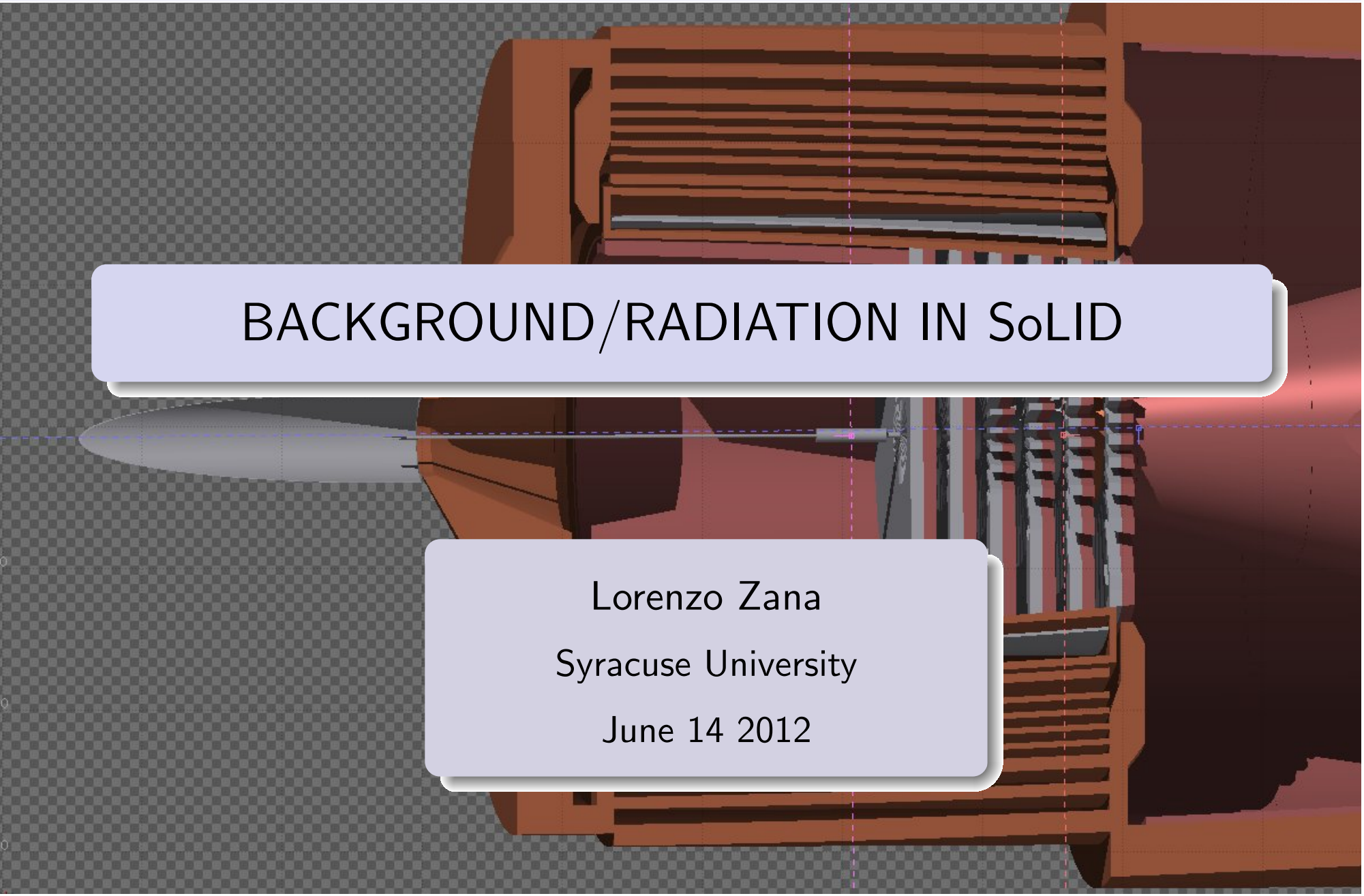


BACKGROUND/RADIATION IN SoLID

Lorenzo Zana

Syracuse University

June 14 2012

Simulation framework

FLUKA

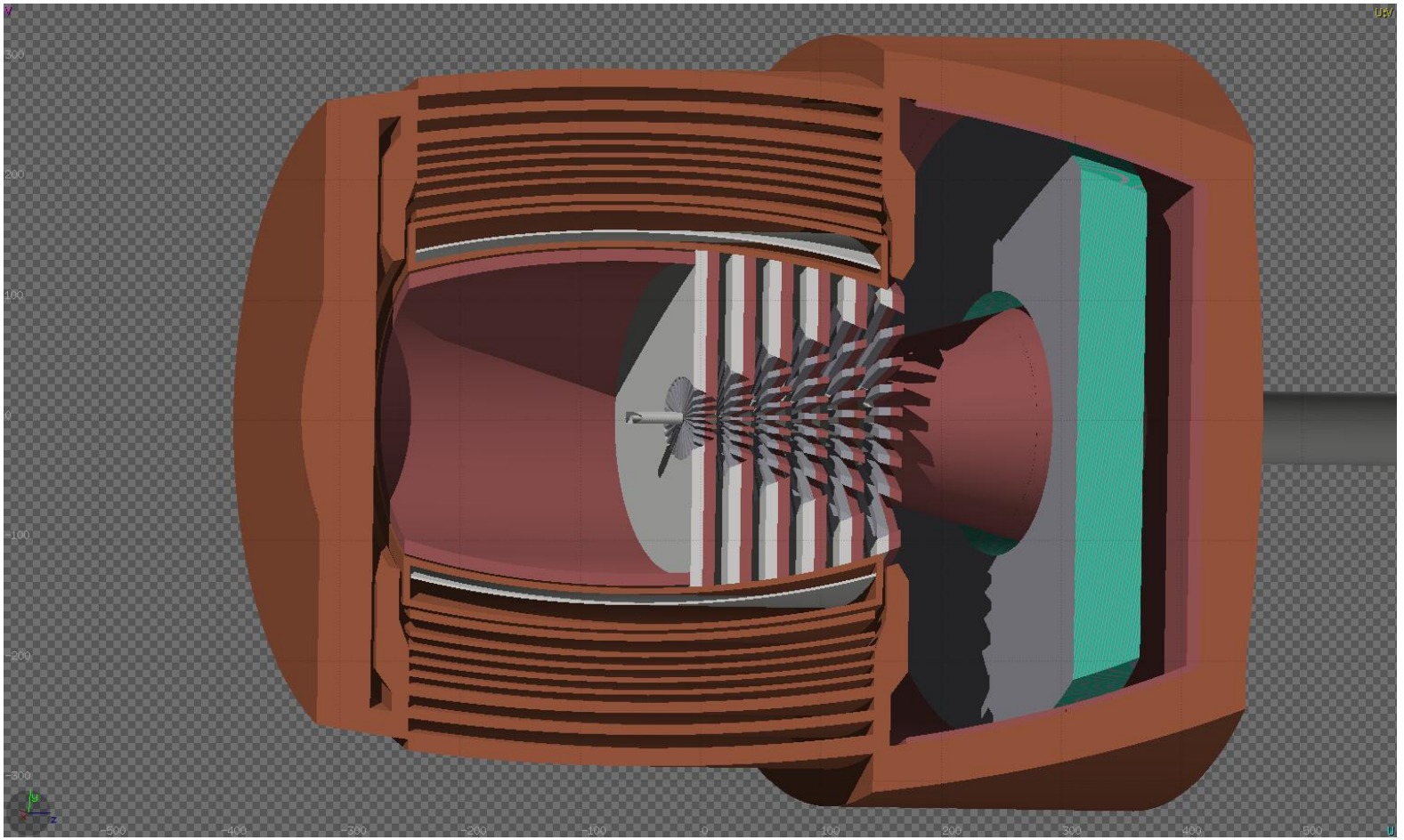
- Easier tools to directly determine Full Radiation quantities.
- Possibility in boosting the statistic for faster iterations.

GEANT4

- Better for particular tasks in order to semplify the Shielding design (like vertex, energy reconstruction on particle fluxes over regions of interest).
- Established framework from other part of the simulation project of SoLID

