e-linac and the ILC

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e-linac and the ILC

- For the worldwide particle physics community, the International Linear Collider is a major initiative
  - to provide a clear and orthogonal view of the new physics landscape at the TeV scale soon to be explored by the LHC

- For TRIUMF, the e-linac is a major new initiative
  - to extend the ISAC science program
  - to open new avenues of research and collaboration
  - to expand its accelerator technology and capabilities
  - to connect with the worldwide ILC effort

e-linac

- The e-linac will use the superconducting RF cavity design developed for the ILC
  - leverage the large worldwide ILC/TESLA R&D investment
  - contribute to the technology development
- Use/adapt existing equipment designs:
  - TTF/ILC 9-cell cavities
  - ILC/Saclay-style tuner
  - TTF/ILC LLRF “SIMCOM”
  - Cornell power couplers – c.w. variant of ILC/Orsay coaxial couplers
  - Cornell cryostat – c.w. variant of TTF cryostat
  - Cornell-type HOM dampers - probably
  - 100 kW klystrons from e2V
- Use aspects from Cornell ERL design

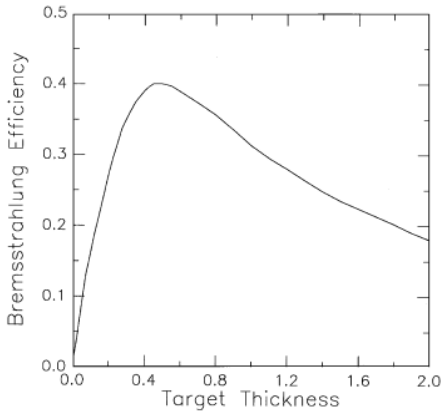
SCRF at TRIUMF

- TRIUMF has developed expertise in SCRF for the ISAC-II linac:
  - $\beta << 1$, ~0.1 GHz, 4K
- The e-linac will expand that expertise:
  - $\beta \sim 1$, ~1 GHz, 2K
- and opens the way to a broad range of accelerator based physics research projects:
  - ILC 1.3 GHz
  - CERN SPL @ 0.7 GHz
  - 4^{th} generation light source (ICS) with CLS
  - MW class photo-fission driver at TRIUMF

Photo-fission driver concept

W.T. Diamond, AECL
NIM A432 (1999) 471

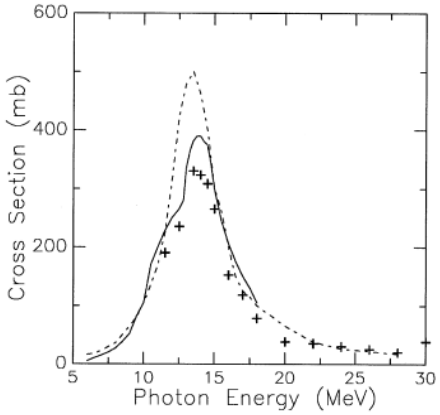
- Electron beam (50 MeV, 10 mA) directed onto a water cooled bremstrahlung production target



High production efficiency

~15 MeV photons are forward peaked

- Photons hit an actinide target: Large photo-fission cross section due to GDR – neutron rich fragments



