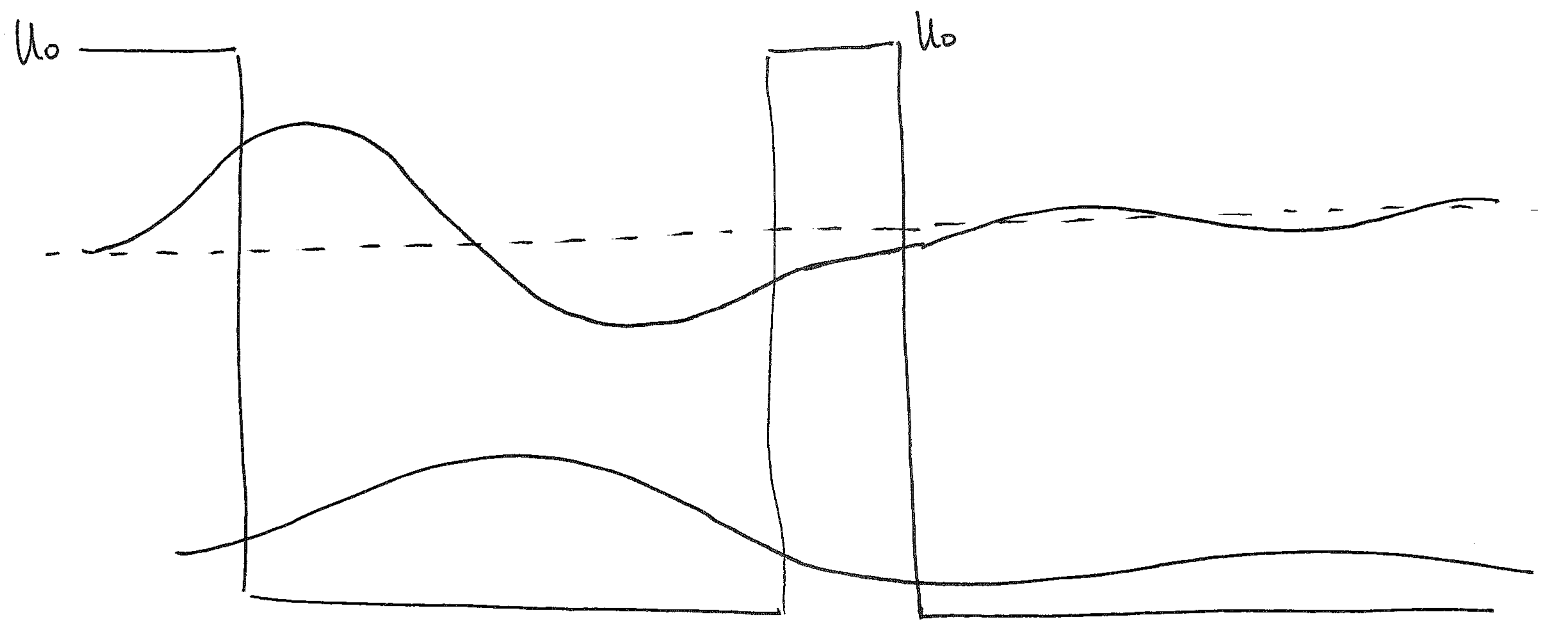
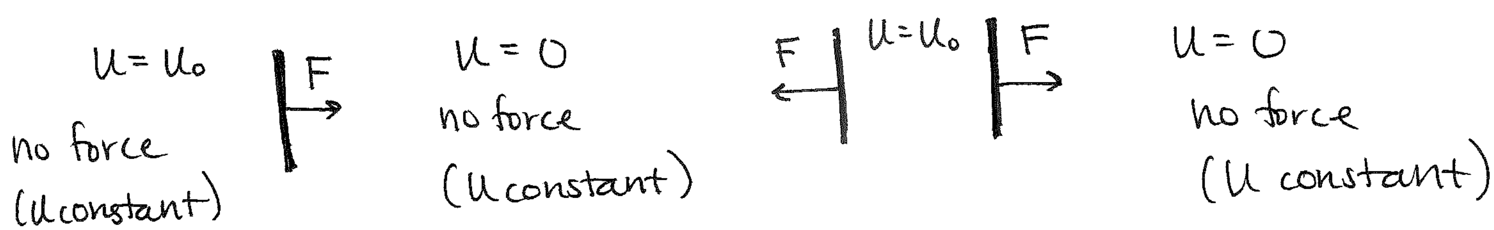
Quantum Tunneling

