TRIUMF Plans for 2010-2015

Canada's National Laboratory for Particle and Nuclear Physics

e-RIBS Workshop

October 10th, 2007

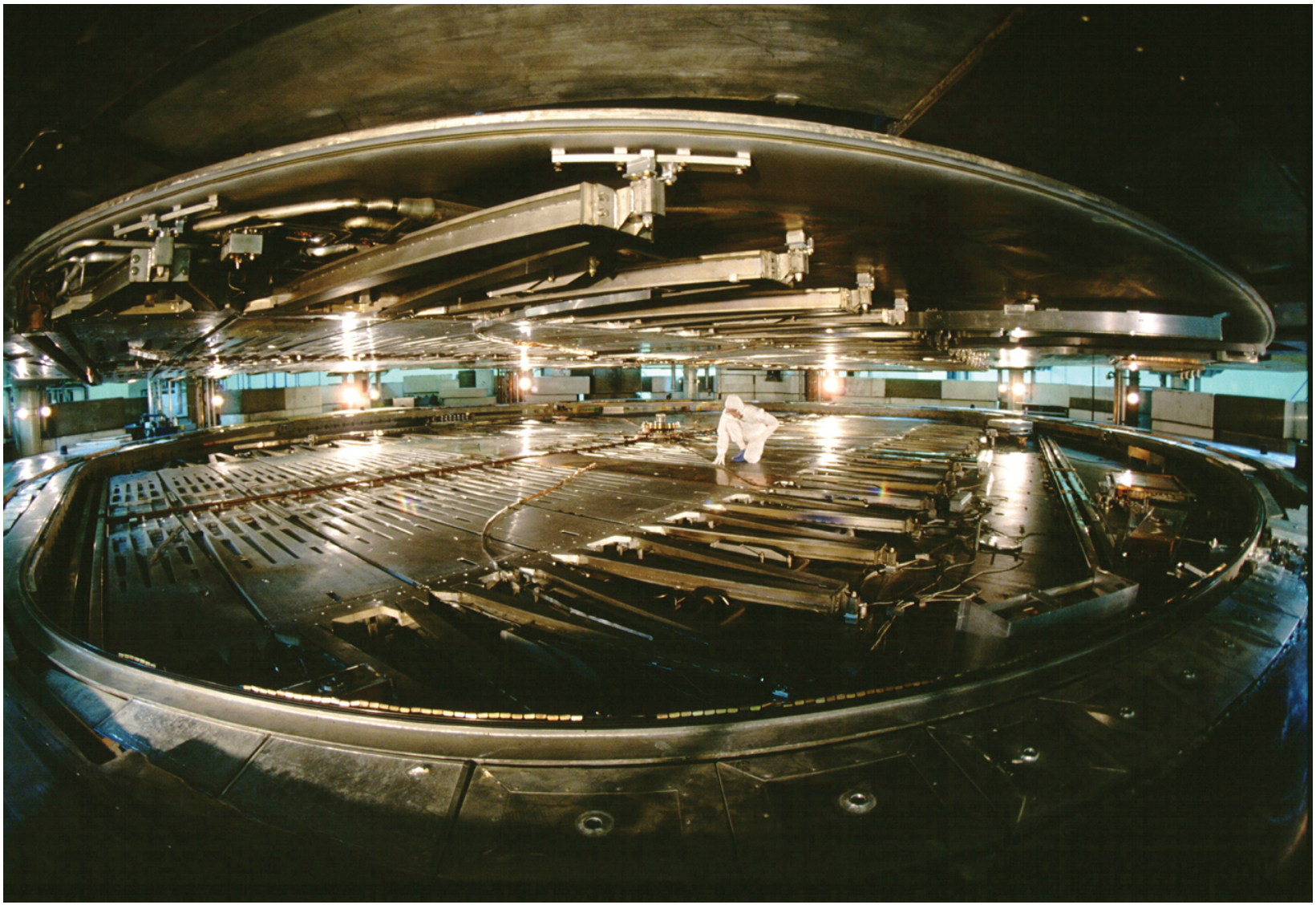
Nigel Lockyer TRIUMF

Members:
Univ. of Victoria
Univ. of BC
Simon Fraser Univ.
Univ. of Alberta
Univ. of Toronto
Carleton Univ.
Univ. de Montreal

Associate Members:
Univ. of Regina
Univ. of Manitoba
Univ. of Guelph
McMaster Univ.
Queen's Univ.
St. Mary's Univ.

