India’s largest radio telescope plays vital role in detecting universe’s vibrations

The Pune-based Giant Metrewave Radio Telescope (GMRT) was among the world’s six large telescopes used to monitor pulsars, called ‘nature’s best clocks’

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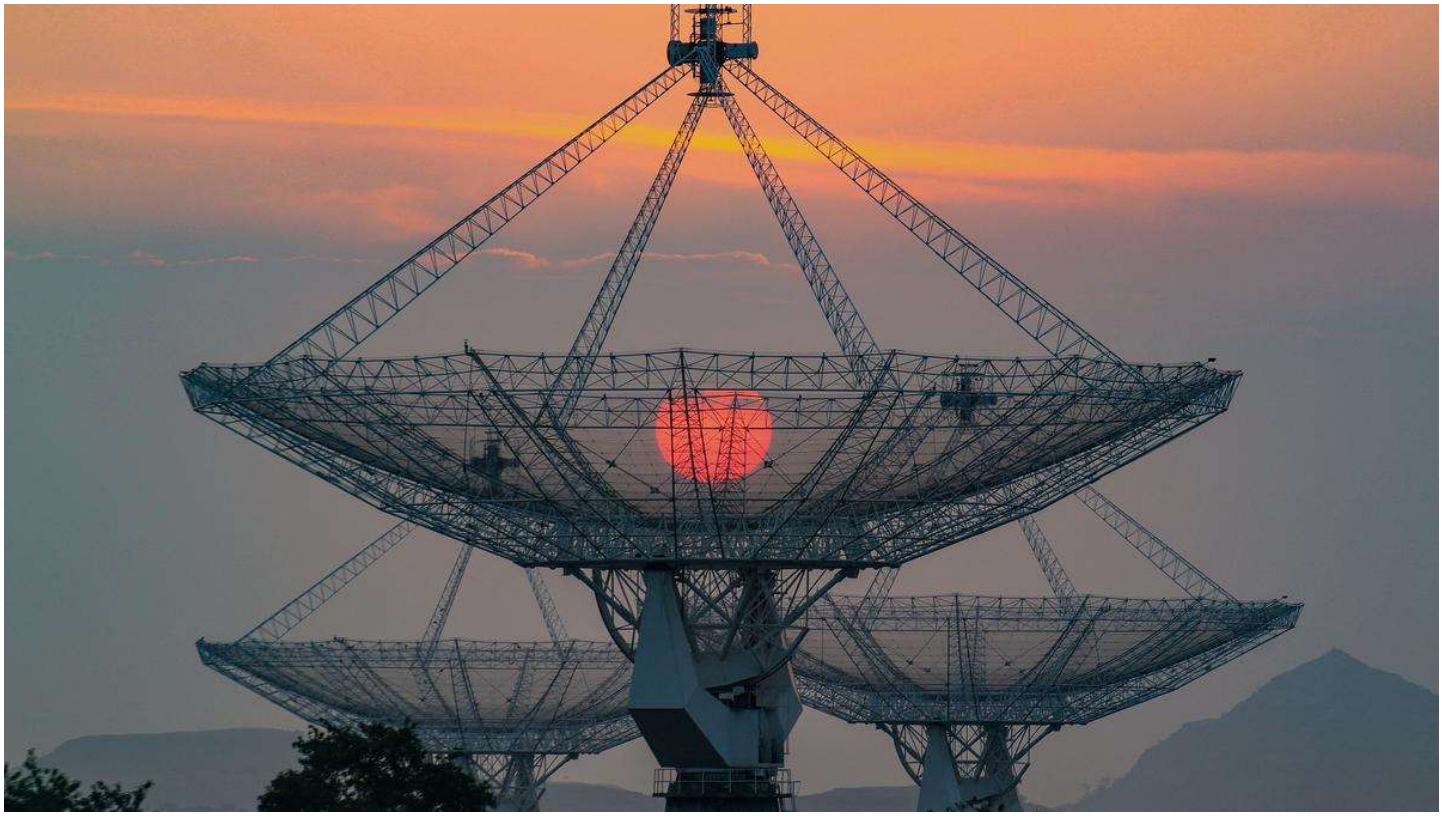

India’s largest telescope, the upgraded Giant Metrewave Radio Telescope (uGMRT), near Narayangaon in Pune district. | Photo Credit: PTI

India's Giant Metrewave Radio Telescope (GMRT) was among the world's six large telescopes that played a vital role in providing evidence confirming the presence of gravitational waves using pulsar observations, said scientists on Thursday.

An international team of astronomers from India, Japan and Europe has published the results from monitoring pulsars, called 'nature's best clocks', by using six of the world's most sensitive radio telescopes, including India's largest telescope, the Pune-based uGMRT.

"These results provide a hint of evidence for the relentless vibrations of the fabric of the universe, caused by ultra-low frequency gravitational waves. Such waves are expected to originate from a large number of dancing monster black hole pairs, crores of times heavier than our sun," said a statement issued by the city-based National Centre for Radio Astrophysics-Tata institute of Fundamental Research (NCRA-TIFR).

The team, consisting of members of European Pulsar Timing Array (EPTA) and Indian Pulsar Timing Array (InPTA) consortia, published their results in two papers in the Astronomy and Astrophysics journal on Thursday and shared that their results hint at the presence of such gravitational waves in their data set.

A time aberration was observed in the signals emerging from these pulsars, their studies suggest.

Pulsars are a type of rapidly rotating neutron stars that are essentially embers of dead stars which are present in our galaxy. A pulsar is like a cosmic lighthouse as it emits radio beams that flashes by the Earth regularly akin to a harbour lighthouse.

As these signals are accurately timed, there is a great interest in studying these pulsars and to unravel the mysteries of the Universe. In order to detect gravitational wave signals, scientists explore several ultra-stable pulsar clocks randomly distributed across our Milky Way galaxy and create an 'imaginary' galactic-scale gravitational wave detector.

There are several signals travelling through spacetime of the Universe. But, the presence of gravitational waves influences the arrival of these signals when detected from Earth. It

was noticed in these studies that some signals arrive early while others, with a slight delay (less than a millionth of a second).

These nano-hertz signals were heard as humming from the Universe. These were caused due to the presence of gravitational waves and due to signal irregularities emerging from pulsars, said the scientists.

Scientists said the team's results are a crucial milestone in opening a new, astrophysically-rich window in the gravitational wave spectrum.

"According to Albert Einstein, gravitational waves change the arrival times of these radio flashes and thereby affect the measured ticks of our cosmic clocks. These changes are so tiny that astronomers need sensitive telescopes like the uGMRT and a collection of radio pulsars to separate these changes from other disturbances. The slow variation of this signal has meant that it takes decades to look for these elusive nano-hertz gravitational waves," explained Professor Bhal Chandra Joshi of the NCRA-TIFR.

According to Professor A. Gopakumar, TIFR, Mumbai, and Chair of the InPTA consortium, "The results presented today mark the beginning of a new journey into the Universe to unveil some of these mysteries. More importantly, this is the first time that an Indian telescope's data was used for hunting gravitational waves."

Professor Yashwant Gupta, Centre Director at NCRA-TIFR, which runs the uGMRT, said it was "fantastic" to see the unique uGMRT data being used for the ongoing international efforts on gravitational wave astronomy.