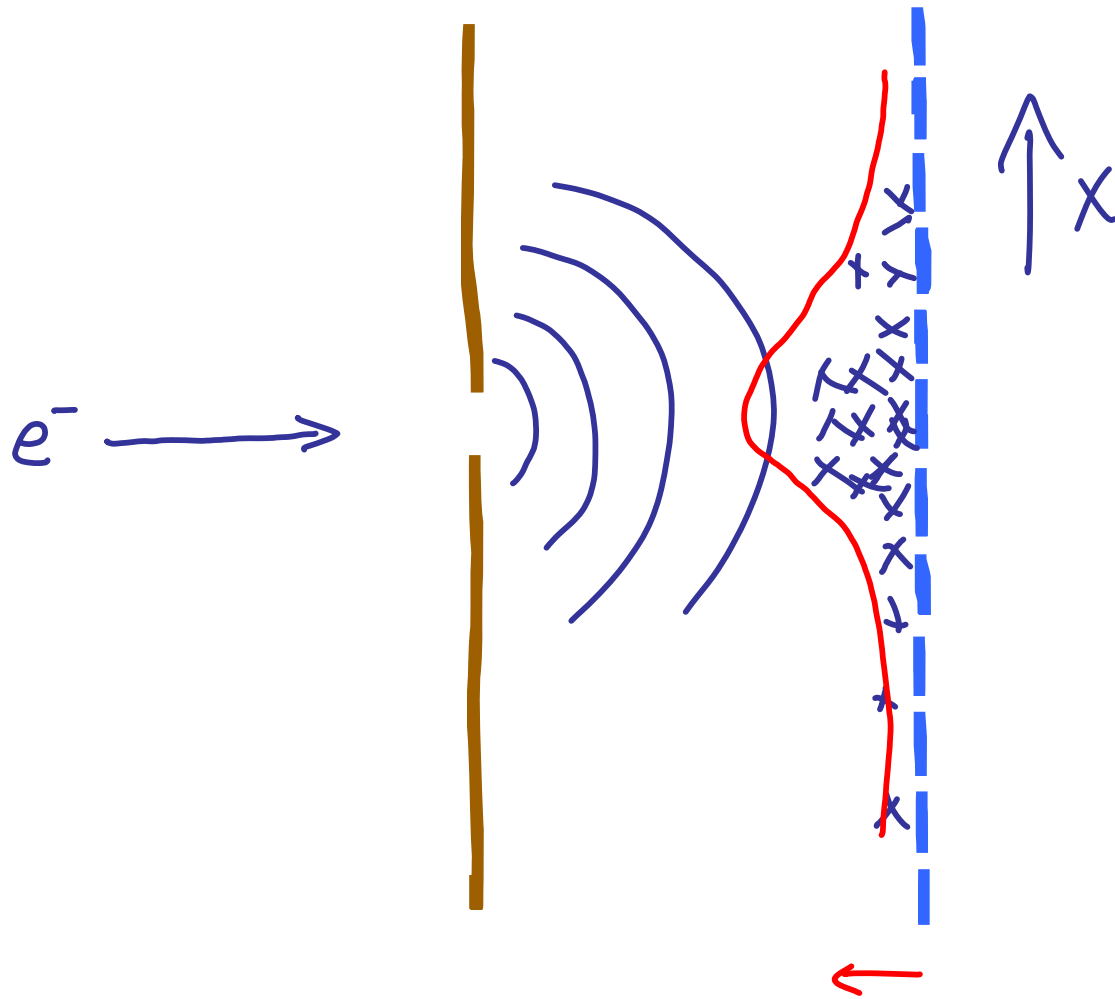


Physics 102 - March 2, 2011

- Exam 1 graded
Sols on Web
Distribution on Web
Mean grade $\sim 80-84$
all grades \swarrow core distribution
- Look over your exam carefully
- Regrade/grade issues



$\Psi(x)$ NOT well defined Probability

$\Psi^2(x)$ is well defined \rightarrow probability

Max Born German (1882-1970)

