



The TRIUMF Newsletter

News from Canada's National Laboratory for Particle and Nuclear Physics

TUEC NEWS

The TRIUMF Users' Executive Committee (TUEC) has focused its efforts during 2004 on determining the main areas of concern to the Users. Most relate to the changing dynamics of TRIUMF experiments which now have requirements which vary on a weekly or even daily basis compared to a monthly basis in the past. TUEC is addressing the needs of the various user communities through its representation on the newly created ISAC Operation Review, ISAC Beam Development Strategy, Actinide Target Task Force, and Communications Committees, as well as through OPCOM. TUEC sees its role as not only pointing out problems but also offering possible solutions. In order to do this effectively, Users are encouraged to communicate with TUEC members on a regular basis - especially before the quarterly TUEC Meetings which are now announced on the TRIUMF Users' Group (TUG) website.

TUEC has undertaken to produce a new web-based version of the TRIUMF Users' Handbook, which was last updated in 1987. It will include sections on ISAC and the other new TRIUMF facilities.

As initial input for the next Long Range Planning Committee, TUEC is preparing a survey to determine where Users see TRIUMF's future developments. This will be a major topic at the 2004 Annual General Meeting which will be held on Wednesday, December 8.●

To join TUG or contact TUEC members, please visit the TRIUMF Users' Group website at:

<http://www.triumf.ca/tug/>.

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NIC VIII CONFERENCE HELD IN VANCOUVER - A HUGE SUCCESS



Participants of the 8th Symposium on Nuclei in the Cosmos. The conference organized by TRIUMF was held July 19-23 in Vancouver. The 237 registered participants were engaged in lively discussions about stellar evolution, and the synthesis and cosmic observation of the elements.

DIRECTOR'S NOTES

International conferences on specific topics of current scientific interest provide excellent forums for information exchanges. One such meeting, the 8th conference of Nuclei in the Cosmos, was held in Vancouver in July. This conference is held every two years and aims to bring together experimentalists, observers, and theoreticians interested in the role nuclear processes play in the evolution of stars throughout their lifetimes. The conference was well attended with delegates from over 29 countries. Feedback to TRIUMF, host of the conference, was very positive concerning the science program, and delegates much enjoyed the excellent weather and social events. The conference dinner was held at the Museum of Anthropology and Donald Clayton gave an entertaining and insightful account of his early days at the Kellogg Radiation Laboratory at Caltech where much of the foundation of nuclear astrophysics as we know it today was laid.

Progress continues to go well with the fabrication and assembly of the ISAC-II accelerator. This is a linear accelerator that will ultimately take radioactive ions $A < 150$ up to an energy of 6.5 MeV/u. Due to resource limitations, the building of the accelerator will be in two stages,

with the first stage delivering beams up to 4.3 MeV/u at the end of 2005 and full energy by 2007. The accelerating structure will consist of superconducting radio-frequency cavities – a new technology for TRIUMF. In July this year, a full accelerating superconducting module was completed and passed radio-frequency and cryogenic tests. Five of these modules will have to be completed to reach the 4.3 MeV/u energy.

For several years TRIUMF has been involved in designing and constructing components for the CERN LHC accelerator due for first beam in 2007. One of the most significant projects TRIUMF has been responsible for is the production of 52 dual beam warm quadrupoles to control the beam at the two beam cleaning stations at opposite sides of the 9 km diameter accelerator ring. The engineering precision needed for these quadrupoles presented a challenge that TRIUMF was able to meet in collaboration with engineers from CERN and Alstom (Canada) – the firm that fabricated the magnets. All magnets have now been delivered to CERN and have met the stringent acceptance tests.●

Alan Shotter, TRIUMF Director

For more information on TRIUMF Projects, visit the TRIUMF website at: <http://www.triumf.info>

RESEARCH DEVELOPMENTS

NEUTRINO ASYMMETRY RESULTS FROM TRINAT

TRIUMF's neutral atom trap (TRINAT) captures radioactive atoms in a 1mm-sized cloud using the pressure of laser light. The trap improves two types of experiments in nuclear beta decay, which produces three decay products, a β , a neutrino (ν), and the daughter recoiling nucleus. The daughter nucleus freely escapes the trap, and by measuring its momentum in coincidence with the β , the ν momentum can be deduced more directly than in previous experiments. We have pioneered these techniques at TRIUMF/ISAC.

