Simulations for the shielding of the dump at PITZ

Consideration for an electron beam from HEDA2

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HELMHOLTZ GEMEINSCHAFT

DESY

Outline

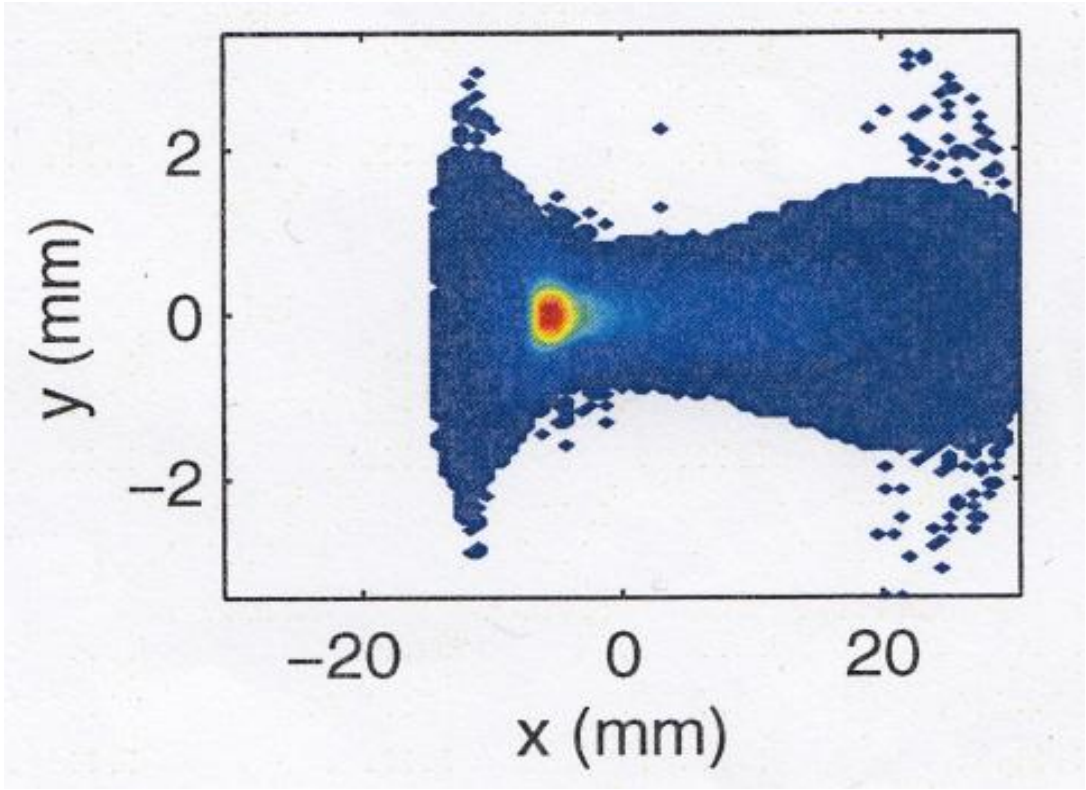
1. Objective
2. Properties of the electron beam
3. Geometry
4. Simulation results
5. Summary

