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NEWS TODAY
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Bose Institute scientists receive Breakthrough Prize in Fundamental Physics

Experimental High Energy Physics group of **Bose Institute (BI)** has been awarded the **Breakthrough Prize 2025** in **Fundamental Physics** as a part of ALICE at CERN.

About the Breakthrough Prize 2025

- Prize for 2025 is awarded to **researchers from more than 70 countries** representing four experimental collaborations at **CERN's Large Hadron Collider (LHC) – ATLAS, CMS, ALICE and LHCb.**
- It has been awarded for:
  - **detailed measurements of Higgs boson properties** confirming the symmetry-breaking mechanism of mass generation;
  - the discovery of **new strongly interacting particles;**
  - the study of rare processes and **matter-antimatter asymmetry;** and
  - the exploration of **nature at the shortest distances and most extreme conditions at CERN's Large Hadron Collider** (LHC).

About CERN (European Organization for Nuclear Research)

- **Established:** In 1954, as Europe's first joint venture after World War-II.
- It is an **international scientific organization** established for the purpose of collaborative research into high-energy particle physics.
- **Location: Franco-Swiss border** near Geneva, Switzerland.
- **Members:** 23 Member States (10 Associate Member States)
  - **India is an Associate Member**

Four experimental collaborations at CERN's LHC

- **A Toroidal LHC Apparatus (ATLAS): Largest detector** ever constructed for a **particle collider.**
- **Compact Muon Solenoid (CMS):** It is a **general-purpose detector** with programme ranging from studying Standard Model (including Higgs boson) to searching for extra dimensions and particles that could make up dark matter.
- **A Large Ion Collider Experiment (ALICE):** It studies the **Quark-Gluon Plasma (QGP),** a state of extremely hot and dense matter that existed in the first microseconds after the Big Bang.
- **Large Hadron Collider beauty (LHCb):** Specializes in investigating slight differences between matter and antimatter by studying a type of particle called the **"beauty quark" or "b quark".**
  - **b Quark** is the **second-heaviest known quark** with a **negative one-third electric charge of the elementary charge of electron.**

Cambridge Scientists discovered Biosignatures on Exoplanet, K2-18 b, using James Webb Space Telescope (JWST)

The landmark discovery detected **two chemical gases – Dimethyl Sulfide (DMS)** and **Dimethyl Disulfide (DMDS),** produced primarily by **marine phytoplankton- algae** on Earth.

- Earlier observations by JWST had identified **methane** and **carbon dioxide** in K2-18 b's atmosphere.

More about the Discovery

- **Variation in Concentration:** Concentration of DMS and DMDS in K2-18b's atmosphere are around **thousands times** stronger than on Earth.
- **Use of the Transit Method:** Astronomers used the **Transit Method,** wherein as K2-18b transits, JWST detected a drop in stellar brightness.
- **Establishing K2-18 b as an Hycean Exoplanet:** Hycean Exoplanet is **habitable ocean-covered planet** underneath a hydrogen-rich atmosphere.
- **Accuracy:** The observations have reached the **'three-sigma'** level of statistical significance (0.3% probability of it being a mere chance occurrence) .

About K2-18 b

- It is an **exoplanet** (planet beyond our solar system mostly orbiting other stars) that is **8.6 times** more massive than Earth with a diameter of about **2.6 times** of Earth.
- It orbits the **cool dwarf star K2-18** in the **habitable zone** and lies **120 light-years** from Earth in the constellation **Leo.**

About JSWT

- Launched in **2021** as an **international partnership** between **NASA, European Space Agency and Canadian Space Agency** to understand the early universe, formation of stars, planets, etc.
- It orbits the Sun **1.5 million kilometres** away from the Earth at the **second Lagrange point (L2).**

Devasthal Optical Telescope (DOT) detected and measured the properties of an IMBHs (Intermediate-Mass Black Holes)

- Discovery was made by the scientists from **Aryabhatta Research Institute of Observational Sciences (ARIES),** autonomous institute under **Department of Science and Technology (DST).**
- The **3.6m DOT** (commissioned in 2016) is the **largest** telescope for studying celestial objects at optical wavelengths in India.
  - Located in **Nainital** and is maintained and operated by **ARIES.**

About IMBH Detected

- **Location:** About **4.3 million light-years away** in a faint galaxy.
- **Finding: A gas cloud** orbiting the black hole at a distance of around **2.25 billion kilometre** with a **velocity dispersion of 545 km per second** was found.
- **Significance of the discovery:** So far IMBH have **remained evasive** due to their **faint nature** and **location** in small galaxies.
  - Unlike their larger counterparts, they generally **do not generate bright emissions.**

