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

0.5 MW eLINAC Converter/Target Concept

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TRIUMF

2nd Oxford-Princeton High Power Target Workshop
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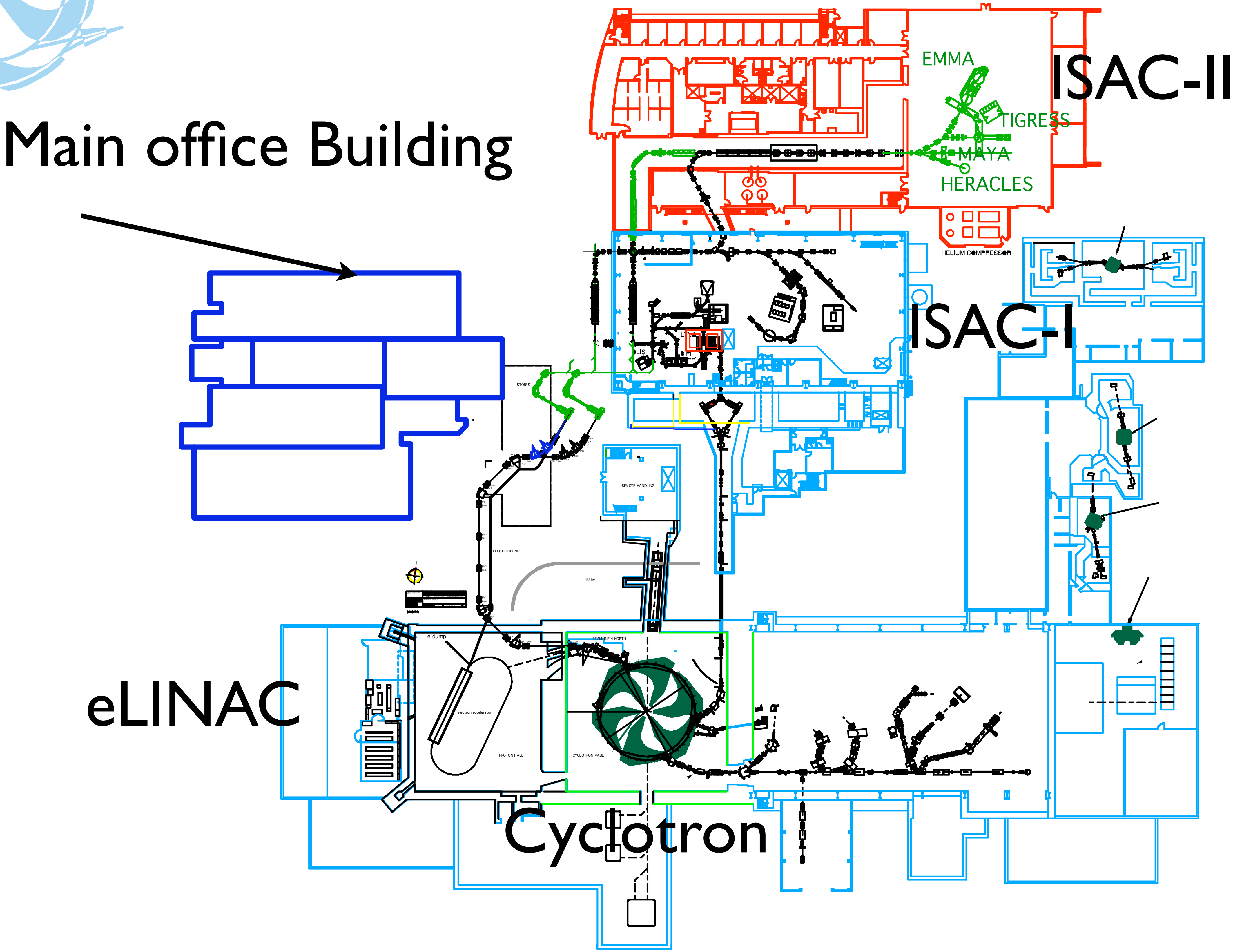
LABORATOIRE NATIONAL CANADIEN POUR LA RECHERCHE EN PHYSIQUE NUCLÉAIRE ET EN PHYSIQUE DES PARTICULES

Propriété d'un consortium d'universités canadiennes, géré en co-entreprise à partir d'une contribution administrée par le Conseil national de recherches Canada

eRIB layout



Main office Building
EMMA
ISAC-II
TIGRESS
MAYA
HERACLES
ISAC-I
eLINAC
Cyclotron

Basic Parameters

Item	Value	Units
Electron energy	50	MeV
Total power	1/2	MW
Electron current	0,01	Ampère
Target, UC_2	15	g/cm^2

