

# **Daily Current Affairs** by Dhananjay Gautam

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GS Paper 3 – Infrastructure and Economic Development

### Historic Vande Bharat Trains Now Connect Katra to Kashmir Valley

**Context:** In a **historic development**, **Prime Minister Narendra Modi** flagged off two Vande Bharat Express trains linking Shri Mata Vaishno Devi Katra with Srinagar, effectively establishing the first-ever direct railway connection to the Kashmir Valley. This transformative move is expected to boost economic development, tourism, trade, and integrate Kashmir more **deeply** with the rest of India.



# Tracing the Journey: From Colonial Tracks to a Modern Marvel

# Early Rail Initiatives in Jammu and Kashmir:

- The **first railway line** in the region was laid in **1897** by the British, linking **Jammu and Sialkot** (now in Pakistan), covering about **40–45 km**.
- In the early 1900s, several proposals including a Rawalpindi-Srinagar line and a Jammu-Srinagar route via Reasi — were supported by Maharaja Pratap Singh, but none materialized due to technical and political hurdles.

### **Post-Partition Isolation:**

- After the **Partition in 1947**, Sialkot became part of Pakistan, severing Jammu's railway ties.
- Until **1975**, **Pathankot in Punjab** remained the closest railhead to the region. ٠
- The **Pathankot–Jammu rail link** was inaugurated in 1975, rekindling connectivity after nearly three decades.
- **Construction of the Jammu–Udhampur line** (53 km) began in 1983, but the project was **completed only in 2004**, taking 21 years due to the difficult terrain.

# Udhampur-Srinagar-Baramulla Rail Link (USBRL): India's Mountain Engineering Feat

# A Project of National Importance:

- The **USBRL project** was formally **sanctioned in March 1995** with an initial estimated cost of **2,500** crore and later declared a 'National Project' in 2002.
- It faced massive engineering, geological, and climatic challenges, but has now been **fully completed** at a final cost of 43,780 crore.
- It features:
  - **272 km** of high-altitude railway track
  - 36 tunnels and 943 bridges 0
  - Designed for year-round, all-weather connectivity  $\circ$

# **Engineering Marvels of the Himalayas: World Records and Innovations**

# **Chenab Bridge: The Crown Jewel**

- The **Chenab Bridge** is now the **world's highest railway arch bridge**, rising **359 metres** above the riverbed — 35 metres taller than the Eiffel Tower.
- The bridge is 1,315 metres long and constructed using steel capable of withstanding temperatures from -10°C to 40°C.
- Designed for a lifespan of 120 years, it can endure wind speeds up to 260 km/h and seismic shocks.

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# Anji Khad Bridge: India's First Cable-Stayed Rail Bridge

- The Anji Khad Bridge, also located in the Reasi district, is another milestone:
  - Spanning **725 metres**, it stands **331 metres** above the Anji riverbed.
  - Its signature **inverted Y-shaped pylon** rises **193 metres**, supported by **96 high-tensile cables**.

# India's Longest Railway Tunnel:

• The USBRL project includes the **country's longest transportation tunnel** at **12.77 km**, located in **Ramban district**, enabling rail operations through some of the most geologically complex terrain in India.

# Vande Bharat Trains: High-Speed Connectivity in Just 3 Hours

- The new Vande Bharat Express trains cut the travel time between Katra and Srinagar to just 3 hours, down from the usual 6–8 hours by road.
- These trains are specially designed to **operate in snowbound conditions**, ensuring **uninterrupted service even during winter**.
- Plans are already in motion to extend the service to Jammu Tawi, enabling direct access from across India to Srinagar via Vande Bharat trains.

# Economic and Cultural Impact: Transforming Lives and Landscapes

# Tourism Boom Expected:

- The seamless and scenic rail journey is expected to revolutionize tourism in Jammu and Kashmir, attracting both domestic and international travellers.
- Destinations like **Gulmarg, Pahalgam, and Sonamarg** are now just a few hours away from major cities via rail, promising an **unprecedented influx of visitors**.

# Boost for Local Trade and Agriculture:

- Local industries including **apple farming**, **walnut and saffron production**, **pashmina weaving**, and **handicrafts** will benefit from **faster and cost-effective transportation**.
- Reduced dependency on road transport means **lower costs** for bringing **daily essentials** into the Valley, helping both **consumers and small businesses**.

