User Comments on TRIUMF's Five-Year Plan for 2010-2015

TRIUMF User Executive Committee

April 8, 2008

1 Introduction

This document from the TRIUMF User Executive Committee (TUEC) represents the input of the broader TRIUMF User Group (TUG) on the developing TRIUMF 5-Year Plan (5YP). Following the reports of the Policy and Planning Advisory Committee (PPAC) Meeting and the TRIUMF Kitchen Cabinet Advisory Committee Meeting, TUEC requested input from the broader user community on these reports and the 5YP, with an emphasis on the initiatives outlined in the Director's Vision statement. Specifically feedback was requested to be sent to expert representatives on the proposed Electron Linear Accelerator (Barry Davids), Life Sciences (Mike Adam), Fundamental Symmetries (Gerald Gwinner), Ultracold Neutrons (Jeff Martin), Particle Physics (Isabel Trigger), Condensed Matter and Materials Science (Andrew MacFarlane), and Detector Development (Fabrice Retiere). This condensed feedback is presented here as provided by the different stakeholders, as well as a section devoted to verbatim comments made directly to TUEC concerning the 5YP.

Viewing these comments, the following observations can be made about the 5YP and the process:

- It is evident that the plan represents the direction endorsed by the user community, based upon the white papers produced at the summer workshops held in 2006 and 2007 by the TRIUMF User Group in an effort to initiate the 5YP process.
- The openness of the planning process is to be commended, and the Users appreciate that input and reviews have been sought from multiple internal and external sources during the development of the plan.
- As indicated in the PPAC and DKC reports, there are significant details remaining to be addressed in the plan, such as the keystone experiments, manpower, and prioritization for funding scenarios.
- Feedback on the current state of the plan sent to TUEC shows that there is a strong consensus of support for the plan among TRIUMF users. However, there exists confusion concerning the process to date and some members of the community are aggrieved by an under-representation in the 5YP of their contributions to TRIUMF science.

2 Electron Linear Accelerator

TRIUMF-ISAC is a preeminent facility for fundamental studies in physics. Currently, it is approaching a very complete range of World-class instrumentation built around the existing exotic beam production facility. The physics opportunities presented in the Director's Vision statement with the construction of an electron linear accelerator (elinac) and development of new high-power target technology offer a significant and unique expansion that would open a window of opportunity to pioneer research efforts in nuclear structure and nuclear astrophysics, establishing TRIUMF-ISAC in the lead position in rare-isotope beam research.

The physics which can be addressed by a second proton beamline with a high-power target are addressed separately in the fundamental symmetries contribution. It must be noted, however, that the second beamline is strongly supported by the ISAC community: all of these users welcome the availability of more beamtime to reduce current backlogs on experiments, allow for more in-depth studies, and provide additional time for beam development and pilot studies. Additionally, it must be noted that construction of the proposed elinac is predicated on the construction of a second beamline to the ISAC facility.

In contrast to the fundamental symmetries science, the physics case for the elinac in the current 5YP documents is lacking in details, especially in specific cases proposed for study. This omission weakens the proposal and must be rectified. The broad questions addressed by the subatomic community at TRIUMF-ISAC are (borrowing from the "Nuclear Physics Brief to the Subatomic Physics Long Range Planning Committee"):

- What is the structure of nuclear matter?
- What is the role of nuclei in shaping the evolution of the universe?
- What physics lies beyond the standard model?

Comparing the species produced via the photofission process to that which would be produced using spallation of an actinide target at TRIUMF-ISAC, there are two clear advantages of the elinac which can be used to great effect in answering these questions:

- Photofission produces neutron-rich beams exclusively, avoiding neutron-deficient contaminants in the ion beam.
- Peak photofission yields occur naturally near the neutron-rich doubly-closed-shell isotope ^{132}Sn.

Taking advantage of these differences with the elinac, we may ask more specific questions:

- What are the limits of neutron-rich matter?
- What is the path of the r-process?
- What are the masses of the neutrinos?

