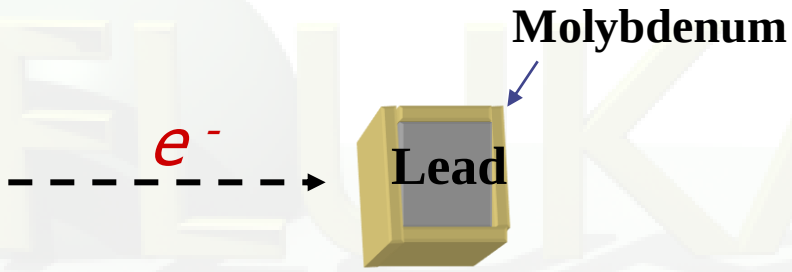
FLUKA Examples

FLUKA Advanced Course

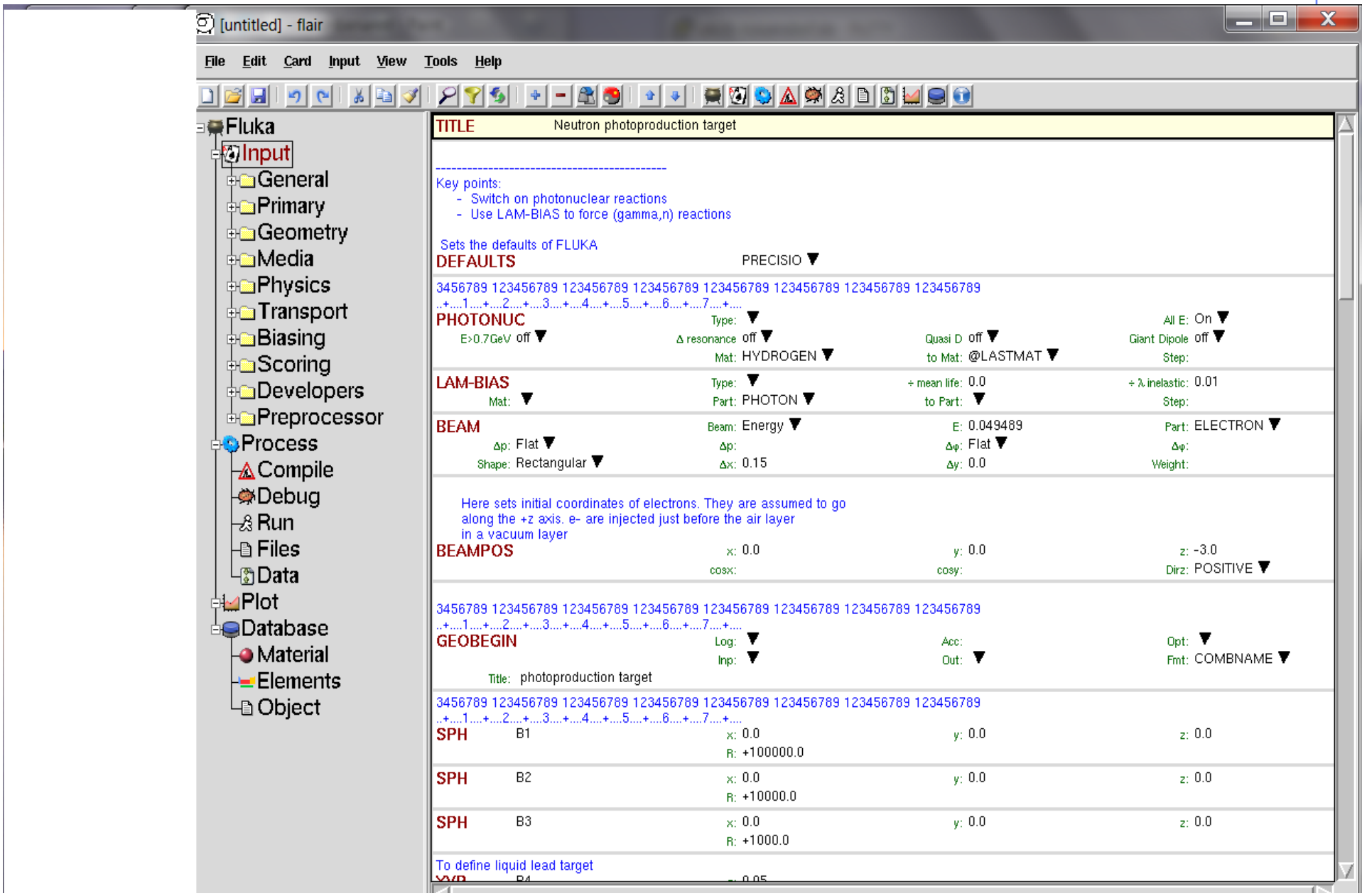
I. Liquid lead radiator for neutron photoproduction

