CANADA'S NATIONAL LABORATORY FOR PARTICLE AND NUCLEAR PHYSICS
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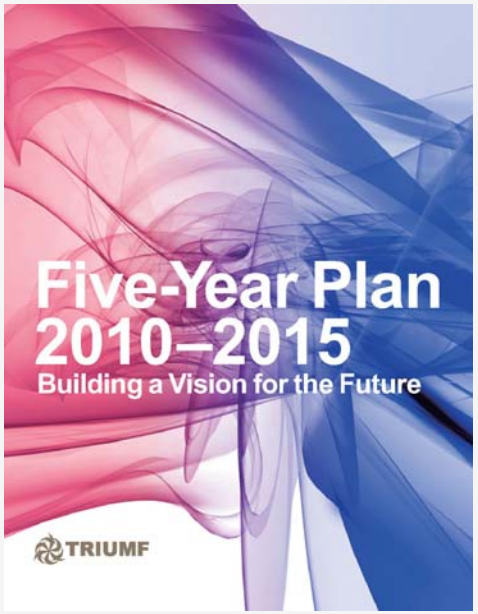
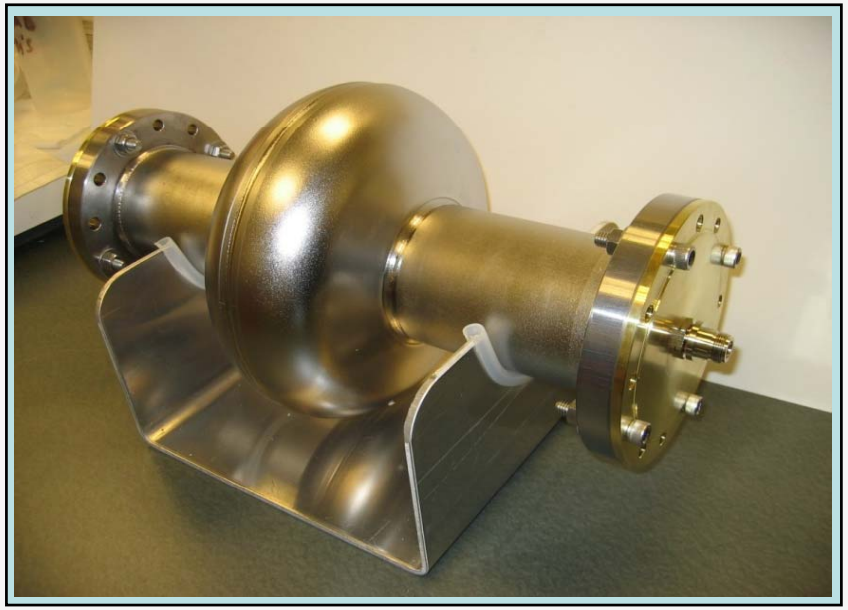