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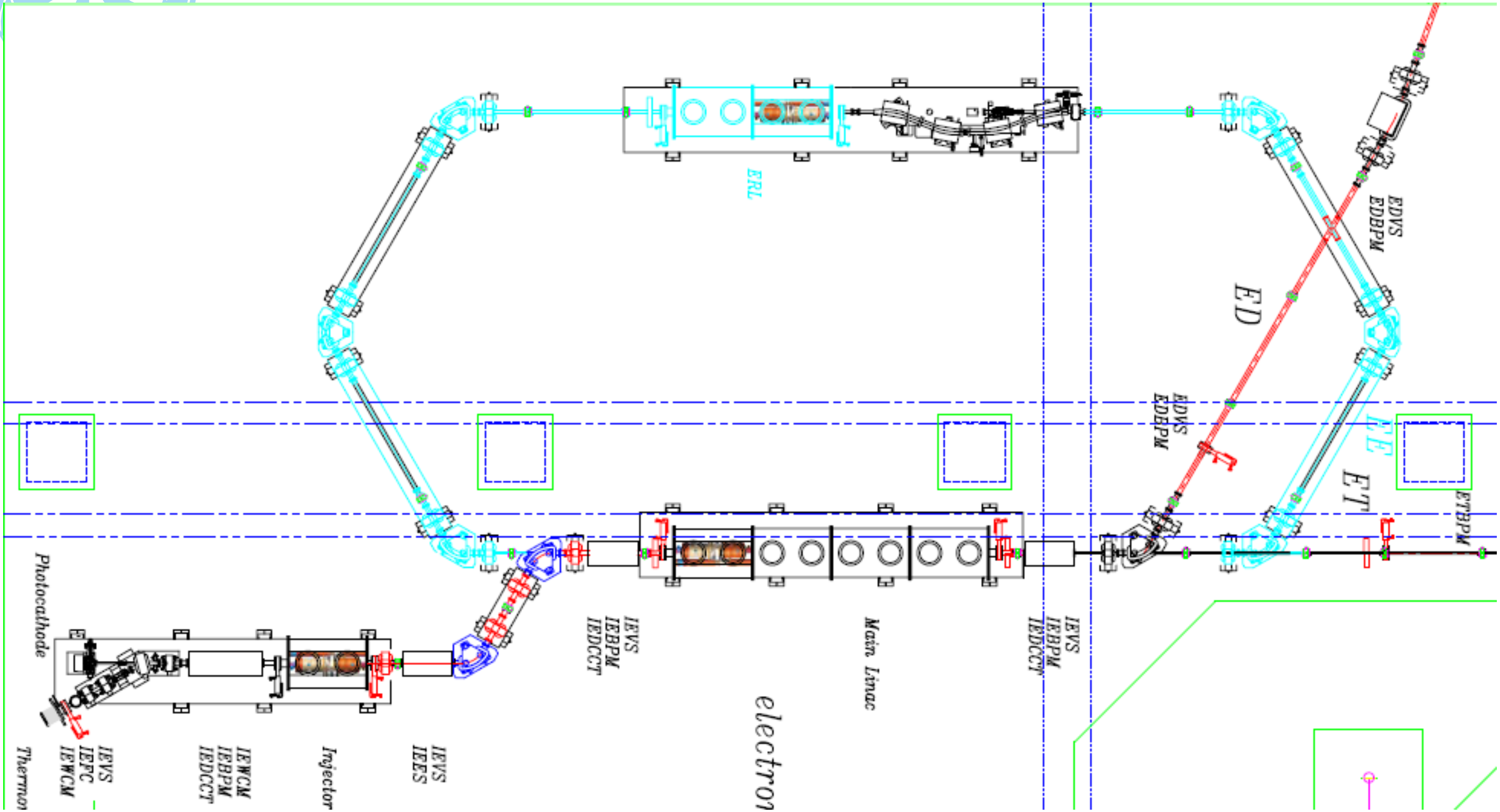
e-LINAC



e-LINAC a tools for future R&D,
Initially e-LINAC will be used for photo-fission to produce rare isotope beams.

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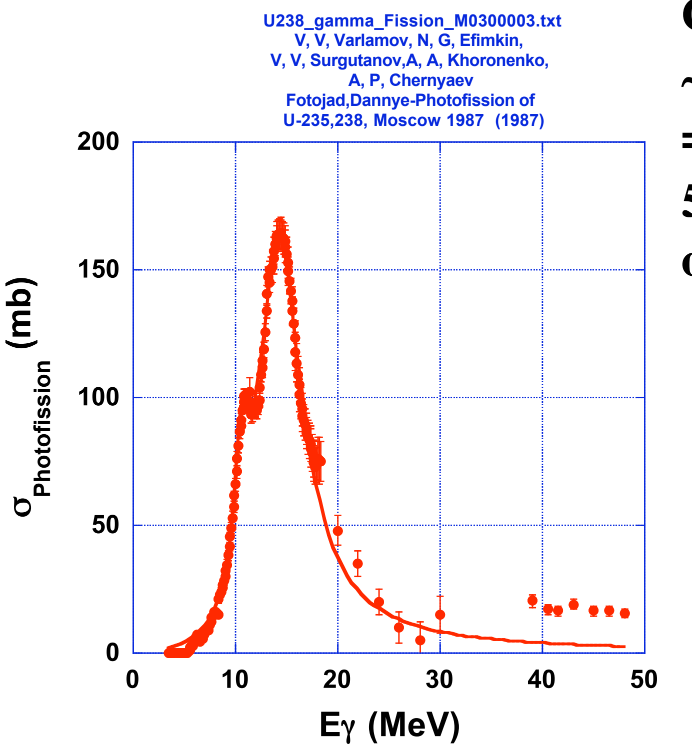
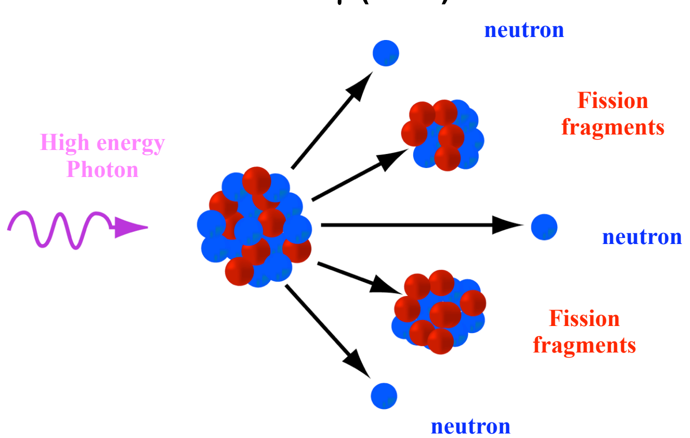
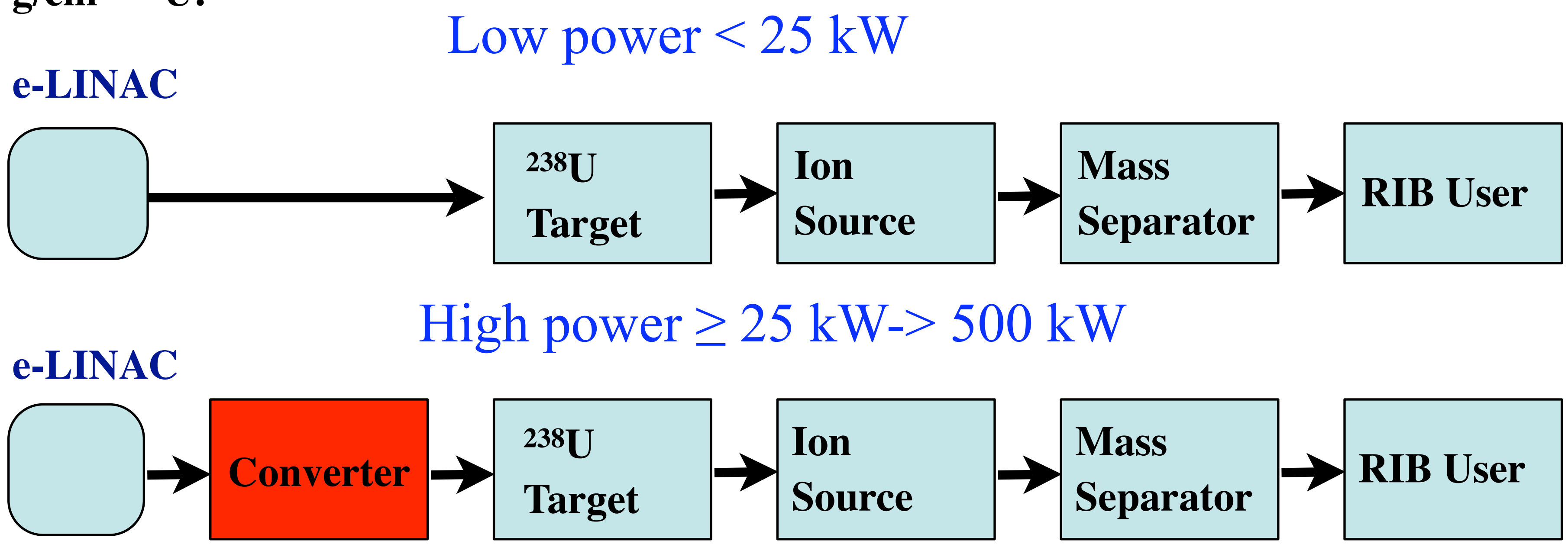
Conceptual Layout