- ***Physics problem:*** describe the neutron photoproduction induced by a 50 MeV electron beam on a lead target, 2 radiation lengths long and with a density of 10.6 g/cm^3 (liquid lead radiator). A thin Mo thickness is around



- ***Goal:*** characterize the neutron and photon fields around the source

- *neutron and photon fluences* in a spatial mesh
- *neutron and photon spectra*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File Edit Card Input View Tools Help
Fluka
Input
General
Primary
Geometry
Media
Physics
Transport
Biasing
Scoring
Developers
Preprocessor
Process
Compile
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Run
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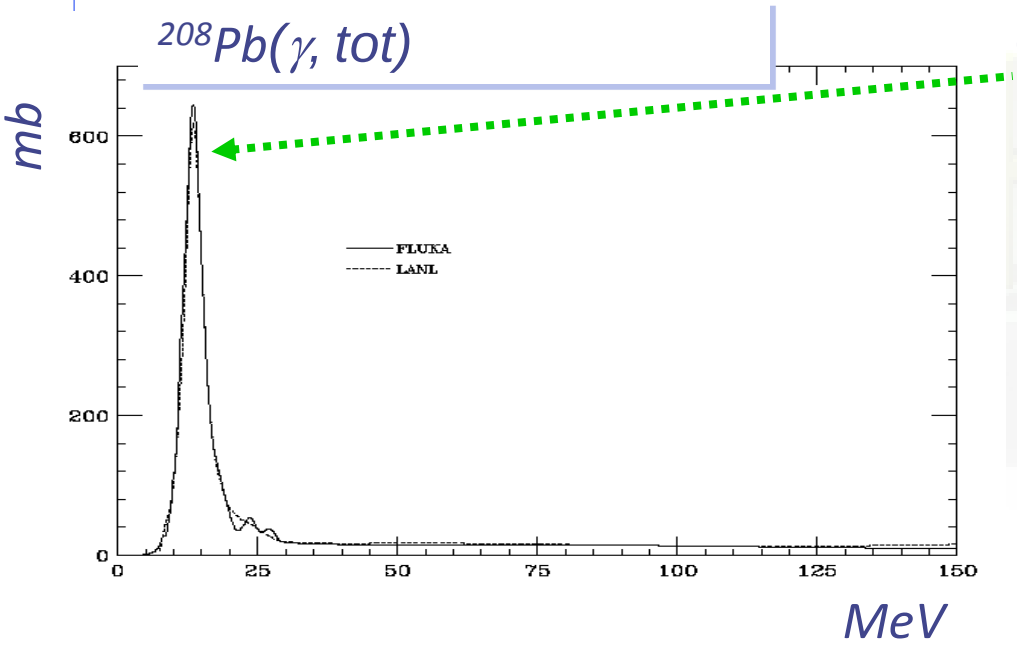
Elements
Object
TITLE Neutron photoproduction target
Key points:
- Switch on photonuclear reactions
- Use LAM-BIAS to force (gamma,n) reactions
Sets the defaults of FLUKA
DEFAULTS PRECISIO
PHOTONUC
LAM-BIAS
BEAM
Here sets initial coordinates of electrons. They are assumed to go along the +z axis. e- are injected just before the air layer in a vacuum layer
BEAMPOS
GEOBEGIN
Title: photoproduction target
SPH B1
SPH B2
SPH B3
To define liquid lead target

How to optimize the biasing value in LAM-BIAS

→ give a look at the cross sections in the game

The macroscopic cross section Σ is $\Sigma = \lambda^{-1} = \sigma \times N_0 = \sigma \times \frac{N_A \times \rho}{P_A}$

Where N_0 is the atomic density.



