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

Electron Linac

Proposal for ½ MW photo-fission driver based on TESLA 1.3 GHz SCRF technology

(Shane Koscielniak, 09 Nov 2007)

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

The requirement: 50 MeV × 10 mA = ½ MW beam power eliminated on target.

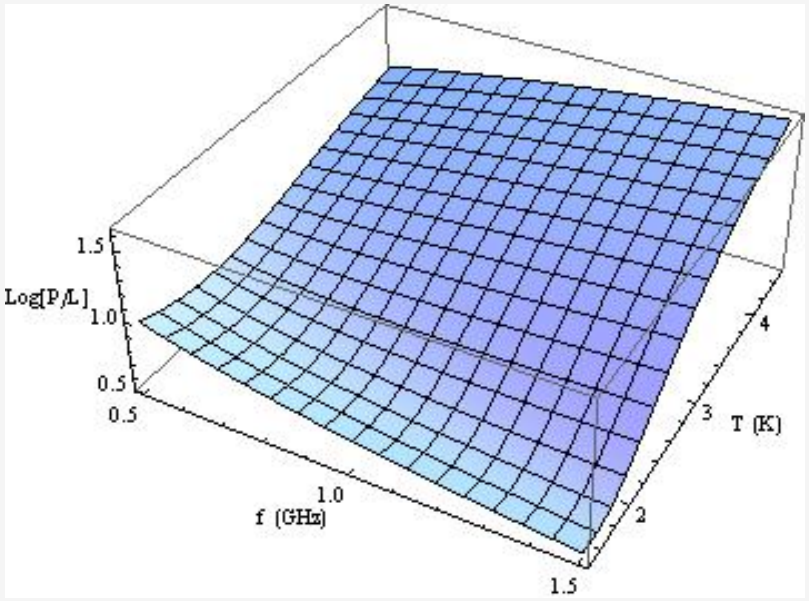
Bunch charge (pC)	8
Bunch repetition rate (GHz)	1.3
Radio frequency (GHz)	1.3
Average current (mA)	10
Kinetic energy (MeV)	50
Beam power (MW)	0.5
Duty Factor	100%
Normalized emittance (μm)	<30π
Longitudinal emittance (eV.ns)	<20π
Bunch length (FW), inject (ps)	<170
Bunch length (FW), eject (ps)	>30
Energy spread (FW), eject	<1%

Why SCRF? High duty factor or c.w. operation inconceivable with NC cavities – for 50 MeV c.w., need 3 MW RF power!

Why 1.3 GHz and 2 K?

Power/Length @ constant gradient =

$$\frac{c\, E0^2 \left(Rdc + \frac{A\, e^{-\frac{B}{T}}\, f^2}{T} \right) (-T + Ts)}{2\, f\, T\, \eta^2}$$



1.3 GHz SCRF cavities have been in development for >30 years, starting with 27 m long 50 MeV SCA at Stanford.

With major impetus from TESLA, technology is now mature with gradients >20 MV/m routine.

Interior dimensions:

