NESCOFI@BTF closure
&
NEURAPID start up meeting

INFN-LNF, 26 February 2014

Aula conversi

Neutron Facility @ PoliMi

Numerical study with the FLUKA Monte Carlo code: results

INFN

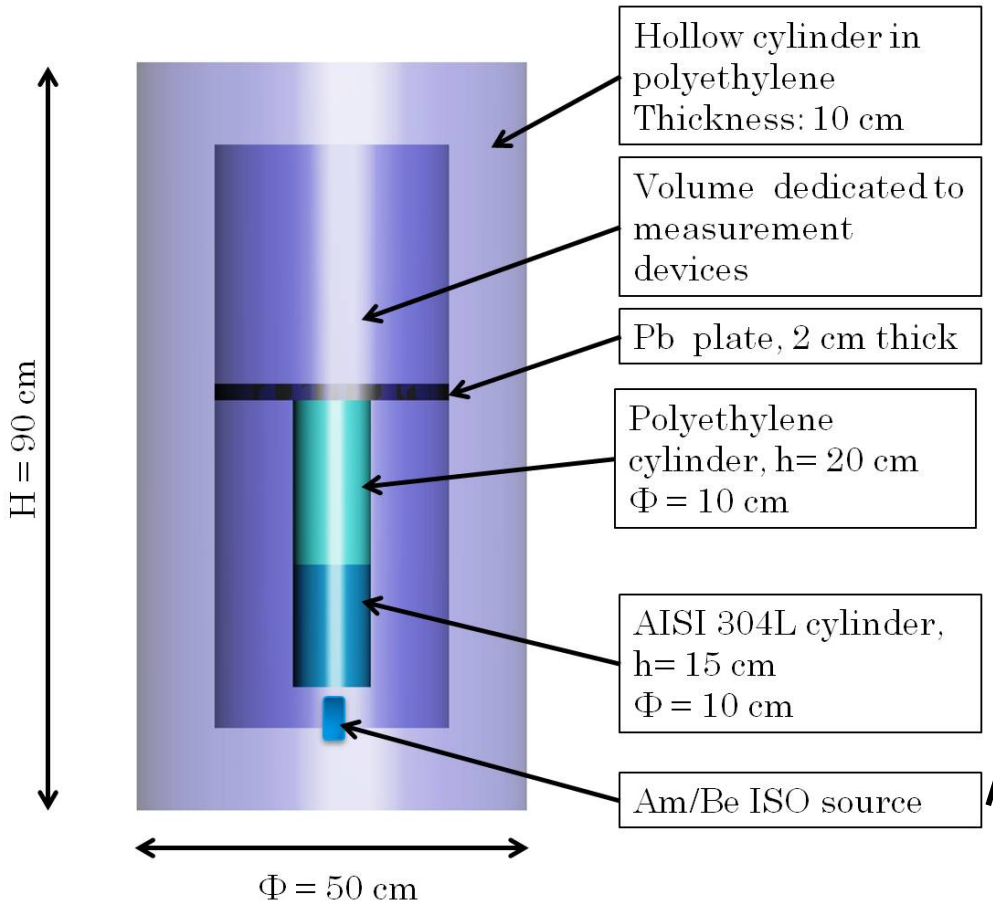
POLITECNICO DI MILANO

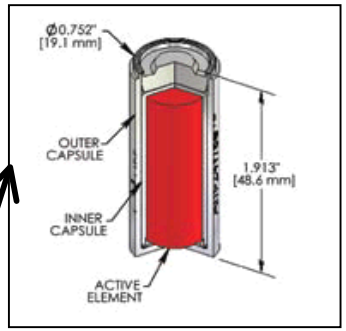
Scientific Aim:

to develop a neutron facility capable of providing radiation fields accurately characterized, a facility adequately equipped in order to host all kind of neutron detectors and measurements.