1. Objective

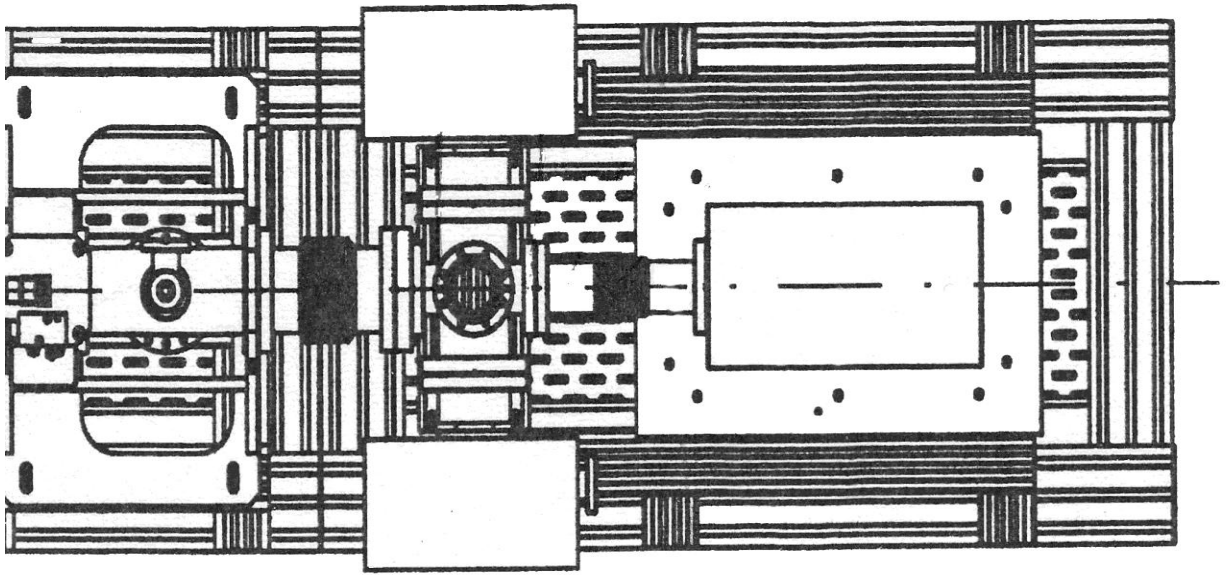
- Simulation for dimensioning of dump shielding
  - Constant running (2000h)
- Implement beam shape after HEDA2
- Compare with previous calculations
  - Sufficient dump dimensions (Al; 40cm length; 10cm radius)
  - Concrete shield (20 cm)
  - Lead shield (10cm)

2. Properties of the electron beam

- p= 23 MeV/c
- Q/microbunch= 1 nC
- 6000 microbunches/s
- P= 150 W
- Permanent irradition (2000 h)
- Special beam shape
  - Positive x_{max}= 32 mm



