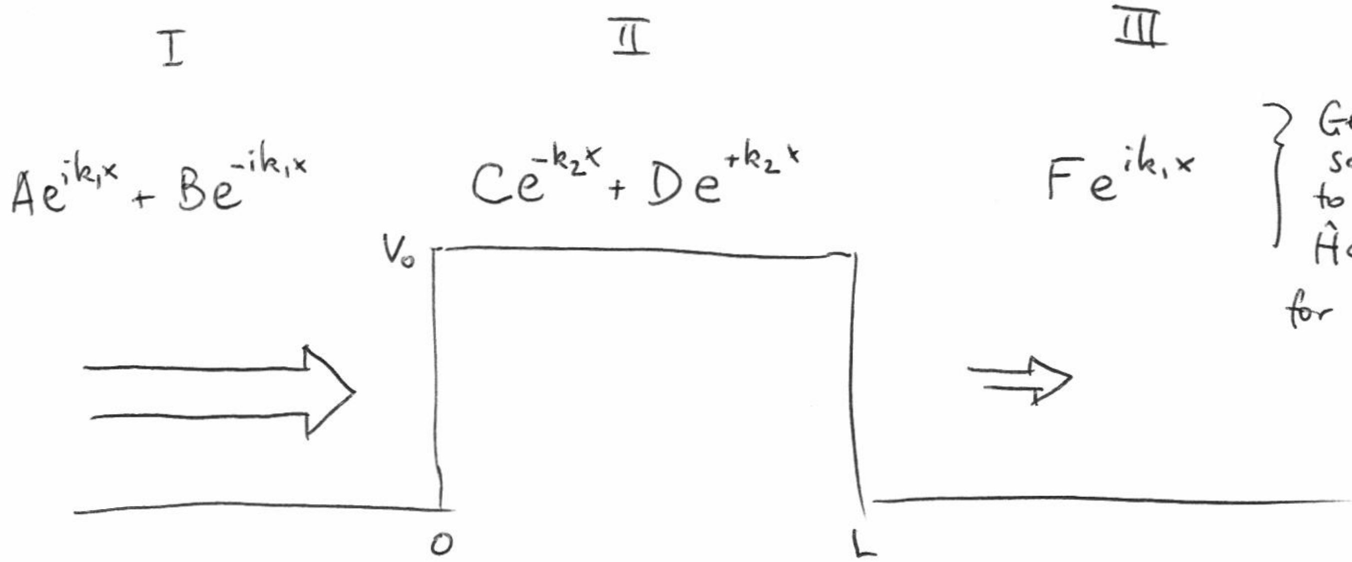
$\boxed{\text{DAY 15}}$

Quote concerning the Dirac eqn.

– Nice motivation

WKB Approximation



} General soln to $\hat{H}\phi = E\phi$ for $E < V_0$

$$\frac{|F|^2}{|A|^2} = ?$$

First part of the approximation: $C \gg D$

i.e. wave fn decays in the barrier.

Second part of the approximation:

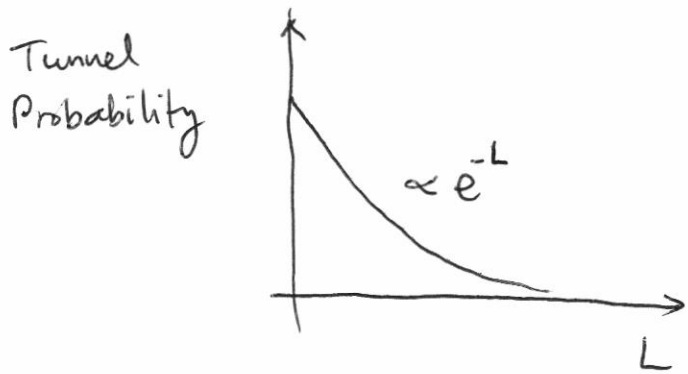
$$\frac{|F|^2}{|A|^2} \approx \frac{|\psi_{II}(x=L)|^2}{|\psi_{II}(x=0)|^2}$$

Applying these two approximations we find

$$\text{Transmission Prob} = \left| e^{-k_2 L} \right|^2$$

$$= e^{-2k_2 L}$$

$$= \exp\left(-\frac{2}{\hbar} \sqrt{2m(V_0 - E)}\; L \right)$$



Compare to a recent research article, see link on web site.

The Heisenberg uncertainty principle.

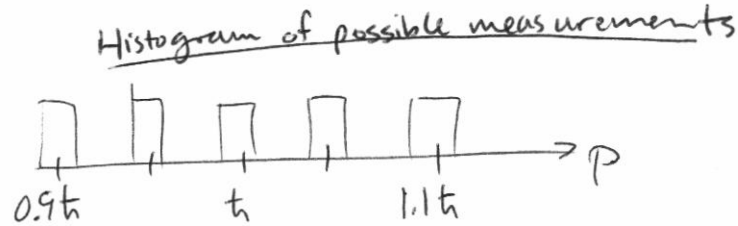
$$\boxed{\Delta x \Delta p \geq \frac{\hbar}{2}}$$

Example 1: Use mathmatica to plot

$$\mathrm{Re}\left\{ e^{i(0.9)x} + e^{i(0.95)x} + e^{i(1.0)x} + e^{i(1.05)x} + e^{i(1.1)x} \right\}$$

see website.

What is Δp?



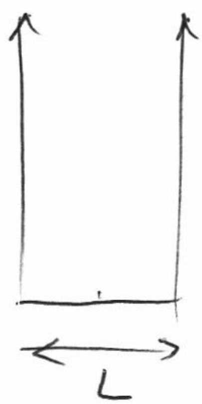
Standard deviation will be approximately $0.05\hbar$.

What is Δx?

Standard deviation is approximately 10.

$$\Delta x \Delta p \cong \frac{\hbar}{2}$$

The uncertainty principle is a fantastic tool for making quick approximations in QM.



What is the smallest kinetic energy we could expect a bound electron to have in this well?

$\Delta x \approx \frac{L}{4}$ i.e. 60% prob of finding e^- between $\langle x \rangle \pm \frac{L}{4}$.

$$KE \approx \frac{\Delta p^2}{2m}$$

Uncertainty principle $\longrightarrow$ $\Delta p \cong \frac{\hbar}{2\Delta x} = \frac{4\hbar}{2L} = \frac{2\hbar}{L}$.

$$KE \approx \frac{\hbar^2 2^2}{2mL^2}$$

Exact/Correct answer is $\frac{\hbar^2 \pi^2}{2mL^2}$.