Stabilizing the transmission of time signals for relativity research

July 28 2015, by Michelle Wheeler

The European Space Agency-led experiment is known as the Atomic Clock Ensemble in Space, and will see atomic clocks placed at ground stations across the planet, including at UWA, and on the International Space Station. Credit: Ant Schinckel, CSIRO

They say time waits for no man but David Gozzard might have found a way to at least tame it.

The UWA PhD student is investigating ways to more accurately transmit time signals.

It is work that will help mega-science projects test Albert Einstein's Theories of General Relativity and Special Relativity and peer back to the birth of the first stars and galaxies.

Mr Gozzard says high precision clocks are needed in several experiments to test fundamental physics and properties of the universe, with time signals transferred through the atmosphere or along fibre optic cables.

"For some experiments we want to compare two clocks that can be thousands of kilometres apart," he says.

"But when we send the signal from one clock to another… disturbances stretch and shrink the fibre optic cable so the signal takes a slightly longer or slightly shorter amount of time to get there."

Mr Gozzard says he is working to stabilise the transmission of time signals so "regular clicks" arrive as they should.

"We actually transmit the signal, bounce a fraction of it back and analyse it," he says.

"Then we…pre-compensate the outgoing signal, so we distort the outgoing signal in the opposite way."

The physicist is set to take part in a project using the International Space Station to test Einstein's theory of relativity.

Atomic clocks on space and ground stations measure constants

The European Space Agency-led experiment is known as the Atomic Clock Ensemble in Space, and will see atomic clocks placed at ground stations across the planet, including at UWA, and on the International Space Station.

"From space centres like the West Australian Space Centre up in Yarragadee, they're going to beam these [time] signals between the space station and the universities and metrology institutes," Mr Gozzard says.

"[They'll] compare the clocks, make the highest precision measurements ever of Einstein's theory of relativity, and check to see if fundamental constants of the universe may actually be changing over time."

Mr Gozzard has also been working on the transmission of time signals between different antennas for the Square Kilometre Array, a multi-billion dollar telescope set to be built partly in outback WA.

By having an atomic clock signal going out to each antenna, it is possible to synchronise observations from different elements of the telescope and ultimately improve the resolution of the final images, he says.

Usually, time signals would be disturbed while travelling the hundreds of kilometres between SKA antennas and would require multiple atomic clocks.

Provided by Science Network WA