2.1 What are the limits to neutron-rich matter?

There are predicted to be thousands of neutron-rich nuclei which, while unstable with respect radioactive decay, have half-lives long enough for them to be studied in the laboratory. A leading question is the location of the so-called "neutron dripline", the very limit of nuclear existence on the neutron-rich side of stability. Nuclei at the dripline instantly lose a neutron and therefore will never be observed in the laboratory. The answer to this question will improve nuclear mass models, increasing our understanding of the structure of these nuclei. Even a few more data points will help constrain mass models and improve the value of their extrapolations.

The photofission driver offers a unique and specific window for fixing a point on the neutron dripline. This is because it will deliver isotopes of tin just beyond the discontinuity at the closed shell ^{132}Sn. Precise mass measurements would lead, via directly deduced neutron separation energies and extrapolation, to the point where the neutron separation energy goes to zero. This point is the neutron dripline for tin.

Currently, there is only mass information for two isotopes of tin beyond the shell closure at $N = 82$, viz., ^{133}Sn and ^{134}Sn. Because of the well-known staggering in even and odd neutron separation energies, extrapolation is not possible. Extrapolation would be possible even with one additional mass measurement, i.e., ^{135}Sn. This measurement would have to be of high precision in order to constrain the extrapolation. At TRIUMF-ISAC, the capability of measuring the masses of unstable nuclei with the necessary precision, in the form of the TITAN facility, will imminently be available. Indeed, the precision available with this facility will equal or exceed the leading facilities in the world.

Establishing the experimental reach to the most neutron-rich nuclei that exist will connect to one of the most fundamental questions in astrophysics, namely, "What are the properties of extremely neutron-rich nuclear matter?" The species which can be produced using a photofission driver can be used to probe the properties of nuclear matter at extreme neutron richness similar to that found in neutron star crusts.

2.2 What is the path of the r-process?

Among the short-lived neutron-rich nuclei are those that are involved in the synthesis of the chemical elements beyond Ni (the nuclei involved in the rapid neutron-capture process in nuclei, viz., the r-process nuclei). We know almost nothing about these nuclei or the details of the r-process: measured half-lives of radioactive decay and reaction rates will play a key role in determining the nuclei on the r-process path of nuclosynthesis. Reaction rates for processes such as (n, γ), where a neutron is captured, leading to the emission of a gamma-ray, are key ingredients for determining the evolution of r-process nucleosynthesis. While this cannot be measured directly, other reactions, measured using DRAGON, EMMA, TUDA, and TACTIC may be used to infer reaction rates. As an example, (d, p) reactions, where a deuteron is captured and a proton emitted, also lead to an increase in neutron number and may be used to infer the (n, γ) reaction rates. This connection also illustrates the vital role that theory plays in understanding how these different reactions are related.

Referring back to Sect. 2.1, the neutron dripline is the natural boundary for the r-process. However, an increase in S_n values would result from the onset of collectivity and thus move the r-process path further away from stability. Detailed spectroscopy to measure collectivity can be achieved by populating excited states in nuclei near the doubly magic nuclei ^{132}Sn and ^{78}Ni (both near the peaks of the photofission yields) through both β^- decay and β-delayed neutron decay [cf. Shergur *et al.*, Phys. Rev. C **71** 064321 (2005)].

2.3 What are the masses of the neutrinos?

Recent discoveries in fundamental physics have shown that the neutrino plays an extremely important role in understanding the nature of particles and the forces between them. The problem is that neutrinos are almost massless and interact very weakly. We only know upper limits in answer to this question; and it may be that their masses are beyond the measurement capabilities of current (or foreseeable) instrumentation. However, there is a predicted fundamental process, namely neutrinoless $\beta\beta$ ($0\nu\beta\beta$) decay, that could provide a way to reach beyond this limit. The rate of neutrinoless $\beta\beta$ decay would depend directly upon the neutrino mass.