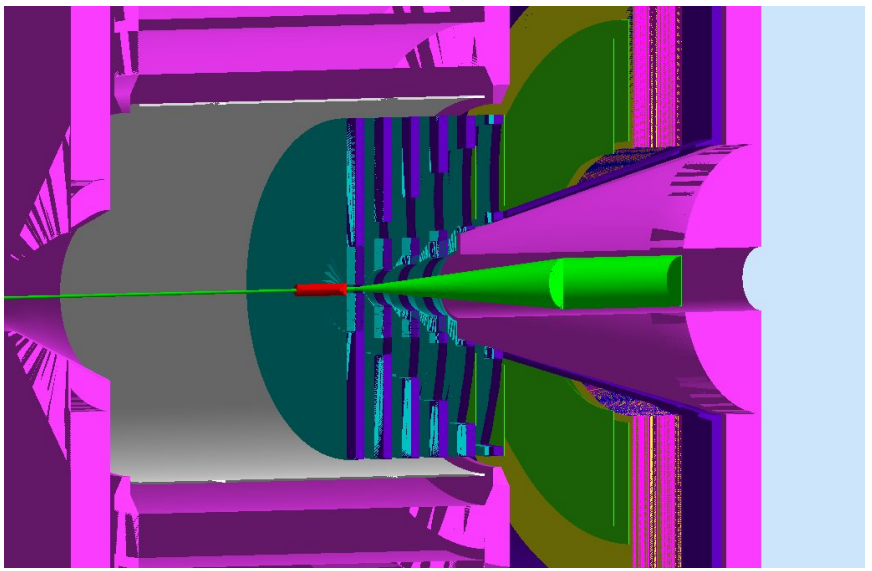
Simulation framework

PVDIS Design with FLUKA

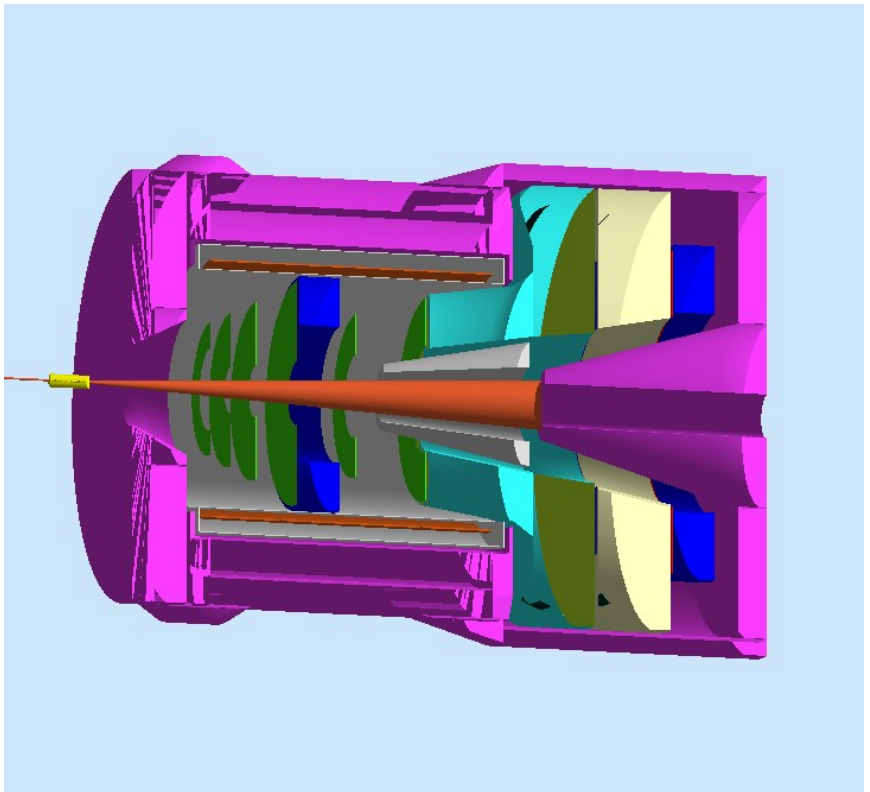


Simulation framework

GEANT4 PVDIS

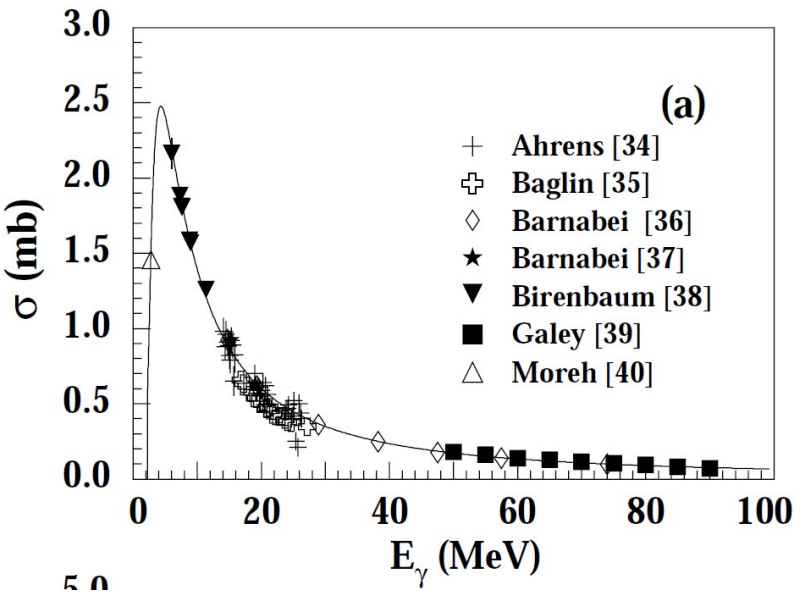


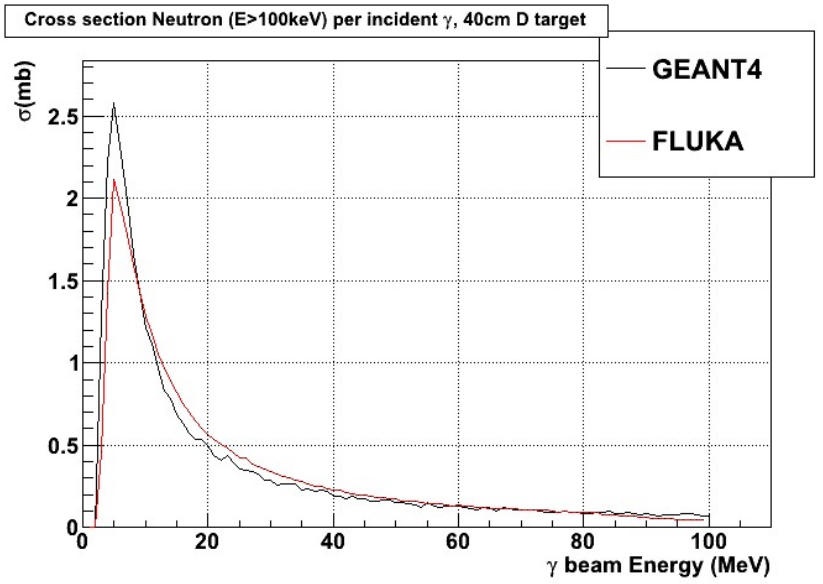
GEANT4 SIDIS



Neutron Photoproduction

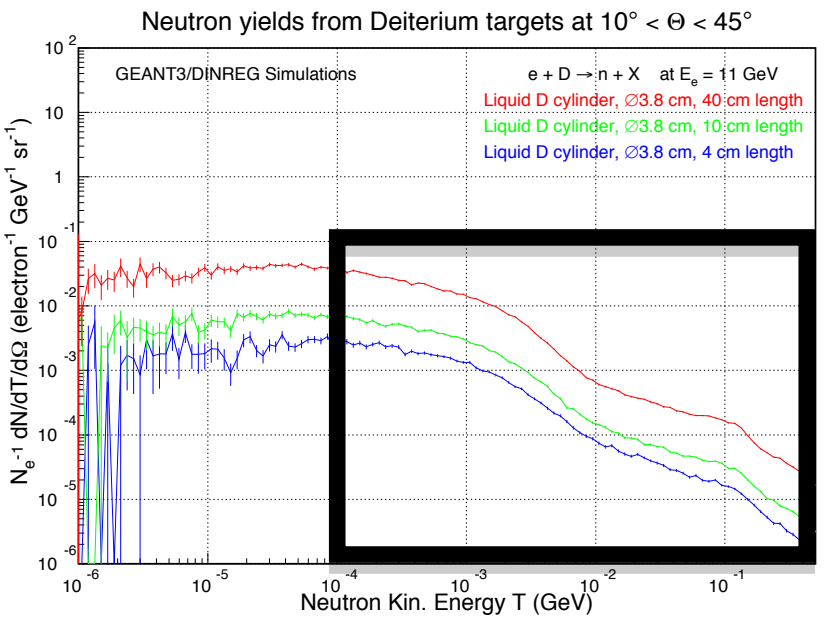
Comparison with real cross section for FLUKA and GEANT4



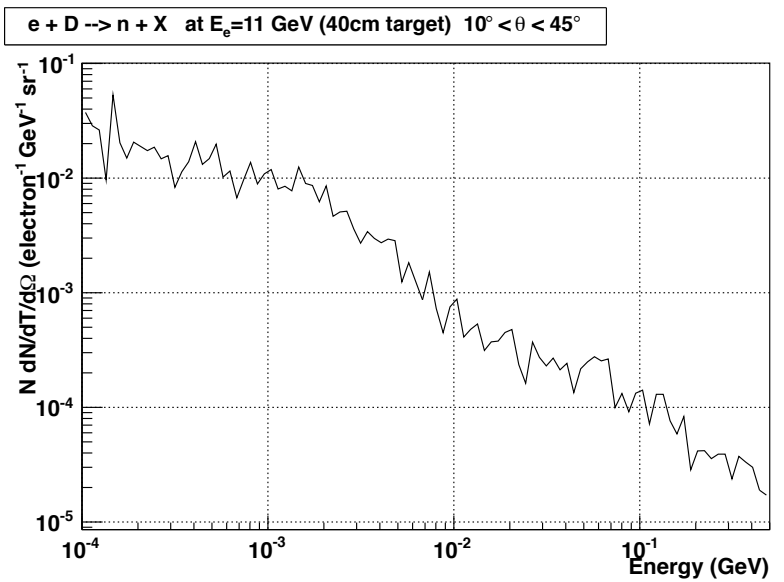


Neutron production from electron on 40cm Deuterium

DINREG(GEANT3, Degtiarenko)

