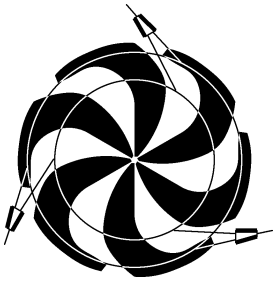
TRIUMF



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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

JULY 2000

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

1999 has been a year of waiting for TRIUMF. The laboratory's proposal for funding for the five years 2000–2005 was presented and reviewed by the NRC Committee in October 1998. This body, chaired by Prof. A.J. Stewart Smith of Princeton, produced its very strong, very supportive report early in 1999. The fortunes of TRIUMF then had to be steered through the NRC Council in February and finally into the political arena with a memo to cabinet in June. As events move further away from the science they become less predictable and essentially impossible to control. Indications are, however, that TRIUMF can anticipate a modest increase in its funding, but the final figure will not be released by the federal government until "Budget 2000" in February.

If 1999 has been mostly waiting, it can honestly be said that the laboratory has not been "hanging about"! The year of 1998 felt so good, that it was generally believed that TRIUMF could not continue to hit such peaks of achievement. This proved to be very far removed from events as the year unfolded, particularly in the ISAC project, where passing milestones on time has become routine.

The science program at ISAC started in earnest and several preliminary results were achieved; however, the show continued to be stolen by the ISAC project team. In July the beam current onto a niobium target was raised to 10 μA, making ISAC technically the highest current ISOL based radioactive beam facility in the world, with the cyclotron driver operating at 500 MeV. December saw the first ^{8}Li beam delivered to the β-NMR experiment. This beam was unpolarized but the measured intensities from the niobium target looked very promising. Finally, just before the laboratory closed for Christmas, a 100 μA test was performed on a molybdenum target. No attempt was made to deliver a beam of ions. The test was directed at understanding the temperature profiles caused by the beam heating. All systems worked well, and the design current of 100 μA is something that experimenters can really anticipate in the future. The accelerated beam at ISAC of 1.5 MeV/u is due to arrive by the end of the year 2000. This will perhaps prove to be the toughest milestone of all, but with the taste of success by now so thoroughly enjoyed by all of the ISAC team, even the almost impossible merely becomes very difficult.

The TRIUMF collaboration with CERN on the provision of a Canadian contribution to the Large Hadron Collider (LHC) continues to be a major success. The contribution now centres on the LHC ring itself with the dominant component being the manufacture of 52 warm, twin aperture quadrupoles for the cleaning insertions – portions of the LHC ring where beam losses are absorbed, thus preventing energy being dumped into the cryogenic magnets. The purchase order for the first 17 magnets was placed in September with the balance to follow in 2000. The second major item involved the injection kickers for the LHC, both power supplies and pulse forming networks.

The TRIUMF/CERN collaboration has worked extremely well, proving that accelerator systems can serve as common projects in much the same way as experiments do. There have been a number of publications jointly authored by CERN and TRIUMF personnel. This international involvement has served TRIUMF well in the quest for new funding. The visibility afforded to Canada as a contributor to the LHC quite naturally leads to ongoing responsibility when discussion turns to new funding.

The basic program at the cyclotron continued with a reduced number of experiments. The parity experiment achieved a final result for its measurement of the longitudinal polarization asymmetry in elastic $p-p$ scattering at 221 MeV, and the charge symmetry breaking experiment collected all of its data. The CHAOS spectrometer has become the workhorse in the meson hall with an extensive program studying low energy pion-nucleon interactions. The preparations for experiment E614 go well. The declared aim is to measure the decay parameters of the muon to a precision of 10^{-4}. This is a very difficult measurement, but if successful it will explore new ground in muon decay. Indications are that the scene will move to the experimental floor late in 2000.

The condensed matter program using the technique of μSR continues to have a very large appetite for beam and pursues a varied menu of science. A high intensity period was lost due to a water leak in a beam dump. However it proved possible to replace the lost time. The use of muons as a unique probe of the internal magnetic fields and electron configurations of materials has established the TRIUMF μSR work alongside the use of synchrotron light and neutron scattering as a recognized tool for research in condensed matter physics and chemistry.

The life science activities at TRIUMF are dominated by the PET group which collaborates with the Neurodegenerative Disorders Centre at the UBC Hospital. During the year the group received substantial MRC funding and can now look forward to a stable period of operation. The TR13 cyclotron (13 MeV) continued to produce ^{13}N ($t_{1/2}$ = 10 min) for the Botany department at UBC. The proximity to the source of such an important but very short-lived isotope allows

the department to follow a unique program of study in plant physiology.

In its role as a national laboratory, TRIUMF provides infrastructure support to the subatomic physics community in Canada in conjunction with the Grant Selection Committee of NSERC. The greatest demand currently is the ATLAS detector, which will take data when the LHC commences operation in July 2005. Canadian physicists in ATLAS will explore particle physics at the energy frontier, defined by proton-proton collisions at 7 TeV per beam. The collisions of the constituents of the beam protons occur at an energy comfortably above that of the electroweak symmetry breaking. At this energy the standard model passes through a transition from a theory of massless particles to one involving the complex spectrum of masses which are determined experimentally. It is assumed that these collisions may reveal the mechanism which creates mass.

In TRIUMF the ATLAS team will build half of the modules of the hadronic endcap calorimeter in the upgraded clean room. This construction program will not be completed until early in 2003. TRIUMF personnel are also playing a key role in collaboration with the University of Victoria to provide feedthroughs for the calorimeter.

The final component of TRIUMF's mandate from NRC is the laboratory's proactive role in technology transfer. The most successful venture remains the collaborative effort with MDS Nordion in the production of isotopes for use in medical diagnostics and therapy.

As the end of the current five year plan (1995–2000) draws to a close, TRIUMF can feel justifiably proud of its achievements. ISAC is a recognized world-class facility for radioactive beams, soon to start nuclear astrophysics in earnest at 1.5 MeV/u. The collaborative effort with CERN to produce a Canadian contribution to the LHC gets glowing praise on both sides of the Atlantic. The basic program in subatomic physics at the cyclotron has been concentrated on to a few key experiments. The condensed matter and life science programs are very visible and bring considerable attention to the laboratory, and the efforts in technology transfer continue very successfully. TRIUMF can claim to be well positioned to build upon these excellent foundations in the next five years – funding permitting of course!

A. Astbury,
Director