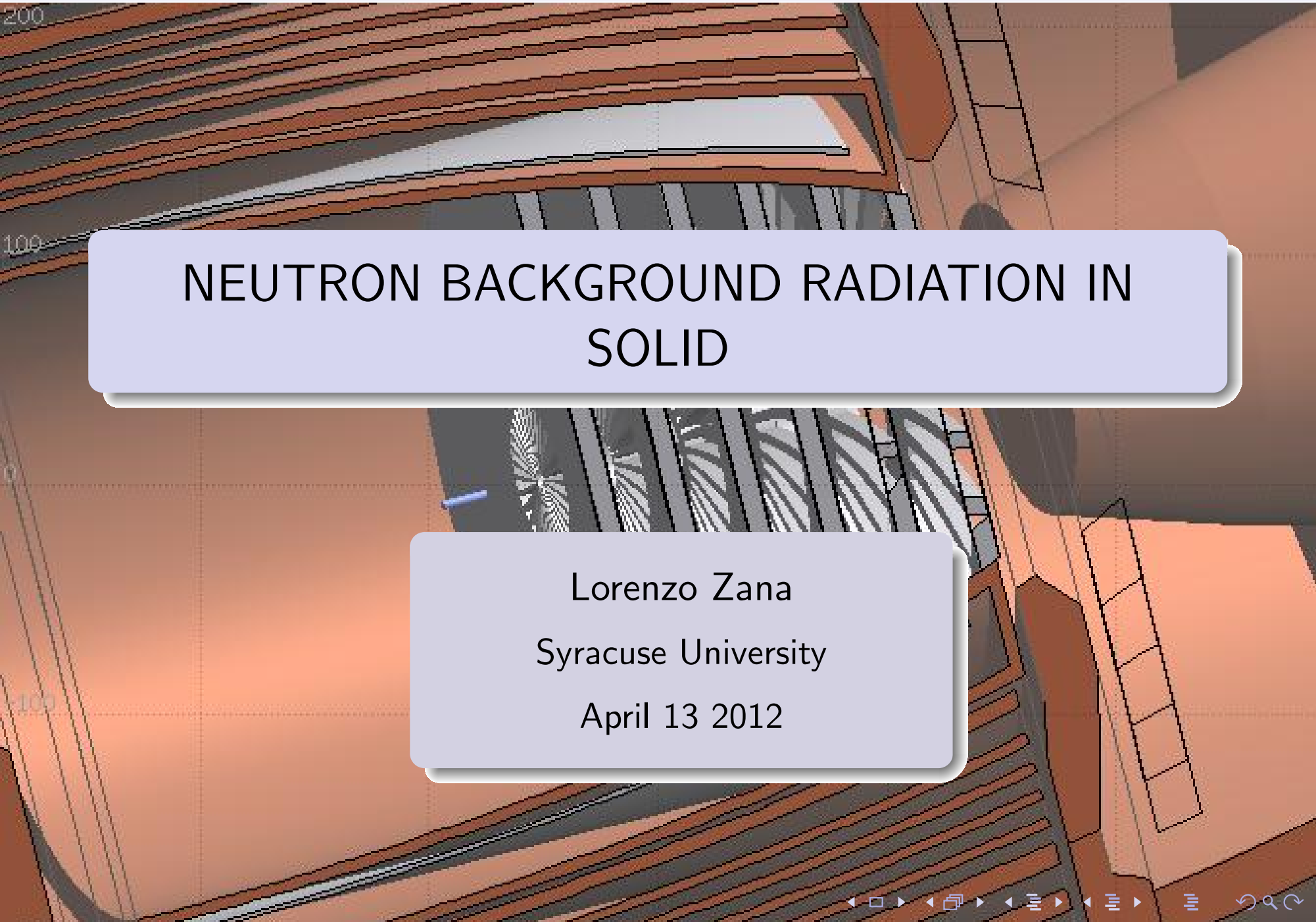


NEUTRON BACKGROUND RADIATION IN SOLID

Lorenzo Zana

Syracuse University

April 13 2012

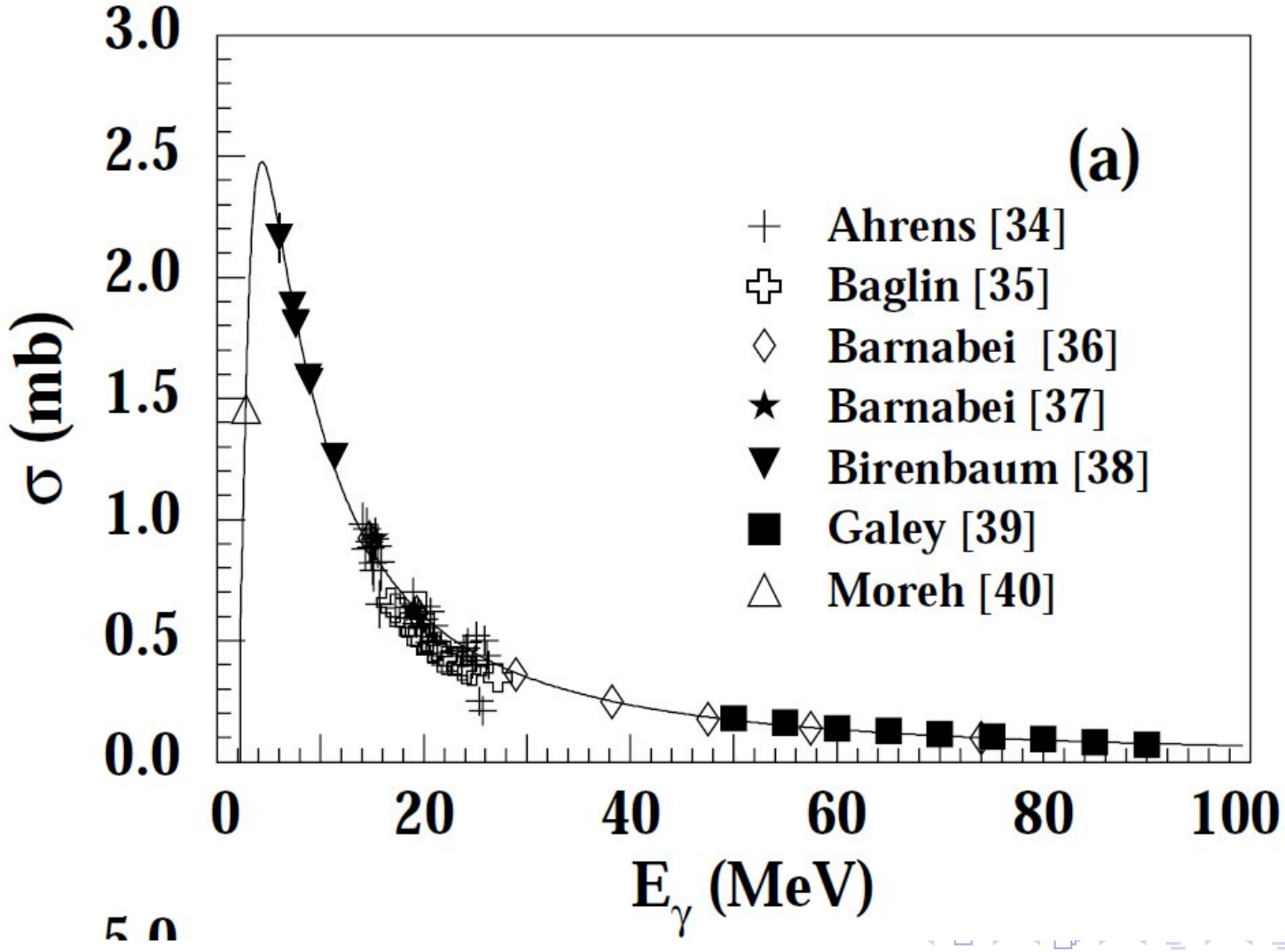
Source term

Problem with Deuterium and FLUKA

- In FLUKA for e- all hadron production is then the result of real gammas produced in electromagnetic interactions interacting with target nuclei.
- Well known problem, implementation is underway from FLUKA develpers
- Really important for Deuterium target.
- Good agreement for Neutron photoproduction on Deuterium.