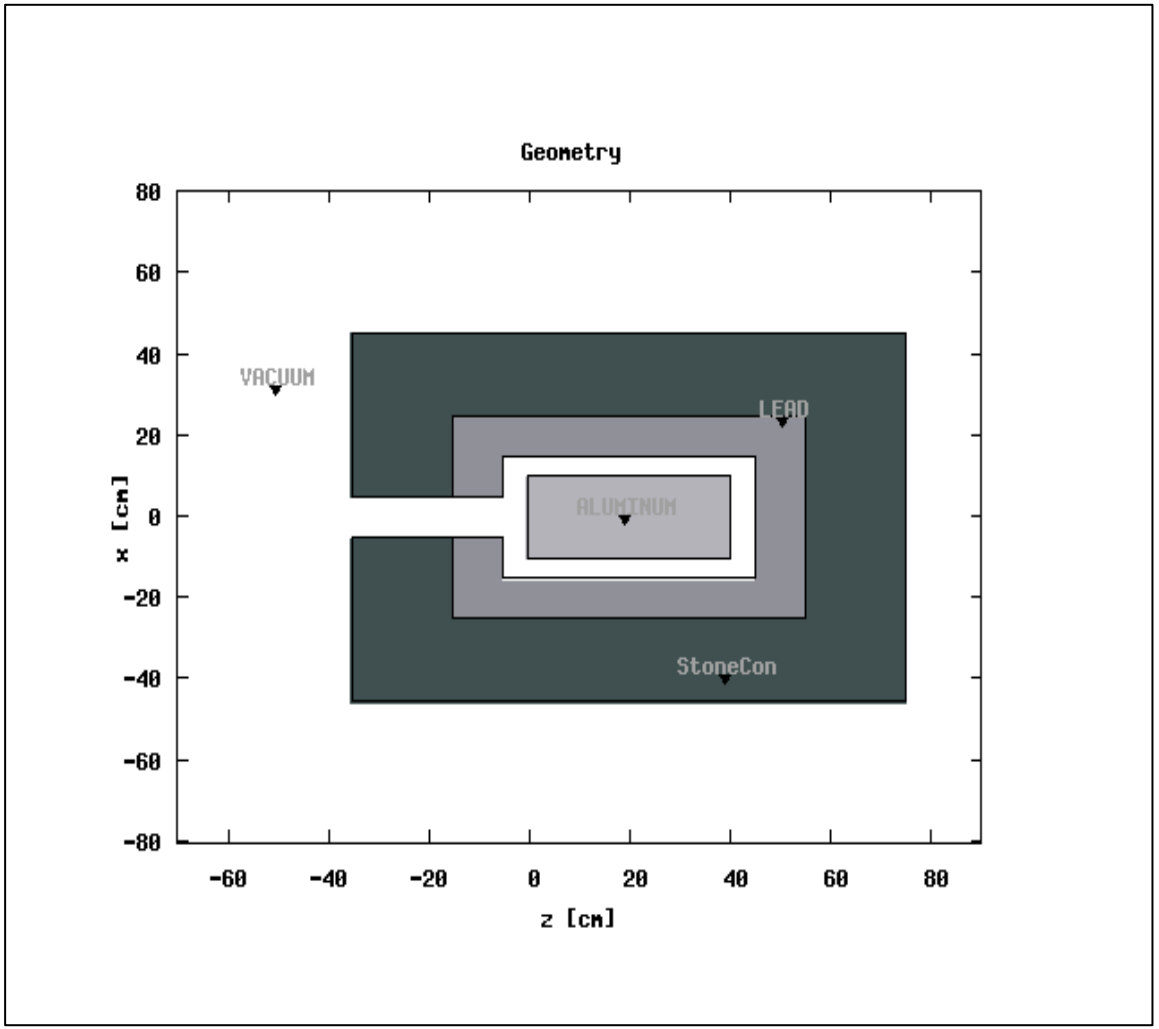
3. Geometry - PITZ



- Radius of the last part of the beamline 32 mm
- Minimum radius of the last bellow 25 mm

