Magnet Design and Radiation Transport for the RIA Fragment Separator

Al Zeller

NSCL/MSU

NSCL

MICHIGAN STATE UNIVERSITY

Thanks to my coworkers:

Reg Ronningen

Jon DeKamp

Brad Sherrill

Valentine Blideanu

Ramesh Gupta

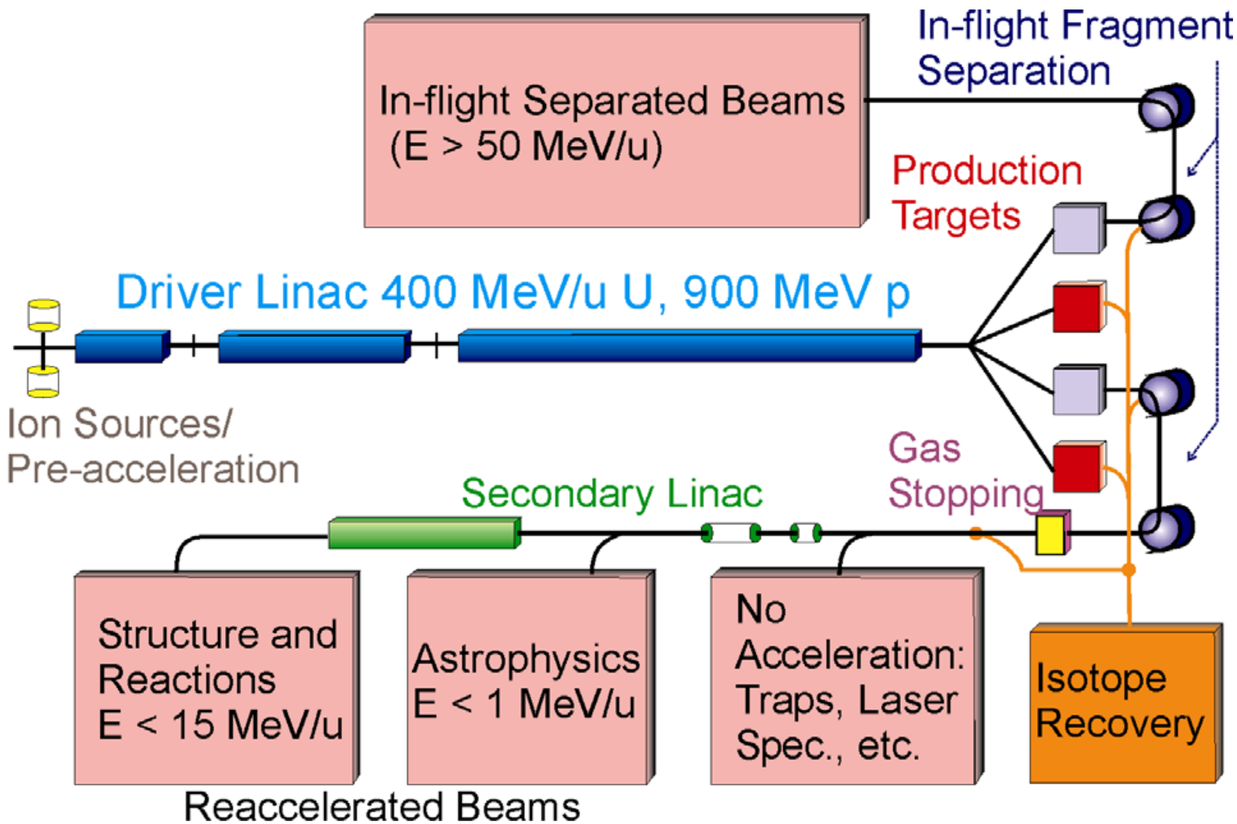
RIA project has about **1000** magnets: many of which are superconducting and are required to operate in high radiation environments.

Rare Isotope Accelerator - RIA

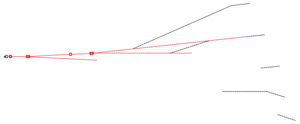
Intense source of rare isotopes

- High power primary beams elements up to uranium at $6x10^{12}$/s and E > 400 MeV/nucleon.
- Possibility to optimize the production method for a given nuclide.