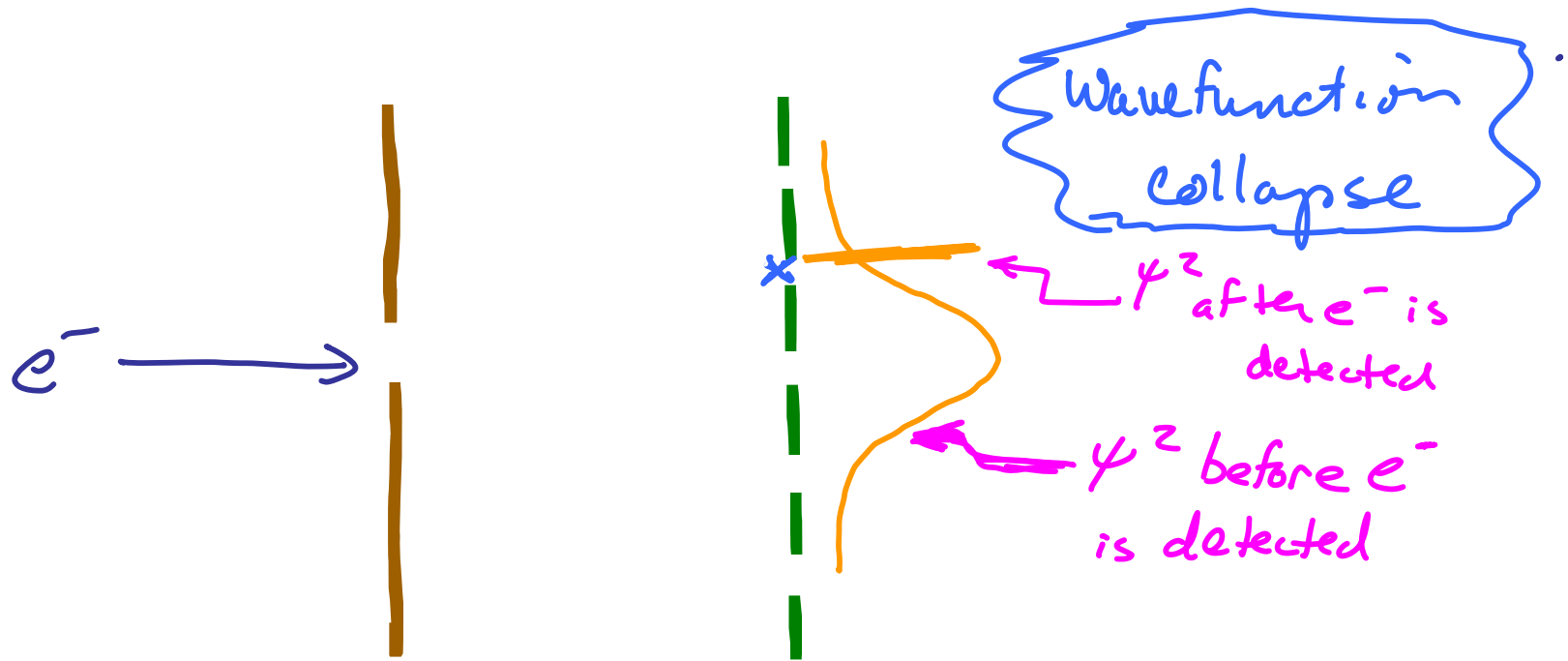


1954 Nobel Prize in physics

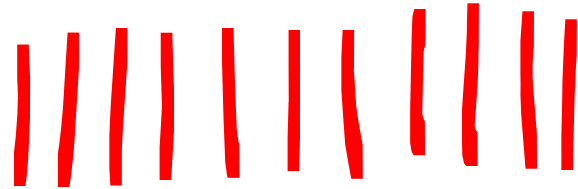
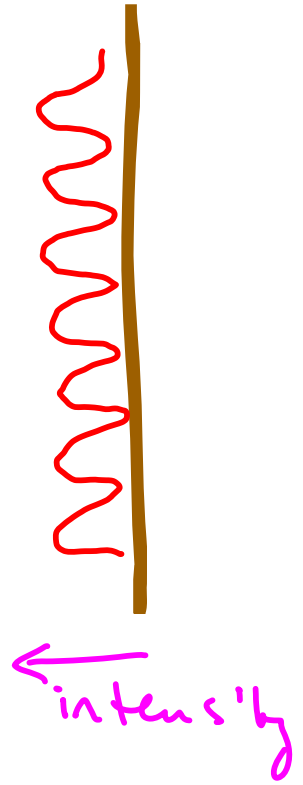
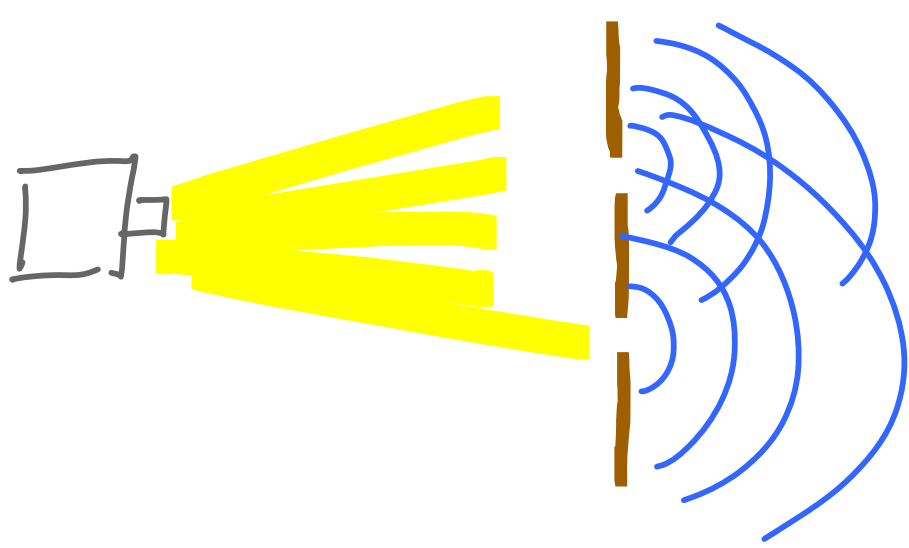
"For his fundamental research
in quantum mechanics,
especially for his statistical
interpretation of the
wavefunction"

