PHY100S - The Magic of Physics - Class 20

"First they told us the world was flat. Then they told us it was round. Now they are telling us that it isn't even there."

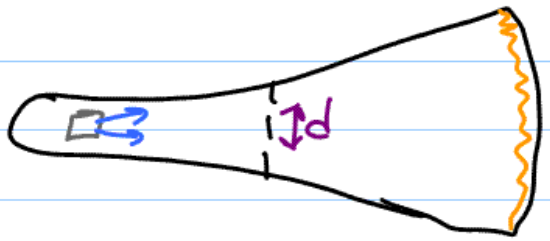
-- Irving Oyle

§ 14.3

Couple of things to add.

$$\Delta \text{position} \; \Delta \text{speed} \geq \frac{h}{4\pi m}$$

(1)



vertical position ~ d

⇒ uncertainty in speed small

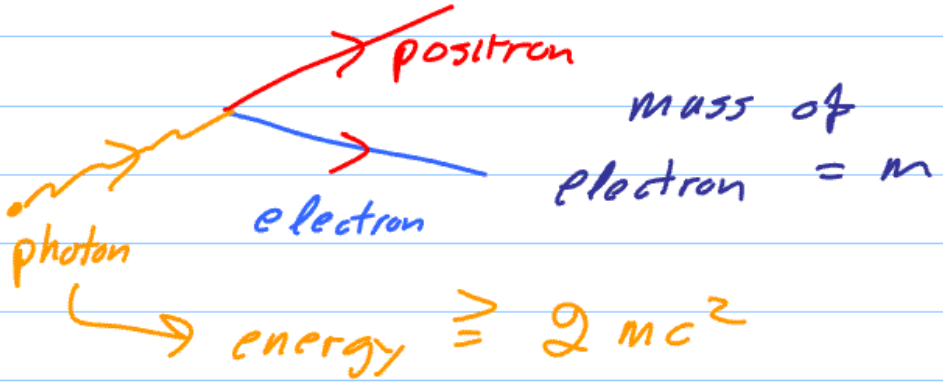
If we look: Δ position ~ width of slit or less ⇒ uncertainty in vertical speed larger

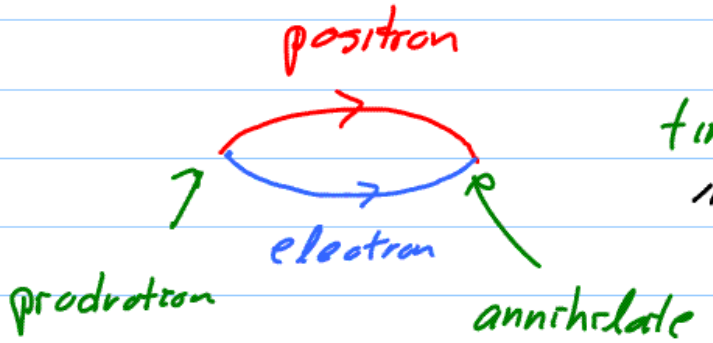
what destroys interference

(2) $\Delta \text{energy}\ \Delta \text{time} \geq \frac{h}{4\pi}$

violate conservation of energy briefly!

recall pair production & annihilation:





strong evidence this happens!

1935 Einstein, Podolsky & Rosen (EPR) – QM is incomplete.

↓

1950's Bohm re-analysed EPR clearly.

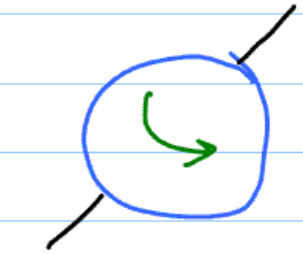
↓

1964 **Bell's Theorem**

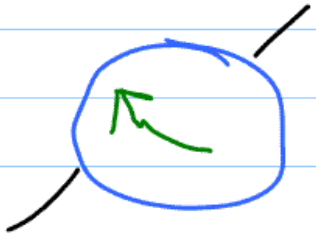
Background

Electrons have "spin"

2 possible states!

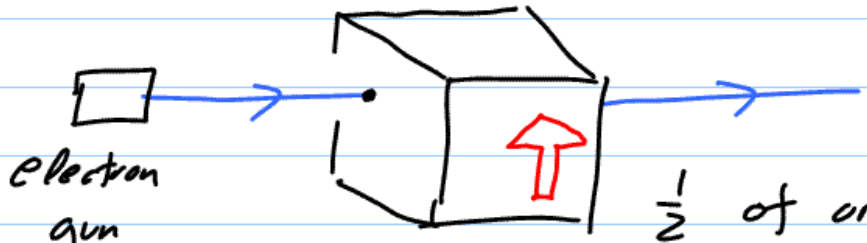


"up"



"down"

Construct a "filter" that selects only spin-up.



$\frac{1}{2}$ of original beam emerges.

For single electron - whether it emerges or not is random.

Is there a hidden variable in electron that determines whether it passes the filter?

Measurement defines "up"
Wipes out any previous measurements.