Status of the H6-H7 beamtube

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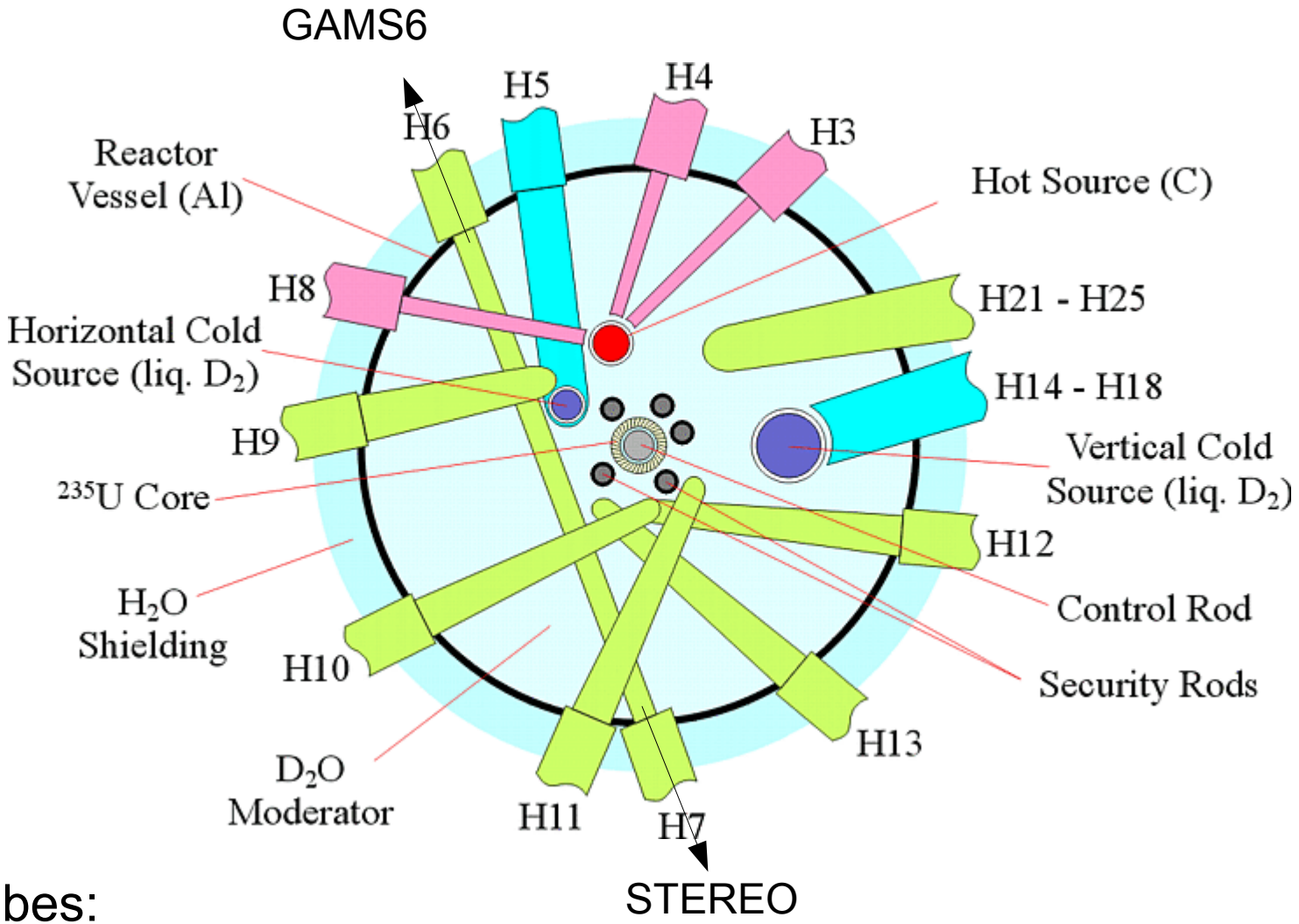
ILL Beamtubes



Beamtubes:

- made of aluminium/zircalloy
- evacuated or filled with He-4
- radiation damage due to high neutron flux => replacement necessary

Beamtube H6-H7

- through-going tube
- installed for gamma spectroscopy experiments (GAMS)