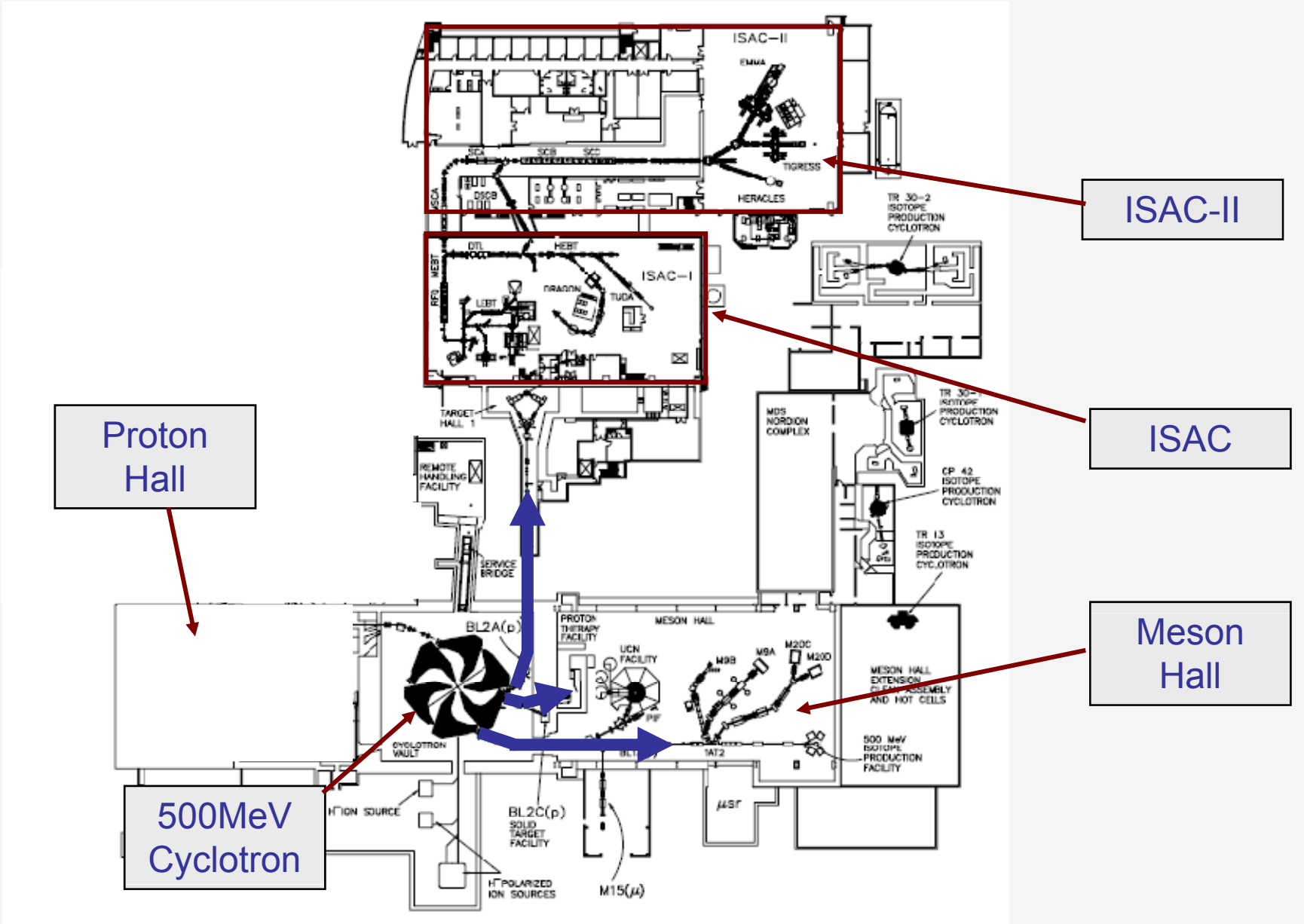
The TRIUMF SRF Program and SPL

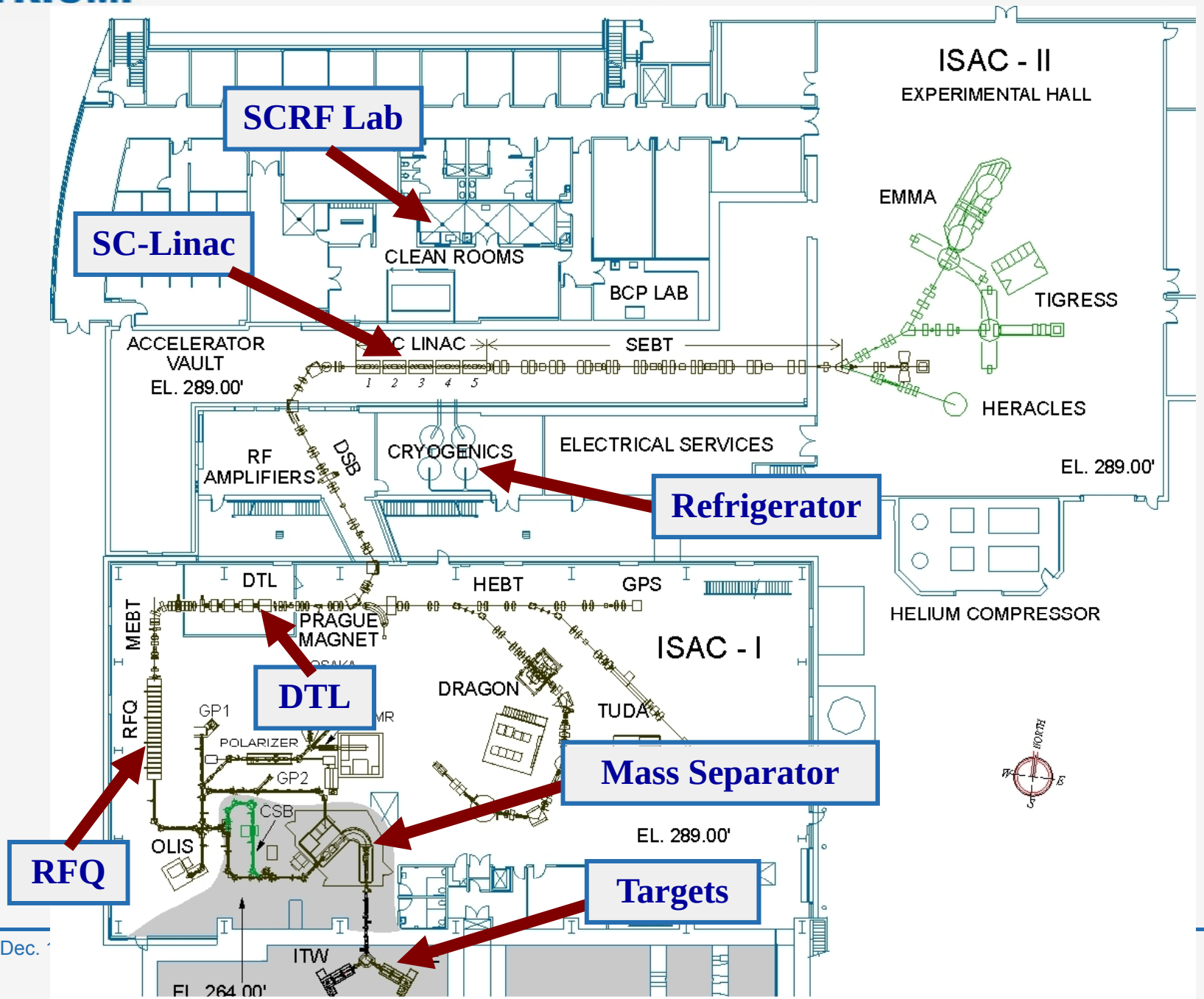
Bob Laxdal, TRIUMF, SRF Group Leader

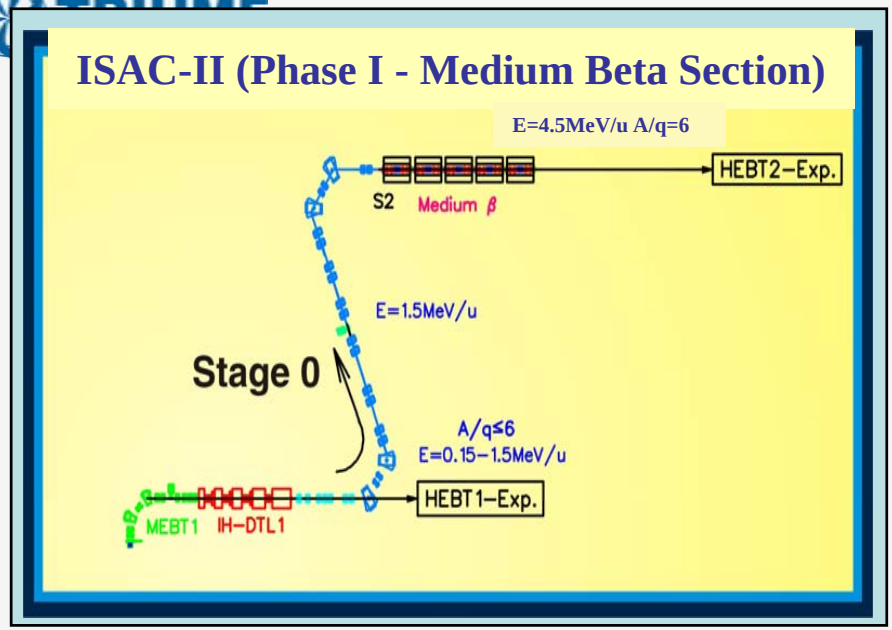
LABORATOIRE NATIONAL CANADIEN POUR LA RECHERCHE EN PHYSIQUE NUCLÉAIRE ET EN PHYSIQUE DES PARTICULES
Propriété d'un consortium d'universités canadiennes, géré en co-entreprise à partir d'une contribution administrée par le Conseil national de recherches Canada

Outline

- TRIUMF/ISAC Overview
  - SCRF infrastructure
- 2010-2015 Five year plan
  - Expanding SCRF
    - e-Linac
    - International Partnerships
- TRIUMF and SPL


ISAC-II
ISAC-I
ISAC-II
ISAC
Proton Hall
Meson Hall
500MeV Cyclotron
TRIUMF
TIGRESS
HERACLES
DRAGON
TUDA
TR 30-2 ISOTOPE PRODUCTION CYCLOTRON
TR 30-1 ISOTOPE PRODUCTION CYCLOTRON
CP 42 ISOTOPE PRODUCTION CYCLOTRON
TR 13 ISOTOPE PRODUCTION CYCLOTRON
MDS NORDION COMPLEX
TARGET HALL 1
REMOTE HANDLING FACILITY
SERVICE BRIDGE
BL2A(p)
PROTON THERAPY FACILITY
MESON HALL
UCN FACILITY
M9B
M9A
M20C
M20D
MESON HALL EXTENSION
CLEAN ASSEMBLY AND HOT CELLS
500 MeV ISOTOPE PRODUCTION FACILITY
CYCLOTRON VAULT
H⁻ ION SOURCE
BL2C(p) SOLID TARGET FACILITY
H⁻ POLARIZED ION SOURCES
M15(μ)
μSR
1AT2


