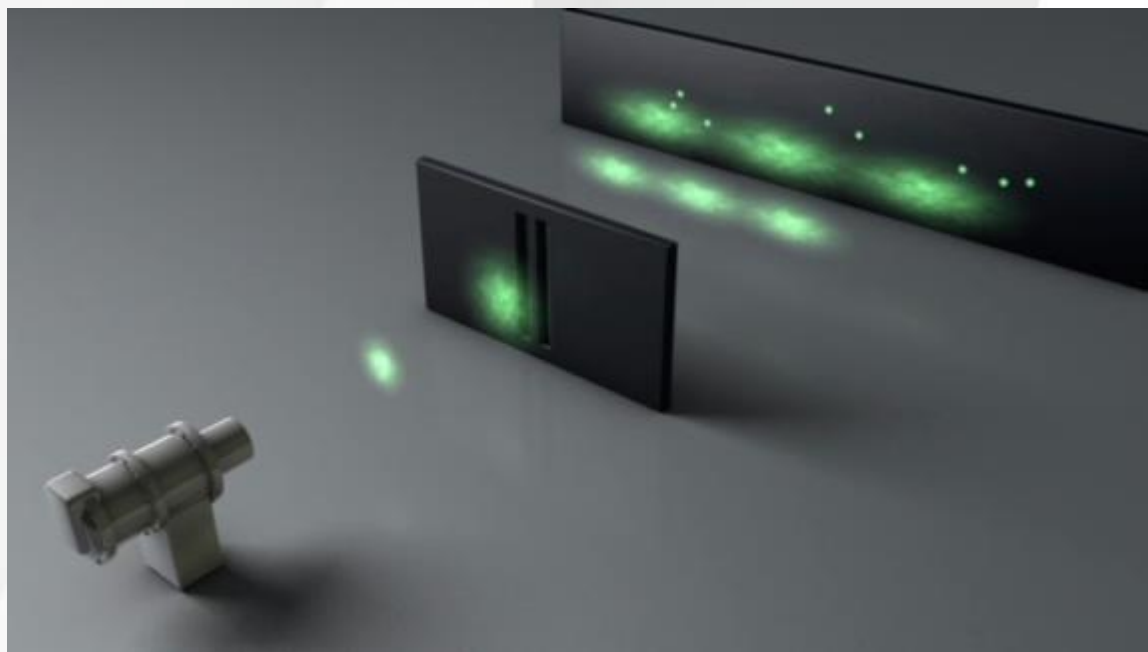
What is the electron doing?



What is your interpretation?