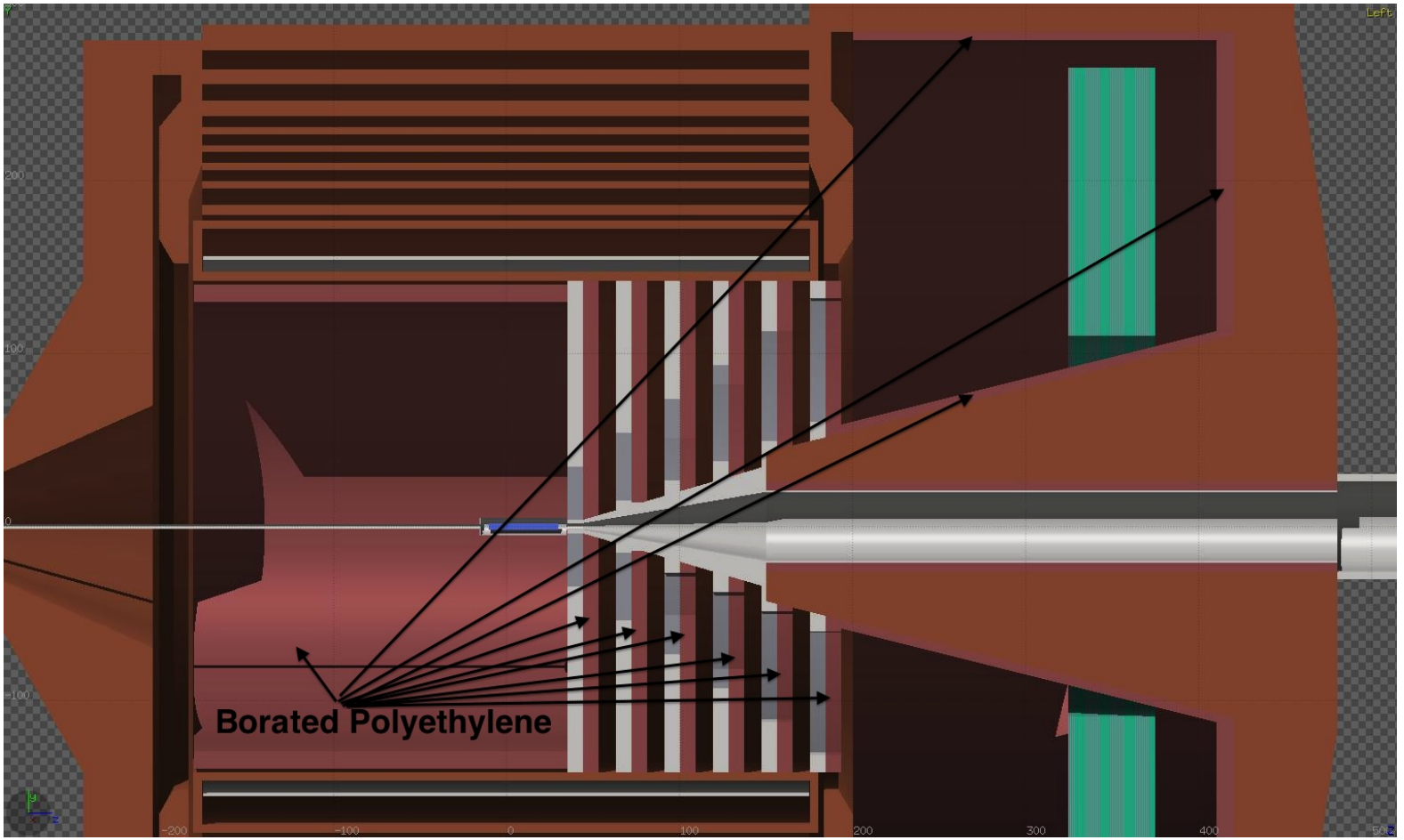


GEANT4



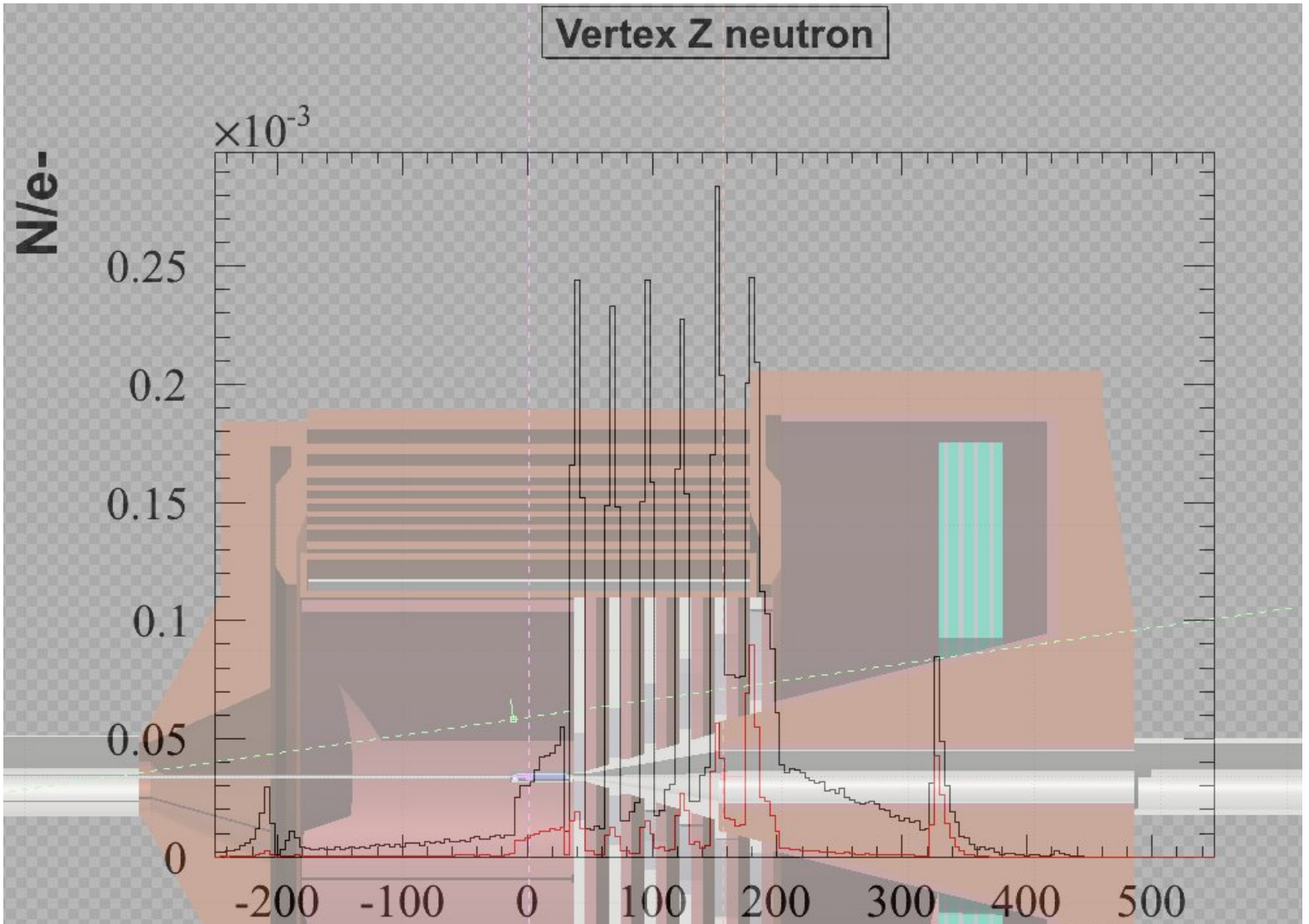
Neutron Origin Vertex on gems (Z)

Design of the shielding



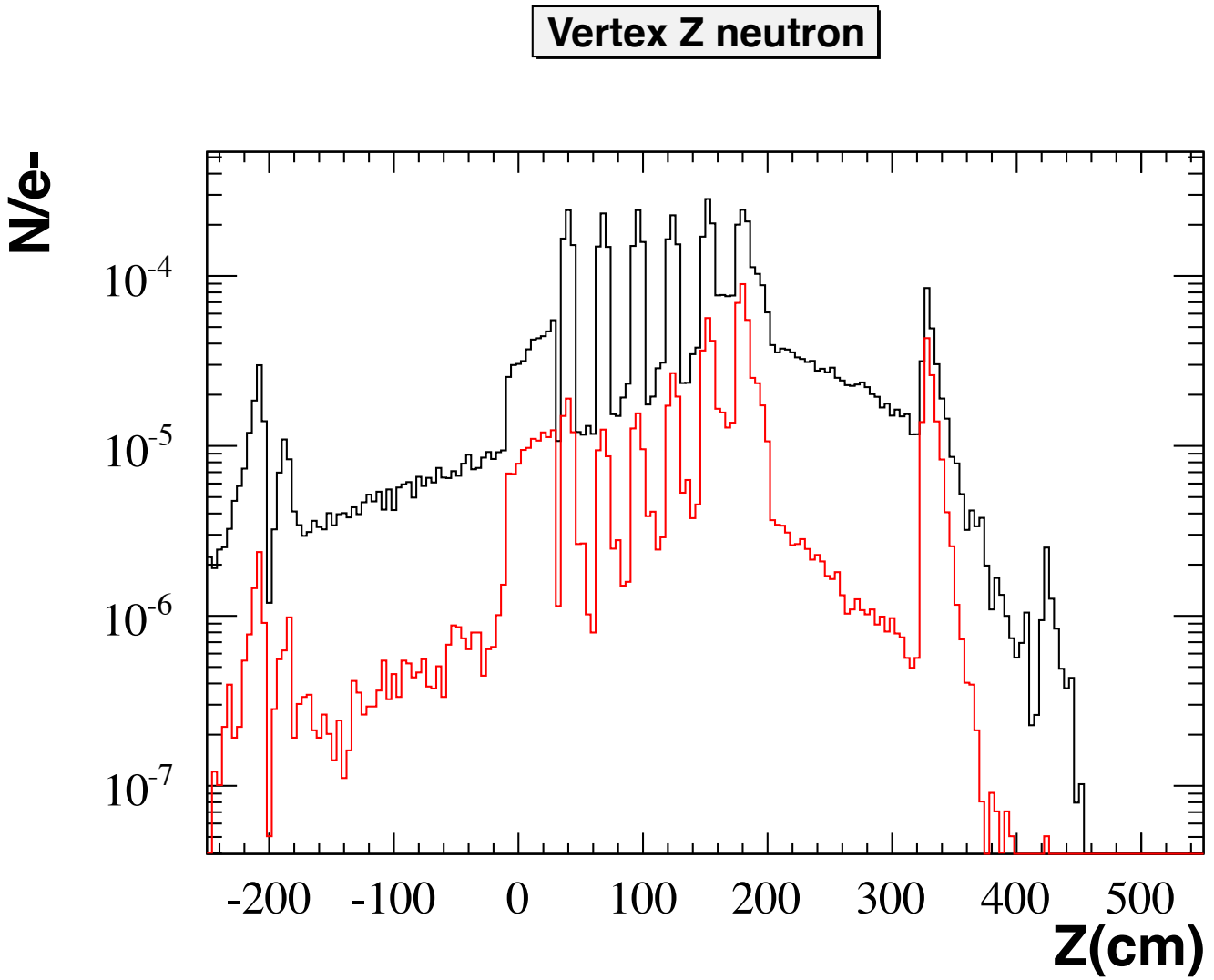
Neutron Origin Vertex on gems (Z)

Neutron Origin Vertex on gems (Z) Position location.



