e-linac project overview

D. Karlen / University of Victoria and TRIUMF
TRIUMF SEEC meeting
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e-linac project

- A key element in the future vision of the laboratory is a new on-site accelerator:
  - high power (approaching 1 MW)
  - 50 MeV CW electron beam
  - superconducting accelerator technology
- It encompasses many important lab goals:
  - extends the ISAC science program
  - advances state of the art accelerator R&D in Canada
  - opens new areas of research and collaboration
  - partners with local high tech industry
  - wide base of applications – from medical to industrial

Extending the ISAC science program

- To produce isotopes for the ISAC experiments:
  - the 50 MeV electron beam is directed onto a liquid cooled bremstrahlung production target
  - the bremstrahlung photons strike a secondary target
- With actinide targets, the photons excite giant dipole resonances, resulting in photo-fission primarily into neutron rich isotopes
  - first proposed by W.T. Diamond, AECL (NIM A432 (1999) 471)
- With ^{9}Be targets, the (γ,p) reaction produces ^{8}Li for use in the β-NMR program
- The e-linac will significantly increase the research capabilities of the lab by both increasing the availability of beams to ISAC experiments and enabling new production processes of radioactive isotope beams that complement those of the current proton driver

Advanced accelerator development

- Superconducting radio frequency accelerator technology has advanced significantly over the past few decades
  - the optimal choice for many new accelerators
- The accelerator design incorporates concepts developed for the International Linear Collider (ILC) and the European free electron x-ray laser project, (XFEL)
  - in particular, the SRF cavities will be nearly identical (1.3 GHz)

Partnership with local industry

- PAVAC
  - small Canadian company located in Richmond, BC
  - specialists in electron beam welding and precision machining
- Presently building low-β prototypes for ISAC-II upgrade
- Building e-linac cavities could qualify PAVAC for future ILC contracts
- Interest in industrial applications

SRF in Canada

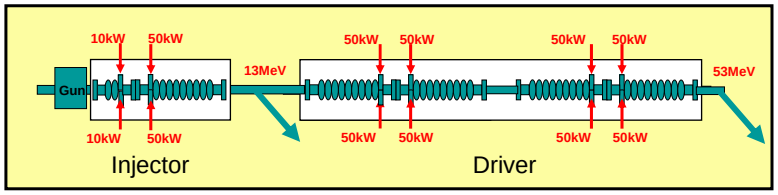
- This project will expand the SRF expertise and infrastructure at TRIUMF, initially developed for ISAC-II:
  - New BCP facility being developed for improving surface quality
  - Build up capability for testing 1.3 GHz cavities
    - DESY to provide initial single cell and nine cell cavities
  - TRIUMF now participating in the Tesla Technology Collaboration (50 institutions in 12 countries)
    - MOUs with DESY, FNAL, KEK
  - Interest by Canadian Light Source (4th gen. LS) and by physicists at University of Toronto (SRF R&D)
  - Enables Canadian participation in ILC or SPL

e-linac design parameters

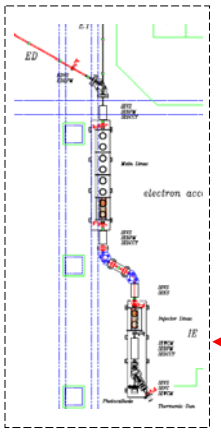
Main Cavity	
Freq (MHz)	1300
Duty cycle	Cw
Cells/cavity	9
No. of cav	5
Gradient (MV/m)	10
Cavity length (m)	1.04
R/Q	1000
Qo, Qext	$1x10^{10}$, $1x10^{6}$
RF Power/cav (kW)	50x2
Pcav (W)	12

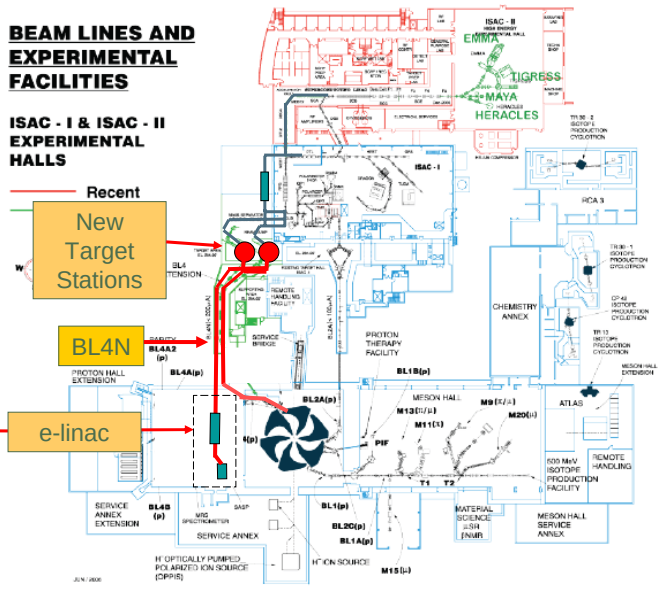
E-Linac	
Final Energy	53
Max I (mA)	10
Charge (pC/bunch)	7

Capture Cavity	
# cells	1.5(2.5)
Gradient (MV/m)	10.
Length (m)	0.173 (0.282)
Ein- Eout (MeV)	0.12-1.85(3.0)
Rf Power/cav (kW)	8.7(14.4)x2
R/Q	200

