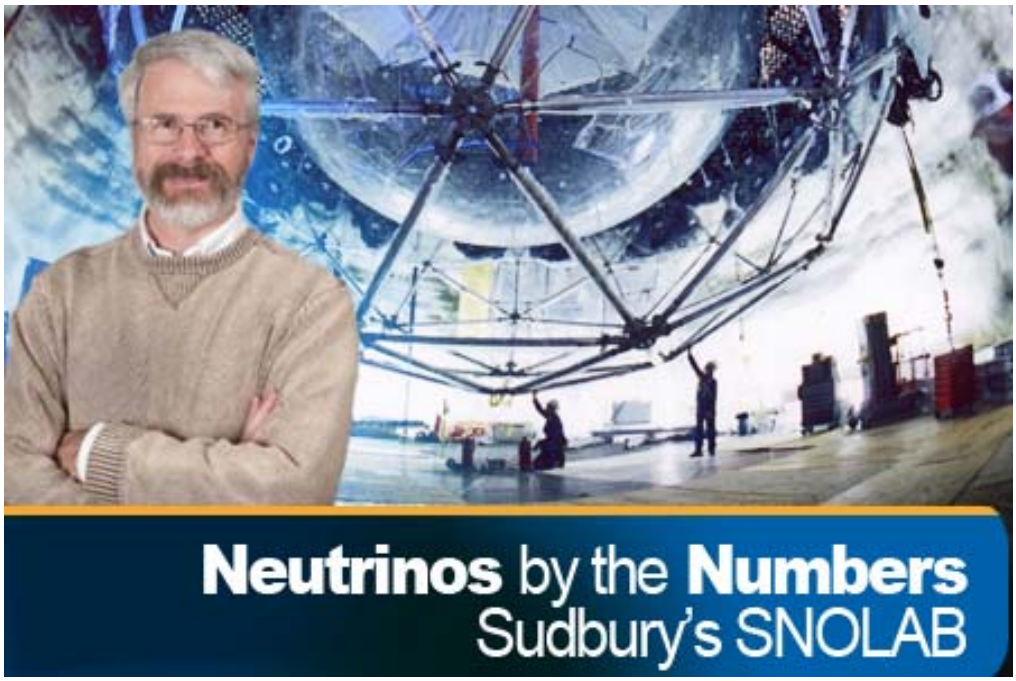
Research Profiles



Researchers at the Sudbury Neutrino Observatory (SNO) are delving deeper into the world of neutrinos with the use of SHARCNET

With no electric charge, and very little mass, neutrinos are elusive. They interact weakly with matter, making them difficult to detect.

But neutrinos are thought to be vital to the understanding of the universe. It's believed millions of neutrinos exist per cubic foot, filling the universe. So even with the smallest mass, they can induce gravitational effects in a huge way.

Neutrinos are emitted by radiation sources. They're known to exist in three types related to three different charged particles -- the electron-neutrino, muon-neutrino and tau-neutrino. Transformations called neutrino oscillation occur between them.

Dr. Melin Huang, Department of Physics, Laurentian University, at the SNOLAB, is studying a specific oscillation parameter, theta_13. The name comes from the fact that it is related to the transformation between the first generation electron-neutrino, to the third generation tau-neutrino. She believes further study of this oscillation parameter could have profound effects on particle physics understanding.

"Without theta_13, the phenomena employed to describe neutrino oscillation behavior is incomplete and could lead to misinterpretations in the particle physics world," says Huang.

New technology has made it possible to model and detect the three different types of neutrinos accurately, and how they oscillate. Theta_13 is the only missing parameter in

the oscillation equation. It's usually overlooked, being the smallest and hardest to assess.

Currently, only a range exists for the parameter. With this value accurately measured, however, the neutrino model would be complete and could lead to future research in particle physics.

Using the modeling power of SHARCNET, Huang is trying to get a smaller range of numbers, so the oscillation parameter value can be made more precise. This involves difficult computational analysis of 3-D space. SHARCNET allows her to compute millions of samples at one time, and produce a better estimate of the small parameter locations. Hopefully, that will lead to a solid number for the oscillation parameter of theta_13.

Dr. Clarence Virtue, Department of Physics at Laurentian University, says that theta_13 is a fundamental value of nature, possibly having implications in cosmology and particle physics. He believes Huang's research could be a crucial step towards solving such physics problems as what happened to all the antimatter – the mirror image of ordinary matter – in our world.

"Some of the greatest ongoing problems in particle physics may be solved by taking a closer look at theta_13," says Virtue.

Research funding is provided by the Natural Sciences and Engineering Research Council and Laurentian University.

For more information on Clarence Virtue or the Sudbury Neutrino Observatory, please visit:
http://www.laurentian.ca/Laurentian/Home/Departments/Physics/People/Faculty/Virtue.htm?Laurentian_Lang=en-CA