Next stop: The fourth dimension

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The Atlas experiment under construction at the LHC site, deep beneath the Alps. The large tubes that surround the empty space are magnets used to control the direction of subatomic particles. Credit: AFTAU

How did the universe come to be? What is it made of? What is mass? Can science prove that there are other dimensions? We may have answers soon.

On September 10, 2008, Tel Aviv University's Prof. Erez Etzion from the School of Physics and Astronomy will be in the control room of the new CERN Large Hadron Collider (LHC) on the border of France and Switzerland when the LHC is first turned on. Scientists are calling it the largest experiment in the world. It's taken about 6,000 researchers, $8 billion and ten years to build.

Of the 50 countries that have participated in the project, Israel is among those which have made the greatest contributions. Tel Aviv University in

particular has played an essential role in constructing equipment for the collider tunnel, dug deep inside the Swiss-French Alps. And when the switch is thrown in September, science may be changed forever.

Prof. Etzion, an experimental physicist in high-energy research, expects the impact of the LHC to be greater than that of the first moon landing. "It is hard to grasp the dimensions of the practical benefits from this project," he says, "but we're expecting to explore the basic forces that hold the world together."

Getting to the Heart of the Matter

If all goes according to plan, the superconducting magnets in the collider will zap atomic particles around the 17-mile tunnel at roughly the speed of light. Then the scientists will smash the particles together, replicating what happened mere nanoseconds after the first big bang.

Prof. Etzion participated in the design and construction of the trigger chambers for ATLAS, one of the two main detectors in the collider. This critical piece of machinery will decide what online data to record — and what data to discard — from the 1 billion atomic collisions per second. There is no storage disk space in the universe big enough to hold all the data, says Prof. Etzion, making this detector a key component in the success of the LHC.

May The "Z*" Be With You

Prof. Etzion will be watching closely to see what happens to proton beams colliding at super speeds. While invisible particles are expected to leave a trace like a watermark after they collide, he believes that some particles will escape detection, possibly travelling to other dimensions.

This is an exotic theory, Prof. Etzion admits, but one which may explain why the force of gravity appears to be so weak. "It could be that while all the matter we know is trapped in three space dimensions, a gravity carrier can move into additional dimensions, resulting in a diluted gravitational force", he says, noting he and his colleagues will be looking for particles delivered by a force carrier called the "Z*" or "zee star." The physicists hypothesize that the Z* may be able to move between our own three-dimensional world and other hidden dimensions.

The notion of new dimensions is stranger than science fiction, though the possibility of their existence is quite real. Prof. Etzion believes that other dimensions may exist in parallel to ours, but that — until now — they were too small for us to experimentally detect. "For the first time we will reach a new energy scale in our lab, the Tera electron volt regime, and we expect to discover new phenomena there," he says. "At such high energies, we may be able to stimulate particles to jump through dimensions and can measure this by the disappearance of mass or energy, or the appearance of new excited state towers of particles."

Hanging by a Vibrating String

Prof. Etzion's research falls within a branch of theoretical physics known as string theory. The theory posits that all matter is made up of vibrating strings of energy, suggesting six or more dimensions we cannot see affect everything we do and see. It is an appealing model to physicists, since it offers mathematical solutions to the major unanswered questions in particle physics.

This September, physicists around the world will be on the edges of their seats to see what happens when the first beam is circulated through the collider. The first high-energy collisions are expected to take place in October 2008.

Source: American Friends of Tel Aviv University