SCRF Lab
SC-Linac
Refrigerator
DTL
Mass Separator
RFQ
Targets
ISAC - II
EXPERIMENTAL HALL
EMMA
TIGRESS
HERACLES
CLEAN ROOMS
BCP LAB
ACCELERATOR VAULT
EL. 289.00'
C LINAC
SEBT
1 2 3 4 5
RF AMPLIFIERS
DSB
CRYOGENICS
ELECTRICAL SERVICES
EL. 289.00'
HELIUM COMPRESSOR
DTL
HEBT
GPS
MEBT
PRAGUE MAGNET
ISAC - I
RFQ
GP1
POLARIZER
GP2
DRAGON
TUDA
CSB
OLIS
EL. 289.00'
ITW
EL. 264.00'



ISAC-II 106MHz Superconducting Linac

- Twenty bulk niobium quarter wave cavities housed in five cryomodules
- Boosts ion energy by 20MV to provide stable and RIB's above the Coulomb Barrier
- Cavities from Italy, solenoid from Germany; cryomodule designed and assembly at TRIUMF

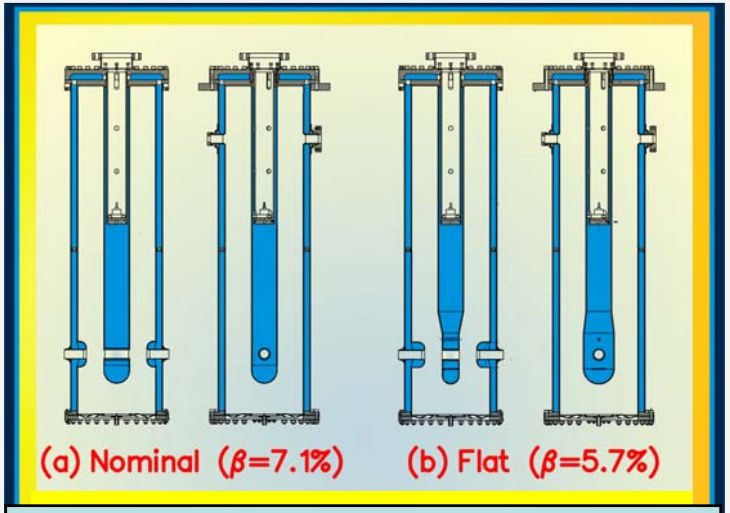
Summary

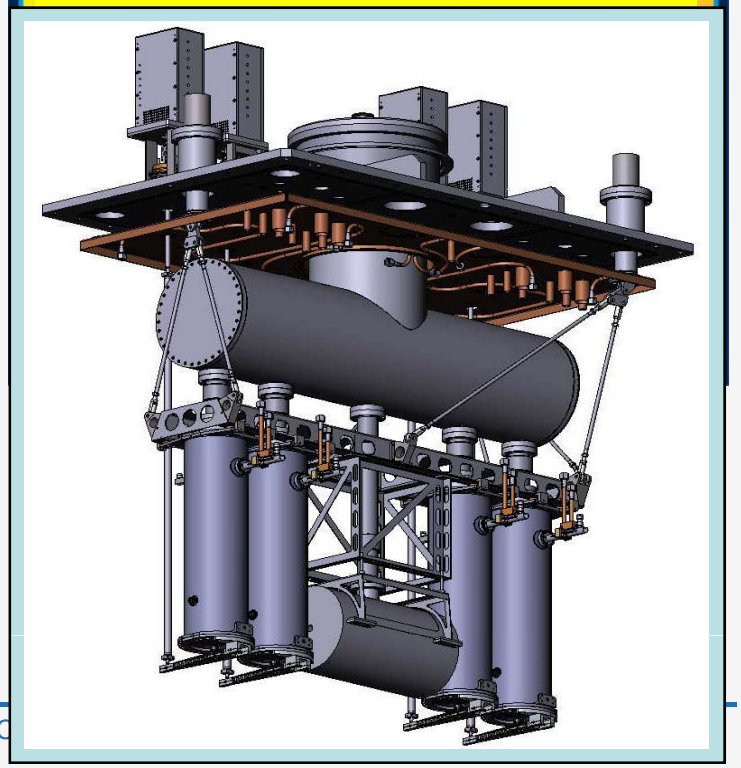
- ISAC-II Accelerator commissioned in Spring 2006 with beam delivery for key experiments in 2007-08