Owned and Operated by a Consortium of Universities

World's Largest Cyclotron at TRIUMF



Superconducting RF Heavy Ion Linac

TRIUMF Statistics

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

- Particle physics (mostly “offshore”) 40%
- Nuclear physics (rare isotope program) 40%
- Life Sciences (Nordion, PET & PPRC) 10%
- Material Sciences (muSR, beta-NMR) 10%

Canadian Long Range Plan Priorities (NSERC)

- Full exploitation of LHC physics potential
- Completion and full exploitation of ISAC for nuclear physics and nuclear astrophysics
- Completion of SNOlab and build experiments
- Participation in long-baseline neutrino oscillation experiments
- R&D for ILC and participate in international deliberations on timing and location
- TRIUMF is fully aligned with these priorities

Strategic Goals (1)

- Focus resources to lead in answering the most exciting questions in particle and nuclear physics
- 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

Strategic Goals (2)

- Position TRIUMF to capitalize on the most compelling scientific opportunities
  - Explore neutron-rich nuclei & probe fundamental symmetries (e- linac & actinides & UCN)
  - LHC discoveries (Western Regional Analysis Centre) & T2K neutrino oscillations
  - Launch decadal initiative in the life sciences, playing to TRIUMF strengths
    - Expand program into Cancer and Tagging of Large Molecules
  - Fully participate in underground science experiments at SNOlab

- Establish TRIUMF as Canada's steward of advanced accelerator technology
  - Develop infrastructure to design & build 1-MW class SRF e- linac
  - Expand beta-NMR program—a unique facility
  - Maintain option of 4th generation light source in Canada

- Expand Canada's global presence through enhanced partnerships among TRIUMF, CERN, and other world laboratories in USA, Europe, and Asia
  - Establish major SRF machine collaborations (e- linac)
    - CERN
    - ILC and its Global Design Effort
  - Maintain pre-eminence in IT, GRID computing
  - Use world-leading detector S&T expertise at experiments around the world

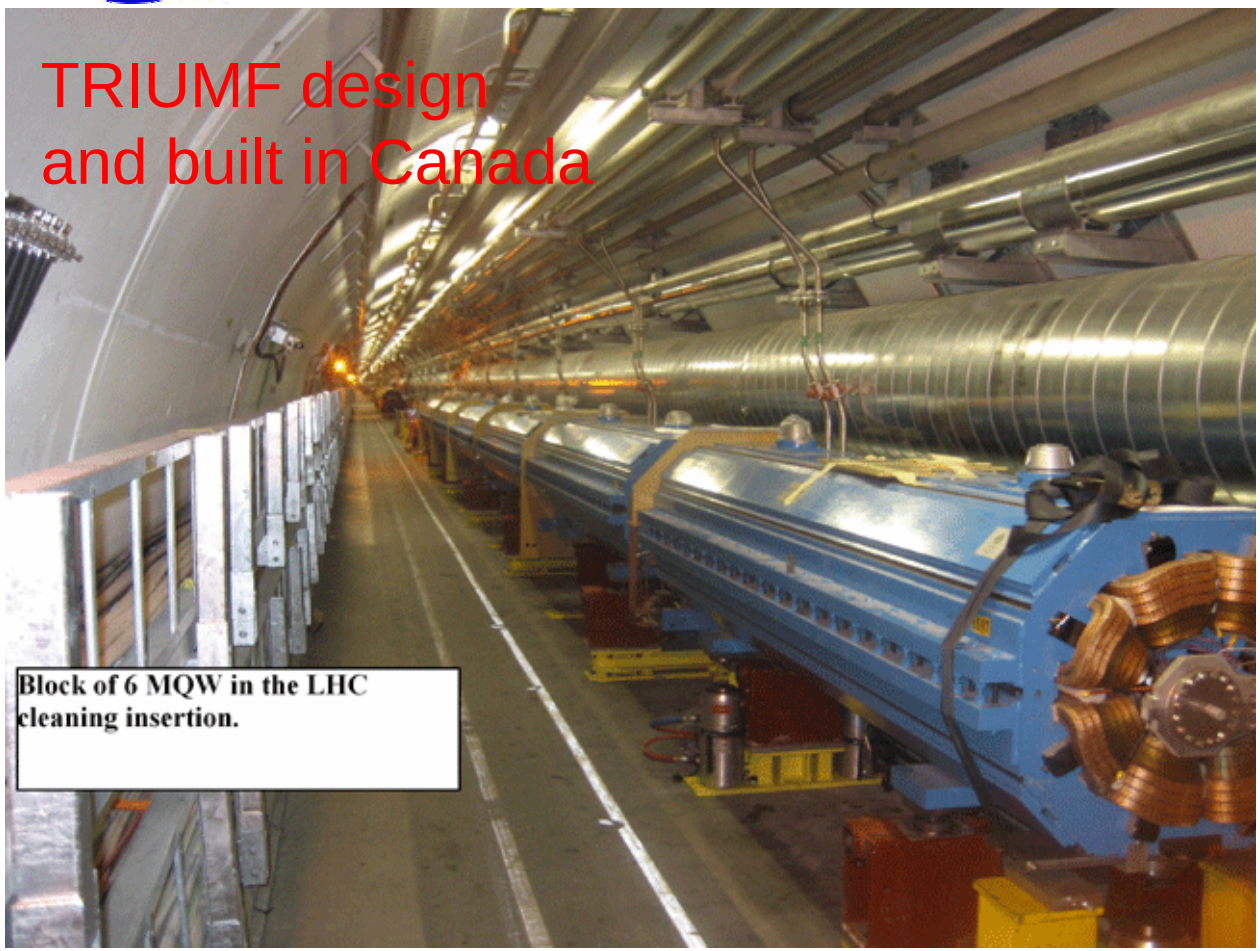
Particle Physics Accelerator Collaborations

