

# 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  
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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.*

## CONFERENCES, WORKSHOPS AND MEETINGS

### WORKSHOP ON EXPERIMENTS AND EQUIPMENT AT ISOTOPE SEPARATORS

The Workshop on Experiments and Equipment at Isotope Separators (WEEIS) was held April 26–29 at TRIUMF and at Harrison Hot Springs Hotel in order to have a view of the future scientific program at ISAC and to prepare for submissions to the July, 1997 TRIUMF Experiments Evaluation Committee meeting. About 80 participants presented and discussed experiments which were ordered according to four subject areas: nuclear astrophysics, nuclear physics, particle physics and fundamental symmetries, and condensed matter physics.

The workshop began with a tour of the TRIUMF-ISAC facility. Then, in the first session held in the TRIUMF auditorium, TRIUMF and ISAC were formally introduced by the director of TRIUMF, Alan Astbury, and the ISAC project leader, Paul Schmor. After these presentations the participants boarded a bus and the workshop reconvened for a reception at the Harrison Hot Springs Hotel. The next day saw the resumption of the scientific part of the workshop. In the first session, details of the ISAC facility and procedures for submitting experiments were outlined to the participants. In the next session, the discussion of individual experiments started with the first presentation on nuclear astrophysics. These sessions in which particular scientific issues were discussed continued well into Tuesday, with an interruption on Monday evening in which the four groups under the leadership of the convenors of the four subject areas (John Behr for particles and symmetries, John D'Auria for nuclear astrophysics, K. Peter Jackson for nuclear physics, and Rob Kiefl for condensed matter) met separately and discussed the requirements and preparations for individual experiments. The workshop dinner was also on Monday evening, causing some people to move around in rhythmic steps. The workshop closed with a summary by the convenors of their subject areas and some concluding remarks by the scientific director of TRIUMF, Jean-Michel Poutissou, who stressed that the TRIUMF Experiments Evaluation Committee (EEC) expected proposals for the ISAC facility for its July session. An extended panel had been set up and the deadline for experimental submissions to the EEC was June 13, 1997.

A book which contains copies of the approximately thousand transparencies as they were presented at the workshop, as well as some additional information like the list of participants, was produced. The transparencies are ordered by the four subject areas, and not the time of presentation, to allow for an easier overview.

It is hoped that this book may serve for a long time to all participants as a usable and useful reference to experiments which will be and are done at ISAC.

Lothar Buchmann chaired the successful workshop which was made possible by TRIUMF management, in particular Jean-Michel Poutissou, and the convenors. Elly Driessen and Maria Freeman ran a well-organized workshop secretariat and Anissa Ip assisted with the production of the book.

### 1997 PARTICLE ACCELERATOR CONFERENCE

The 17th Particle Accelerator Conference was held at the Hotel Vancouver, Vancouver, British Columbia, from May 12–16, under the joint auspices of the Nuclear and Plasma Sciences Society of the IEEE, and the Division of Physics of Beams of the APS. This was the second time the meeting has been held in Canada and once again TRIUMF was chosen as host; the Institute for Plasma Research at the University of Maryland was responsible for organizing the program. Though the attendance (1221) was not an all-time record, it was up 20% from the 1985 Vancouver meeting and up 15% from PAC'95. The international component has also continued to grow, with 33% of the delegates coming from 23 countries outside North America.

PAC'97 might well be said to mark the centenary of accelerator technology, since Thomson's measurement of the mass of the electron and his identification of it as sub-atomic were published 100 years ago to the month, and his was the first important experiment to rely on the accurate formation and measurement of a particle beam in well-defined electric and magnetic fields. As the first plenary speaker noted, the masses of the electron and its sister particles remain of central interest in physics today!

The opening plenary session covered four highlights of the conference: recent important advances for linear colliders (B. Richter) and laser accelerators (C. Joshi); and the initial operation of two major accelerator projects – the CERN LEP2 collider, which has reached 93 GeV, comfortably exceeding the W-production threshold (S. Myers), and the highest energy third-generation light source SPring-8 (H. Kamitsubo). Several more machines reported initial beam commissioning, including the PEP-II B-factory high-energy ring, RHIC (one sextant) and the IUCF Cooler Injection Synchrotron. Many reports described projects under construction, ranging from the Large Hadron Collider at CERN and the Main Injector at Fermilab (now joined by a permanent-magnet Recycler) to the BESSY-II light source and various radioactive ion-beam accelerators, including the development

of a cw RFQ at TRIUMF. A number of major proposals are also close to approval: the 1 GeV 1 MW National Spallation Neutron Source at Oak Ridge, the compact 2.9 GeV Canadian Light Source at Saskatoon, the 50 GeV 0.01 mA Japanese Hadron Facility at KEK, and the RI-Beam Factory at RIKEN, which includes a 400 MeV/A superconducting ring cyclotron and the MUSES storage rings. Somewhat further off are the challenging prospects of the APT linac for producing tritium and the muon collider.