# **Did You Know?**

- The Chenab Bridge is taller than **New York's Statue of Liberty** and can withstand earthquakes up to **magnitude 8** on the Richter scale.
- Kashmir's pashmina exports are expected to rise by **30–40%** due to improved logistics and reduced transit time.

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GS Paper 3 – Governance, Constitution, Polity, Social Justice

Funds Meant for Poor Prisoners Lie Idle as States Fail to Implement MHA's Relief Scheme

**Context:** In a move to address the plight of **financially distressed prisoners**, the **Union Ministry of Home Affairs (MHA)** has voiced serious concerns over the **poor implementation** of the **Support to Poor Prisoners Scheme** by various **States and Union Territories**. Despite repeated advisories and dedicated funding, the scheme remains **grossly underused**, leaving thousands of poor inmates behind bars simply because they can't afford **bail or fines**.



### What Is the Support to Poor Prisoners Scheme?

Launched in **May 2023**, the scheme is aimed at ensuring **access to justice** for undertrial and convicted prisoners who remain incarcerated **due to poverty**, not legal guilt. The **National Crime Records Bureau (NCRB)** has been designated the **Central Nodal Agency** for implementation, while **District Legal Services Authorities (DLSAs)** and **Empowered Committees** are tasked with identification and financial disbursement at the local level.

### Key Features of the Scheme:

### Eligibility and Process for Undertrial Prisoners:

- **Trigger Point:** If a prisoner is **not released within 7 days** of getting bail, **jail authorities** must inform the **DLSA Secretary**.
- Assessment: Within 10 days, the DLSA—alongside NGOs, social workers, or revenue officers must verify the prisoner's inability to provide surety.
- **Financial Assistance:** On approval, up to **40,000 per case** can be granted, often through **Fixed Deposits** for use by the courts.
- **Review System: Empowered Committees** meet every **2–3 weeks** to process verified applications.
- **Exclusions:** No aid is extended to prisoners booked under serious laws such as:
  - Prevention of Corruption Act
  - NDPS Act
  - **UAPA**
  - Money Laundering laws
  - Other serious offenses

### For Convicted Prisoners Unable to Pay Fines:

- **Trigger Point:** If a prisoner remains in jail due to **nonpayment of court fines**, the **Jail Superintendent** must notify the DLSA within **7 days**.
- **Investigation:** The DLSA, with help from **NGOs and probation officers**, must verify financial inability within another **7 days**.
- **Sanctioned Relief:** Up to **25,000** can be sanctioned by the District Committee, while larger amounts require approval from the **State Oversight Committee**.

### Why the Scheme Matters: Overcrowded Jails and Denied Justice:

The **India Justice Report 2025** paints a grim picture of the current prison system:

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To the Point Daily Current Affairs



- India's average jail occupancy rate stands at a staggering 131%.
- A shocking **76% of inmates** are **undertrial prisoners**, many held simply due to financial constraints.
- At the current pace, India's **prison population may hit 6.8 lakh by 2030**, while available infrastructure will support only **5.15 lakh**, creating an alarming shortfall.

# **Global Comparison:**

India ranks among the countries with **the highest proportion of undertrials**. In contrast, many countries in Europe and North America maintain undertrial percentages under 30%, emphasizing the urgent need for **legal reform and implementation** of support schemes like this one.

MHA Slams States for Poor Execution and Inaction

Despite making funds available and issuing **Standard Operating Procedures (SOPs)**, the MHA has expressed **disappointment** over the failure of many States and Union Territories to:

- Identify eligible inmates
- Hold regular Empowered Committee meetings
- Coordinate with DLSAs and NGOs
- Utilize central funds already allocated

# Repeated Reminders Ignored:

The MHA has conducted **multiple video conferences**, followed by official advisories and reminders. Yet, in many regions, **no significant progress** has been made. As a result, **prison overcrowding persists**, and **justice remains inaccessible** for the poorest behind bars.

# What Needs to Be Done: A Call for Immediate Action:

The Ministry has **urged States and UTs** to:

- Proactively identify eligible prisoners through DLSAs.
- Ensure timely and regular Empowered Committee meetings.
- **Collaborate with NGOs**, probation officers, and civil society groups.
- Monitor fund utilization and provide regular updates to the Centre.

The Bigger Picture: Beyond Bail – Towards Inclusive Justice

This scheme is not just about **financial aid**. It reflects a broader principle: **Justice should not be denied due to poverty**. With more than three-fourths of the prison population waiting for trials — often for petty or bailable offenses — this initiative can significantly reduce **the burden on the judiciary**, ensure **quicker reintegration**, and promote **equity in legal access**.

