Massive project to re-enact Big Bang

Last piece of giant machine lowered into place

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The "discovery machine" may be half a world away, but Isabel Trigger of Vancouver and her Canadian colleagues are hard-wired into what is perhaps the most ambitious and audacious experiment ever.

The $6-billion endeavour aims to re-create the searing conditions last seen billions of years ago just after the Big Bang.

The scientists took a big step closer to the goal Friday as the last piece, a cathedral-sized detector called ATLAS, which Canadian researchers helped design and build, was lowered into the underground cavern in Switzerland.

CREDIT: Prof. Robert McPherson, UVic

IPP / The ATLAS, a 100-tonne precision particle detector that is nine metres in diameter, has been lowered into place in Switzerland. Vancouver researchers helped design and build the enormous detector.

"We got it all in there in time," says physicist Trigger, who works with the giant detector remotely from the TRIUMF national physics lab tucked in the woods at the edge of the University of B.C.

The nail biting now begins as the physics world ramps up for the first experiments, slated to start later this year.

"This is the biggest, most complex science project ever undertaken," says Nigel Lockyer, director of TRIUMF, noting the project is unprecedented in almost every way -- ambition, size and global reach.

"It's pretty mind-boggling, even for scientists," he says.

Thousands of scientists from around the world are involved and a network of "computing farms," including one humming away at a new processing centre at TRIUMF, are needed just to house the massive amounts of data that will flood out of the small-scale re-enactment Big Bang.

The action will take place 100 metres underground in a 27-kilometre tunnel that houses the Large Hadron Collider that runs in a circle from Switzerland to neighbouring France and back again. It is the largest particle accelerator ever built, and will collide protons beams at energies not seen since the milliseconds after the Big Bang, which lay the foundations for the universe.

Two enormous detectors -- ATLAS and another known as CMS, short for Compact Muon Solenoid detector -- will record everything that happens when the beams smash into each other. Physicists estimate there'll be up to 40 million particle collisions a second. They will spend years combing through the wreckage looking for insight into the secrets of the universe.

They hope to clarify how the energy of the Big Bang was transformed into mass and matter. They will try to uncover new dimensions of space, probe mysterious dark energy and dark matter and perhaps even create the first human-made black

holes.

"We really feel as if we're on the verge of discovering the next whole layer of how the universe works," says Trigger, physics coordinator for ATLAS-Canada, the group of more than 100 Canadian scientists working with the detector. Canada has invested close to $100 million in hardware and brain power for the overall project, which is expected to run for 20 years.

Powerful "kicker" magnets manufactured in Quebec will help rev up the proton beams in the collider; key pieces of ATLAS, which contains 1.2 million particle detectors, were designed by Canadians; and the $24-million computing centre at TRIUMF is hard-wired to ATLAS by world's fastest network -- a system that uses a dedicated ultra-high speed fibre optics cable that runs under the Atlantic Ocean.

The "computing farm," as its manager Reda Tafirout describes it, is one of 10 processing centres that will handle the deluge of data generated by the collisions inside ATLAS -- about 15 million gigabytes a year, or the equivalent of a stack of DVDs three kilometres high.

The investments give Canadian researchers a real advantage in the race to make discoveries, says Robert McPherson, of the University of Victoria and the Canadian Institute for Particle Physics, official spokesman for ATLAS-Canada.

Canadians are guaranteed access to data, which he says should help them "get the first physics out."

There are big expectations for exciting discoveries, but much of the next year will be spent commissioning and calibrating the equipment, says Trigger, who has been remotely testing some of the ATLAS detectors by counting high energy subatomic particles called muons that naturally stream to Earth.

By the end of the year, the researchers expect the search will begin in earnest for "signatures" of exotic and fleeting particles created as the high-energy beams collide, and for the dark energy which could make up make up 75 per cent of the cosmos.

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