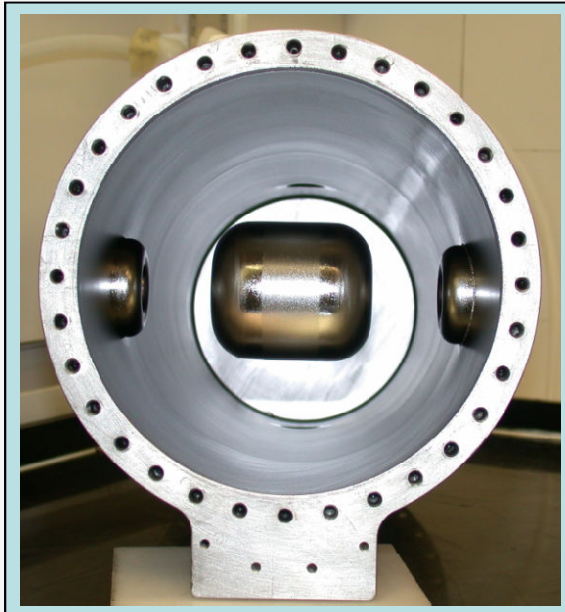




TRIUMF

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



Present

Beginning & Future

SRF Activities at TRIUMF & PAVAC

Nigel Lockyer
TRIUMF/UBC

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

Propriété d'un consortium d'universités canadiennes, géré en co-entreprise à partir d'une contribution administrée par le Conseil national de recherches Canada

Who is PAVAC?

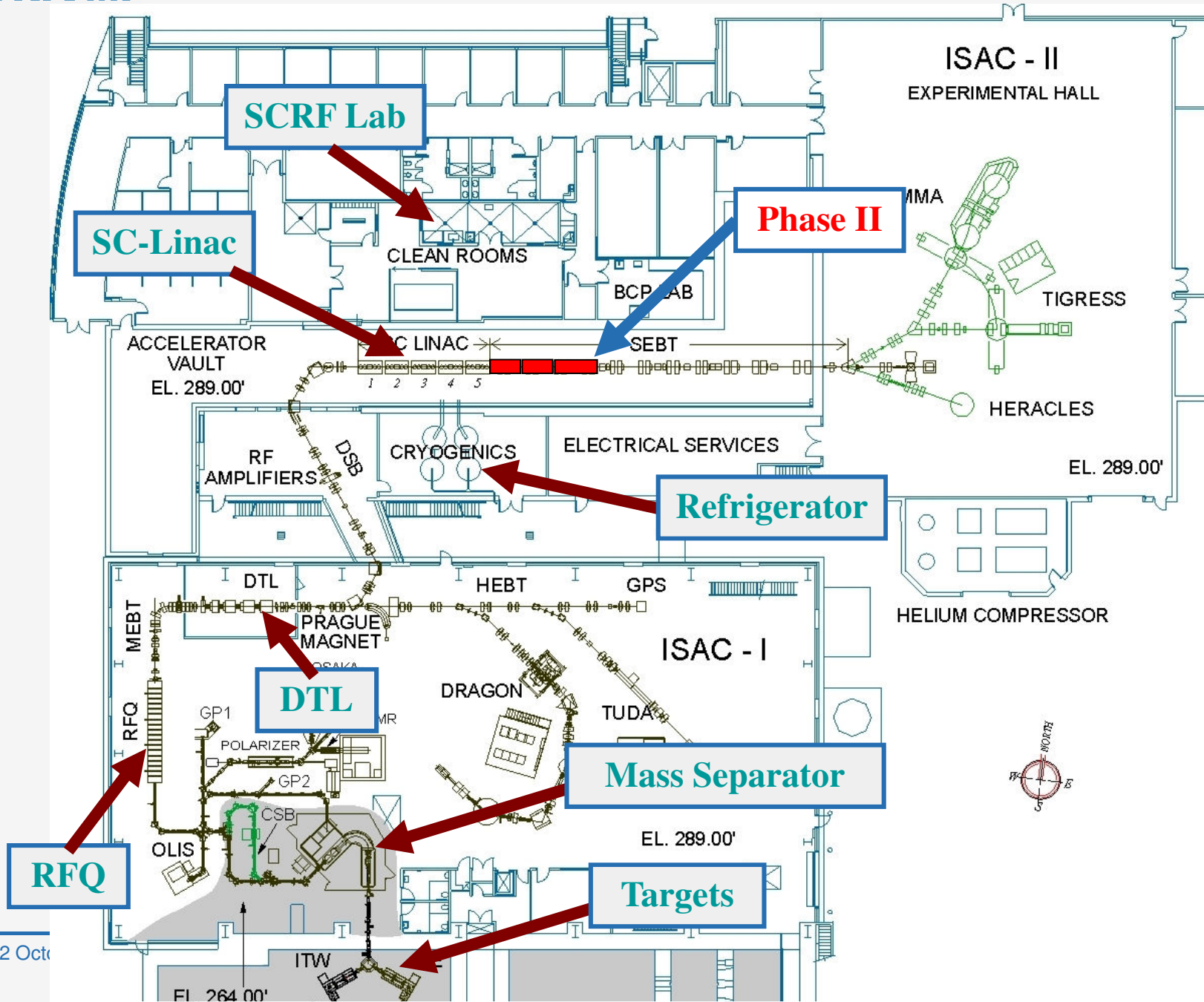
- A Canadian Company located in Richmond B.C.