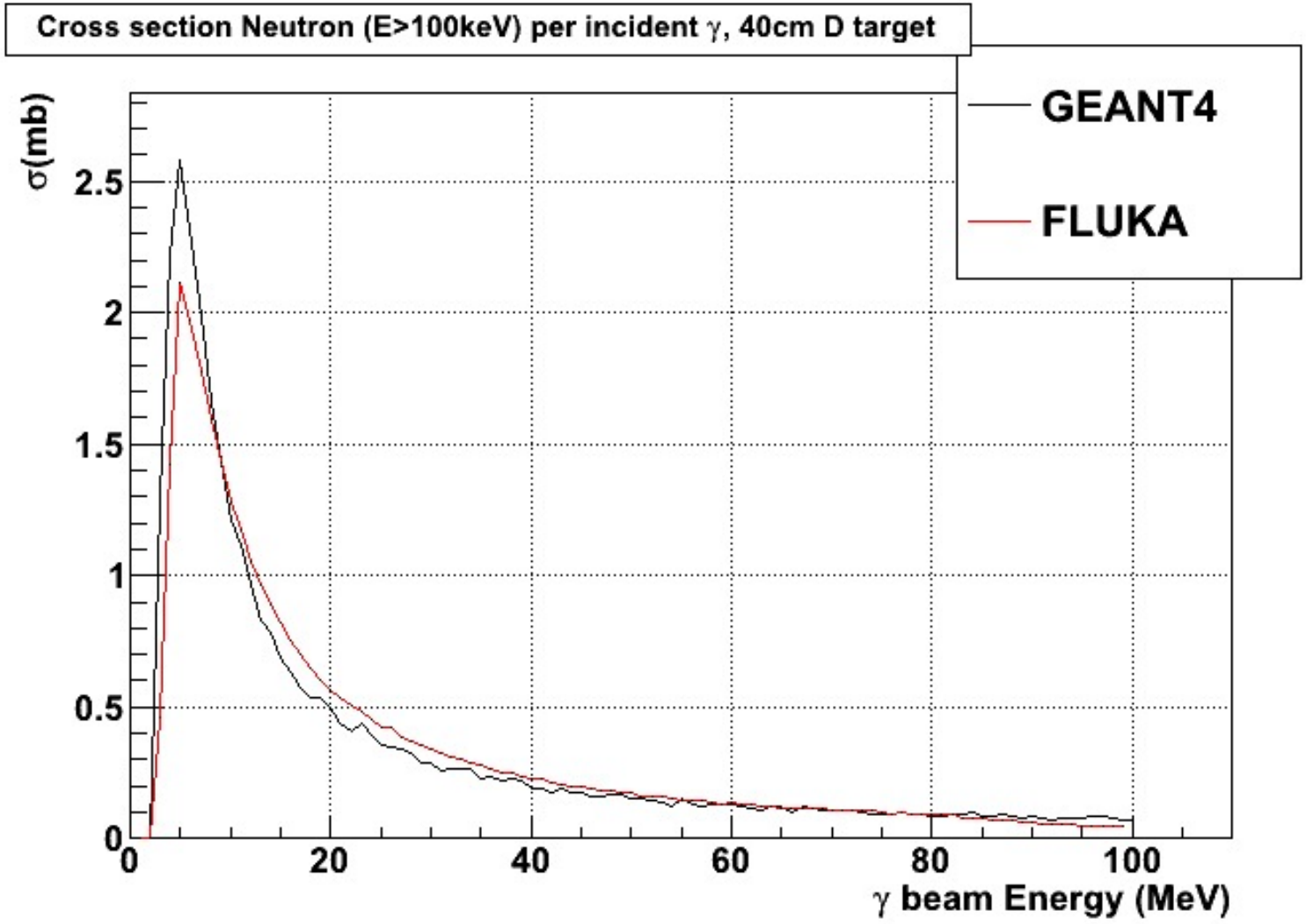
Source term

Measured cross section Neutron photoproduction on Deuterium



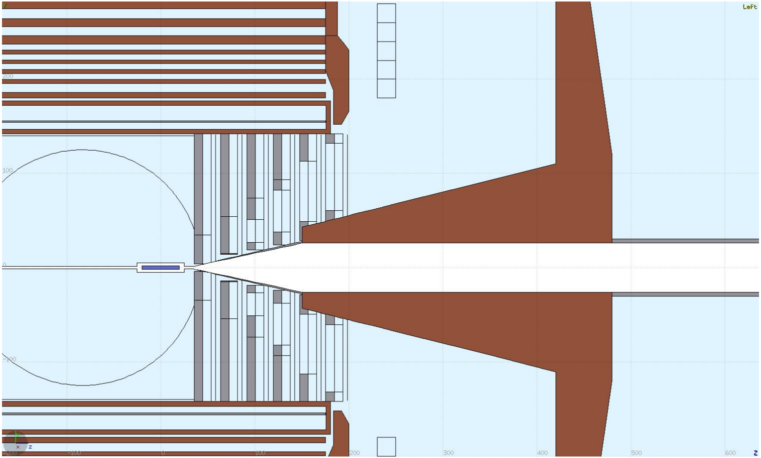
Source term

Neutron photoproduction on Deuterium GEANT4 vs FLUKA



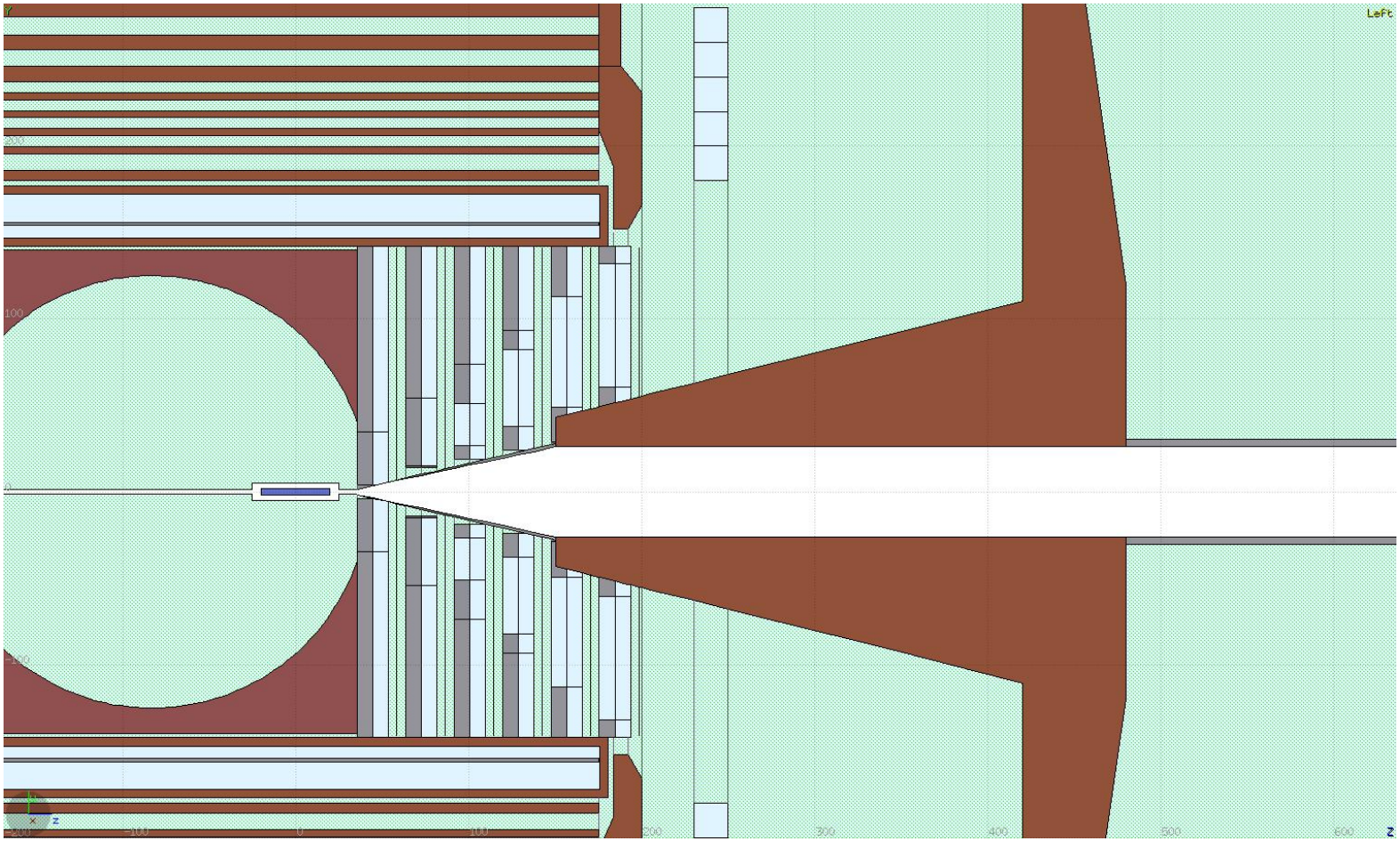
Baffle design

Baffle design NO SHIELD