Numerical study with the FLUKA Monte Carlo code

Simulated geometry

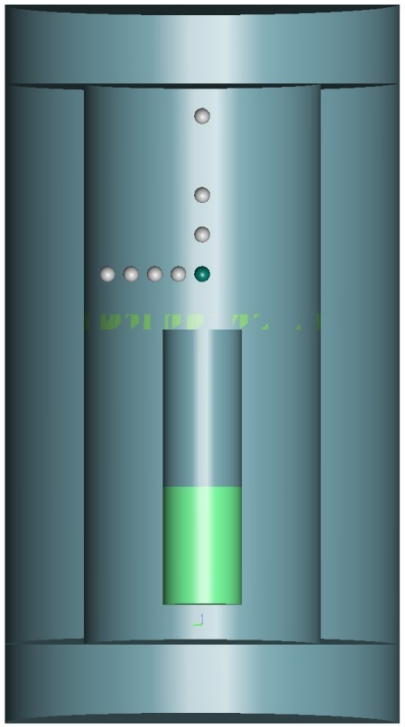




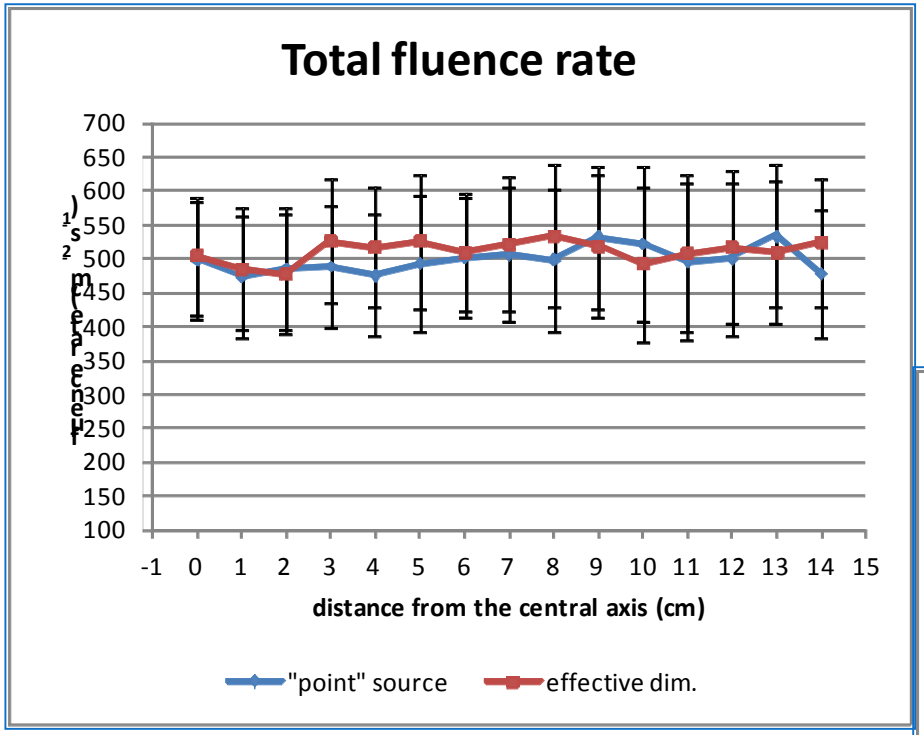
Activity: 37 GBq

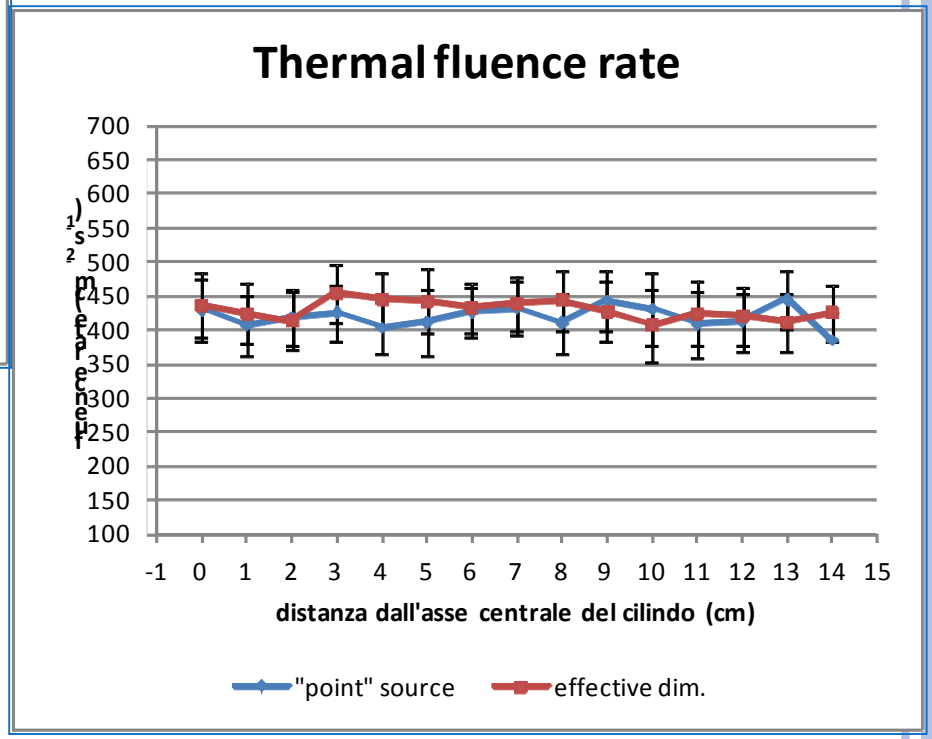
FLUKA simulations: settings

- Source: AmBe spectrum (ISO/DIS 8529-1); cylindrical isotropic source - right cylinder (Φ=1 mm).
- Scoring: neutron and photon fluence with the card USRTRACK, a "track-length estimator" which estimate the fluence by the ratio between the mean value of the track lengths within the reference volume and the volume itself ($cm/cm^3 \Rightarrow cm^{-2}$). **Results of USRTRACK are expressed in terms of part/cm2/GeV/primary.**
- Reference volume: void spheres with R=0.25 cm, R=0.5 cm and R=1 cm
- Number of spheres: 15, 8 and 5 (for R=0.25 cm, R=0.5 cm e R=1 cm, respectively) along the radius of the cylindrical structure, inside the “measurement volume” at 5 cm from the Pb plate.