Neutron Origin Vertex on gems (Z)

Possible strategy of shielding Z vertex results (Red: with SHIELD)



Displacement damage in Si, NIEL

A. Vasilescu (INPE Bucharest) and G. Lindstroem (University of Hamburg), Displacement damage in silicon, on-line compilation

see http://sesam.desy.de/members/gunnar/Si-dfuncs.html

for actual use of this tabulation, please refer to:
A. Vasilescu and G. Lindstroem
Displacement damage in Silicon
on-line compilation: http://sesam.desy.de/~gunnar/Si-dfuncs

neutron induced displacement damage in silicon
-most reliable data, listed for kinetic energies between 0.1meV and 10 GeV-
P.J. Griffin et al., SAND92-0094 (Sandia Natl. Lab. 93), priv. comm. 1996
A. Konobeyev, J.Nucl.Mater. 186 (1992) 117
M. Huhtinen and P.A. Aarnio, NIM A 335 (1993) 580 and private comm.*)
*) tabulation see also A. Ferrari (ATLAS TDR '97), priv. comm. 1997

Griffin

Ekin [MeV]	D/(95MeVmb)
1,025E-10	1,575E-02
1,075E-10	1,537E-02
1,125E-10	1,503E-02
1,175E-10	1,470E-02

Huhtinen

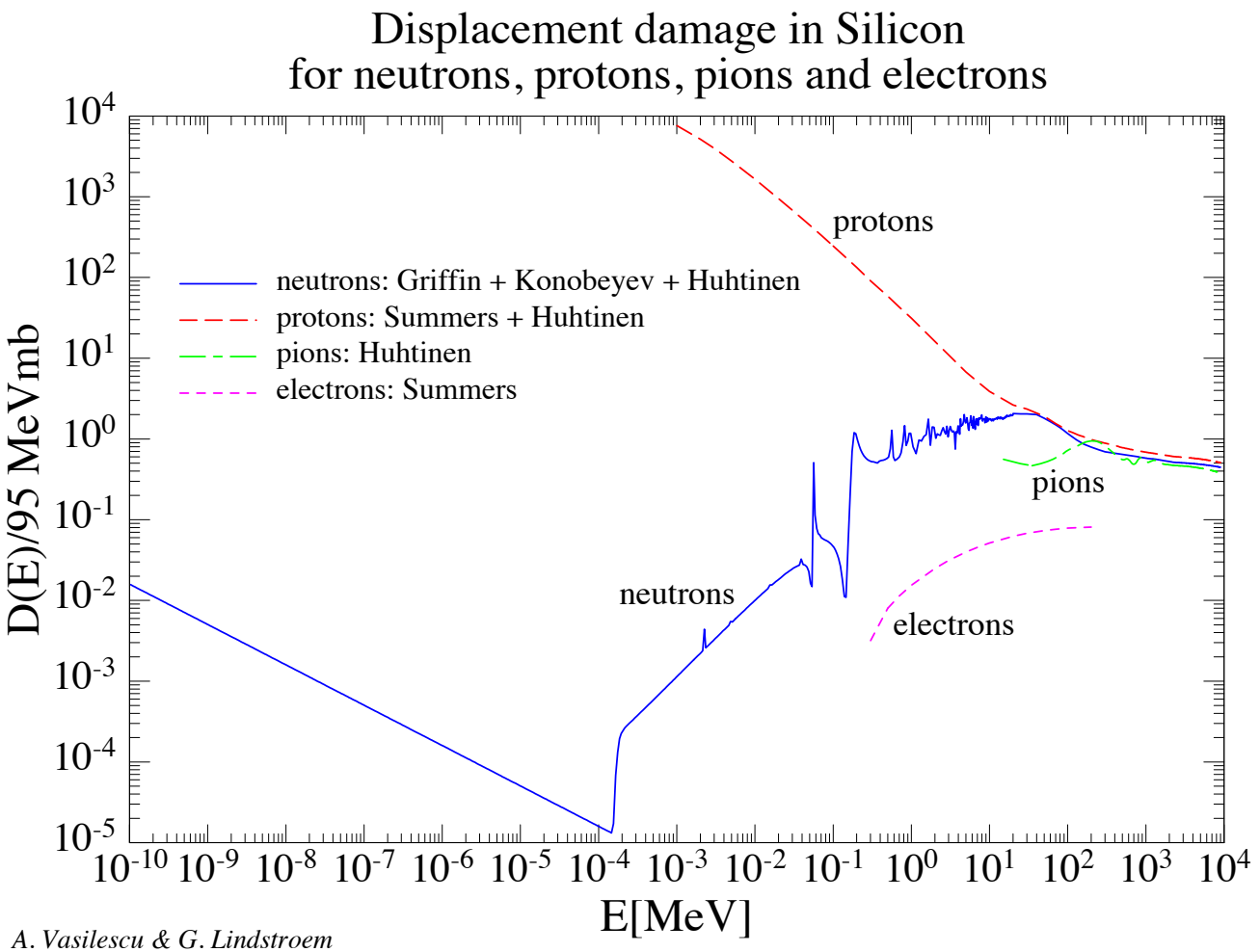
Ekin [MeV]	D/(95MeVmb)
8,050E+02	6,004E-01
8,150E+02	5,980E-01
8,250E+02	5,959E-01
8,350E+02	5,942E-01

Konobeyev

Ekin [MeV]	D/(95MeVmb)
2,000E+01	2,071E+00
2,500E+01	2,049E+00
3,000E+01	2,041E+00
4,000E+01	2,012E+00