Interesting advances were reported in all areas of accelerator technology, especially superconducting rf and magnets. In the related areas of high-current multi-particle beam dynamics and pulsed-power and high-intensity beams, noteworthy progress was reported through the Z-pinch and the induction-linac flash X-radiography approaches. In beam instrumentation, novel measurements were reported on ultrashort bunches: emittance measurements with picosecond resolution at BNL, and bunch-length measurements down to 100 femtoseconds using coherent radiation at Jefferson Lab. Controls highlights were the growing acceptance of the EPICS system and a growing trend to use more programmable devices in safety systems.

Accelerators continue to serve a multitude of applications: cancer therapy, neutron radiography, sterilization, and production of isotopes, spallation neutrons and synchrotron light, are now joined by interesting schemes for contraband detection and high-energy proton radiography. Notable developments were reported at free-electron laser facilities: provision of photon beams from sub-eV to multi-MeV energies at the Duke FEL user facility, first operation of the Jefferson Lab's cw FEL, and the use of self-amplified spontaneous emission (SASE) for the TESLA FEL at DESY.

The final plenary session offered a look to the future, with surveys of high-energy physics (J. Peoples), nuclear physics (K. Gelbke), synchrotron light sources (H. Winick), and ultra-high-intensity proton accelerators (W. Weng).

In all, 1564 abstracts were submitted, for 76 invited and 120 contributed talks, and 1368 posters. In addition, a very successful 3-day industrial exhibition was held, limited by space to 30 participants, and over 40 satellite topical and committee meetings were held.

As at PAC'95, electronic publication was the norm, but with the innovation of direct submission of abstracts to the APS. This relieved the organizers of a huge task and resulted in the early posting of the complete program of abstracts on the Web version of the APS Bulletin. The proceedings are being published by IEEE in both book and CD-ROM form, and are also available on a combined PAC/EPAC/APAC Web site. Altogether, 1261 papers are included, just 2% below

the all-time record. Publication has been supported by generous grants from the US Department of Energy, National Science Foundation and Office of Naval Research.

The social program began on Monday evening with a Pacific Coast salmon barbecue for 1000 at TRIUMF, followed by a tour of the laboratory. The conference banquet was held in the Hotel Vancouver on Wednesday evening and attended by a record 980 – attracted perhaps by the subsequent Awards Ceremony and some memorable entertainment by the Physics Chanteuse, Lynda Williams. The conference is indebted to Advanced Ferrite Technology, MDS Nordion and TRIUMF for their generous contributions as co-sponsors of these events.

There were 211 companions registered, and many of these enjoyed a Welcome Breakfast and orientation talk and walk, various tours of Vancouver, and excursions to Victoria and Whistler – all assisted by a week of good weather.

Space is unfortunately too limited to mention all the people whose dedicated efforts, often over a period of many months, ensured the success of the conference. Major responsibilities were undertaken by:

M. Barnes, <i>Equipment</i>	M. La Brooy, <i>Printing</i>
C. Bellamy, <i>Program Sec.</i>	S. Reeve, <i>Treasurer</i>
E. Blackmore, <i>Tour</i>	K. Reiniger, <i>Posters</i>
M. Comyn, <i>Database</i>	M. Reiser, <i>Program Chair</i>
M.K. Craddock, <i>Chairman</i>	J. Richards, <i>Database</i>
E. Driessen, <i>Co-ordinator</i>	R. Samarasekera, <i>Registn.</i>
M. D'yachkov, <i>WWW site</i>	J. Thomson, <i>Proceedings</i>
S. Koscielniak, <i>Proceedings</i>	G. Wait, <i>Exhibits</i>

## RADIOACTIVE ION BEAMS

A workshop on diagnostic techniques for radioactive ion beams (RIB) was held at TRIUMF in May. This was attended by 15 people from other laboratories and over 20 TRIUMF personnel. The overhead transparencies used by the speakers were photocopied and distributed to participants; some spare sets are still available.

## MENU'97

The Seventh International Symposium on Meson-Nucleon Physics and the Structure of the Nucleon (MENU'97) was held at the Instructional Resource Centre of the University of British Columbia in Vancouver, British Columbia, from July 28 – August 1. There were 121 participants from 19 countries in attendance. A total of 81 speakers were invited to make presentations, including 27 plenary talks. The conference Web page is at <http://www.triumf.ca/menu97/menu97.html>.

