Black holes provide us with knowledge of the Earth

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Black holes in distant galaxies can provide us with vital knowledge about our planet. Chalmers is currently building two new telescopes which, despite the fact they are directed out into space, will measure and map the Earth.

"It could be described as surveying on a global scale," says Rüdiger Haas, as he explains how the telescope could be used. Normally, he researches and teaches in space geodesy although at the moment a great deal of time is being spent on planning the construction project, which is due to commence in summer 2014.

Before this, land issues need to be investigated, building permit applications need to be submitted and the telescopes and peripheral equipment need to be procured. Once the two new radio telescopes are in use in four years' time, Rüdiger Haas predicts that Onsala will be one of the most modern observatories in Europe for space geodesy research, a science in which the Earth is studied with the aid of distant heavenly bodies.

"The aim is to study geodynamic processes, which generally means the way the planet is changing. This involves variations in the Earth's rotation and the angle of the Earth's axis, increases in land height, changes in sea level or how an earthquake affects the shape and rotation of the Earth."

Black holes as reference points

For the type of measurement required, fixed reference points outside the planet are needed and this is where galaxies with the black holes come into the picture. Quasars, as they are called, emit electromagnetic energy , which is picked up by the researchers' radio telescope and can be used as reference points from which calculations can be made.

"Really it is not the distance we are measuring but time," says Rüdiger Haas. He explains that they measure the time difference between when the wave front from a quasar reaches a telescope in Onsala, for example, and when it reaches a telescope in Chile.

"As the method requires that telescopes at different locations around the world are linked, space geodesy has become a research area where virtually everyone knows everyone," says Rüdiger Haas.

"There are only around 50 observatories throughout the world where these types of measurements are made and those of us who work with this have become something of a family."

Greater precision required

The management technique, known as VLBI (Very Long Baseline Interferometry) was developed in the USA. Onsala Space Observatory was the first in Europe to become affiliated and made the first transatlantic observation possible in 1968. The investment in two new telescopes at Onsala is part of a joint plan to gradually update the geodetic VLBI network around the world.

"We have reached the limit and the technology that began to be developed in the 1960s and 1970s will not bring us any farther. We are

therefore building a new type of telescope, which, among other things, means that measurements will be ten times as accurate."

At the water's edge and with a view across open sea on the western side of the Onsala Peninsula, there is one of the observatory's old space telescopes with his 25-metre wide dish directed at the sky. To prevent it from being blown over in high winds, the surface comprises a fine mesh grille. The extremely bright autumn sunlight is sieved through the holes and falls softly on Rüdiger Haas as he points up towards the curved dish and explains how the new telescopes will be different.

"The most tangible differences are that the new telescopes will be half as big and that they will move considerably more and much more quickly. They will focus on a new radio source every 30 seconds and will thus provide us with a great deal of data in a very short period of time. They are also placed just 75 m from each other and work as a pair, what is known as a twin telescope, which makes it easier to cope with various disruptions in the atmosphere."

Measuring processes take time

Rüdiger Haas is not prepared to promise any revolutionary research results from this new generation of radio telescope this side of 2020. The work will mostly involve gathering data over a long period and studying processes and changes. An example of this research is how global warming will affect the sea level.

"At present, we unable in reality to decide what effect individual sources will have on the sea level. We don't know, for example, what impact the rise in water level resulting from the melting of the Greenland inland ice will have in relation to global warming and smaller glaciers. This requires a better frame of reference, which is one of the many things that we will have the opportunity to contribute using the new telescope.

Provided by Chalmers University of Technology