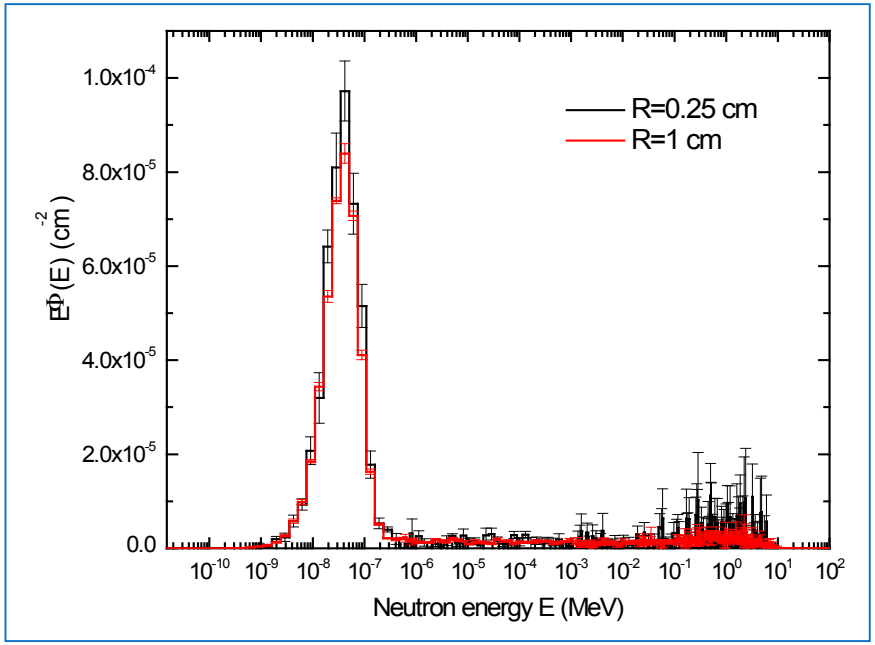


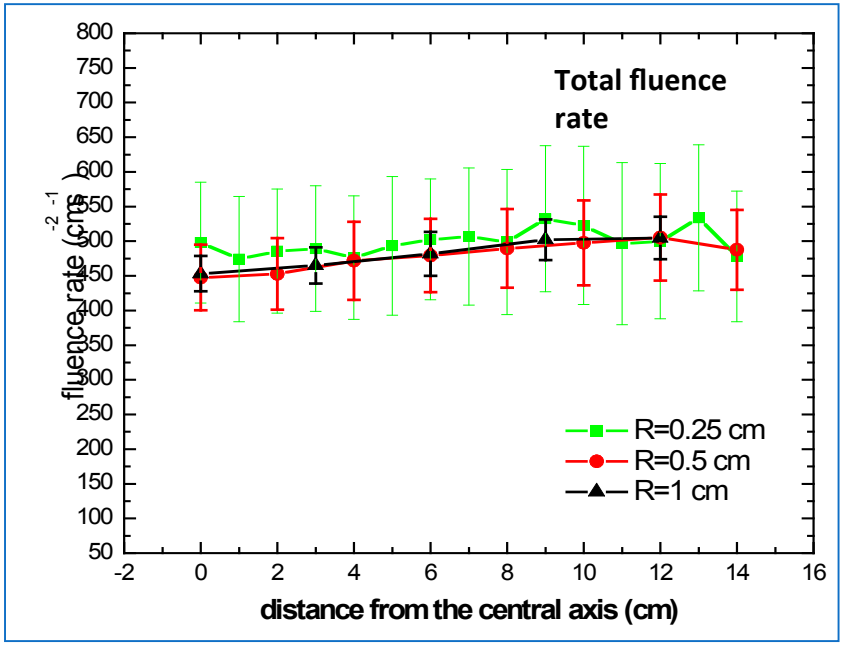
Comparison between results obtained by simulating a “point” source and by simulating a source with effective dimensions (cylinder, Φ=1.9 cm h=5 cm)