Many research groups worldwide have commenced investigations of $0\nu\beta\beta$ decay with the ultimate goal to determine neutrino masses. These include SNO+ at SNOLAB, CUORE/CUORICINO, EXO, MOON, Nemo, CARVEL, CAMEO, CANDLES, COBRA, GEM, GENIUS, GERDA, GSO, BOREXINO, and XMASS, and would amount to a worldwide investment on the order of \$1 billion. The magnitude of these research efforts accurately reflects the importance of determining whether or not neutrinos are Majorana or Dirac particles. These experiments involve the $0\nu\beta\beta$ decay of the most neutron-rich isotopes of selected elements and have as their ultimate goal to measure the $0\nu\beta\beta$ decay rate. However to arrive at masses of neutrinos, the environment in which the $0\nu\beta\beta$ process is occurring, namely the nuclear environment, must be accurately understood. A recent article by Schiffer *et al.* [Phys. Rev. Lett **100**, 112501 (2008)] indicates that more detailed spectroscopy is needed to understand the structure of these nuclei in order to extract the nuclear matrix elements.

Nine of the eleven candidate $0\nu\beta\beta$ decay parents (^{76}Ge, ^{82}Se, ^{96}Zr, ^{100}Mo, ^{116}Cd, ^{118}Te, ^{130}Te, ^{130}Ba, ^{150}Nd) are uniquely accessible through actinide fission, and are thus of interest using the elinac. The particular value of the elinac beam is that it is free of the neutron-deficient isobars which are a major product when using proton-induced fission. Following on from the work of Schiffer *et al.*, an important study is the decay of ^{76}Ga which would populate the excited states in ^{76}Ge: γ-ray spectroscopy following this decay would further elucidate the structure of the excited states in this double-beta decay parent, but to study this decay through spallation with the proton driver would result in massive amounts of ^{76}Rb which would hinder the measurement.

A unique first choice for study is ^{150}Nd. This nucleus is predicted to have the shortest half-life with respect to $0\nu\beta\beta$ decay. Also, this choice for $0\nu\beta\beta$ decay has been selected by the SNO+ double-beta decay experiment experiment at SNOLAB. The combination of shortest predicted half-life, large source sample at low cost, and World-best low background environment at SNOLAB presents strong arguments for this focus. A structure study of ^{150}Nd populated in the decay of the fission product nucleus ^{150}Pr would be nearly at the peak of the fission yield and would provide a clean beam which would not ordinarily be desirable, as spallation would also produce copious amounts of ^{150}Eu ($T_{1/2} = 36$ years).

The need for experimental study of ^{150}Nd to constrain the all-important nuclear matrix element in the $0\nu\beta\beta$ decay is made critical by a recent and significant change in the interpretation of the immediate even-even $N = 90$ neighbor, ^{152}Sm. It has been demonstrated that even the ground state of this nucleus has been incorrectly described. However, the spectroscopy that is required for the $^{150}\mathrm{Pr} \rightarrow {}^{150}\mathrm{Nd}$ decay study is closely matched to instrumentation and expertise at TRIUMF/ISAC. Indeed, the 8π/SCEPTAR/PACES/DANTE facility has played a significant role in the ^{152}Sm study and other related studies in this mass region (including ^{150}Sm, the daughter nucleus in the $\beta\beta$ decay of ^{150}Nd). These studies have provided some of the most precise spectroscopic information in radioactive decay (such as we are proposing with $^{150}\mathrm{Pr} \rightarrow {}^{150}\mathrm{Nd}$) and have lead to detailed information on shapes, pairing, and the mixing of these degrees of freedom. We note here that, because this is a second-order process, intermediate states in the intervening nucleus, ^{150}Pm will also be of key interest. There is a key complementary initiative to investigate such intermediate states with the TITAN facility.

A natural extension of this nuclear structure investigation will be in-beam γ-ray spectroscopy studies. Multiple-step Coulomb excitation studies using TIGRESS with the BAMBINO array (or the planned super-CHICO detector) would provide essential information about the collective structure of these nuclei. In this way, decay and in-beam spectrometers such as the 8π and TIGRESS, respectively, are natural complements to each other, mapping both the weakest and the strongest decay branches in nuclei.

2.4 Summary

There remain some concerns about a diversion of laboratory resources (human and material) away from the production and exploitation of neutron-deficient beams needed for the bulk of the nuclear astrophysics program and toward the production of neutron-rich beams from the e-linac.

