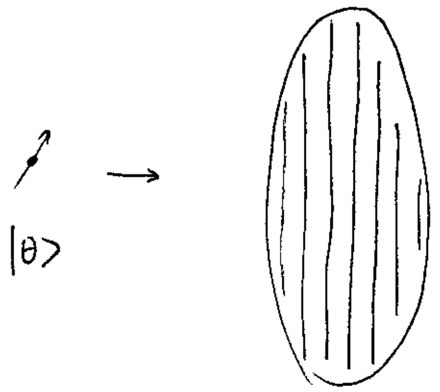
LAST TIME :



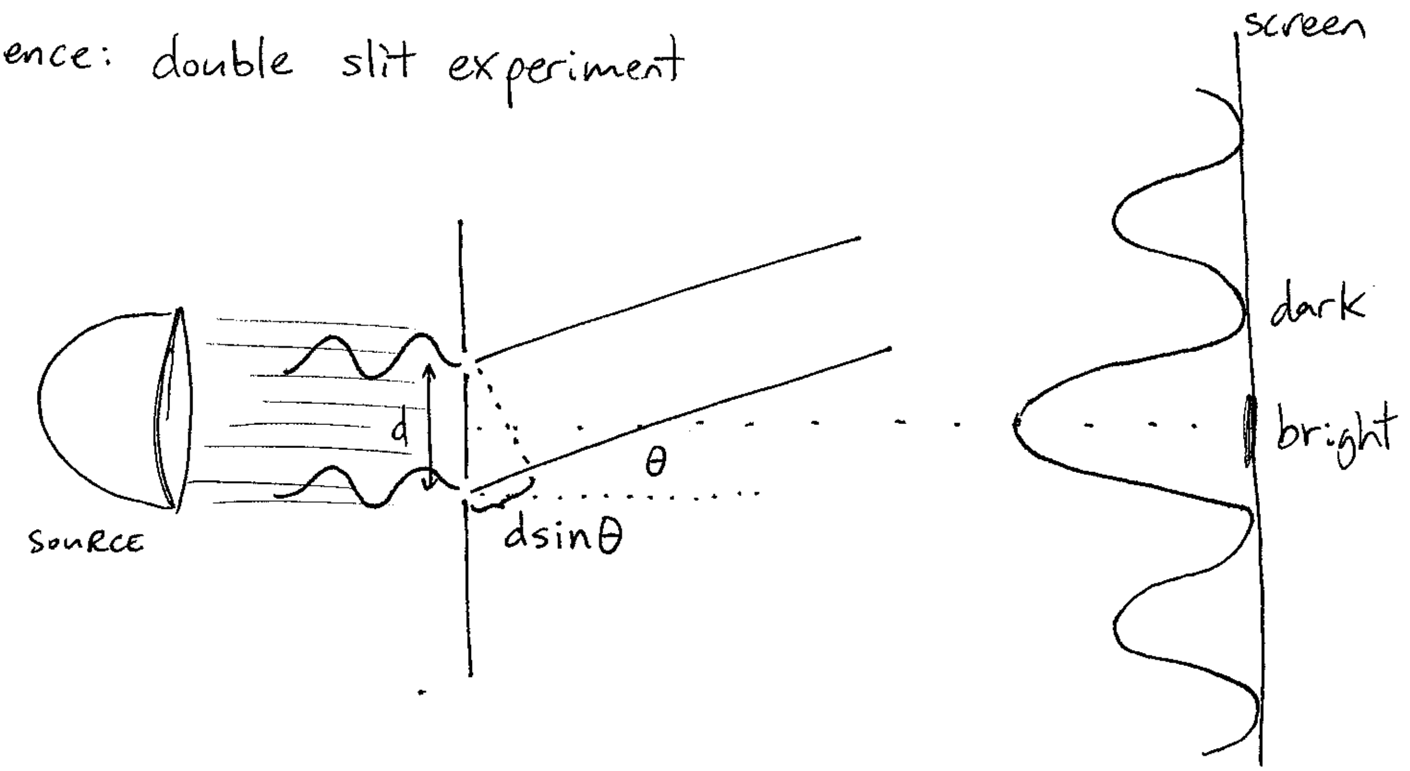
general photon polarization state = quantum superposition of eigenstates

$$|\theta\rangle = \cos\theta\,|0^\circ\rangle + \sin\theta\,|90^\circ\rangle$$

At polarizer: changes to this or this w. probability $\cos^2\theta$ or $\sin^2\theta$.