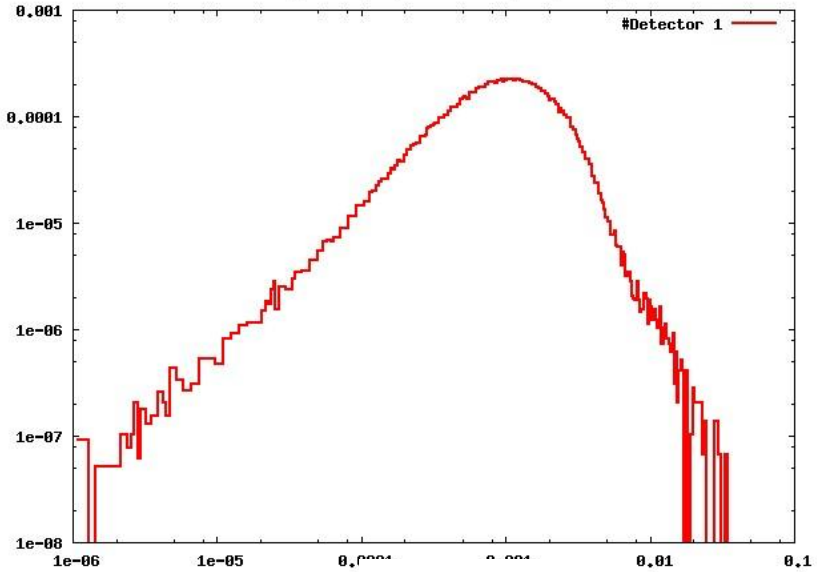
The giant dipole resonance peak is around 700 mb

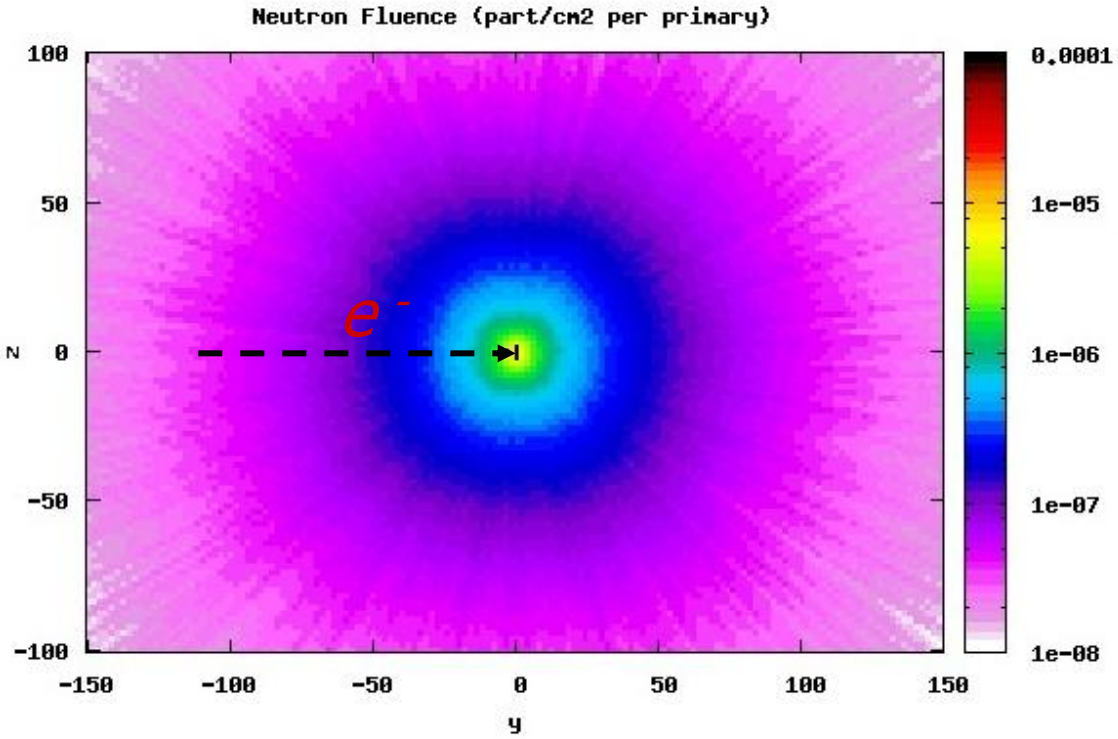
→ the mean free path λ at the peak is ~ 50 cm (Σ= 0.02 cm^{-1}).