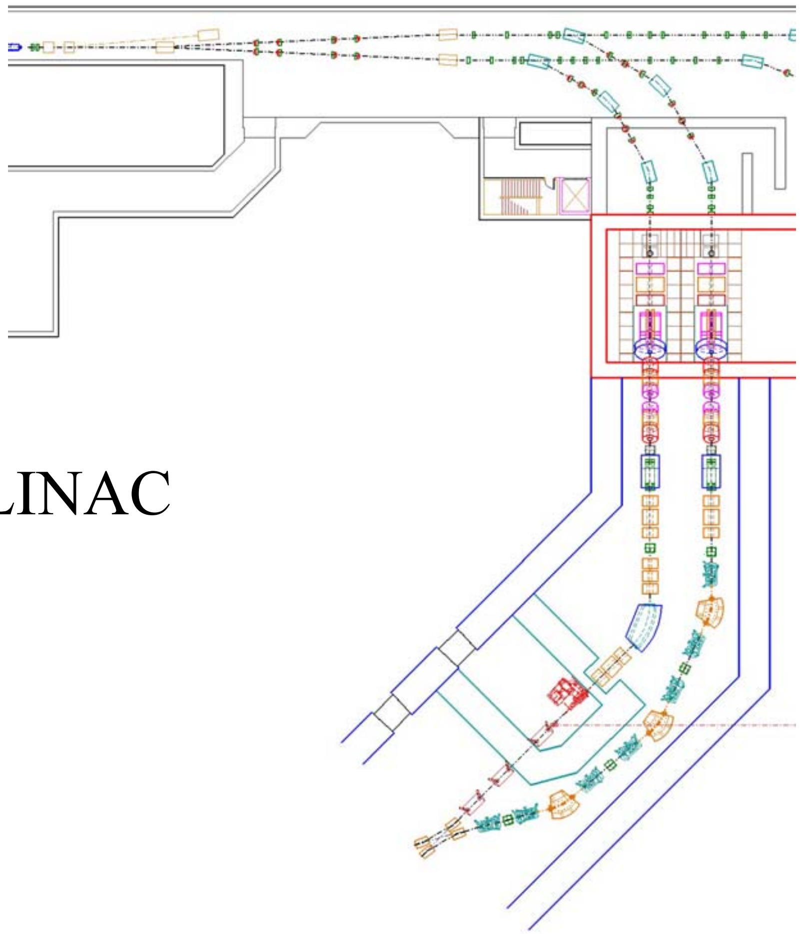
Schematic of the RIA Concept



NSCL overview plan for RIA



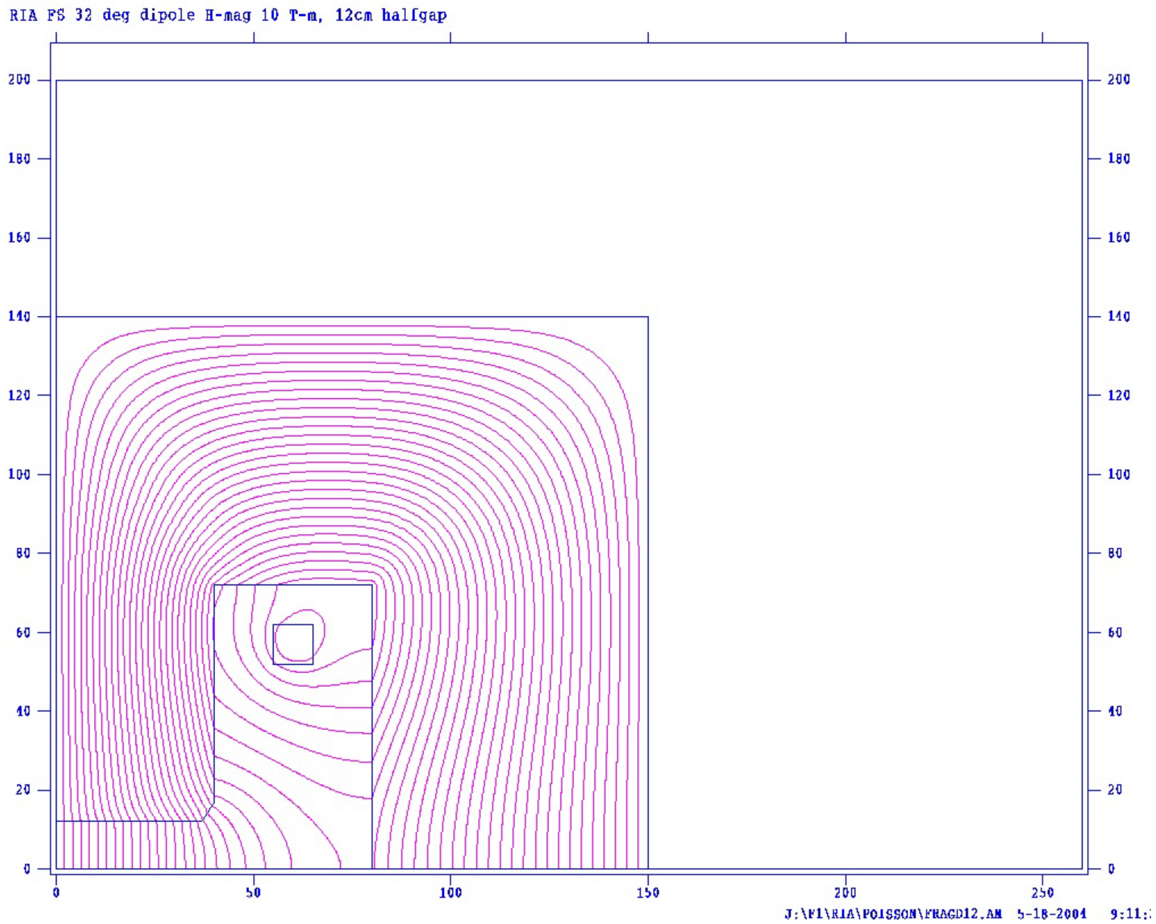
LINAC



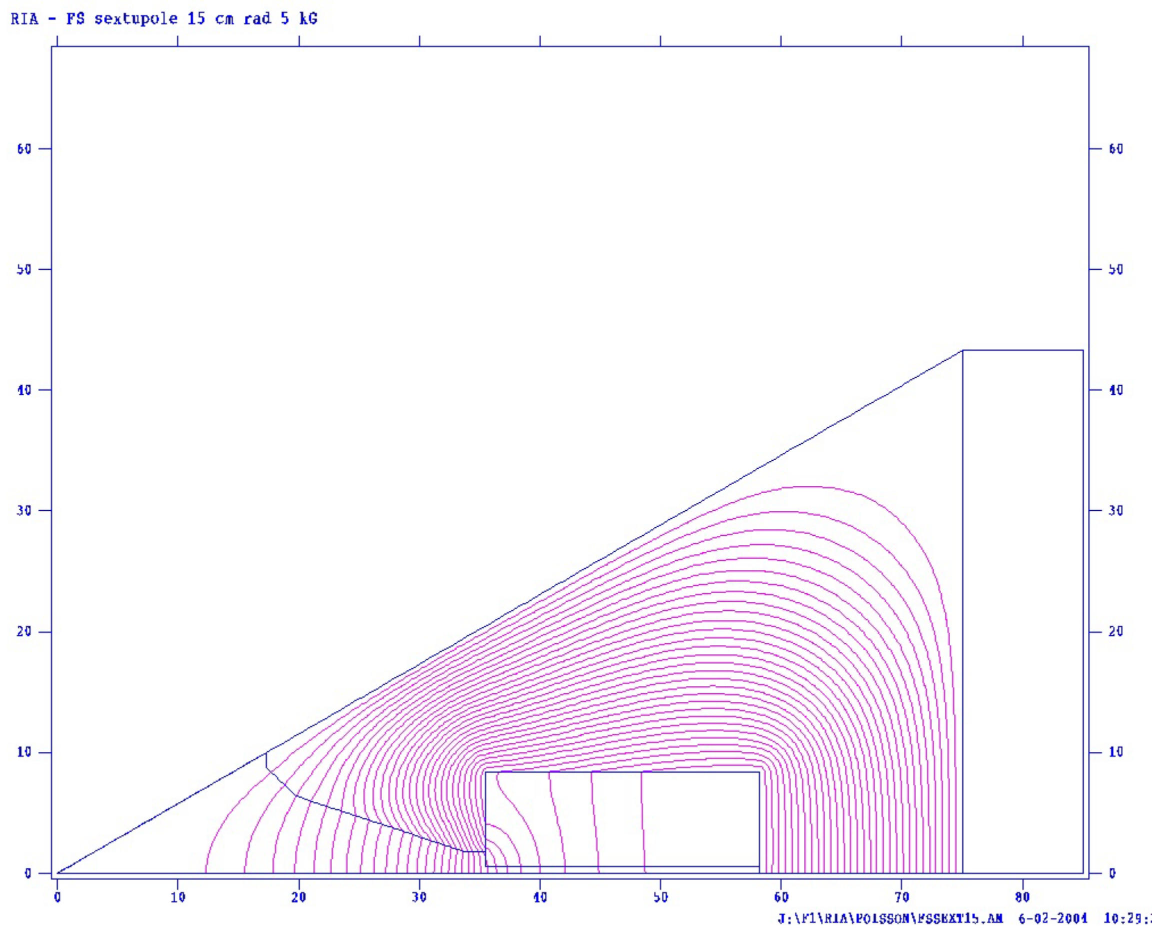
Pre-separator quads. Blue are radiation resistant

Type	Radius(mm)	Field(T)	L(mm)
Quad 1,12	150	1.0	1000
Quad 2 ,11	200	1.5	1500
Quad 3,10	250	1.9	1000
Quad 4,5,8,9	250	1.5	1250
Quad 6,7	250	1.1	500
Dipole 1,2			
(32 deg)	120	1.9	2940
Sex 1	200	0.5	750
Sex 2	200	0.5	750

