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NUCLEAR TRANSMUTATION OF RADIOACTIVE ELEMENT FOLLOWS PRECIOUS METALS BY NUCLEAR FUSION

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ABSTRACT

Nuclear transmutation is the conversion of one chemical element or isotope into another by changing the number of protons or neutrons in its atomic nucleus.

Main Types of Transmutation:

- Natural Transmutation: Occurs spontaneously through radioactive decay (such as alpha decay or beta decay) or cosmic ray bombardment in nature. For example, uranium-238 eventually decays into stable lead-206.
- Artificial Transmutation: Induced deliberately in laboratories or reactors by bombarding target atomic nuclei with subatomic particles like neutrons, protons, or alpha particles, or via particle accelerators.

Key Methods and Mechanisms

- Neutron Bombardment: Because neutrons carry no electrical charge, they are not repelled by the positive charge of an atomic nucleus, making it easier for them to penetrate and alter the nucleus.
- Charged Particle Bombardment: Protons, deuterons, or alpha particles require high-energy particle accelerators to overcome electrostatic repulsion from the target nucleus.
- Nuclear Reactors and Fission: Utilized in research and power reactors to create synthetic elements, produce medical radioisotopes (such as cobalt-60 or iodine-131), or attempt to reduce long-lived radioactive nuclear waste by converting actinides into shorter-lived or stable nuclides.

KEYWORDS: protons, electrons, neutrons, radionuclide, half-life, alpha ray, beta ray, gamma ray, transmutation, fusion.

INTRODUCTION

Radioactivity is the spontaneous emission of energy and subatomic particles from an unstable atomic nucleus as it breaks down to reach a more stable state.

Core Concepts & Types of Radiation

The primary emissions during radioactive decay include

- **Alpha Particles (α):** Consist of two protons and two neutrons (a helium-4 nucleus: $_2He^4$). They have low penetrating power and can be stopped by a sheet of paper or human skin, but pose a high ionizing risk if ingested or inhaled.
- **Beta Particles (β):** High-speed electrons or positrons emitted from the nucleus. They penetrate

further than alpha particles (needing wood or aluminium to block them).

- **Gamma Rays (γ):** High-energy electromagnetic photons that frequently accompany alpha or beta decay. They have very high penetrating power, requiring dense materials like thick lead or concrete to block.

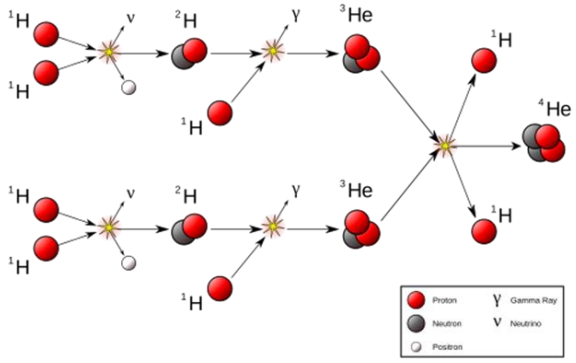


Figure-1: Nuclear fusion.

Half-Life and Decay Rate

- **Half-Life:** The time required for half of the unstable nuclei in a given sample to decay. Half-lives vary dramatically, ranging from a fraction of a second (10^{-23} seconds) to billions of years ($>10^{24}$ years).
- **Measurement:** Radioactivity is quantified in Becquerels (Bq), where 1 Bq equals one disintegration per second. Tools like Geiger counters and scintillation detectors measure these emission rates.

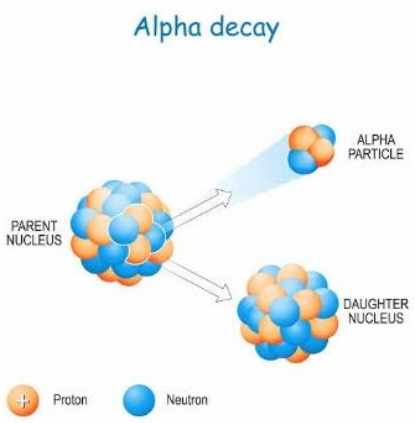
Radioactive decay is the spontaneous process by which an unstable atomic nucleus loses energy by emitting ionizing radiation, transforming into a different nuclide (a decay product).

