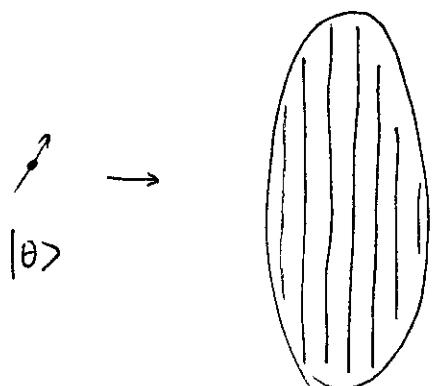


LAST TIME :



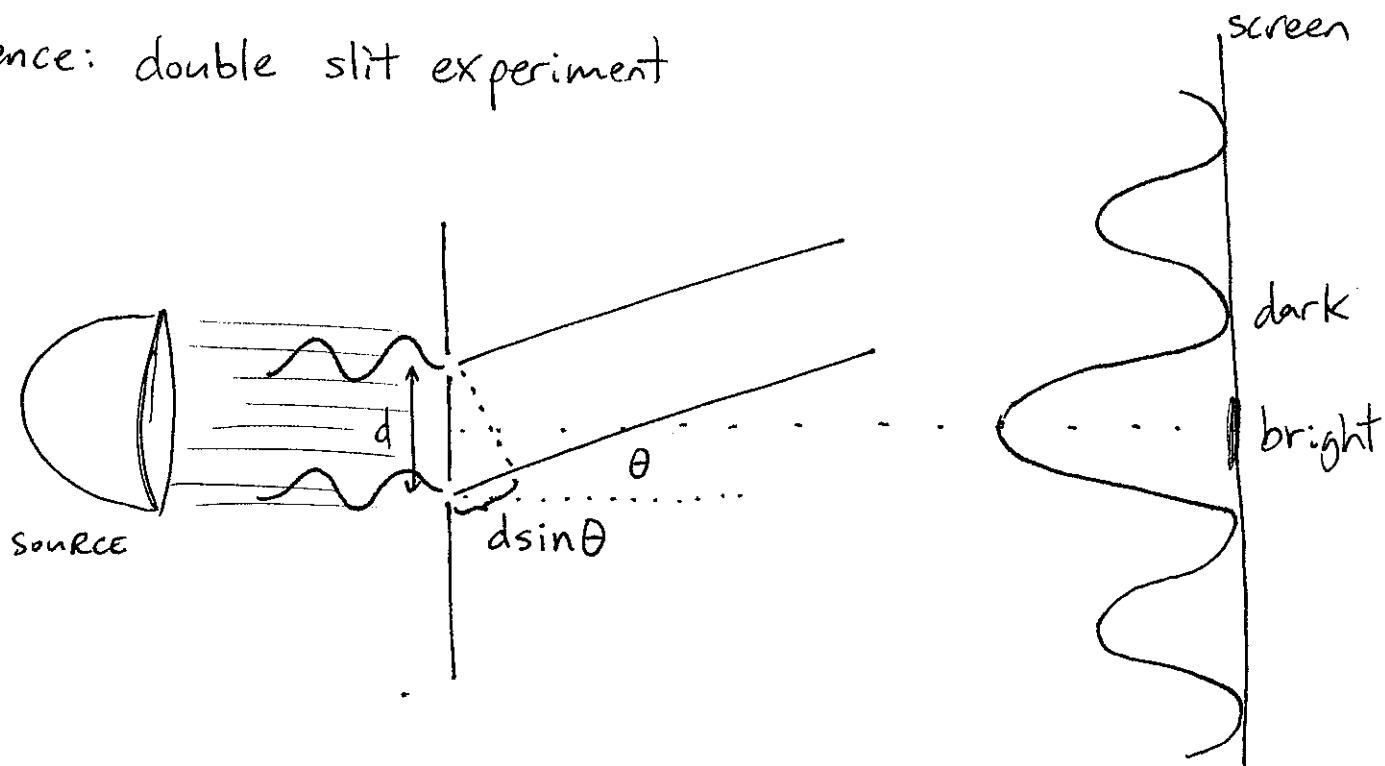
general photon polarization state  
= quantum superposition of eigenstates