This means that a value what(2)=0.01-0.02 in the LAM-BIAS card is reasonable

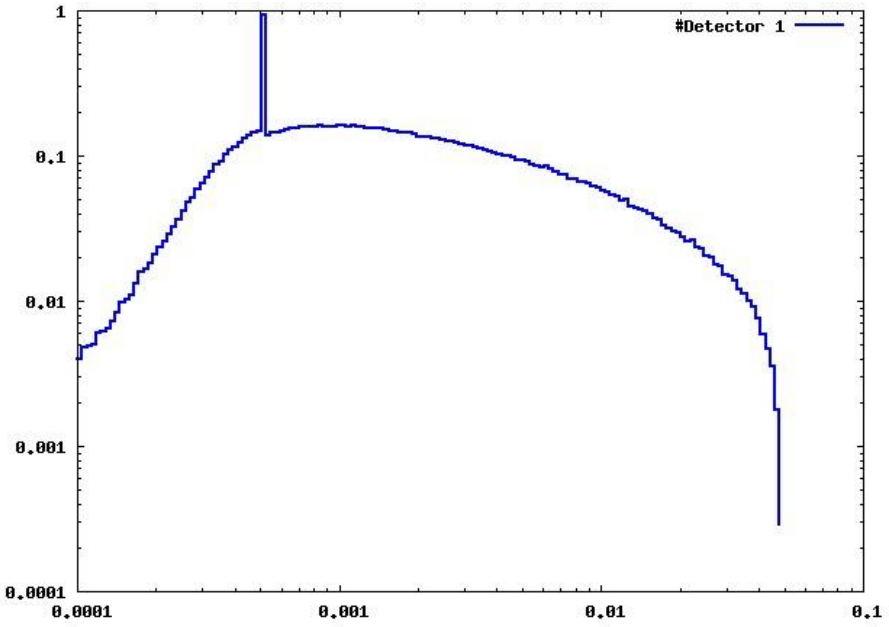
Results

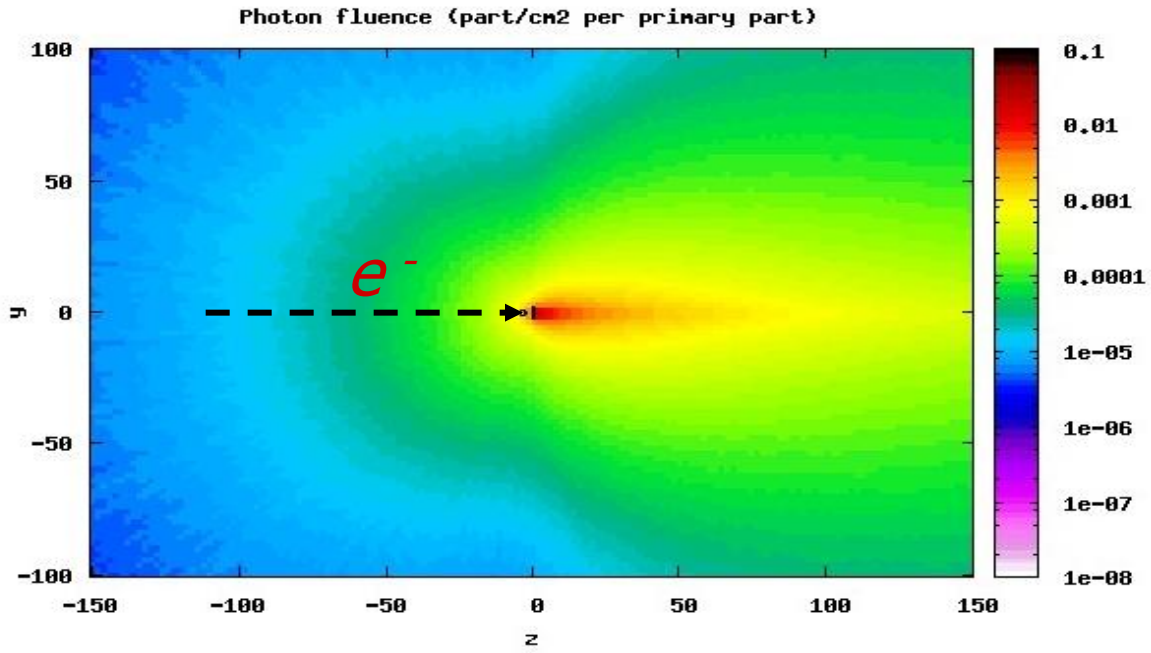
(a) Neutron spectrum





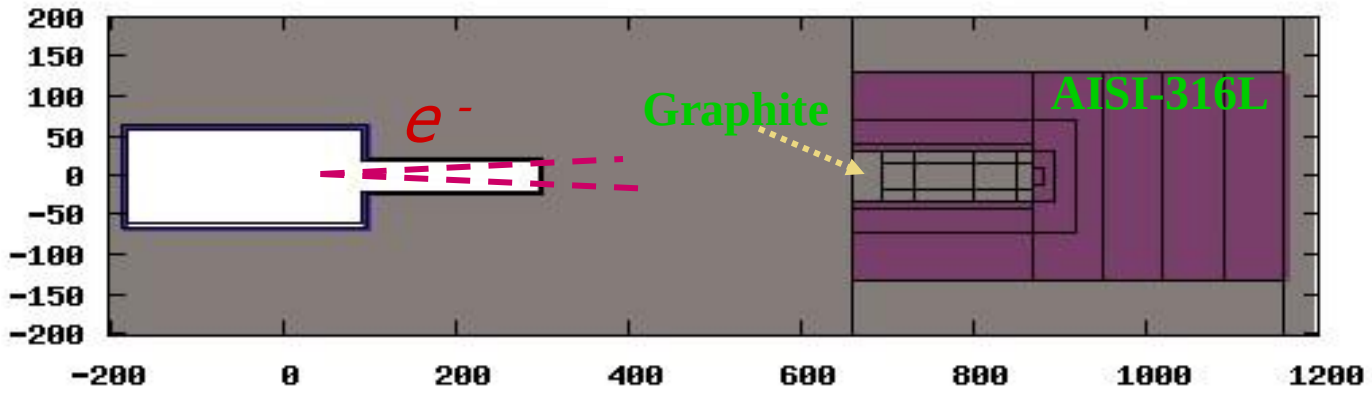
(b) Bremsstrahlung spectrum