# **Did You Know?**

- India has **1,300+ prisons**, but over **1 lakh inmates** are detained for want of bail or fines under 50,000.
- Inmates often stay in jail **longer than their maximum possible sentence** because they can't afford to pay the imposed fine.
- Legal Aid Services Authorities Act, 1987 already provides for free legal aid, but the financial arm of that aid is often neglected.

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GS Paper 3 – Environment, Security and Disaster Management

PPP PPPP PPP

How Chinese Dams Could Influence the Brahmaputra's Flow into India: Facts, Fears, and Strategy

**Context:** Amid growing infrastructure developments in **Tibet**, concerns have emerged in India over how **China's dam-building on the Brahmaputra River**—known as the **Yarlung Tsangpo** in Tibet—might affect water availability downstream. Recently, **Assam Chief Minister** sought to allay fears, highlighting that **over 65% of the river's flow originates in India**, and that reduced inflow from China could actually **ease Assam's annual flood crisis**.

Originating in the Tibetan Plateau, the river flows into India through **Arunachal Pradesh as the Siang**, traverses **Assam as the Brahmaputra**, and finally enters **Bangladesh as the Jamuna**.

What China Is Building: Hydropower Projects, Not Diversion—For Now

### Upstream Hydropower: Current Status:

 China has built or proposed several hydropower projects along the upper reaches of the Yarlung Tsangpo, but most are run-of-the-river dams with minimal water storage capacity. These are located far upstream and currently pose no major threat to India's water security or to flows in Arunachal Pradesh and Assam.

### The Medog Mega-Dam: A Potential Game-Changer

• Of serious interest is China's proposed 60,000 MW Medog Hydropower Project, near the Great Bend of the river in Tibet's Medog County. If completed, it would be the largest hydroelectric project in the world—three times the capacity of the Three Gorges Dam.

While precise technical data remains undisclosed, early indications suggest the **Medog dam may have limited storage** and may focus mainly on **power generation**, not water diversion. However, even **temporary water impoundment** or sudden releases could impact **flow variability** downstream.

### Is China Diverting the Brahmaputra?

### The South-North Water Diversion Plan:

There have long been **speculations** about the **Western Route** of China's **South–North Water Diversion (SNWD)** scheme involving the **diversion of Brahmaputra waters** to its drought-prone northern regions. However, to date, **no official confirmation** or **feasibility study** has been made public, and such a diversion would face **massive geopolitical and environmental hurdles**.

### Who Really Feeds the Brahmaputra?

### India's Dominant Contribution:

Despite covering just **34.2% of the basin area**, **India contributes more than 80%** of the Brahmaputra's **total water yield**. This challenges the misconception that the river is primarily Tibetan in origin.

### Why India Contributes More Water:

- The **Tibetan Plateau** receives only about **300 mm of annual rainfall**, while the **Indian part of the basin** gets a **rich monsoon rainfall average of 2,371 mm**.
- A network of **monsoon-fed tributaries** in Arunachal Pradesh and Assam, such as the **Subansiri**, **Dibang**, **and Lohit**, significantly boosts the river's volume.

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• Snowmelt from the Indian Himalayas also adds to the river's year-round flow, especially in spring.

# Potential Impacts of Chinese Dams: What's at Stake for India?

# Flow Reductions: Minimal, But Not Negligible

• India's heavy rainfall and strong tributary network mean that **Chinese upstream interventions** are unlikely to cause a **major reduction in overall flow**, especially during the **monsoon**.

# Seasonal Challenges and Hydropower Impacts:

• However, during the **dry season**—when India's **hydropower demand peaks**—even minor upstream flow regulation by China could affect **hydropower plants on the Siang**, such as the **proposed Upper Siang project**.

# **Risk of Flash Floods or Dam Breaches**

# Potential threats also include:

- Sudden releases from upstream dams
- Dam failures, landslides, or earthquakes in the seismically active Tibetan plateau
- These could trigger **devastating flash floods** downstream in Arunachal Pradesh and Assam.

# Ecological and River Morphology Concerns:

Altered flow patterns can disrupt the **natural sediment load**, **aquatic ecosystems**, and **biodiversity** in the Brahmaputra basin. Riverine communities depending on fishing and seasonal agriculture could also be adversely affected.

