Photo: Reidar Hahn, Fermilab

TRIUMF in Canada

Canada, affectionately known to Americans as the "Great White North," boasts the world's largest reserve of fresh water and the biggest oil reserves outside the Middle East. It's the largest trading partner of the United States; and when it comes to science, it's destined to become the main regional partner of the United States, as well.

A key player in that partnership—and in the global physics community—is TRIUMF, the Canadian national laboratory for particle and nuclear physics, located on the Vancouver campus of the University of British Columbia.

TRIUMF opened 33 years ago with the world's biggest cyclotron. Now, with a staff of more than 550 and more than 1000 active users around the world, its mission has evolved to encompass everything from understanding the fundamental nature of matter to investigating new materials, such as warm superconductors, and treating eye tumors with beams of protons.

The lab's main thrust is the production and study of rare, short-lived isotopes. TRIUMF is a world leader in using rare-isotope beams to probe how nuclei form—including the exotic nuclear matter within white dwarfs and neutron stars. We are far from a complete understanding of these things, but expect major progress in the next two decades as new experimental facilities open around the world and theorists make significant strides of their own. The challenge for TRIUMF, and for Canada, will be to maintain a lead position in this field.

TRIUMF scientists also work in close collaboration with the particle physics community. Part of the lab's mission is to provide clean rooms, machine shops and the expertise needed to build high-energy detectors for experiments at other laboratories. The drift chamber for the BaBar experiment at Stanford Linear Accelerator Center was built here; so were the transition radiation detectors for the Hermes experiment at DESY, the German national laboratory. These contributions allow Canadian scientists to participate in large international collaborations at a level that otherwise would not be possible.

The lab also has major involvement in two projects at the frontier of high-energy physics: the ATLAS experiment at the Large Hadron Collider near Geneva, and Japan's T2K, projected to start up in 2009.

For T2K, which will aim a beam of neutrinos at an underground detector 295 km away, TRIUMF and its university collaborators are designing and building the near detector tracker and proposed a key concept for the overall design—aiming the neutrino beam slightly off-center. We also have a hand in monitoring the target area for the experiment—a natural fit, given TRIUMF's years of experience in remotely handling highly radioactive targets for its rare-isotope beams.

As for ATLAS, TRIUMF took a central role in the design, construction, and integration of half the modules for the Hadronic End-Cap Calorimeter. A TRIUMF scientist managed the project, the copper plates were machined at the University of Alberta and signal feedthroughs were assembled at the University of Victoria. Members of the TRIUMF staff, along with researchers from the University of Toronto and Carleton University, took key roles in designing and building two tungsten forward calorimeter modules. And in collaboration with the University of Alberta, TRIUMF led the Canadian contribution to the calorimeter front-end electronics.

TRIUMF also has been designated a "Tier 1" computing hub that will process data for the ATLAS collaboration and give Canadian universities access to that data.

Its participation in ATLAS puts TRIUMF in an excellent position to address some of the most exciting questions being posed by the global community. The quest to understand mass, find extra dimensions of space, and discover possible new symmetries in nature has a good chance of bearing fruit at the Large Hadron Collider over the next decade; candidates for dark matter may even turn up there.

Meanwhile, Canada's membership in T2K allows it to continue exploring the properties of neutrinos and their role in the matter-antimatter asymmetry of the universe.

TRIUMF will continue to develop exotic isotope beams and press for a fundamental understanding of the basic building blocks of nature, while finding new ways to use nuclear and particle physics to study new materials and identify and treat human disease. And our accelerator physicists look forward to the next high-priority project at the energy frontier, the International Linear Collider, which is still on the drawing board. Canadian scientists are already at the forefront of developing tracking detectors, and that involvement will grow as the collider looks for approval early in the next decade.

Nigel Lockyer

Nigel Lockyer starts as the new director of TRIUMF in Vancouver, Canada on May 1, 2007.