The record attendance at this meeting meant we had to introduce some parallel sessions, although every

effort was made to keep this to a minimum. The result was long, sometimes grueling days of talks from early in the morning to late in the afternoon, days made all the more difficult due to the exceptionally fine weather we enjoyed during the conference. On the other hand, the participants made the conference a success with the high quality of the presentations, as well as rich discussions both during the formal question periods and the informal periods at the end of each day.

Topics covered at the conference included chiral perturbation theory,  $(\pi, 2\pi)$  reactions, electromagnetic interactions (reflecting the growing importance of this topic in this conference series), partial wave analysis,  $\pi N$  scattering, deep inelastic scattering, dibaryons  $\eta N$  and  $KN$  scattering, theory, and others. Special emphasis was placed on discussions of the  $\pi N$  coupling constant, the  $\pi N \Sigma$  term, and recent analyses of low energy  $\pi N$  scattering results, areas of interest to the local TRIUMF participants.

Financial assistance was provided by the Tri-University Meson Physics Facility (TRIUMF), the Los Alamos Meson Physics Facility (LAMPF), and the Indiana University Cyclotron Facility (IUCF). In addition, many resources were provided by TRIUMF including the talents of the MENU'97 secretarial staff: Elly Driessen, Maria Freeman, and Jana Thomson, as well as the local organizing committee consisting of Byron Jennings, Erich Vogt, Martin Comyn, Larry Felawka, and Blair Jamieson.

The proceedings of the conference were published as a TRIUMF brown report,  $\pi N$  Newsletter No. 13, ISSN 0942-4118 [TRI-97-1].

The Paul Scherrer Institute (PSI) will host the next meeting in this series (MENU'99). The venue is Zuoz, Switzerland, in the Engadin, a beautiful resort town nestled in the Alps. The meeting will take place from August 16-20, 1999, and the organizers are Andreas Badertscher (ETH Zurich), Milan Locher (PSI), and Quentin Ingram (PSI). A preliminary Web site has been set up at <http://www1.psi.ch/bader/menu99.html>.



## DNP FALL MEETING

The Annual Fall Meeting of the Division of Nuclear Physics of the American Physical Society, co-sponsored by the Canadian Association of Physicists, including three workshops, was held October 5-8, at the Chateau Whistler Resort, in Whistler, B.C. Whistler is most famous as a world class ski resort. The surroundings are a spectacular mix of fjords, mountains, alpine lakes, and glaciers, located in close proximity to the Pacific Ocean. The weather in October is variable, and it greeted the participants with rain before providing spectacular views after the clouds cleared. Fall colours around the Chateau Whistler Resort were bright. The Fall Meeting was organized with the help of a local organizing committee consisting of: J.M. D'Auria (SFU), D.F. Measday (UBC), G.A. Miller (Washington), J.-M. Poutissou (TRIUMF), G. Roy (Alberta), G.R. Smith (TRIUMF), W.T.H. van Oers, chairman (Manitoba) and E.W. Vogt (UBC/TRIUMF). The Meeting secretary was W. Dilling (TRIUMF).

Registered participants at the meeting totalled 524, including some 96 student, retired, or unemployed attendees. More than 250 registered for the three workshops on the Sunday preceding the main meeting. A number of well-attended events highlighted the main meeting. The Monday morning plenary session in memory of Chien-Shiung Wu was held in the Frontenac Ballroom to accommodate the large audience. C.N. Yang provided a fascinating biographical sketch; C.E. Wieman discussed atomic parity violation and the nuclear anapole moment; V. Yuan summarized epithermal neutron studies of parity violation in nuclear resonances and provided some personal remarks about his mother; M. Goldhaber presented a historical perspective as well as a status report on investigations by the Super-Kamiokande collaboration. P. Rosen spoke on "A New A.D.'s View of HENP (at the U.S. Department of Energy)" in his talk at the Town Hall Meeting on Tuesday afternoon. A reception to honor D.L. Hendrie was held prior to the banquet; S. Freedman inspired a number of laboratories and institutions to bring "items of no value" to remind Dave Hendrie of his years of service to the community at the U.S. Department of Energy. More than 325 attended the banquet to hear after-dinner speaker C.G. Salvo of JPL, the flight director for the Pathfinder in the recent Mars exploration. His "Mars Exploration Meets the 98 Cents Store" (the cost of the mission was less than \$1/U.S. citizen) was punctuated with video simulations of the bouncing landing plus slides (some in 3D) of the rock exploration by the surface explorer. Seven User Group meetings were held on Monday afternoon and evening: HRIBF, TJNAF (CE-BAF), 88-Inch Cyclotron, GAMMASPHERE/ATLAS,

ISL, Bates (BLAUGI), and NSCL. Potential users of LISS met informally over dinner.

