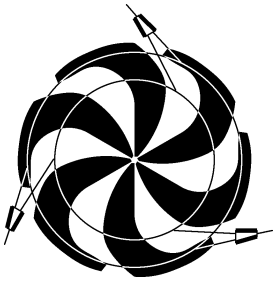
TRIUMF



ANNUAL REPORT
SCIENTIFIC ACTIVITIES
1998

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

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UNDER A CONTRIBUTION FROM THE
NATIONAL RESEARCH COUNCIL OF CANADA

APRIL 1999

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

This year, TRIUMF and the physics community said goodbye to one of their greatest experimenters when Professor Otto Häusser lost his battle with cancer in March. He had embraced the TRIUMF science program since 1983 and was leading the scientific group promoting opportunities offered by ISAC, TRIUMF's radioactive beam facility. While we all knew of that inevitable ending, we were motivated by his strength and intellectual leadership displayed until the very last moment. To a large extent, his vision of the role of radioactive beams for the future of nuclear physics at TRIUMF is being carried forward, and by the end of 1998 the ISAC team had delivered the first potassium beams from the new source. Not surprisingly, the TRIUMF neutral atom trap (TRINAT) facility, which Otto had established in 1994, was the first recipient of this new beam.

Considerable efforts were expended this year to develop the initial program at ISAC with its required experimental facilities. In fact, before Christmas, two set-ups saw beams from ISAC: TRINAT and the β-decay tape station which will measure half-lives of nuclei involved in $0^+ \rightarrow 0^+$ superallowed transitions.

Also on the ISAC front, the layout of the low energy area was established, with the low temperature nuclear orientation set-up (LTNO) acquired from Oak Ridge being recommissioned, and a unique polarized ion beam delivery system for condensed matter studies developed.

For the accelerated beams which will be available in the fall of 2000, the backbone facility for the science program will be the DRAGON spectrometer. It will be used to measure radiative capture cross sections for reactions of interest in supernovae explosions.

1998 saw the transition between the TISOL program and the beginning of ISAC. Developed in the late 1980's, the TISOL test facility on beam line 4 served not only as a development tool for defining what ISAC is now, but also serviced a large number of experiments including a series of measurements on the $^{12}\mathrm{C}(\alpha,\gamma)$ cross section, studies of light exotic nuclei like ^{9}Li and ^{9}C, the development of the TRINAT, and the initial measurements of $\beta-\nu$ correlations on $^{38\mathrm{m}}$K decays, to mention just a few. It is planned to maintain TISOL as a development station for the ISAC targets and ion sources using modest (<1 μA) proton beam currents.

While the main focus of the Science Division was on the preparation of ISAC's future scientific program, a number of important milestones were achieved in the non-ISAC program as well. As documented in this Annual Report, the parity experiment had very successful data-taking runs in the winter and summer polarized beam periods. The charge symmetry breaking experiment, Expt. 704, entered the data-taking phase with good control of its systematic uncertainties. The CHAOS program generated more than 10 publications this year and, were it not for our failure to operate the new thin cryogenic target, it would be starting its low energy measurement of the forward differential πp scattering cross section in the Coulomb-Nuclear interference region. No dibaryons were seen in the data taken previously and the data on $\pi\vec{p}$ asymmetries will anchor the new phase shift analyses. Tests of chiral perturbation theory predictions for the pion scattering length $a^0_{\pi\pi}$ were published recently. Towards year-end, the RMC spectrometer together with its associated protium target was recommissioned and about 300 events were collected on the rare process $\pi^- p \rightarrow \gamma\gamma n$ in a region of phase space which should eventually allow for a test of the pion polarizability. The high precision study of muon decay entered the decisive construction phase with the purchase of the 2T superconducting coil and preparations for stringing of the wire chambers.

For off-site programs, the BaBar drift chamber was strung in 1997 and delivered to SLAC on time. All 28,000 wires survived the trip to San Francisco and the chamber has been commissioned at SLAC with cosmic rays without too many problems.

An important milestone was achieved at year-end when the search for the rare decay $K \rightarrow \pi\nu\bar{\nu}$ under BNL E787 ended its data-taking at the AGS (15 years after the initial approval of the proposal, one event seen and published and perhaps a few more on tape). It will be replaced by an upgraded version under BNL E949 which is approved for running at the AGS by 2001.

TRIUMF infrastructure is now being used to build the liquid argon hadronic calorimeters for ATLAS. This is a pan-Canadian effort to join the experimental program at LHC in 2005. TRIUMF also continues to support the Canadian effort on the HERMES experiment at DESY and the SNO effort in Sudbury.

The Condensed Matter program at TRIUMF is still mainly based on the μSR techniques with emphasis on high temperature superconductivity, semiconductors, magnetism and chemistry. Major advances were made on the development of new instruments for the μSR facility taking advantage of a fast timing spectrometer and of multiple muon tracking systems to improve the data-taking quality and efficiency. These instruments will keep our μSR facility at the forefront as evidenced by the large number of requests for muon beams.

Preparations are being made to take advantage of

the opportunities presented by the light polarized ions at ISAC to study thin structures, and by the LTNO set-up to use NMR techniques on oriented samples.

The Life Sciences program is still dominated by the effort on positron emission tomography. The dedicated TR13 cyclotron produced a record number of irradiations and radiotracers were dispatched to three local hospitals. Although considerable effort went into the development of an attractive proposal to build a state-of-the-art processing facility at TRIUMF (TRIPL) to supply Canadian researchers with innovative tracers, no funding was received from the Canadian Foundation for Innovation and our plan to develop a Centre of Excellence in radiotracer imaging will have to be revised.

1998 will be remembered as a year of major achievements, particularly in ISAC, and this is the best tribute TRIUMF could deliver to the memory of Otto Häusser.