– CERN: In 1995, TRIUMF assumed responsibility for co-ordinating Canada's contribution to the construction of the LHC.

- PS
  - Fast blade scanner
  - Kicker upgrade
  - Tuners and HOM dampers for 40MHz and 80MHz cavities
- LHC
  - Injection kickers
  - Twin aperture clean-up quadrupoles
  - Beam dynamics – Optimization of beam optics and collimator placement

– T2K J-PARC target area-remote handling

LHC/ATLAS



Total Investment by Canada ~$100M

Advancing Accelerator Technology

- SRF: Technology of choice for New Projects
  - Radioactive beam expansion → New electron accelerator
  - International Linear Collider (ILC) (world design underway)
  - SPL (MW Class 4 GeV LINAC at CERN for LHC injector, EurISOL, neutrinos, beta-beams, neutrons
  - Most promising for commercialization
  - 4th generation light source

ILC Plans

- TRIUMF has signed an umbrella MOU with Fermilab for ILC (draft MOU with DESY)
- Addendum being prepared
  - Make three single-cell cavities 1.3 GHz using multi-grain niobium (electro-polish elsewhere)
  - Move towards single crystal large grain version which only needs BCP
- Produce a 9-cell cavity and qualify PAVAC as an ILC vendor for North America
- Host FALC Meeting January 17th, 2008