Displacement damage in Si, NIEL

(Non Ionizing E-Loss) for e^-, p, π, n

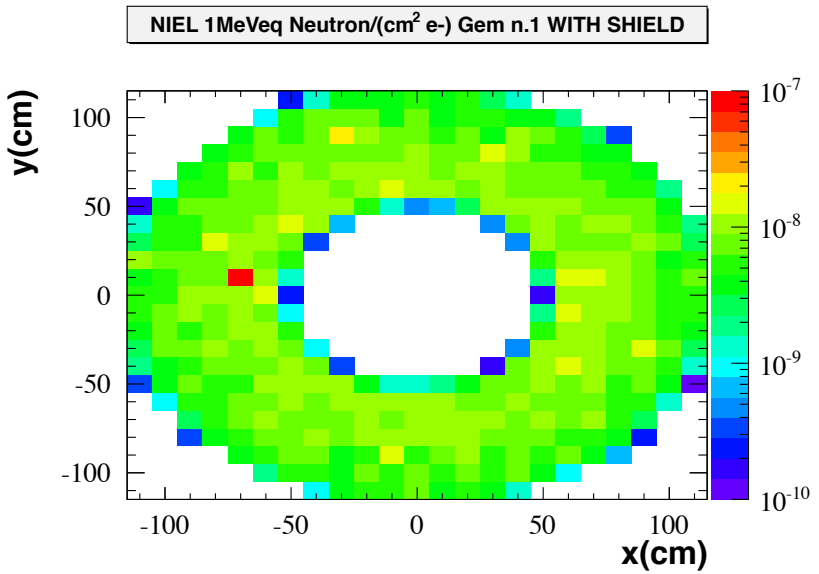


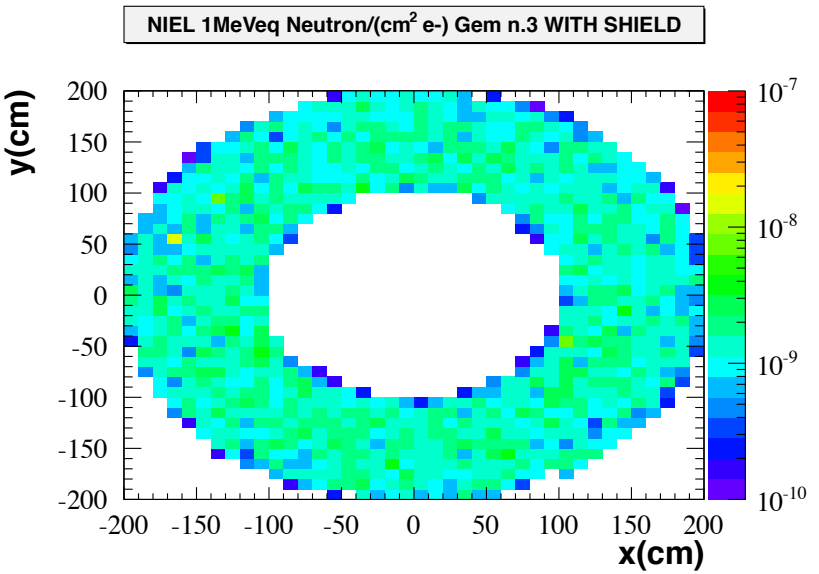
Displacement damage in Si, NIEL

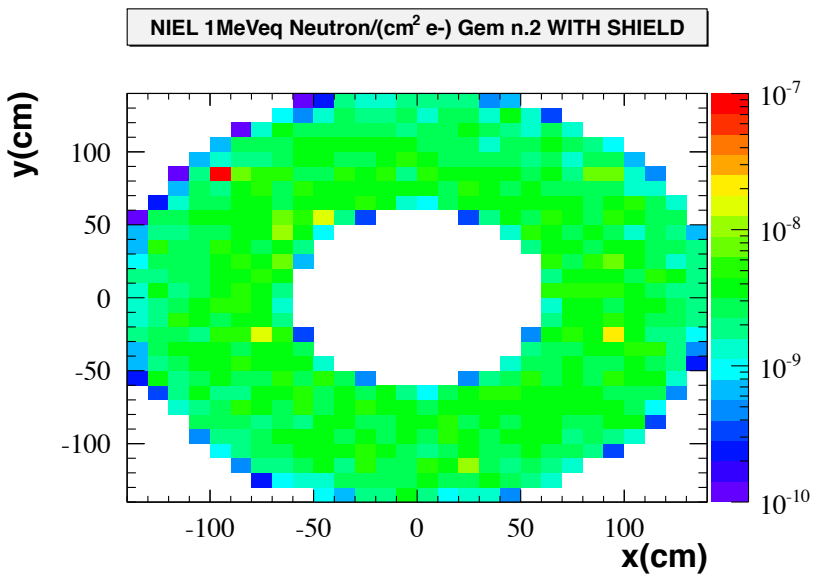
What is a tolerable level for APV25 (GEM) ?

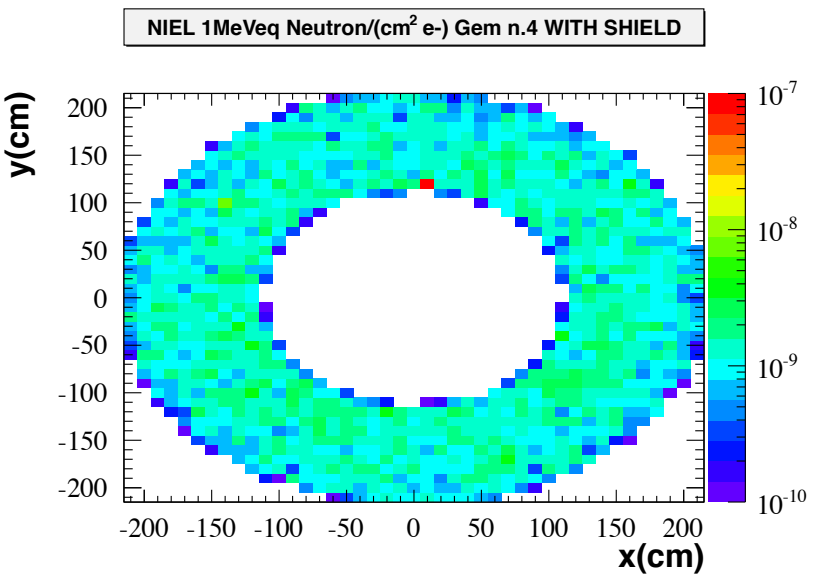
- CMS experiment total dose expected be around $5x10^{13}\frac{N}{cm^2}$
- CMS experiment Neutron flux peaks at 1MeV (curves norm to 1MeV Neutron)
- Our flux is ($2000h$ at $100\mu A$) $5x10^{13}\frac{N}{cm^2} \Rightarrow 1.1x10^{-8}\frac{N}{e^- cm^2}$

PVDIS 1MeV eq $\frac{N}{e^- cm^2}$ WITH SHIELDING









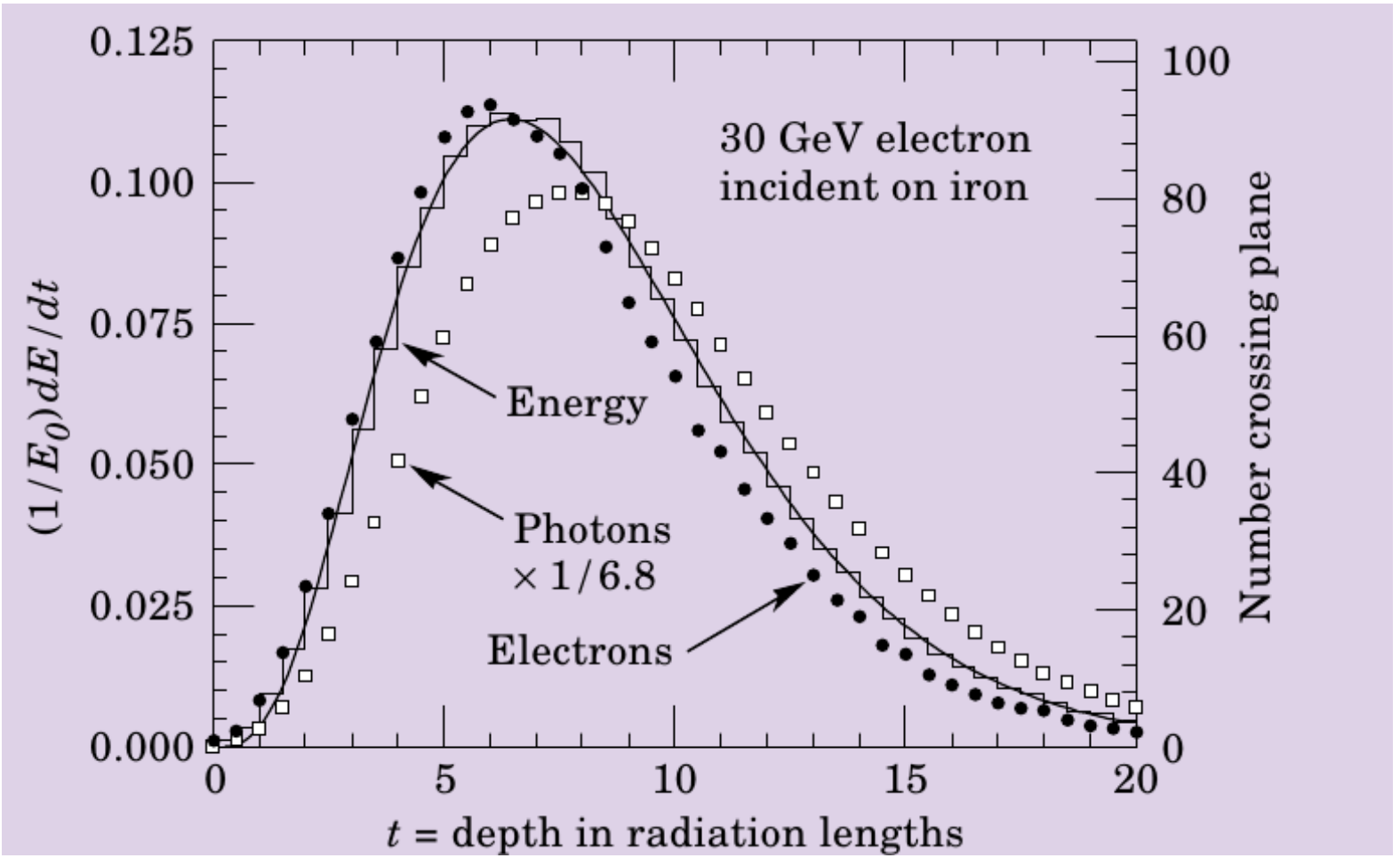
Radiation damage on Scintillator + Fiber

What is a tolerable level for Shashlik Calorimeter?

- Extensive irradiation test has been carried on by the LHCb collaboration
- A limit of 1Mrad of full dose can be established.

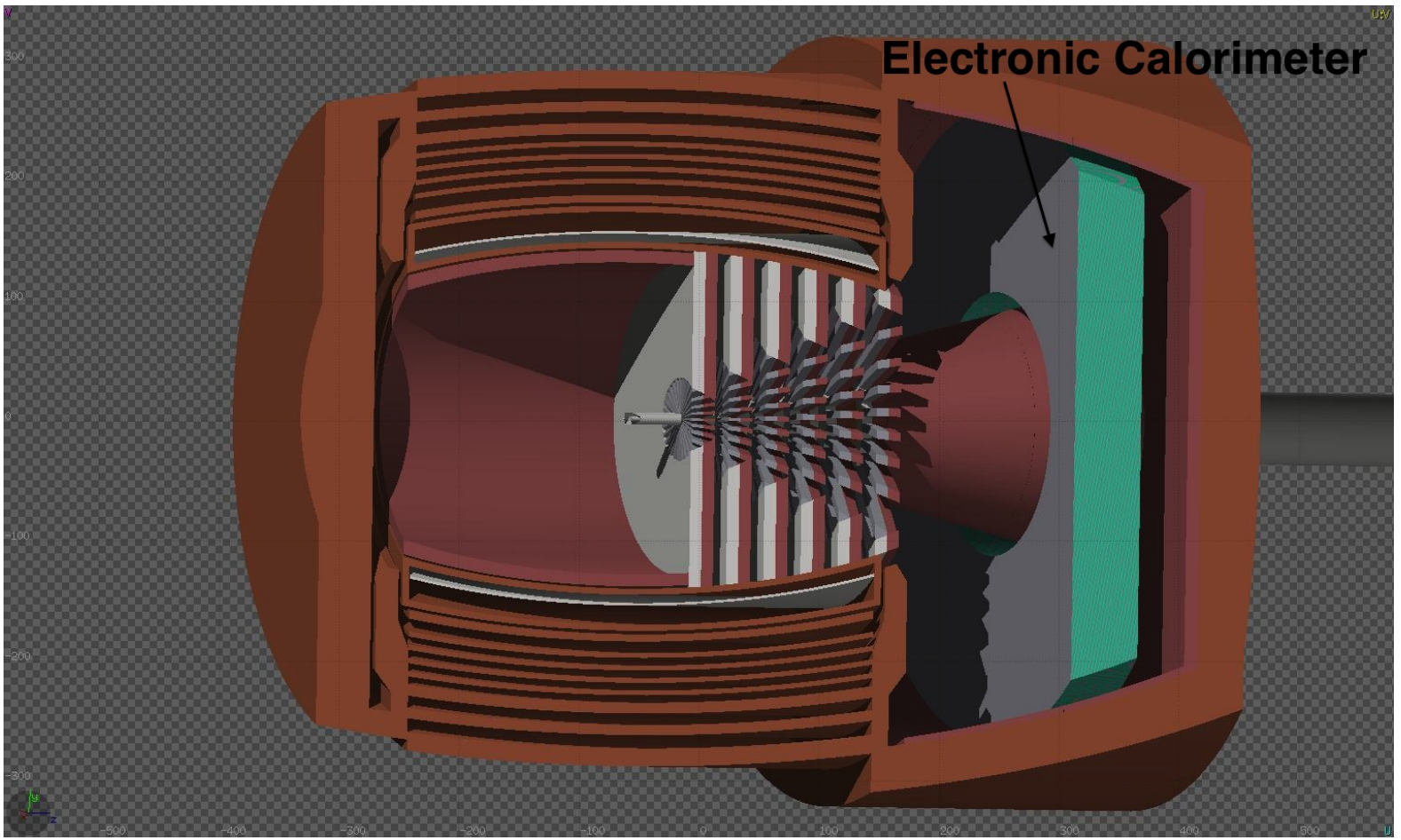
Radiation damage on Scintillator + Fiber