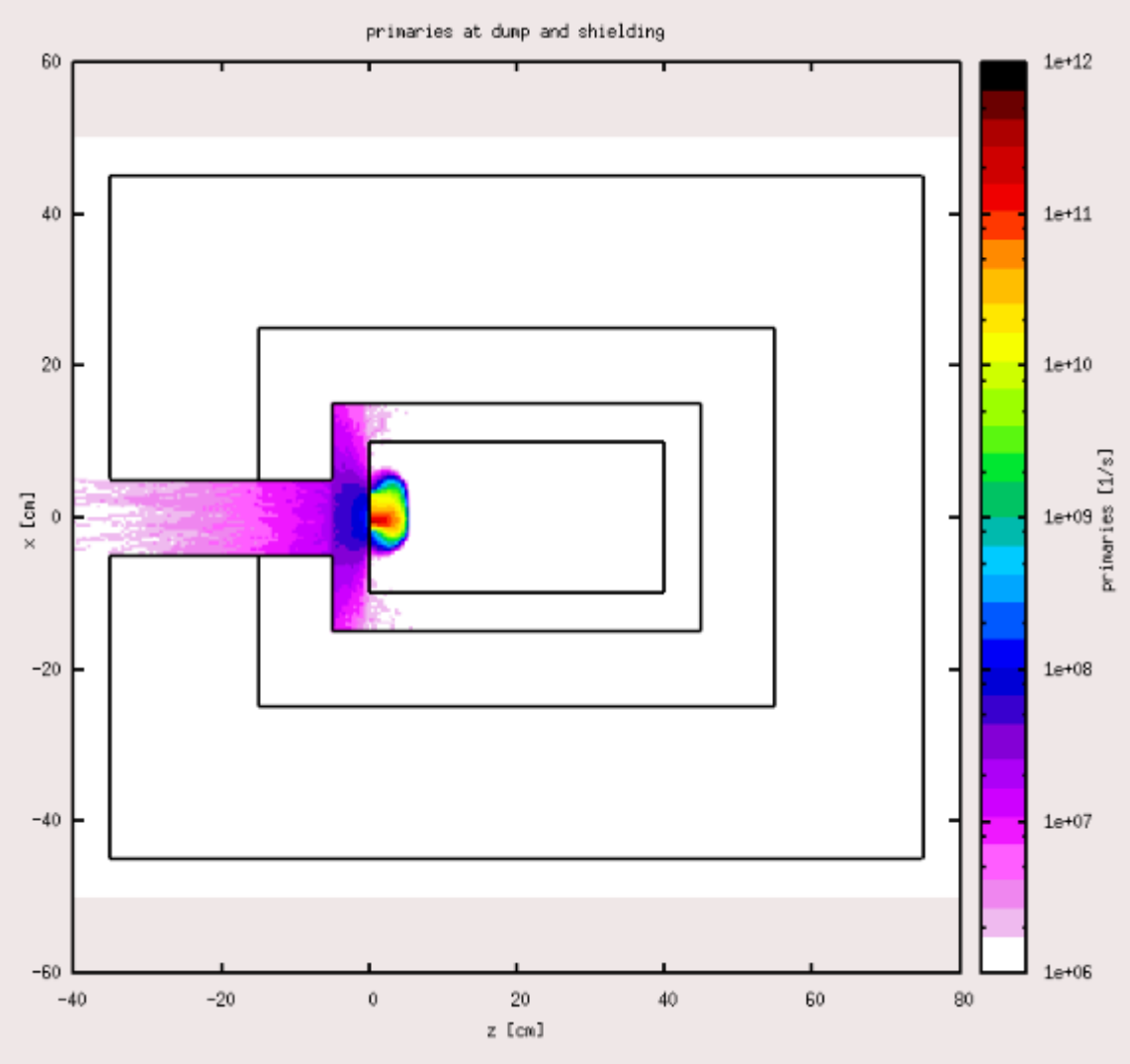
3. Geometry - Simulation

- Dump
  - Radius 10 cm
  - Length 40 cm
- Lead shield
  - Thickness 10 cm
- Concrete shield
  - Thickness 20 cm
- Gap for beamline
  - 5x5 cm