India's Utilisation of the Brahmaputra Basin: Huge Untapped Potential

According to the CWC-ISRO Brahmaputra Basin Atlas, the river holds:

- Over 30% of India's total water resources
- 41% of the country's total hydropower potential

# Arunachal Pradesh: The Hydropower Hub

Arunachal Pradesh is the focal point of India's Brahmaputra hydropower strategy. Yet, progress is **slow** due to:

- Land acquisition delays
- Environmental clearance hurdles
- Concerns over forest and habitat submergence

# India's River-Linking Vision:

India is exploring **inter-basin water transfer** options, including:

- Manas-Sankosh-Teesta-Ganga Link
- Jogighopa-Teesta-Farakka Link

These projects aim to divert **surplus Brahmaputra water to drier parts** of the **Ganga basin**, offering long-term water security in drought-prone areas.

**Good News:** These plans are **unlikely to be affected** by China's upstream activity, thanks to India's own dominant contribution to the river's flow.

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Looking Beyond the Brahmaputra: China's Dams on Indus and Sutlej

### Indus and Sutlej Origins in Tibet: Download Our Application





China has also developed hydropower projects on the Indus and Sutlej, both of which rise in Tibet.

### **Sutlej Impact Mitigated by Indian Infrastructure:**

The Bhakra Dam (Gobind Sagar) acts as a large regulatory reservoir, buffering against Chinese flow variation. However, run-of-the-river plants like Nathpa Jhakri may experience output fluctuations depending on upstream releases.

### **Minimal Consumptive Use on Indus:**

India's use of the Indus River is largely non-consumptive, meaning it relies more on the river for hydropower than for water withdrawal. Projects like Nimoo Bazgo in Ladakh may face seasonal changes, but overall risk remains low.

### India's Strategic Response: Balancing Science, Diplomacy, and Infrastructure

- 1. Scientific Monitoring and Impact Studies: India must invest in high-resolution hydrological models, remote sensing, and climate-linked river behavior assessments to fully understand any flow manipulation upstream.
- 2. Strengthening Diplomatic Channels: Engaging China through bilateral mechanisms and international platforms can ensure **access to crucial hydrological data**, especially during emergencies like floods.
- 3. Establishing Real-Time Data Sharing Protocols: India should pursue formal data-sharing agreements, particularly during the monsoon and dry seasons, to manage early warning systems and prevent disasters.

### Did You Know?

- The **Yarlung Tsangpo Grand Canyon** in Tibet, where the Brahmaputra bends into India, is **deeper** than the Grand Canyon in the USA.
- If constructed, the **Medog Dam** could potentially displace tens of thousands of people in one of China's most remote and biodiverse regions.
- India already receives hydrological data from China during the flood season—but only on selected rivers and for a limited time.













**GS Paper 1** – Geography

### **Ranthambore Tiger Reserve: A Royal Wilderness Under Protection**

Context: In a significant conservation boost, the Supreme Court of India has directed the Rajasthan government to immediately ban all mining activities within the core zone of the Ranthambore Tiger Reserve (RTR). This move aims to protect critical tiger habitats from ecological degradation and ensure long-term survival of wildlife in one of India's premier tiger reserves.



### Where Nature Meets Heritage: About Ranthambore Tiger Reserve

Located in Sawai Madhopur district, in southeastern Rajasthan, the Ranthambore Tiger Reserve stands as a majestic blend of history and wilderness. It gets its name from the iconic Ranthambore Fort, a **UNESCO World Heritage Site**, nestled within the park's boundaries.

The reserve is cradled between the Aravalli and Vindhya hill ranges, and is known for its picturesque landscapes, featuring rugged hills, plateaus, rivers, and ancient ruins that echo its regal past.

Once a royal hunting ground for the Maharajas of Jaipur, Ranthambore was declared a Wildlife Sanctuary in 1955, and became part of **Project Tiger** in 1973. Today, it is recognized as one of northern India's largest and most visited tiger reserves, covering an area of about 1,411 sq. km.

### **Geography and Water Bodies: Life Lines of the Reserve**

- The park is **bounded by the Banas River** to the north and the **Chambal River** to the south.
- It is dotted with several scenic lakes, including:
  - Padam Talab
  - Raj Bagh Talab
  - Malik Talab  $\circ$

These wetlands not only support a rich diversity of flora and fauna but also serve as popular watering holes for wildlife, making them prime tiger-spotting zones.