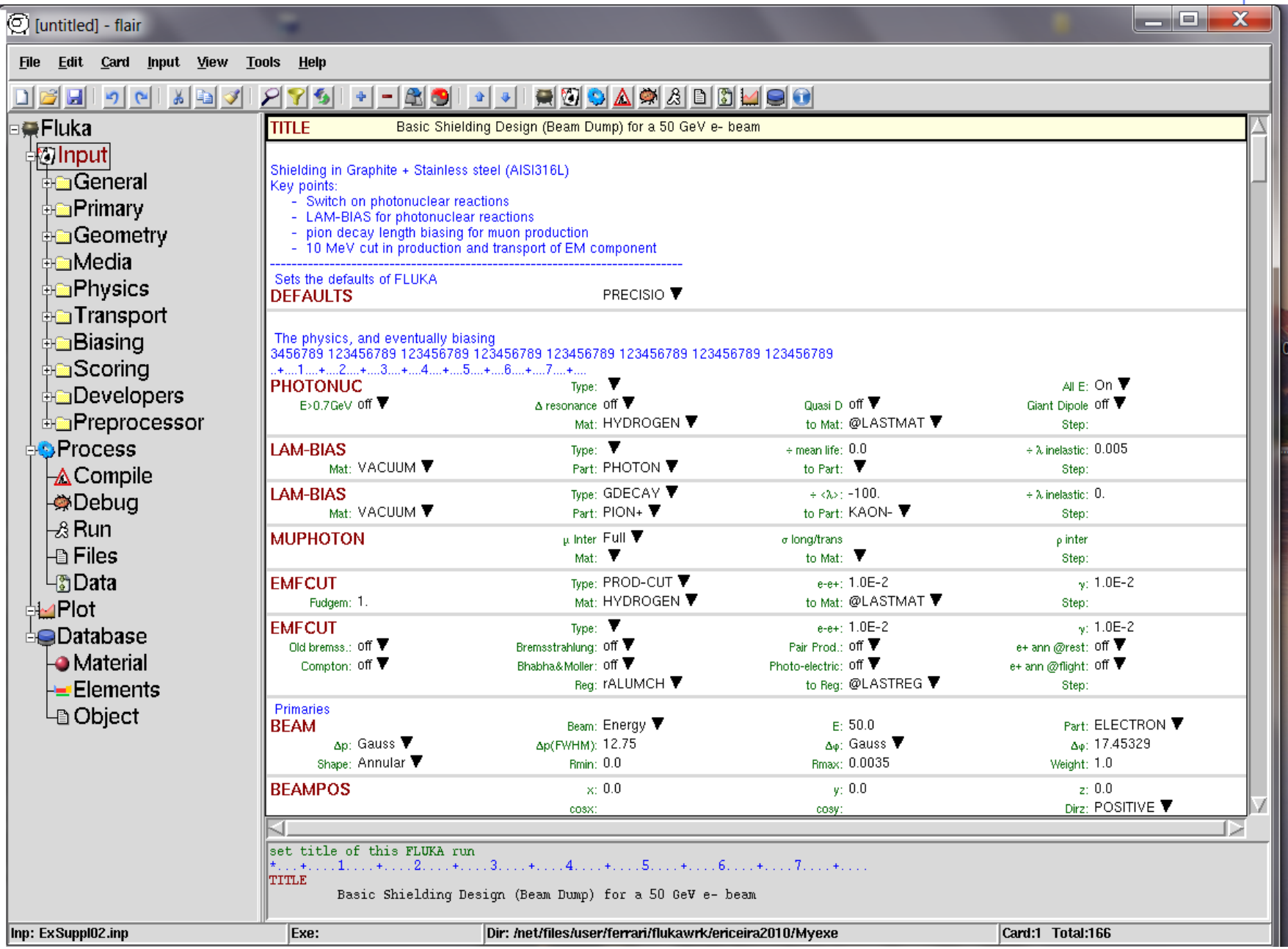


II. Shielding assessment in presence of muon photoproduction

- ***Problem:*** characterize the irradiation of a beam dump by a 50 GeV electron beam, taking into account the photoproduction processes



