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TRIUMF

The TRIUMF Newsletter

NEWS FROM CANADA'S NATIONAL LABORATORY FOR PARTICLE & NUCLEAR PHYSICS

Official Opening of ISAC-II
Gordon Campbell, Premier of British Columbia (l), and TRIUMF Director Alan Shotter (r).

ISAC-II BUILDING OPENING CEREMONY

On Wednesday, June 11th, 2003, the Hon. Gordon Campbell, Premier of British Columbia, came to TRIUMF to officially open the newly-completed ISAC-II building. The Premier thanked the researchers and other TRIUMF staff who drive the pursuit and discovery of knowledge and acknowledged that advances in technology and development are born from this fundamental research. He went on to say, "We're committed to promoting excellence in research by providing the kind of infrastructure that allows this type of innovative work to take place." His announcement was enthusiastically received by a large audience of TRIUMF staff and invited guests.

SUMMER STUDENT NEWS

UK Physics Student of the Year – Congratulations to Christopher Osborne, winner of the prestigious Physics Student of the Year Award in the UK, sponsored by the UK Institute of Physics for the best physics undergraduate research project. Chris completed a 1-year research project at TRIUMF working with Dr. Gordon Ball on high-precision measurements in nuclear beta-decay. Chris plans to continue his studies in a PhD program at the University of Heidelberg.

Summer Nuclear Institute (SNIT) – This year's Summer Nuclear Institute at TRIUMF gave the students a background in the area of determining the mixing matrices for quarks (CKM) and leptons (MNS). Thirty-nine students from around the world attended. Over a third of the students were working on SNO with the next largest group working at TRIUMF. Ten invited speakers came from Canada, the United States, and Japan. Next year's Summer Nuclear Institute will be held July 5-16, 2004, just prior to the Nuclei in the Cosmos conference and Jens Dilling will be the lead organizer.

Student Symposium 2003 - The Third Annual Summer Student Symposium Competition was held at TRIUMF on July 16th where undergraduate summer students shared the work they did this summer with their peers, supervisors, and staff. Nineteen students participated, more than any previous year, with each presentation lasting about 20 minutes. The overall quality of the talks was very high. Based on the presentations, Cassie Galt of the University of Toronto was invited to attend the 2004 Western Regional Nuclear and Particle Physics Conference in Lake Louise as TRIUMF's guest. Two honourable mentions were awarded to Nick Cowan and Kristen Koopmans.

FOR MORE INFORMATION ON THE SUMMER STUDENT PROGRAMS CONTACT RICHARD HELMER AT STUDENT@TRIUMF.CA

WESTGRID: High Performance Computing for Western Canada

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Computers have become a more and more important tool for research in all fields of science and engineering. In response to this increased need for computing and storage, TRIUMF is collaborating on a project called WestGrid (Western Canada Research Grid) that will provide a network of high-performance computing (HPC) facilities in western Canada.

The partners in this unprecedented collaboration of British Columbia and Alberta institutions are:

University of British Columbia
University of Alberta
Simon Fraser University
University of Calgary
New Media Innovation Centre
University of Lethbridge
TRIUMF
The Banff Centre

The project, which has a total value of about $44 million, is funded by the Canada Foundation for Innovation (CFI; $12M), the British Columbia Knowledge Development Fund (BCKDF; $5.7M), and the Alberta Science and Research Investment Program (ASRIP; $6M). The remainder of the value of the equipment is provided by contributions from the vendors beyond the normal educational discount. In addition to the capital investment, roughly $4M in operating funds has been granted. This will be supplemented by the participating institutes to provide system management and some level of user support.

There are 4 major hardware components to WestGrid. The initial purchases will be:

1. A large cluster of commodity-based computers to be housed at the University of British Columbia and TRIUMF: 1008 x 3GHz CPUs plus 10 TeraBytes of disk space and a capacity for 138 TB of tape storage. These are relatively low-cost computers with a low-speed interconnect; for serial and loosely coupled parallel computing jobs (those that require only modest communication between processors).
2. A cluster of multiprocessors (CluMP) at the University of Calgary: 128 processor Alphaserver SC45 (4 CPUs per node) connected by a high-speed Quadrics interconnect, plus 4 TeraBytes of disk space. This tightly-coupled cluster will be used for true parallel compute jobs that require extensive communication between processors, but that need only a few CPUs.
3. A large shared-memory machine at the University of Alberta: a 256 processor SGI shared memory machine plus 5 TeraBytes of disk space. This facility will be used for large-scale parallel computing jobs that require a large number of CPUs and/or a large amount of shared memory.
4. A large network storage system at Simon Fraser University: 24 TeraBytes of disk and up to 135 TeraBytes of tape storage. This facility, which will provide large-scale storage for all WestGrid sites, will run a Hierarchical Storage Manager (HSM) that will optimize the use of disk and tape. SFU/NewMIC will also house a state-of-the-art graphics server.