23.8 m (E-W), 28.9 m (N-S) – wall to wall

RF gallery 8×8 m^2

Cryogenic: 4×6 m^2

Electron linac alone 15×3 m^2

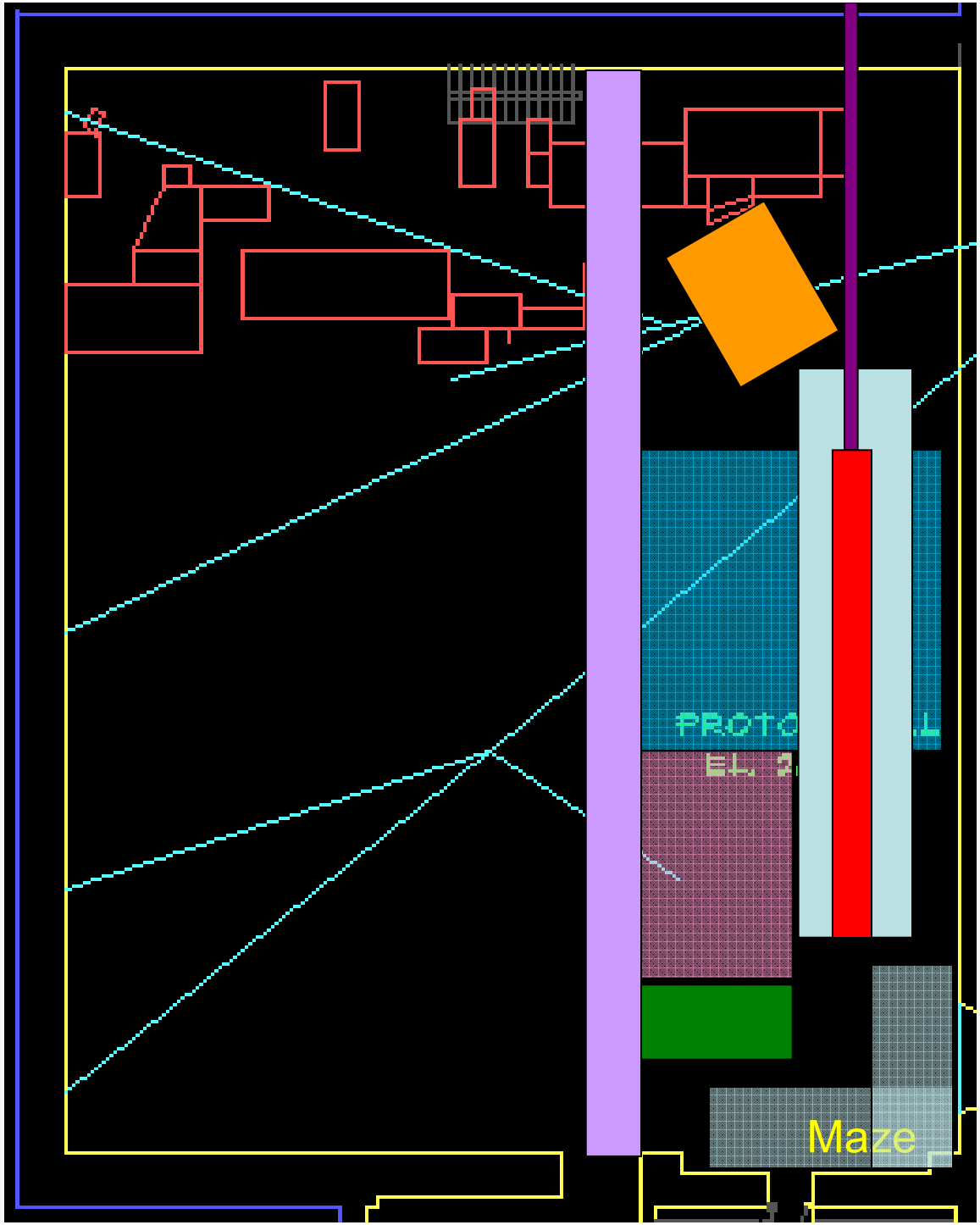
50 kw dump: 4×3 m^2

Total footprint approx 8.5×25 m^2

This does includes maze; could move linac south if maze re-designed.

This does not include shielding of 1.5 m concrete

Equipment racks & PS: 4×2 m^2



Shielding: shield who from what?

GANIL/SPI2/007-A = Spiral-II Electron Option Preliminary Design Study

Base radiation protection on goal of $\leq$ 7.5μSv/h (so-called “Surveillance Zone”)

Scenario: 1 μA localized loss at 50 MeV, leading to istotropic brehmstrahlung gives gamma flux 10^{13} MeV/s/$m^{2.}$

Produces dose equivalent of 1.24×10^{7} μSv/h

Requires 1.43 m high density concrete to reduce to 7.5 μSv/h

WORK IN PROGRESS!!