SCRF Overview

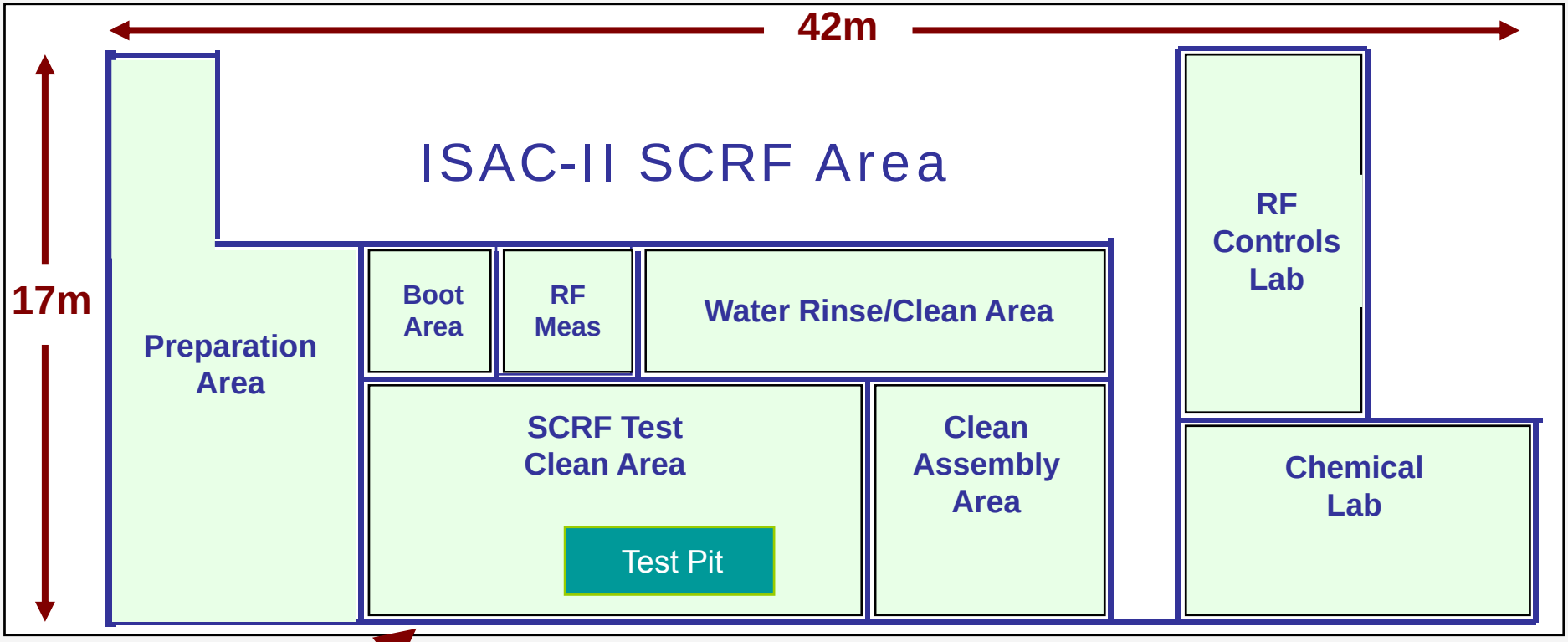
Superconducting Cavities

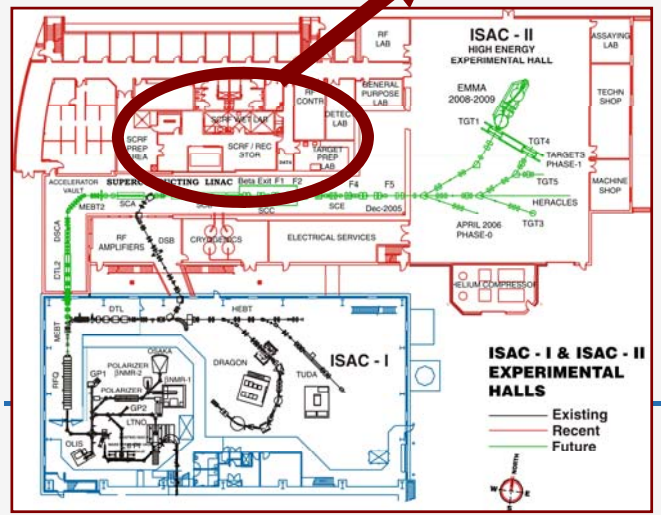
- Cavities designed in collaboration with INFN-Legnaro
- Cavities fabricated from niobium
- Fabricated in Italian industry (Zanon) and chemically etched in CERN and J-Lab
- Twenty installed in five cryomodules





SCRF Infrastructure

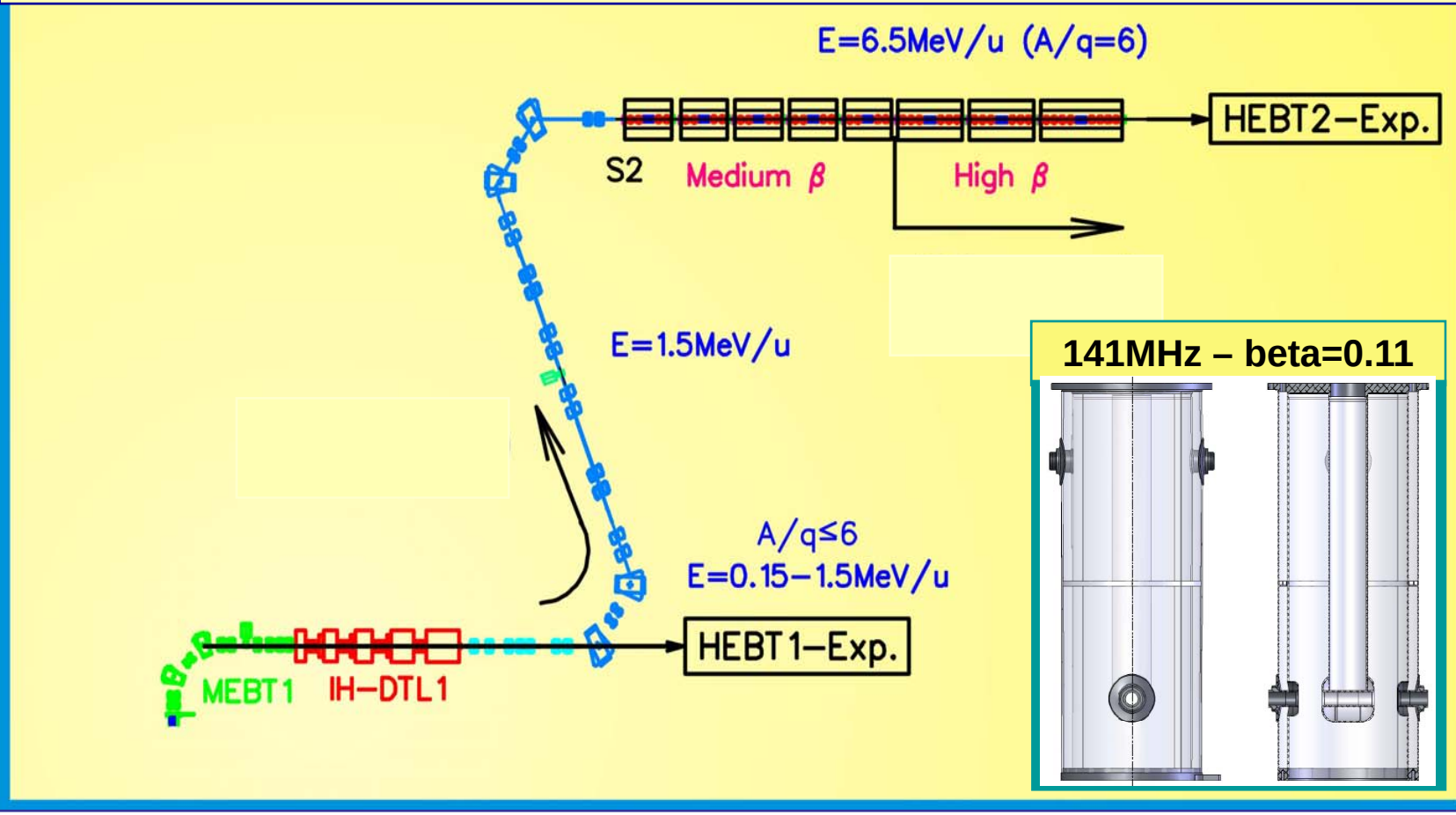




- The ISAC-II building houses the SCRF test and assembly areas
  - 500m^2 of floor space, overhead crane
  - Ultrasound cleaning tanks, High Pressure Water Rinse area, shielded rf test area, cryomodule assembly area, chemical etching lab
  - Over 40 single cavity tests performed and five cryomodules assembled since 2004

ISAC-II Phase II

ISAC-II (Phase II - High Velocity Section - 2009)



141MHz – beta=0.11

- The Phase-II Extension of ISAC-II calls for the addition of 20 higher velocity (β=0.11) quarter wave cavities by the end of 2009
- The twenty cavities will be housed in three cryomodules and add an additional 20MV to the ISAC-II ions