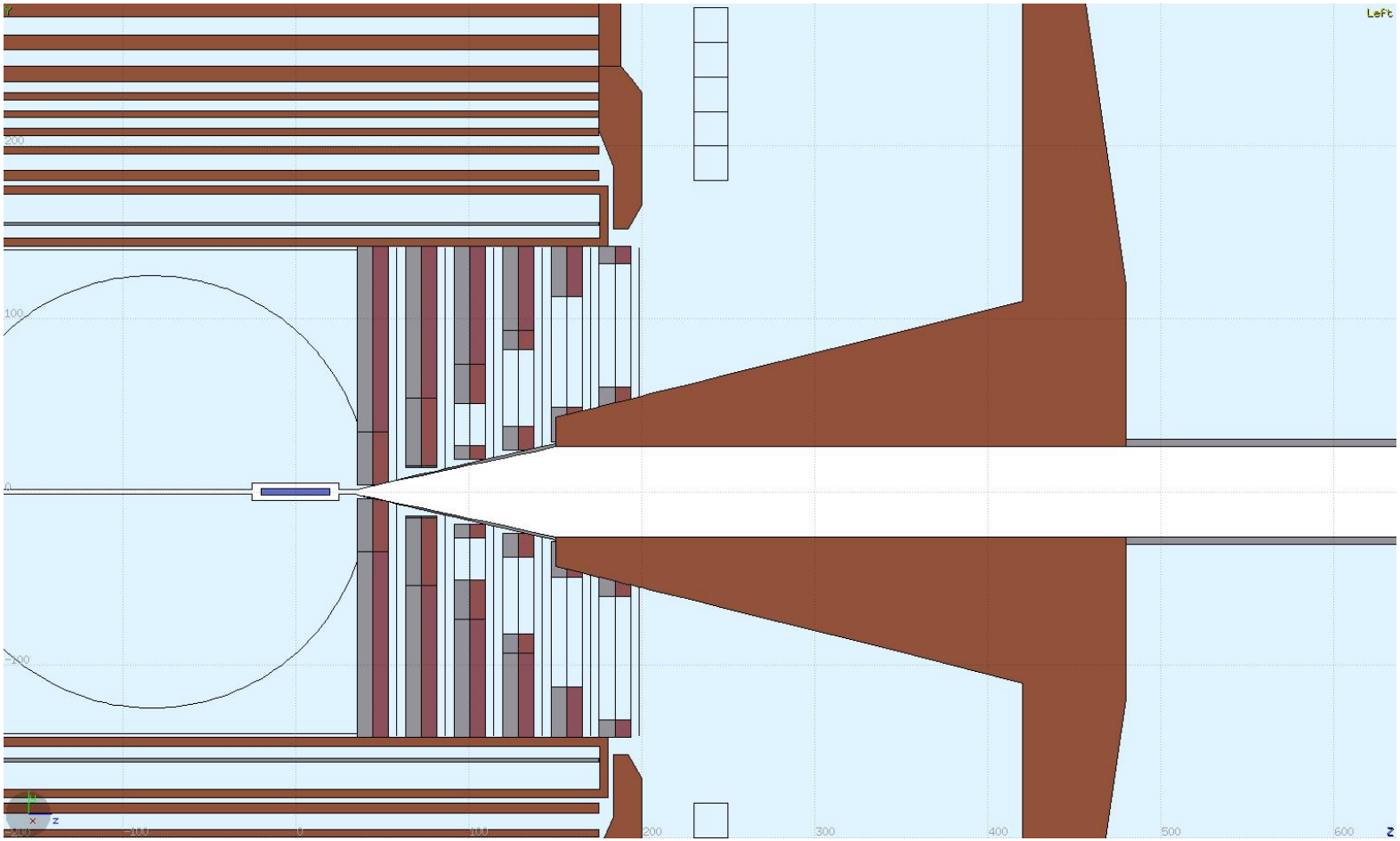
Baffle design

Baffle design SHIELD 1



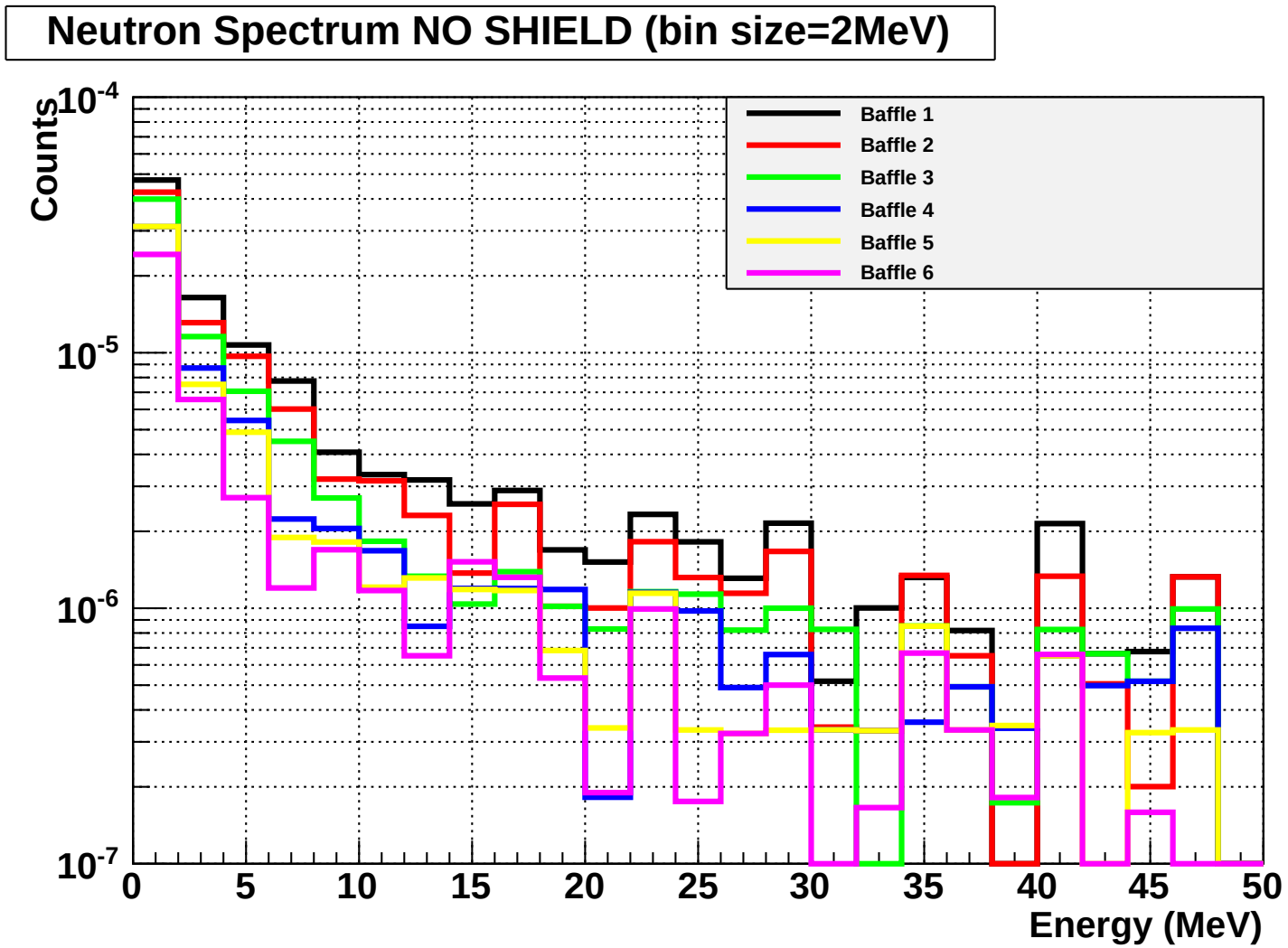
Baffle design

Baffle design SHIELD 2



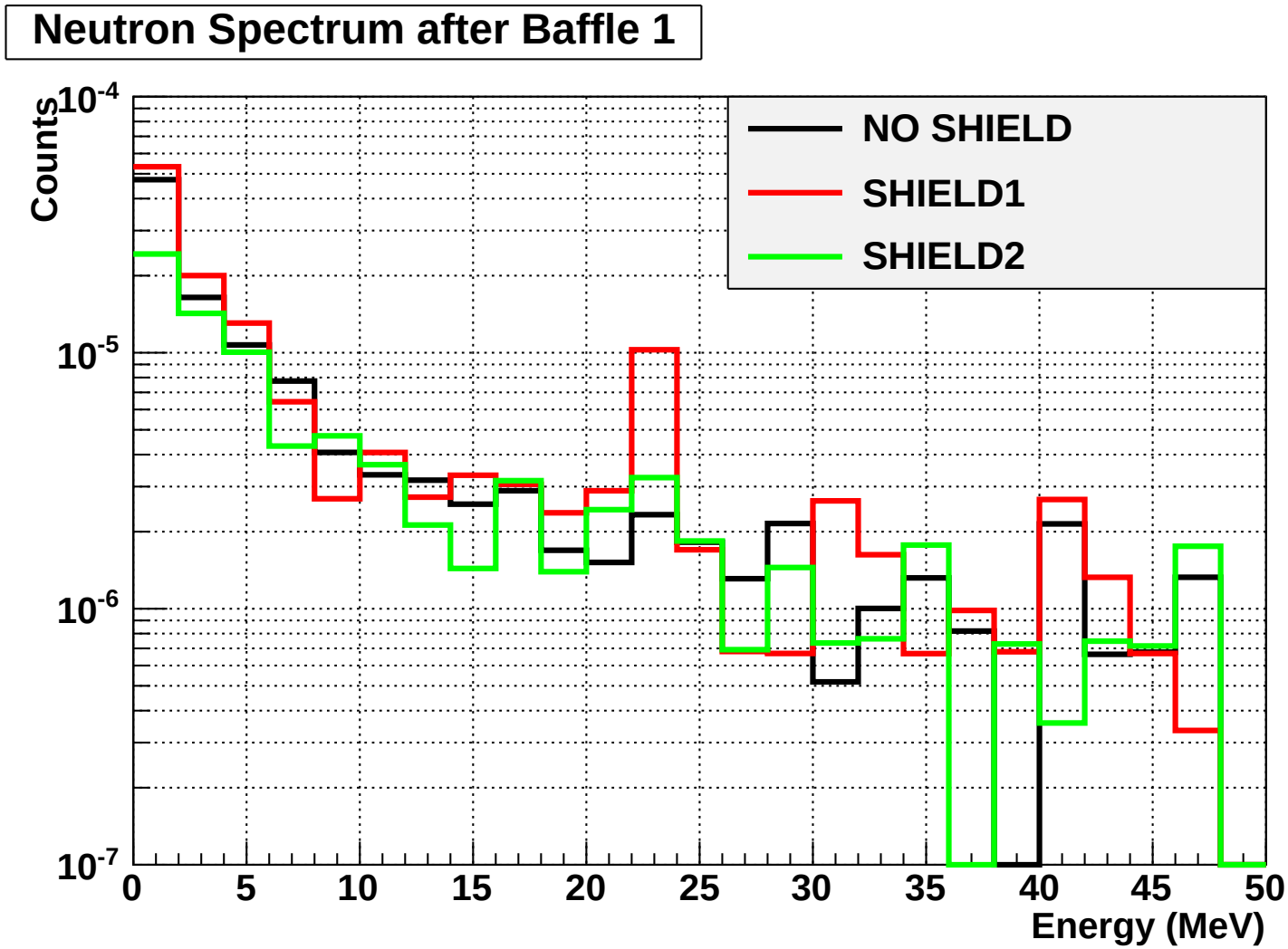
Full integrated flux

NO SHIELD



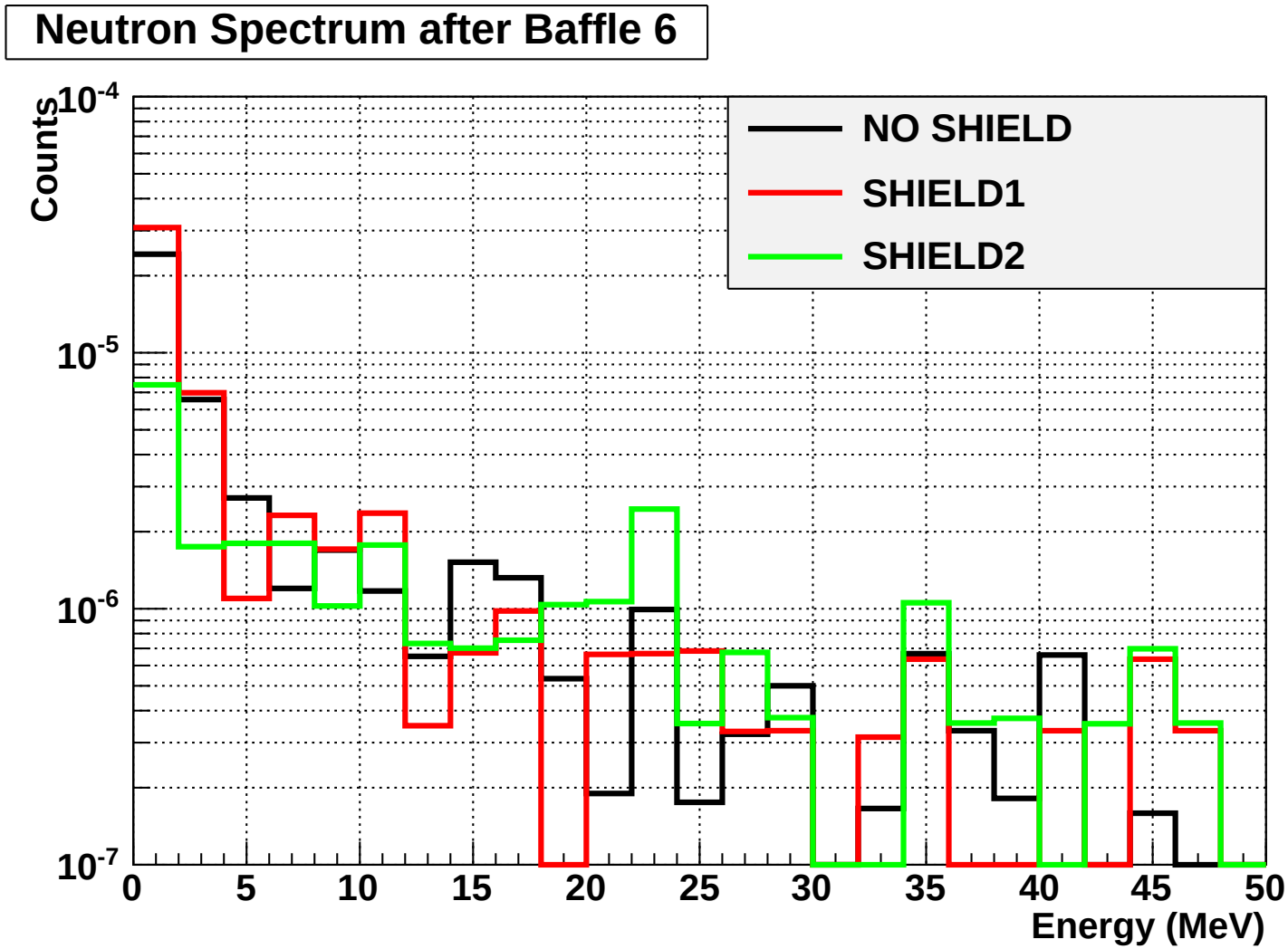
Full integrated flux