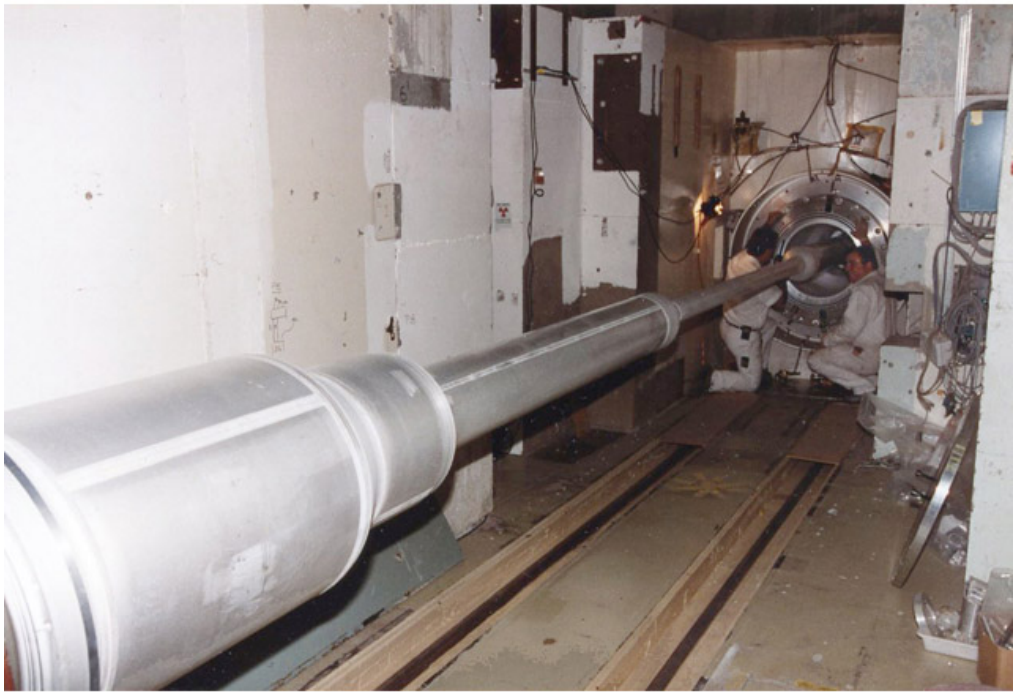
- 2014: 'bouchon' inserted on H7 side => reduction of n/γ background for STEREO

- 2017: end of maximum allowed lifespan of the beamtube reached at end of cycle 181 (March '17)

➔ tube must be removed

but

➔ definitely no replacement in 2017!!



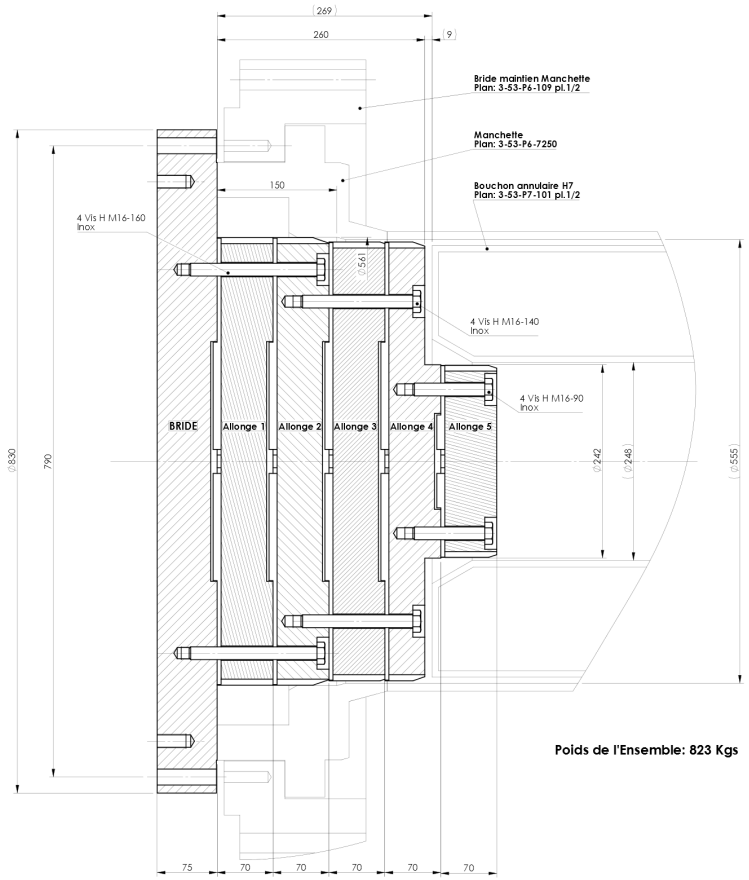
Without Beamtube H6-H7

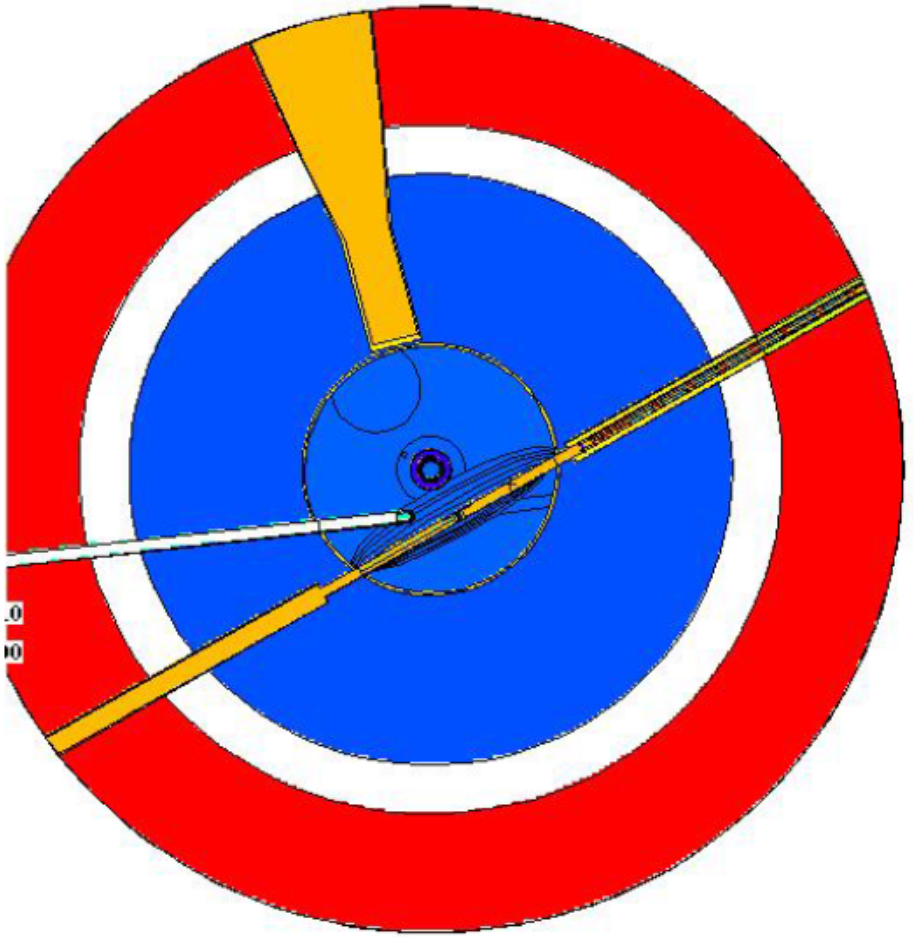
- outer manchette from moderator vessel to casemate remains

