‘God particle’ may shed light on dark matter

Scientists hope to get answers about the universe by studying the Higgs boson

Grace Chua

Now that the elusive Higgs boson has been found, scientists are using it to answer big questions about the universe.

The Higgs boson is a particle predicted by theory and is often called the “God particle”. It was considered a missing cornerstone of particle physics, and helps explain what gives all matter in the universe size and shape.

Last July, scientists using the world’s biggest atom smasher, the Large Hadron Collider, to hunt for the Higgs particle announced that they had found something that behaved very much like it.

“Without the Higgs field, the universe would be a very different place,” said Duke University physicist Mark Kruse, one of the many scientists on Atlas, one of the two teams that worked to find it. The other team was from the European Organisation for Nuclear Research (Cern).

So what’s next for scientists working on the Higgs boson question at the US$10 billion (S$12 billion) Large Hadron Collider – and for the world’s biggest atom smasher itself, tucked away under the French-Swiss border?

Now, Associate Professor Kruse said, they are trying to answer other key questions about the universe, such as: What is dark matter, the invisible stuff that makes up much of the universe’s mass? Why is there more matter than anti-matter?

He and Cern senior research scientist Albert de Roeck spoke last month at a workshop in Singapore organised by the Institute of Advanced Studies at the Nanyang Technological University (NTU) and Cern on Particle Physics and Cosmology – Status, Implications and Technology.

Right now, the Large Hadron Collider is being shut down slowly to prepare it for upgrading which will last till 2015. When it restarts, the collider will be able to shoot bunches of particles around its 27km-long tunnel at even faster speeds, with stronger magnets to control the particles’ path.

Dr de Roeck explained that this would enable collisions to produce heavier particles – and that some of these could be possible candidates for dark matter.

Such heavy particles are not always stable – they may break down into various other particles. Researchers can look at the mix of lighter particles to work out what they originally came from – much like looking at a fossilised footprint to see if it was made by a mammoth or a T-Rex.

Prof Kruse added that these high-energy conditions were more like conditions in the early universe, close to the dawn of time, so one could work out what happened immediately after the universe’s birth.

At a more down-to-earth level, the technology of the Large Hadron Collider could have medical applications, said Dr de Roeck.

For example, more sensitive measurement techniques can be used for scans so that patients do not have to be bombarded with high doses of radiation for doctors to image the inside of their bodies.

In Singapore, there is little research on these aspects of high-energy particle physics, but there are opportunities for students: The NTU-Cern workshop was part of a three-week mini-course on topics in the field. The National University of Singapore also has an agreement with Cern to send advanced undergraduates, graduate students and other researchers there to study high-energy particle physics and work on related data and information technology.

And Prof Kruse said there was another side effect of finding the Higgs boson: more interest and questions from students.

“Particle physics is in the public eye a lot more than it was,” he said. “It’s been very good for the field.”

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PHOTO: REUTERS

A technician standing near equipment for the Compact Muon Solenoid experiment at Cern. It is one of several experiments which use the Large Hadron Collider and its detecting equipment.

WORLD’S BIGGEST ATOM SMASHER

The Large Hadron Collider is a very large piece of equipment used to study very tiny particles with big implications for the nature of the universe.

The world’s largest and highest-energy particle accelerator was completed in 2008 by the European Organisation for Nuclear Research (Cern) and lies under the border between France and Switzerland.

It shoots particles called protons around a 27km-long tunnel, smashing them into one another to split them into smaller, more exotic and shorter-lived particle types.

Thousands of scientists, engineers, technicians, students and staff from more than 40 countries work on it, running experiments using the collider and its detecting equipment.

For instance, the Compact Muon Solenoid, named after the type of particle detector it uses, and Atlas experiments – that Professor Albert de Roeck, a senior research scientist at Cern, and physicist Mark Kruse of Duke University in the US work on – both look for the Higgs boson, extra dimensions and particles that could make up dark matter.

Dr de Roeck says the technology of the Large Hadron Collider could have medical applications.

Prof Kruse says that without the Higgs field, the universe would be a very different place.