About Black Holes

- **About:** Regions in space where an **enormous amount of mass** is packed into a **tiny volume** creating a **gravitational pull** so strong that **not even light can escape.**
  - They **neither emit nor reflect light**, making them **invisible** to telescopes.
  - They are created when **giant stars collapse** and are surrounded by a boundary called an **Event Horizon.**
- **Detection:** Based on their impact on surroundings through
  - **Accretion disks** (ring of gas and dust surrounding black holes).
  - **Gravitational waves** (ripples created when very massive objects accelerate through space), etc.
- **Significance of Studying Black Holes:** Testing fundamental theories of Universe like the **General Theory of Relativity** and **Quantum Physics,** etc.

Types of Black Holes

Stellar-Mass Black Holes	Intermediate-Mass Black Holes (IMBH)	Supermassive Black Holes
Mass: Ranging from a **few to hundred** times that of Sun. Gain mass through **collisions with stars** and other black holes.	**Mass:** Around one **hundred to hundreds of thousands** of times the Sun's mass. Scientists are actively hunting for these missing link black holes.	**Mass: Hundreds of thousands to billions** of times the Sun's mass. Grow by **feeding on smaller objects,** like stellar mass ones, neutron stars or merge with other supermassive ones when galaxies collide.

IIT Bombay Scientists develop Lotus leaf-like Solar Evaporators for Salt-water Treatment

Developed a new **hydrophobic Graphene-based material that can facilitate water desalination,** this could be a significant breakthrough to **address the fresh water crisis in the world.**

Fresh water crisis

- While 71% of its surface is covered by water, the world population depends on **only the 3% available fresh water.**
  - Out of which **only 0.06% can be easily accessed** as the rest comprises the frozen polar ice cap or glaciers, groundwater, and swamp.

Desalination Technologies and Processes

Desalination Technologies	Thermal Technology	Membrane Technology
Concept	**Heating of saline water and collecting the condensed vapor** (distillate) to produce pure water. **Usage:** Mainly for **seawater desalination.**	Feedwater is pumped through **semi-permeable membranes** to filter out the dissolved solids. **Usage:** Mainly for **brackish water desalination.**
Sub-categories (Processes)	**Three groups:** Multi-Stage Flash Distillation; Multi-Effect Distillation; Vapor Compression Distillation	**Two groups:** Electrodialysis / Electrodialysis Reversal (ED/EDR); Reverse Osmosis (RO)
Merit	Ability to **reduce the maximum salinity concentration.** Demands **less input electrical energy** compared to membrane techniques.	**Environmental Friendly:** E.g., ED eliminates the need for chemicals. **Smaller footprint:** Typically require **less space** than conventional technologies.
Demerits	**Using conventional energy sources** like coal etc. **High costs involved:** So, rarely been used for brackish water desalination. **Subject to corrosion:** E.g., MSF plants.	Susceptible to **Fouling.** Require **Regular Maintenance** Face challenges in **Membrane Waste Disposal.** May **not fully remove Total dissolved solids (TDS) or pathogens.**
Example	**Low Temperature Thermal Desalination (LTTD) plants** were established in the **Kavaratti, Minicoy and Agatti Islands in the UT of Lakshadweep.**	**Nemmeli Seawater Desalination Plant, Tamil Nadu,** on Reverse Osmosis. (Largest desalination plant in the South Asia)

India and International Big Cat Alliance (IBCA) Signed the Headquarters Agreement

The Agreement provides **India** to host the **IBCA Headquarters** and **Secretariat** helping IBCA efficiently discharge its official functions.

More on the Agreement

- It pertains to **visas, privileges and immunities** being extended to the IBCA Secretariat and personnel, premises, etc.
- Further, India to provide a **budgetary support** of **150 crore rupees to IBCA** for creating a corpus, building infrastructure, meeting recurring expenditure for **5 years from 2023-24 to 2028-29.**

About IBCA (Hq: India)

- **Genesis:** Launched by **India** in **2023** to commemorate **50 years** of **Project Tiger.**
  - The IBCA and its Secretariat become a **full-fledged treaty based inter-governmental international organization and international legal entity** in January, 2025 with the enforcement of its Framework Agreement.
- **Members: 5 countries** (Nicaragua, Eswatini, **India,** Somalia and Liberia) have formally signed its Framework Agreement.
- **Aim:** Conservation of **7 big cats** namely **Tiger, Lion, Leopard, Snow Leopard, Cheetah, Jaguar** and **Puma.**
  - Out of these, **5 big cats** viz., **Tiger, Lion, Leopard, Snow Leopard** and **Cheetah** are found in India.