- ***Goal:*** describe all the radiation fields important for the shielding assessment (mainly muons and neutrons)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File Edit Card Input View Tools Help
Fluka
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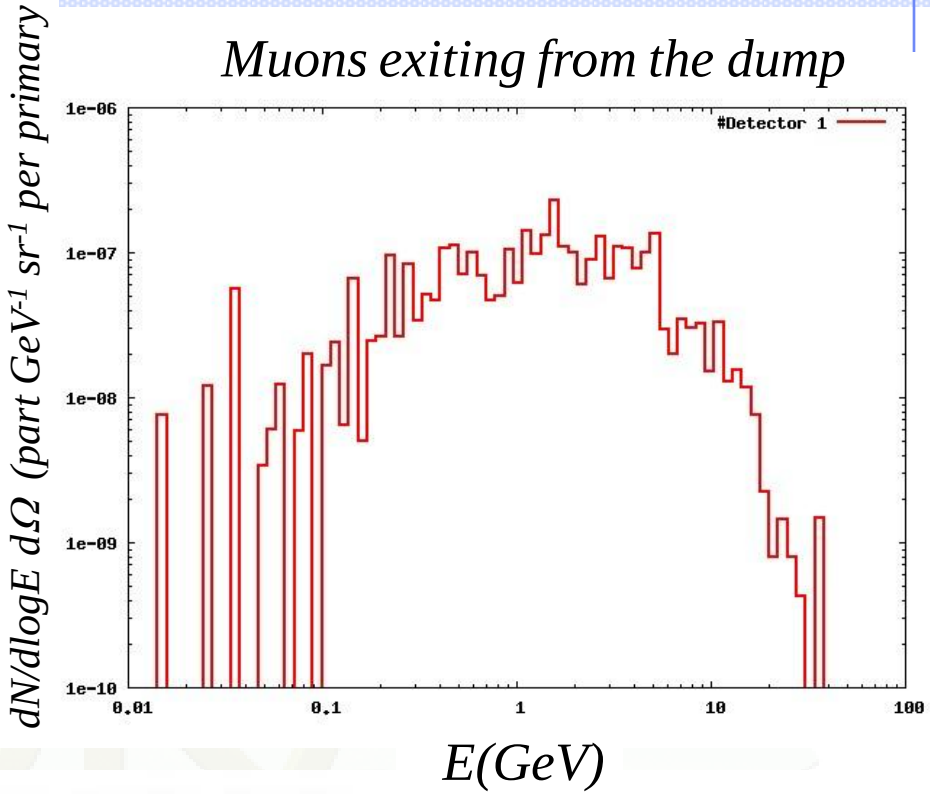
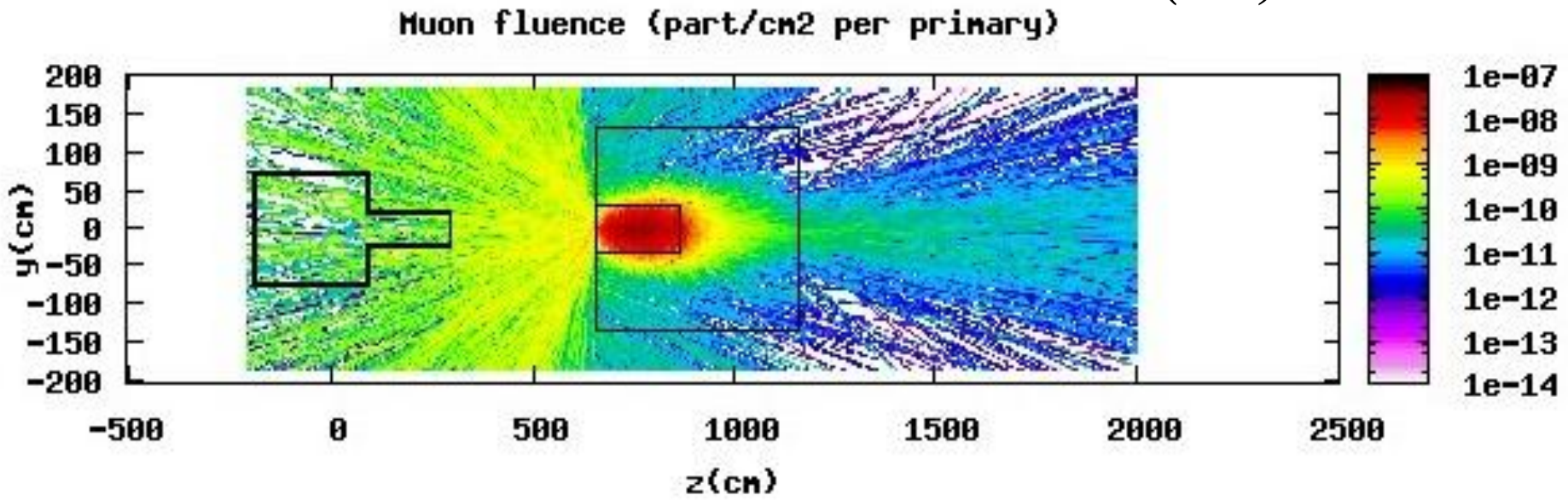
Object
TITLE Basic Shielding Design (Beam Dump) for a 50 GeV e- beam
Shielding in Graphite + Stainless steel (AISI316L)
Key points:
- Switch on photonuclear reactions
- LAM-BIAS for photonuclear reactions
- pion decay length biasing for muon production
- 10 MeV cut in production and transport of EM component
Sets the defaults of FLUKA
DEFAULTS PRECISIO
The physics, and eventually biasing
PHOTONUC Type: All E: On
E>0.7GeV off Δ resonance off Quasi D off Giant Dipole off
Mat: HYDROGEN to Mat: @LASTMAT Step:
LAM-BIAS Type: ÷ mean life: 0.0 ÷ λ inelastic: 0.005