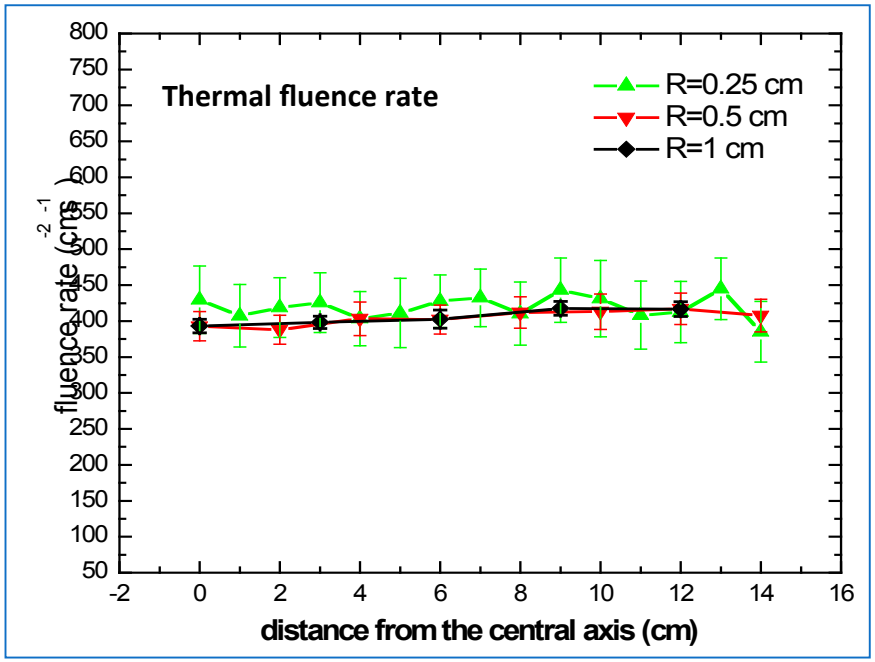


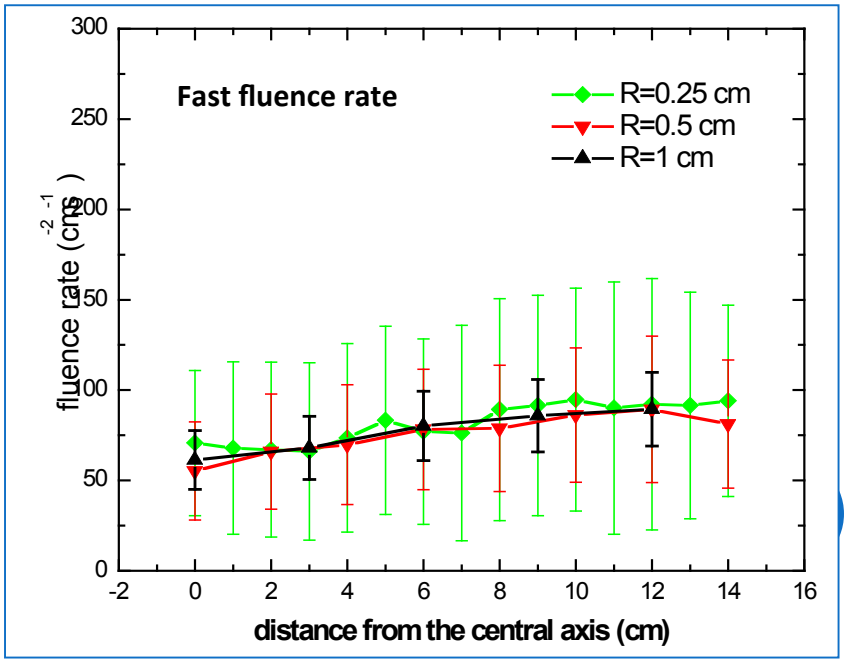


Spheres with different dimensions: statistics

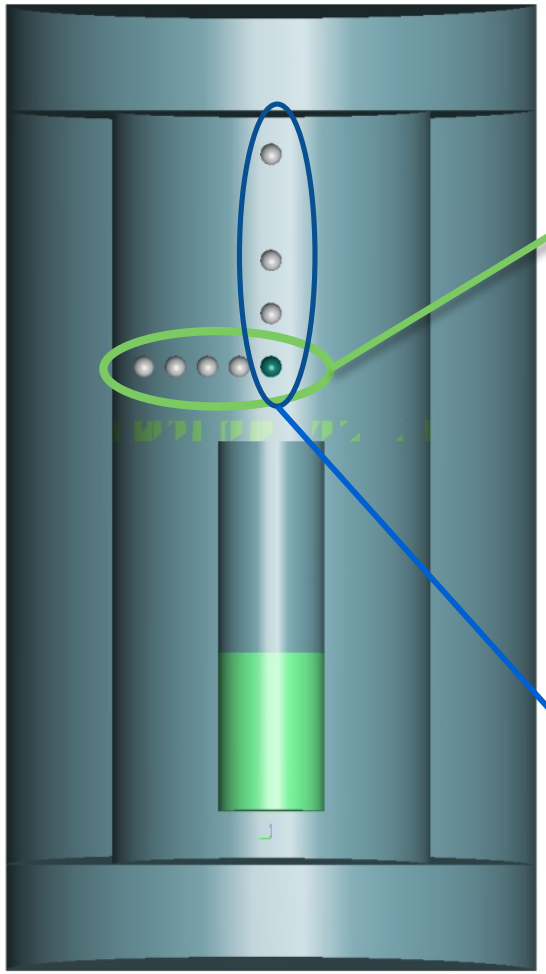


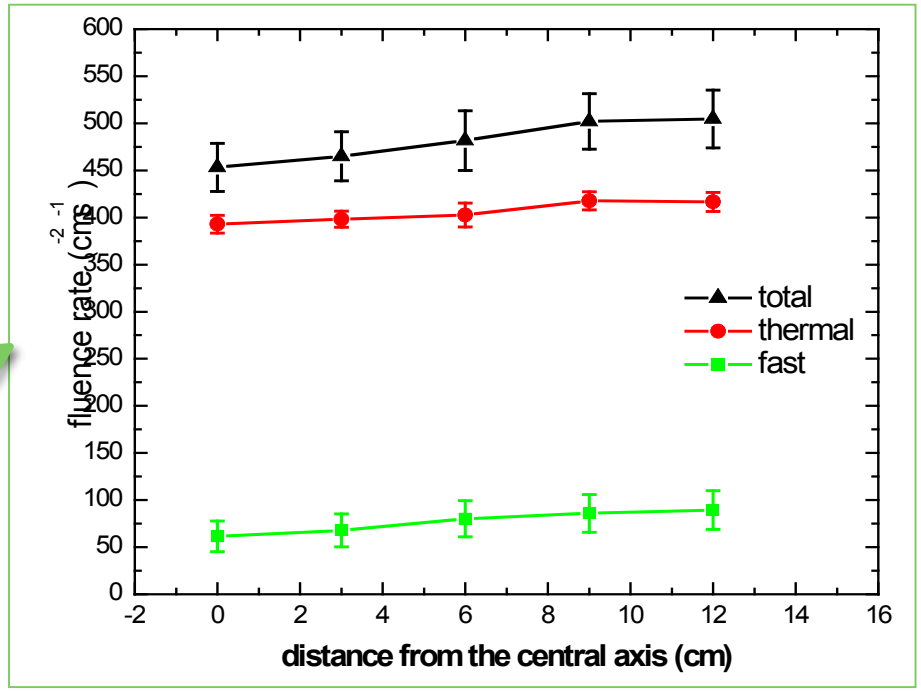