Other Efforts for Conservation of Big Cats

- **St. Petersburg Declaration on Tiger Conservation (2010):** Members of **13 tiger range countries** agreed to the **Tx2 goal** (double the world's wild tigers by 2022).
- **India: Project Tiger (1973); Project Lion (2020)** for conserving Asiatic Lions, etc.

C-DOT and Sterlite Technologies Ltd. tested India's First Quantum Key Distribution over Multi-Core Fibre

Multi-Core Fibre (MCF) technology provides a powerful solution by enabling data transmission **across multiple cores within a single fibre,** significantly saving physical space and infrastructure costs.

About Quantum Key Distribution (QKD)

- It is a **secure communication method** for exchanging **encryption keys** only known between shared parties.
- It utilizes the unique properties of **quantum mechanical systems** to generate and distribute cryptographic keying material using special purpose technology.
- **Working:** QKD works by transmitting many light particles, or photons, over **fiber optic cables** between parties.
  - **Each photon** has a random quantum state, and collectively, the photons sent make up a stream of ones and zeros (called qubits).
- **Types of QKD:**
  - **Entanglement-based protocols:** In this, a source generates **entangled pairs** of quantum states, and each party receives one member of the pair.
  - **Prepare-and-measure** protocols: In these protocols, the sender prepares a **quantum state** (often as a superposition of the polarization states of light) and sends it to the receiver, who then measures it.
- **Benefits of QKD:** Capable of detecting and **mitigating eavesdropping** (the act of listening to, recording or intercepting private communications) attacks.
- **Limitations:** Increases infrastructure costs, risk of denial of service, need for specialized equipment, difficulties in integrating with existing networks, etc.

Also in News

Index of Industrial Production (IIP)

From April 2025 onwards, **All India Index of Industrial Production (IIP)** will be released on 28th of every month, **within 28 days** (from the current 42 days) from the reference month.

- Further, only **two estimates (Quick estimate and Final estimate)** would be released instead of the earlier practice of releasing three estimates.

About IIP

- **About: Composite indicator** measuring the **short-term changes** in the volume of **production of a basket of industrial products** during a given period with respect to a **chosen base period.**
- **Base Year:** 2011-12.
- **Compiled and Published By: Central Statistics Office (CSO)** on a monthly basis.
- **Scope: Covers mining and quarrying, manufacturing** and **electricity** sectors.

National Organ and Tissue Transplant Organisation

Recently, National Organ and Tissue Transplant Organisation (NOTTO) has written to states, UTs to implement swap organ transplant.

- **Swap organ transplant** is a process where two or more incompatible donor-recipient pairs swap their organs.

About NOTTO

- National level organization set up under **Directorate General of Health Services, Union Ministry of Health & Family Welfare.**
- Carries out activities as per **Transplantation of Human Organs and Tissues Act (THOTA), 1994.**
- It has **two divisions:**
  - National Human Organ and Tissue Removal and Storage Network
  - National Biomaterial Centre.
- **Located:** Safdarjung Hospital, New Delhi.
- Set up under the **National Organ Transplant Program** (NOTP), along with Regional Organ and Tissue Transplant Organizations (ROTTOs) and State Organ and Tissue Transplant Organizations (SOTTOs).

Financial Intelligence Unit- India (FIU-IND)

FIU-IND and **Reserve Bank of India (RBI)** signed an MoU for coordinated efforts towards effective implementation of the **Prevention of Money Laundering Act** and **Rules** framed thereunder.

About FIU-IND

- **About: Central National Agency** for receiving, processing, analyzing and disseminating information relating to **suspect financial transactions.**
  - Also deals with **coordinating and strengthening efforts** of National and international intelligence, investigation and enforcement agencies in pursuing the **global efforts against money laundering and financing of terrorism.**
- **Genesis:** 2004
- **Nature: Independent body** reporting directly to the **Economic Intelligence Council (EIC)** headed by the **Finance Minister.**

Vehicle-to-Grid Technology

Kerala State Electricity Board (KSEB) and the Indian Institute of Technology Bombay (IIT Bombay) have initiated a pilot project to explore the implementation of Vehicle-to-Grid (V2G) technology.