Mat: VACUUM Part: PHOTON to Part: Step:
LAM-BIAS Type: GDECAY ÷ <λ>: -100. ÷ λ inelastic: 0.
Mat: VACUUM Part: PION+ to Part: KAON- Step:
MUPHOTON μ Inter Full σ long/trans ρ inter
Mat: to Mat: Step:
EMFCUT Type: PROD-CUT e-e+: 1.0E-2 γ: 1.0E-2
Fudgem: 1. Mat: HYDROGEN to Mat: @LASTMAT Step:
EMFCUT Type: e-e+: 1.0E-2 γ: 1.0E-2
Old bremss.: off Bremsstrahlung: off Pair Prod.: off e+ ann @rest: off
Compton: off Bhabha&Moller: off Photo-electric: off e+ ann @flight: off
Reg: rALUMCH to Reg: @LASTREG Step:
Primaries
BEAM Beam: Energy E: 50.0 Part: ELECTRON
Δp: Gauss Δp(FWHM): 12.75 Δφ: Gauss Δφ: 17.45329
Shape: Annular Rmin: 0.0 Rmax: 0.0035 Weight: 1.0
BEAMPOS x: 0.0 y: 0.0 z: 0.0
cosx: cosy: Dirz: POSITIVE
set title of this FLUKA run
TITLE
Basic Shielding Design (Beam Dump) for a 50 GeV e- beam
Inp: ExSuppl02.inp
Exe:
Dir: /net/files/user/ferrari/flukawrk/ericeira2010/Myexe
Card:1 Total:166