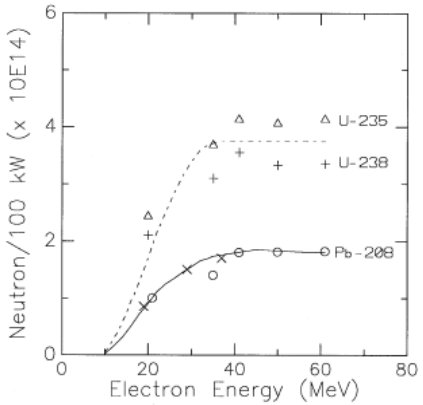


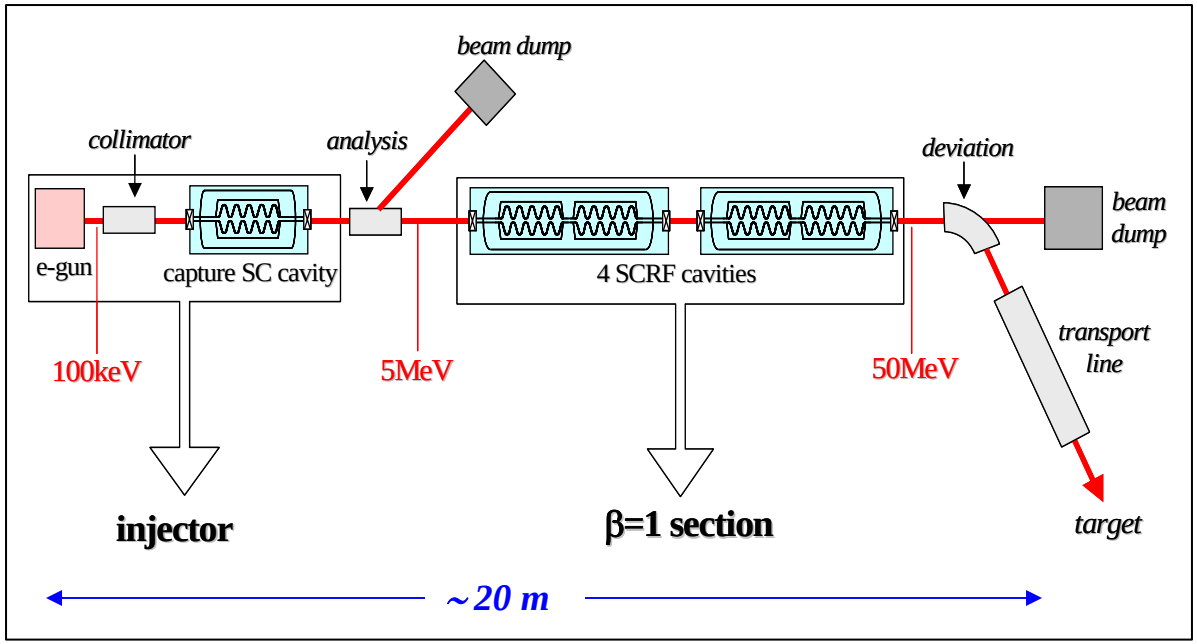
Photo-fission driver specifications

- A 100-500 kW electron beam could produce 10^{13} - 10^{14} fissions/second from a ^{238}U target, leading to copious neutron-rich isotopes.

- Electron linac: low gradient, high power, c.w.
  - 250 kW (5mA, 50 MeV) already challenging for the targets
  - 500 kW (10mA, 50 MeV) challenge for linac (power couplers, HOMs, etc).

- ILC main linac: high gradient, low power, not c.w.