$\psi(x)$ wave function

$\psi^2(x) \sim$ probability of finding particle
in region of space



Once electron hits the film/detector we know with 100% certainty where the electron hits
- So wavefunction has to "collapse"



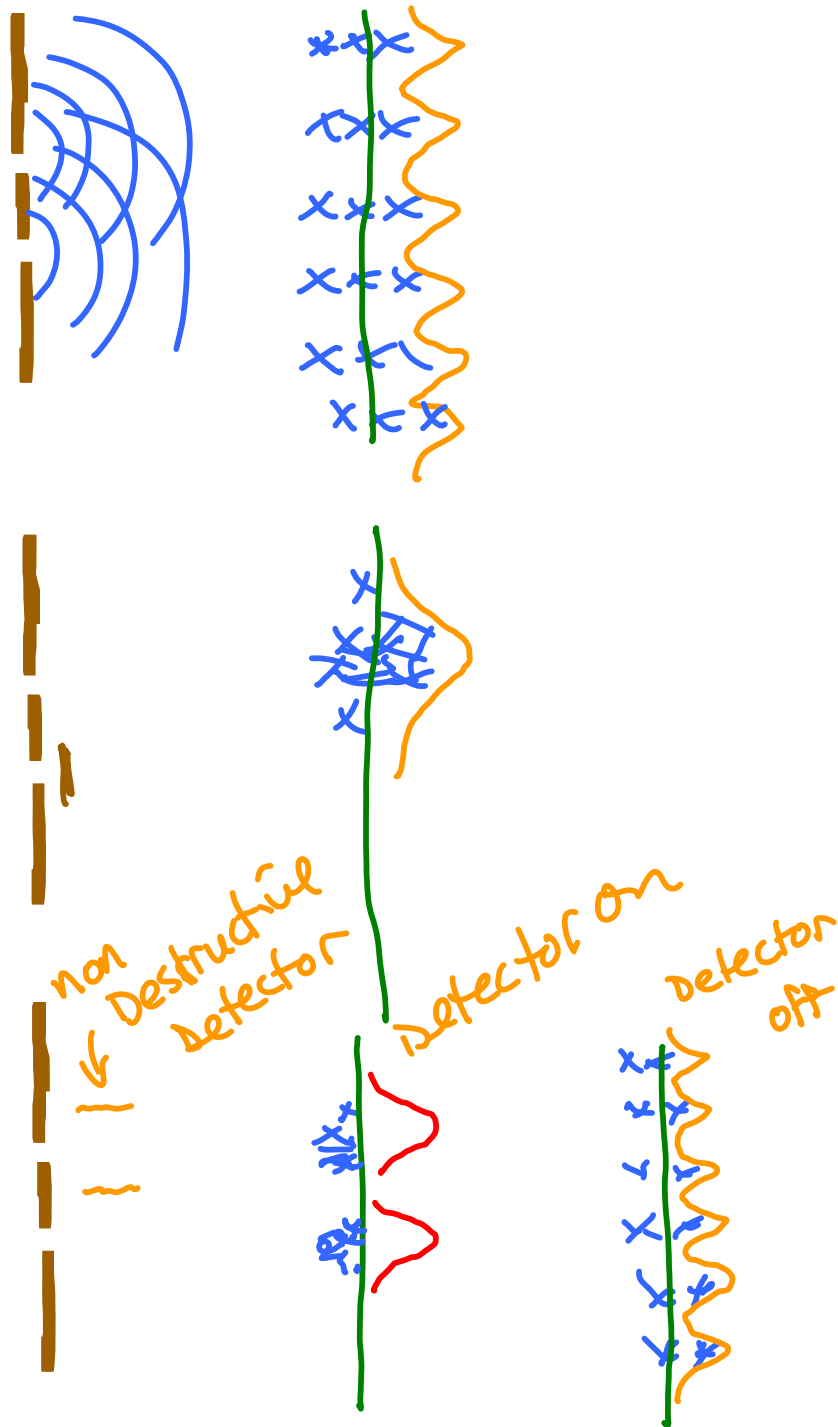
$e^- \rightarrow$



Handwritten notes in blue ink, including mathematical symbols and text, located at the bottom of the page.