➔ will be filled with D_2O

- bouchon cannot be inserted anymore

➔ 40 cm stainless steel cap instead





Current Situation (Maxime's simulations)

- bouchon: 2 cm boral, 8 cm Pb, 1 m heavy concrete, 8cm Pb
- gap of 3 mm around to allow movement
- simulated fluxes at the outside

	Neutrons	Gammas
behind bouchon	1.2E-4 1/cm^2/s	1.3E1 1/cm^2/s
behind gap	5.0E6 1/cm^2/s	1.6E7 1/cm^2/s

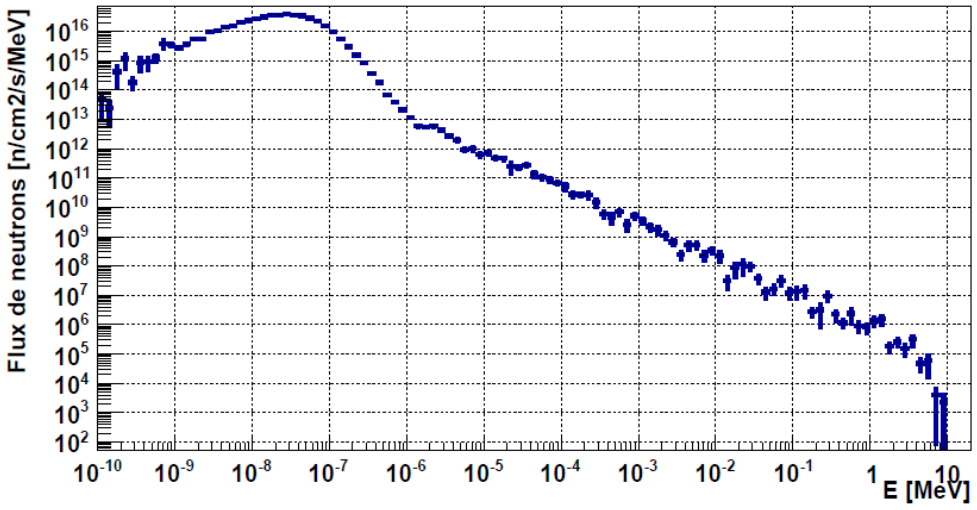
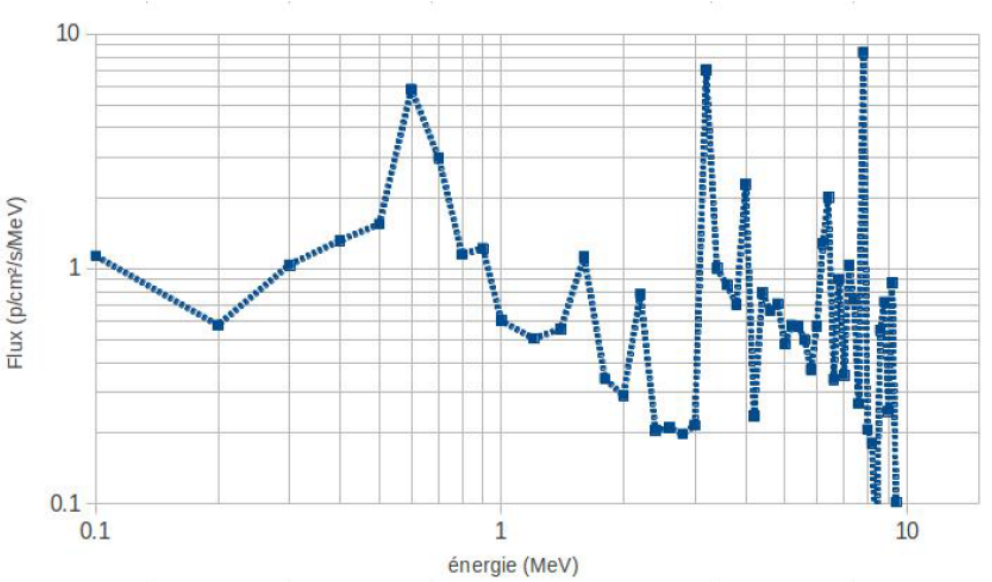
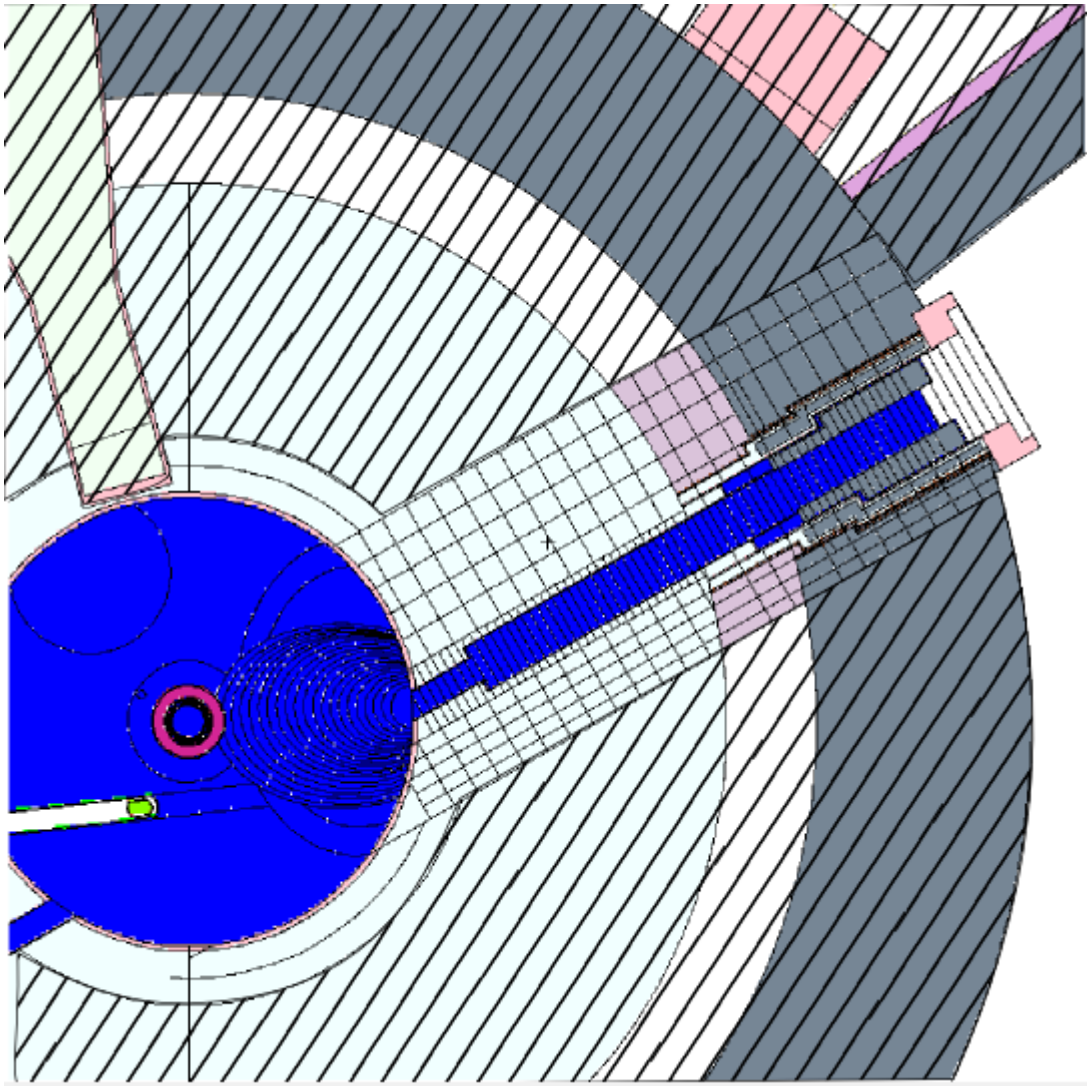


FIGURE 7.2: Spectre en énergie des neutrons sortant de H7.