Claim : idea of eigenstates/quantum superposition extends to all physical properties e.g. position

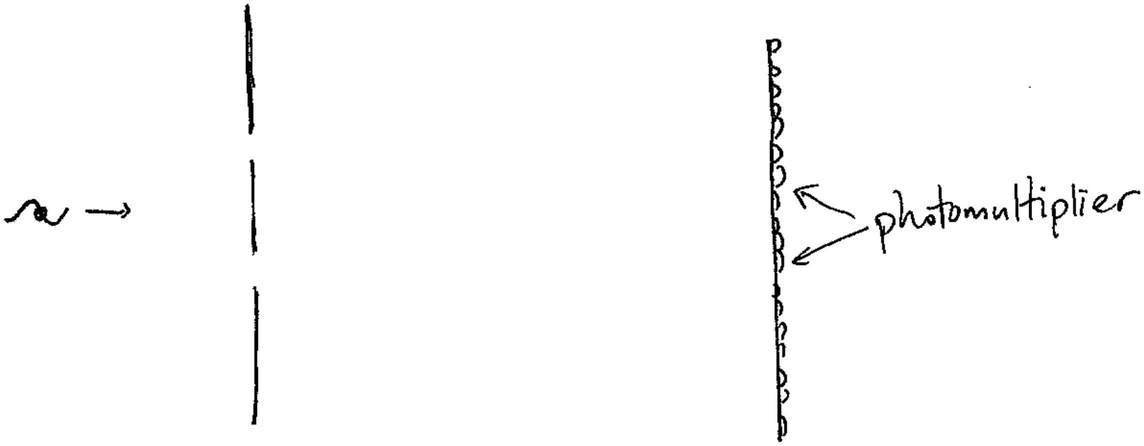
Evidence: double slit experiment



$$d\sin\theta = 0, \lambda, 2\lambda, \ldots \rightarrow \text{constructive interference}$$

$$d\sin\theta = \frac{\lambda}{2}, \frac{3\lambda}{2}, \ldots \rightarrow \text{destructive interference}$$

What happens for very low intensity (single photons)?



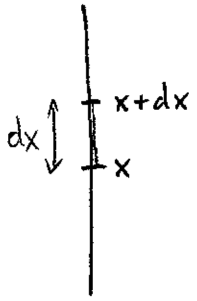
Answer: same pattern emerges

each photon $\longmapsto$ hits specific location

distribution of hits: matches classical intensity pattern.

CLICKER

explanation: for each photon, probability of hitting screen between x, $x+dx$ $\underset{\substack{\uparrow \\ \text{prop. to.}}}{\propto}$ classical intensity

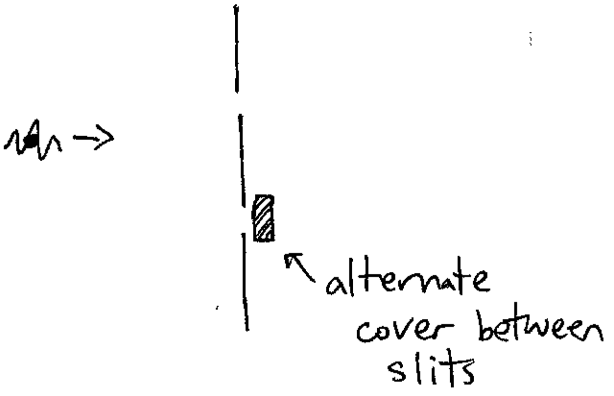


$$\overbrace{\underset{\substack{\uparrow \\ \text{probability} \\ \text{density}}}{P}(x)\cdot dx}^{\text{probability.}} \propto I(x)$$

BUT: classical explanation involved interference of light from two slits.

Doesn't each photon have to go through one slit or other?

Test: cover one slit each time & alternate.



result: pattern changed

→ most photons hit behind open slit.

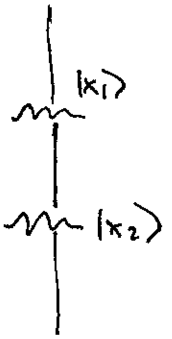
- Single photon can pass through both slits & interfere with itself!

BUT: still hits specific position on screen

Understand via QUANTUM SUPERPOSITION:

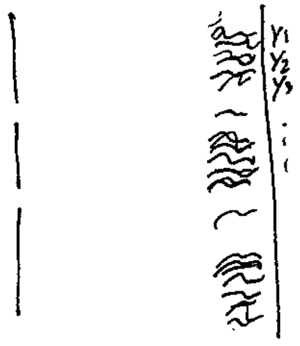
MODEL: can have photons with specific positions (position eigenstates)

BUT: general state is a superposition of these



e.g. $\frac{1}{\sqrt{2}}|x_1\rangle + \frac{1}{\sqrt{2}}|x_2\rangle$

LATER:



state:

$\psi(y_1)\,|y_1\rangle + \psi(y_2)|y_2\rangle + \ldots$

when photon hits screen:

state changes to $|y_1\rangle, |y_2\rangle$, etc...

with probability

$|\psi(y_1)|^2, \; |\psi(y_2)|^2, \ldots$

measure photon at definite location.