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### Vegetation: The Beauty of the Dry Deciduous Forests

Ranthambore is dominated by **dry deciduous forests**, interspersed with **open grasslands**, particularly on elevated plateaus. The terrain creates a visually captivating contrast of rocky outcrops and sparse greenery.

- The forest is largely composed of **Dhok trees** (*Anogeissus pendula*), which thrive in arid conditions. •
- Other plant species found here include:
  - Acacia
  - Zizyphus 0
  - 0 Capparis
  - **Prosopis** 0

The **biodiversity of vegetation** plays a critical role in supporting herbivores and the predators that depend on them.

### Wildlife: A Haven for Tigers and Beyond

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While **Bengal tigers** are undoubtedly the star attraction, Ranthambore is home to a wide variety of **wildlife species**, making it a **biodiversity hotspot**.

# Notable Fauna:

- Leopard
- Caracal A rare, elusive wild cat
- Jungle cat
- Sambar deer
- Chital (spotted deer)
- Chinkara (Indian gazelle)
- Wild boar

Birdwatchers are also drawn to Ranthambore for its **diverse avian population**, including **crested serpent eagles, parakeets, kingfishers**, and **peacocks**.

# **Did You Know?**

- Ranthambore is one of the best places in the world to see **tigers in the wild**, especially **during the day**—a rarity among tiger reserves.
- The Ranthambore Fort, dating back to the 10th century, stands as a testament to Rajput valor and is a fortress within a jungle, offering panoramic views of the reserve.
- The park was once visited by **President Bill Clinton** and many other global dignitaries, adding to its international fame.

# **Conservation Challenges and the Way Forward:**

Despite its success in tiger conservation, Ranthambore faces ongoing challenges such as:

- Mining and habitat encroachment
- Human-wildlife conflict in buffer zones
- Tourism pressure on core habitats

The **Supreme Court's mining ban** is a critical step in reinforcing the protection of core areas. For long-term sustainability, experts emphasize the need for:

- Enhanced patrolling and monitoring
- Community-based eco-tourism
- Expansion of buffer zones
- Habitat corridor connectivity with neighboring reserves like Sariska and Mukundra Hills

**Ranthambore is more than just a tiger reserve—it's a living archive of India's natural and cultural heritage.** As the majestic roar of the tiger echoes through its ancient valleys and forts, it serves as a reminder of the delicate balance between conservation and development.



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**GS Paper 3** – Science and Technology

DRUM Web App: IIT Kharagpur's Smart Solution for Clean and Efficient Urban Travel

**Context:** In a noteworthy development, a team of **students and an associate professor from IIT Kharagpur** has developed a cutting-edge tool for sustainable urban mobility—the **DRUM Web App (Dynamic Route Planning for Urban Green Mobility)**. This innovative platform is designed to help users **navigate city routes not just by speed or distance**, but also by **air quality and energy efficiency**, setting a new benchmark in eco-conscious travel technology.



### What is the DRUM Web App?

Think of it as an **environmentally intelligent version of Google Maps**. The **DRUM app** empowers users to choose travel routes based on **multiple environmental and efficiency factors**, enabling smarter, healthier urban commuting.

### Key Features of the DRUM App:

The DRUM platform offers **five intelligent route choices**:

- 1. Shortest Route Minimizes distance
- 2. Fastest Route Minimizes travel time
- 3. LEAP (Least Exposure to Air Pollution) Prioritizes cleaner air
- 4. LECR (Least Energy Consumption Route) Optimizes energy use
- 5. Suggested Route A balanced choice combining the best of all four criteria

Unlike conventional maps that refresh data periodically, **DRUM fetches live pollution and traffic data** at the exact moment a user enters a route—**ensuring maximum accuracy** in real-time navigation.

# How It Work<mark>s: The T</mark>ech Behind DRUM

- Routing Engine: DRUM is built using GraphHopper, a high-performance Java-based routing library known for its scalability and flexibility.
- Real-Time Updates: Mapbox provides dynamic traffic data, while pollution insights come from the Central Pollution Control Board (CPCB) and the World Air Quality Index (WAQI).
- **Pollution Interpolation Strategy**: To tackle areas with **limited sensor coverage**, the app uses a **segment-wise interpolation technique**. Routes are broken down into smaller parts, and pollution levels are **estimated using nearby sensor data**, ensuring **complete coverage**.
- Simulation and Testing: The app was successfully tested on various corridors across Delhi (East, West, North, and Central), each with differing road, traffic, and pollution conditions. The results revealed that traditional routes—though faster or shorter—often passed through highly polluted zones, reducing their overall benefit.