Remove experimental backlog at ISAC

Expand ISAC science to include fundamental symmetries

Participate with world leaders in r-process research

Participate in ILC

Participate in LHC Accelerator Upgrades

Expand material science beta-NMR

Develop new radio tracer isotopes

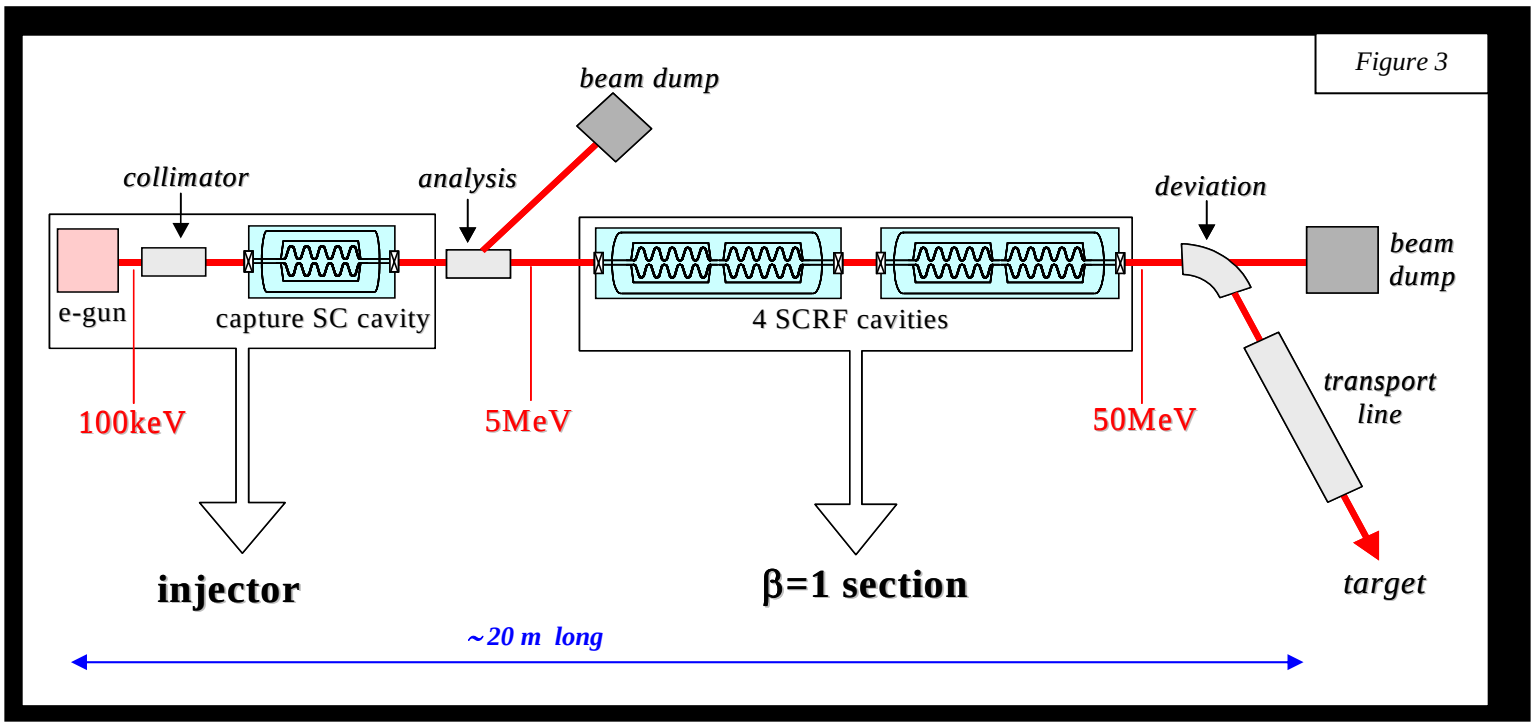
Superconducting Electron Linear Accelerator