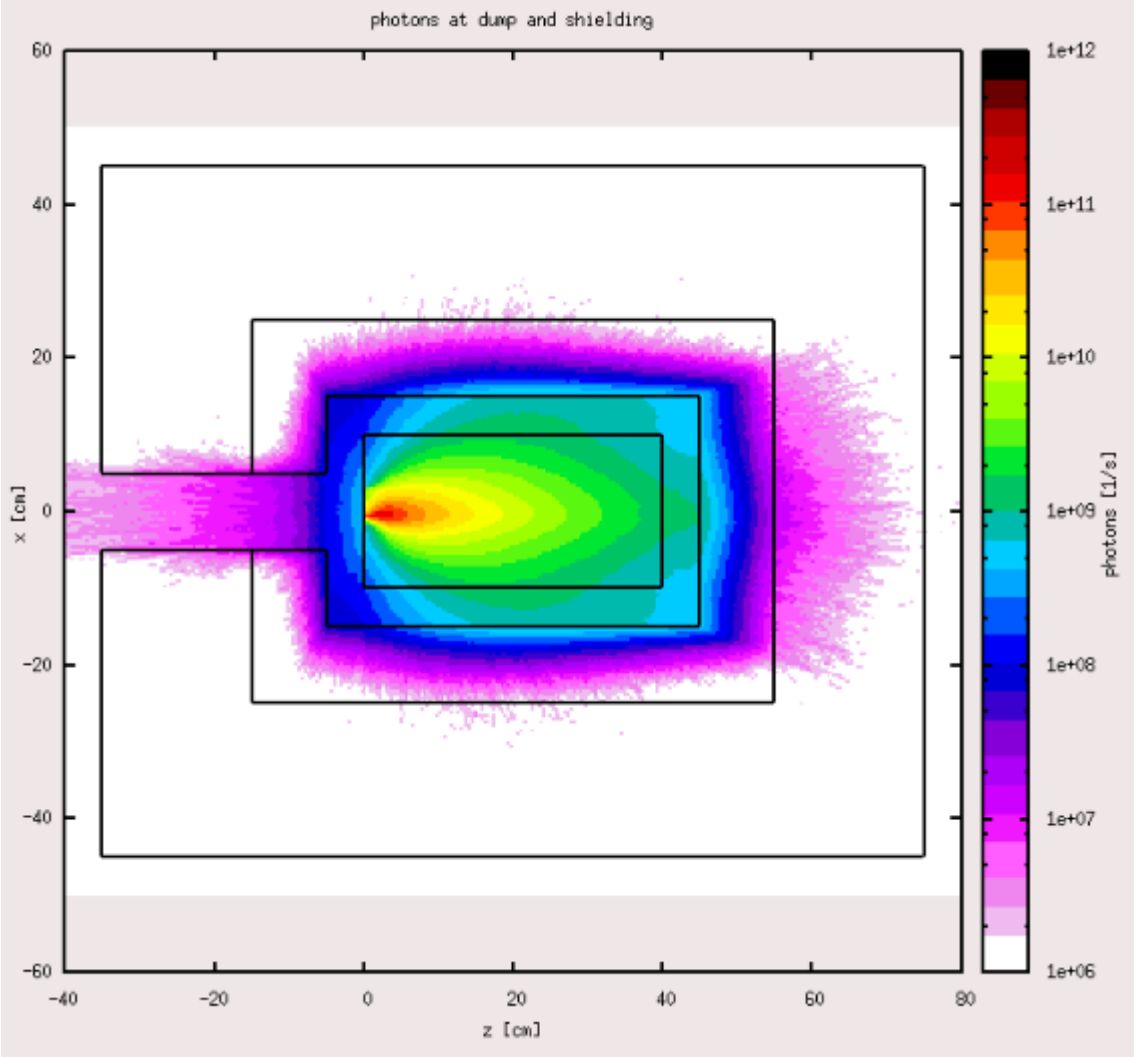
4. Simulation results - primaries

- Number of back scattered primaries: 0.01%
  - allowed maximum: 3%



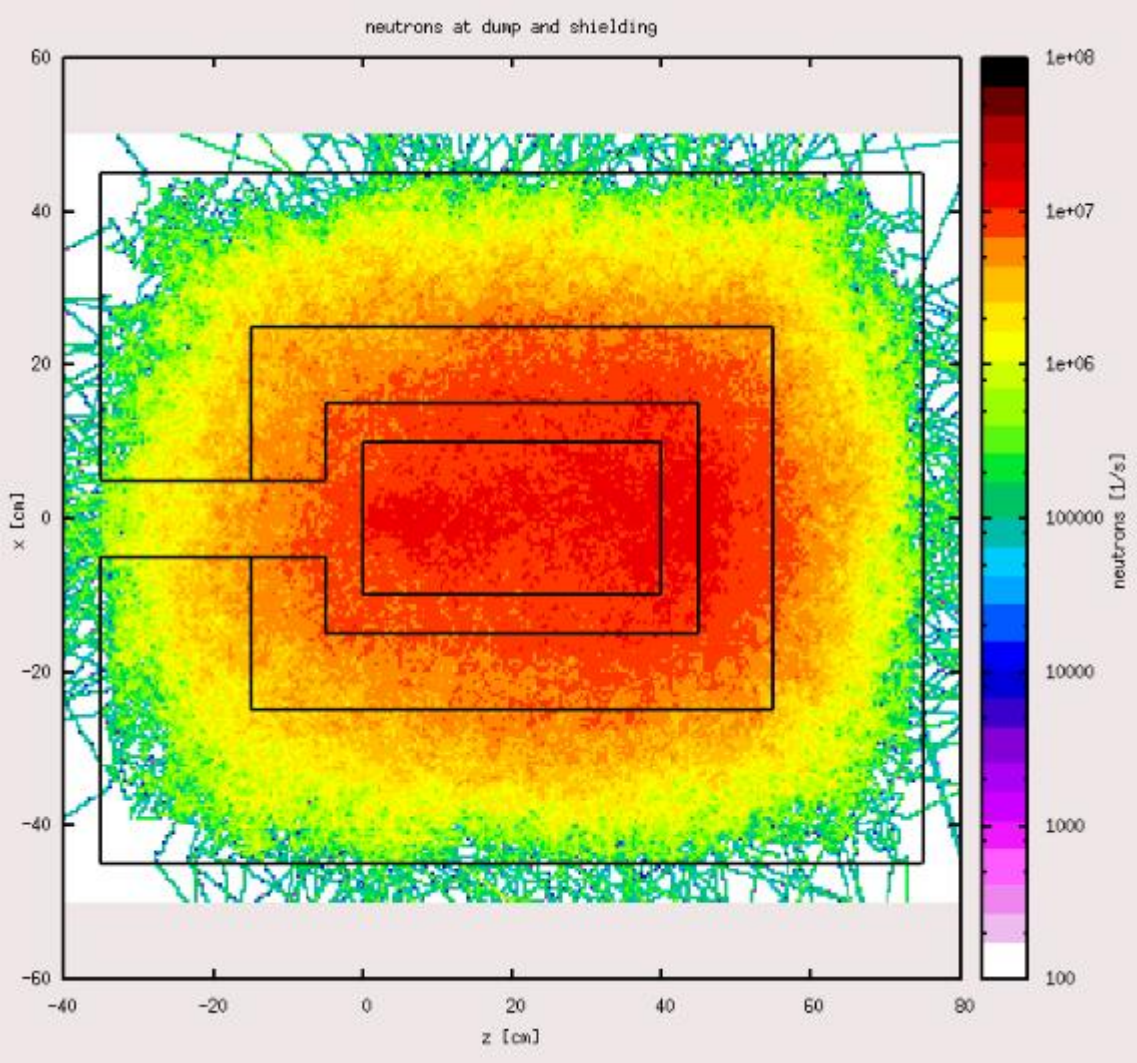