About V2G Technology

- V2G refers to **technologies that enable EV batteries to send power back to the grid.**
  - When an EV is not in use, it can act as a **decentralised battery energy storage device.**
- By incorporating V2G technologies, EVs offer an opportunity to facilitate the **integration of Renewable Energy (RE) and support a demand response** market.
- It can also help **modulate power in an EV battery to reduce the impact of variable RE** on the grid and improve grid stability.

Aral Sea

Research indicates signs of **geological changes** (elevation of the dried land of the basin) since the water disappeared on Aral Sea.

About Aral Sea

- **About:** Was once a **large saltwater** lake of **Central Asia.**
- **Location:** Boundary between **Kazakhstan (North)** and **Uzbekistan (South).**
  - It was fed by **Amu Darya** and **Syr Darya rivers.**
- **Cause of Disappearance:** Diversion of the **Amu Darya** and **Syr Darya** rivers during the Soviet era.
  - The dried-up Aral Sea became the **hazardous Aralkum Desert**, which ranks as a major global dust source.

Flue Gas Desulphurisation (FGD)

A study commissioned by the Office of the Principal Scientific Adviser recommended the rollback of the 2015 policy mandating the **installation of FGD systems** in all of India's coal-fired plants.

- Rather, it recommended FGD to only those plants **using imported coal or high (>0.5%) sulphur coal.**

About FGD

- It involves the **removal of SO2 (Sulphur Dioxide)** in exhaust gases from coal-fired power plants before being released to the atmosphere.
- Uses **scrubbing technique** involving an **alkaline reagent** (typically a sodium- or calcium-based alkaline regent).
- **Types of FGD Systems:** Dry Sorbent Injection, Wet Limestone Based, Sea Water Based, etc.

Cradle of Humankind

South Africa's **'Cradle of Humankind'** caves reopened for public after being closed three years ago due to flooding.

About Cradle of Humankind

- UNESCO **World Heritage Site** dotted with **subterranean limestone caves.**
- **Location:** Near Johannesburg, South Africa
- **Sites Included:** Fossil Hominid Sites of **Sterkfontein, Swartkrans, Kromdraai and Environs,** and the **Makapan Valley** and **Taung Skull Fossil Site.**
- **Discovered Specimens:** Australopithecus Africanus, Paranthropus, domestication of fire, etc.
- **Significance :** Abundant scientific information on the **evolution of modern humans over at least the past 3.5 million years.**

Permanent Lok Adalat

Kerala becomes first State in India to launch Online Permanent Lok Adalat Services.

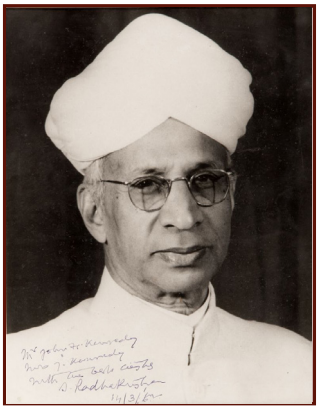
About Permanent Lok Adalat

- It is organized under **Section 22-B** of the **Legal Services Authorities Act, 1987.**
- **Power:** Same powers as are vested in a **Civil Court** under the **Code of Civil Procedure, 1908.**
- **Jurisdiction:** Compulsory pre-litigation mechanism for conciliation and settlement of cases relating to Public Utility Services like transport, postal, telegraph, etc.
- **Nature of judgment:** Final and binding on all the parties.
- **Jurisdiction:** Up to **Rs.1 Crore.**

Personality in News

Dr. Sarvepalli Radhakrishnan (1888 - 1975)

Eminent statesman and India's **second President Dr. Sarvepelli Radhakrishnan** was remembered on his death anniversary (April 17).



About Dr. Sarvepalli Radhakrishnan

- He was a **renowned Indian philosopher** born in a small town of Andhra Pradesh.
- Firm believer in the **principles of education as a transformative tool for society.**
  - **His birthday, September 5,** is celebrated as **"Teacher's Day" in India**

Key Contributions

- Worked as **Professors of Eastern Religions and Ethics** at the University of Oxford.
- Served as **India's Ambassador to the Soviet Union** from 1949 to 1952.
- He served as the **Vice President (1952-1962)** and **President of India (1962-1967).**
- **Literary works:** The Principal Upanishads, The Hindu view of Life, Dhammapada, etc.

Rewards and Recognition: Knighthood (1931) and Bharat Ratna (1954).