The weak interaction (as far as we know) is mediated by vector bosons with spin one. By measuring the β - ν angular distribution in the decay of ^{38m}K , where parent and daughter both have no nuclear spin, we test whether scalar bosons with spin zero also contribute to the weak interaction. A preliminary result consistent with no scalar bosons was presented by Alexandre Gorelov at the APS DNP Fall meeting 2003 in Tucson, with sensitivity somewhat better than previous β -decay experiments. By reconstructing the ν momentum, we have also made a missing mass search for heavy (1 MeV) ν 's mixing with the electron ν , and we have published upper limits on the admixtures (Mike Trinczek et al. Phys. Rev. Lett. 90 012501 (2003)).

The weak interaction also couples only to left-handed ν 's, and in that sense parity — mirror symmetry — is said to be fully violated. "Optical pumping" with lasers can highly polarize the trapped atoms and nuclei with known polarization. By measuring β - ν angular distributions from the decay of polarized ^{37}K , we can search for right-handed ν 's.

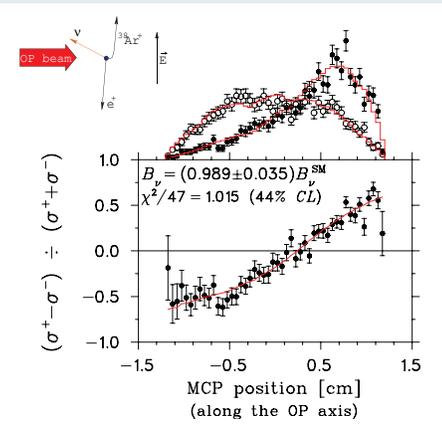
Preliminary results were shown by Dan Melconian at DNP Tucson (see figure). The β is detected at 90° to the spin direction, so the recoil spin asymmetry is directly opposite to the ν spin asymmetry, B_ν . The only previous measurements of B_ν were in the decay

of the neutron. These experiments are complementary to other searches for right-handed ν 's, like TRIUMF's TWIST muon decay experiment.

To improve these experiments, we are developing a circularly polarized dipole force trap to produce fully polarized nuclei in a better-controlled environment. A similar geometry will search for time-reversal violation. Other experiments include recoil singles asymmetries in pure Gamow-Teller decays, which vanish in the absence of tensor interactions. •

John Behr and Dan Melconian

For more information about TRINAT, please visit the TRINAT website at: <http://www.triumf.ca/welcome/trinat>



Argon recoil event asymmetry from which the neutrino asymmetry, B_ν is determined (see text).

E949 UPDATES RARE K-DECAY MEASUREMENT

Measurements of exceedingly unlikely decays of the K^+ meson made by the E949 collaboration using data collected at the Alternating Gradient Synchrotron (AGS) at Brookhaven National Laboratory (BNL) on Long Island, New York, provide an important and potentially definitive test of the so-called "Standard Model" of particle physics interactions. Theoretical calculations predict that the unstable K^+ should decay into a charged pion (π^+) accompanied by an undetectable neutrino, anti-neutrino ($\nu, \bar{\nu}$) pair approximately 1 out of every 13 billion times. Any significant deviation from this prediction could spell trouble for the Standard Model, which to date has provided a consistent explanation for all experimental observations.

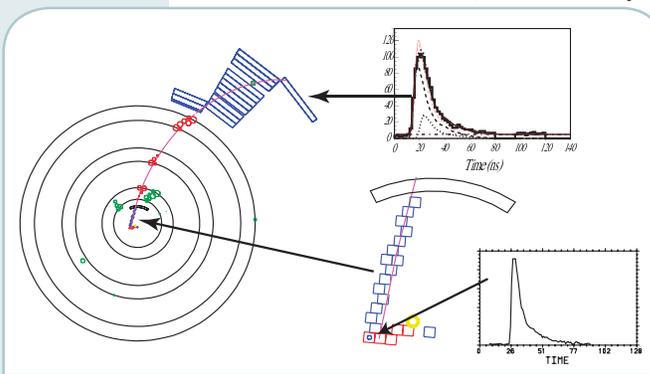
The most recent results from the data taken in 2002 have now been published in Physical Review Letters, and continue to indicate that the measured decay rate is about twice the rate predicted by the Standard Model. However, because only

three candidate events have been spotted in total - one of them in the 2002 data set - the large statistical uncertainty means the result is still consistent with the prediction. The only way to unambiguously resolve the question is to reduce the size of the statistical uncertainty by taking more data, something for which funding is not presently available.