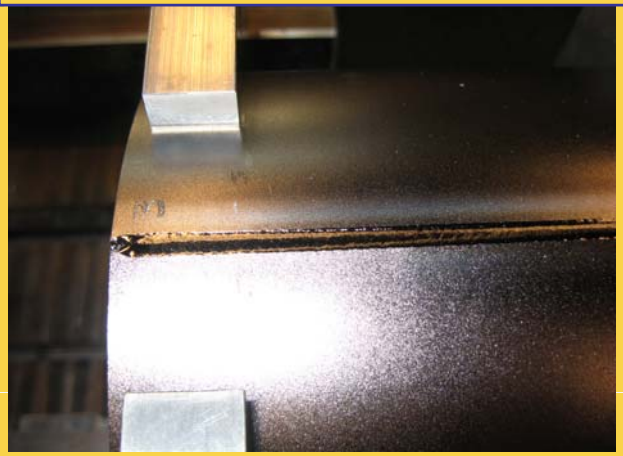
PAVAC

- Who is PAVAC?
  - A Canadian Company located in Richmond B.C.
- Specializing in
  - Electron Beam Welding
  - Precision machining
  - Pulsed Electron Beam Coating

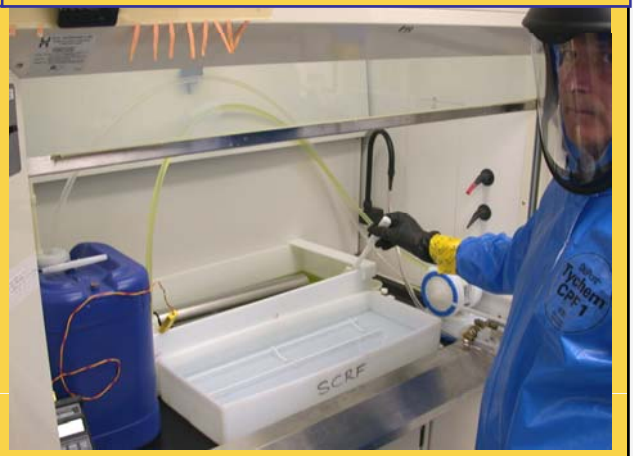
First Frequency Tuning

Forming and Machining

Electron Beam Welding

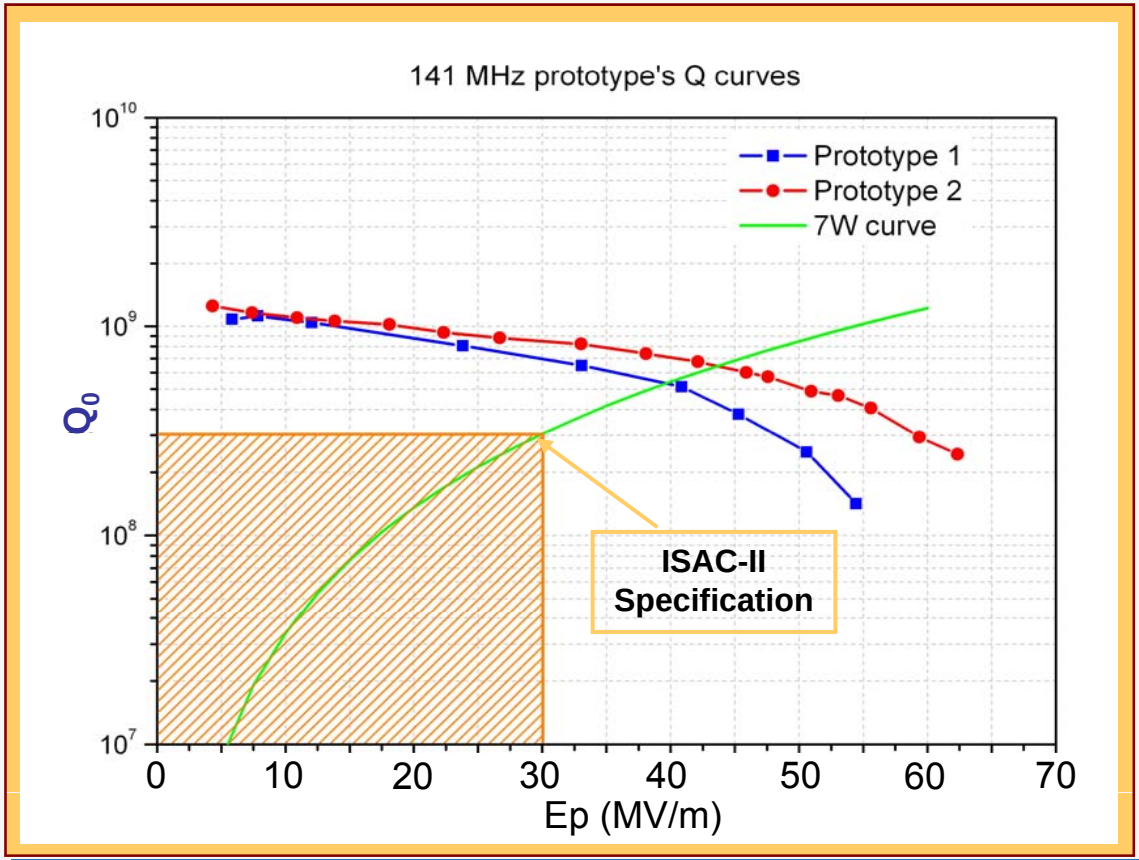


Pre-weld Etching - TRIUMF



Two Prototypes Tested

- Parts fabrication and EB welding at PAVAC; Pre-weld etching, cavity processing and cold testing at TRIUMF
- Both prototypes perform significantly above ISAC-II specifications; average values of E_a=8MV/m (specification 6MV/m)