radiation resistant dipole



Sextupole

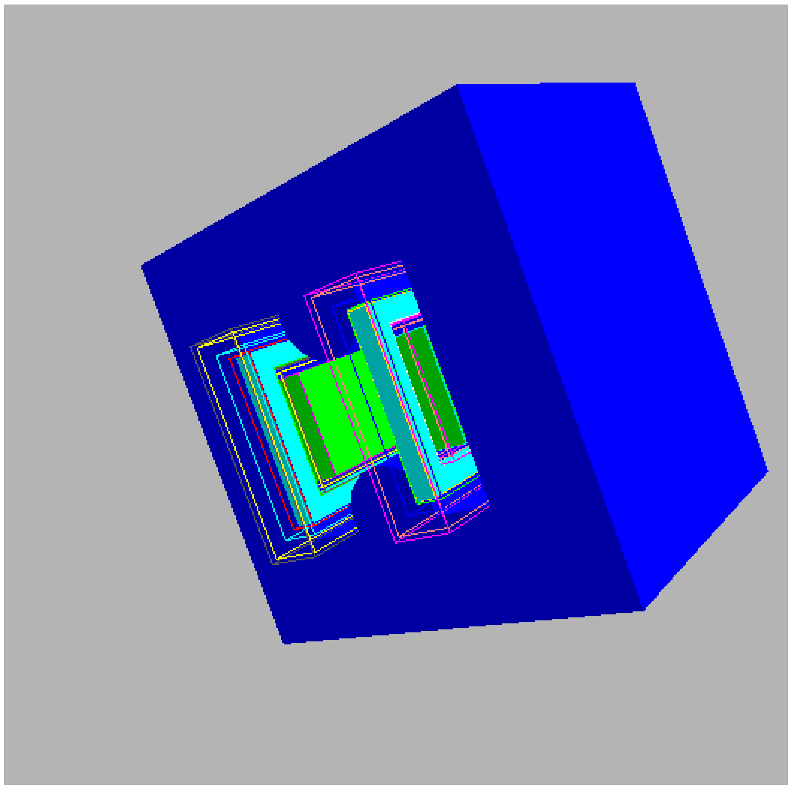

RIA - FS sextupole 15 cm rad 5 kG
0
10
20
30
40
50
60
0
10
20
30
40
50
60
70
80
J:\F1\RIA\POISSON\FSSEXT15.AM 6-02-2004 10:29:

How do we go from POISSON to PHITS?

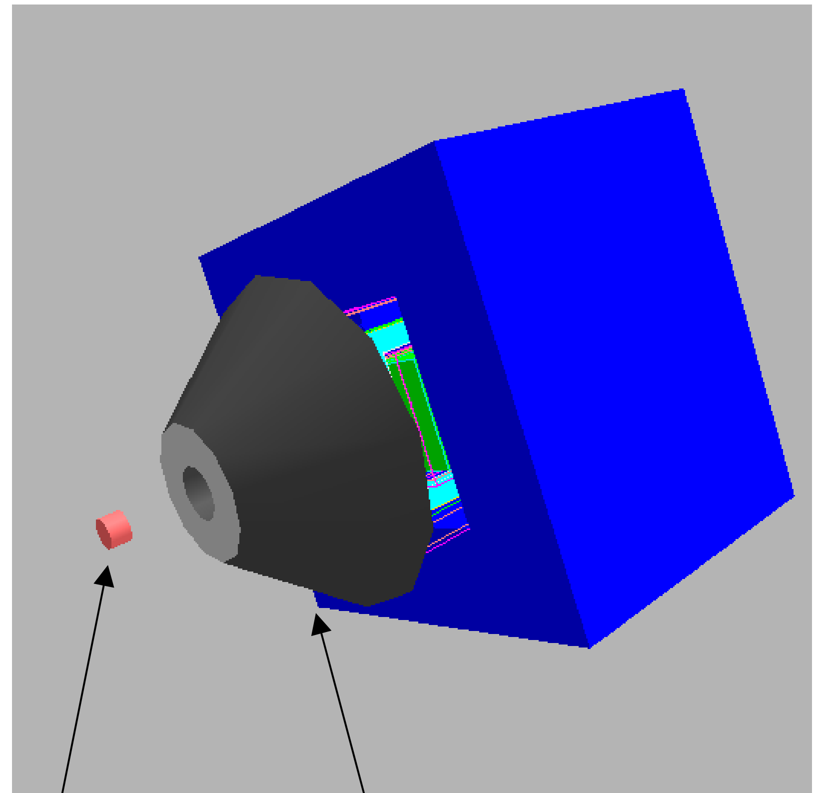
Now:

1. Take POISSON and draw with CAD
2. Use front end drawing package
3. Run PHITS

Very slow!!!