The nuclear astrophysics effort relies crucially on high intensity proton beams producing neutron-deficient nuclei and we agree with the DKC suggestion that development of 400 μA of current from the cyclotron must be one of the highest priorities.

However, there is great enthusiasm for neutron-rich studies at TRIUMF-ISAC, especially with the very intense neutron-rich beams provided by the proposed elinac. A review of documents prepared at the TUG summer workshop in 2007 is urged, where a number of additional cases for the elinac were identified, for example:

- study of spin-orbit, tensor and monopole interactions (e.g., spectroscopic studies of single-particle states in the ^{132}Sn region for nuclei with $N > 82$),
- exploration of pairing along singly-closed shell lines (e.g., the aforementioned mass measurements of the neutron-rich Sn isotopes or spectroscopy of nuclei near ^{78}Ni),
- studies of nuclear collectivity, deformation, and shape coexistence (e.g., spectroscopy of excited states in the ^{82}Ge region for nuclei with $N > 82$ and the neutron-rich nuclei near $N = 90$).

Additionally, the nuclear astrophysics community is concerned about a diversion of laboratory resources (human and material) from the production and exploitation of neutron-deficient beams needed for the bulk of the nuclear astrophysics program toward the production of neutron-rich beams from the e-linac. The nuclear astrophysics effort relies crucially on high intensity proton beams producing neutron-deficient nuclei; development leading to the extraction of 400 A of current from the cyclotron must be one of the highest priorities.

3 Life Sciences

A significant component of the life sciences users are involved in writing the Life Sciences part of the plan and have reviewed this 5YP initiative during the Life Sciences EEC very recently (3-4 April 2008). Discussion of the radioisotope production, imaging, and micro-fluidics programs are thus in progress at the moment and further comment may be provided at a later time.

However, there is broad support both in the TRIUMF user community, the local community (UBC-Chemistry, Engineering, and Botany) and medical community (Children's Hospital, BCCA, and PPRC) for an increase in the life sciences at TRIUMF. New hires at TRIUMF and capital investment in a new Health Sciences building to support this expansion are critical steps as part of this initiative, and are thus endorsed by TUG.

4 Fundamental Symmetries

The Directors Vision for TRIUMF puts strong emphasis on fundamental symmetries experiments at ISAC. The low-energy Standard Model tests based on rare isotopes and precision laser techniques are seen as a major new thrust for the lab, and the need for ‘actinide target technology not available anywhere else in the world is stressed. The Directors presentation to PPAC considers the probing of fundamental symmetries as one of the strategic goals of the lab, and lists the actinide-target based Rn and Fr programs (together with nuclear astrophysics & structure) as one of three major new initiatives. The need for dedicated beam delivery over long periods of time is acknowledged and motivates TRIUMFs goal of simultaneous beam delivery via three beam lines to ISAC.

The committee reports by PPAC and the sEEC, as well as the DKC response to the PPAC plan unanimously support this view, in a strong form. PPAC considers the delivery of simultaneous beams to ISAC experiments and actinide targets a top priority for TRIUMF and urges the lab to achieve this goal as quickly as possible, recommending a staged approach with an early proton beamline, to provide ‘beams required for top-priority fundamental symmetries experiments. PPAC explicitly endorses the Directors call for the ‘major new interdisciplinary thrust in fundamental symmetry tests, and consequently ranks a new proton beamline with actinide target stations as the highest priority for on-site accelerator development. The sEEC close-out report identifies the fundamental symmetries program as a ‘key element for justifying the new proton beamline. It goes further to stress that ‘the time is now to execute this program. Overall, support by the panels for the fundamental symmetries program at ISAC is as strong as it can be, creating a very positive outlook for these activities.

