Solution

Polonium has an effective barrier width of ~10 fermi, leading to a tunneling probability of ~10^{-15}. Now consider Uranium, which has a similar barrier height, but an effective width of about ~20 fermi.

Estimate the tunneling probability in Uranium:

a. 10^{-30}

b. 10^{-14}

c. 10^{-7}

Think of it this way – there is a 10^{-15} chance to get through the first half of the barrier, and a 10^{-15} chance to then get through the second half.

Alternatively, when we double L in

$$T \approx e^{-2KL}$$

this is equivalent to squaring the transmission T.

Polonium: Using 10^{21} "attempts" at the barrier per second, the probability of escape is about 10^{6} per second → decay time ~1 μs.

Uranium: Actually has a somewhat higher barrier too, leading to P(tunnel) ~ 10^{-40} → decay time ~10^{10} years!