TRIUMF

CANADA'S NATIONAL LABORATORY FOR PARTICLE AND NUCLEAR PHYSICS

Owned and operated as a joint venture by a consortium of Canadian universities via a contribution through the National Research Council Canada

A Vision for TRIUMF 2010-2015

LABORATOIRE NATIONAL CANADIEN POUR LA RECHERCHE EN PHYSIQUE NUCLÉAIRE ET EN PHYSIQUE DES PARTICULES

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Welcome to TRIUMF

- Thank you for agreeing to serve on "Special EEC"
- Thank you for your hard work in advance
- Thank you Bob Tribble for accepting role as Chair
- Thank you to the 5-year planning committee
  - Special thanks to Tim Meyer, Byron Jennings, and Rob McPherson for leading this effort
- Thank you proponents for documentation
- Thank you Jean-Michel for putting review together

Vision

- Goal of 5-year plan -- take TRIUMF ISAC to next-Level
- Unique moment to seize scientific discovery opportunity
  - Study of neutron-rich nuclei important for element abundances, supernova explosion neutron density models, neutron star crusts, theory advances, 3-nucleon interactions..
  - Great opportunity in fundamental symmetries (one of holy grails in nuclear physics)
  - TRIUMF has strong fleet of experiments & eager young researchers
  - Large international user base wanting and waiting for varied beams
  - ISOL target & ion source expertise has grown & is ready to advance
  - accelerator team strong
- Canada: Opportunity to lead on world nuclear physics stage

Strategic Goals (1)

- Focus resources to lead in answering the most exciting and important questions in particle & nuclear physics, nuclear medicine & material sciences
- Establish TRIUMF as Canada's steward for advanced superconducting accelerator technology
- Expand TRIUMF's global presence through enhanced "two-way" partnerships with major international laboratories
- Increase TRIUMF's social and economic impact

Input thus Far

- PPAC has completed its first task (15 universities)
  - Strong endorsement of major thrusts of program
  - Suggestions for prioritization
- Director's Kitchen cabinet – TRIUMF staff weigh in
  - Support PPAC statement that prioritization balanced
  - Supports balance of inside & outside programs
  - Support of accelerator steward emphasis
  - Main concern is demand for increase in human resources
  - Needs provincial support for tunnel & buildings
  - Suggests detailed resource be evaluated soon

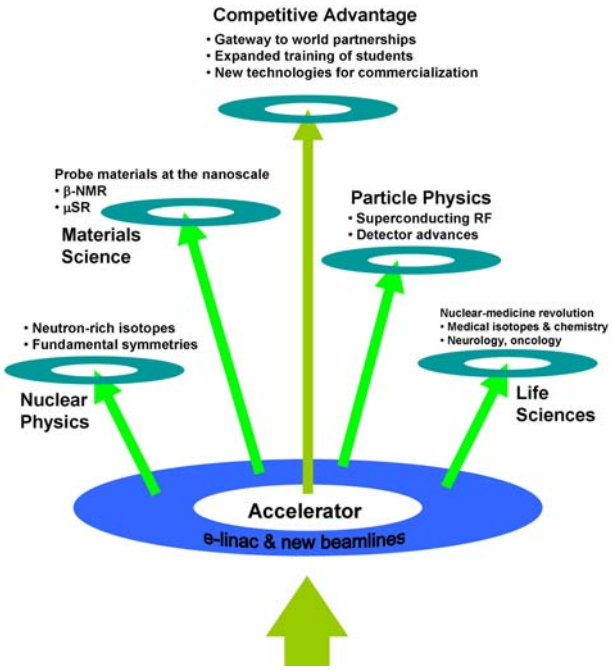
Guidance to SEEC

- We are primarily interested in your view of the excellence of the science we propose to accomplish with this plan
- Is there a potential Nobel Prize in this mix?
- How unique is this science program?
- How coherent is program?
- Is it too ambitious? Not ambitious enough?
- What are your concerns?
- Your input will be made available to subsequent reviews especially ACOT

Considerations

- TRIUMF is not getting out as much science as hoped for
  - Experiments excellent but lacking varied beams wanted by researchers
- TRIUMF scientific success tied to multiple beam delivery
  - need at least 2 beams (actinides to low energy area for fundamental symmetries & 1 beam to medium or high energy areas)
  - eventually 3 simultaneous independent beams delivered > 2015
  - 3 phases:
    - new beam line (1 new actinide target 10 μamp)
    - one new target development module
    - e-linac
    - next 5-year plan new front end for acceleration -→ 3 independent beams
  - Designing beam line for 200 μamps for high power target development

- Opportunity with Ultra-Cold Neutrons
  - Investment by TRIUMF (NRC) is modest
  - Expect strong investment from Japan
  - Expect Canadian Foundation for Innovation proposal successful
  - Start with gravity (Japanese led) lifetime (US led) and move toward EDM later