1. remember: energy is constant, well defined, and $< U$

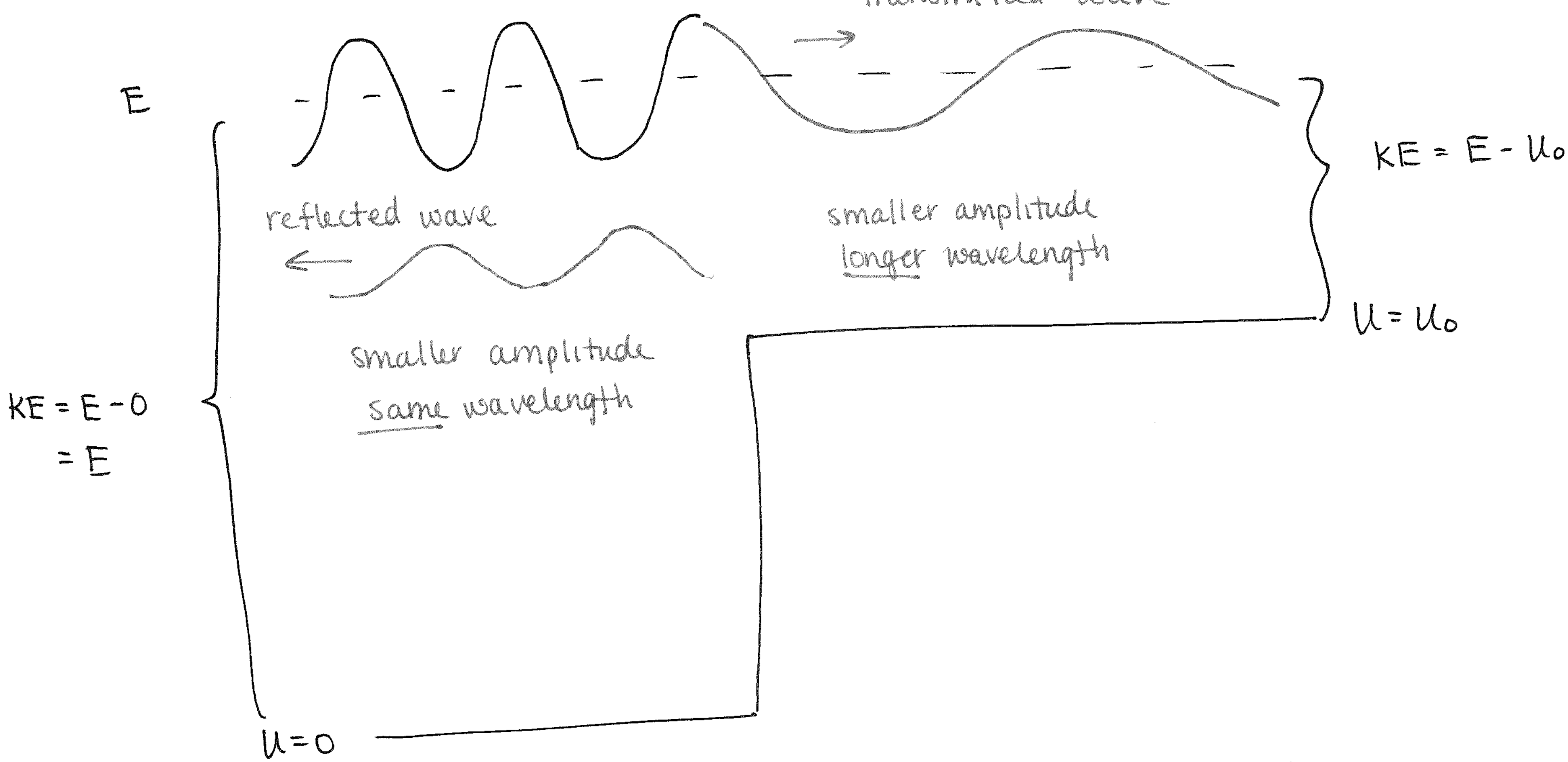


particle does not have enough energy to go over the barrier

there is a probability that the particle "walks" through wall!