4. Simulation results - photons

- Number of photons decresed by 10^3 at shielding

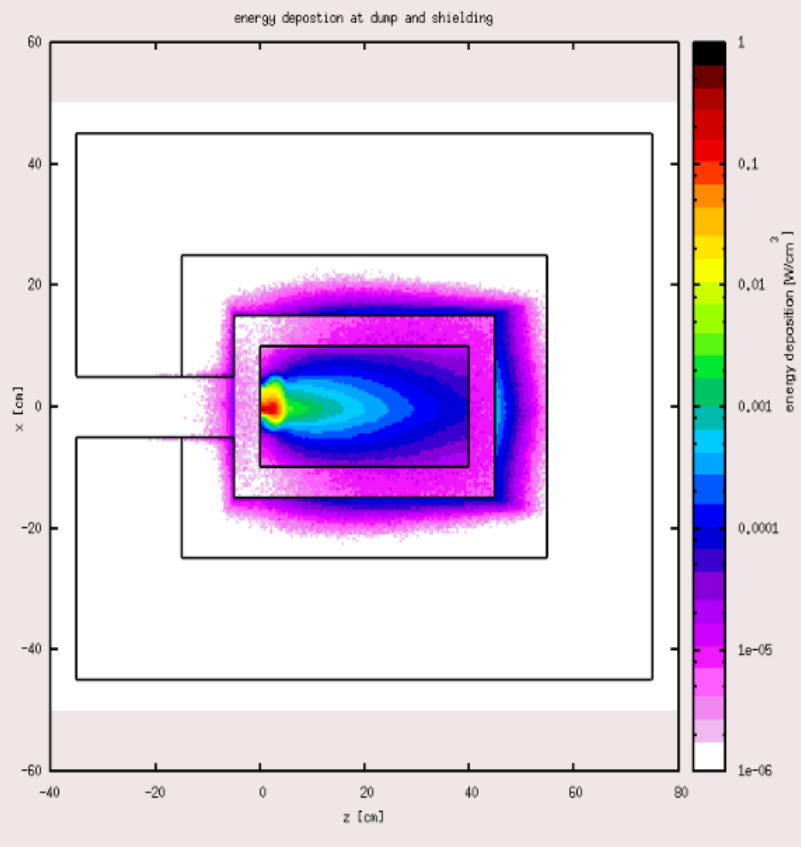


4. Simulation results - neutrons