The formidable task of sifting through trillions of K^+ decays to identify the few with this particular "signature" has been tackled by the international - Canada, U.S., Japan, Russia - collaboration of E949 physicists, including a group from TRIUMF which has played a key role in the design and construction of several major components of the E949 detector and associated electronics. The data collected by this state-of-the-art detector are analyzed using a sophisticated suite of software that employs a variety of pattern recognition and statistical techniques to extract as much useful information as possible from the very large (approx. 20 TByte) data sets. Here also, TRIUMF has been the principal locus of activity, taking the lead role within the collaboration by planning and co-ordinating the analysis effort, providing most of the software, and actually performing the excruciatingly-detailed analysis with the help of a dedicated 20-node (40 CPU) Linux-based computing cluster. •

Joe Mildenerger

More details about the new results and the E949 Collaboration can be found at: <http://rarek.triumf.ca/e949>



Event display for the 2002 $\text{K}^+ \Rightarrow \pi^+ \nu \bar{\nu}$ candidate event

ISAC II CRYOMODULE COLD TEST

Many proposals (RIA, Eurisol, ISAC-II) are emerging for a new generation of high gradient heavy ion accelerators. TRIUMF is now preparing a new heavy-ion superconducting linac as an extension to the ISAC facility, to permit acceleration of radioactive ion beams up to energies of, at least, 6.5 MeV/u. The superconducting linac is composed of two-gap, bulk niobium, quarter wave rf cavities, for acceleration, and superconducting solenoids, for periodic transverse focussing, housed in several cryomodules. The linac is grouped into low, medium and high beta sections. An initial installation of 18 MV of medium beta cavities ($\beta = 5.8\%, 7.1\%$) is due for commissioning in 2005. The first major milestone, reported here and achieved in June 2004, is the first rf cold test of the completed cryomodule.

The ISAC-II medium beta cryomodule (see figure) incorporates many new techniques to improve the performance over machines presently being used for beam delivery. The machine lattice, compatible with multi-charge acceleration, uses high field (9T) superconducting solenoids with bucking coils for active fringe field compensation. The bulk niobium quarter wave medium β cavities produce 6 MV/m over an effective length of 18 cm with a peak surface field of ~ 30 MV/m. The gradient corresponds to an acceleration

voltage of 1.1 MV and a stored energy of $U_0 = 3.2$ J and is a significant increase over other operating heavy ion facilities. TRIUMF has developed a mechanical tuner capable of both coarse (kHz) and fine (Hz) frequency adjustments of the cavity. The demonstrated tuner resolution is better than $0.1 \mu\text{m}$ (0.6 Hz). To achieve stable phase and amplitude control, the cavity natural bandwidth of ± 0.1 Hz is broadened by overcoupling to accommodate detuning by microphonic noise and helium pressure fluctuation. The chosen tuning bandwidth of ± 20 Hz demands a cw forward power of ~ 200 W and peak power capability of ~ 400 W to be delivered to the coupling loop. A new rf coupling loop has been developed that operates at 200 Watts forward power with less than 0.5 Watt of power being added to the helium load. Cold alignment in ISAC-II has been done with rf pick-ups using a stretched wire technique. Finally all cryomodule assembly and testing has been done in a clean environment.

Two cold tests have been successfully completed. In the first cold test, the

cryogenic characteristics of the cryomodule were determined. The thermal static load on the 4K surfaces was measured to be 11 W while the LN2 consumption in the thermal shield was 5 ltr/hour both in line with design estimates. In a second test, the solenoid and the four rf cavities were powered simultaneously. In Oct. of 2004 a third cold test is planned with the goal to accelerate alpha particles. •

Bob Laxdal

TRIUMF HOUSE

Construction for TRIUMF's new guesthouse began in mid-January 2004 and the TRIUMF House staff are looking forward to welcoming their first guests in early 2005. The new TRIUMF House is being built in a wonderful location on the University of British Columbia campus. Like the old TRIUMF House, the new guesthouse is within walking distance of the laboratory, has all the amenities of the campus, is close to 10th Avenue, public transportation and offers the pleasures of Pacific Spirit Park. The added feature is that the new guesthouse is being built away from the campus noises and distractions that marred the peace of our old TRIUMF House.

Architect's rendering of the new TRIUMF House



Construction photo taken Sept. 10, 2004

The staff and users of TRIUMF House spent a great deal of time designing the new 35-room guesthouse. They have ensured it will be quiet and comfortable with many new amenities and conveniences, such as internet connections in every room and outside patios and gardens. All the new features have been tastefully done while still maintaining the homey and collegial atmosphere that made TRIUMF House so popular with visitors to TRIUMF.