- We are proposing to built a new 50 MeV ½ MW electron LINAC.
- This LINAC will be used for photo-fission using GDR in ^{238}U.

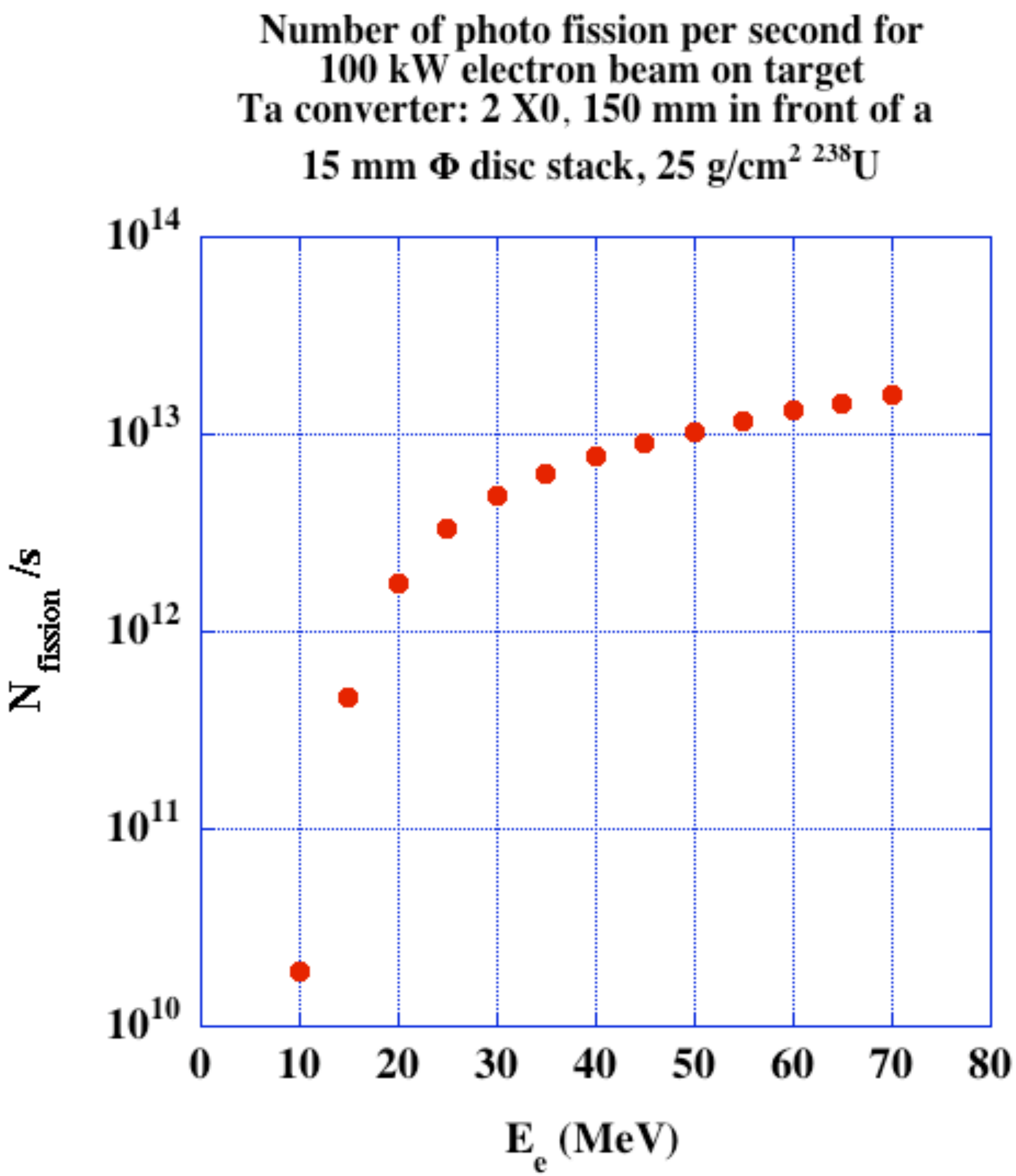


Cross section
~ 160 mb @ 15 MeV
=> 9.6e-4 pf/electron
50 MeV electron beam on 15 g/cm² ^{238}U.