Products and services in:

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

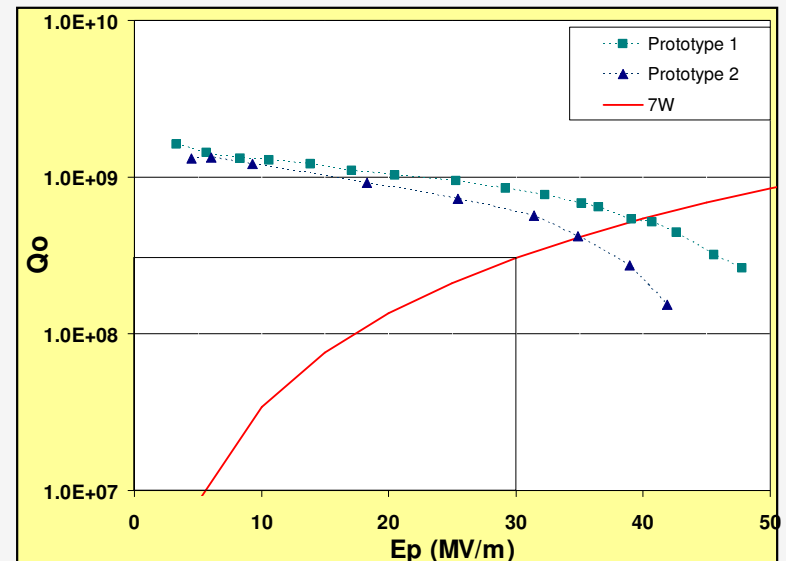


**10,000 + square feet
facility at:
12371 Horseshoe Way
Richmond, B.C., V7A 4X6**



Phase-II Cavity Report

- Cavities ordered from PAVAC Industries of Richmond BC
 - Two prototype cavities tested
 - $E_p=38\text{MV/m @ }7\text{W}$
- Twenty production cavities ordered
 - fifteen cavities received



ISAC-II Phase-II Cryomodules

- **SCC1 cold tests complete**

- Checked cavities and rf systems

- Measured static load

- 24W @4K compared to 13W for Phase I (heat leak?)

