



China's High Energy Photon Source

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Why in News?

China is on the brink of a major scientific breakthrough with the construction of the **High Energy Photon Source (HEPS)**, a state-of-the-art fourth-generation synchrotron light source.

- This development places China among a select group of nations capable of producing some of the **brightest X-rays in the world**.

Note:

- A synchrotron is a large circular machine the size of a football field that produces **intense beams of light using high-energy electrons** forced to travel in a circular orbit inside tunnels with strong magnetic fields.
 - The light is used to reveal the innermost secrets of materials, leading to advancements in medicine, agriculture, and materials science.

What is the HEPS Facility?

- **About:**
 - The High Energy Photon Source (HEPS) located approximately Huairou, this facility is designed to **accelerate electrons up to energies of 6 giga electron volts** within its 1.36-kilometer circumference storage ring.
- **Key Features of HEPS:**
 - HEPS will produce high-energy X-rays that **can penetrate deep into samples, revealing intricate details at the nanometer scale**.
 - **Technical Specifications:**
 - **Electron Acceleration:** Up to 6 giga-electron volts.
 - **Time Resolution:** 10,000 times better than third-generation synchrotrons, enabling measurements in nanoseconds.
 - **Beamlines:** 14 initially, with the capacity to expand up to 90.
 - **Scientific Impact:**
 - **Nanometre-Scale Probing:** Ability to study molecular and atomic structures in real time.
 - Can analyse minuscule samples, including small protein crystals that are challenging for older synchrotrons.
 - **Broad Applications:** Will benefit fields such as biomedicine, energy, advanced materials, and condensed-matter physics.
 - **Faster Experimentation:** Experiments that took days at older facilities can now be completed rapidly.
- **Challenges:**
 - **Beam Stability:** Ensuring the X-ray beam is stable enough for practical use requires

meticulous, step-by-step adjustments.

- **Technical Precision:** The process of fine-tuning thousands of components is critical to maintaining the light's brightness and stability.

How does HEPS Compare to Other Synchrotrons?

- **Current Status in China:** HEPS will surpass the Shanghai Synchrotron Radiation Facility, China's most advanced existing synchrotron.
- **Global Context:** Joins the ranks of only a **few fourth-generation synchrotron facilities** worldwide, including:
 - MAX IV Laboratory (Lund, Sweden), Sirius (Campinas, Brazil), Extremely Brilliant Source (Grenoble, France), and Advanced Photon Source (Lemont, Illinois).
- **Synchrotrons in India:**
 - India has **two synchrotron radiation sources** at the Raja Ramanna Centre for Advanced Technology (RRCAT) in Indore.
 - **Indus-1:**
 - A 450 MeV source that has been operating since 1999 and emits in the soft x-ray and vacuum ultraviolet (VUV) regions.
 - **Indus-2:**
 - Indus-2 is an **indigenously built third generation Synchrotron Radiation Source (SRS)** with 2.5 GeV energy and 200 mA beam current, operating at Raja Ramanna Centre for Advanced Technology (RRCAT), Indore.
 - It has a provision of 21 beamlines based on bending magnets and additional 5 beamlines based on insertion devices.

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