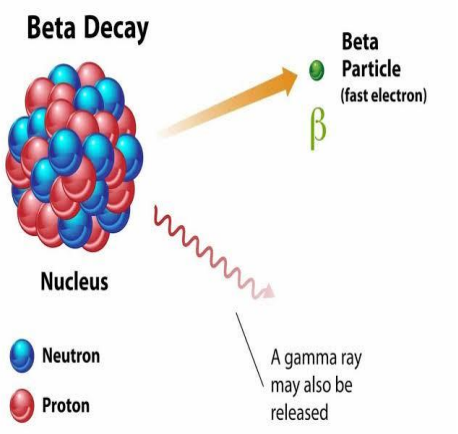
Characteristics

- **Random Process:** Individual atomic decay events are random and quantum-mechanically unpredictable.
- **Exponential Law:** Aggregate decay across a large population of atoms follows a predictable mathematical rate.
- **Half-Life (t=1/2):** The time required for half of the radioactive nuclei in a sample to decay. $t_{1/2}=0.693/\lambda$. Half-life: $t_{1/2}$ Decay constant: λ

Common Types of Radioactive Decay

- **Alpha (alpha: σ) Decay:** The nucleus emits an alpha particle (two protons and two neutrons, equivalent to a Helium-4 nucleus). It reduces the mass number by 4 and the atomic number by 2. Low penetration (blocked by paper or skin).
- **Beta (beta: β) Decay:** A neutron changes into a proton (or vice versa), releasing a high-energy electron or positron (beta particle) along with an antineutrino or neutrino.
- **Gamma (gamma: γ) Decay:** An excited nucleus releases high-energy electromagnetic radiation (photons) without changing its number of protons or neutrons.
- **Other Forms:** Include positron emission, electron capture, spontaneous fission, and neutron emission.





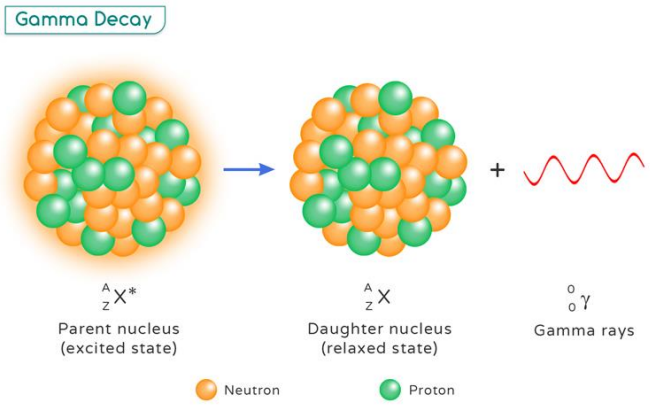


Figure-2: Radioactive decay.

Applications and Uses

- **Medicine:** Targeted radiation therapy (such as iodine-131 for thyroid conditions) and diagnostic imaging.
- **Radiometric Dating:** Techniques like carbon-14 dating to determine the age of archaeological and geological specimens.

Converting mercury into gold is possible through nuclear transmutation, a process that alters an element's atomic structure by changing the number of protons in its nucleus. Mercury $_{80}Hg^{200}$ has 80 protons and Gold $_{79}Au^{197}$ has 79.

Units: Activity is measured in Becquerel's (1 Bq) = 1 disintegration/second or curies (1 Ci) = 3.7×10^{10} Bq). Radiation dose to tissues is measured in Sieverts.

Measurement and Law

- **Decay Equation:** Quantified via the Radioactive Decay Law: $N(_t) = N_0e^{-\lambda t}$. Where $N(_t)$ is the quantity at time t, $N_0 = N(_0)$ is the initial quantity, that is, the quantity at time t = 0.

Recent Claims and Methods

- **Marathon Fusion Experiment:** A San Francisco-based start-up named Marathon Fusion announced in October 2026 that it successfully converted mercury into gold during an experiment in September.
- **The Physics:** The method exposes mercury-198 to high-energy neutrons from a nuclear fusion reaction. This knocks out a neutron to form radioactive mercury-197, which decays into stable gold-197.
- **CERN Comparison:** Marathon Fusion claimed a production rate ten times higher than a previous record reported by CERN in 2025, where the Large Hadron Collider produced minute trace amounts (picograms) of gold.
- **Alternative Claims:** In October 2026, an Indian scientist and former Pokhran-II nuclear test associate named Lal Bahadur also claimed to have transformed a small sample of mercury into gold using ancient alchemical techniques (Rasa Shastra) combined with modern lab methods in Jaipur.

Key Caveats and Limitations

- **Lack of Independent Verification:** Neither Marathon Fusion nor the Indian researcher has provided public peer-reviewed data or independently verified the total amount of gold actually created.
- **It Is Transmutation, Not Fusion:** The gold and mercury atoms do not fuse; rather, neutron bombardment forces the decay of one element into another.
- **Radiation Risks:** The intermediate products (such as mercury-197) are radioactive, meaning newly synthesized gold can be mixed with radioactive isotopes.
- **Commercial Infeasibility:** Projections of producing thousands of kilograms of gold per gigawatt of power rely on unverified computer simulations rather than a working commercial-scale nuclear reactor.