- 5ltr/hour LN2



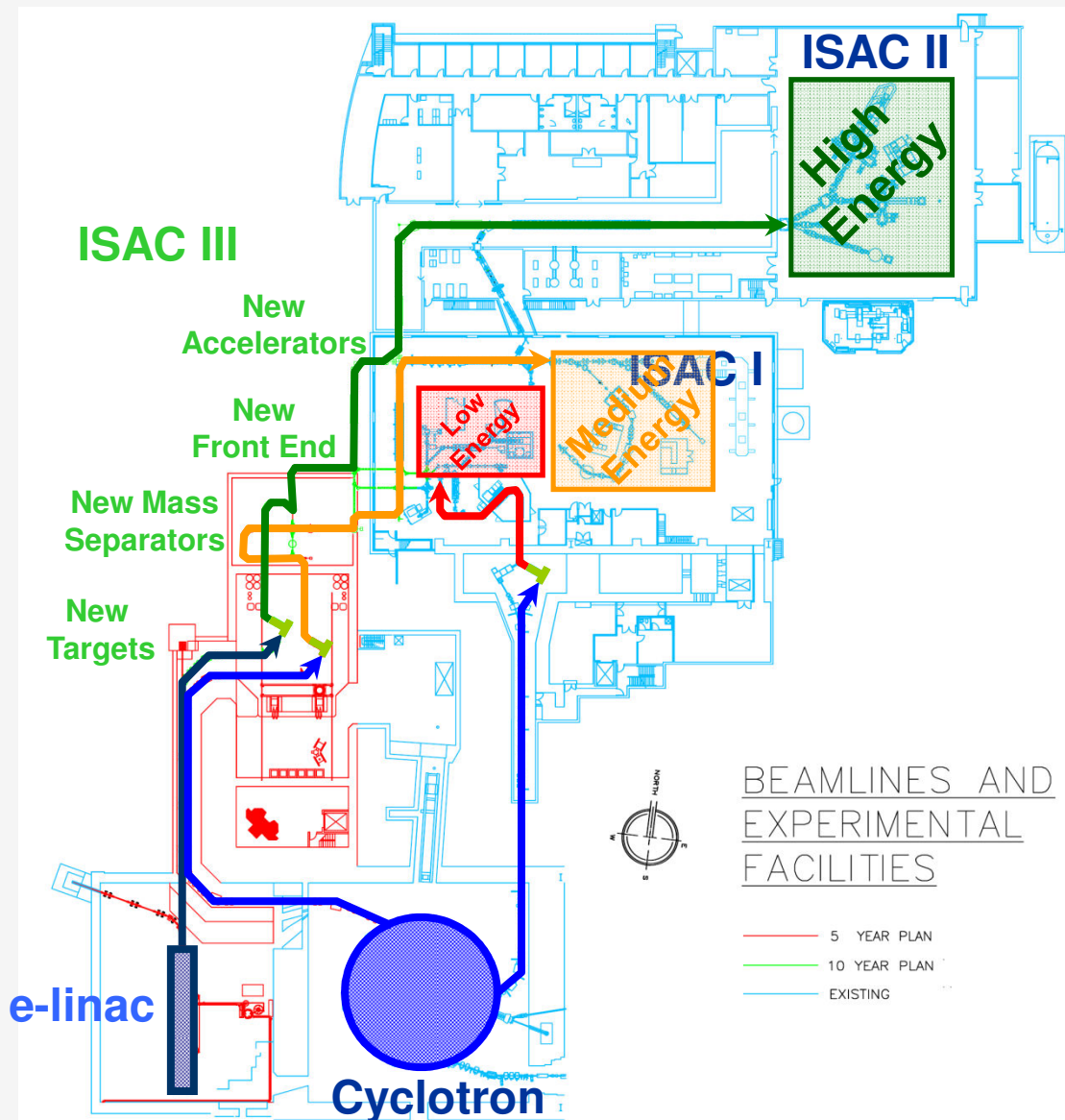
Installation Schedule

- Vault installation has begun
 - Beamline removed
 - Cryogenics installation nearing completion
- SCC1 to be installed Oct 15
 - Will be fully tested after installation
- SCC2/3 – Nov. 15/Dec. 15
- Beam commissioning in Jan.-March 2010
 - first experiments April 2010



ISAC-II Phase-II Summary

- Phase-II linac extension will add 20MV to ISAC-II SC-linac
 - On schedule for 2009 installation
- Fifteen production cavities received
 - Cavities for first module meet specification
 - Some problems with leaks – solution developed
- First cryomodule tested
 - All systems work; alignment good
 - Signs of Q-disease in on-line cavities
 - Direct venting system implemented
- Installation has begun
 - Installation of all cryomodules by end of 2009
 - Commissioning in Jan. 2010



- Goal: three simultaneous radioactive beams
- New complimentary driver (e-linac): electron driver for Photo-Fission
- New target stations and mass separators
- New front end and post accelerators
- Staged installation