Compare Shielding at Baffle 1



Full integrated flux

Compare Shielding at Baffle 6



Displacement damage in silicon, on-line compilation

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

neutrons.xls

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
1,238E-10	1,432E-02
1,313E-10	1,391E-02
1,388E-10	1,353E-02
1,463E-10	1,317E-02
1,550E-10	1,280E-02
1,650E-10	1,242E-02
1,750E-10	1,206E-02
1,850E-10	1,172E-02
1,950E-10	1,142E-02
2,050E-10	1,113E-02
2,150E-10	1,087E-02
2,250E-10	1,063E-02
2,350E-10	1,039E-02
2,475E-10	1,013E-02

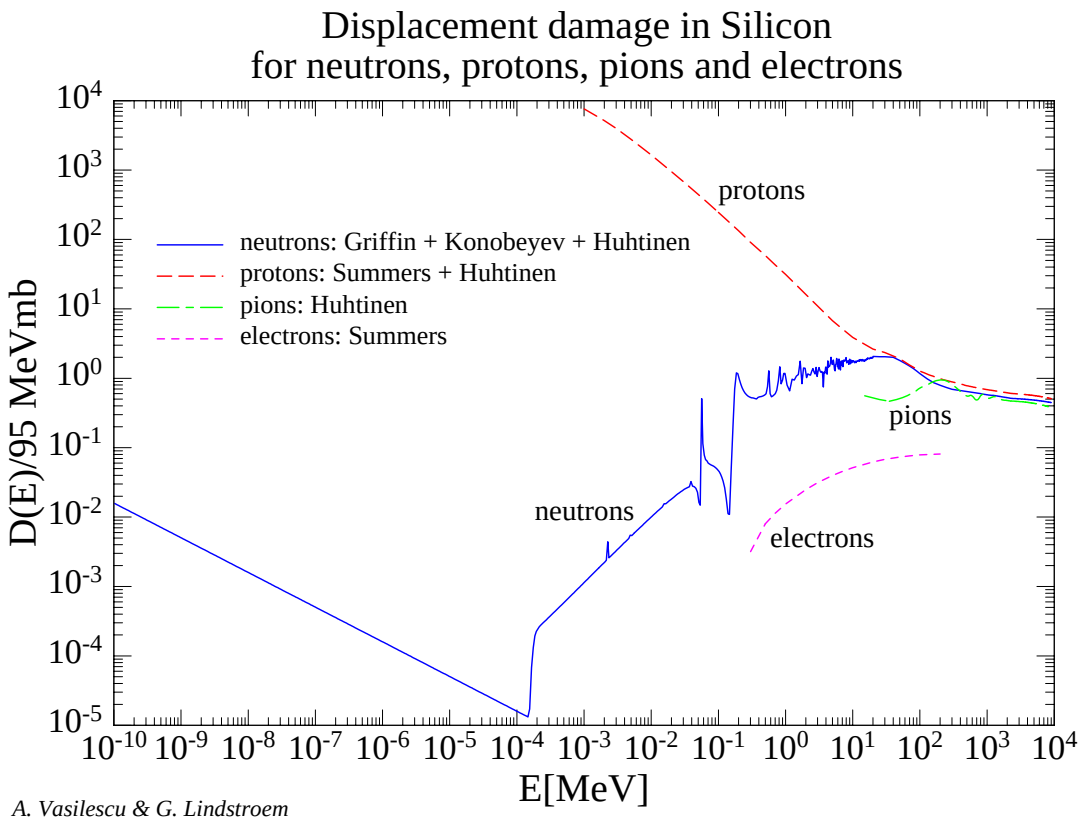
Huhtinen

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
8,450E+02	5,932E-01
8,550E+02	5,922E-01
8,650E+02	5,912E-01
8,750E+02	5,902E-01
8,850E+02	5,892E-01
8,950E+02	5,883E-01
9,050E+02	5,873E-01
9,150E+02	5,863E-01
9,250E+02	5,854E-01
9,350E+02	5,845E-01
9,450E+02	5,836E-01
9,550E+02	5,828E-01
9,650E+02	5,819E-01
9,750E+02	5,810E-01