Potential Step



large kinetic energy

⟶ large momentum p

⟶ small wavelength λ

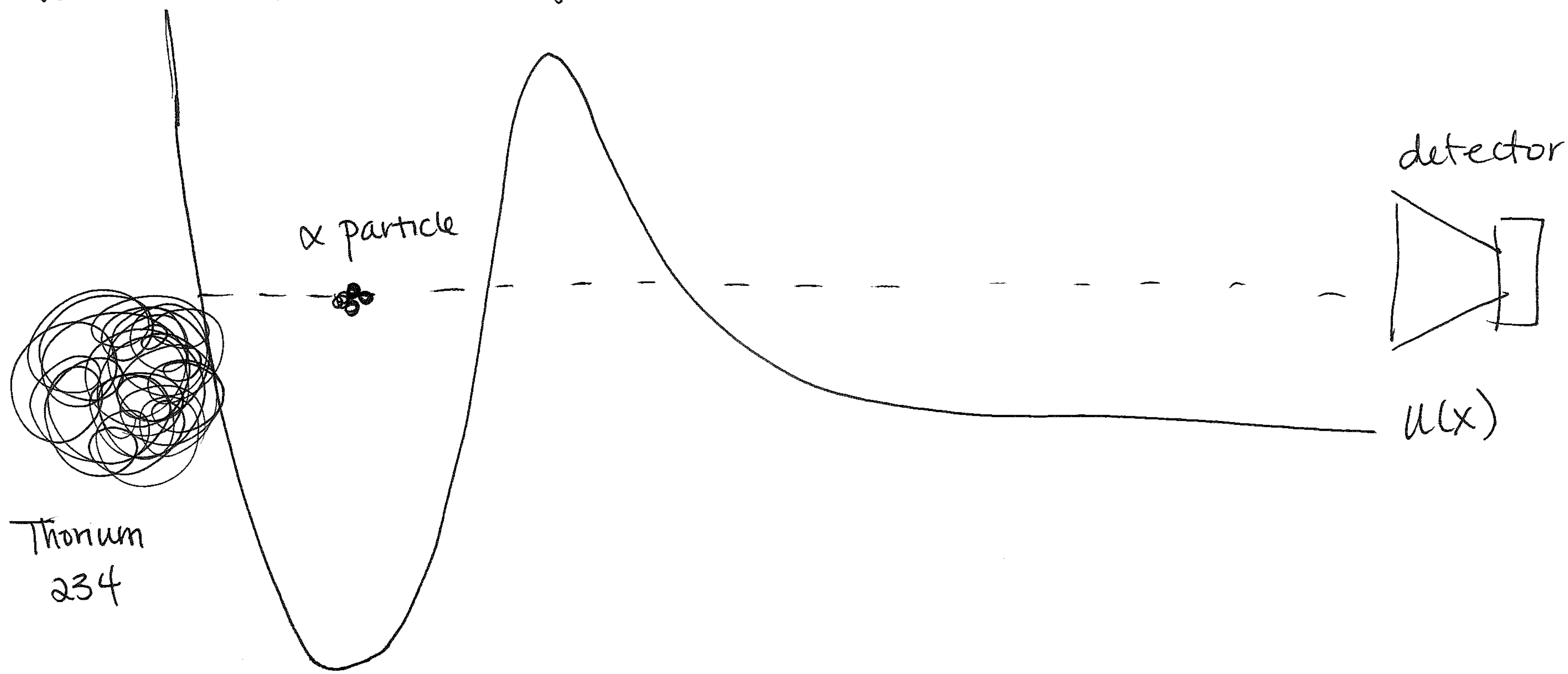
small kinetic energy

⟶ small p

⟶ large λ

Alpha Decay

Do we ever see particles "walking through walls?"