E-LINAC

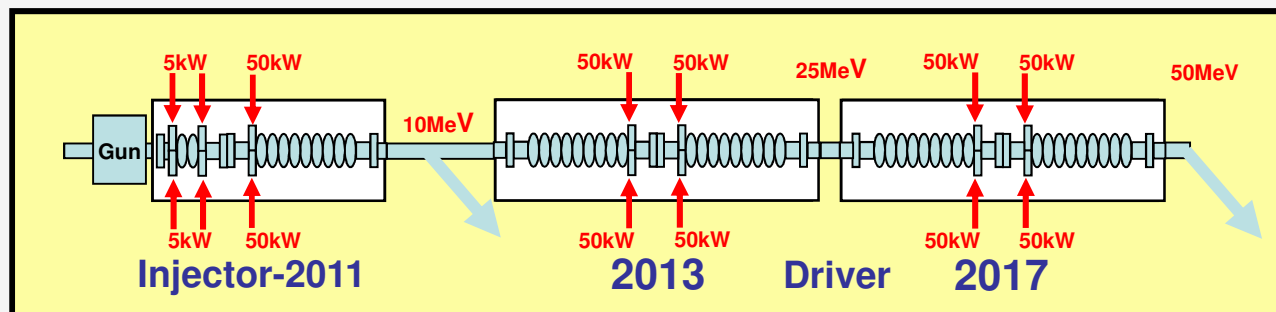
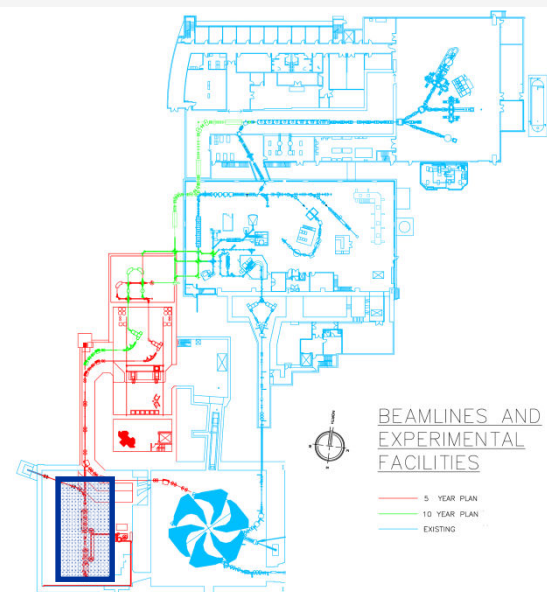


- **Electron driver for photofission: independent and complementary to 500 MeV cyclotron**

- Composed of five elliptical cavities at 1.3 GHz
- Final specification 50 MeV/10mA ->0.5 MW beam power, cw – by 2017 (cash flow dependent)

- **Staged installation: 30 MeV and 3 mA - 2013**

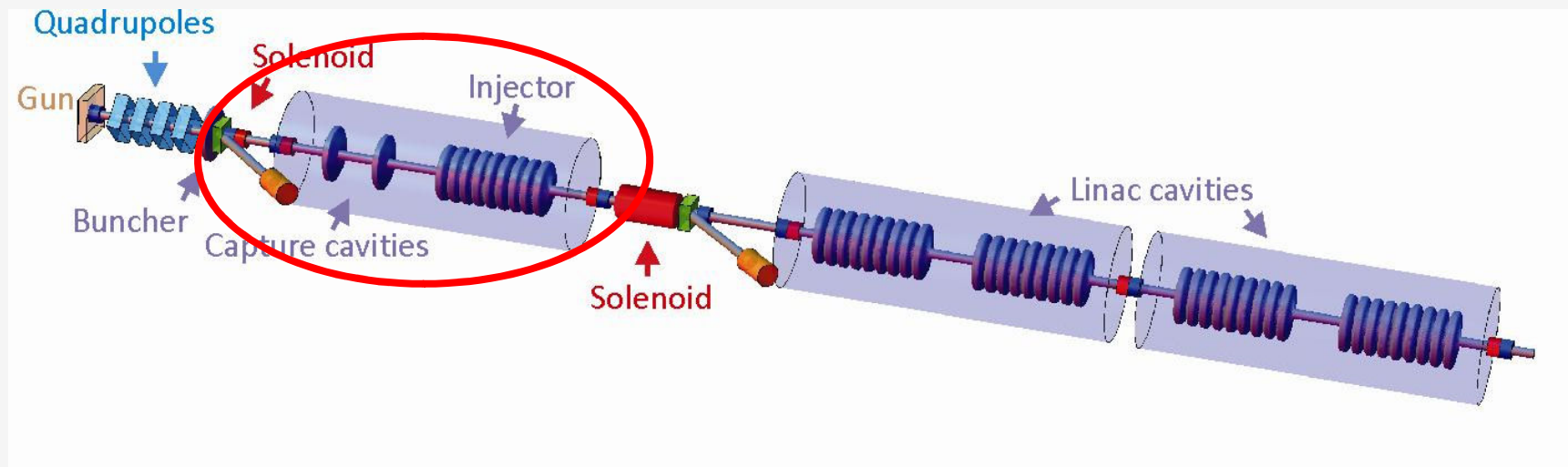
- **Injector cryomodule (ICM) - designed, built and tested as part of the VECC collaboration - 2011**