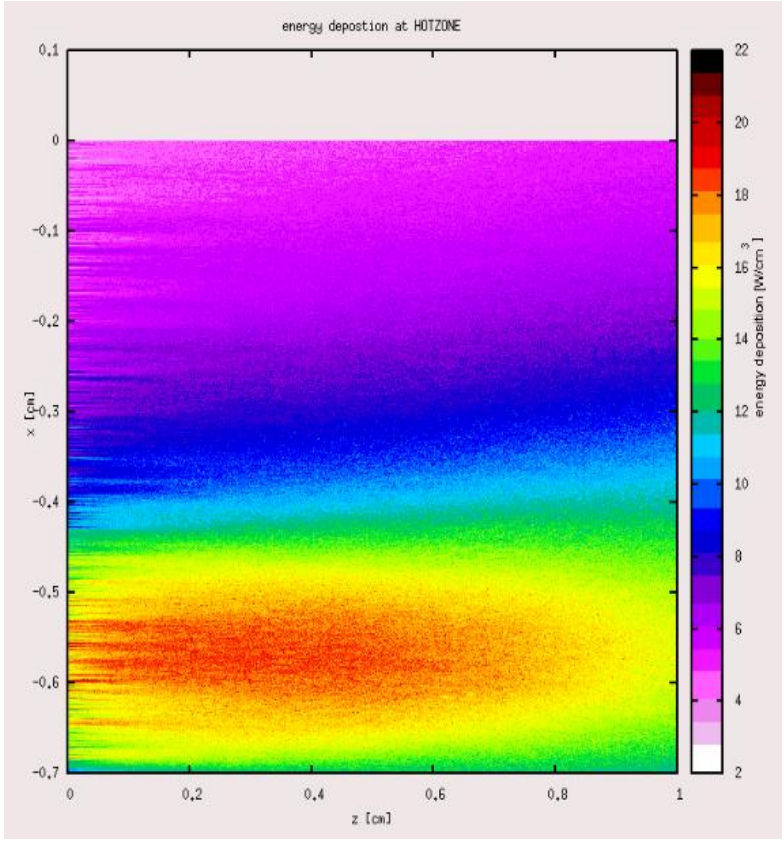
- Number of neutrons decresed by 10^3 at shielding
- Neutron yield
  - Simulations: $3.61*10^{-4}$ 1/primary
  - Calculation: $2.56*10^{-4}$ 1/primary