Konobeyev

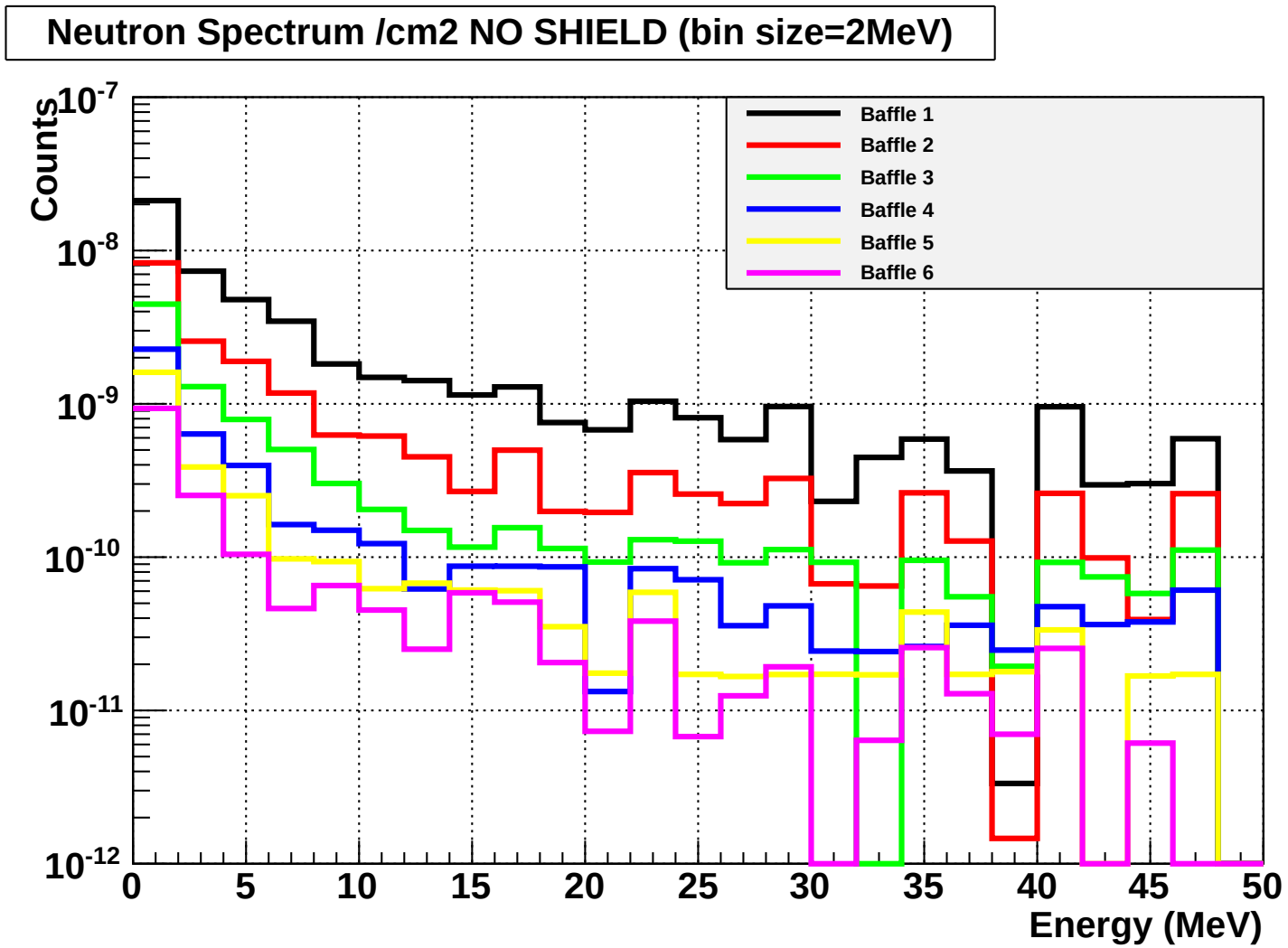
Ekin [MeV]	D/(95MeVmb)
2,000E+01	2,071E+00
2,500E+01	2,049E+00
3,000E+01	2,041E+00
4,000E+01	2,012E+00
5,000E+01	1,805E+00
6,000E+01	1,644E+00
7,000E+01	1,499E+00
8,000E+01	1,378E+00
9,000E+01	1,264E+00
1,000E+02	1,168E+00
1,300E+02	9,740E-01
1,600E+02	8,650E-01
2,000E+02	7,910E-01
2,500E+02	7,330E-01
3,000E+02	6,960E-01
3,500E+02	6,930E-01
4,000E+02	6,850E-01
4,500E+02	6,850E-01

Displacement damage in silicon, on-line compilation



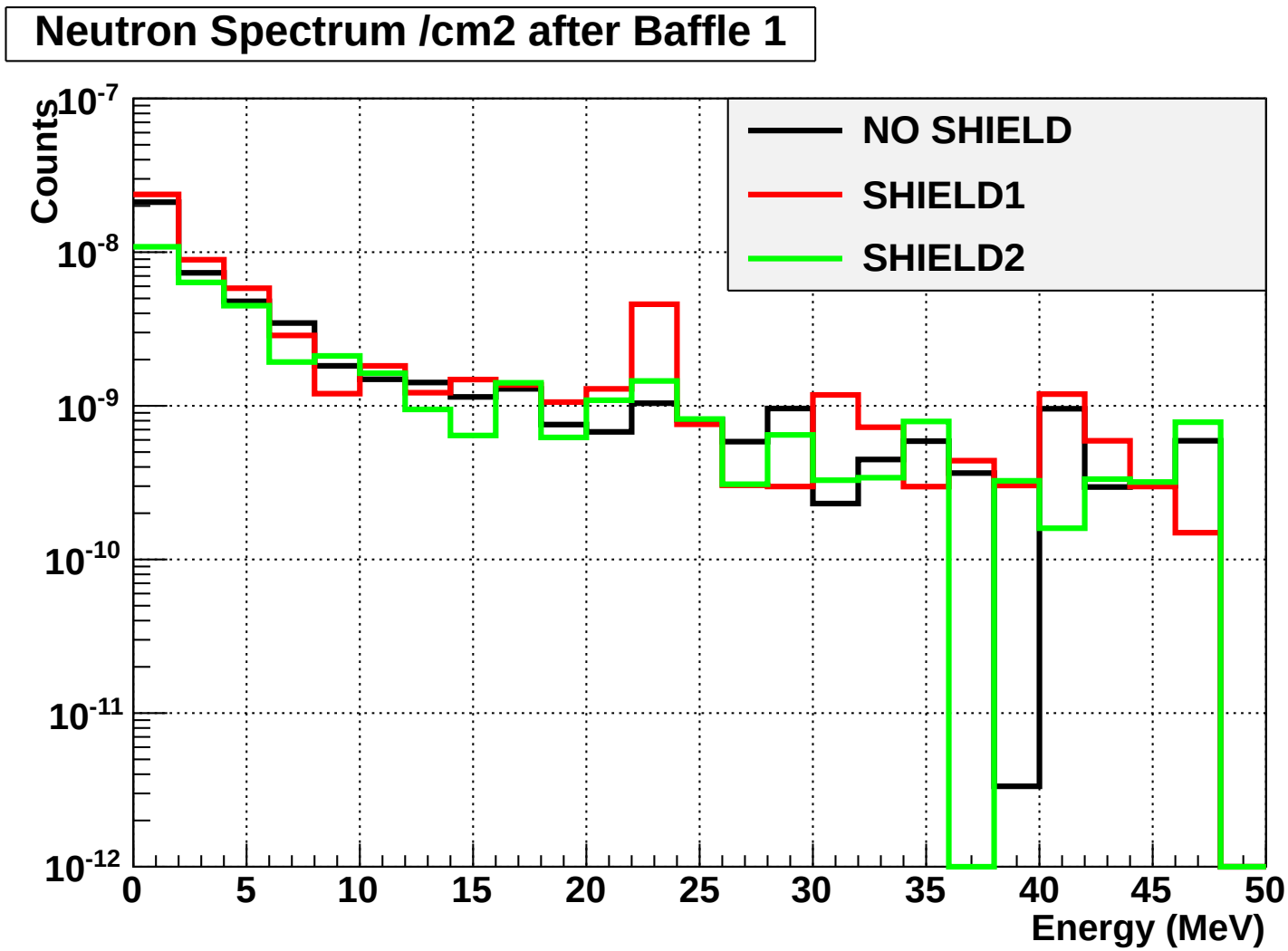
Integrated flux/cm2 weighted with NIEL curve

