

Lead-to-Gold Transmutation

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Lead-to-Gold Transmutation Latest News

CERN's ALICE detector has experimentally confirmed the conversion of lead into gold through a process of nuclear transmutation at the Large Hadron Collider (LHC).

About Chrysopoeia

- The concept of turning **lead into gold**, known as **chrysopoeia**, was a **medieval alchemist's dream**, based on the similar **density** of the two metals, but modern science clarified that they are **distinct chemical elements** and **chemical methods** cannot achieve such a transformation.

Mechanism of Transmutation

- **Gold nuclei (Au-203)** are created when **three protons** and **two neutrons** are **ejected** from **lead nuclei (Pb-208)** during **ultra-peripheral collisions** in the LHC, where nuclei pass close without directly colliding.

- These near-miss collisions generate **strong electromagnetic fields** due to the **82 protons** in each lead nucleus moving at **99.999993% of the speed of light**, compressing the field into a short-lived **photon pulse**.
- The process, called **electromagnetic dissociation**, triggers **internal nuclear oscillations**, causing the emission of **protons and neutrons**.

Role of ALICE Detector and ZDC

- The **ALICE detector** utilises **Zero Degree Calorimeters (ZDCs)** to **identify photon-nucleus interactions** and detect the ejection of **zero, one, two, or three protons**, linked to the formation of **lead, thallium, mercury, and gold**, respectively.
- This is the **first systematic experimental detection** of gold creation at the LHC, thanks to ALICE's **high precision** in recording both **high-energy** and **rare low-particle** collisions.

About the Large Hadron Collider (LHC)

- The **LHC** is the **world's largest and most powerful particle accelerator**, built by **CERN** to study **fundamental particles** and test predictions of the **Standard Model**.
- It consists of a **27-kilometre circular ring** with **superconducting magnets** and **accelerating structures**, located on the **Franco-Swiss border** near **Geneva**.
- Inside, **two beams of hadrons (usually protons or lead nuclei)** are accelerated to **99.999999% the speed of light** in **opposite directions**, then made to **collide** at four detector sites: **ALICE, ATLAS, CMS, and LHCb**.

About CERN

- **CERN (European Organisation for Nuclear Research)** was established in **1954** as Europe's **first joint scientific venture** after WWII.
- It is headquartered near **Geneva**, with **23 member states** and **10 associate members**, including **India as an Associate Member**.
- CERN is dedicated to **collaborative high-energy particle physics research** and houses the **LHC and its associated detectors**.

Lead-to-Gold Transmutation FAQs

Q1. What is ALICE in the context of CERN?

Ans. ALICE (A Large Ion Collider Experiment) is a major detector at CERN's Large Hadron Collider (LHC), designed to study heavy-ion collisions and investigate conditions similar to those just after the Big Bang.

Q2. Where is CERN located, and why is it relevant to India?

Ans. CERN is located on the Franco-Swiss border, and India is an associate member of CERN, contributing to research and scientific collaboration.

Source: PHY

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