Fission vs Ee; 100 kW



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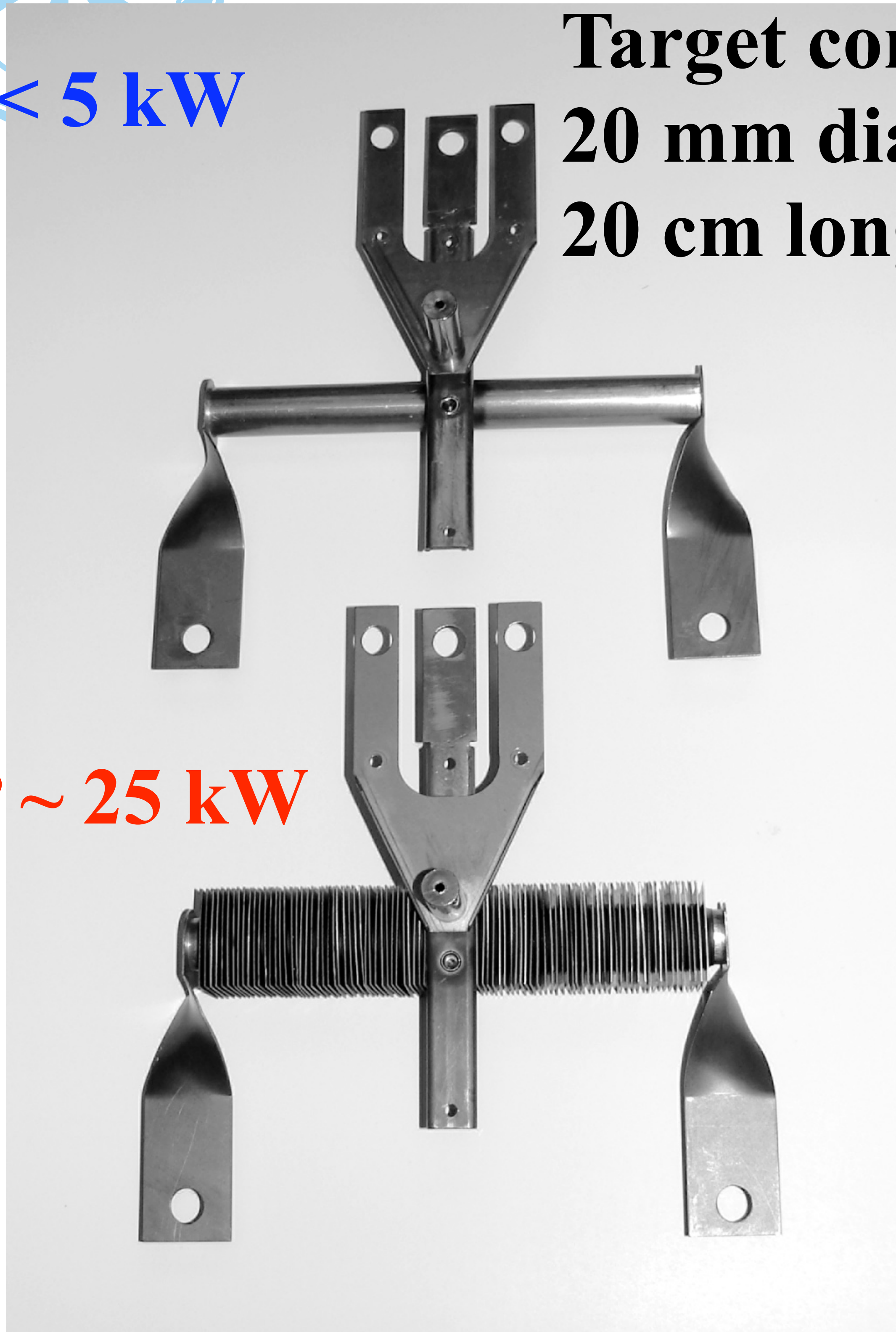
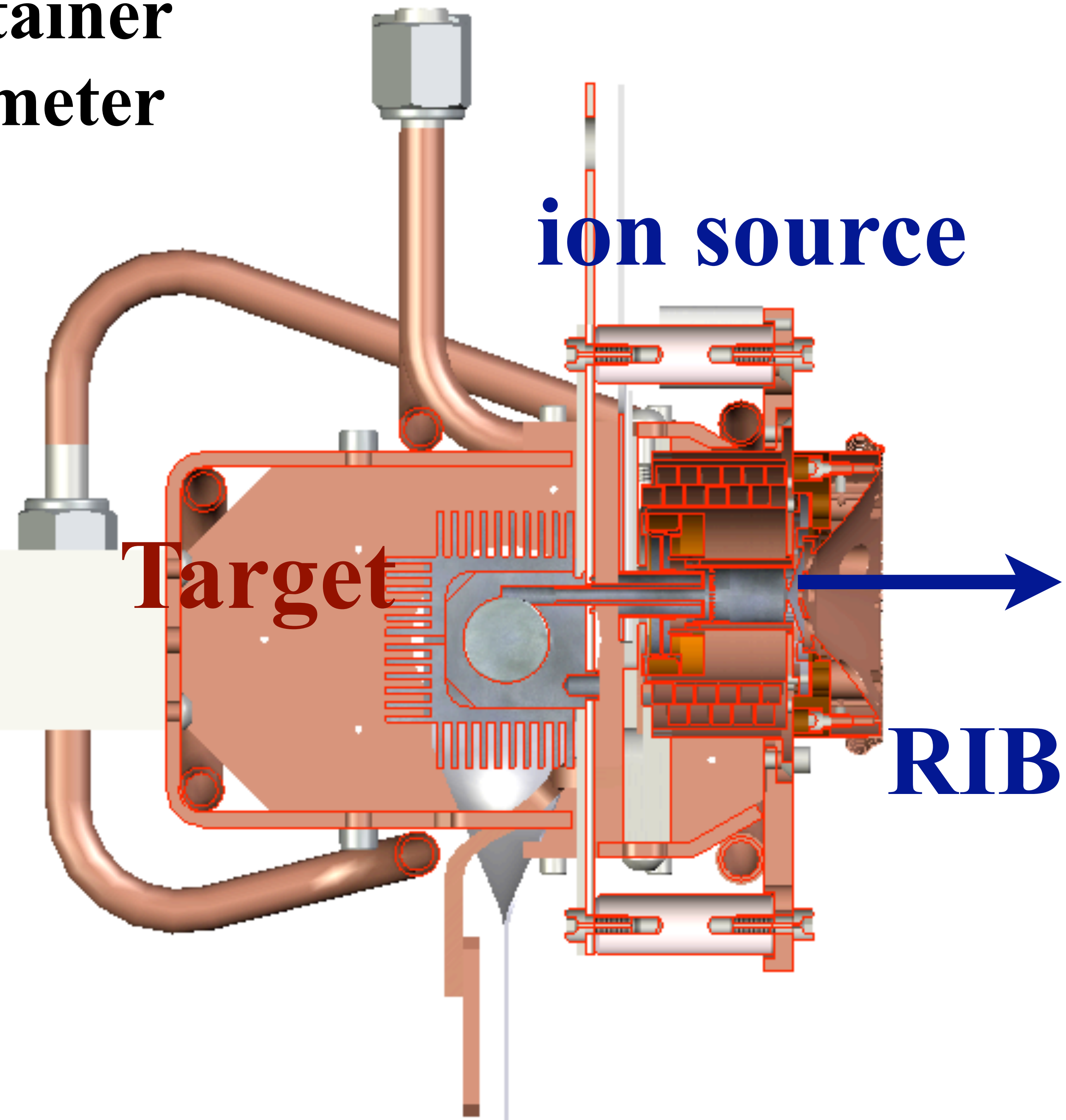
ISAC Target/Ion Source