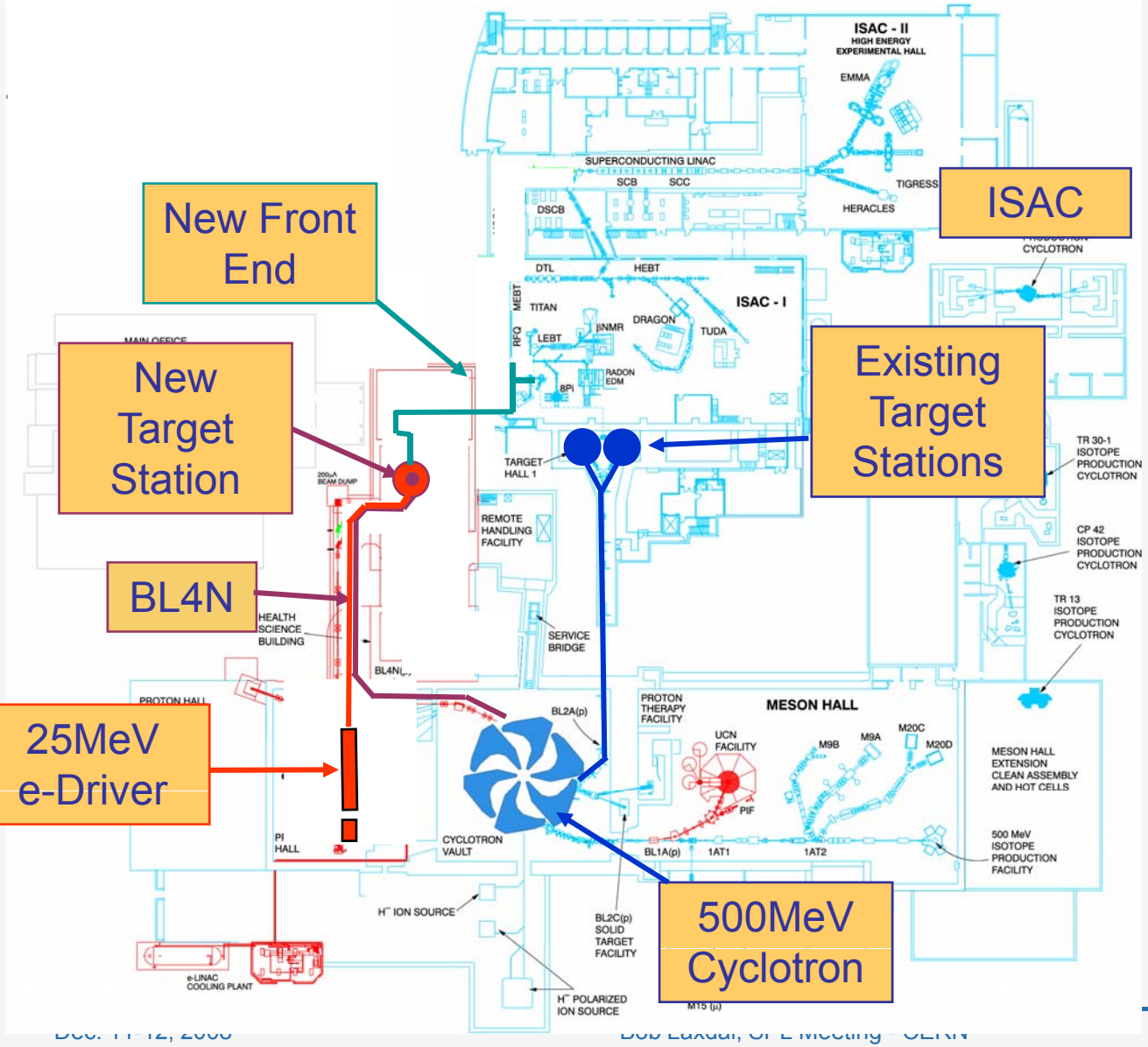


Superconducting RF

- Core competencies
  - Heavy ion SCRF capability developed in house
    - LLRF controls
    - mechanical tuner and coupling loop design
    - Cavity processing (HPWR, BCP) and testing
    - Clean room assembly
    - Rf cavity modelling
  - Cryogenic engineering support
    - Cryomodule design, cryogenic system design and installation
  - PAVAC
    - Local fabricator - qualified for bulk niobium heavy ion cavity production

TRIUMF Five Year Plan 2010-2015

Future (2010-2015)



Proposal:

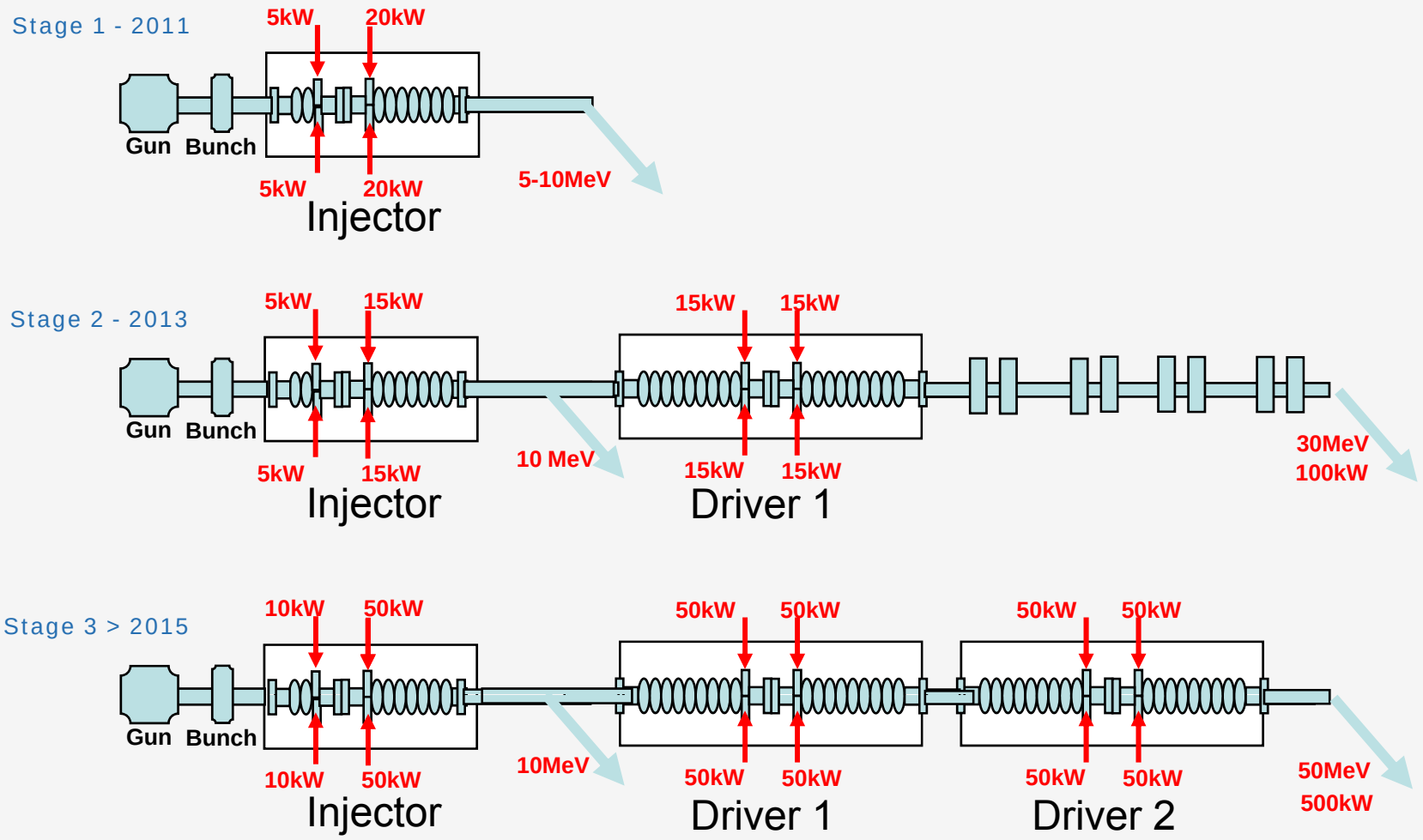
By 2013:

- **Add a 30MeV electron driver to supply electrons to one new target**
- **Add a new ISAC front-end to deliver a second RIB beam to ISAC**

By 2015:

- **Add a new beam line from the cyclotron to deliver 500MeV protons to the new target**

E-Linac Possible Evolution



Growing SCRF – Expanding the infrastructure

SCRF Development (2008-2009)

