Fast Radio Bursts

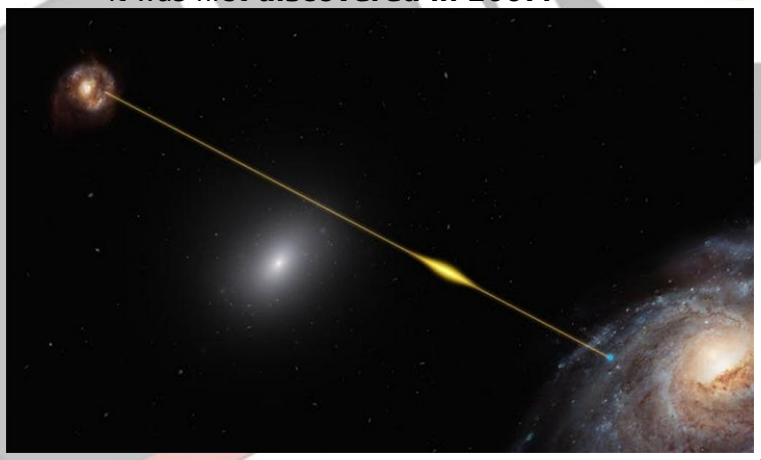
Why in News

Recently, researchers from the **Pune-based Tata Institute for Fundamental Research (TIFR)** and the **National Centre for Radio Astrophysics (NCRA),** have assembled the largest collection of **Fast Radio Bursts (FRBs)** catalogue.

- The data is from **Canadian Hydrogen Intensity Mapping Experiment (CHIME).**
- In 2020, the **National Aeronautics and Space Administration (NASA)** spotted **FRB for the first time in the Milky Way.**

Key Points

- **Fast Radio Bursts:**
  - FRB are **bright bursts of** radio waves (radio waves can be produced by astronomical objects with changing magnetic fields) whose **durations lie in the millisecond-scale,** because of which it is difficult to detect them and determine their position in the sky.
    - It was first **discovered in 2007.**



  - A defining property of these bursts is their **dispersion** (scattering or separation), the bursts **produce a spectrum of radio waves,** and as the waves travel through matter, they spread out or disperse with bursts at higher radio frequencies arriving at telescopes earlier than those at lower frequencies.
    - **Dispersion** can result in **signal degradation in many applications, especially over large distances.**
  - This dispersion allows researchers to learn about two important things:
    - They can measure this dispersion to **learn about the stuff that radio bursts pass through as they travel toward Earth**
    - They can indirectly **determine how far apart things are.**
- **FRBs Catalogue & Findings:**

- The new catalogue significantly **expands the current library of known FRBs,** and is already **yielding clues as to their properties.**
- For instance, the newly discovered bursts appear to fall in **two distinct classes: those that repeat, and those that don't.**
    - The **repeaters looked different,** with **each burst lasting slightly longer** and emitting more focused radio frequencies than bursts from single, non-repeating FRBs.
    - These differences strongly suggest that emission from repeaters and non-repeaters is generated either by different physical mechanisms or in different astrophysical environments
- The bursts were **evenly distributed in space, seeming to arise from any and all parts of the sky.**
- Bright FRBs occur at a rate of about **800 per day** across the entire sky - the most precise estimate of FRBs overall rate to date.

- **Origin of FRBs:**
    - FRBs have been spotted in various and distant parts of the universe, as well as in our own galaxy. Their **origins are unknown and their appearance is highly unpredictable.**
    - The **CHIME** project has nearly quadrupled the number of fast radio bursts discovered to date.
        - The telescope has detected **535 new FRBs** in its first year of operation itself, **between 2018 and 2019.**
        - With more observations, astronomers hope soon to **find the origins of the FRBs.**
- **Chime:**
    - It is a **novel radio telescope that has no moving parts.** Originally **conceived to map the most abundant element in the universe - hydrogen -** over a good fraction of the observable universe, this unusual telescope is **optimized to have a high mapping speed.**
    - It is located at the **Dominion Radio Astrophysical Observatory,** operated by the **National Research Council of Canada in British Columbia, Canada.**
    - The telescope **receives radio signals each day from half of the sky as the Earth rotates.**
- **Significance of Studying FRBs:**
    - The unique properties of fast radio bursts and their host galaxies combined with recent technological advancements have given researchers **hope that these phenomena can be used to answer some long-standing questions** about the **universe.**
    - It can be **used to understand the three-dimensional structure of matter** in the universe and to learn about **poorly understood early moments in the evolution of the universe.**

Source: DTE