VECC-ICM

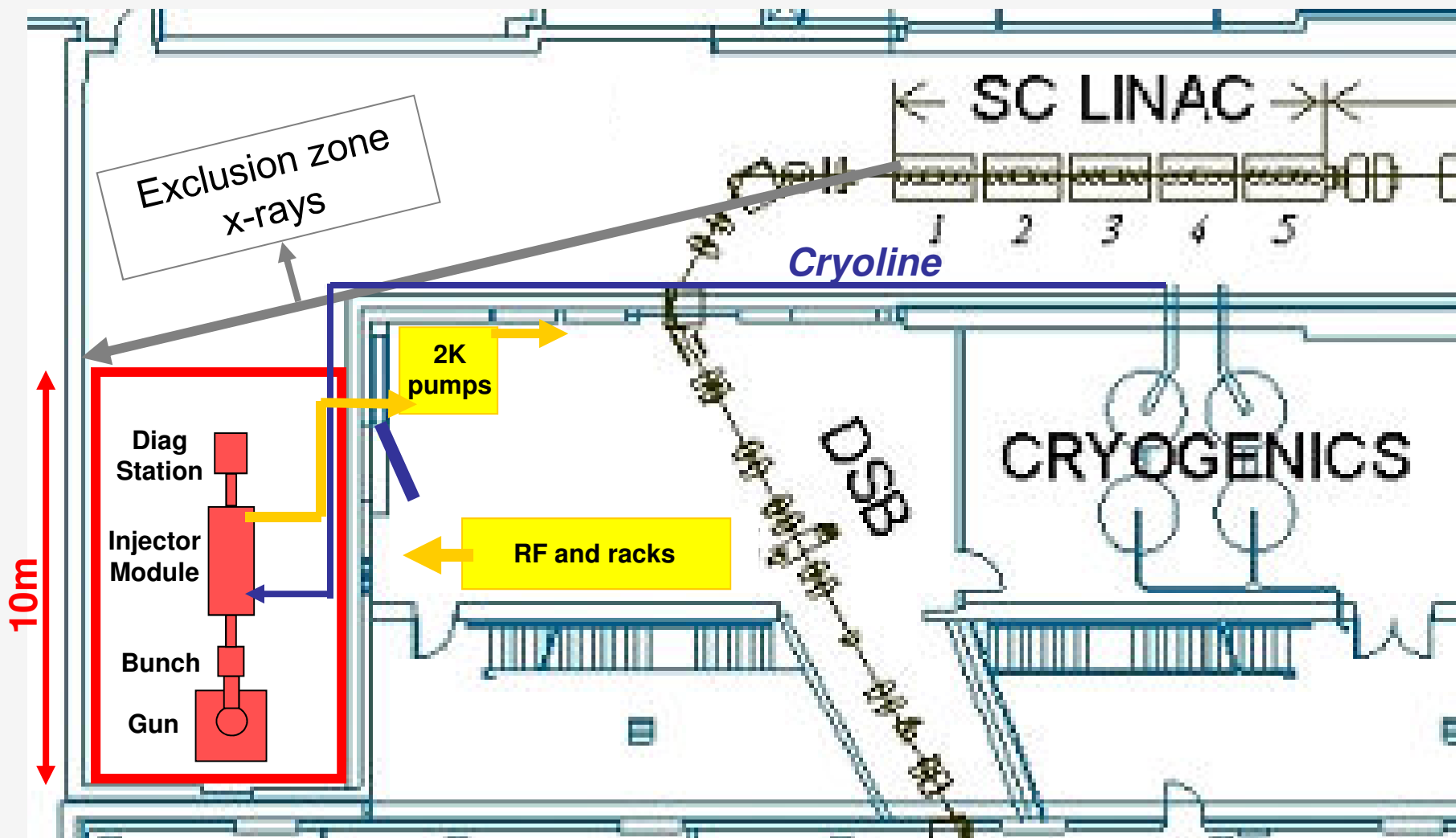
- TRIUMF and VECC are collaborating on a 50MeV high intensity (10mA) cw electron linac for the production of radioactive ions through photofission
- The first stage is the design and construction of two Injector Cryomodules (ICM) to accelerate beams to 10MeV
- Injector module base-line design
 - Two single cell cavities; independently powered and phased
 - One multi-cell beta=1 cavity
 - Operating at 1.3GHz and 2K
- A beam test area is being established at TRIUMF for beam studies in early 2011
 - Test high intensity beam dynamics up to 10mA; halo formation
 - Test beam interaction with cavities and LLRF, HOM excitation, power coupler operation; 30kW cw operation