- Five year plan goal is to build the superconducting e-Linac in house at 1.3GHz
  - Strengthens and expands our core competency in SCRF
  - Acts as a springboard for linking to broader community (beta~1 technology)
- Have initiated1.3GHz cavity testing program in ISAC-II
  - Test cavities sourced from DESY and FNAL
  - Bath cryostat fabricated for single cell tests
    - collaboration with U of Toronto
  - Sub-atmospheric pump for 2K operation tested
  - 500 W rf amplifier ordered
  - LLRF and rf ancillaries produced in house
- Initiating cavity fabrication at PAVAC
  - Production dies sourced from FNAL
    - now at PAVAC
  - Single cell fabricated by March 2009
  - Nine-cell fabricated by end of 2009

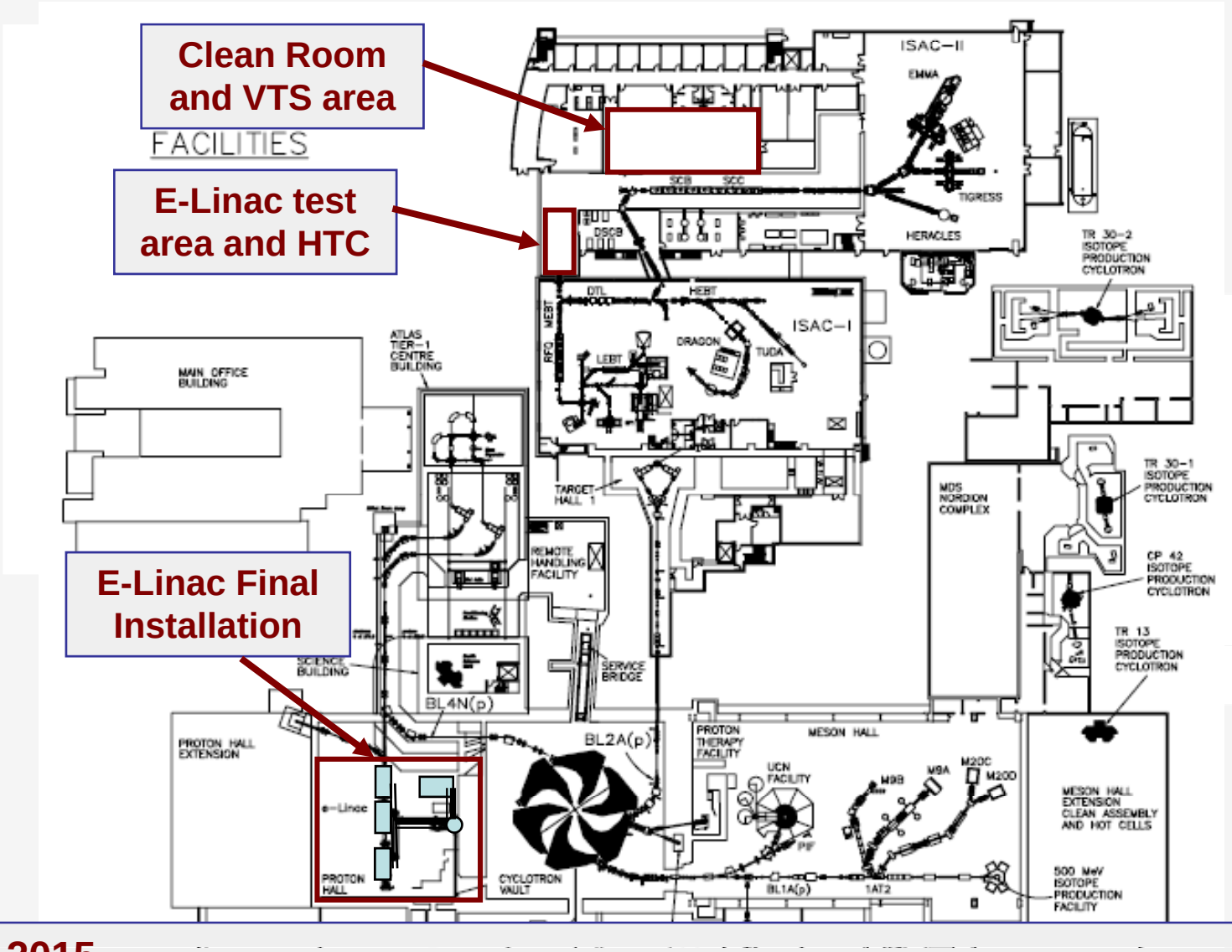
FNAL Single Cell

SCRF Collaborations

Connecting to the beta~1 world

- **Tesla Technology Collaboration (TTC)**
- **MOU with VECC Kolkata for the design and construction of an e-linac for photo-fission**
  - Stage 1 – two e-Linac injector modules; one each for TRIUMF and VECC
- **Pavac – qualify as a North American supplier of ILC elliptical cavities**
  - Produce and test single and nine cells
- **U. of Toronto - have joined TRIUMF SCRF group to support 1.3GHz testing**
- **Collaboration with CERN on SPL**
  - Produce 704 MHz prototype with PAVAC of beta=0.65 or beta=1
- **MOU with Fermilab - ILC SRF development**
- **Fundamental studies – student program**