Some further comments on the details of the program:

- For much of the projected course of the Rn and Fr fundamental symmetries programs, TRIUMF does not have to “beat ISOLDE” in yield. Rather, TRIUMF must make very large numbers of shifts available to allow experimenters to beat down systematic errors.
- Assuming yields from 1 to 2 μA on 25 g/cm^2 targets in the present stations, amounts of beamtime compatible with the rest of the ISAC program over 3 years would establish the methods needed to measure anapole moments and atomic PNC, make the nuclear structure measurements needed to choose the best isotope for Rn EDM enhancement, and establish the Rn EDM methods.
- It is crucial to the health of the program to not wait until 2013 (i.e. the 2nd set of stations) for these startup experiments, because of the timeliness of the physics and because university students and untenured faculty are working on these experiments now.
- Similar yields but with dedicated, long beamtimes to beat down systematic errors will be needed to complete the programs seriously. This is the most important use of a dedicated station for actinide targets.
- The Rn EDM proposal was designed for 10 μA of protons on 50 g/cm^2 targets.
- Most of the Fr program could ultimately be done with 2 μA of protons on similar thickness targets.

- Upgrades of Rn EDM and extension of the Fr parity-violating measurements to the less abundant isotopes could eventually make use of more beam.

5 Ultra Cold Neutrons

We hope that the endorsement of the UCN source by PPAC and its recommendation for "a more detailed engineering study to define the TRIUMF and CFI resource requirements, as well as implications of the UCN installation for CMMS and other users" will be acted upon by the laboratory. We also agree with PPAC's statement that: "The UCN facility will represent a major new fundamental symmetry and nuclear physics capability at TRIUMF."

We think that the UCN source is important for the overall strength of the TRIUMF 5YP. We have estimated that the UCN source would require relatively little in terms of funding for infrastructure from TRIUMF. Most of the funds are expected from a combination of Japanese sources and from CFI.

Therefore, we hope that it is clearly understood that the engineering design of the UCN source will be pursued with all possible vigour. Since none of the proposals are funded, as yet, it is important to make all the proposals positive and realistic, to ensure the best possible chance of their being funded.

The project was recently positively reviewed by the TRIUMF SEEC. Specifically we were encouraged to improve upon the proposal document submitted to the SEEC for the TRIUMF 5YP document.

6 Particle Physics

Particle physicists use TRIUMF for a number of reasons. TRIUMF has personnel and facilities (designers, engineers, technicians, clean rooms) suitable for designing and building large detectors for particle physics experiments. TRIUMF also has an accelerator division whose expertise can be used to help Canada make important contributions, both intellectual and concrete, to international accelerator projects. A small, but growing, part of the TRIUMF Theory division is interested in particle physics.

6.1 Accelerators – offsite

At the meeting [4] on Terascale detectors held at TRIUMF in August 2007, in the context of the Subatomic Physics long-range plan,a short document [5] was produced summarizing the priorities of the Particle Physics community in Canada for the High Energy Frontier, in the future. TRIUMF's priorities as expressed in the Director's Vision Statement [1] and the PPAC Report [3] are clearly in line with the priorities expressed in that document: "as there is no clear indication what form the new physics will take, our plan for 2010-2015 is to continue to move forward on both the sLHC 'discovery machine' and the ILC 'precision measurement machine', as these two approaches are complementary in their physics reach. Subsequently, when first discovery data becomes available from the LHC, we will re-evaluate the optimal future programme, along with the rest of the worldwide particle physics community" [5]. It is important that the Plan emphasize the scale, both financial and in terms of personnel, of TRIUMF's participation in ILC and sLHC research and development, and demonstrate that our actual commitment is within our means. We share the concerns expressed in the report from the Director's Kitchen Cabinet [6] about the effect of large funding cuts in other countries such as the US and UK on the ILC schedule; however, we feel that since the ILC represents the long-term future, it is vitally important that we invest there. It is to be hoped that early LHC results will show us more clearly what physics to expect at an ILC, and that international plans and schedules will solidify at that point.

6.2 Accelerators – onsite

There is considerable enthusiasm for the eLinac project; it is felt that this will strengthen ties with the particle physics community. The fundamental reasons for building the eLinac at TRIUMF need to be explained better; presumably this is best done by emphasizing the benefits for ISAC? From the particle physics perspective, we need to understand to what extent work on the eLinac represents real synergies with development for an ILC. The scale and financial implications of the eLinac project are not sufficiently clear from the documentation circulated.