P < 5 kW

Target container
20 mm diameter
20 cm long



P ~ 25 kW



Braking Radiation

$$\frac{dE_{Rad}}{\rho dx} \simeq -\frac{E}{X_0}$$

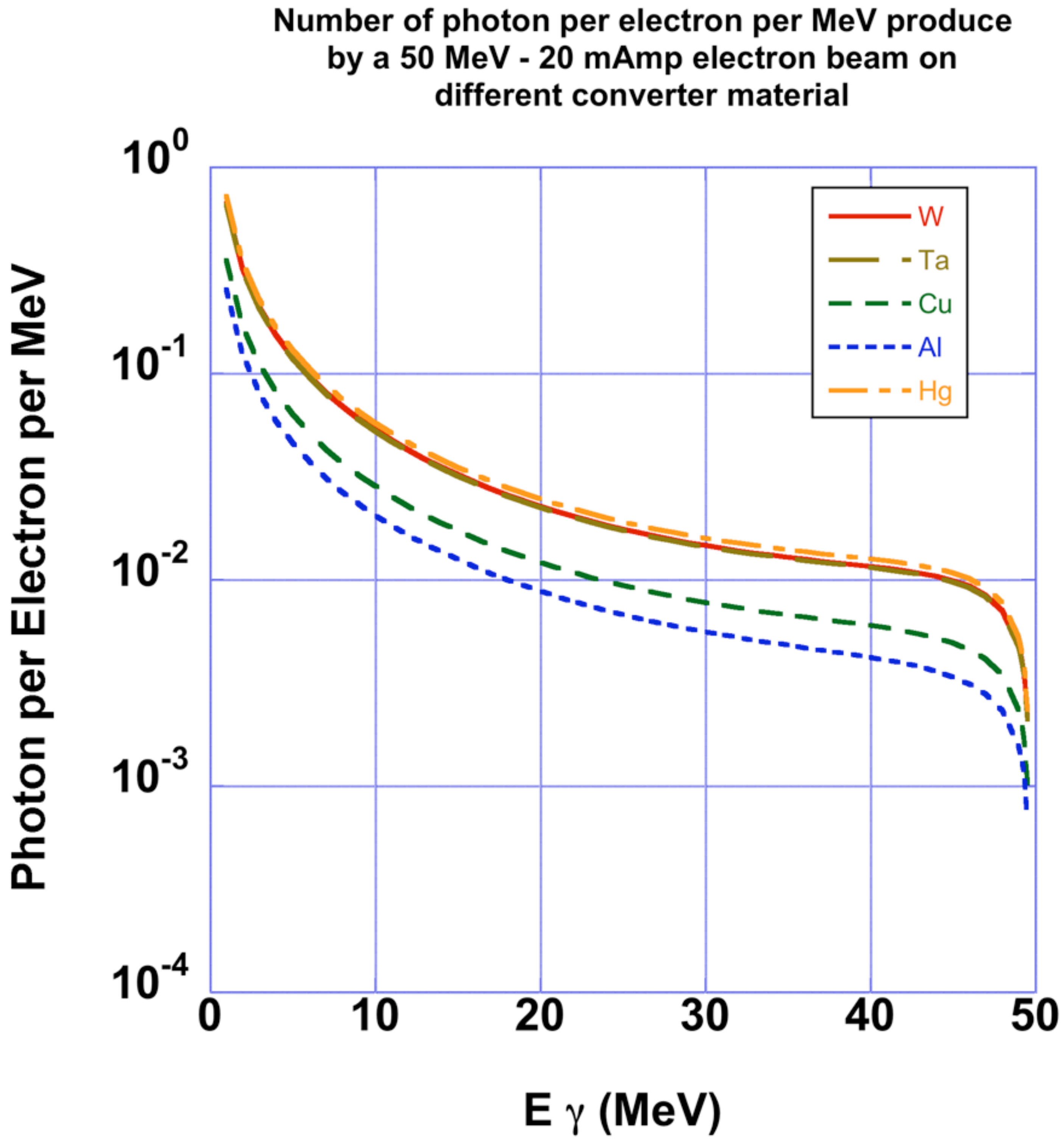
$$\frac{1}{X_0} = \frac{4\alpha N_A Z(Z+1) r_e^2 log(183 Z^{-1/3})}{A}$$