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

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

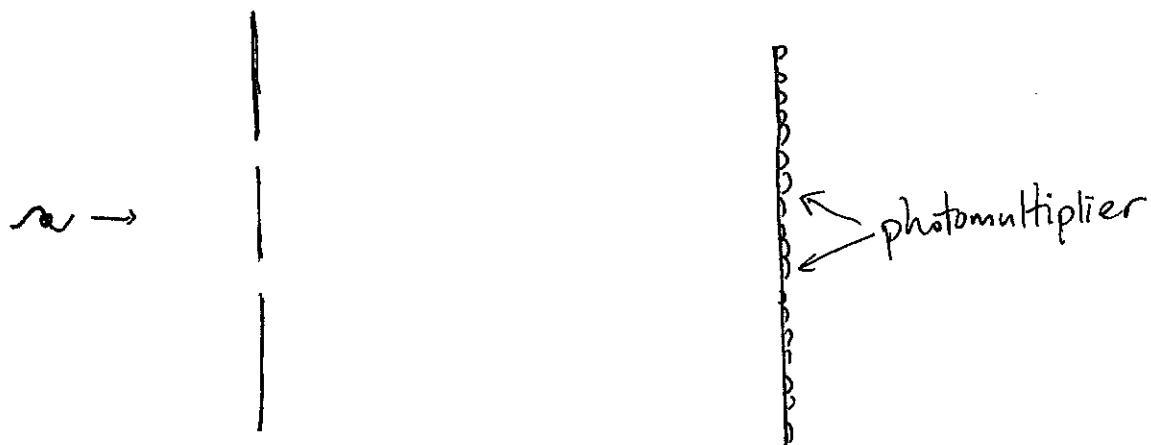
Evidence: double slit experiment



$ds\sin\theta = 0, \lambda, 2\lambda, \dots \rightarrow$  constructive interference

$ds\sin\theta = \frac{\lambda}{2}, \frac{3\lambda}{2}, \dots \rightarrow$  destructive interference

What happens for very low intensity (single photons)?



Answer: same pattern emerges

each photon  $\rightarrow$  hits specific location

distribution of hits: matches classical intensity pattern.

(clicker)

explanation: for each photon, probability of hitting screen between  $x, x+dx \propto$  classical intensity

$\uparrow$   
prop. to.

A hand-drawn diagram of a probability distribution curve. The horizontal axis is labeled with  $x$  and  $x+dx$ , with a small vertical arrow labeled  $dx$  pointing downwards. The area under the curve between these two points is shaded grey and labeled "probability". Below the curve, the expression  $P(x) \cdot dx \propto I(x)$  is written, with a bracket over  $P(x) \cdot dx$  labeled "probability" and a bracket over  $I(x)$  labeled "density".

$$P(x) \cdot dx \propto I(x)$$

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.

↑ alternate cover between slits

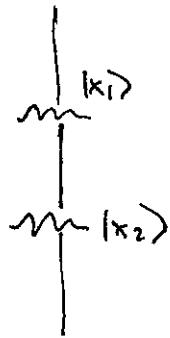
- Single photon can pass through both slits + interfere with itself!

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

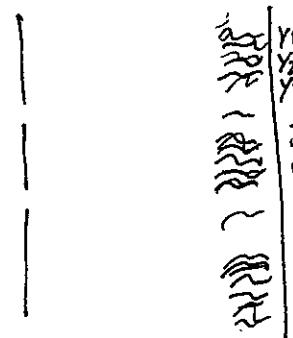


e.g.  $\frac{1}{\sqrt{2}}|x_1\rangle + \frac{1}{\sqrt{2}}|x_2\rangle$

state:

$$\Psi(y_1)|y_1\rangle + \Psi(y_2)|y_2\rangle + \dots$$

LATER:



when photon hits screen:

state changes to  $|y_1\rangle, |y_2\rangle, \dots$   
with probability

$$|\Psi(y_1)|^2, |\Psi(y_2)|^2, \dots$$

measure photon at definite location.