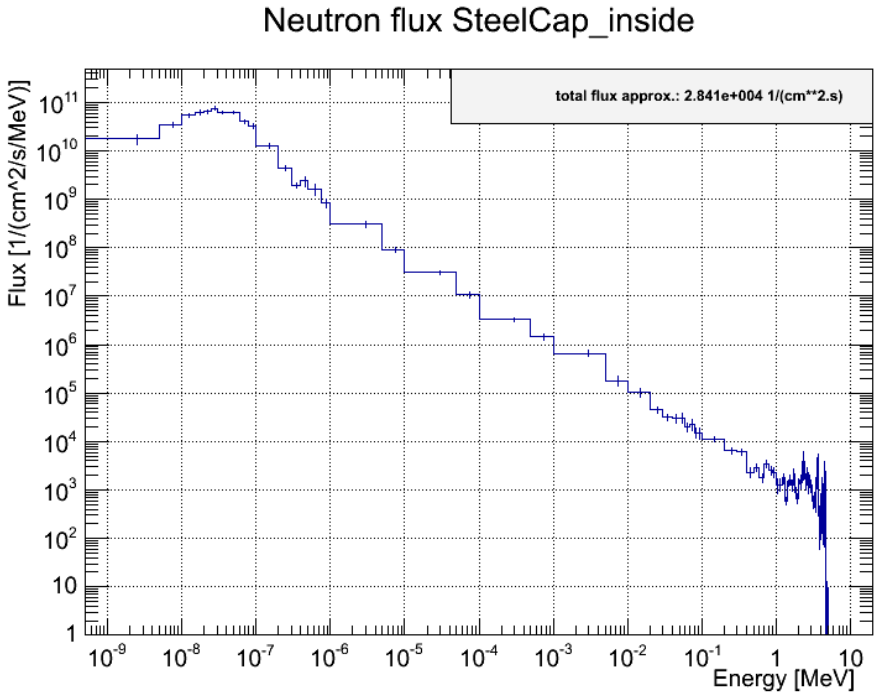
Simulation of new Situation

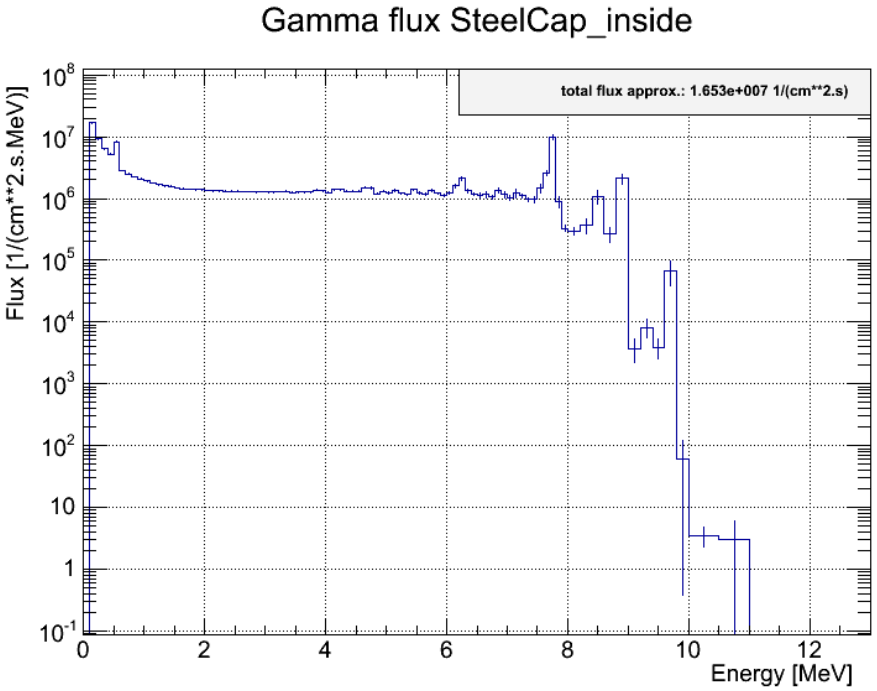
- about 4 m heavy water column between fuel element and H7 exit
- restricted simulated volume for feasibility and limited calculation time:
  - moderator vessel
  - surrounding cylinder of 30 cm of light water
  - sleeve around beamtube
- gamma energies > 100 keV



Results: Fluxes at the end of the beamtube

Fuel element → end of beamtube (filled with heavy water)





Neutrons:

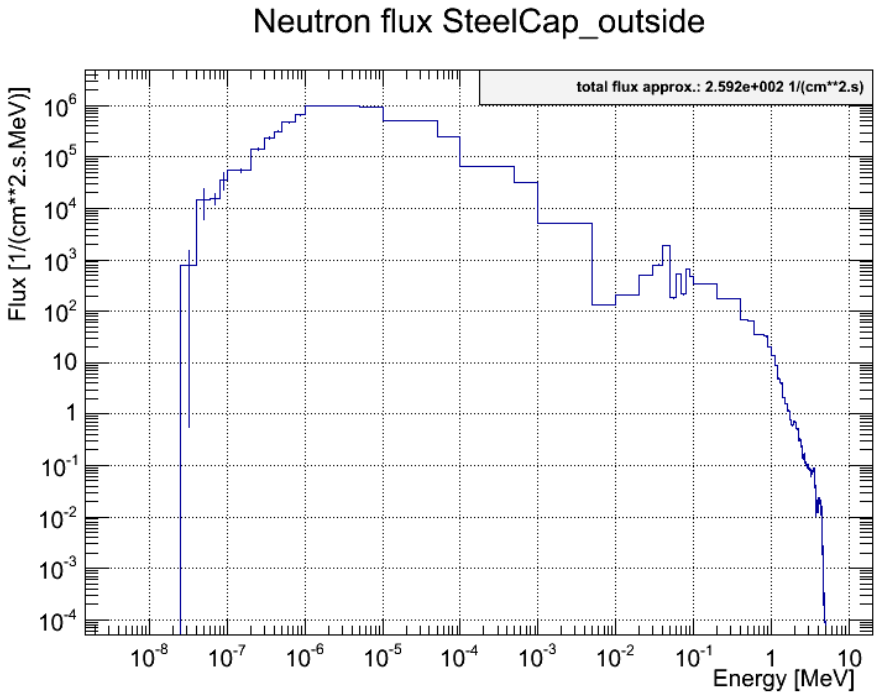
- 2.87E4 1/cm^2/s
- 1.39E7 1/s

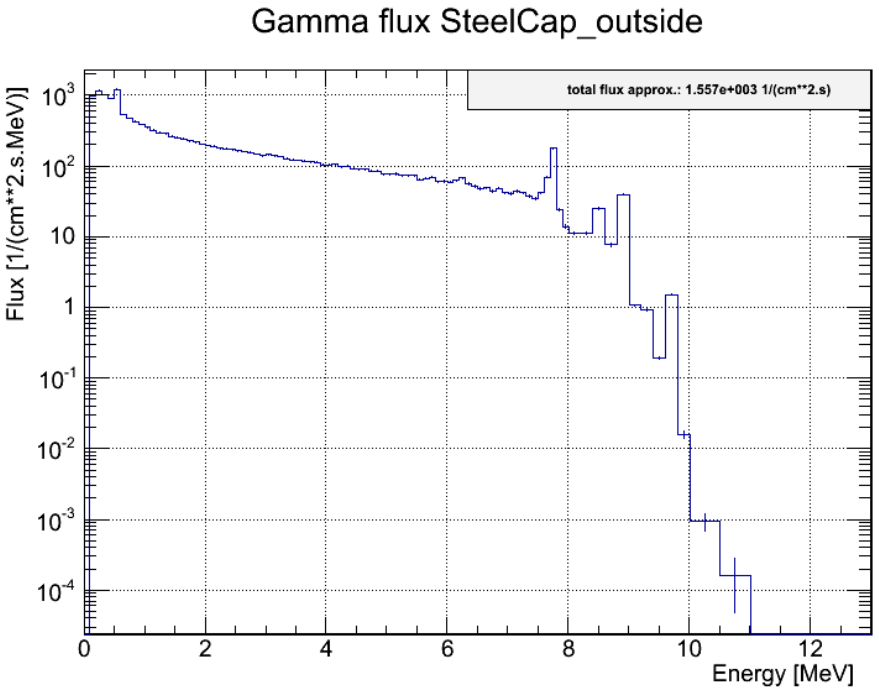
Gammas:

- 1.65E7 1/cm^2/s
- 7.98E9 1/s

Results: Fluxes outside steel cap

Steel cap, reactor side → Steel cap, outside





Neutrons:

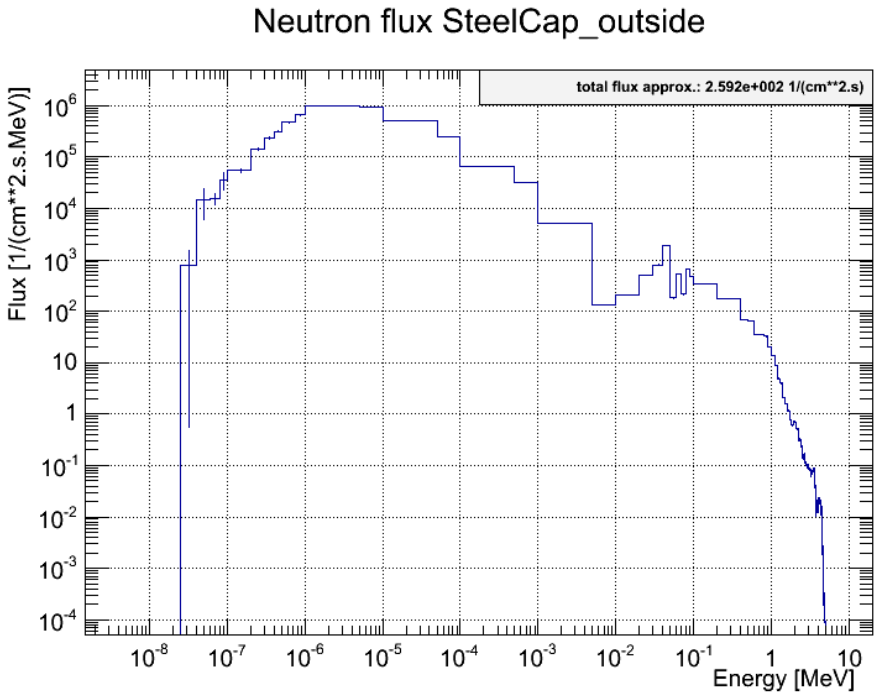
- 1.08E2 1/cm^2/s
- 2.58E5 1/s

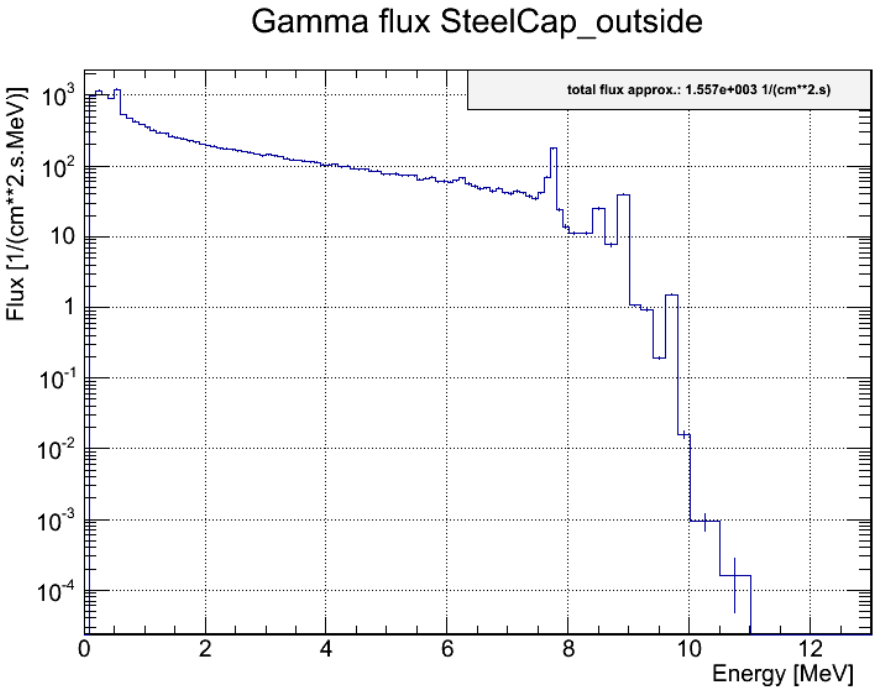
Gammas:

- 6.49E2 1/cm^2/s
- 1.55E6 1/s

Results: Fluxes outside steel cap