6.3 Onsite experiments

The fundamental symmetries program is seen as a good way for TRIUMF to keep a site-based experimental particle physics program. This strengthens ties between TRIUMF experiments and the particle physics theory community.

6.4 Infrastructure for offsite experiments

It is important to emphasize the infrastructure role played by TRIUMF in the construction of detectors for particle physics in Canada. We agree with the very high priority for the agship ATLAS program, and that funding the Tier 1 centre at TRIUMF is critical to Canada's success in ATLAS. The ATLAS Western Regional Analysis Centre concept needs to be eshed out more in order for its benefits to be clear, but there is widespread support for the idea that TRIUMF should provide this type of support for all ATLAS-Canada member institutions. There was a feeling that the commitment to assist in detector development for SNOLAB was an important one, both for strengthening ties to the user community in Canada and for reinforcing TRIUMF's role as Canada's National Laboratory for particle physics; however, it was felt by some that the actual proposal looked weak and poorly defined. In particular, there was concern that very few TRIUMF scientists (or other local, Vancouver-based scientists) actively participate in SNOLAB detector development. The PPAC document is not specific about which SNOLAB experiments TRIUMF should get involved in; there needs to be more communication between SNOLAB and TRIUMF. In order to allow TRIUMF to participate in SNOLAB and other detector development projects, we wholeheartedly concur in the PPAC's recommendation that LADD must become a community resource. That is, it must be adapted to meet the needs and priorities of the community by the implementation of a transparent process to give all Canadian nuclear and particle physicists access to LADD resources and and a say in the determination of LADD priorities. It is vital that TRIUMF be able to respond to the infrastructure needs of the particle physics community, and that resources be allocated in line with the priorities of the whole community: ATLAS upgrades for the sLHC, T2K upgrades, ILC detector development, SNOLAB detector development, medical physics detector development. There is still a place for so-called "curiosity-driven" detector research: clearly it is important to do fundamental research in detector technologies, but the "curiosity" should be aligned with the general interests of the community at large. As one reviewer said "I like the idea of Curiosity-Driven Detector Research projects, but I am not quite sure what it means in the real world." There was also a feeling that our commitment to detector development for the ILC should be proportional to our accelerator commitment to the ILC and ILC-related aspects of the eLinac, much as TRIUMF's contributions to the LHC allowed Canada to "buy-in" to the physics opportunities presented by ATLAS. In terms of the language to be used, we agree that "searching for, and understanding, the origin of mass" is one of the highest priorities in particle physics, but feel that the goals of ATLAS are broader: ATLAS was conceived to understand the nature of fundamental particles and forces, their underlying symmetries, and the symmetry-breaking mechanisms that give rise to the astonishing universe we inhabit. As stated in the NSERC Long-Range Planning Committee's report [7], we recommend that a broad program of efforts be maintained to provide breadth and diversity to the Canadian subatomic physics community, and to allow for novel and emerging initiatives.

6.5 Ultra-cold Neutrons

There was a feeling that this very large project would need to be much more completely defended before it could be defended. Established UC neutron centres have taken many years to understand their systematic errors, and it needs to be clearly shown that TRIUMF can become competitive in a short time. If there is a strong advantage in running at an accelerator rather than a reactor, this should be stressed.

6.6 Simulation

TRIUMF has acquired some expertise in GEANT4 simulations. This represents a small investment, and there was a strong feeling from several people that this should not be abandoned; however, there was also a general impression that the simulation effort should be better connected to the detector development that is going on at TRIUMF and elsewhere in Canada.

6.7 Theory

The particle physics community greatly appreciates that TRIUMF has just hired another particle phenomenologist, and is actively hosting workshops on topics of interest to particle physicists. We would like to applaud and encourage this synergy between the largest experimental user community and the TRIUMF theory division. Summary There was a general concern about the proliferation of CFI proposals (and proposals to other funding agencies) associated with most of the projects; as we are not peer-reviewed by a single body for projects, personnel and infrastructure support, there are obvious strains on TRIUMF human resources, space and technical expertise. Finally, we wish to remind the Five-Year Plan Steering Committee that TRIUMF is often the critical mass that makes a project or an experiment a success. Furthermore, with more young scientists at universities across Canada focusing primarily on data analysis, it is becoming increasingly important that our National Laboratory for Nuclear and Particle Physics lead the way for the development of the next generation of instrumentation.