Shower evolution in the Calorimeter



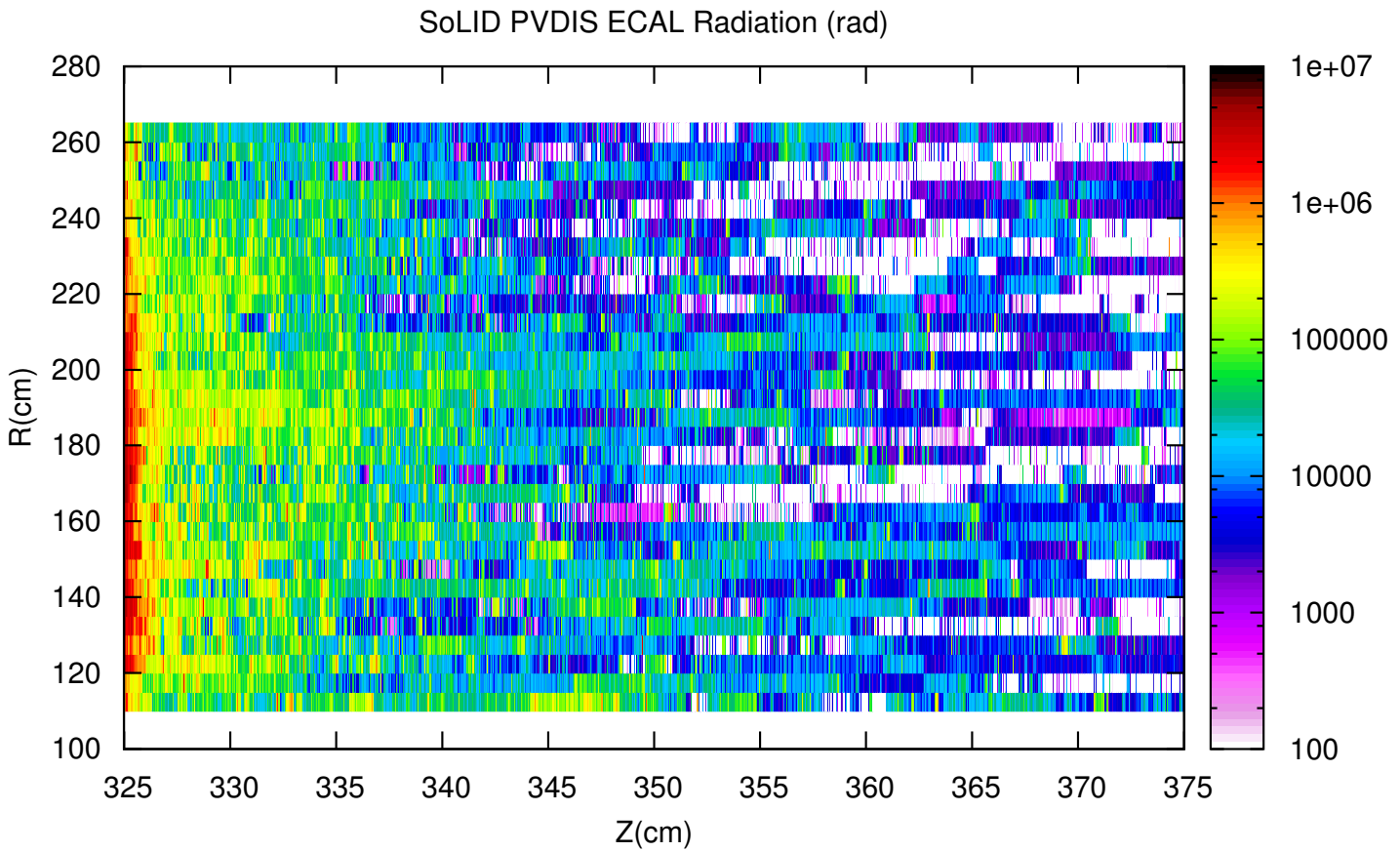
Radiation damage on Scintillator + Fiber

Calorimeter position PVDIS



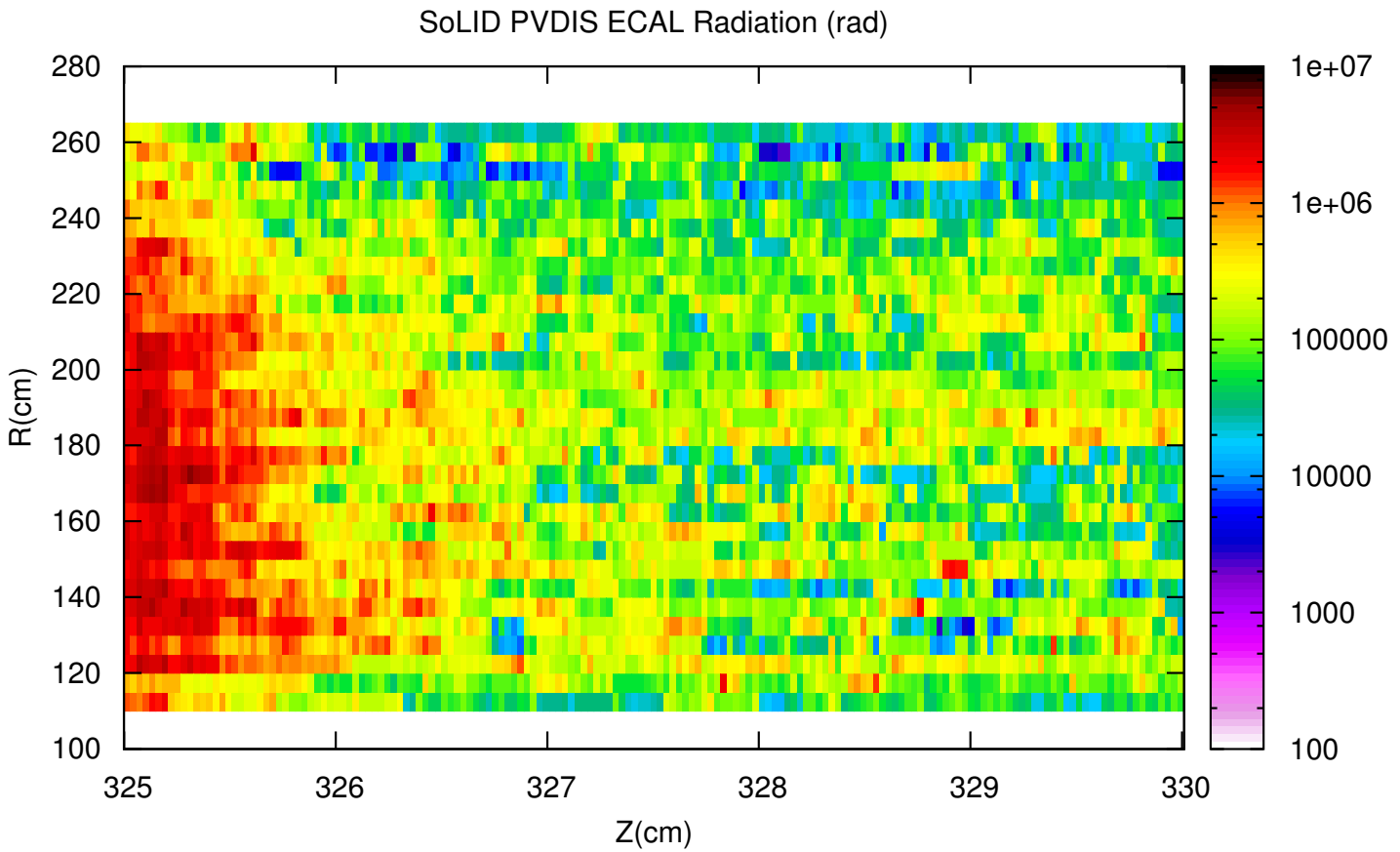
Radiation damage on Scintillator + Fiber

Radiation dose (rad) in PVDIS for $2000h$ at $100\mu A$



Radiation damage on Scintillator + Fiber

(ZOOM 5cm) Radiation dose (rad) in PVDIS for $2000h$ at $100\mu A$



Radiation damage on Scintillator + Fiber

How radiation is affecting the calorimeter?