Q: How do we find the probability?

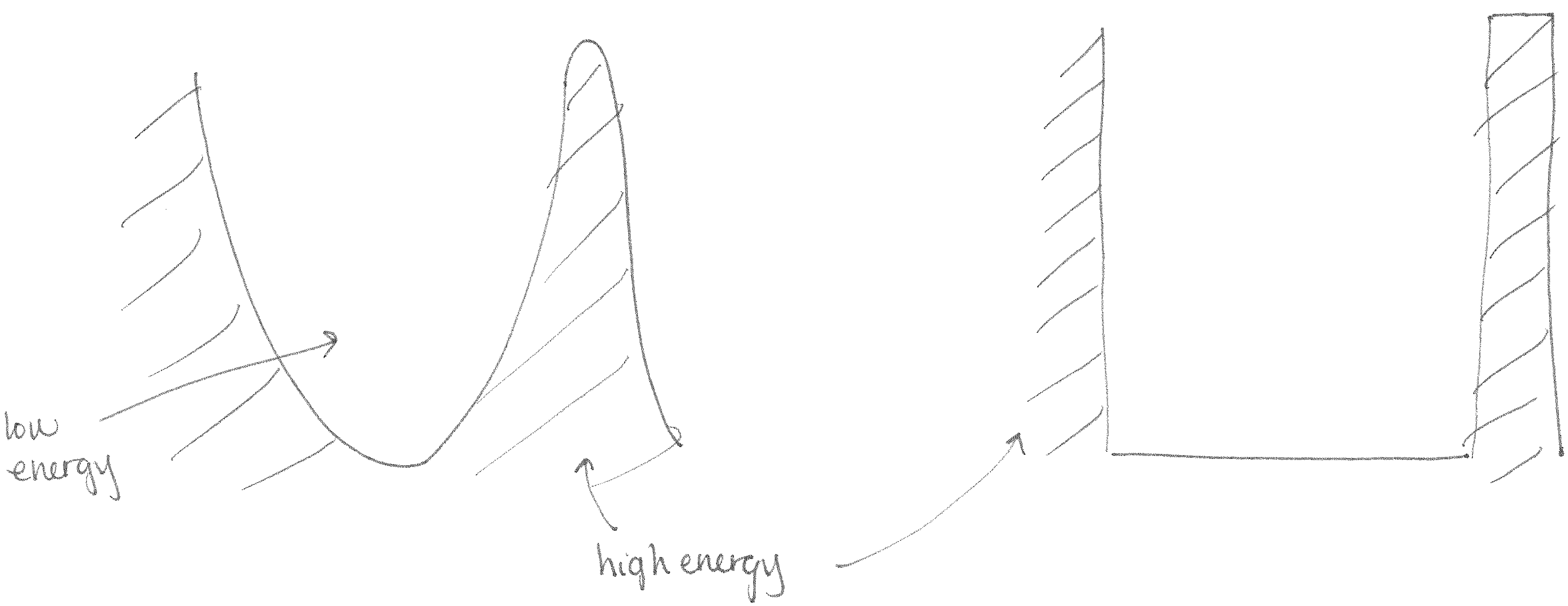
~~1/ governing equation~~
~~equation~~

A: find the wavefunction Ψ (Ψ^2 = prob.)

1. governing equation
   - equation that tells us how the wavefunction behaves
   - looks similar to diffusion equation
     - *time "turned on" ⟶ wavefunction <u>spreads out</u> (like ink in cup)
     - *time "turned off" (stationary states) ⟶ wavefunction exhibits <u>standing waves</u> (like waves on string)

2. boundary conditions
   - what's happening on edges of system
   - draw some examples of different kinds of boundaries:

energy box looks like ... can approximate with...



particle wants to be in low energy places

~~Want to ask~~ Question: what is the particle doing? Where is it? How fast is it going?

Answer: we <u>don't know</u>

~~only know (proba~~

Question: So what ~~do~~ can we know?

Answer: ~~probability~~ wavefunction (gives us probability)