References

[1] http://admin.triumf.ca/facility/5yp/PPAC/Directors-Vision-V3.pdf
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[2] http://admin.triumf.ca/facility/5yp/PPAC/PPAC-Tarball-V2.pdf
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[3] http://admin.triumf.ca/facility/5yp/PPAC/ColinGay-PPAC-15-Mar-2008.pdf
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[4] https://indico.triumf.ca/conferenceDisplay.py?confId=618
Terascale Detector Development at TRIUMF, TRIUMF, Vancouver, August 1-2, 2007.

[5] https://indico.triumf.ca/materialDisplay.py?materialId=0&confId=618
One-page Summary of the Terascale Detector Meeting.

[6] http://admin.triumf.ca/facility/5yp/DKC_ResponseToPPACReport-1-1.pdf
Director's Kitchen Cabinet response to the PPAC Report.

[7] http://www.subatomicphysics.ca/documents/Sub_Bro_Eng.pdf
Perspectives on Subatomic Physics in Canada 2006-2016. Report of the NSERC Long-Range Planning Committee.

7 CMMS

The users of TRIUMF's Centre for Materials and Molecular Science (CMMS) is broadly supportive of the 5YP concepts that have been presented and refined by PPAC.

In particular, PPAC's recommendation that "a significant increase in number of TRIUMF-supported personnel and operating resources is essential" was very warmly received.

There are significant concerns that:

1) The 5YP clearly recognize the multidisciplinarity (including condensed matter as well as chemistry components) of the CMMS community, and that doing do will strengthen the 5YP.

2) TRIUMF should take into consideration that the CFI funded muon beamline expansion will be in its midst at the start of this 5YP, i.e. in order to complete M20 project, it is expected that significant personnel will be required in 2010/2011. This may have implications for the detailed implementation of the 5YP.

3) Concerns that other demands on the cyclotron (ISAC, Sr-90 production, proposed ultracold neutrons) should not have a negative impact on the CMMS' ability to provide high intensity beams of surface and high momentum (backward) muons (the latter at M9).

4) muSR depends on BL1A, and that maintaining that beamline, improving production targets and addressing concrete issues on the floor are an important part of supporting the CMMS facility.

Additional concerns include:

- It is imperative that M9B also be maintained during M9A installation, insofar as that is feasible. Some users are concerned with the perennial problems with M9B and the solenoid which often does not receive proper attention (maintenance) prior to beam time.

- There was concern among CMMS users regarding the UCN proposal. In particular, users are against any proposal that wipes out M13, a very good surface muon beamline, that was used very productively by CMMS for muSR from 1987-1998. If the proposed UCN source is located in the M11/M13 real estate, it will also potentially have a very negative effect on the downstream users (i.e. CMMS). These concerned users would also like to point out the PPAC recommendation that a careful study be carried out so that UCN does not negatively affect the CMMS facility.

- A factor limiting the growth and development of the CMMS user facility continues to be the expense for off-site users, i.e. travel, accommodation, user and Helium fees. The users note that comparable competitive facilities such as PSI present much lower costs to users hard-won research funding. We encourage TRIUMF to consider how it can reduce the costs, particularly for new users, so as to continue to broaden the community, as well as to continue to draw distant users from Europe and Japan.

- The CMMS relies on cryogenic liquid helium for superconducting magnets and cryogeny of experimental samples. With the ongoing worldwide Helium shortage, and consequent extreme inflation in price, the CMMS considers the helium liquifier and recycling proposal as an absolutely crucial part of the 5YP.

8 General Feedback

In addition to the collaborative responses above, TUEC received comments from individual users. The nature of these contributions indicates that there must be a transparent and peer-reviewed process for providing infrastructure support for offsite experiments. The comments are provided verbatim, but for the removal of names where appropriate.