- Just $1^{st} cm$ of the calorimeter will be getting a dose $> 1 Mrad$
- $1cm$ correspond in ~ 0.4 radiation length (will not affect too much the e^- shower)
- Future implementation of the shielding will be designed to still lower the radiation on those modules

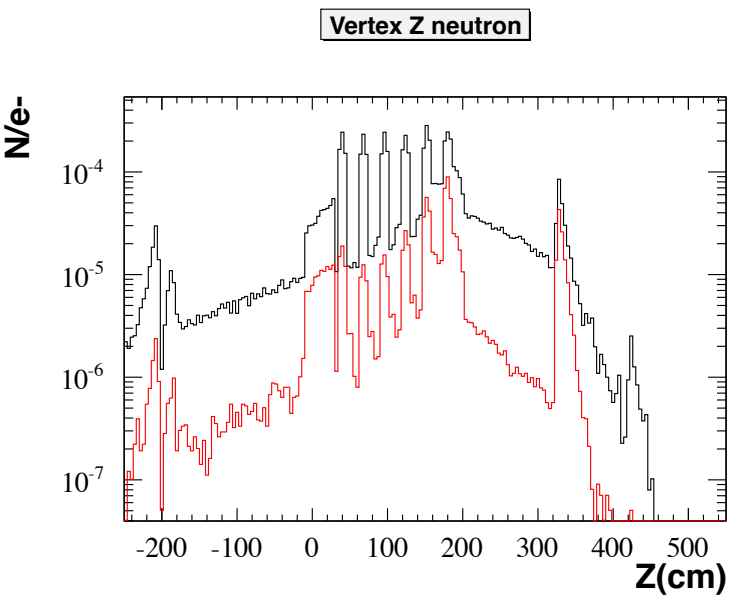
Radiation on SIDIS

Neutron radiation dominates the PVDIS configuration.
What is the comparison with SIDIS?

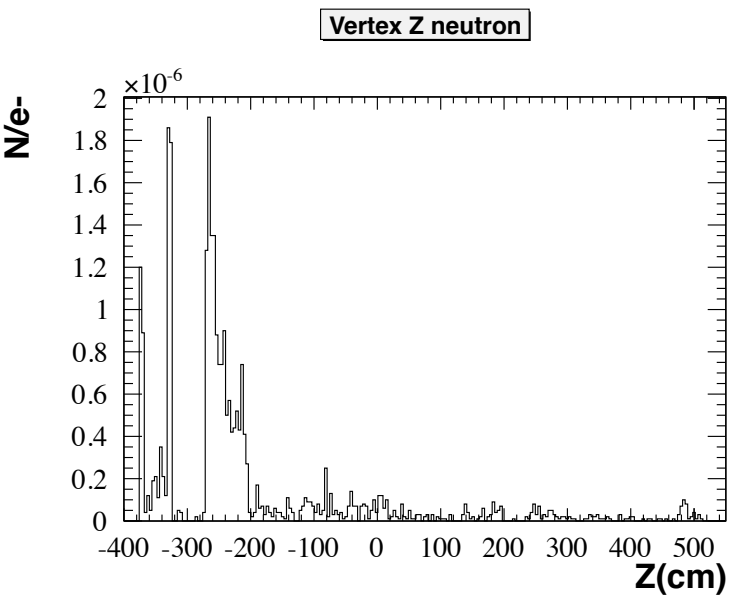
Radiation on SIDIS

Neutron radiation dominates the PVDIS configuration.
What is the comparison with SIDIS?

PVDIS

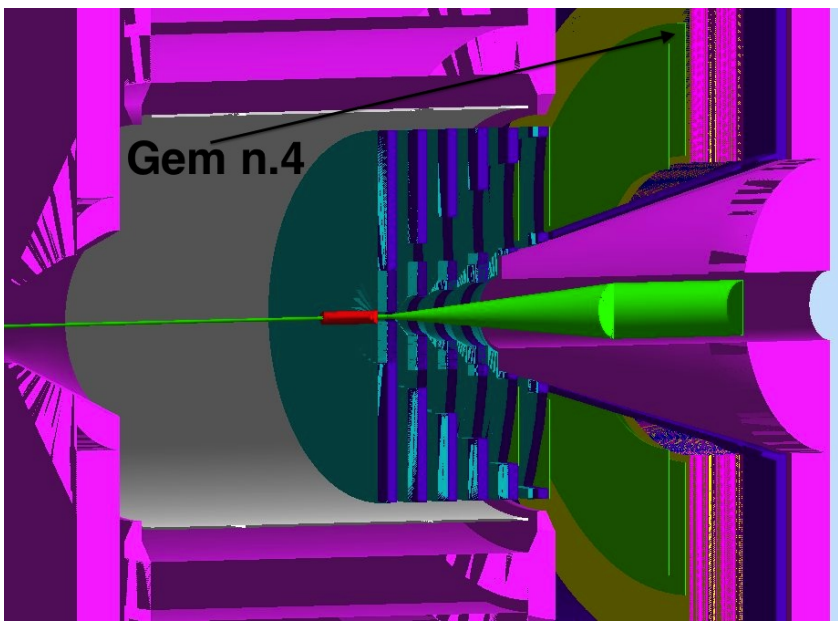


SIDIS

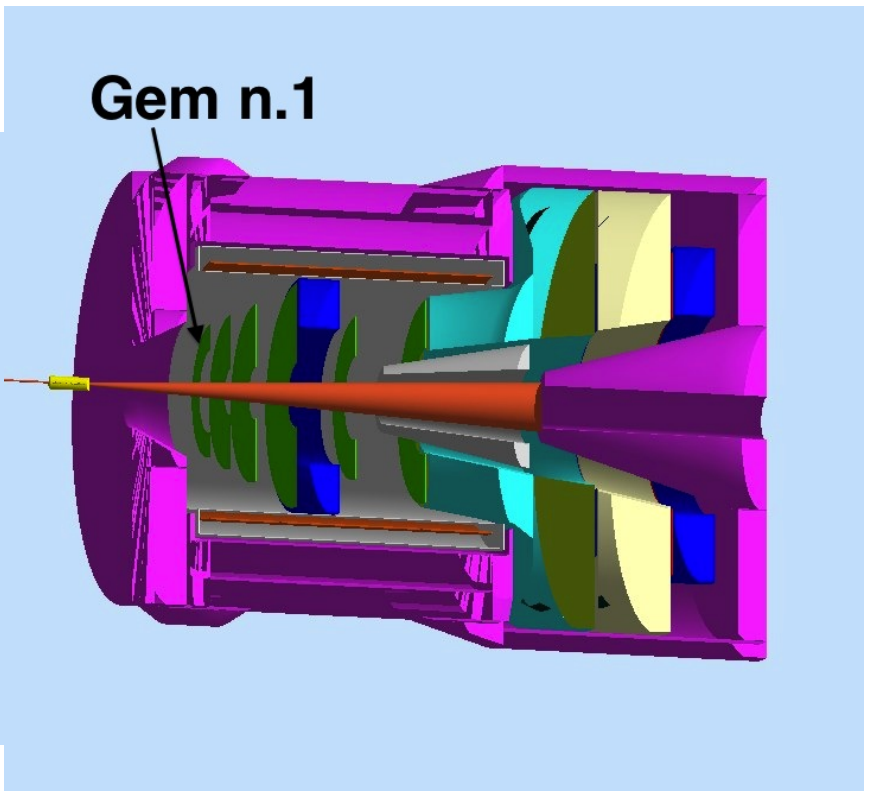


Radiation on SIDIS

PVDIS



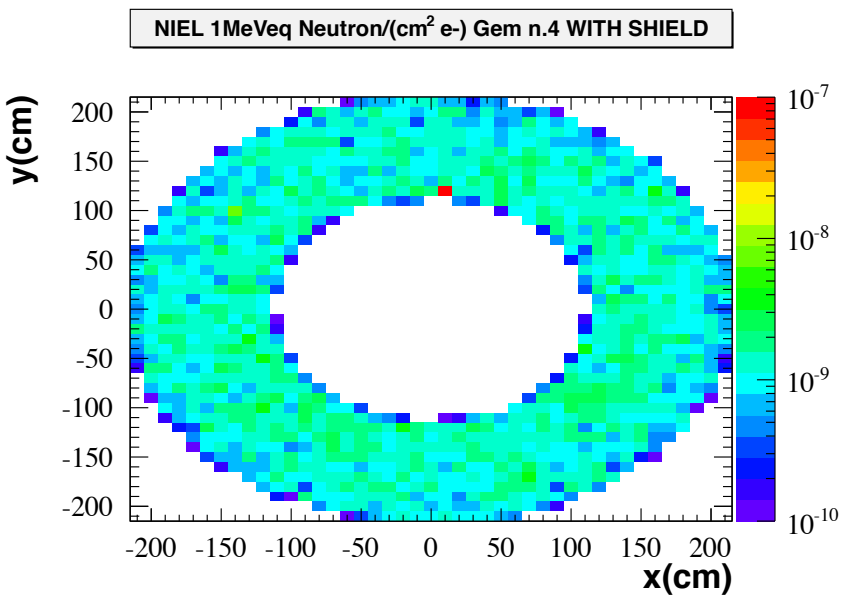
SIDIS



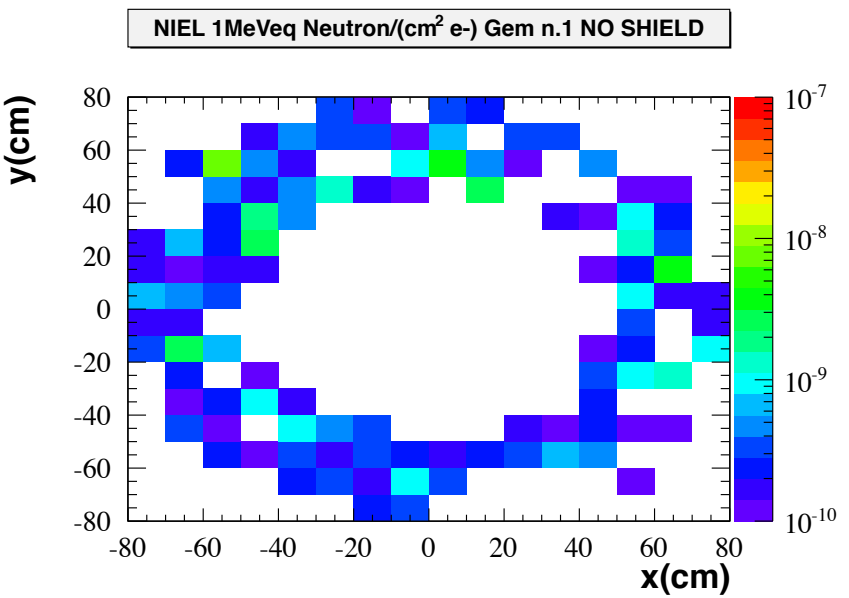
Radiation on SIDIS

What is the comparison for 1MeV eq radiation in the gems?