TRIUMF Statistics

- ~500 scientists and staff on campus
- ~90 (50+40) staff MDS Nordion
- 50+ international agreements/partnerships
- ~1000 users (large fraction non-Canadian)
- ~2000 visitors per year (many school kids)

- Particle physics (mostly “offshore”)
- Nuclear physics (rare isotope program)
- Life Sciences (MDS Nordion, PPRC, BCCA)
- Material Sciences (μSR, β-NMR)

Building on Success

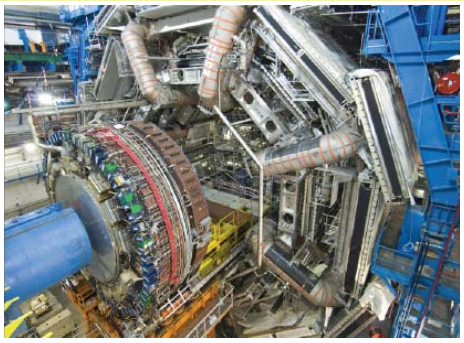
- Particle Physics
  - ATLAS Canada
    - Accelerator contributions commissioned
    - Detector ready to take data
    - Largest academic computer in Canada by 2011
    - Largest amount of data stored by 2011
    - Western Regional Analysis Centre
  - T2K neutrinos
    - Premier accelerator neutrino experiment in world
    - Canada builds 2/3 of near detector

ATLAS Canada

TRIUMF design

built at

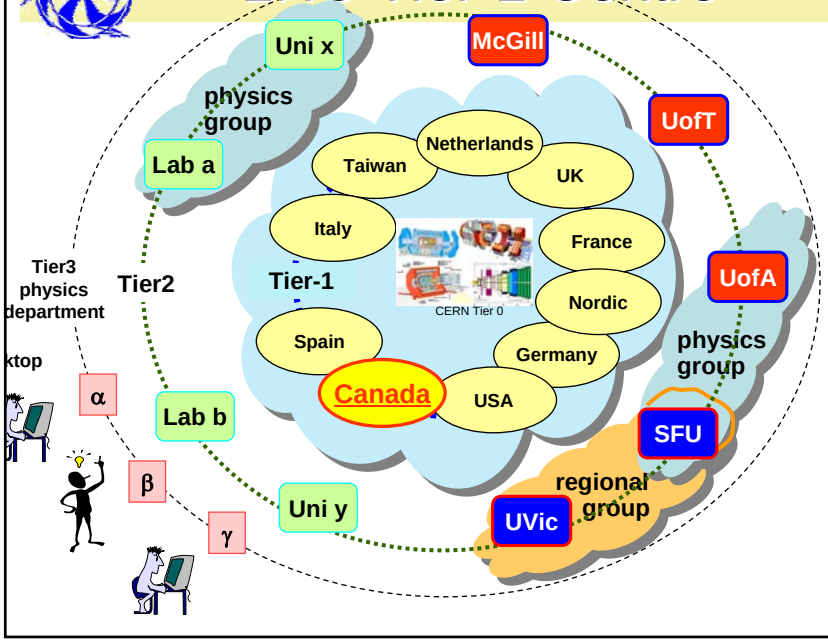
Alstom Tracy Quebec



Hadronic Encap &
Forward Calorimeter

Total Investment by Canada ~$100M

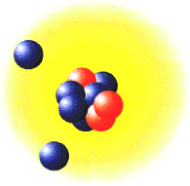
LHC Tier-1 Centre



les.robertson@cern.ch

Building on Success

- Rare Isotope Beam (RIB) Program
  - Highest power ISOL facility in world
  - Most intense beams of certain species in world
  - A dozen world class experiments on floor
  - Leading proton rich nuclear astrophysics
  - TRIUMF leads world in ^{11}Li halo nucleus studies



^{11}Li halo nucleus (workshop planned)

Building on Success

- Life Science Program
  - World leading Pacific Parkinson's Research Centre (PPRC)
    - Placebo effect
    - Trauma
  - Core competences:
    - Imaging
    - Radiochemistry (18F, 11C….)
    - Target development techniques

Building on Success

- Material Science
  - Muon spin relaxation (μSr)
    - World recognized research in warm superconductors
    - Hydrogen storage research
    - Presently undergoing major upgrades of beam lines++
  - β-NMR
    - Studies interfaces at 4 nm longitudinal resolution
    - Basic research of material boundaries
    - Unique facility in world

Building on Success

- Technology Transfer
  - a model program for the world
    - Produce 2.5 million patient doses of medical isotopes per year
  - MDS Nordion (Synergy award 2003)
  - D-PACE (Synergy award 2007)
  - TRIUMF designed cyclotrons worldwide
  - AAPS (only physical science winner in competition)