Interior dimensions:

24 m (E-W), 29 m (N-S)

RF gallery 8×8 m^2

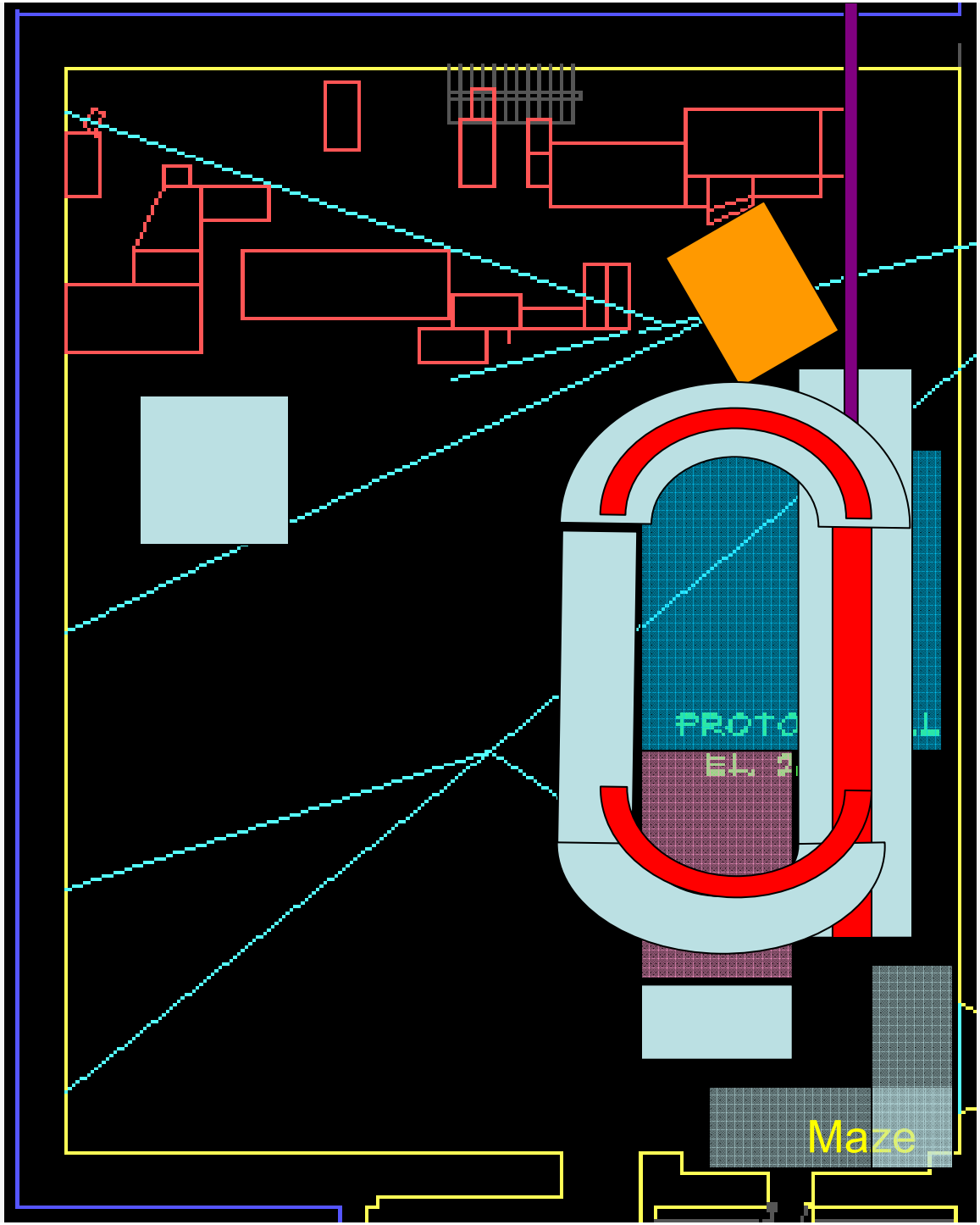
Cryogenic: 4×6 m^2

Electron linac alone
15×3 m^2

50 kw dump: 4×3 m^2

Total footprint approx
8.5×25 m^2

This includes maze;
could move linac south if
maze re-designed.



Insert acknowledgements, if needed

4004 Wesbrook Mall
Vancouver, B.C. Canada V6T 2A3
Tel: 604 222-1047 Fax: 604 222-1074

www.triumf.ca