

Nuclear Weapons

Question:

Is it possible to have 100 tons of plutonium and not have it explode?

Observations About Nuclear Weapons

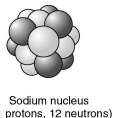
- They release enormous amounts of energy
- They produce incredible temperatures
- They produce radioactive fallout
- They are relatively hard to make
- They use chain reactions

Atomic Nucleus

- Atoms are usually electrically neutral
 - They must have as many + charges as – charges
 - Each electron must be matched by a + charge
- At the center of an atom is its nucleus
 - Extremely small (1/100,000th of the atom's diameter)
 - Contains most of the atom's mass
 - Also contains most of the atom's potential energy
 - Evidence is related to: $E=mc^2$

Structure of Nucleus

- Nucleus contains two kinds of nucleons
 - Protons are positively charged
 - Neutrons are neutral
- Two forces are active in a nucleus
 - Electrostatic repulsion between protons
 - Nuclear force attraction between touching nucleons
 - At short distances, nuclear force is stronger than electric
 - At long distances, electric force is stronger than nuclear

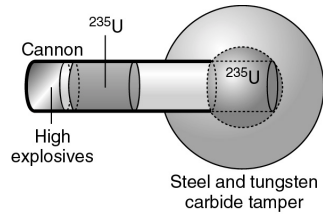


Nuclear Stability

- In a nucleus, nucleons are in equilibrium
- To be classically stable, equilibrium must be stable
- To be quantum-mechanically stable, equilibrium must also be the potential energy minimum
- Quantum mechanics and the Heisenberg uncertainty principle allow the nucleons to try out arrangements outside their equilibrium positions
- If they find a path to a new equilibrium, they may take it and the nucleus may fall apart

Little Boy

- ^{235}U hollow sphere below critical mass (60 kg)
- Cannon fired plug through sphere to exceed critical mass
- Tungsten-carbide shell contained explosion initially



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