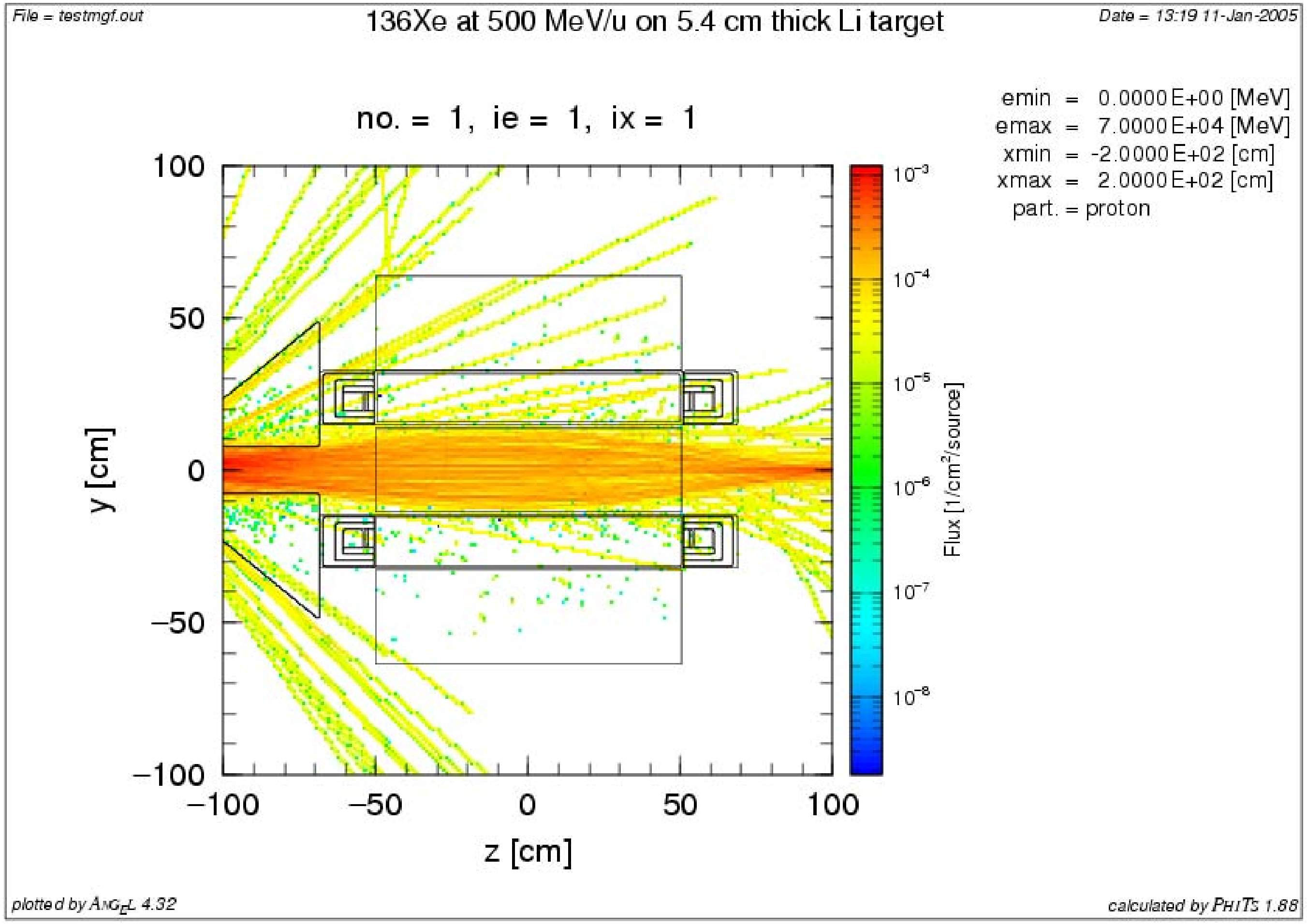
Frames are cryostat walls

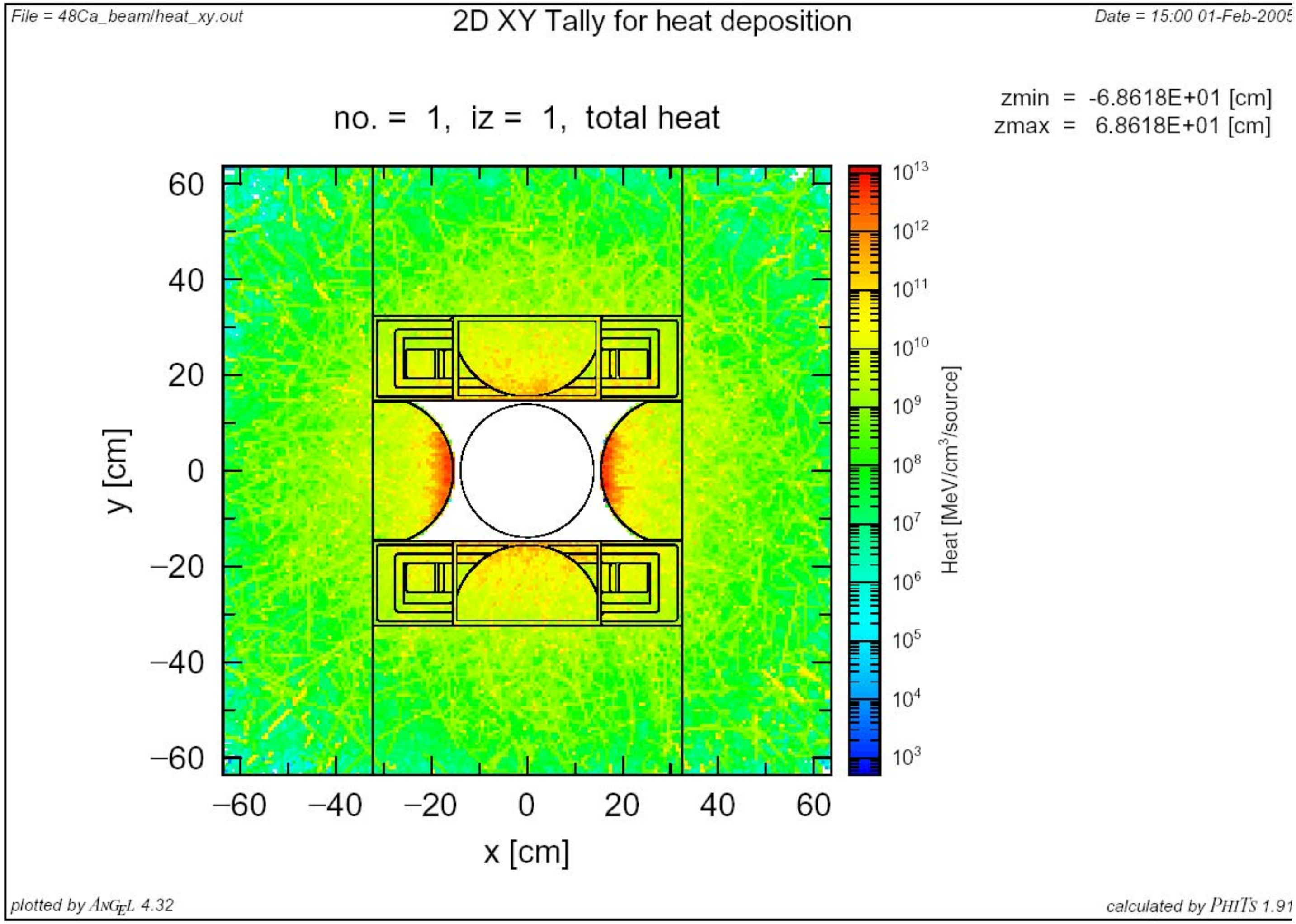


Target

Hevimet shield

Protons – magnetic field



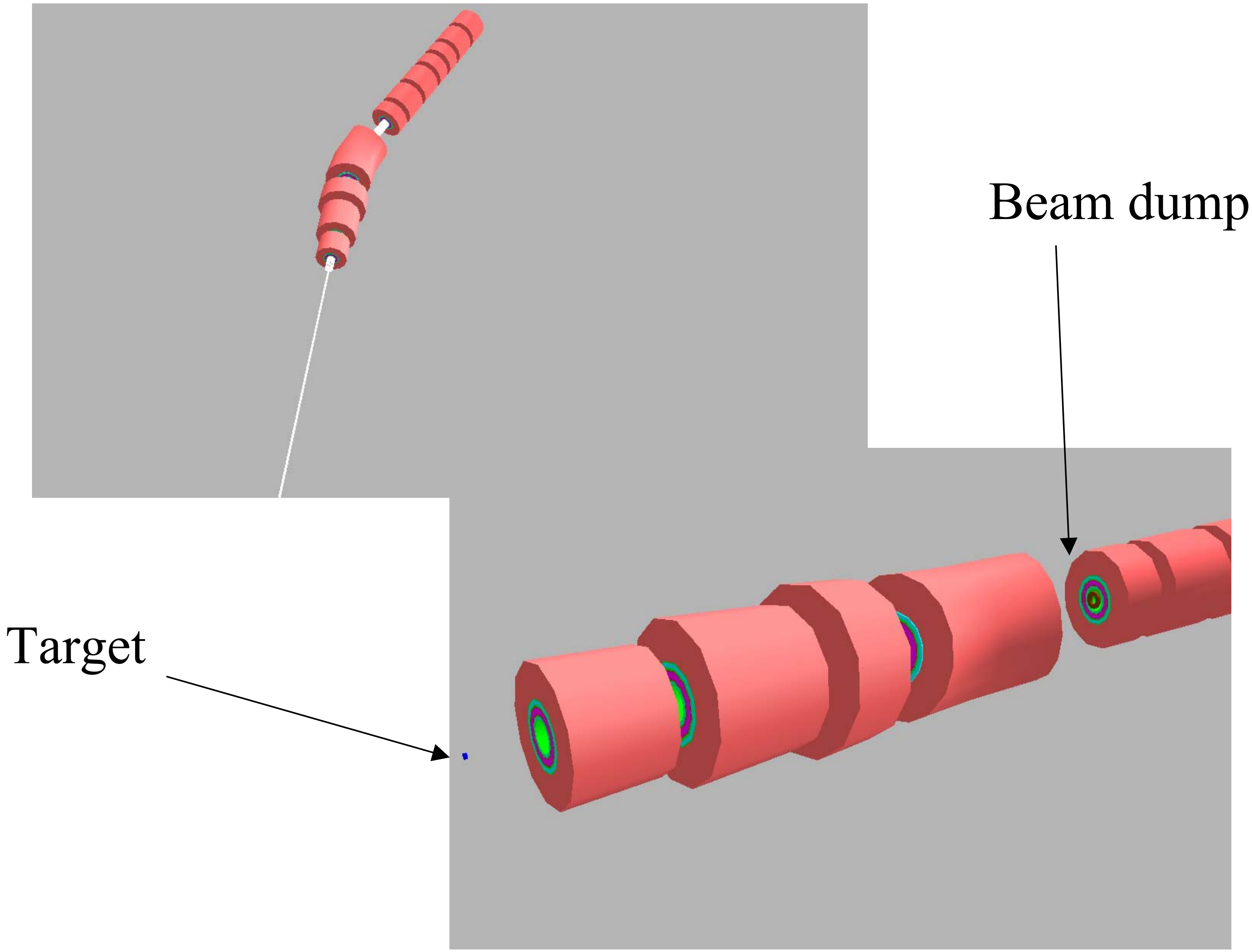