SCRF Development 2010-2015

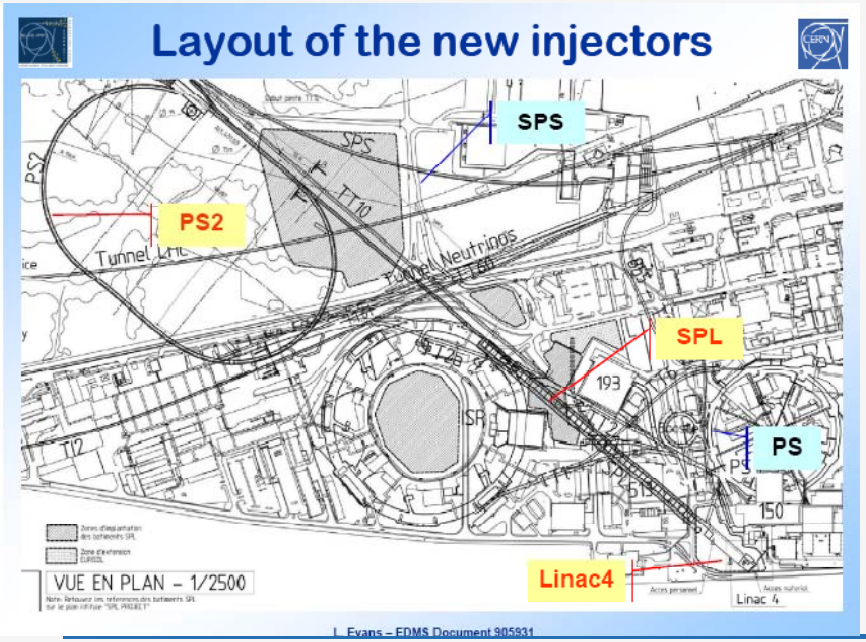


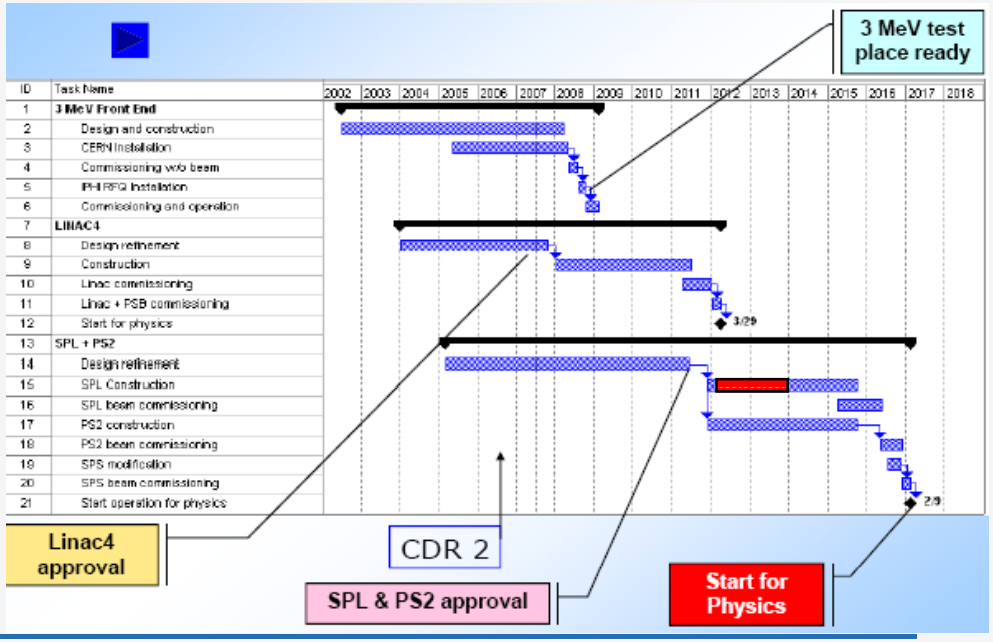
Goal for 2010-2015

- Fabricate, process and test (vertical and horizontal) cavities for e-Linac as well as support international collaborations – VECC, SPL, ILC

TRIUMF/CERN Collaborations

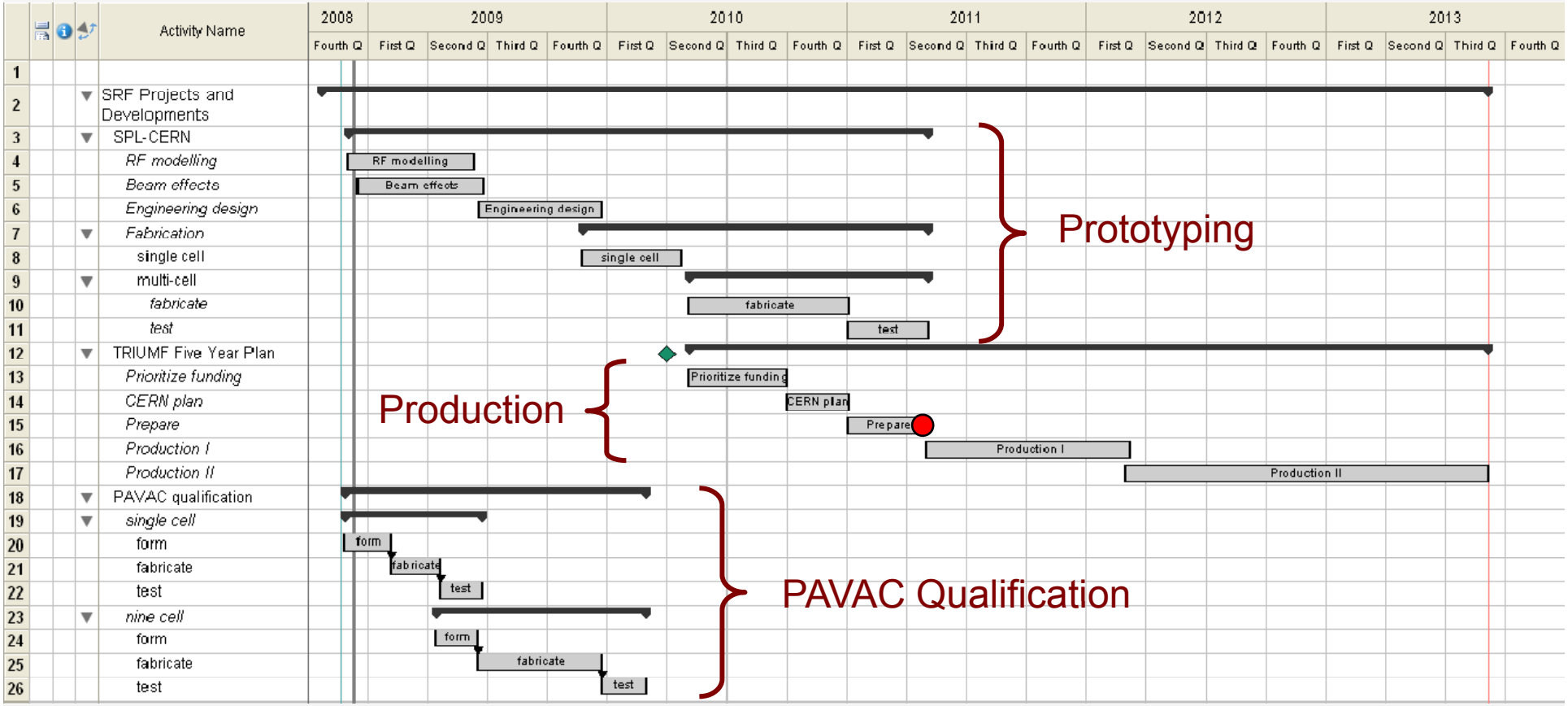
- TRIUMF has a long history of collaborations with CERN both on LHC and ISOLDE
  - Canadian contribution to LHC organized through TRIUMF
- TRIUMF – Five year plan proposal includes funds to support Canadian contribution to International Accelerator Projects at ~4M$ and 4FTE's
  - Prototype one SPL 704MHz (beta=0.65 or beta=1) cavity with PAVAC
  - Qualify PAVAC as a vendor for CERN-SPL
  - Contribute to SPL building phase as allowed by funding





SPL/TRIUMF Schedule

- Hold point in the schedule after the prototyping phase to assess the level of TRIUMF/Canadian commitment to production of hardware



First Steps

- EM Modeling of cavity
  - First model created of 5-cell beta=0.65 cavity
- HOMs/BBU simulations
  - Codes sourced from J-Lab and SNS
  - Work aligns well with similar studies for e-Linac 1.3GHz cavities

TRIUMF

SPL Project Aligned with FYP Goals

- Support in-house science program with development of new accelerator capabilities
  - E-Linac design and installation
  - New photo-fission driver will more than double RIBs in 2010-2015
- Maintain TRIUMF leadership role in Canadian accelerator technology
  - Proton, heavy ion and electron accelerator technologies
- Support Canadian particle physics community by in kind contributions to international accelerator centers
- Strengthen core competence in SRF technology by expanding to elliptical cavity production and development
  - Grow international partnerships
  - Supports student program
- Support Canadian industry with technology transfer

Thanks!