The equipment at UBC/TRIUMF and SFU will be supplied by IBM, while Hewlett-Packard and SGI will provide the hardware at the Univ. of Calgary and the Univ. of Alberta respectively. The graphics server at SFU/NewMIC will be supplied by SGI.

A crucial aspect of WestGrid is that all facilities will use Grid tools to share resources. The Grid is a new development in computing that provides trusted authentication between sites so that users can use distributed resources without having to worry about the details of where their jobs will run. At the most basic level, WestGrid users will need to log in only once to get access to all WestGrid resources. The ultimate goal is that a user will not submit a job to a specific WestGrid site, but that a "meta-scheduler" will analyze the requirements for that job as well as the currently available WestGrid resources and run the job most efficiently at the appropriate site.

Another important aspect of WestGrid is collaboration/visualization. Tools for collaboration such as state-of-the-art video conferencing will be included at all sites. Several institutes will develop advanced visualization tools such as real-time displays and 3-D visualization. TRIUMF has benefited from this aspect of the project with the installation of a new video conferencing room in the ISAC-II building. WestGrid has provided $93k in equipment for this room.

Funds have been reserved for a second round of purchases within 12-18 months. These acquisitions will be driven by the relative demand at each facility.

WestGrid is not only a multi-institutional project, it will also serve a large variety of scientific and engineering fields.
A brief sample of the applications that will be greatly enhanced by the

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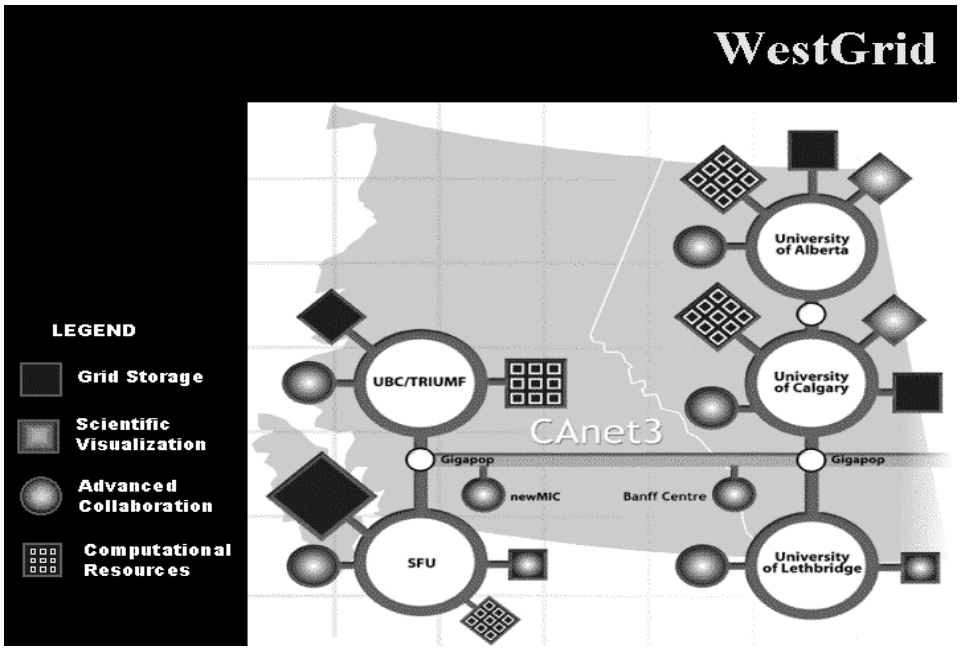
availability of WestGrid resources includes: the development of new catalysts for chemistry; the simulation of the collision between two black holes with the production of gravitational waves for astrophysics; the analysis of DNA sequences for biology; the analysis of images from new PET scanners for medicine; the modeling of advanced internet systems for computer science; the development of advanced encryption algorithms for mathematics. The Arts will also benefit, for example through the 3-D reconstruction of historical monuments and motion capture for the Performing Arts. A typical enhancement to research will be the extension of simulations to 3-dimensions from two and the ability to model dynamical systems rather than a succession of static cases (i.e. time can now be included as an explicit variable). These extensions require a significant increase in computing power that will be provided by WestGrid.

