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Gravity waves may still wash up in the dry Karoo

Scientists in SA are gearing up to join the search for exotic cosmic phenomena, writes Tamar Kahn

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SOUTH African scientists are getting ready to join the global hunt for gravity waves — which, though predicted by Albert Einstein in 1916, still elude astronomers almost a century later.

Almost everything astronomers currently know about the universe has been learnt by using devices that detect electromagnetic radiation, including light, gamma waves, radio signals and X-rays.

Should they detect gravity waves, it would open up a whole new field of astronomy, says Prof Scott Ransom, a scientist at the National Radio Astronomy Observatory in Virginia, US.

"There is the potential we could learn truly new and potentially revolutionary things with them," he says.

The discovery would also win fame for those involved.

"It's almost guaranteed to be a Nobel prize," says Justin Jonas, a professor in physics and electronics at Rhodes University.

In 2016, SA is expected to complete the MeerKAT, a precursor to the Square Kilometre Array radio telescope, which will be the most sensitive device of its kind. One MeerKAT's task will be to hunt for gravity waves.

A variety of projects are already searching for the elusive waves, ripples in the fabric of space and time that have spread out in the aftermath of massive events such as stellar explosions and the collision of black holes.

Most of these efforts are expensive laser interferometry observatories that try to detect gravity waves by their minuscule effects on the movements of test masses placed equal distances apart in the two legs of an L- shaped vacuum.

Lasers are used to detect any movement in the masses caused by a gravity wave, which would shorten the distance between the masses in one leg, while lengthening it in the other.

That at least is the theory.

But so far none of the big- budget gravitational wave observatories have come up with the goods. These include the Laser Interferometer Gravitational- Wave Observatory (Ligo) in the US, Europe's Virgo, and a smaller detector in Japan. There are also joint European and US plans to build a space-based version called Lisa, the Laser Interferometer Space Antenna.

Scientists also have some low- budget ideas for detecting the waves, by seeking the distortions that theory tells us gravity waves would cause to the faint radio signals emitted by pulsars.

This is where the MeerKAT, an array of 64 radio dishes under construction near Carnarvon in the Northern Cape, will come into the picture.

Pulsars are the very dense remains of exploded supernovae, which are as compact as if the "sun was squeezed into Johannesburg", says Prof Jonas.

Astronomers know pulsars emit regular beams of radio waves as they spin, rather like the light shining from a lighthouse, although why this is the case remains a mystery.

Recently scientists have discovered particularly regular and extra-fast pulsars, which emit bursts of radio waves every thousandth of a second. If they can identify enough of these millisecond pulsars, astronomers should be able to detect the effects that a slow-moving gravity wave would have on the signals they send forth, says Prof Jonas.

Because gravity waves move so slowly, scientists will need to look for tiny variations in the arrival time of the signals from a number of pulsars over a long period of time, perhaps years .

"Pulsars are very regular clocks, but we need extra stable ones for this experiment."

Scientists have so far found only about 20 pulsars with the right characteristics for detecting gravity waves.

While new pulsars are being discovered all the time by the US space administration Nasa’s Fermi Gamma-ray Space Telescope, the MeerKAT will nevertheless be important because it will be more sensitive than current telescopes.

It should therefore lead to the discovery of many more of the millisecond pulsars needed to detect gravity waves, says Prof Ransom, who is part of a large international team of scientists that plans to use the telescope to hunt for more pulsars and search for gravity waves.

"The timing of pulsars is a very tricky thing to do, and a lot of technical work still needs to be done," says Prof Jonas.

"KAT-7, the seven-dish prototype for the MeerKAT due to be completed by the end of this year, will help scientists refine their methods," he says.

Regardless of which gravity wave detector wins the race (and the Nobel prize), there will still be a role for all of them.

This is because they are "tuned" to different events: the laser interferometers hunt for the rapid pulsing of merging neutron stars, while pulsar timing arrays search for the signals left from the merging of black holes.

That may well offer some comfort to funders in an era where money is tight, and science budgets shrinking.

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