$$\overline{E} \simeq E_0 exp(-\frac{\rho \Delta x}{X_0})$$

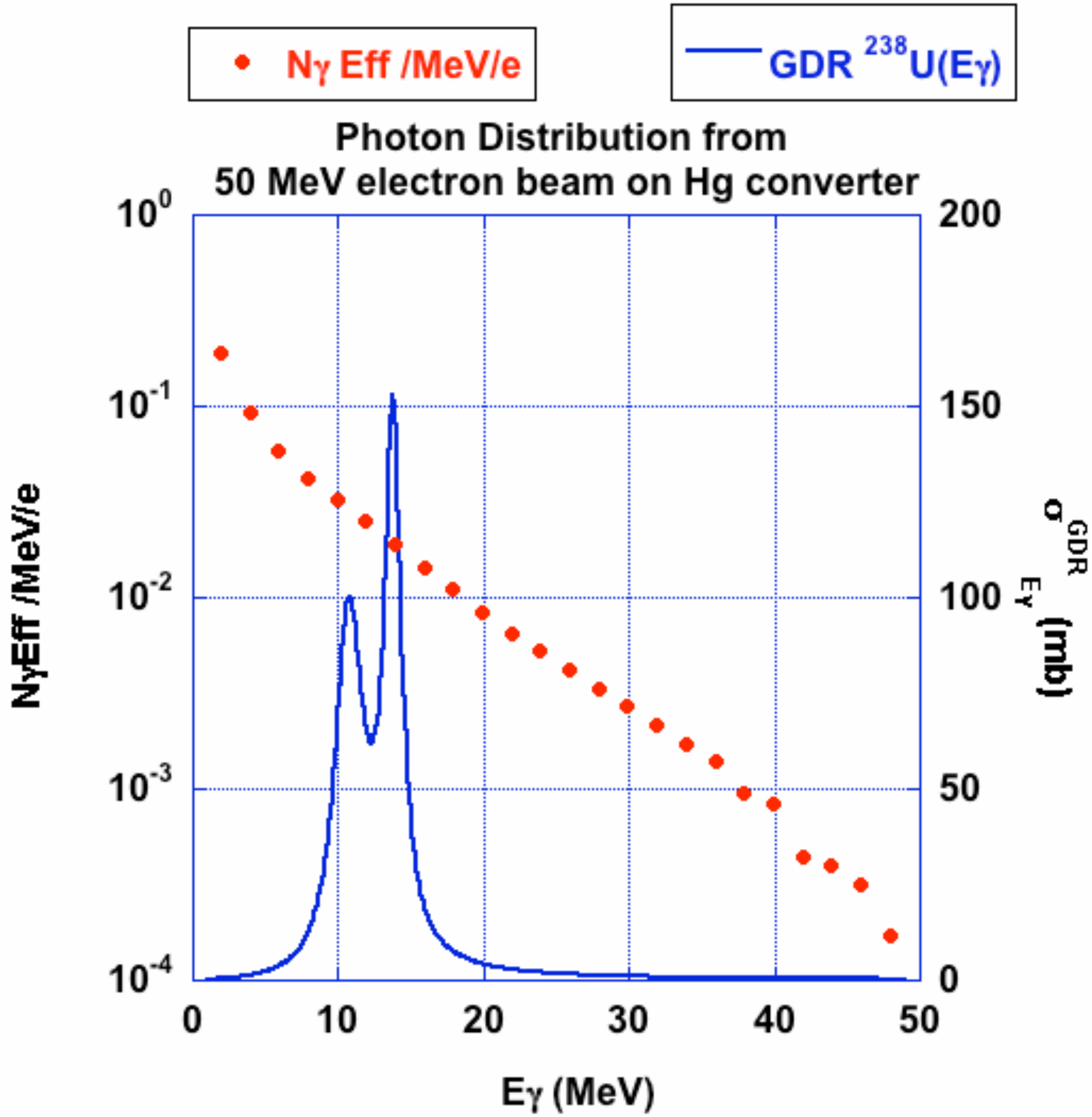
- E is the electron energy
- α ~ 1/137
- N_A is the Avogadro number, 6,023e23 at/mole
- Z is the material atomic number
- r_e is the classical electron radius ~ 2,818e-13 cm
- A is the molar mass of the material

Element	Z	A	ρ (g/cm³)	$1/X_0$	X_0 (g/cm²)	τ (cm)
Al	13	27	2,3	0,0178	56,17	24,42
Cu	29	63,5	8,92	0,0340	29,45	3,30
Ta	73	181	16,65	0,0684	14,62	0,88
W	74	184	19,25	0,0691	14,48	0,75
Hg	80	202	13,58	0,0729	13,71	1,01
Pb	82	208	11,34	0,0742	13,47	1,19

