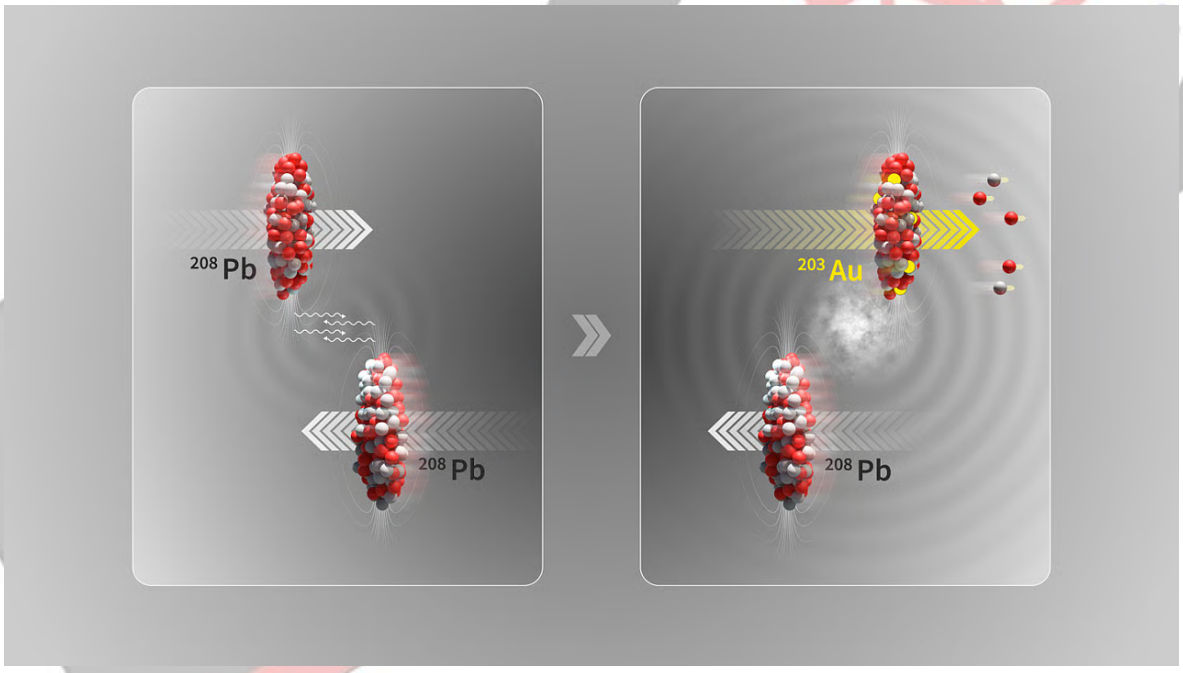
Turning Lead into Gold

Source: DTE

Scientists at **CERN** briefly **transformed lead (Pb) into gold (Au)** (just a nanosecond) in **tiny amounts** using **high-energy particle collisions** inside the **world's most powerful particle accelerator,** **Large Hadron Collider (LHC)**.

- This was achieved **not by direct collisions** but through **ultra-peripheral "near-miss" interactions** between accelerated **lead nuclei (atomic number 82),** demonstrating **nuclear transmutation**.
    - **Nuclear transmutation** is the process of **changing one element into another by altering the number of protons or neutrons in an atom's nucleus**.



Ultra-Peripheral Collisions

- At CERN's LHC, **ultra-peripheral collisions** occur when **lead nuclei** pass very close **without direct contact.**
    - Their **electromagnetic fields** interact, emitting **high-energy photons** that trigger **electromagnetic dissociation**- a process where **protons and neutrons are ejected** from the nucleus.
- In such events, **removal of 3 protons** from **lead (atomic number 82)** results in the formation of **gold (atomic number 79)** and depending on the number of protons lost, elements like **thallium and mercury** were also created.
    - The experiment offers a **striking example of how extreme physics can alter the identity of matter**, showcasing modern **artificial nuclear transmutation** and deepening our understanding of atomic interactions under extreme conditions.

RADIOACTIVE DECAY VERSUS NUCLEAR TRANSMUTATION

RADIOACTIVE DECAY	NUCLEAR TRANSMUTATION
Radioactive decay is the process by which an unstable atomic nucleus releases energy in the form of radiation to reach a more stable state	Nuclear transmutation is the process of changing one element into another by altering the nucleus of the atom
A spontaneous process	Requires an external trigger
Uncontrollable	Has the potential to be controllable
Occurs without the need for external energy input	Requires significant energy input
Releases a relatively small amount of energy	Can release a much larger amount of energy

Read More: [Hadron Collider Run 3]