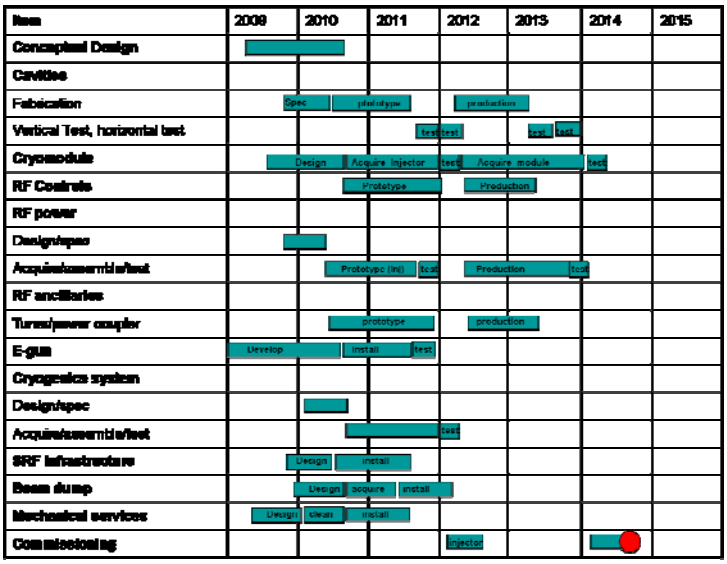


e-linac at TRIUMF



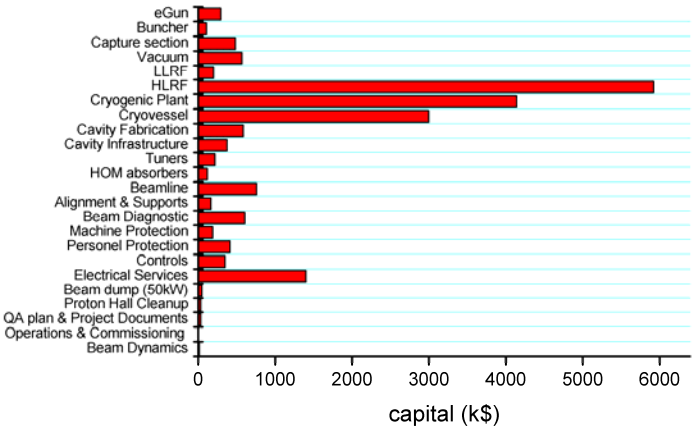


e-linac project timeline (draft)



Project costs and manpower

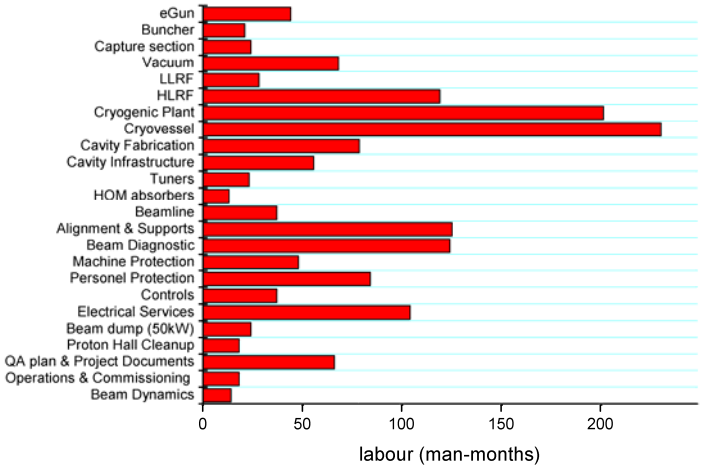
- Much of the capital costs and manpower have been estimated (first pass)
- Does not include buildings / HVAC



Total capital cost: $20M

Project costs and manpower

- Total manpower (physicists, engineers, technicians, machinists) = 130 person-years



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Building the e-linac…

- Canadian Foundation for Innovation (CFI) published its call for proposals: Feb 2008
  - Intend to apply as a National project ("New Initiative")
  - potential applicants: Dean Karlen, Shane Koscielniak, Justin Albert, Mike Roney, Andrew MacFarlane, Rob Kiefl, Tom Mattison, Chris Hearty, Janis McKenna, Corina Andreoiu, Barry Davids, Jeff Sonier, Kim Chow, Mark De Jong, Mauricio Barbi, Paul Garrett, Carl Svensson, Alan Chen, Graeme Luke, Robert S. Orr, William Trischuk, Alain Bellerive, Jean-Pierre Martin, Rene Roy, Roby Austin, Rituparna Kanungo
  - CFI timeline: application due October 2008, decisions June 2009
- TRIUMF staff involved in design phase:
  - Friedhelm Ames, Rick Baartman, Iourie Bylinsky, Remy Dawson, Ken Fong, Andrew Hurst, Rolf Keitel, Alexey Koveshnikov, **Shane Koscielniak**, Bob Laxdal, Nigel Lockyer, Franco Mammarella, Marco Marchetto, Amiya Mitra, Dragan Mitrovic, Bill Rawnsley, Tom Ries, Roman Ruegg, Igor Sekachev, Victor Verzilov
- E-linac construction will involve international partners
  - strong interest by VECC in Calcutta, to collaborate on construction of e-linac (interest in building their own)
  - ILC and TTC partnerships