Photon Distribution



TRIUMF Residual photon distribution



Pierre Bricault, TRIUMF

Nov. 6-7, 2008

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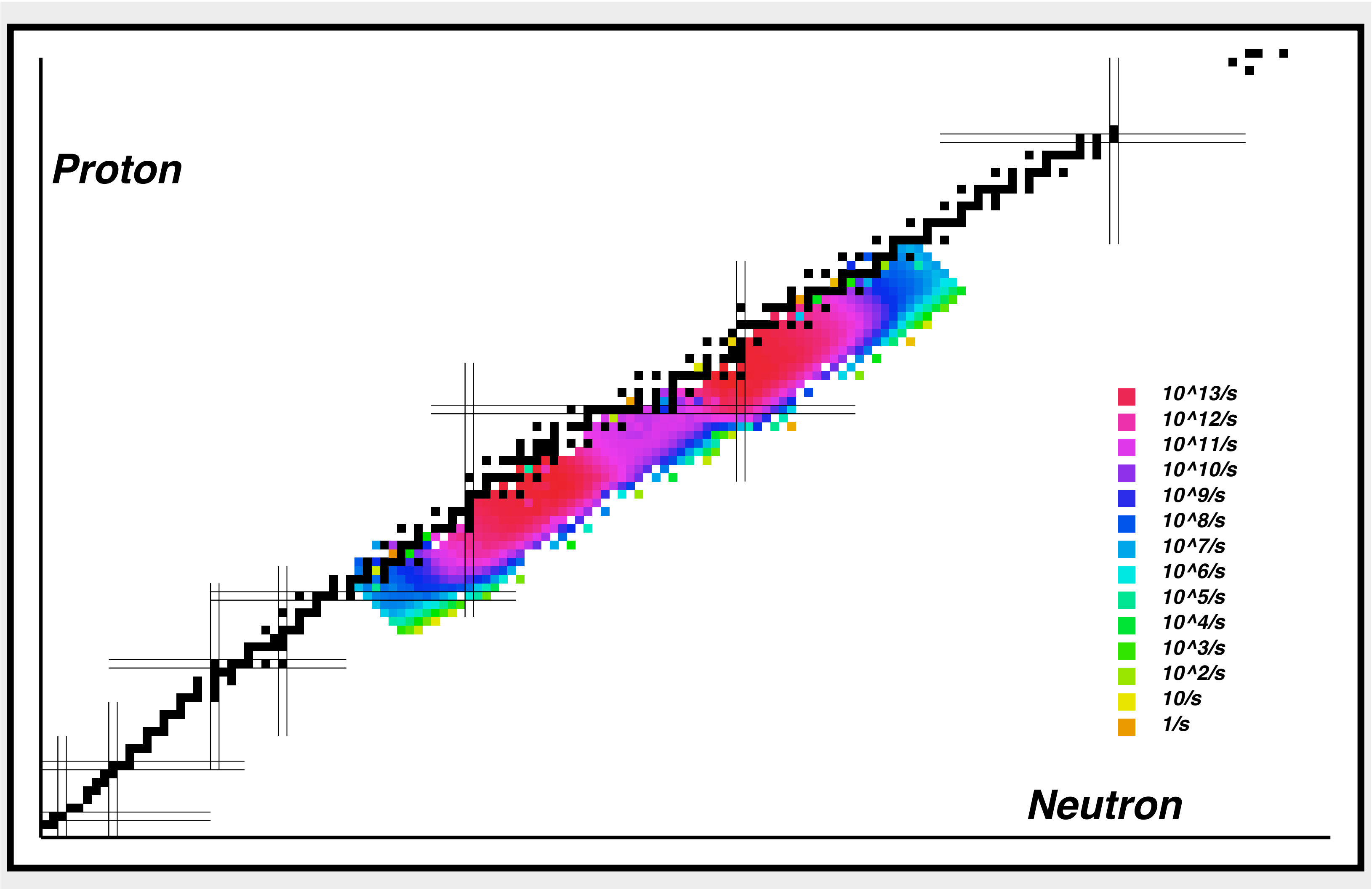
3) Photo-fission yield

- Use GEANT4[1] and FLUKA[2] to simulate the photo-fission.
  - 50 MeV, 500 kW yield to ~ $1x10^{14}$ photo-fissions/s.