# Why DRUM Stands Out: Smarter Choices for Urban Living

Traditional navigation apps focus on time and distance. **DRUM introduces a game-changing perspective**: **your route impacts your health and the environment**. With rising urban air pollution and traffic congestion, this app offers a **scientifically backed tool** for choosing routes that balance **convenience with sustainability**.

### **Did You Know?**

• A **10-minute detour** through cleaner routes could **reduce air pollution exposure by up to 40%**, according to pilot studies. *Download Our Application* 









- The transport sector contributes nearly 18% to urban PM2.5 pollution levels in major Indian cities—better route planning can significantly lower individual carbon footprints.
- DRUM can be scaled to other metro cities like Mumbai, Bengaluru, and Kolkata, offering nationwide potential for eco-conscious commuters.

# **Future Potential and Way Forward:**

The DRUM team envisions integrating more features such as:

- Public transport route mapping
- EV route optimization based on charging station availability
- User feedback loops for route refinement

With increasing emphasis on sustainable smart cities, DRUM could become a core component in green mobility planning and urban policy-making.

DRUM is more than just a navigation tool—it's a conscious step toward a cleaner, healthier, and smarter future for India's urban travelers.

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**GS Paper 3** – Science & Technology



# Proton Emission: Unveiling a Rare Form of Radioactive Decay

Context: In a remarkable scientific advancement, an international team of researchers has successfully measured the half-life of the heaviest known proton emitter—the Astatine-188 (<sup>188</sup>At) isotope. This unstable isotope of **astatine** was observed to decay by **emitting a single proton**, offering deeper insights into the exotic realm of **proton-rich nuclei** and advancing the field of nuclear physics.



### What is Proton Emission? A Rare Decay Phenomenon

**Proton emission**, also referred to as **proton radioactivity**, is a **rare and exotic type of radioactive decay** in which an **unstable atomic nucleus expels a proton** to achieve a more stable configuration.

This form of decay typically occurs in **extremely proton-rich nuclei**—nuclei that lie **beyond the proton** drip line, where proton separation energy becomes negative. In such cases, the proton is no longer **bound** within the nucleus and **escapes by quantum tunneling** through the nuclear potential barrier.

### How Does It Differ from Other Types of Radioactive Decay?

Radioactive decay is the **natural transformation** of an **unstable atom** into a **more stable one**, often by releasing subatomic particles and energy. Here's how proton emission compares with more common types:

- Alpha Decay: Releases an alpha particle (2 protons and 2 neutrons). Common in heavy nuclei like uranium and thorium.
- **Beta Decay:** 
  - **Beta-minus** ( $\beta^{-}$ ): A neutron transforms into a proton and emits an electron.
  - **Beta-plus** ( $\beta^+$ ): A proton converts into a neutron and emits a **positron**.
- **Proton Emission**: Ejects a **single proton** from the nucleus, either:
  - Directly from the ground state, or
  - Following beta decay, known as beta-delayed proton emission.

### When and How Does Proton Emission Occur?

Proton emission only occurs in nuclei that are highly proton-rich, and typically not found in nature. Such isotopes are **synthesized artificially** in laboratories using **particle accelerators** and **nuclear reactions**.

To emit a proton:

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- The **proton separation energy must be negative**, meaning the proton is **energetically unbound**. ٠
- The emission rate depends on:
  - The **nuclear potential**
  - The **Coulomb barrier** (electrostatic repulsion) 0
  - The centrifugal barrier, which increases with the proton's orbital angular momentum 0

### Why Half-Life Matters in Proton Emission:

The **half-life** of a radioactive isotope is the **time required for half of a sample to decay**. For proton emitters:

The **shorter the half-life**, the **more unstable** the nucleus.







The **proton's energy** and **angular momentum** directly affect how fast it escapes the nucleus.

The detection of Astatine-188's half-life gives physicists valuable data on nuclear forces and helps refine nuclear models near the limits of stability.

### Scientific and Practical Relevance:

Though **proton emission** has no direct application in daily life, it plays a **crucial role in nuclear research**, helping scientists:

- Understand the structure of nuclei at the edge of the nuclear landscape
- Explore fundamental interactions between nuclear particles
- Improve theoretical models used in nuclear astrophysics, especially for understanding nucleosynthesis in stars

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