

PROTON EMISSION - SPACE

NEWS: Scientists at the **University of Jyväskylä, Finland** detected and measured **the half-life of the ^{188}At (Astatine) isotope** which decayed by **emitting a proton**

WHAT'S IN THE NEWS?

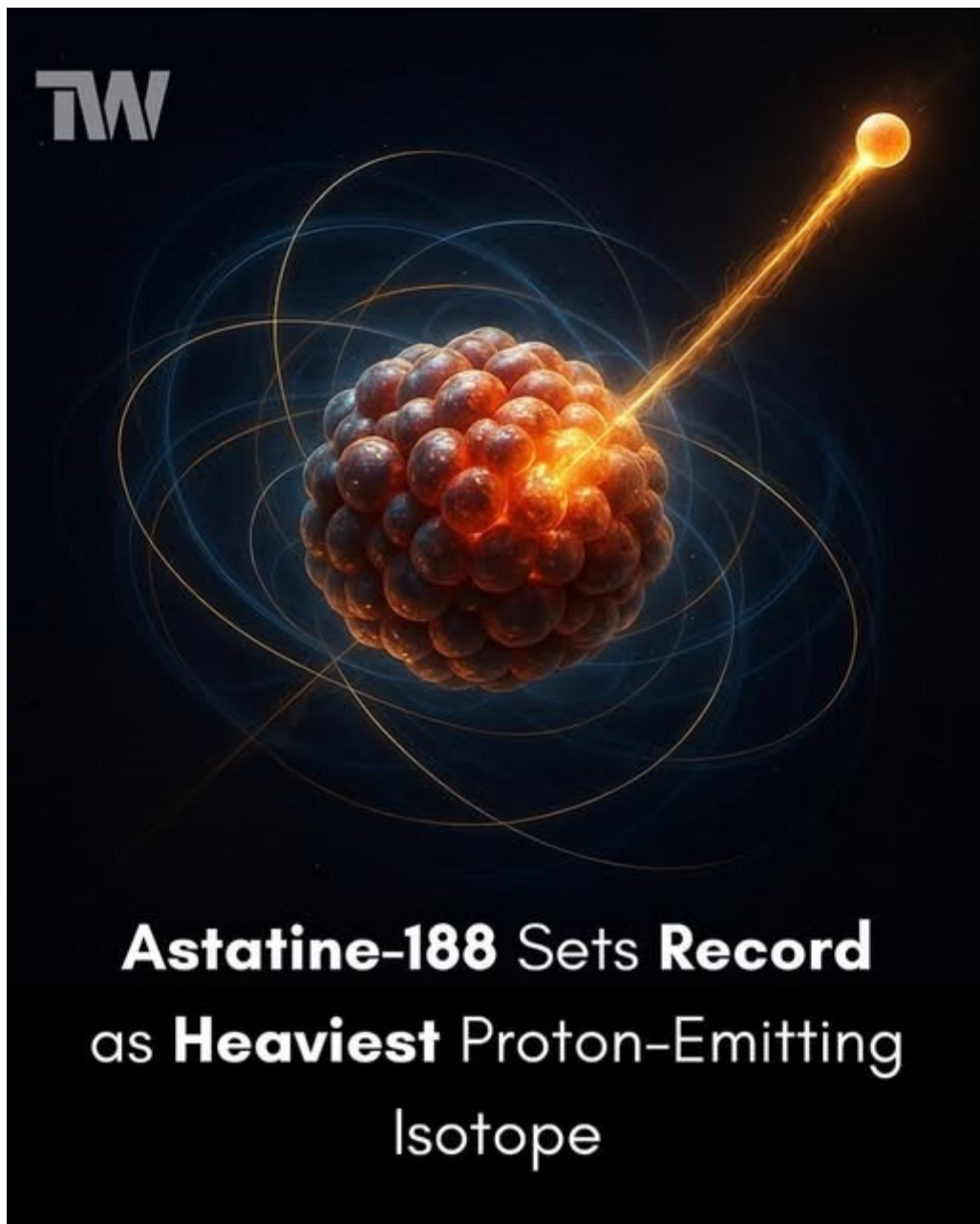
What is Proton Emission?

- Proton emission is a **rare nuclear decay process** in which an **unstable atomic nucleus ejects a proton** to achieve a more stable configuration.
- It typically occurs in nuclei that lie **beyond the proton drip line**, where the **nuclear binding energy is insufficient to hold an excess proton**.
- This process results in the formation of a **new element with an atomic number reduced by one**.

Why Proton Emission Happens

- When a nucleus has **too many protons compared to neutrons**, the **Coulomb repulsion** between protons becomes too strong for the nuclear force to hold the last proton.
- The excess proton becomes **unbound** and is emitted spontaneously—this is known as **proton drip**.

- Such nuclei are **highly unstable**, and their production requires **high-energy particle accelerators** or specific nuclear reactions.



Astatine-188 Sets Record as **Heaviest** Proton-Emitting Isotope

- Proton emission is rarely observed due to the **short half-lives** of these nuclei and the **challenges in their experimental detection**.

How It Differs from Other Decay Types

- **Alpha decay** involves the ejection of a helium nucleus (2 protons + 2 neutrons).
- **Beta decay** involves the transformation of a neutron into a proton (or vice versa) with the emission of an electron/positron.
- **Gamma decay** involves the release of electromagnetic energy from an excited nucleus.
- **Proton emission**, unlike the above, involves the direct release of a **single proton** from the nucleus, making it **far less common** and a subject of interest for nuclear physicists.

Examples of Proton-Emitting Isotopes

- **Astatine-188 (188At)** was recently confirmed to decay via proton emission—making it a key experimental case.
- Other known proton emitters include **Tellurium-111 (111Te)** and **Bismuth-185 (185Bi)**.
- These isotopes are created in laboratories and **decay rapidly**, often within milliseconds or microseconds.

Scientific Importance of Proton Emission

- Provides crucial data on **nuclear stability and the limits of the periodic table**, especially for **proton-rich nuclei**.
- Helps improve **theoretical nuclear models**, particularly for understanding **decay modes in heavy and exotic elements**.
- Plays a role in **astrophysics**, particularly in the study of **nucleosynthesis in stars**, where such rare decay processes influence the formation of elements.
- Supports research in **nuclear medicine, radioisotope development, and fundamental physics**.

About Astatine (At)

- **Astatine** is a **radioactive halogen element** with **atomic number 85**, located in **Group 17** of the periodic table.
- It is one of the **rarest naturally occurring elements on Earth** and is **synthesized in minute quantities in laboratories**.

Key Features of Astatine

- **Highly Radioactive:** None of its isotopes are stable; over **41 isotopes** are known, with mass numbers ranging from **188 to 229**.
- **Physical Properties:** Believed to be a **dark-colored solid**; emits a **blue glow in air** due to ionization from radiation.
- **Decay Characteristics:**
 - **Astatine-188 (188At)** emits a proton to become **Polonium-187 (187Po)**.
 - **187Po** then quickly decays to **Lead-183 (183Pb)** via alpha decay.
- **Chemical Behavior:** Shows **similar reactivity to iodine**, its halogen group neighbor, but with **increased metallic properties** due to its larger atomic size and instability.

Source: <https://www.thehindu.com/sci-tech/science/heaviest-proton-emitter-astatine-188-detected/article69661352.ece>