TRIUMF

ANNUAL REPORT
SCIENTIFIC ACTIVITIES
2003

ISSN 1492-417X

CANADA'S NATIONAL LABORATORY
FOR PARTICLE AND NUCLEAR PHYSICS

OPERATED AS A JOINT VENTURE

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UNDER A CONTRIBUTION FROM THE
NATIONAL RESEARCH COUNCIL OF CANADA

DECEMBER 2004

The contributions on individual experiments in this report are outlines intended to demonstrate the extent of scientific activity at TRIUMF during the past year. The outlines are not publications and often contain preliminary results not intended, or not yet ready, for publication. Material from these reports should not be reproduced or quoted without permission from the authors.

INTRODUCTION

TRIUMF, one of Canada's premier international scientific institutions, is a national institution serving the needs of university scientists from across Canada. It is supported by a renewable five-year federal government financial contribution channeled through the National Research Council. The current funding cycle covers the period 2000–2005. During the period up to the end of 2003, many of the challenges identified for this five-year funding cycle have been successfully met. Highlights include the development of ISAC as the world's leading exotic-isotope production facility, and, based on Canadian know-how, the design and construction of advanced equipment for the world's largest scientific project, the Large Hadron Collider (LHC), based at CERN in Geneva.

During this report year, 2003, the ISAC program reached an important milestone with the completion of the ISAC-II building, which was formally opened in June by the Premier of British Columbia, the Hon. Gordon Campbell. A number of other prominent provincial ministers as well as several hundred guests attended the opening ceremony. The ISAC science program received a significant boost by the commissioning of a major piece of equipment, the 8π spectrometer, which from startup is proving an exceptional tool to probe the properties of the exotic nuclei produced at TRIUMF. Other tools being developed include TITAN, TRIUMF's Ion Trap facility for atomic and nuclear science, which will probe the limits of existence of nuclei, and TIGRESS, the TRIUMF-ISAC Gamma-Ray Escape Suppressed Spectrometer, which will be used to probe the structure of exotic nuclei. All these projects involve many physicists from across Canada and around the world.

Another major milestone during the year was the completion of the construction and delivery of 52 warm quadrupole magnets for the LHC at CERN. Due to the very exacting specification of these magnets, producing the magnets was a real challenge, and it is a tribute to TRIUMF and ALSTOM staff in Tracy, Quebec that the magnets were delivered to CERN on time and on budget. During the year good progress has been made in the construction of the hadronic endcap modules, which are part of the Canadian contribution to the ATLAS detector of the LHC. Commissioning of these modules is on schedule to take place in 2004. Interesting results continued to emerge from the deep inelastic experiment HERMES at the DESY laboratory. Significant efforts were made during the year to prepare for new experiments concerning rare K decay (KOPIO at Brookhaven National Laboratory), neutrino oscillations (T2K at J-PARC), and measurement of flavour singlet form factors of the proton ($G\emptyset$ at the Thomas Jefferson National Accelerator Facility).

The μSR program has been part of TRIUMF's scientific portfolio for many years. Each year exciting new work continues to flow from this program that is relevant to fundamental physics, materials science, chemistry and nuclear physics. For such a wide field it is difficult to pick examples, but perhaps the work identifying a new test of quantum electrodynamics concerning the behaviour of the muon under extremely high electric and magnet fields, and the use of muons to help understand industrial catalysts, shows just how wide the field has become.

The life sciences program took a major leap forward with the delivery of new PET scanners. One of these scanners, the High Resolution Research Tomograph, will enable the human brain to be probed to a higher level of precision than ever before. The other scanner, the MicroPET, is a small animal scanner that will expand the collaborative network using PET for *in-vivo* biochemical studies and will include oncology as well as the established collaboration with the neuroscience community.

TRIUMF has a number of commercial licensees for its technologies that range from life sciences to environmental protection techniques. According to the latest statistics from the Association of University Technology Managers (AUTM), TRIUMF ranks second in Canada in terms of Gross Licence Income received as a percentage of Total Sponsored Research. A good example of this technology transfer is that during the year MDS Nordion commissioned their third small commercial cyclotron at the TRIUMF site. This TR30 machine is based on a TRIUMF design and built by a local company, Advanced Cyclotron Systems Inc.; some of the work was subcontracted to another TRIUMF licensee, Dehnel Consulting Ltd., of Nelson, B.C. With the addition of this third cyclotron, MDS Nordion will supply about 50,000 medical patient doses per week, in Canada and around the world, from the TRIUMF site.

Another example of where TRIUMF expertise has been vital to an outside organization is the strong collaboration that has been established with the B.C. Cancer Agency to set up a new Centre of Excellence in Functional Imaging.

The new TRIUMF Outreach Program is in its second full year of operation. New initiatives such as the Teacher Internship Program continue to attract interest among high school teachers, with a dozen teachers from all over British Columbia waiting to take part.

The last two years, 2002 and 2003, have seen the

Canadian scientific community collaborate with TRIUMF staff to develop a scientific plan for the next funding cycle, 2005–2010. The main features of this plan are completion of the ISAC facility to ensure it firmly establishes and maintains world leadership; an increase in the capabilities of the μSR facility for materials science and chemistry; increased capacity for radioisotope production for the life sciences program in order to, among other things, take optimal advantage of two new PET scanners; and to make strong Canadian contributions to some exciting projects at other national laboratories around the world. The plan identifies TRIUMF as the Canadian centre for the world computing grid network that will handle the vast data outflow from the ATLAS experiment at CERN's LHC. Among other activities, the plan identifies important Canadian contributions to the rare K-decay experiment at Brookhaven in the USA, and to an experiment in Japan which is a natural extension of the highly successful and visible Canadian program at SNO, located in Sudbury, Ontario. Technology transfer and outreach activities are important components of the plan.

The plan was reviewed during the year by panels of internationally renowned scientists and was given their very strong support. It is an ambitious plan but it is a realistic one, building on TRIUMF's past and present record of achievement. It will deliver first-rate science at an internationally competitive cost in a timely and efficient manner, and will ensure for the Canadian Government, and therefore the taxpayer, the highest return on their previous investment in TRIUMF. The plan is under active consideration by the Federal Government and, if accepted, the plan will ensure that the Canadian scientific community using TRIUMF will continue to be competitive at the highest international levels.

Alan Shotter

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Director