Cost effective

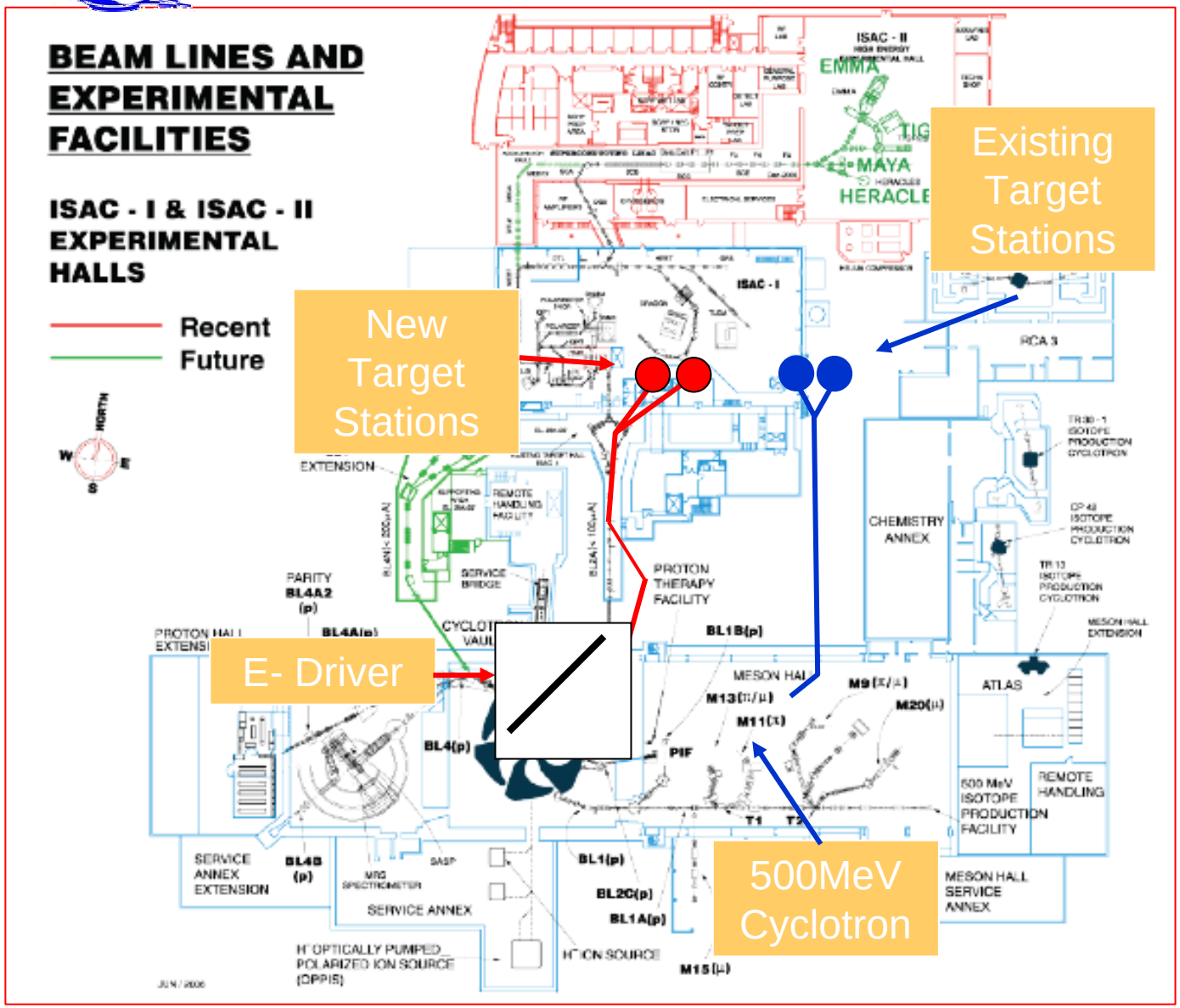
World-wide effort developing SRF technology

Proposing SRF Electron Driver

- TRIUMF is planning to build a new electron linac driver (50-60MeV)
- Photo-fission leads to “very” neutron rich nuclei
- Nuclear structure & astrophysics, beta-NMR



1 MW Class SRF Electron Driver and Photo-fission



Proposal:
A new electron accelerator produces 50 MeV electrons
Electrons impinge on converter and photos are generated
Photons hit target and photo-fission occures
New, very exotic, neutron rich isotopes are produced
Isotopes are delivered to existing state-of-the-art ISAC complex and experimenal facilities

PAVAC: Commercial Partners

PAVAC

Who is PAVAC?

- A Canadian Company located in Richmond B.C.

The LASTRON technology services and systems offered for

- Electron Beam Welding
- Pulsed Electron Beam Drilling and Surface-Micro Machining
- Pulsed Electron Beam Coating (PEB-PVD)
- Rapid Manufacturing (RM)
- Electron Beam Flue Gas Cleaning (EBFGT)

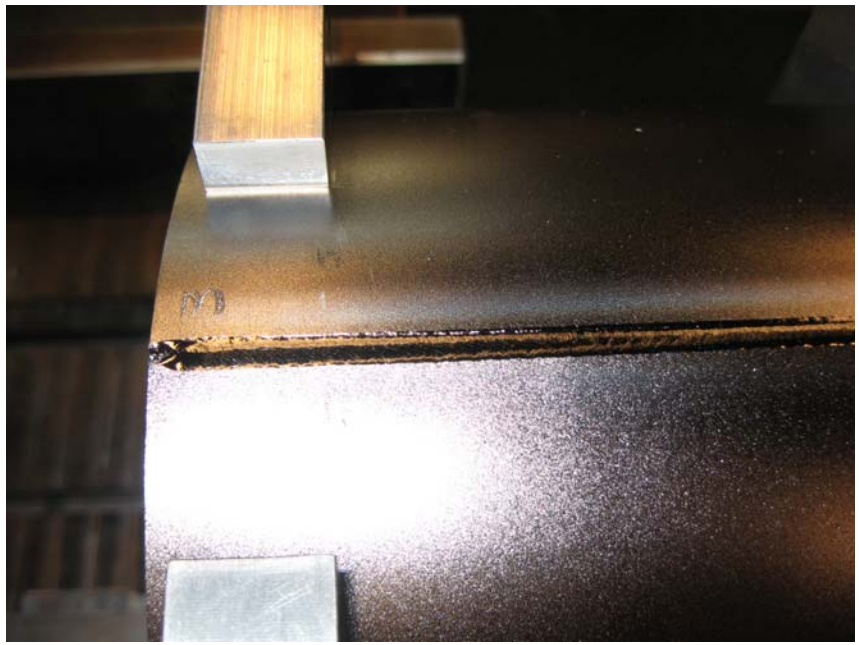
Our new 10,000 + square feet facility at:
12371 Horseshoe Way
Richmond, B.C., V7A 4X6