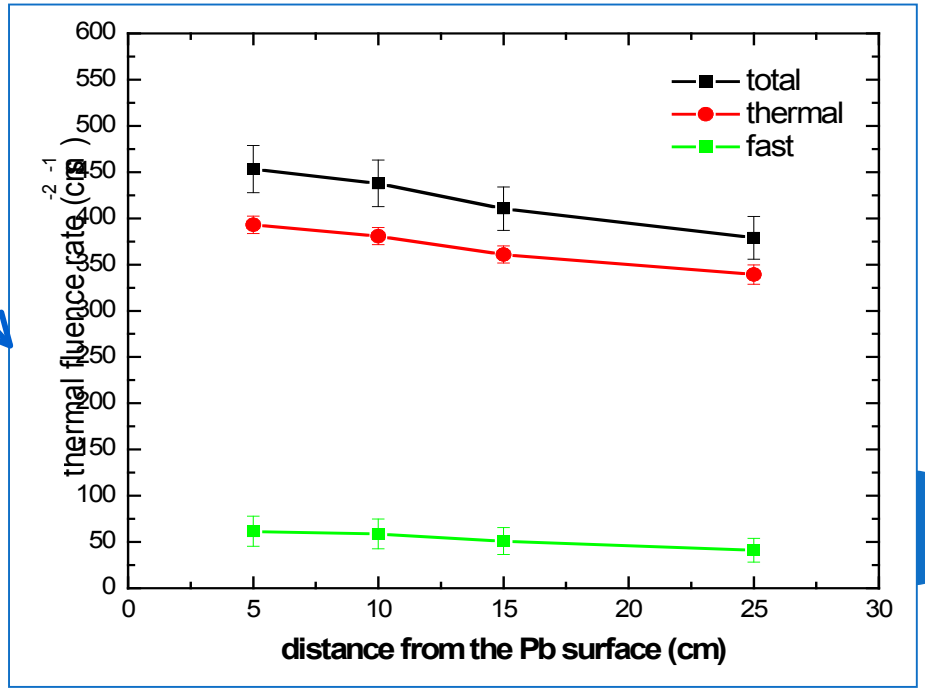




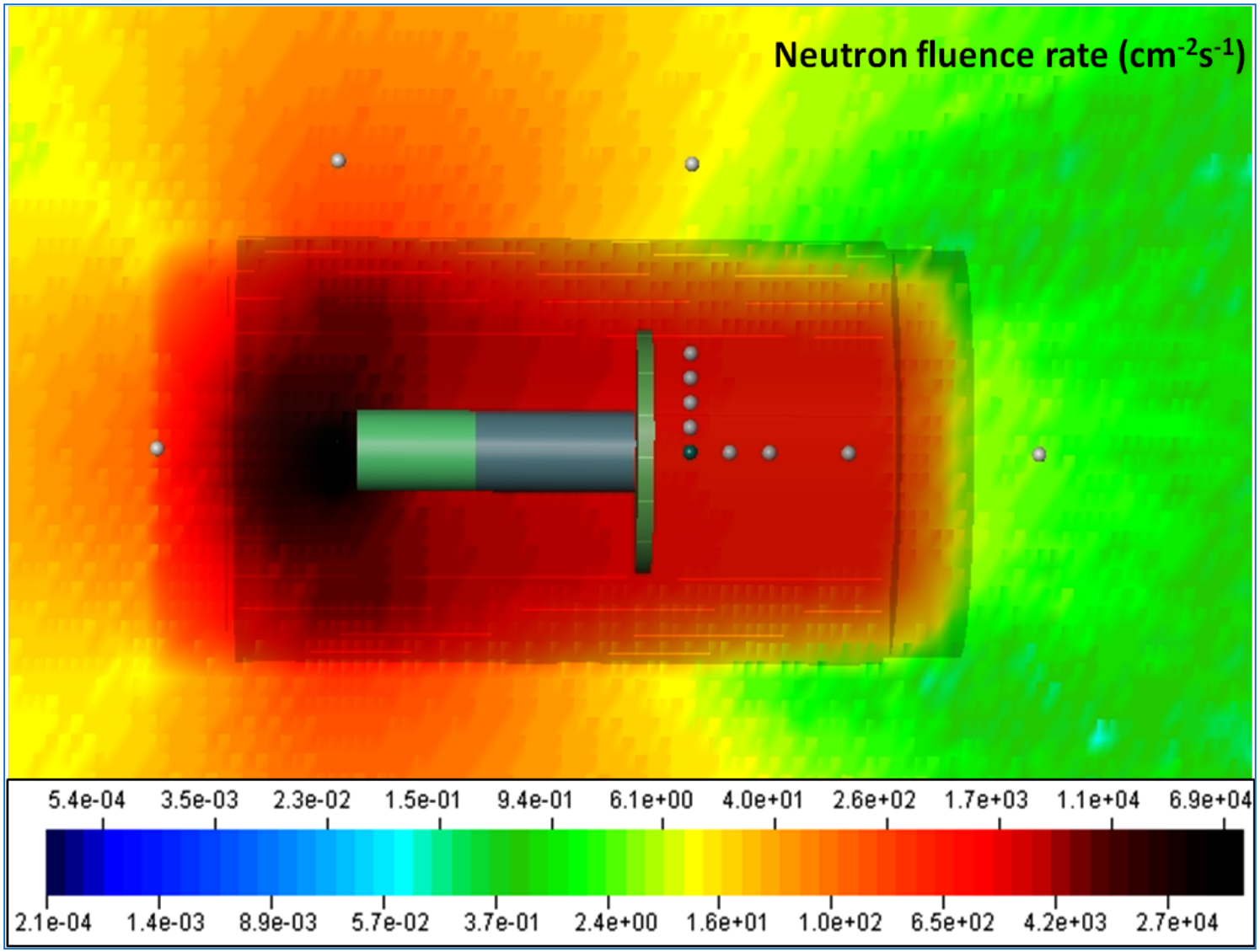
Results for R_{sph}=1 cm





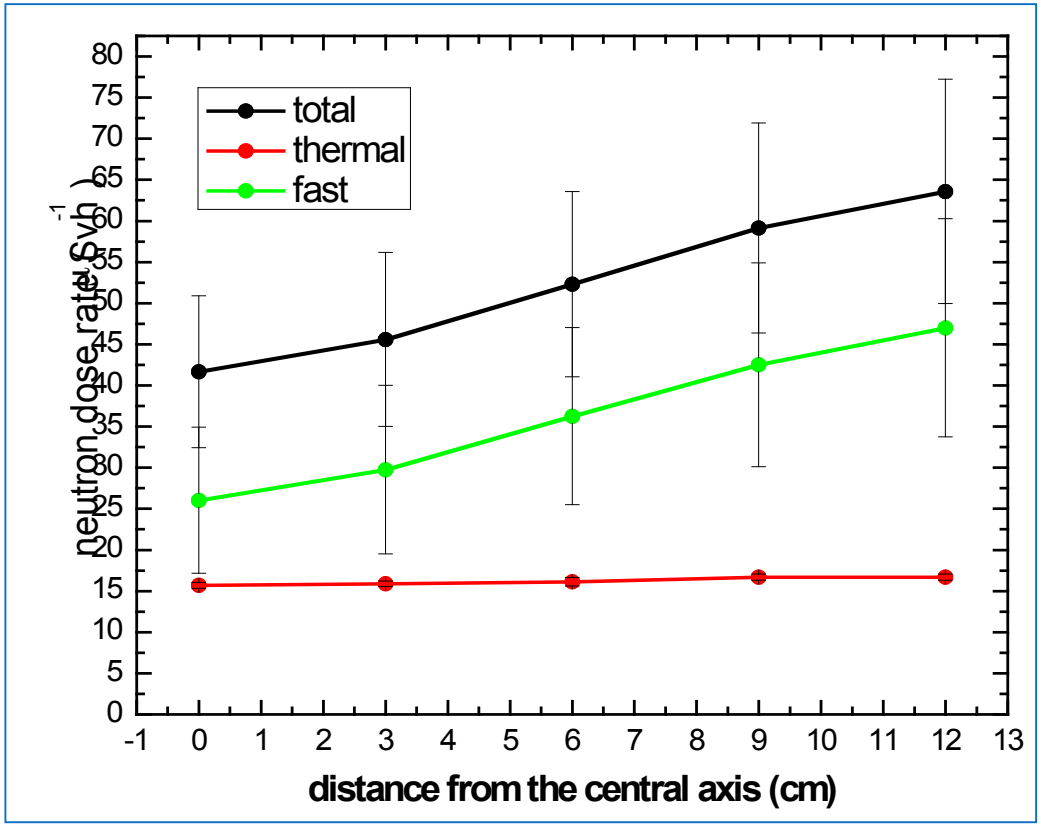


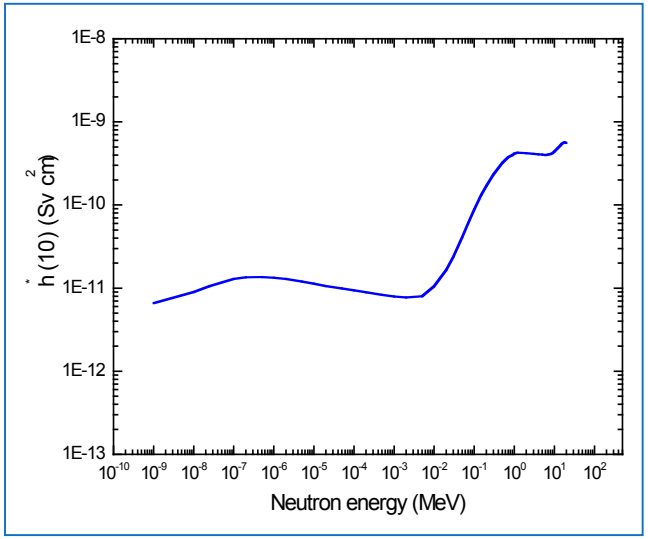
Mean ratio thermal/total = 84.3%


Neutron fluence rate (cm-2s-1)
5.4e-04
3.5e-03
2.3e-02
1.5e-01
9.4e-01
6.1e+00
4.0e+01
2.6e+02
1.7e+03
1.1e+04
6.9e+04
2.1e-04
1.4e-03
8.9e-03
5.7e-02
3.7e-01
2.4e+00
1.6e+01
1.0e+02
6.5e+02
4.2e+03
2.7e+04

Log scale

Neutron dose rate in terms of H*(10)