File = 48Ca_beam/heat_xy.out
2D XY Tally for heat deposition
Date = 15:00 01-Feb-2005
no. = 1, iz = 1, total heat
zmin = -6.8618E+01 [cm]
zmax = 6.8618E+01 [cm]
y [cm]
x [cm]
Heat [MeV/cm3/source]
plotted by ANGEL 4.32
calculated by PHITS 1.91

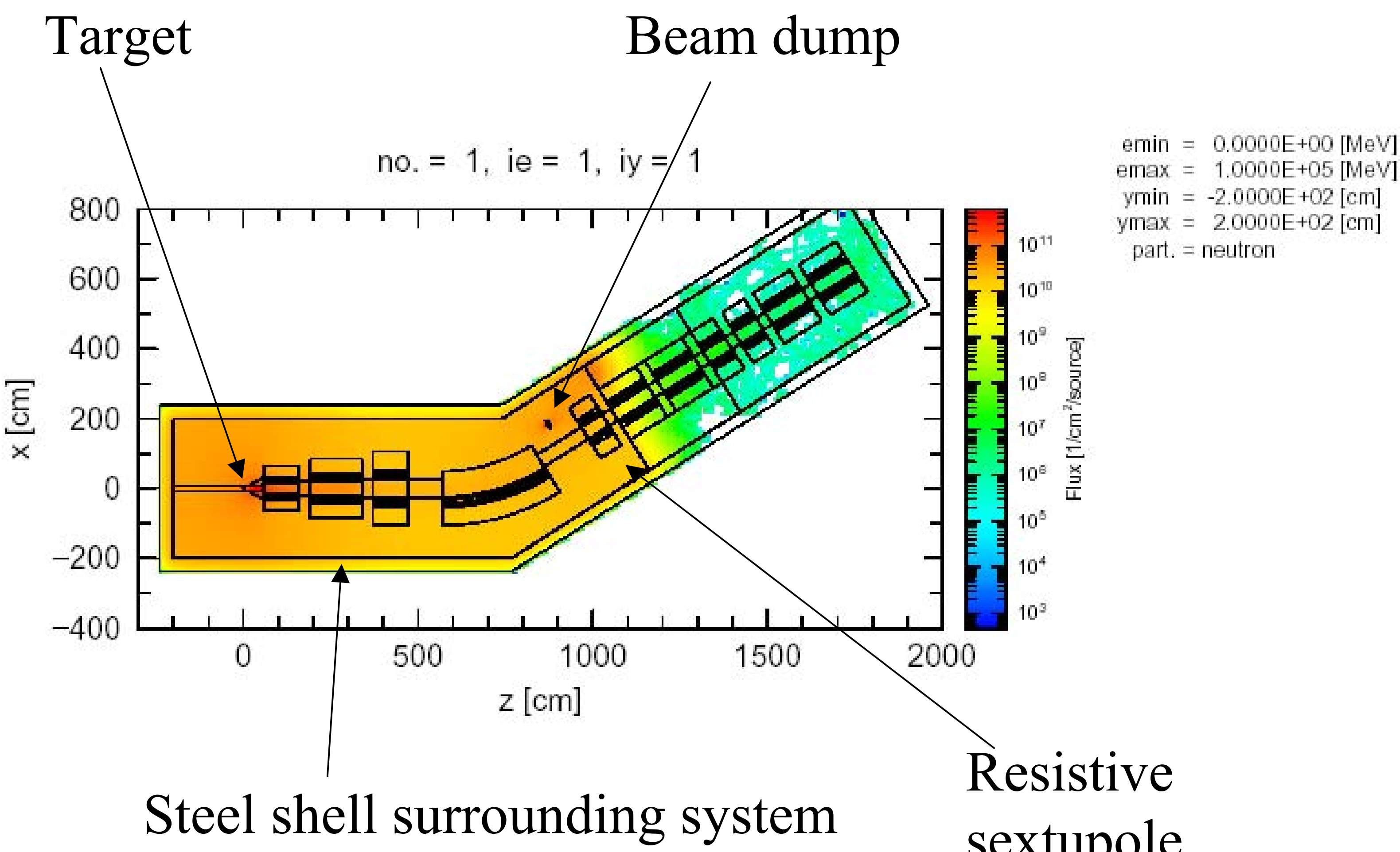
To go to multiple elements, we assume concentric shells of iron, air and coil.