PVDIS Gem n.4



SIDIS Gem n.1



Results and future goals

CONCLUSIONS, TO DO

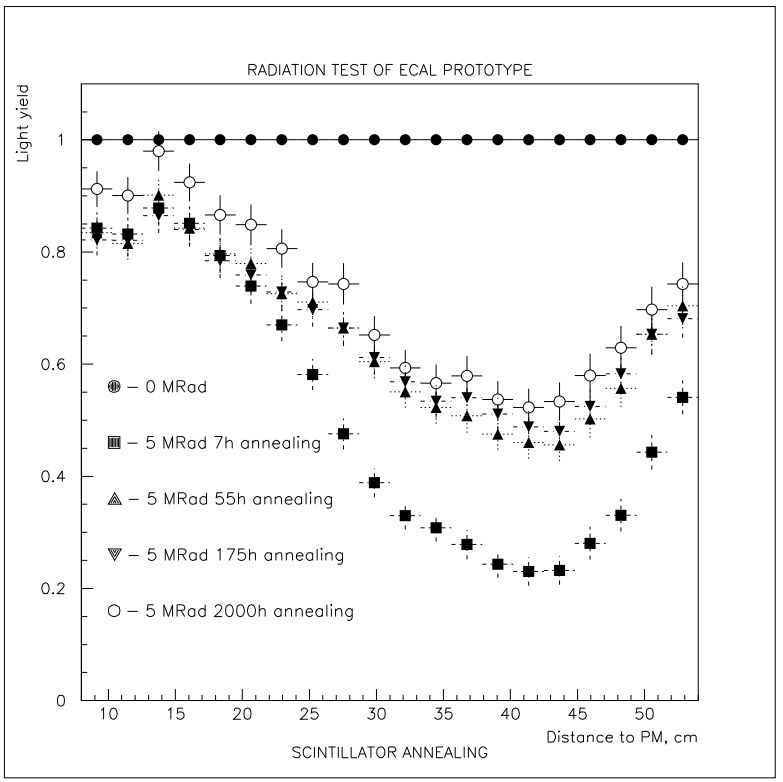
- A Shielding configuration has been developed and studied in order to control to a desired level the radiation with PVDIS configuration for SoLID
- The SIDIS configuration shows consistently less radiation damage
- Further implementation on the design are under way in order to further reduce the damage on the electronic.

BACKUP SLIDES

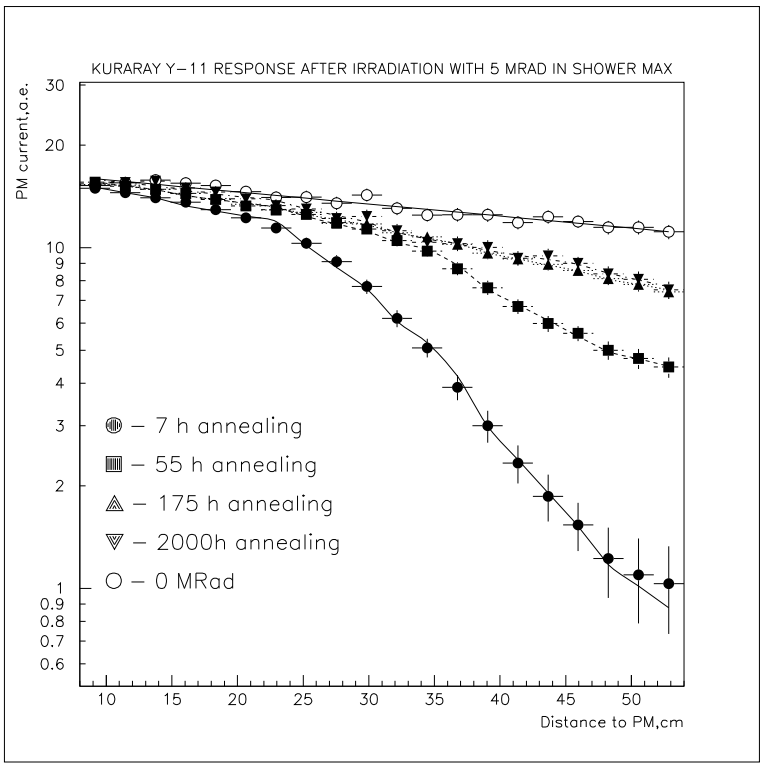
EC radiation damage LHCb test on Shashlik

link to LHCb report

SCINTILLATOR

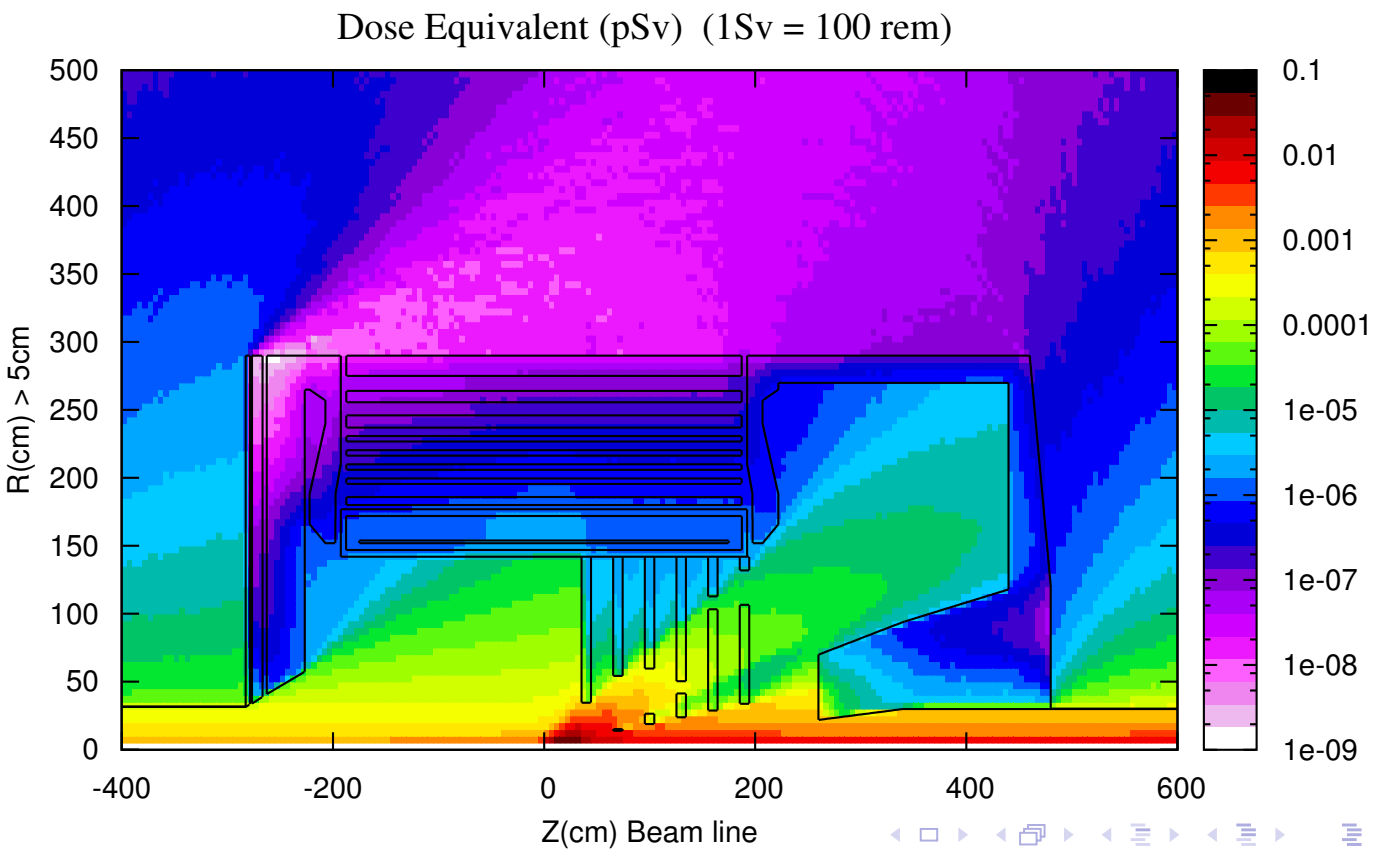


FIBER



Radiation in Hall A

$$1\frac{pSv}{e^-} = 2.25x10^8\frac{rem}{h100\mu A}$$



1MeV neutron eq NIEL flux on last scintillator layer of EC

Niel weighted $\frac{Neutron}{cm^2}$ flux for $2000h$ at $100\mu A$