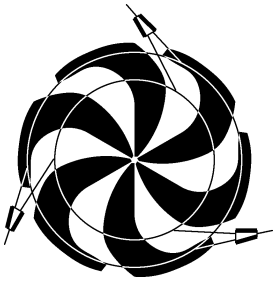
TRIUMF



ANNUAL REPORT
SCIENTIFIC ACTIVITIES
2001

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

OCTOBER 2002

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

The TRIUMF laboratory is Canada's national laboratory for particle and nuclear physics. The mission of the laboratory is to provide in-house world class facilities for specialized areas, provide infrastructure support for Canadian scientists to participate in experiments outside Canada, and to encourage the transfer of technology developed at the laboratory to the commercial sector.

The facilities within the laboratory have been rapidly evolving over the past few years, so the laboratory is now one of the leading world facilities to provide high intensity radioactive beams for a variety of scientific fields. The radioactive ions are produced by spallation reactions using the 500 MeV protons from the main TRIUMF cyclotron. Isotopes are then selected by a mass separator before delivery to the experimenters. These ions of energy several keV/u are used for a variety of studies such as fundamental decay studies, nuclear structure studies, and materials science studies. During this year a milestone was passed with the completion and commissioning of the RFQ and DTL accelerators that can accelerate both stable and unstable ions from 0.15 to 1.5 MeV/u. This energy range is ideal for investigating nuclear reactions of particular relevance to nuclear astrophysics. The accelerator system can accelerate 1^+ ions of up to mass 30, but in the future this will be extended to heavier masses for higher charge states with a charge state booster now under construction. During the year another significant milestone was reached with the successful commissioning of the DRAGON and TUDA systems, special apparatus designed to investigate nuclear astrophysics reactions associated with radioactive beams. Both experimental systems undertook successful experimental investigations of the reaction $^{21}\mathrm{Na}(p,\gamma)^{22}\mathrm{Mg}$. This particular reaction is of great interest for the investigation of ^{22}Na production in the galaxy since ^{22}Na is produced from the decay of ^{22}Mg.

Now that most of the main components of the first phase of ISAC are nearly all built, the laboratory began to turn its attention to the second phase. This second phase will enhance the energy of radioactive ions to 6.5 MeV/u for masses up to $A = 150$. The accelerator complex needed for this will require a new building, the funds for which have been generously provided by the BC provincial government. Construction of this new building will start in January 2002 and should take one year to complete. The accelerator structures associated with this second phase should be ready in the year 2005.

The TRIUMF laboratory over the past few years has made substantial contributions to the LHC accelerator at CERN. These contributions have been associated with several discrete projects. One of the major ones in terms of resources has been the design and construction of 52 conventional double beam quadrupole magnets for beam control in the cleaning sections of the main LHC accelerator. These magnets have been a challenge to produce due to the demanding accuracy needed for their function. It is a tribute to all concerned at TRIUMF and the manufacturing company, ALSTOM, that the manufacturing problems have been solved and steady production started towards the end of the year. ATLAS Canada has the responsibility to produce the hadron endcap calorimeter, a component of the ATLAS detector. This project involving TRIUMF and several universities is nearing completion. TRIUMF provides for the management of the project and the clean rooms for assembling the detector modules before they are shipped to CERN for testing.

TRIUMF has and continues to provide general infrastructure support for many Canadian physicists across Canada to enable them to participate in a meaningful way in many experiments outside Canada. By way of example, the inner tracking detector for the BaBar experiment at SLAC was made at TRIUMF. This experiment is now producing exciting new results concerning heavy quark physics, and the Canadian team members through their responsibility for the operation of the inner detector continue to be an essential part of this experiment.

Again TRIUMF is much involved in supporting the K-meson rare decay experiment at Brookhaven. New results from this experiment are given in this report and, while providing better limits for the branching ratio, the statistical errors are still too large for the results to challenge the standard model; clearly, more data are needed to reduce the statistical errors.

The main 500 MeV cyclotron has worked well during the year. The cyclotron can simultaneously deliver a variety of beams, and has mainly been used during the year either to provide the proton beam for ISAC, or to produce muons for the μSR program or TWIST. The TWIST experiment aims to measure the physical parameters associated with muon decay to an accuracy that will provide a stringent test of the standard model predictions. This last year saw the full commissioning of all components of the detector and a large superconducting magnet. The μSR program is an important part of the laboratory's portfolio since the modulation of μ decay characteristics in materials provides an excellent probe for various chemistry and materials science investigations. It continues to be a particularly important probe to investigate the magnetic proper-

ties of superconductors and complements the new ^{8}Li β-NMR facility commissioned at ISAC.

The biological/medical program continues to be an important component of the laboratory portfolio. The main activity centres on the PET technique with TRIUMF providing the essential radioisotopes for this work. Successful grant applications during the year will mean new PET machines will be installed in the near future. In particular, a new micro-PET for small animal experiments will increase the importance and diversity of this research area. Proton irradiation both for cancer therapy treatment and for general irradiation work has continued to be an important activity during the year.

Technical knowledge transfer is an integral part of the mission of many scientific laboratories; TRIUMF is no exception. The highlight of this activity during the year was MDS Nordion's decision to build a new cyclotron on the TRIUMF site. This $20M commercial investment for radioisotope production gives testament to the excellent relationship TRIUMF has with MDS Nordion.

In a couple of pages it is difficult to give an overview of all aspects of the laboratory; however, one general statement is that a laboratory is no better than the people within it. That the laboratory continues to run well is a tribute to all staff whether they are scientists, engineers, technicians, or administrative staff. That it has been an excellent, productive year is a tribute to all. Finally, but by no means least, on behalf of all staff I would also like to thank the previous director, Dr. Alan Astbury, who retired during the year, for his many years of hard work.

A. Shotter,
Director