NO SHIELD



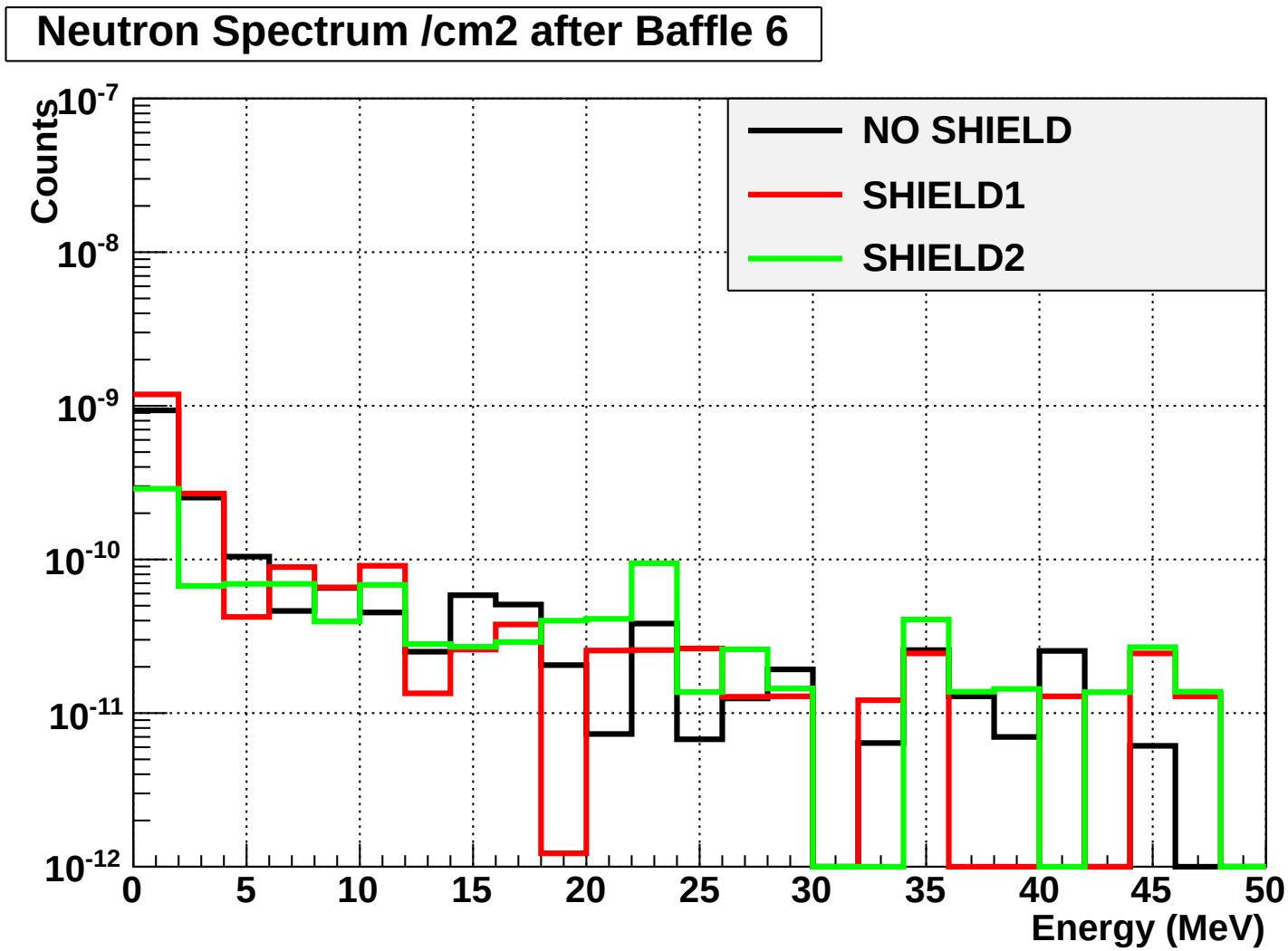
Integrated flux/cm2 weighted with NIEL curve

Compare Shielding at Baffle 1



Integrated flux/cm2 weighted with NIEL curve

Compare Shielding at Baffle 6



Integrated flux/cm2 weighted with NIEL curve

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 picks at 1MeV (curves norm to 1MeV Neutron)
- Our flux is ($2000h$ at $100\mu A$) $5x10^{13}\frac{N}{cm^2} \Rightarrow 1.1x10^{-8}\frac{N}{e^- cm^2}$

Conclusions

- FLUKA and GEANT4 seems to have good Neutron Photoproduction
- Solid PVDIS level seems comparable to CMS levels
- The GEMS seems to be able to tolerate the radiation level