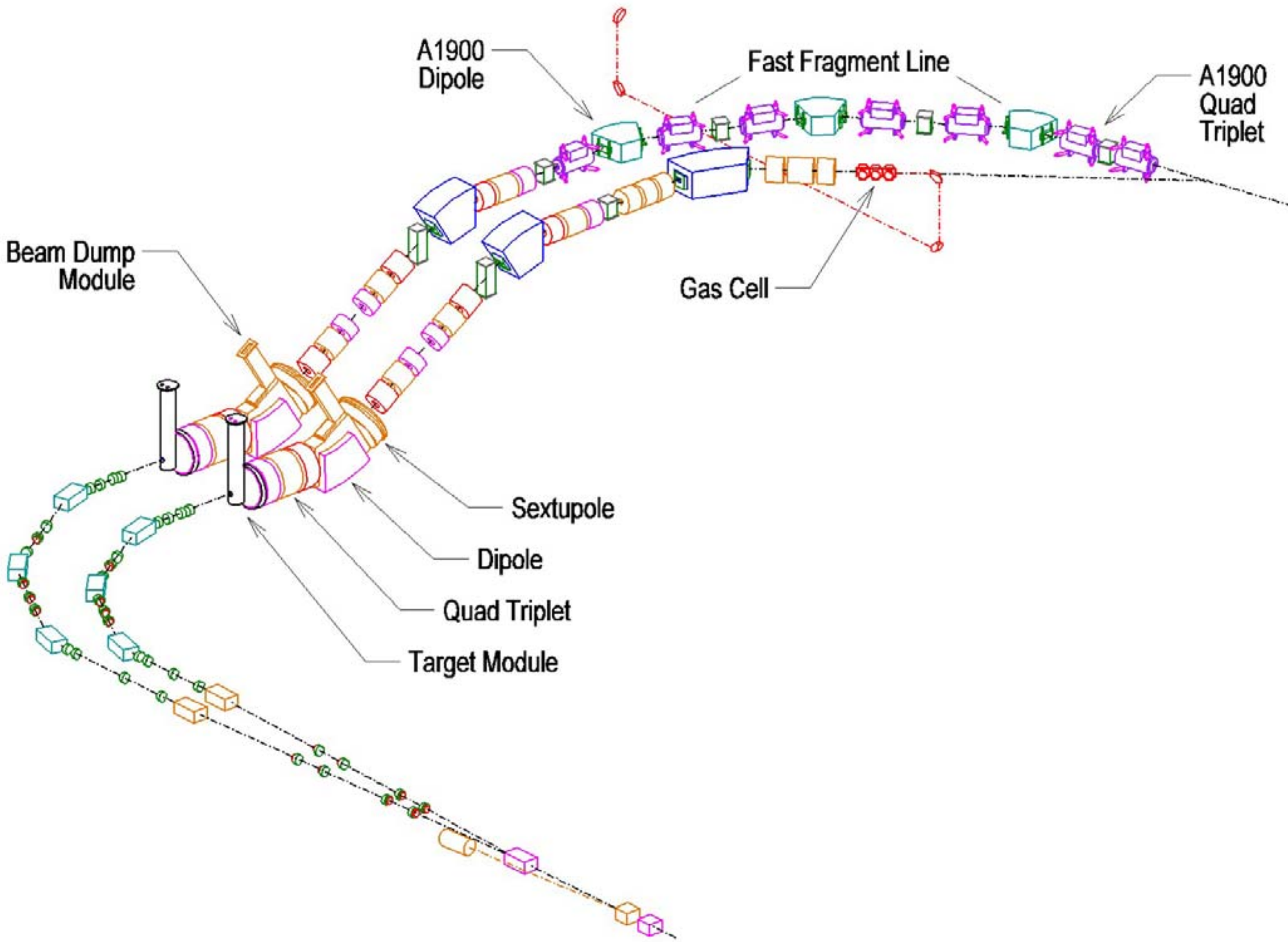
No magnetic fields

Clearly not very good


Beam dump
Target

Neutrons in pre-separator




A1900 Dipole
Fast Fragment Line
A1900 Quad Triplet
Beam Dump Module
Gas Cell
Sextupole
Dipole
Quad Triplet
Target Module

Need:

Interface between 3-D codes like TOSCA that takes output directly and converts to MARS or PHITS input.