Atomic Hydrogen Content of Galaxies

Why in News

In a significant discovery, the Pune-based **Nationwide Centre for Radio Astrophysics (NCRA-TIFR) and Raman Analysis Institute (RRI),** Bengaluru have used the **Giant Metrewave Radio Telescope (GMRT)** to measure the **atomic hydrogen** content (of 8 billion years ago) of galaxies when the universe was young.

- This will **help in unveiling the reason behind declining star formation in the Milky Way** in the present time.

Key Points

- **The Study:** For the first time the atomic hydrogen gas content of star forming galaxies for a past date (about 8 billion years ago) was measured with the help of the upgraded GMRT.
    - Unlike stars which emit light strongly at optical wavelengths, the atomic hydrogen signal lies in the radio wavelengths, at a wavelength of 21 cm, and can only be detected with radio telescopes.
    - **Stacking:** This 21 cm signal is intrinsically very weak, to overcome this limitation, the team used a technique called “stacking” to combine the 21 cm signals of nearly 8,000 galaxies that had earlier been identified with the help of optical telescopes.
        - This method measures the average gas content of these galaxies.
- **Significance of Discovery:**
    - Galaxies in the universe are made up mostly of gas and stars, with gas being converted into stars throughout the life of a galaxy.
        - Understanding galaxies requires us to determine how the amounts of both gas and stars change with time.
    - The star formation activity in galaxies peaked about 8-10 billion years ago (galaxy was young) and has been declining steadily till today.
        - The cause of this decline was unknown as there had been no **information regarding the amount of atomic hydrogen gas —** the **primary fuel for star formation** — in galaxies in these early times.
    - The observed decline in star formation activity could thus be explained by the exhaustion of the atomic hydrogen. Given the intense star formation in these early galaxies, their atomic gas would be consumed by star formation in just one or two billion years.

Giant Metrewave Radio Telescope

- GMRT is an array of **thirty fully steerable parabolic radio telescopes of 45 metre diameter.** It is operated by the National Centre for Radio Astrophysics of the Tata Institute of Fundamental Research. It is an **indigenous project.**
- It functions at the **metre wavelength part of the radio spectrum** because **man-made radio**

interference is considerably lower in this part of the spectrum in India and there are **many outstanding astrophysics problems** which are best studied at metre wavelengths.

- Detecting the 21 cm signal from the most distant galaxies in the universe was the main science goal of the GMRT, when it was designed and built by a team led by the late pioneering astrophysicist **Govind Swarup** in the 1980s and 1990s.
- The big jump in sensitivity was due to the upgrade of the GMRT with new wide band receivers and electronics in 2017.
- The **location** for GMRT, Pune meets several important criteria such as **low man-made radio noise,** availability of **good communication,** vicinity of **industrial,** educational and other infrastructure and, a geographical latitude sufficiently north of the geomagnetic equator in order to have a reasonably quiet ionosphere and yet be able to observe a good part of the southern sky as well.

Source: TH