8.1 Letter A

Dear TUEC,

I wish to reiterate the importance of supporting the "smaller projects" category in the upcoming TRIUMF 5 Year Plan. Clearly, the existence of the laboratory depends on large flagship projects, but I believe that it is the scientific diversity of the program that makes the laboratory worthy of its existence as an academic institution. While it is tempting, and perhaps politically smart in the short term to cut back on smaller projects to focus on a few large ones, we must resist this temptation for the long term health of the laboratory. To this end, recall that the "breadth" is one of the highest priority items in the NSERC Subatomic Long Range Plan. We should also recall in the world-wide scene, while laboratories with interdisciplinary themes such as JPARC and GSI are flourishing on one hand, single-purpose laboratories are often suffering from cut backs these days on the other hand.

Smaller and/or interdisciplinary projects are generally disadvantaged in the community discussion processes because of the lack of an appropriate lobbying base. To this end, I am somewhat disappointed that the excellent work done by Des Ramsey for a TUG Report last year, making the case for infrastructure support for smaller off-site projects, has not received the attention it deserves. It is not appropriate to combine these projects with very large off-site particle physics projects such as LHC and ILC, as was done in PPAC. It is the job of the TUEC to represent the under-represented, to bring all the voices to the floor.

We must remember that society at large, for its long-term benefits, sets aside a part of its resources to do curiosity-driven purely basic research. This, despite the fact there are many pressing issues in modern society that require immediate attentions, be it global epidemics, social injustice or the environment. By the same token, smaller TRIUMF related projects, if the impact is high compared to the required resources (as often is the case at TRIUMF)), should not be eliminated in the hope of short-term gain. I ask TUEC to press for the support of smaller high impact projects.

8.2 Letter B

I agree with 8.1. Support of smaller offsite projects such as I am involved in at JLab have produced a return in terms of science and international reputation for TRIUMF that is large compared to the modest investment.

8.3 Letter C

I strongly agree with 8.1 that the PPAC ranking system is very flawed. I believe that TRIUMF must continue to provide a balance between a strong in-house program and support for off-site Canadian particle physics. This off-site SAP infrastructure suppory should NOT be restricted to just LARGE Projects.

I hope that TUEC will present our point of view that "small or medium sized projects" should not be forgotten.

8.4 Letter D

I'd like to support 8.1's sentiments. In the past, up through the current 5-year plan, TRIUMF has strongly supported intermediate size projects of high quality (consistent with generous NSERC support). These have provided some of the most widely recognized scientific and technical achievements of the laboratory. The rare decay program, for instance, has enjoyed success due to this support and, in turn, generated important resources for TRIUMF such as LADD. The PPAC, in its recommendations, however, did not find an appropriate balance that appreciated the importance of such programs to TRIUMF and to science.

When I inquired about the scientific or technical reasons for the low rating of the rare decay program, in particular, which has strong support at CERN, Fermilab, JPARC and PSI, the chair responded only that some members thought it was too large for only a single university professor, neglecting the contributions of the four associated TRIUMF scientists. TUEC should certainly object to such reasoning which appears to place TRIUMF scientists in a lower class and to the apparent lack of scientific rigor in the PPAC analysis and procedures which do not appear to have promoted impartial conclusions.

8.5 Letter E

I'd like to support 8.1's arguments on the small scale experiments. Some of those projects have shorter time scales, and a transition to a next project happens within the 5-year plan (like PIENU to RARE DECAY). The number of people involved is always much less than that of large scale experiments. This nature of small projects was completely ignored in the PPAC process. For example, as 8.4 pointed out, the PPAC unfairly gave the lowest rate to the rare decay program because of "the lack of the interests" of the community, omitting four TRIUMF researchers in the interest counting. I am certain that the rest of the small scale experiments were rated, regardless their physics, in a similar way. However, if you add the interests of all small scale experiments (like "the ISAC project"), it should be above the critical mass to receive much higher rates. Physics does not need to be added though, since strong physics cases are presented in the reviews at other laboratories, such as at CERN, Fermilab, JPARC and PSI.

In the process of drafting the current 5-year plan, I'd like TUEC to consider the small scale experiments as one whole project (like the ISAC project) that brings in flexibility and diversity to TRIUMF, key elements for a healthy laboratory.