VECC Injector Cryomodule and E-Linac



- Goal is to build two Injector Cryomodules (ICM) one for TRIUMF and one for India by 2012
 - cryomodule conceptual design study initiated

E-Beam test area - 2009-2011

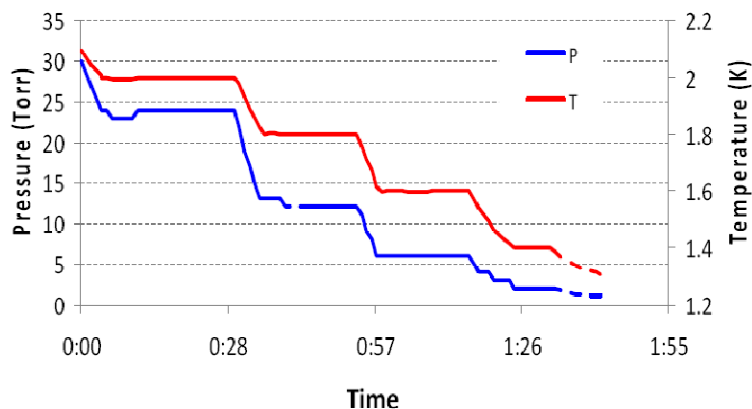


1.3GHz hardware development: cryostat

- Vacuum vessel and bath insert for single cell test cryostat in hand
- Pumps for 2K tested
- top plate assembly for initial single cell tests operational
- Modification for nine cell tests later this year