Steel cap, reactor side → Steel cap, outside





Neutrons:

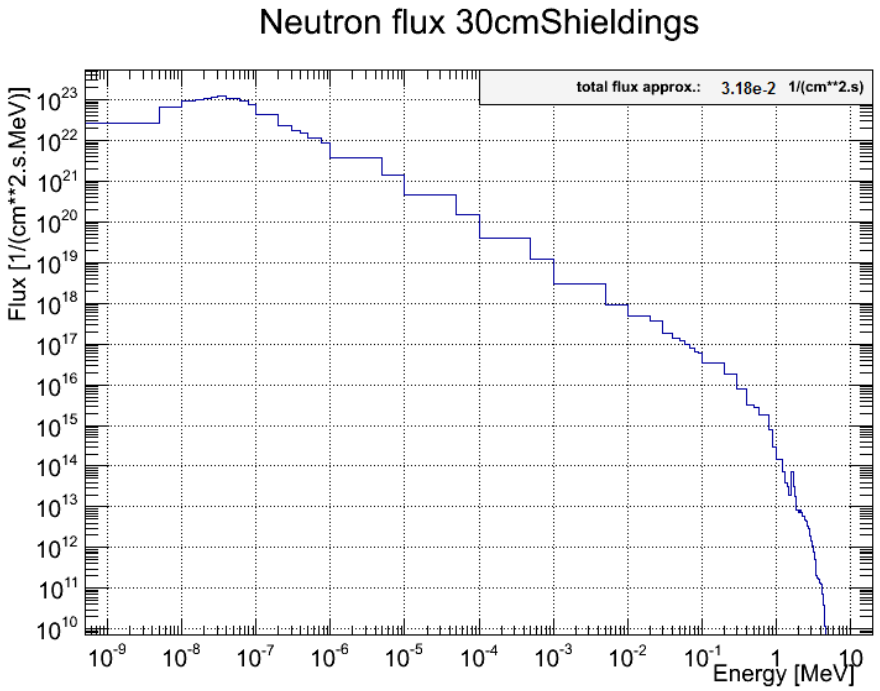
- 1.08E2 1/cm^2/s
- 2.58E5 1/s

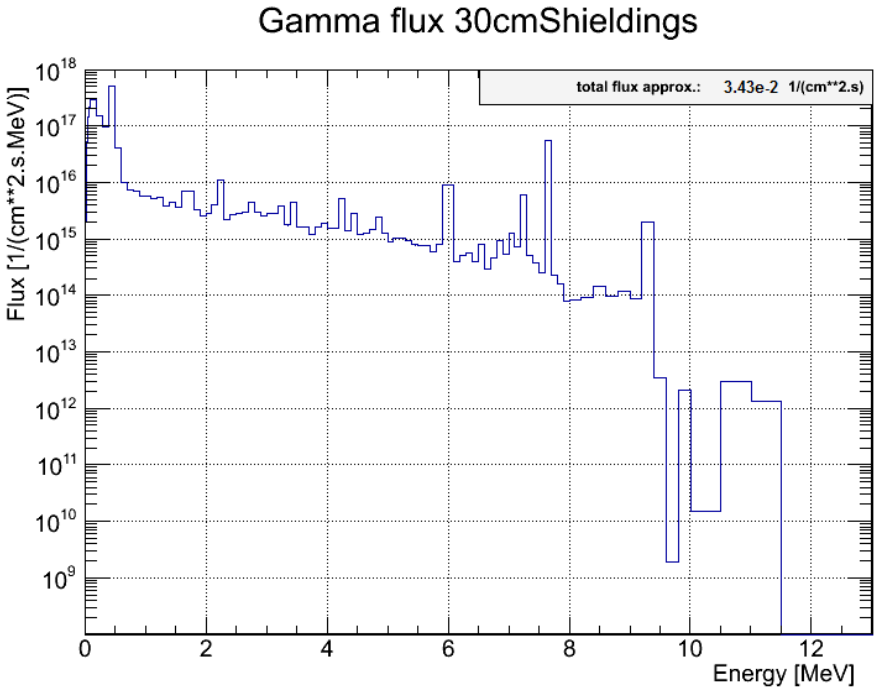
Gammas:

- 6.49E2 1/cm^2/s
- 1.55E6 1/s

Results: Fluxes after external shielding

Proposed shielding (from note to ILL, 2016): alternating layers of 5 cm of Pb and 5 cm of PE, 60 cm in total





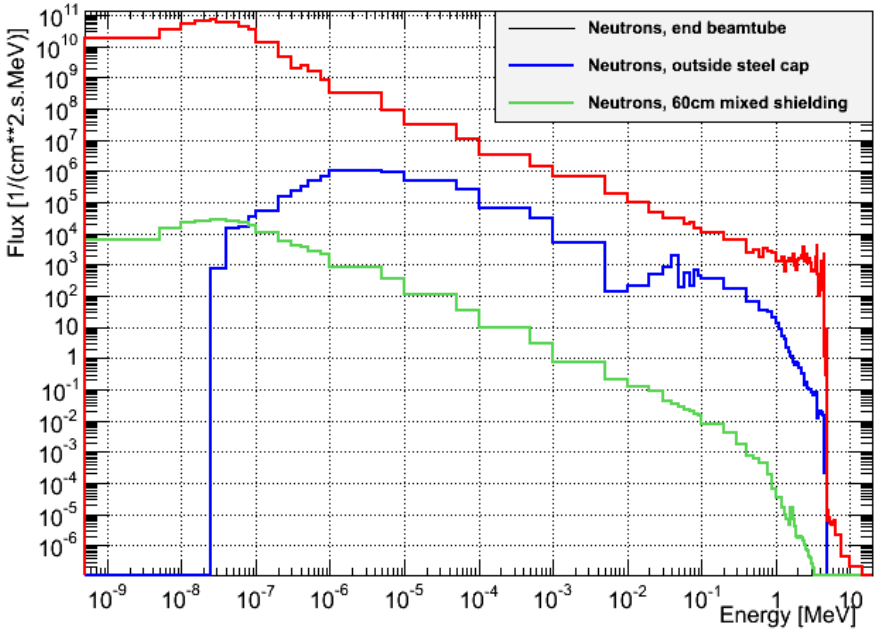
Neutrons:

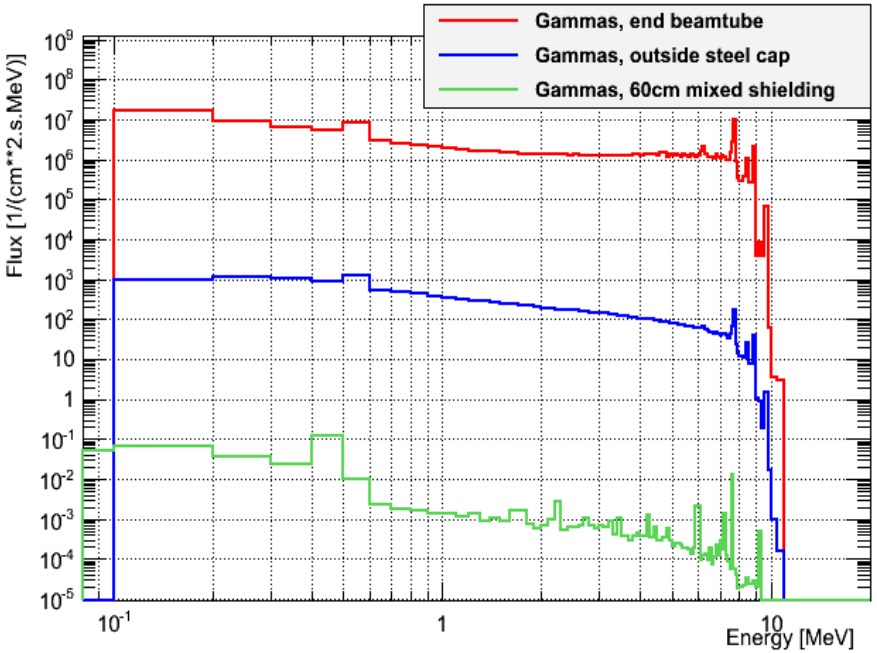
- 3.18E-2 1/cm^2/s
- 3.18E2 1/s

Gammas:

- 3.43E-2 1/cm^2/s
- 3.43E2 1/s

Summary of the simulations





without beamtube:

	Neutrons	Gammas
Steel cap, inner side	2.87E4 1/cm^2/s	1.65E7 1/cm^2/s
Steel cap, outer side	1.08E2 1/cm^2/s	6.49E2 1/cm^2/s
behind ext. shielding	3.18E-2 1/cm^2/s	3.43E-2 1/cm^2/s

current situation

	Neutrons	Gammas
behind bouchon	1.2E-4 1/cm^2/s	1.3E1 1/cm^2/s
behind gap	5.0E6 1/cm^2/s	1.6E7 1/cm^2/s