Interpretations: Collapse

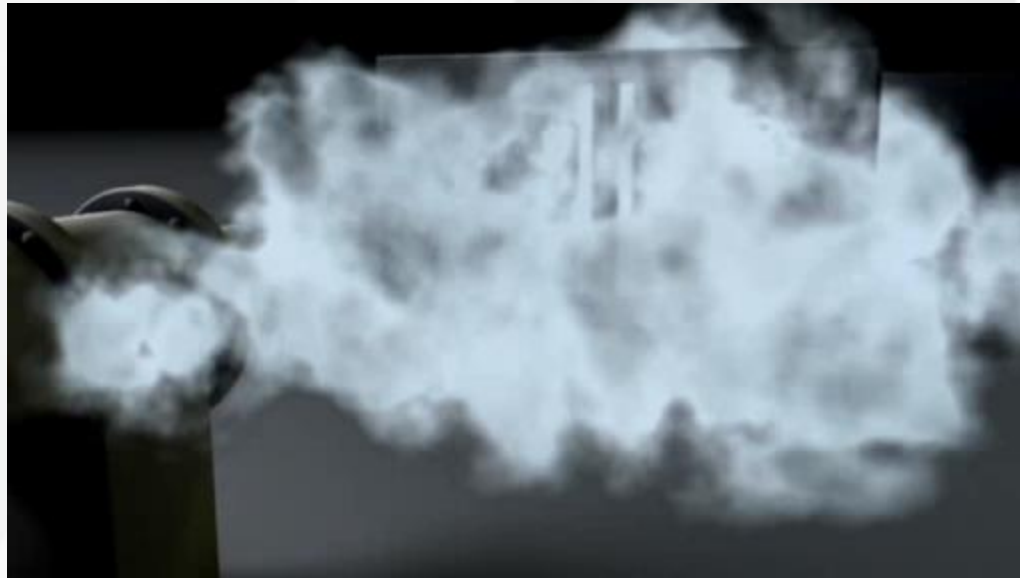


Interpretations: Collapse

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Interpretations: Copenhagen

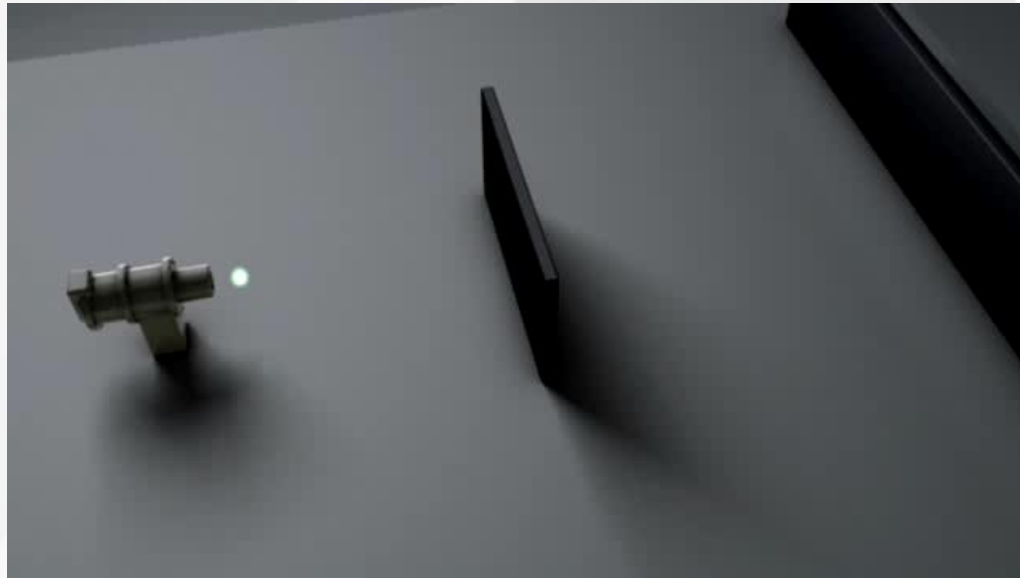


Interpretations: Copenhagen

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Interpretations: Many Worlds

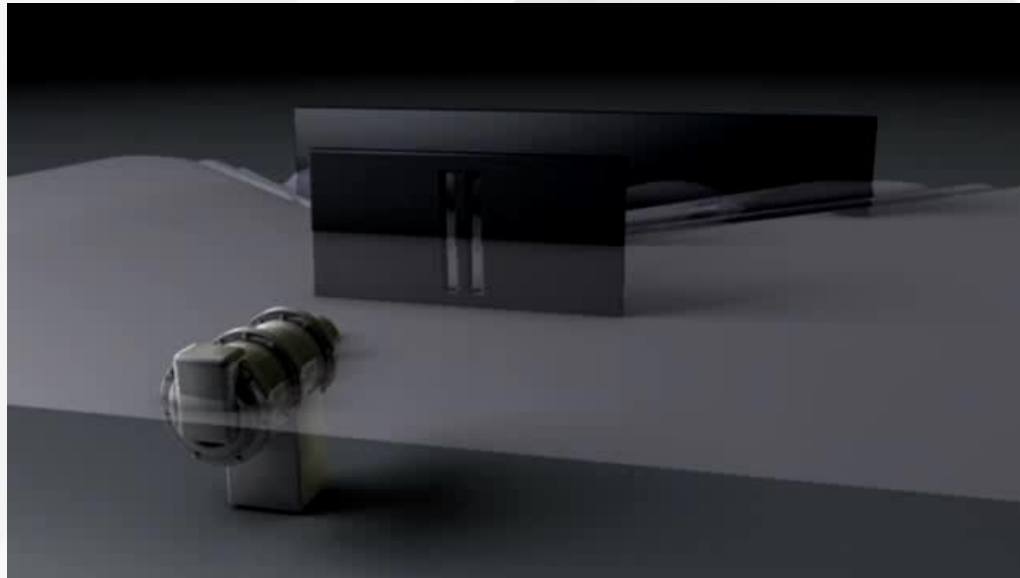


Interpretations: Many Worlds

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Interpretations: Pilot Wave



Interpretations: Pilot Wave

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Quantum Used in Technology



Thank You!!

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