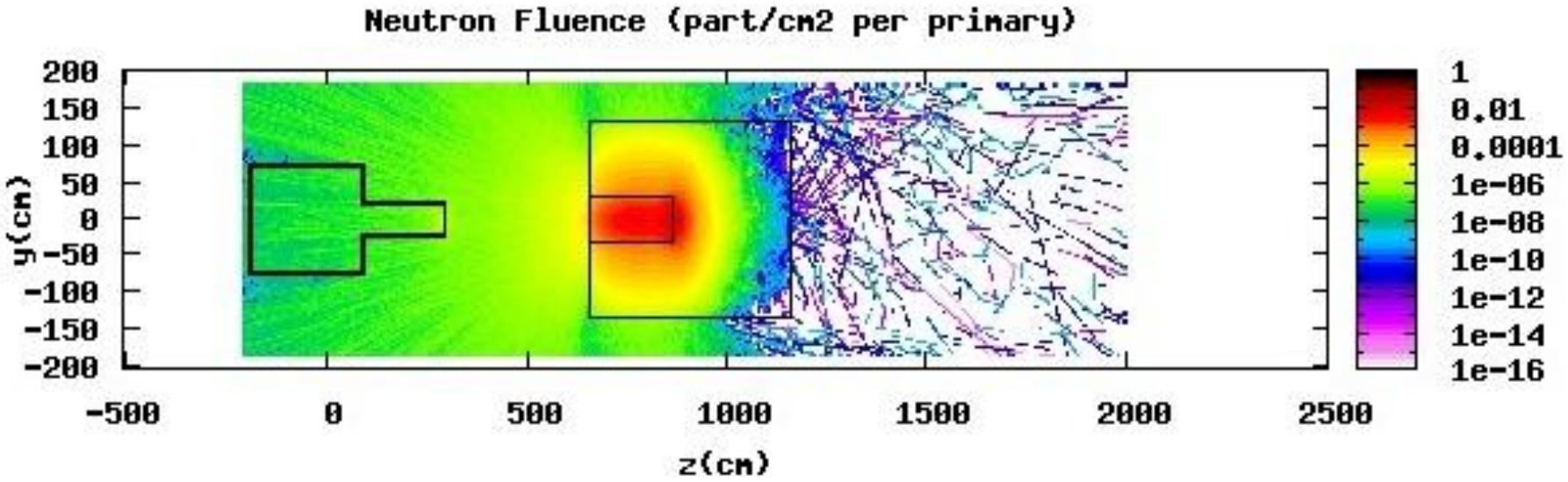
Results

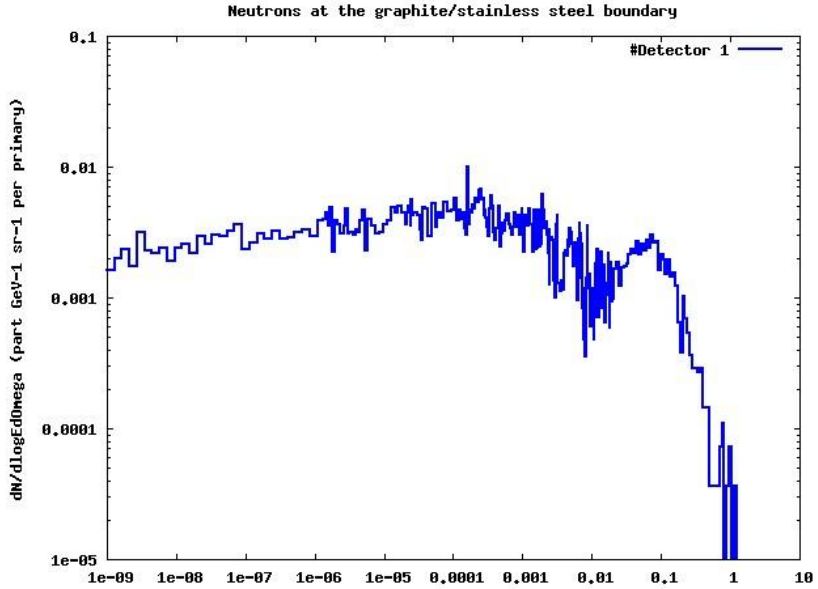
(a) Muon fluence



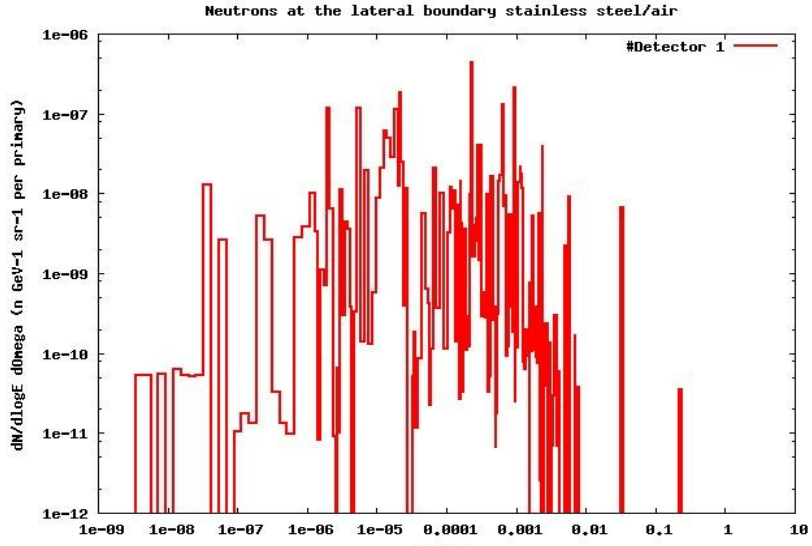


(b) Neutron fluence





E(GeV)



E(GeV)