This is but a small sampling of the avenues of research that will benefit from WestGrid. It is estimated that 250 faculty researchers and their research groups will use WestGrid. This leads to a potential user base of over 1000 researchers.

Most of the applications related to TRIUMF will be run on the commodity cluster at UBC/TRIUMF, since this facility best matches the type of computing required for subatomic physics and related fields. TRIUMF will also make extensive use of the storage facility at SFU.



The last few years have seen an order of magnitude increase in the amount of data produced by subatomic physics experiments. For example, the TWIST experiment at TRIUMF will produce about 70 TeraBytes (70 thousand GigaBytes) of data per year. To set the scale, the average home computer has a hard drive of 30-40 GigaBytes. These data must be stored and served out for analysis in an efficient way. Data will be transferred from TRIUMF to WestGrid (UBC or SFU) where they will be stored on tape (legacy data will simply be copied over). They will then be staged to disk for further analysis once algorithms have been optimized on a sub-set of the data. The analysis of this year's TWIST data set (10 TB of data, plus 10 TB of Monte Carlo simulations) is expected to take 3 months using about 15% of the computing capacity at the UBC/TRIUMF center.

Looking to the future, TRIUMF is participating in the ATLAS experiment at CERN, which is expected to produce more than one PetaByte (1000 TB) of data per year. This enormous data set will be analyzed using an international network of high-performance computing facilities, one of which is planned for TRIUMF. The experience gained with WestGrid will be invaluable for the design and running of this facility.

The sites at the Univ. of Alberta, the Univ. of Calgary and at SFU are currently running, although they are not yet open to public use. Installation is proceeding at UBC/TRIUMF. It is expected that all sites will be operational by the end of September, although this will likely be with only the minimum Grid services. An information session will be organized in October to educate users on the procedures for obtaining accounts.

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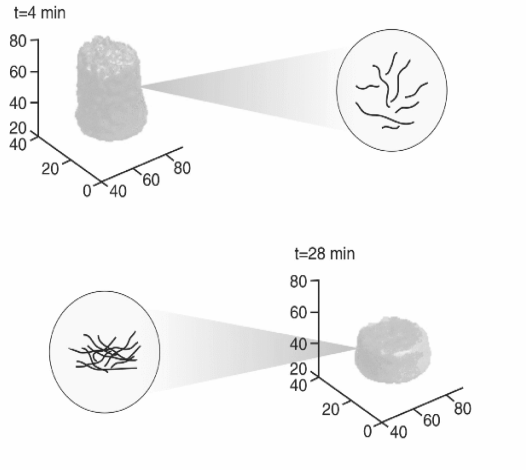
PET UPDATE

Tom Ruth
Director, PET Program

For much of the last 20 plus years the major thrust of the Life Science program has been the use of positron emission tomography (PET) for research into the origins, progression and therapies of Parkinson's disease (PD). Using PET we have shown *in vivo* evidence for substantial release of endogenous dopamine in the striatum of PD patients in response to placebo. Our findings indicate that the placebo effect in PD is powerful and is mediated through activation of the damaged neurons associated with the dopamine system, which controls movement.

More recently we have investigated the use of PET to track dynamic changes associated with wood pulp sedimentation. Paper making involves the settling of wood fibers in a flowing stream. The variables associated with making high quality paper are not well understood. Thus researchers from the Department of Chemical



Engineering at UBC in collaboration with the TRIUMF PET team designed a simple settling experiment where a small sample of fibers were labeled with a positron emitting isotope (F-18) and then mixed with a bulk of the fibers. The fiber mixture was placed in the PET camera and the rate of settling was tracked over time. The figure above shows 2 time points during this settling process. Based on the fiber size and rate of settling the researchers were able to define a *crowding* number which is a measure of the concentration of pulp fibers that can be used to predict the optimal conditions for paper making. This information has subsequently been used to alter the manner in how several paper mills in BC operate. One mill in particular has acknowledged that the recommended adjustments has resulted in the savings of millions of gallons of water per year which has positive impacts on both the environment and the economy.

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