The meeting consisted of the plenary session, the Town Hall Meeting, five sessions of invited talks, four mini-symposia, and 23 sessions of contributed papers. Two sessions of invited talks were on topics selected at the April program committee meeting: “Probing Chiral Perturbation Theory” arranged by W.T.H. van Oers, D.M. Skopik and R. Roy, and “Recent Results with Intermediate Energy Hadron Probes” arranged by S. Wissink. Two voted sessions were selected by ballot of the program committee from speaker nominations by the DNP membership and arranged into sessions by the program committee chairman, S. Freedman: “Weak Interactions and Spin Structure” and “Diverse Aspects of Hadronic Matter”. The local organizing committee provided a fifth session of invited talks: “Discrete Symmetries”. A tour of TRIUMF was offered on Thursday following the meeting as well as a get-together with local high school students and their teachers. Bus service was arranged from the Chateau Whistler Resort to TRIUMF for this purpose. Three parallel workshops were held on Sunday, October 5: “Symmetries” by W.C. Haxton and E.M. Henley, “Electromagnetic Probes of Mesons and Nucleons” by J. Bergstrom, D.F. Geesaman and R.G. Milner, and “Radioactive Beams and Nuclear Astrophysics”, organized by J.M. D’Auria and J.D. King. By all accounts this was one of the most successful DNP Fall Meetings.

### TRIUMF USERS GROUP ANNUAL GENERAL MEETING

A brief Users Group Meeting was held at the Whistler DNP/APS meeting on October 6. The main topic of discussion was a progress report on the ISAC facility.

The 1997 Annual General Meeting was held in the TRIUMF Auditorium on December 3. The morning program included the standard reports from the Director and Associate Director along with a special memorial lecture in honour of Rudi Abegg, who passed away in July. A scholarship fund has been established in his memory. The afternoon session highlighted the various possible items which different users have proposed for inclusion in the next 5 year plan for TRIUMF (April, 2000–March, 2005). There was also a presentation by P. Sinervo, the current chair of the NSERC SAP grant selection committee and co-chair of the reallocation committee, on the draft SAP re-allocation report.

The detailed program is listed below. During the business meeting there was a discussion about changing the date of the AGM to July and also whether or not to schedule it on a weekend day or adjacent to a

weekend. A poll of the users via a Web page was proposed. A revision of the current by-law specifying an update of the membership list each year was passed. In future this update will take place every three years.

A wine and cheese reception was held in the new ISAC experimental hall after the meeting was finished and the Users Group dinner was held at the Asiana Restaurant on Kingsway. The afterdinner speaker was our former director, Erich Vogt, who gave an entertaining and uplifting talk on the subject of “HOPE”.

#### AGM’97 Program

A. Astbury	TRIUMF Director’s Report
J.-M. Poutissou	TRIUMF Science Review
W. Haeberli	Rudi Abegg Memorial Lecture
G. Dutto	Machine Performance’97 & Necessary Upgrades for ’00–’05
P. Schmor	ISAC Progress Report
E. Blackmore	Infrastructure Support
M. Wiescher	Signatures of Explosive Nucleosynthesis
P. Sinervo	NSERC GSC & Reallocation Report
P. Kitching	E787: The Search for Rare K Decays

#### 5 Year Plan Presentations ( $\leq 10$ min each)

D’Auria	Radioactive Beam Possibilities
Waddington	ISAC at 6 MeV/A, 8 PI Spectrometer
Kreitzman(Brewer)	Muon Dreams
Kitching/Pinfold	Tau Charm Factory
Bryman	Muon BlowTorch at TRIUMF
(Hasinoff)Olin	Japanese Hadron Facility
Ruth	Life Sciences Program
Kiefl	Implantation & Nuclear Orientation at ISAC
Yen	High-Energy Boosters
Vetterli	Physics at an $e^- + p$ Collider

#### TUEC membership for 1997

M. Hasinoff	UBC
Chair	
L. Buchmann	TRIUMF
Chair-elect	
G. Roy	Univ. of Alberta
Past-chair	
J. D’Auria	SFU
S. Kreitzman	TRIUMF
E.L. Mathie	Univ. of Regina
S. Yen	TRIUMF
M. La Brooy	TRIUMF
Liaison Officer	