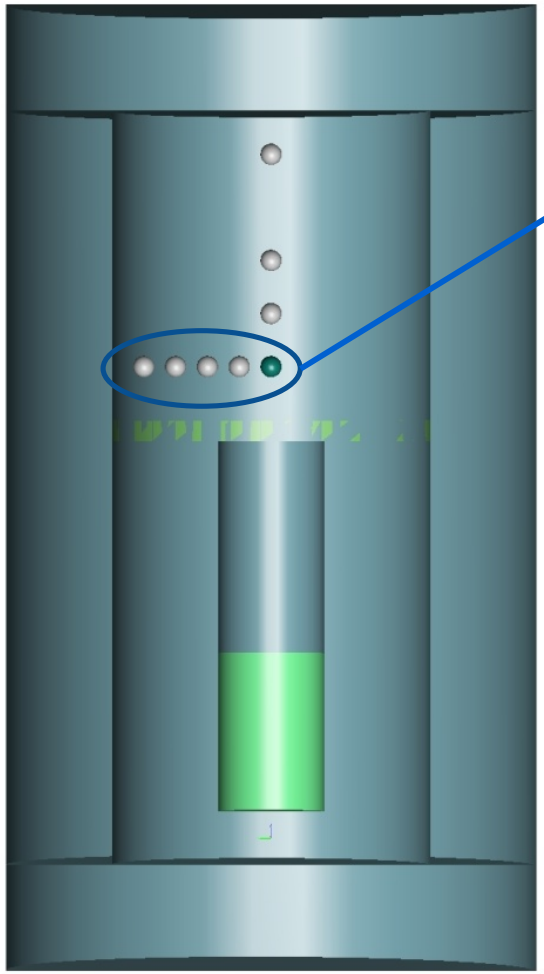


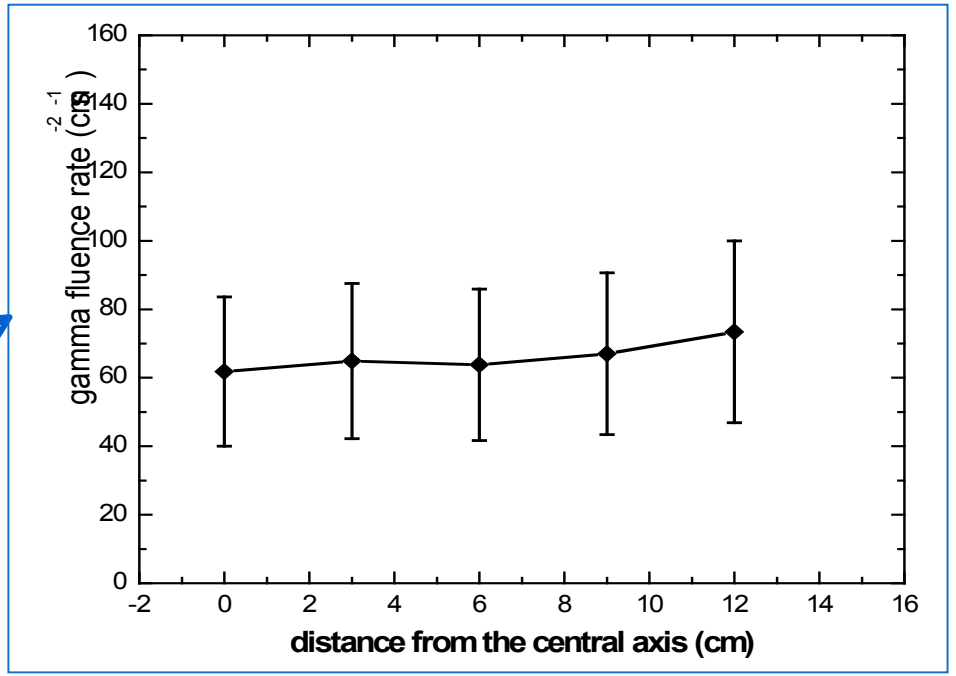


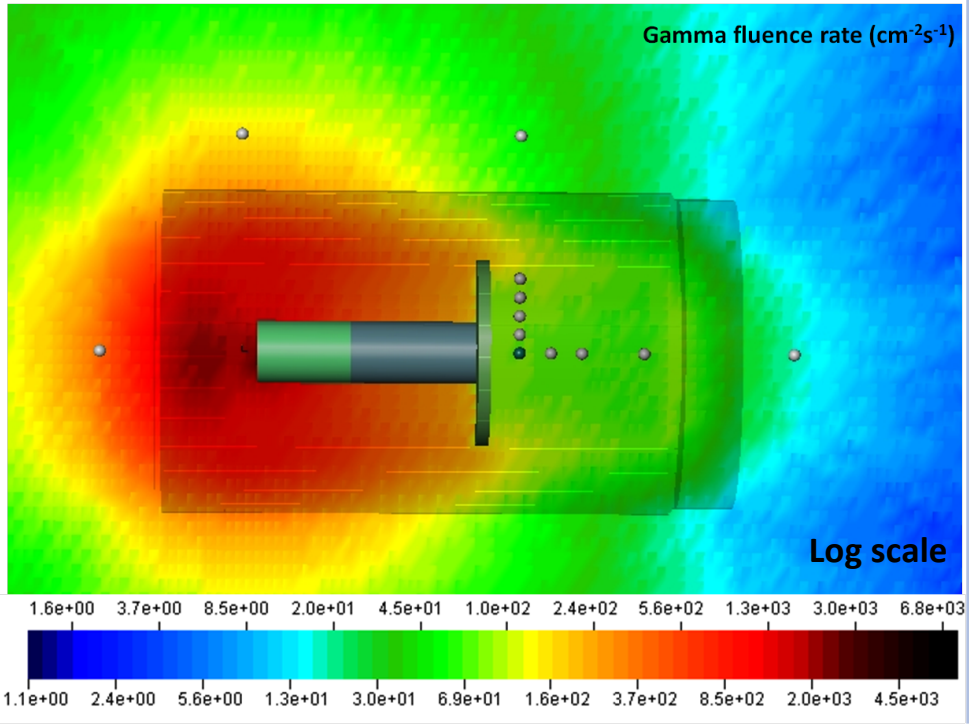
pos(cm)	total dose rate	thermal dose rate	fast dose rate
0	41.65 ±22%	15.68 ±2%	26.03 ±34%
3	45.57 ±23%	15.87 ±2%	29.75 ±34%
6	52.3 ±22%	16.12 ±3%	36.24 ±30%
9	59.12 ±22%	16.69 ±2%	42.5 ±29%
12	63.58 ±21%	16.66 ±2%	46.99 ±28%