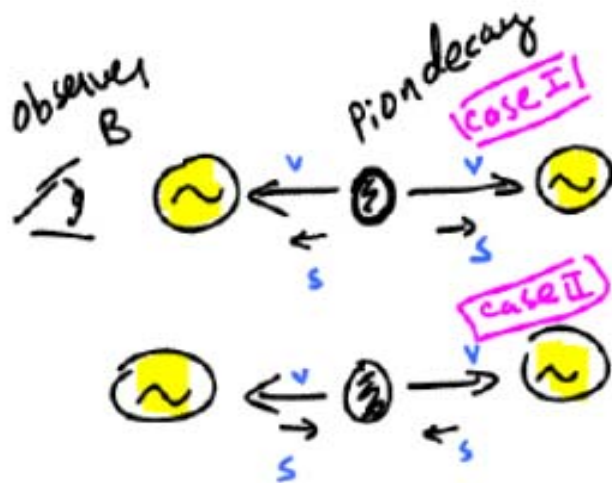
just determining the slit that the e^- passes thru (even with non-destructive detector) is sufficient to collapse the wave function.



EPR Paradox — Einstein, Podolski, Rosen
1935

8

"Spooky Action at a distance"



photon spin = 1



Two photons are produced at once — They are correlated.

If one has spin one way the other has spin the other way.

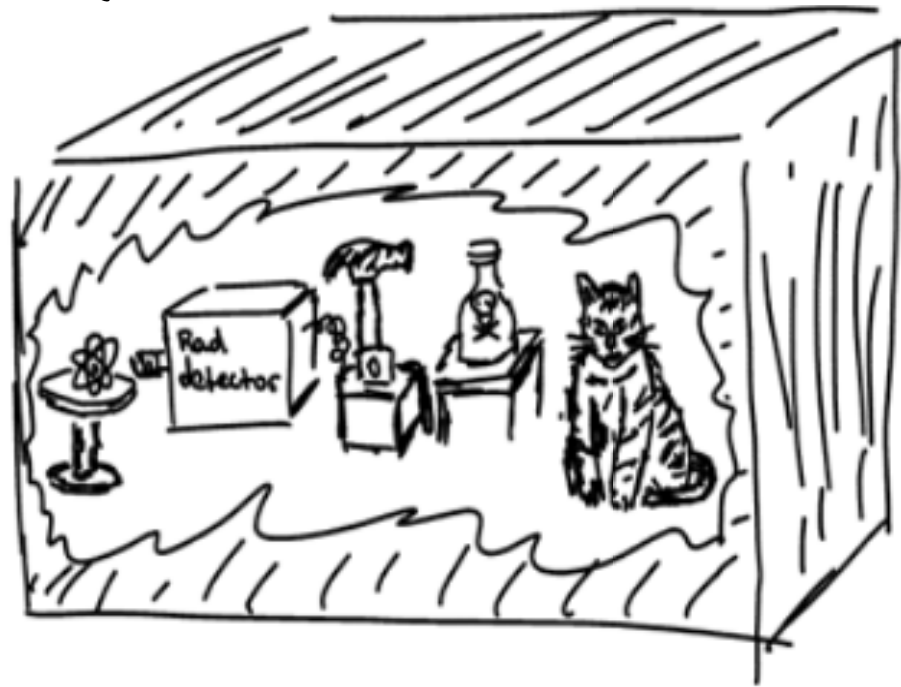
They are in an "entangled quantum STATE"

When observer A observes the spin of photon — The wavefunction collapses and the spin of the photon observer B will observe is determined.

But collapse instantaneous and observers A + B far apart

Does this mean information conveys faster than speed of light?

Schrödinger's Cat



Thought experiment
nucleus has
50:50 chance
of decaying +
killing the cat.
What is the
"state" of the
cat before box
opened?

Copenhagen
Interpretation

$$\text{nucleus quantum state} = \frac{1}{2}(\text{decayed}) + \frac{1}{2}(\text{not decayed})$$



$$\text{cat state} = \frac{1}{2}(\text{dead}) + \frac{1}{2}(\text{alive})$$





Hugh
Everett (1957)

Bryce DeWitt
1960's + 70's
↳ Many
Worlds
interpretation

Overall wavefunction does not collapse. IT evolves in time.
"Decoherence" forces wavefunction to evolve into different
streams that do NOT interact.