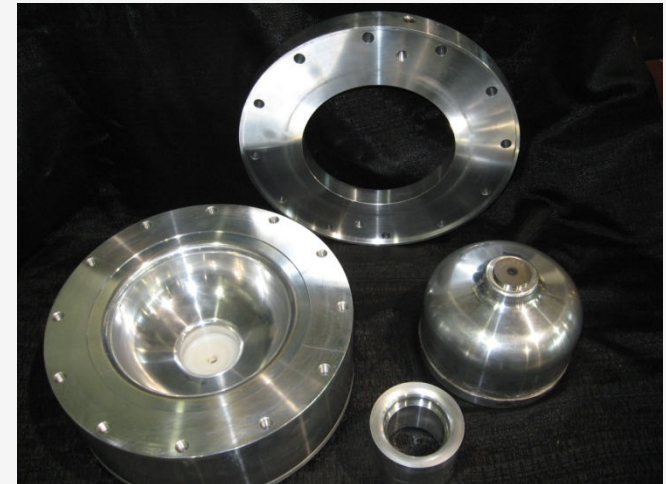
2K Cryostat Test

T and P vs. time



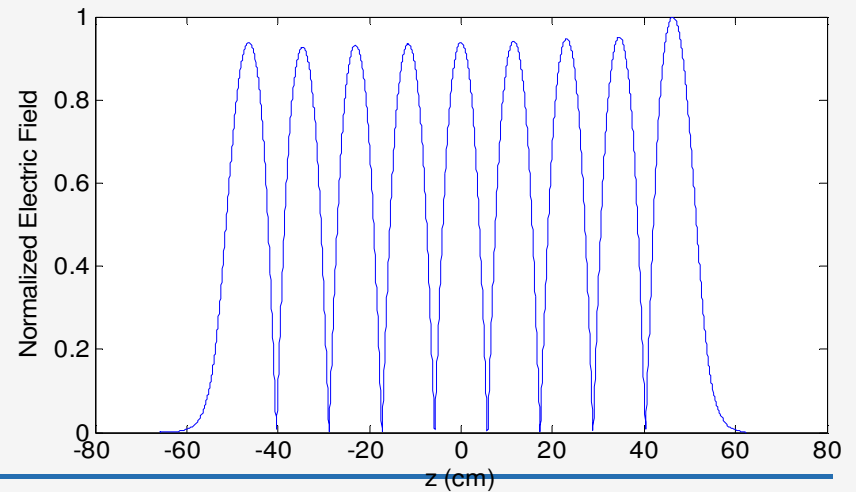
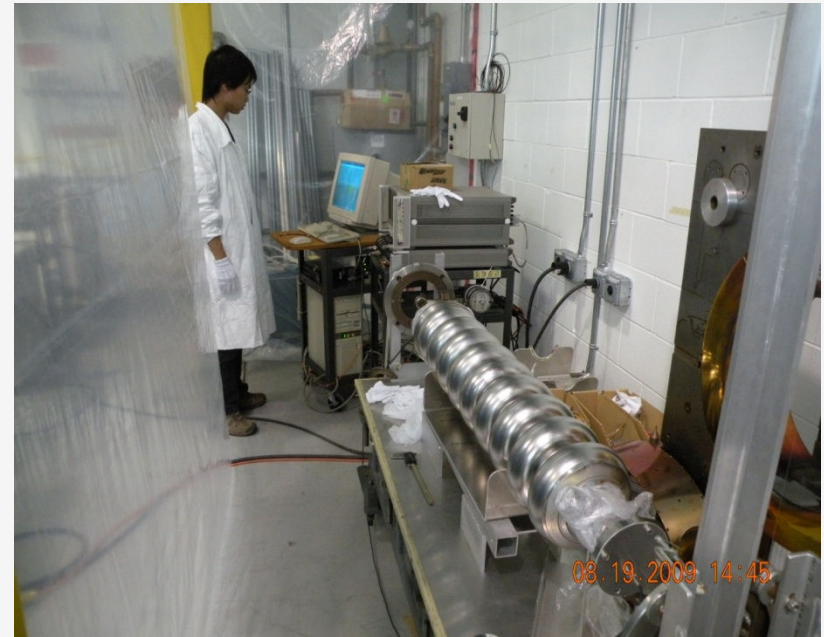
R+D with PAVAC

- PAVAC to produce two single cells by end of 2009
 - Produce and test fixtures, FNAL/RRCAT dies and Nb
 - Forming / Welding tests
 - Cavity production and testing
- **Fundamental studies**
 - Weld samples, HAZ analysis, explore weld parameter space, diagnostics include RRR/visual/beta-NMR