The capital cost of the new guesthouse is substantial, but TRIUMF will not pass these costs on to TRIUMF House guests. TRIUMF House will continue to be operated at cost to ensure that visitors and students to TRIUMF can obtain the best possible housing for the best possible price. •

Shirley Reeve

The first medium beta cryomodule assembly for ISAC-II



Important Upcoming Dates

* see insert

NSERC	Discovery grant applications due	October 25	Ottawa
NSERC	Research Tools and Instruments grant applications due	October 31	Ottawa
ACOT	Advisory Committee on TRIUMF meeting	November 5-6	TRIUMF
OPCOM	Operating Committee meeting	November 9	TRIUMF
BOM	TRIUMF Board of Management Meeting	November 26	TRIUMF
TUG AGM*	TRIUMF Users' Group Annual General Meeting	December 8	TRIUMF
SAPEEC*	Subatomic Experiments Evaluation Committee Meeting	December 9-11	TRIUMF
MMSEEC*	Molecular and Materials Science Experiments Evaluation Committee meeting	December 9-10	TRIUMF
CAP '05	Canadian Association of Physicists 2005 Annual Congress	June 5-8, 2005	UBC

OUTREACH UPDATE

The TRIUMF Outreach Program (TOP) is hard at work developing science education and public outreach programs. Still in its infancy, TOP is making good progress towards building comprehensive and coherent educational opportunities for the public, students, teachers and graduate students. A few new programs have been developed recently which are helping TRIUMF achieve those goals.

A major new initiative was the establishment of a new six-week, \$3000 High School Fellowship, administered in cooperation with the Innovation and Science Council of British Columbia. The Fellowship attracted applications from 99 of the province's top physics students. This year's winner was Reka Moldovan of Kelowna, who worked at TRIUMF under the supervision of Jess Brewer. Among other activities, Reka attended the NIC

VIII Conference in Vancouver, and gave a summary talk to the undergraduate summer students. She is a truly outstanding student, and TRIUMF wishes her well as she begins her studies at UBC this fall. The program was deemed to be a big success, and plans are underway to increase the number of student fellows in the future.

The NALTA (North American Large Area Time Coincidence Array) cosmic-ray detector project is entering into a new phase as it seeks to expand into high schools across Canada. At the June 2004 CAP Congress in Winnipeg, it was decided to place detector systems in science centres across the country in time for the World Year of Physics (WYP2005) celebrations in 2005. This approach was endorsed by both the CAP Executive and the WYP2005 committee, and with several science centres already signed on, efforts are underway to secure the necessary funding.

Planning for the World Year of Physics 2005 is well underway with a wide variety

TRIUMF Beam Schedule

The current TRIUMF beam schedule is available on the Web at:

<https://admin.triumf.ca/docs/eec/>

Users should subscribe to the automated update notification to receive notice of changes which may be required during the period already scheduled.



Reka Moldovan receiving her TRIUMF High School Fellowship Award from Director Alan Shotter.

of events in preparation across Canada, including a cross-country lecture series and exhibits at all major science centres. Those interested in WYP2005 activities are encouraged to check the CAP website at www.cap.ca/edu/year/year.html for updates.

A new TRIUMF Communications Committee has been formed to coordinate all aspects of internal and external communications, including the Newsletter and website. Queries should be forwarded to marcello@triumf.ca.

Funding for the outreach program is provided by grants from the Vancouver Foundation and the TRIUMF Technology Transfer office. • *Marcello M. Pavan*

For more information on the outreach program, contact: outreach@triumf.ca

Contact Information:

Director:	A.C. Shotter	director@triumf.ca
Associate Director/Science:	J-M Poutissou	sciencediv@triumf.ca
Accelerator Technology:	E. Blackmore	acceldiv@triumf.ca
Cyclotron Operations:	R.Poirier	cdadmin@triumf.ca
ISAC Division:	P. Schmor	isacdiv@triumf.ca
Technology Transfer:	P. Gardner	techtrans@triumf.ca
Administration and HR:	J. Hanlon	admin@triumf.ca
Education Outreach:	M.M. Pavan	outreach@triumf.ca
Financial Officer:	S. Reeve	finance@triumf.ca

TRIUMF: 4004 Wesbrook Mall, Vancouver, B.C. V6T 2A3 Canada
 Telephone.....604-222-1047
 Fax.....604-222-1074
 Website.....www.triumf.info

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Send any Newsletter queries or comments to: newsletter@triumf.ca

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