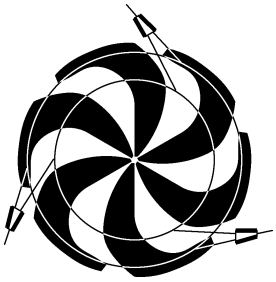
# TRIUMF



# ANNUAL REPORT
# SCIENTIFIC ACTIVITIES
# 1997


CANADA'S NATIONAL MESON FACILITY
OPERATED AS A JOINT VENTURE BY:

UNIVERSITY OF ALBERTA
SIMON FRASER UNIVERSITY
UNIVERSITY OF VICTORIA
UNIVERSITY OF BRITISH COLUMBIA

ASSOCIATE MEMBERS:

UNIVERSITY OF MANITOBA
UNIVERSITÉ DE MONTRÉAL
UNIVERSITY OF REGINA
UNIVERSITY OF TORONTO



UNDER A CONTRIBUTION FROM THE
NATIONAL RESEARCH COUNCIL OF CANADA

APRIL 1998

*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.*

# SCIENCE DIVISION

## INTRODUCTION AND OVERVIEW

1997 has been a very tragic year for the Science Division as we lost three members of our staff. In January, Miranda Ward, a young co-op student from the Univ. of Victoria was killed on her way home from TRIUMF. In April, John Pederson, a senior technician in our Cryogenics group was accidentally killed in Vancouver, and in July we lost one of our senior scientists, Dr. Rudy Abegg, to cancer. We thank them for their contributions to TRIUMF and its scientific program.

While the major focus of the Science Division was to develop the initial program at ISAC (see the ISAC section of this Annual Report), significant achievements are also to be reported in the base program centred around our cyclotron and in efforts abroad.

In subatomic physics, several successful data-taking runs for the parity experiment (longitudinal asymmetry in $p$ scattering at 223 MeV) took place in 1997. A major upgrade of the cryogenic proton target produced a very stable target, improving one of the remaining unreliable components of the experimental set-up. The complete data set is expected to be available in August, 1998. The CHAOS spectrometer which was funded 10 years ago, is now producing several interesting publications and theses. In 1997, a major milestone was reached with the completion of Expt. 560, which had been waiting for a reliable proton frozen spin target. Everything came together during a six weeks' run in November–December.

Another major high priority experiment took data this year: Expt. 704 is attempting to measure charge symmetry breaking effects in $np \to d\pi^0$ scattering, using the large acceptance spectrometer SASP to record the full angular distribution of the emitted deuterons. Initial data analysis of the data taken so far indicates that a sensitivity of a few $10^{-3}$ for the forward-backward asymmetry is possible.

Our TISOL facility was used to deliver isotopic beams of potassium and neon ions to experiments. Experiment 715 trapped neutral $^{38m}$K, $^{37}$K atoms to measure asymmetric distribution of their decay products while Expt. 741 is trying to identify levels in $^{16}$F which can be used to determine the E2 component of the cross section for $^{12}$C$(\alpha,\gamma)$, complementing previous determination of the E1 component also done at TISOL.

Our muon catalyzed fusion group is reporting on their proposed measurement of the $\alpha$-sticking probability in $d-$t fusion; one experiment to determine the cross section for producing long-lived isotopes in meteorites or lunar rocks was completed in BL4B using an ingenious transport system.

A large fraction of the high intensity beam time is used by $\mu$SR groups on hydrogen-like impurities in semi-conductors, on high temperature superconductors, on exotic spin structures, and on chemistry. Our facilities are well managed and attract a large community even though our raw muon fluxes are low compared to those available at PSI. New instruments were commissioned this year which will extend our capabilities and will allow us to remain quite competitive.

Our experimental program abroad has had remarkable success this year with the first observation of the decay $K^+ \to \pi\nu\overline{\nu}$, a flavour changing neutral current reaction which links the decay rate to the top quark mixing matrix element $V_{td}$'s amplitude. After 15 years of hard work, one unmistakable event was seen in the 1995 data set with several more probably on tape in the 1996-97 data.

Our investment in the HERMES program is also bearing fruit with several publications on the spin structure function of the proton and neutron.

As part of our infrastructure support role, considerable time was spent testing the electronics of the Sudbury Neutrino Observatory (SNO) and we also built some of the fixtures for handling calibration sources. The large drift chamber for the BaBar experiment at SLAC was strung in our clean room: in 4 months some 28,000 wires were positioned by a team which included temporary staff and Italian robots. In parallel, a new sector of a prototype of the hadronic endcap calorimeter for the ATLAS experiment was produced using most of the final production techniques. Our major project for the next three years will be to produce the full two-wheel assemblies of these modules. This effort complements the large hardware contribution TRIUMF is providing to the Large Hadron Collider at CERN through a CERN-TRIUMF agreement.

These investments in particle physics detectors will secure a very attractive future for our universities at the energy frontier, while at home Canada will have in ISAC one of the best nuclear physics research facilities in the world.

Our program in life sciences remains centred around positron emission tomography with the TR13 cyclotron as the prime source of $^{18}$F isotopes. However, TRIUMF's strength is its superb radioisotope production capability with cyclotron beams covering the energy range from a few MeV to 500 MeV. A new facility for isotope processing has been designed and its financing will be requested from the Canadian Foundation for Innovation in 1998.

Our proton therapy facility was used to treat 20 patients with ocular melanomas, while several groups made use of our low intensity variable energy beams to assess radiation damages to electronic components from industry.

We look forward to an exciting research program at TRIUMF.