Converting mercury into gold is possible through nuclear transmutation, a process that alters an element's atomic structure by changing the number of protons in its nucleus. Mercury has 80 protons and gold has 79.

Converting mercury into gold is a real nuclear process called transmutation, though commercial or industrial production remains unverified. Transmutation is the process of converting one chemical element, isotope, or substance into another.

Key Types and Contexts

- **Nuclear Transmutation:** The scientifically proven process where the number of protons or neutrons in an atomic nucleus changes, turning one element into another through radioactive decay (like alpha or beta decay) or induced nuclear reactions (such as particle bombardment in a reactor or accelerator). The conversion of one chemical element or nuclide into another. This happens naturally through radioactive decay, nuclear fission, or nuclear fusion, or artificially by bombarding an atom's nucleus with particles to change its proton count.

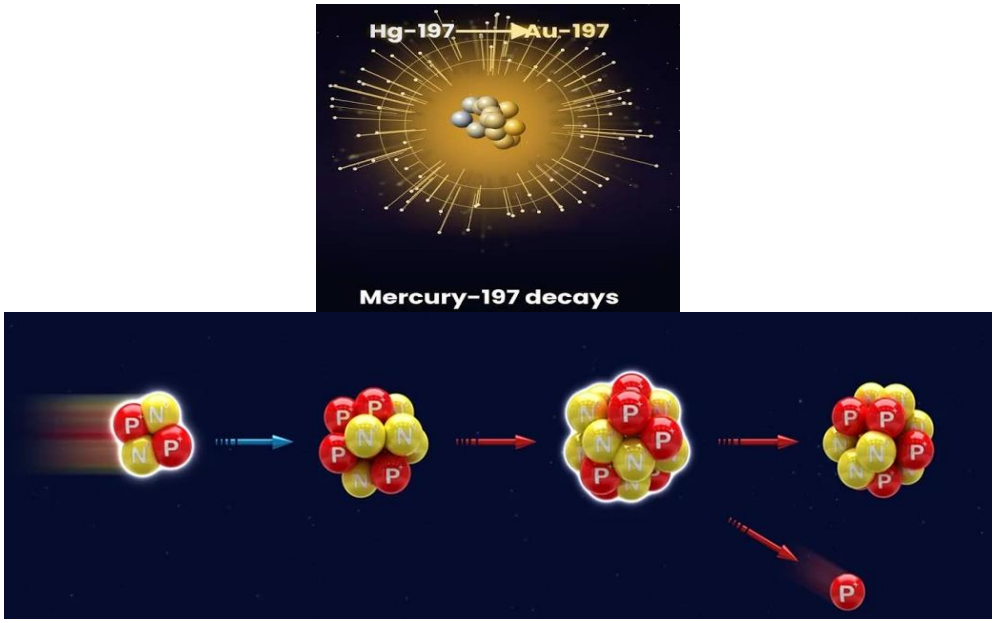


Figure-3: Nuclear bombardment.

- **Alchemy:** The historical practice where early alchemists attempted to use heat and chemical mixtures to turn base metals like lead or copper into precious gold or silver—laying the early foundation for modern chemistry.
- **Property Law:** A legal doctrine allowing spouses to convert separate property into community/marital property (or vice versa) through a formal agreement.
- **Psychology and Philosophy:** The redirection of raw or intense emotional, mental, or sexual energy into constructive, creative, or therapeutic outlets.
- **Fictional & Pop Culture Media:** A common magic system or sci-fi trope (such as in Fullmetal Alchemist) where matter is reshaped or converted into different forms.
- **Biology:** The historical or theoretical concept of one species evolving or transforming into another.
- **General / Metaphorical:** A complete shift or transformation in character, form, or condition—such as turning a caterpillar into a butterfly or channelling negative emotions into creative energy.