Prototype Production

- First parts delivered Tuesday Aug. 21 – two outer conductors

Welds on Outer conductor

- Welds completed Friday Aug. 25 @ Pavac



SCRF Development: Infrastructure

Preparation Area

Boot Area

RF Meas

HPWR Rinse Clean Area

RF Controls Lab

SCRF Test Clean Area

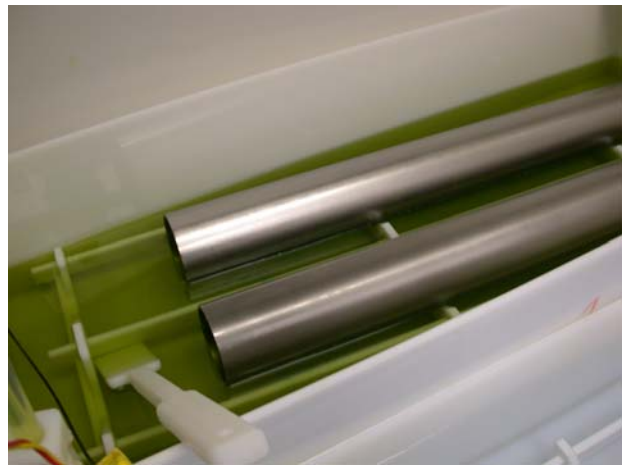
Test Pit

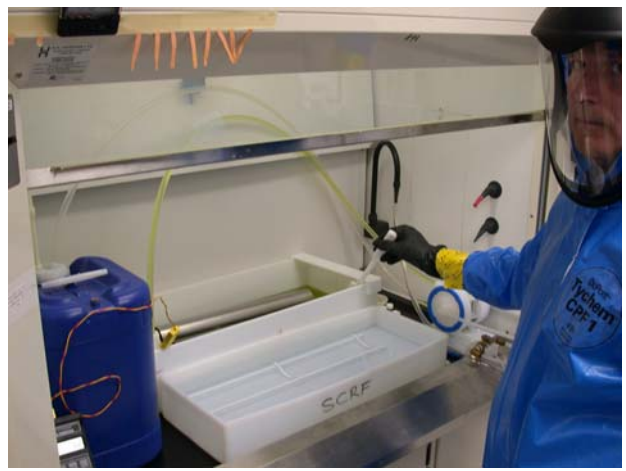
Clean Assembly Area

BCP Chemical Lab

Etching Inner conductors

•Sept. 10 – etched weld seam on inner conductors (20microns)





Highest TRIUMF Priority: E-linac & Two New Beam-lines

- One electron and one proton beam-line in a common tunnel using new common target technology
- Proton Physics Case: Fundamental symmetries (unique in world)
  - High profile physics
- E-linac Physics case: r-process and neutron rich structure studies
- New actinide target modules need to be designed -- mass separators and RFQ --- international design team forming
- E-linac design --- international team forming

- Goal is three separate beam-lines to ISAC
  - Nuclear Astrophysics (Neutron rich r-process, proton rich rp-process), and fundamental symmetries
  - Allow beta-NMR to triple
  - Opportunity for new radio-tracer development with actinides

Conclusions

- e-linac appears to be a competitive machine
- Need quantitative comparison vs protons
- Need quantitative assessment of reach in neutron number enrichment vs fragmen
- Need production numbers of 8Li from non-actinide targets for beta-NMR
- Need production rate of “medical” isotopes