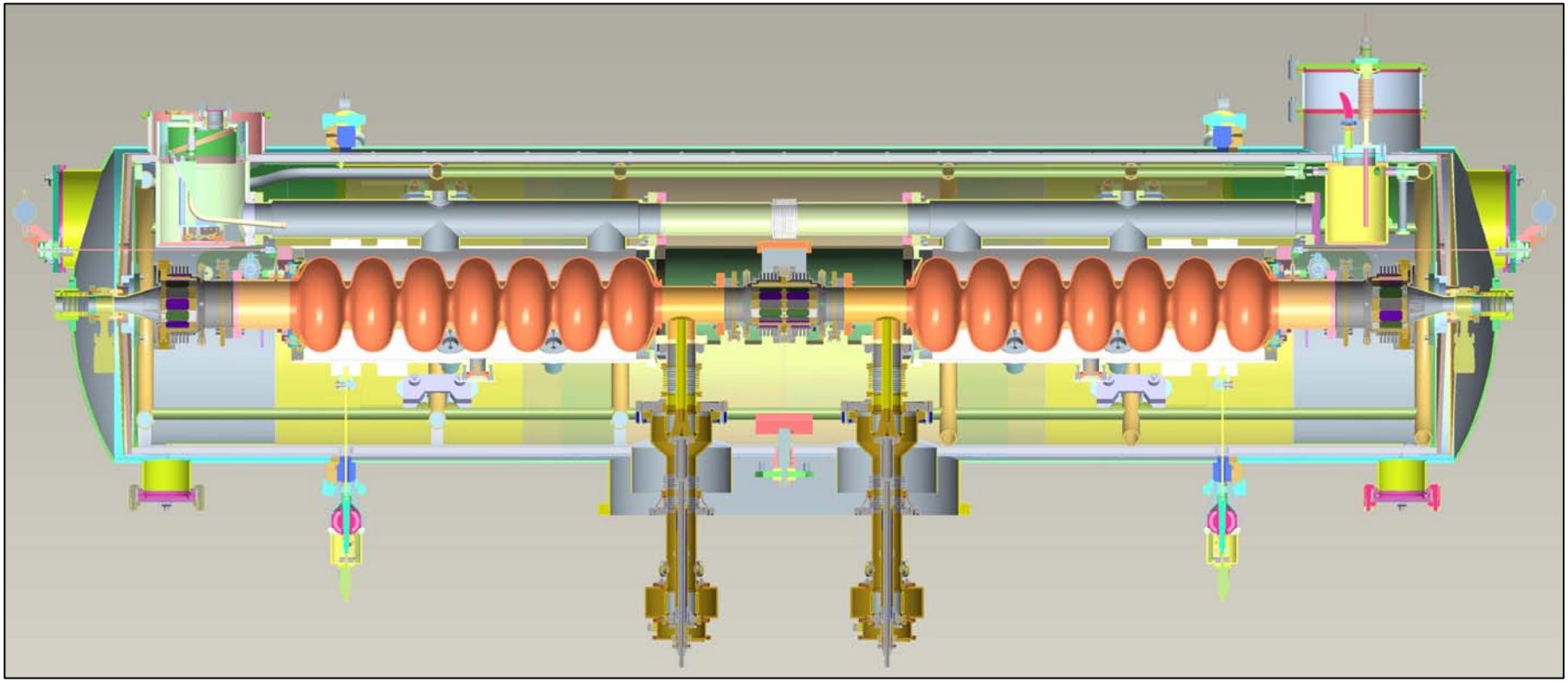
Photo-fission driver concept



rough estimate for capital costs of components: ~$11M

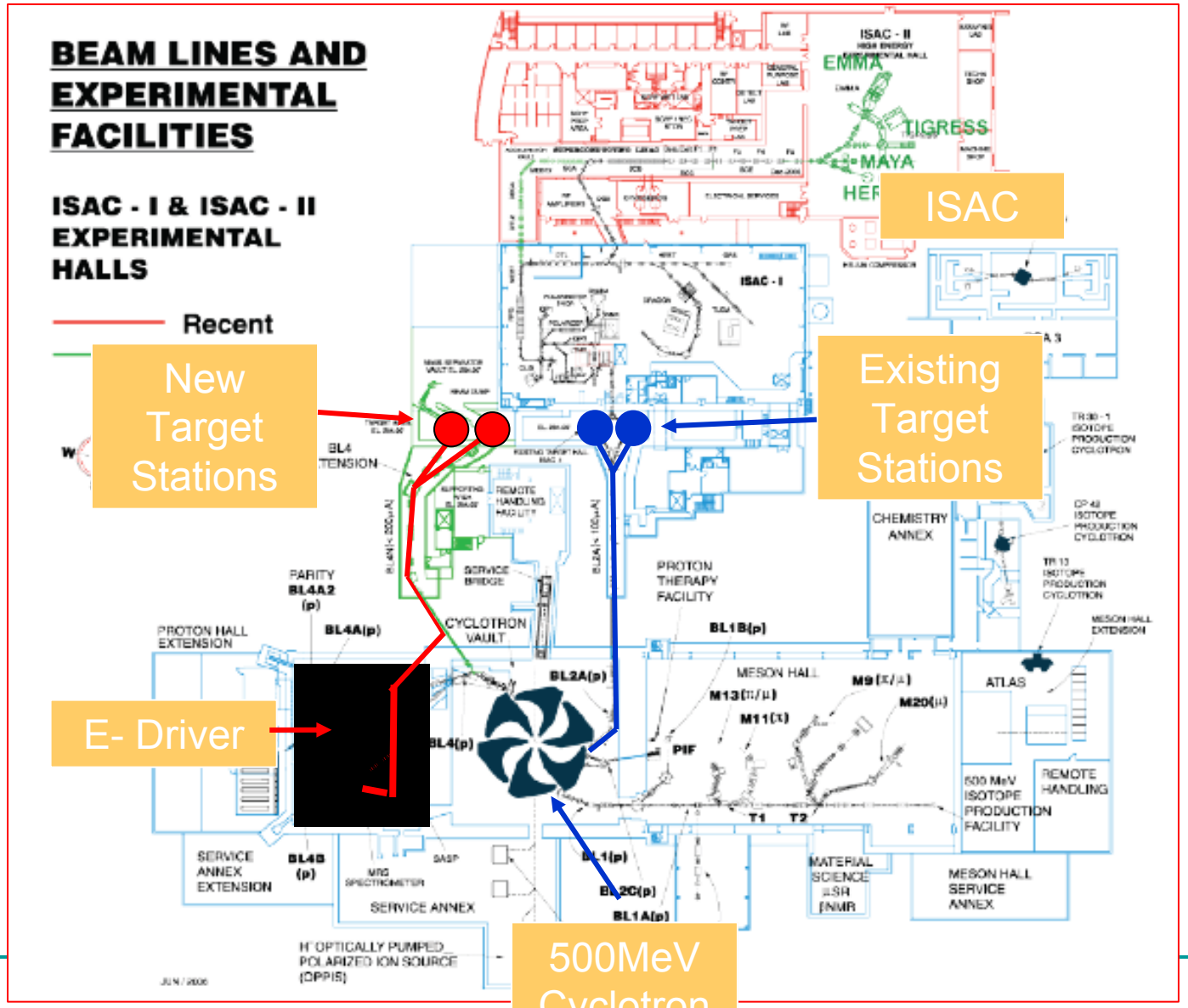
10 mA, 5 MeV 50 kW beam pwr	10 mA, 50 MeV 500 kW beam power	**Fission driver**
Single 9-cell cavity	4 cavities; 9 cell/cavity	All K.E. dumped in target
Two 50 kW input coupler;10 MV/m	Two 50 kW coupler/cavity; 10 MV/m gradient	
Single HOM absorber	1 HOM absorber/cavity	500 kW