4. Simulation results - energy

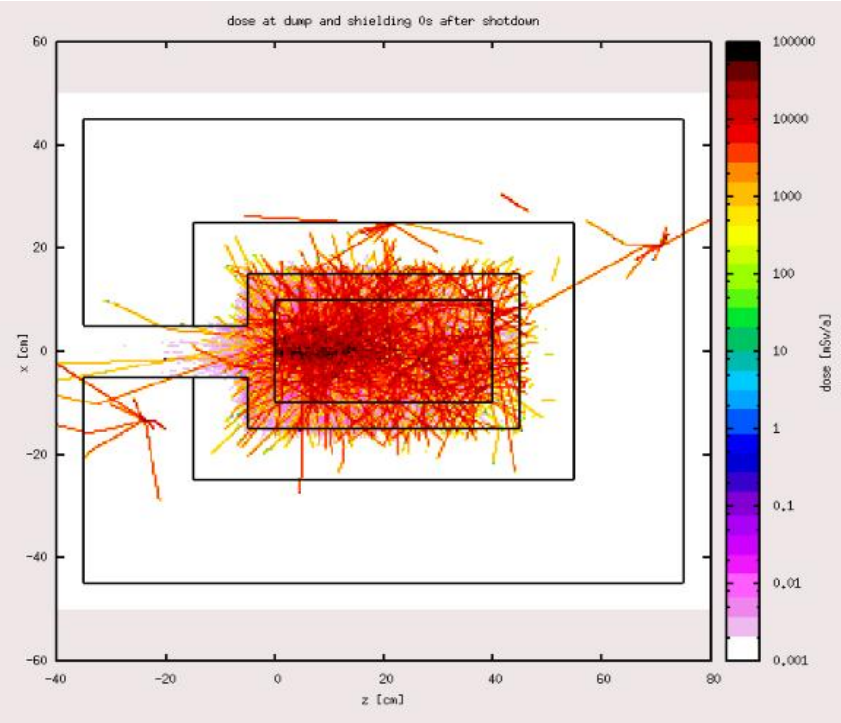


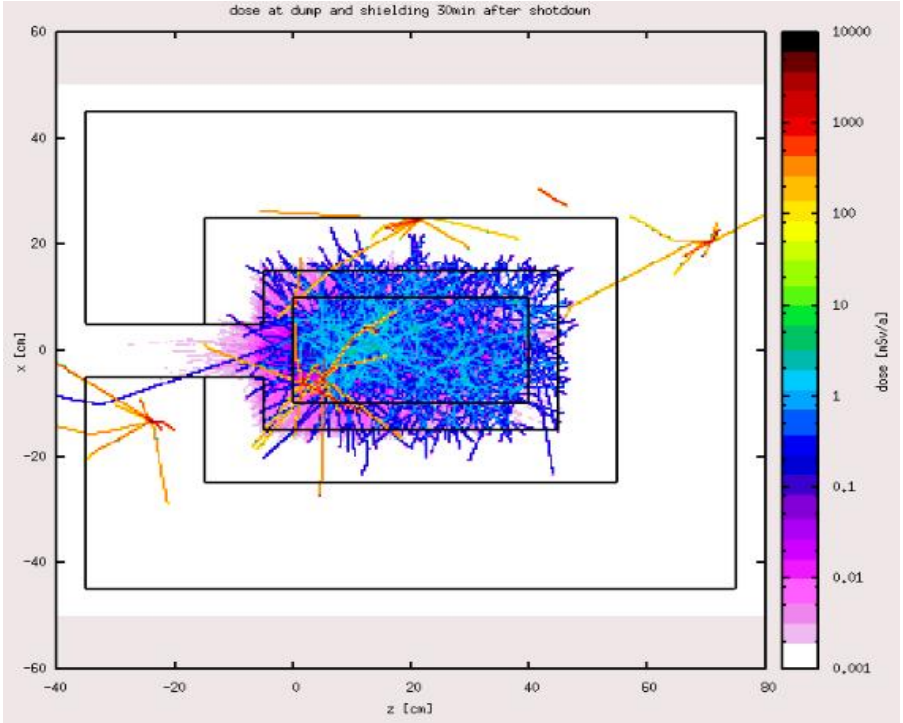
- Dump= main absorber
- Scaled in W/cm³



- Energy at “hotzone”
  0.1 J/makrobunch
  → temperature raises by 25 K

4. Simulation results - activation





- Right after shutdown
- 10^5 mSv/a → 10^4 µSv/h
- Hotspots at concrete

- 30min after shutdown
- 1 mSv/a → 0.1 µSv/h
- Still hotspots at concrete (very low cool down)

5. Summary

- Number of photons is decreased by a factor of 10^3
  - Absorbed or energy lower 1 MeV
- Number of neutrons is decreased by a factor of 10^3
- Neutron yield of simulations and calculations are nearly equal
- Temperature at dump rises by 25K → no risk to damage the dump
- Fast cool down at dump → 30 min until dose reaches harmless values
  - Lower cool down at hotspots in concrete
- Beam shape after HEDA2 contains high risk, that primaries hit the beamline