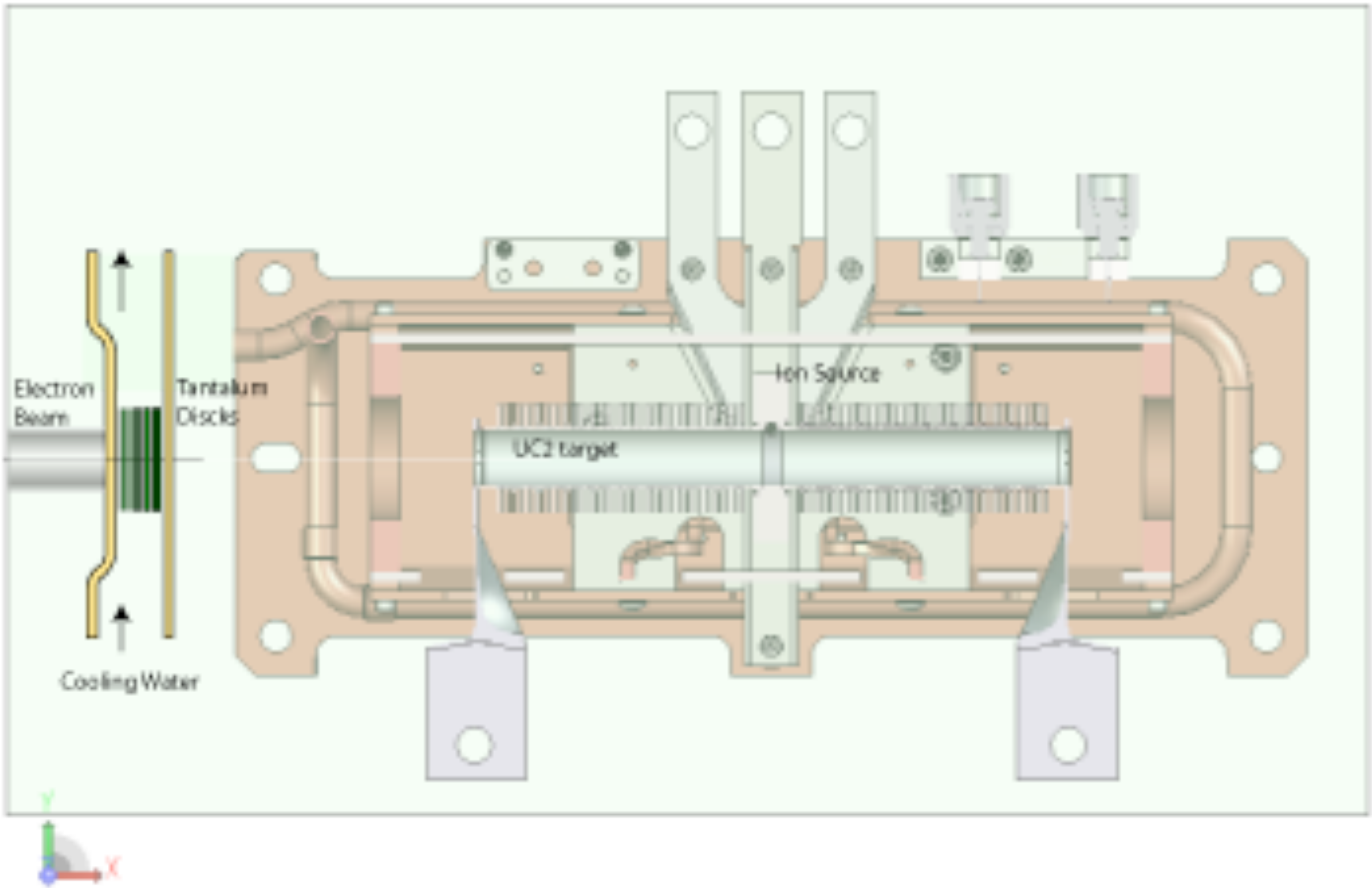


1) Geant4 Developments and Applications, J. Allison et al., IEEE Transactions on Nuclear Science **53** No. 1 (2006) 270-278
Geant4 - A Simulation Toolkit, S. Agostinelli et al., Nuclear Instruments and Methods **A** 506 (2003) 250-303
2) Copyright Italian National Institute for Nuclear Physics (INFN) and European Organization for Nuclear Research (CERN)("the FLUKA copyright holders"), 1989-2007.

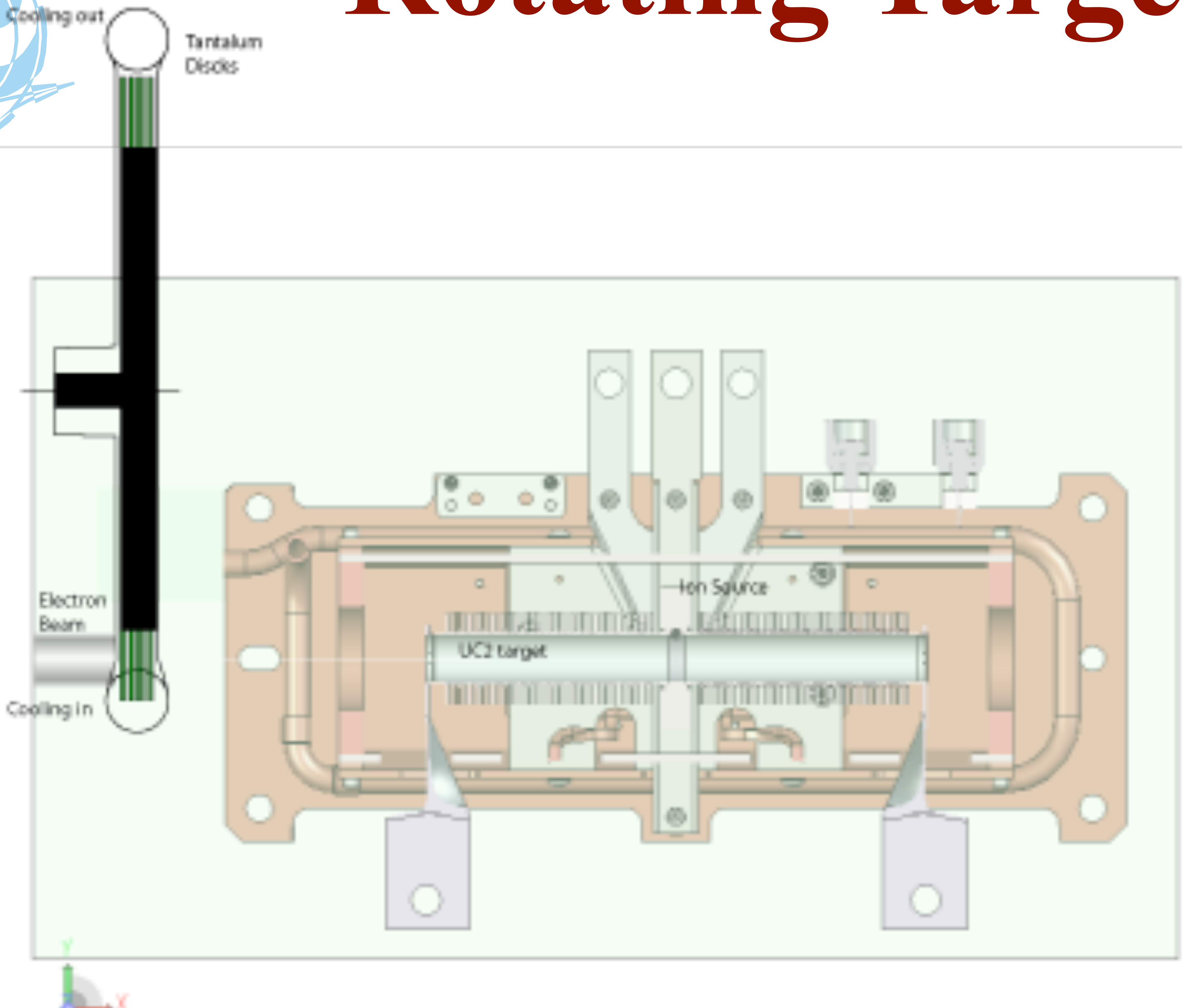
TRIUMF Converter options

- Fixed solid target
  - + Easiest way to get converter
  - + Can used water cooling
  - - Can work up to 100 kW.
- Rotating wheel
  - + Can reach 1/2 MW,
  - - Rotating target requires coupling driver outside radiation area,
  - - Coupling cooling and rotating shaft
- Liquid target
  - + Seems easy to implement, good cooling capabilities,
  - - We have to deal with liquid Hg or Pb.
  - - For Hg we do not have easy disposal solution
  - - Hg contamination.

Fixed solid target



Rotating Target



Liquid Target