Present

Beginning & Future

SRF Activities at TRIUMF & PAVAC

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TRIUMF/UBC
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
    • $Ep=38 \text{MV/m} @ 7W$
  • 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?)
    - 5litr/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
TRIUMF – e-Linac

- 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
• 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

Exclusion zone x-rays

Cryoline

2K pumps

RF and racks
• 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
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

Normalized Electric Field

z (cm)

0.2 0.4 0.6 0.8 1

-80 -60 -40 -20 0 20 40 60 80
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

**Layout of the new injectors**

**SPL beta=0.65 704MHz cavity**
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