Bead Pull Measurement Setup

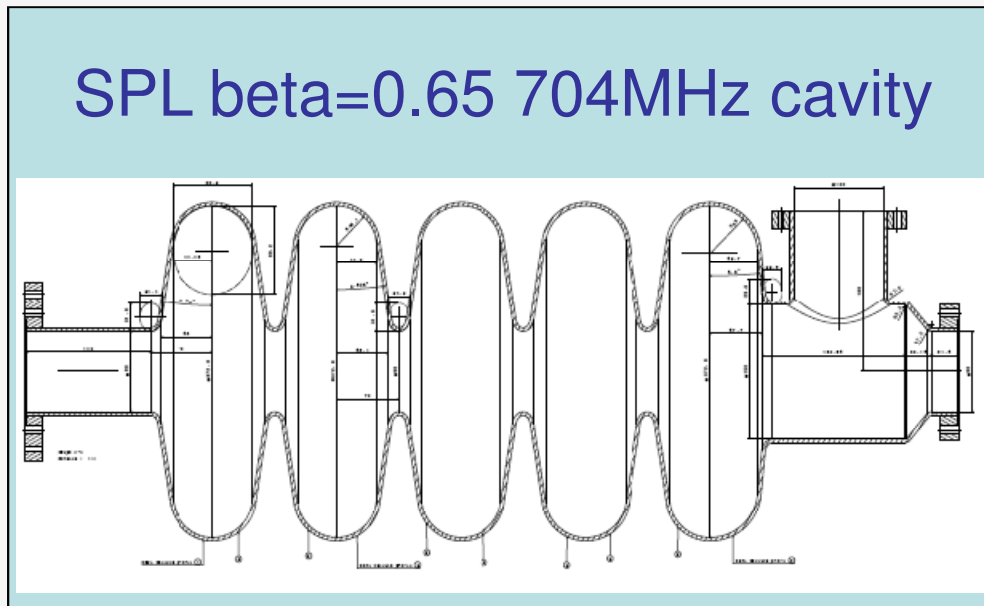
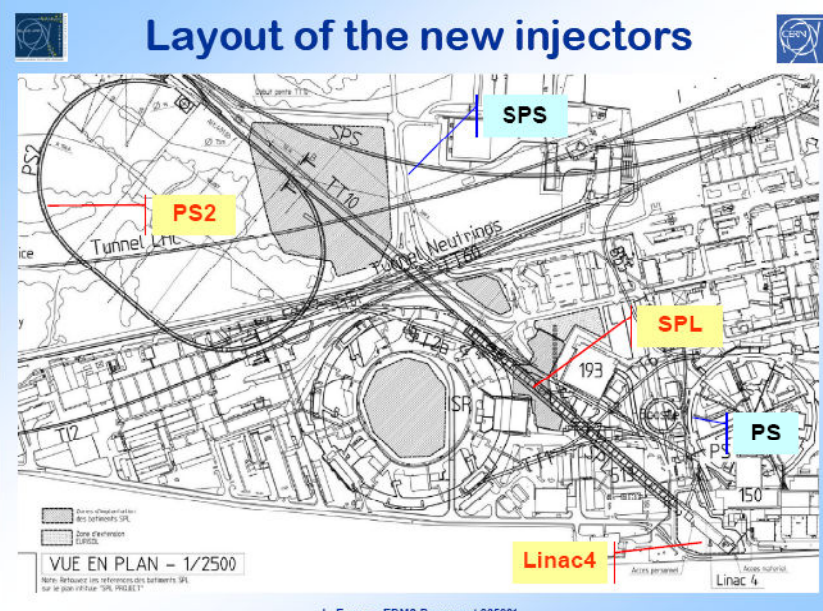
- Bead pull apparatus set-up
- Warm tuner being designed in collaboration with U of T
- Other ancillaries in design
 - Vertical high pressure water rinse
 - String assembly frame



The Schedule

- **Stage 1 – completed by Oct. 2009**
 - define the ICM conceptual design with iterative design cycles of beam simulations and rf modeling
 - single cavity prototyping of $\beta=1$ with PAVAC and initializing 1.3GHz test program in ISAC-II
- **Stage 2 – completed by Nov. 2010**
 - Design/develop/prepare ICM1
 - Prototype and test cavities – July 2010
 - Design, fabricate and assemble cryomodule
 - Procure/install rf ancillaries; power couplers, tuners
- **Stage 3 – completed by May 2011**
 - Beam test with ICM1 in the ISAC-II vault e-test area
- **Stage 4 – completed by Dec. 2011**
 - Fabricate, assemble, test ICM2

- TRIUMF has a long history of collaborations with CERN both on LHC and ISOLDE
 - Canadian contribution to LHC organized through TRIUMF
- TRIUMF – Five year plan proposal includes funds to support Canadian contribution to International Accelerator Projects at ~4M\$ and 4FTE's
 - Prototype one SPL 704MHz (beta=0.65 or beta=0.92) cavity with PAVAC
 - Qualify PAVAC as a vendor for CERN-SPL
 - Contribute to SPL building phase as allowed by funding



Summary

- SRF represents a core competency in the lab
 - New chemical lab expands the capability
- Heavy ion SRF technology centered on ISAC-II Phase-II linac extension
 - On schedule for 2009 installation
- E-Linac given a timely boost with VECC collaboration
 - E-Linac Injector beam test by 2011
- International partnerships undertaken to support and augment the existing capability
 - Aligned with the goals of the next five year plan

**Thanks
to Bob
Laxdal
for slides**

**Head of SRF
Department**

**see his talk
Berlin SRF**

