China completes world's largest radio telescope

July 11 2016, by Elias Brinks

The FAST telescope. Credit: EPA

Boasting half a kilometre in diameter, it is the largest telescope dish in the world to date. The 500-metre Aperture Spherical Radio Telescope (FAST), which has been under construction in the Guizhou Province in south-west China since 2011, was completed on July 3 when the final panel was lowered into position. Excitingly, this new eye on the sky will be able to search for new exoplanets, gravitational waves and even signals from extraterrestrial civilisations.

FAST handsomely beats the Arecibo telescope in Puerto Rico into second place, with its 305-metre diameter dish. But the two giant telescopes are similar. Each uses natural geological depressions in the landscape known as "karst", giant sinkholes created by nature, that fit the rough outline of the telescope dish. Both are static structures in the sense that the dish only looks straight up, staring at the zenith. They therefore depend on the rotation of the Earth for different parts of the sky to come into view over the course of the day. To follow an object for a few hours at a time, the detector, which is suspended above the centre of the dish, can be shifted. This is much akin to moving one's head in front of a mirror left to right in order to scan what lies behind.

But while the Arecibo detector cage hangs in a fixed position, the FAST telescope uses an ingenious mechanism based on cables and pulleys that allows it to position the entire detector cage anywhere across the face of the dish. Another major difference is that Arecibo's dish is of a fixed, spherical shape whereas FAST uses an advanced system of cables and actuators that deform the spherical mirror, much like a rubber sheet, to create a parabolic shape. This allows a two to three times larger part of the sky to be accessed than is possible with Arecibo.

Thanks to its innovative design, FAST can track objects passing overhead for longer than Arecibo. It is also expected to be twice as sensitive and have five to ten times the surveying speed of Arecibo.

Arecibo observatory aerial view. Credit: wikimedia

Listening to the universe

Even though construction is completed, Chinese scientists and engineers still have a huge task to make the system reach the design specifications and ultimately deliver new and exciting scientific results. As the name already suggests, this is a radio telescope, picking up radiation from the cosmos at wavelengths of between 0.1 meter and 4 meters This is light with a wavelength a million times or so longer than our eyes can detect.

Not surprisingly, the sky at these long wavelengths looks vastly different which is exactly why observations at radio wavelengths reveal information that is not accessible with optical telescopes.

The long wavelength does have problem though, which is that the resolution, or sharpness of an image, decreases with increasing wavelength. To compensate for this, the telescope aperture has to increase, which is the main reason for FAST's giant proportions. Despite its size, the resolution will at best be several times worse than that of the human eye, and 400 times worse than the image quality routinely achieved by ground-based optical telescopes. There is a benefit, however, which is that the large size of the dish makes for a giant "bucket" to collect emission coming from the cosmos, making it a sensitive detector able to pick up weak signals. So "bigger is really better", especially when it comes to radio telescopes.

FAST is optimised to detect signals coming from neutral hydrogen, the most abundant element in the universe. This is found in diffuse clouds in the interstellar medium that fills the space between the stars in galaxies. This is the raw material from which stars form. FAST will be able to make a complete census down to much lower levels of the hydrogen content of the local universe than has been possible so far. How much hydrogen is found, where and in what kind of agglomerations, will have direct consequences for how scientists think the universe evolved from its earliest phase and how galaxies formed and have continued to grow with time.

The planet Jupiter emits metre-wave radiation. Thanks to its exquisite sensitivity Jupiter-like planets may be detected with FAST around around stars in the neighbourhood of the sun. Fascinatingly, it can also eavesdrop on distant worlds to search for intelligent life (a technique known as SETI). FAST is also expected to detect thousands of pulsars – rotating, dead stellar remnants of old, burned-out stars that emit a beam of radiation – in the Milky Way.

Scientists can use the incredibly stable pulses these objects emit as high-precision clocks to reveal gravitational waves from massive black holes or even from the Big Bang. This is because a gravitational wave passing through space will momentarily change distances between pulsars resulting in ever so slight changes in the arrival time of their pulses.

FAST complements and extends the capabilities of other leading radio telescopes, such as the Very Large Array in New Mexico, US. But eventually it is expected to be overtaken by the Square Kilometre Array (SKA), an international project in which China is a full partner. SKA combines a huge collecting area some four times larger than FAST with superb imaging capabilities, rivalling that of space-based optical telescopes.

This article was originally published on The Conversation. *Read the* original article.

Source: The Conversation

Citation: China completes world's largest radio telescope (2016, July 11) retrieved 26 April 2024 from https://phys.org/news/2016-07-china-world-largest-radio-telescope.html

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.