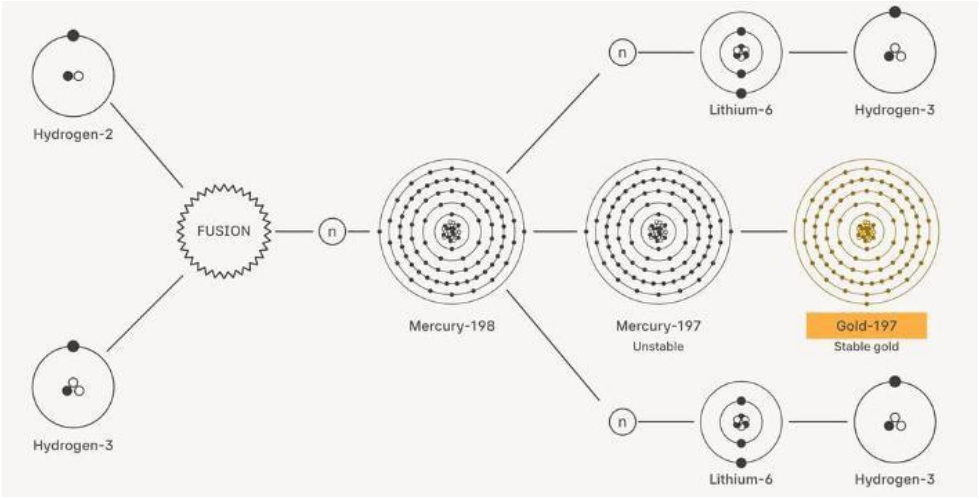


Figure-4: Nuclear fusion.

Transmutation means to completely change something from one form, nature, substance, or element into another. The word comes from the Latin transmutare, meaning "to change across".

How the Transmutation Works

Elements are defined by the number of protons in their atomic nucleus:

- Mercury (Hg): Has 80 protons.
- Gold (Au): Has 79 protons.

To change mercury into gold, scientists use high-energy neutrons (such as those from particle accelerators, nuclear reactors, or fusion experiments) to bombard a specific isotope, mercury-198.

1. **Neutron Interaction:** A fast neutron strikes the mercury-198 atom and knocks out a neutron (an n, 2n reaction), turning it into mercury-197.
2. **Radioactive Decay:** Mercury-197 is unstable and has a half-life of roughly 64 hours.
3. **Conversion to Gold:** Through electron capture or beta decay, the atom loses a proton equivalent or shifts its structure, transforming into gold-197, which is a stable, non-radioactive precious metal.

Marathon Fusion (Kyle Schiller and team) (2025–2026): A San Francisco-based nuclear fusion startup that claimed in October 2026 to have converted mercury into stable gold using fusion-generated neutrons, outperforming prior experimental benchmarks.



Figure-5: Marathon Fusions.

Marathon Fusion is a San Francisco-based nuclear fusion startup founded in 2023 that focuses on building fusion reactors, fuel-cycle technologies, isotope separation, and medical isotope production.

The Mercury-to-Gold Claim ("Alchemy")
The Announcement: In October 2026 (building on a July 2025 research preprint), Marathon Fusion claimed it used fusion-generated high-energy neutrons to transmute mercury-198 into stable gold-197, beating a previous 2025 record set by CERN by a factor of 10.

How It Works: The process exposes mercury-198 to fast neutrons, knocking out a neutron to form radioactive mercury-197, which decays over a few days into stable gold-197.

The Status: The claim is unverified by independent peer review, the exact quantity of gold produced has not been publicly disclosed, and the resulting gold can be mixed with radioactive isotopes requiring long-term storage.

Nuclear fusion reactors can theoretically be used to create gold, though the process itself is actually nuclear transmutation rather than fusion.

How the Process Works

- **Neutron Generation:** A nuclear fusion reactor (using deuterium and tritium) releases high-energy fast neutrons.
- **Bombardment:** These fast neutrons are directed at a "breeder blanket" containing mercury-198.
- **Transmutation:** A neutron knocks a neutron out of mercury-198, turning it into unstable mercury-197.
- **Decay into Gold:** Mercury-197 naturally decays into stable gold-197 within roughly 64 hours.

Current Status and Claims

- **Marathon Fusion:** A San Francisco-based startup called Marathon Fusion claimed to have used this neutron-driven method to produce gold at a rate 10 times higher than past experiments at CERN.
- **Lack of Verification:** The startup has not disclosed exact output quantities, and its claims have not yet been independently verified or peer-reviewed.
- **Commercial Reality:** Working, commercial-scale nuclear fusion power plants do not yet exist, and any large-scale gold production remains purely theoretical. Furthermore, the resulting gold may contain radioactive impurities that require years of safe storage.

CONCLUSION

The Marathon Fusion mechanism refers to a full-stack commercial nuclear fusion reactor architecture developed by the startup Marathon Fusion. Rather than relying solely on electricity production, their mechanism combines a deuterium-tritium (D-T) beam-driven fusion reactor with a multi-purpose transmutation blanket designed to co-produce highly valuable isotopes, specifically medical radiopharmaceuticals and stable gold.

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