Cryomodule



- follows Cornell design

Proposed location



Industrial partnership

- Collaborate with PAVAC on Nb cavity manufacture
  - Richmond, BC
  - specialize in electron beam welding

New 10,000 sq ft facility

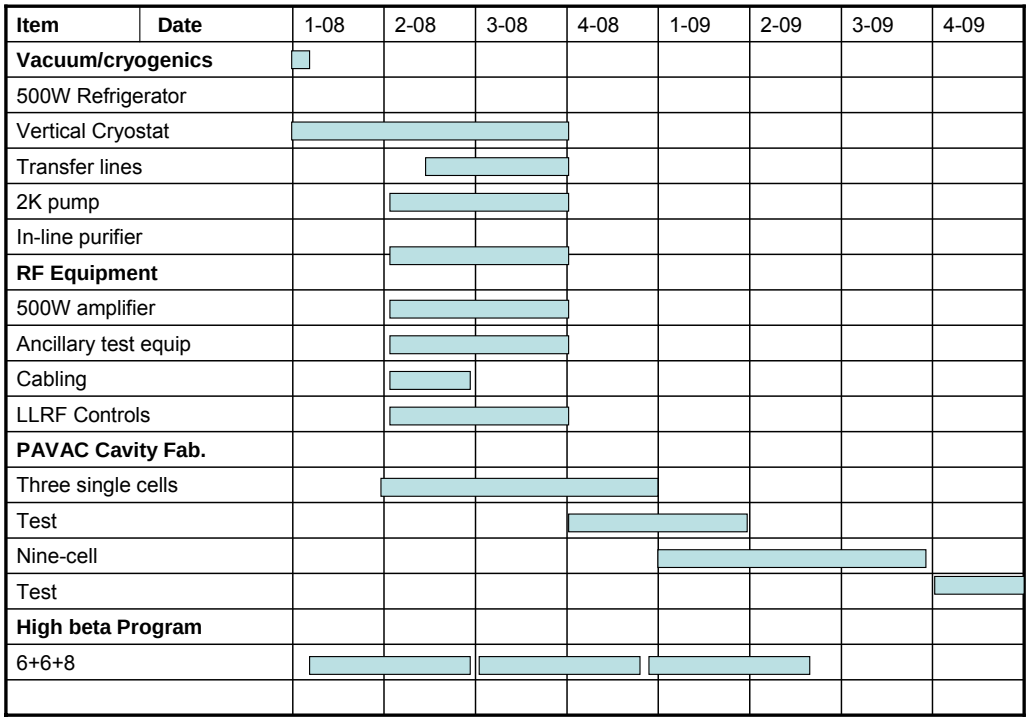
- Work to qualify PAVAC as a North American supplier of ILC cavities
  - Single-cell production, 9-cell cavity fabrication, R&D on process control & single-crystal cavity
  - TRIUMF Infrastructure will allow chemical etch (BCP) but not electro-polish (EP)

SCRF R&D plan

- Focus for next two years: master 1.3 GHz SCRF, and concentrate on those areas that have greatest overlap with ILC:
  - build vertical cryostat compatible with 140 MHz and 1.3 GHz cavities
  - co-opt the 500W cryo-system that will be available 2 years in advance of delivery of λ/4 hi-beta cavities
  - purchase test equipment

- Manpower:
  - Additional resources will be required (physicist, engineer, rf engineer, mechanical tech, etching tech).

1.3GHz SRF Test Program



SCRF at TRIUMF in the longer term

- By ~2010 the path for the future of particle physics will be clarified (LHC results, ILC EDR)
  - choice of emphasis for HEP SCRF program (ILC, SPL) will depend on circumstances at that time
- ILC now beginning to prepare engineering design report, to be completed by 2010
  - Earlier this year, reference design report completed (on schedule)
  - initial costing:
    - $1.8B site specific
    - $4.8B shared
    - 24M person-hours
    - $0.5B detector

Summary

- e-linac has the potential:
  - to expand the physics program at ISAC-II
    - neutron rich isotopes
    - second source, independent of cyclotron schedule
    - cost effective – uses existing ISAC detector complex
  - to open new areas of research
    - materials science, medical isotope production
  - to develop new collaborations
    - ILC, CERN SPL, ERLs, CLS
  - to maintain the vitality of Canada's national accelerator facility for decades to come