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Future Plans for TRIUMF

20,000 metres

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Three Major New Initiatives

- Neutron rich RIBs from photo-fission of actinides
  - Nuclear astrophysics and structure
  - Expansion of beta-NMR running
- Radon and Francium Program from actinides
  - Fundamental symmetries stringent probes of physics BSM
  - Nuclear astrophysics and structure
- Nuclear Medicine
  - Strong Parkinson's Program is essential
  - Radiotracer development in national CFI
  - Expand into cancer imaging and therapy
  - Commence initiative with MDS Nordion

Three New Smaller Initiatives

- Terascale Physics
  - LHC upgrades SPL & PS2 & detector R&D Large investment awaits physics (intensity or energy upgrade)
  - Tier-1 Centre Expands
  - ILC R&D Large investment awaits LHC physics discoveries
- Ultra Cold Neutron facility
  - Gravity (level spacing in earths g-field), lifetime (Vud), EDM
- SNOlab experiment support

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Future of ISAC (III)

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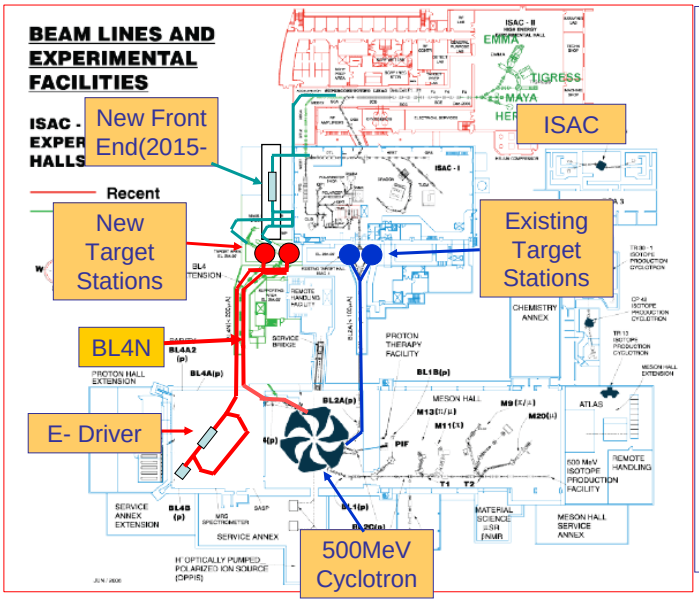
e-linac & New Beam-line

- One electron and one proton beam-line in a common tunnel using new common target technology
- Proton Physics Case: Fundamental symmetries (unique in world)
- e-linac Physics case: r-process and neutron rich structure studies
- New actinide target modules need to be designed –
- DTL & RFQ --(this is being pushed into next 5-year plan)
- e-linac design

- Longer term goal is three separate simultaneous beam-lines to ISAC
  - Nuclear Astrophysics (Neutron rich r-process, proton rich rp-process), and fundamental symmetries
  - Allow beta-NMR to triple in running time
  - Opportunity for new radio-tracer development with actinides
  - Strengthen theory commensurate with success level

TRIUMF: ISAC Five Year Plan



Proposal:

•BL4N is proposed to deliver 500MeV protons to two target stations for beam production and an additional RIB station for development

•Take advantage of the shielded and unused proton hall to add an electron driver to supply electrons to the new target area via a separate beamline;

•Develop new ISAC front end to permit three simultaneous RIB beams (two accelerated).

Motivation for e-linac Photo-fission Driver

- High yield of limited number of neutron rich species but lower isobar contamination
- Very few unwanted isotopes produced hence “safer” in our neighbourhood and so we can put full power on target unlike protons on actinides
- New driver hones skills of accelerator division on a new technology thus opening future windows of discovery
  - Development of SRF core competence
    - Canadian industry (1 of 4 in North America)
- Neutron rich rare isotopes niche region complements proton rich rare isotope program
- Expansion of β-NMR essential for unique Canadian facility
- TRIUMF & VECC India will co-build-connects TRIUMF to ASIA
- Explore novel medical isotope production
- Building two-way collaboration with CERN on SPL
  - TRIUMF may pursue low beta cavity design and construction
  - “Possible” Eurisol facility may be the “HPSPL”
  - High powered target collaboration establishing with CERN at TRIUMF
- Compact x-ray Light Source (backscattered Compton) with Canadian Light Source
  - Industry interest
- 4^{th} generation light source technology
- ILC technology

- TRIUMF is a member TESLA Technology Collaboration (connect to world)

Investment in 5-year plan results in

- Breakthrough science discoveries
- Established leadership in RIB nuclear physics

- Canada amongst the global leaders able to use accelerators to bridge hi-tech interdisciplinary programs in materials research, molecular imaging, and new cancer therapy techniques.
- The benefits to present and future Canadian society will be well worth the investment.

Proposed Advanced Technology and Molecular Imaging Bldg

Includes Tunnel for New Beam Lines

BC Province support is essential for success

Thank you

4004 Wesbrook Mall
Vancouver, B.C. Canada V6T 2A3
Tel: 604 222-1047 Fax: 604 222-1074
www.triumf.ca