Mean dose rate: 52 μSv h^{-1}

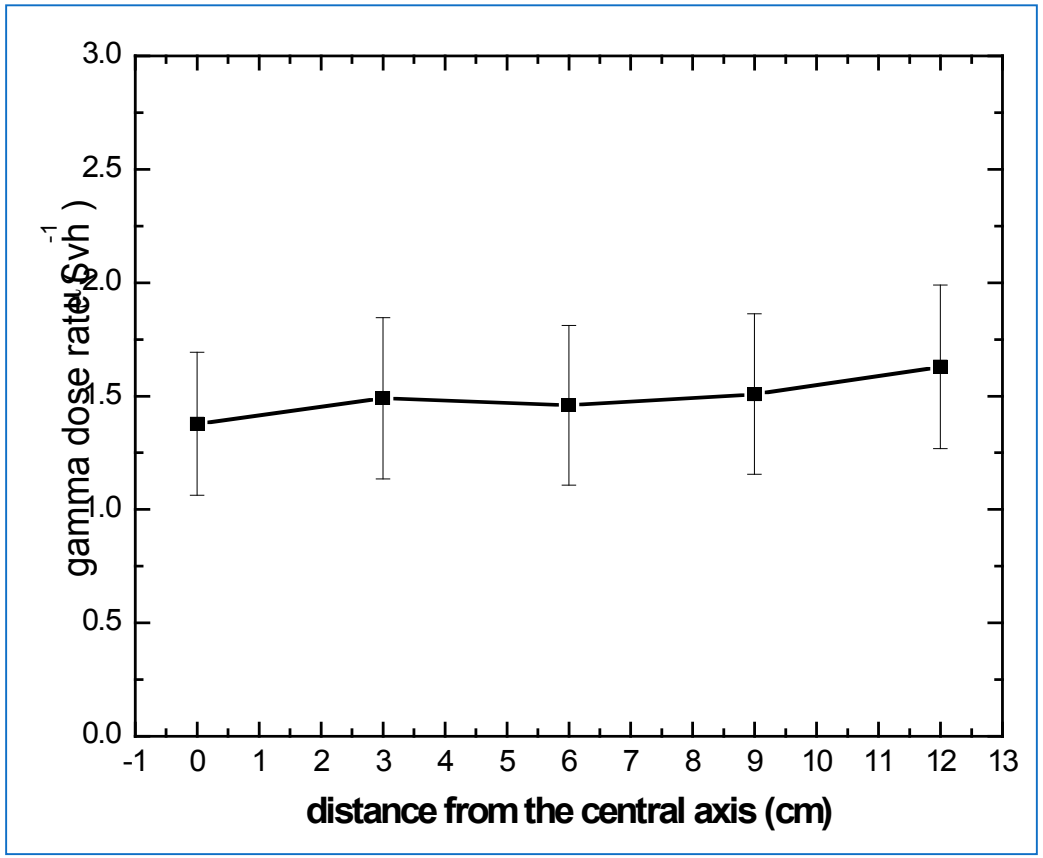
Gamma fluence rate

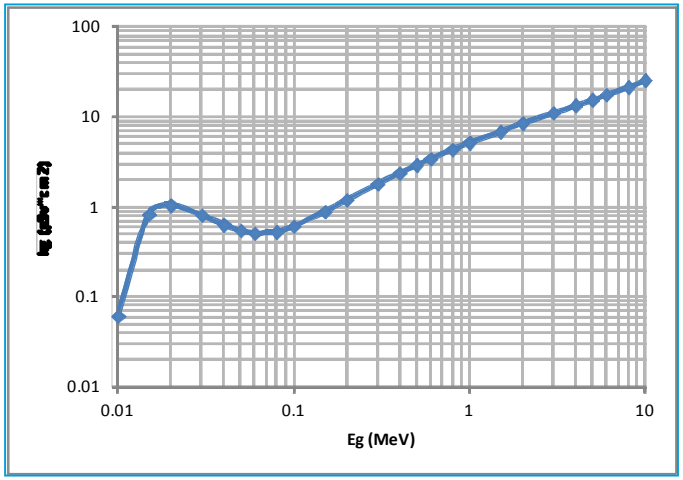






Gamma dose rate

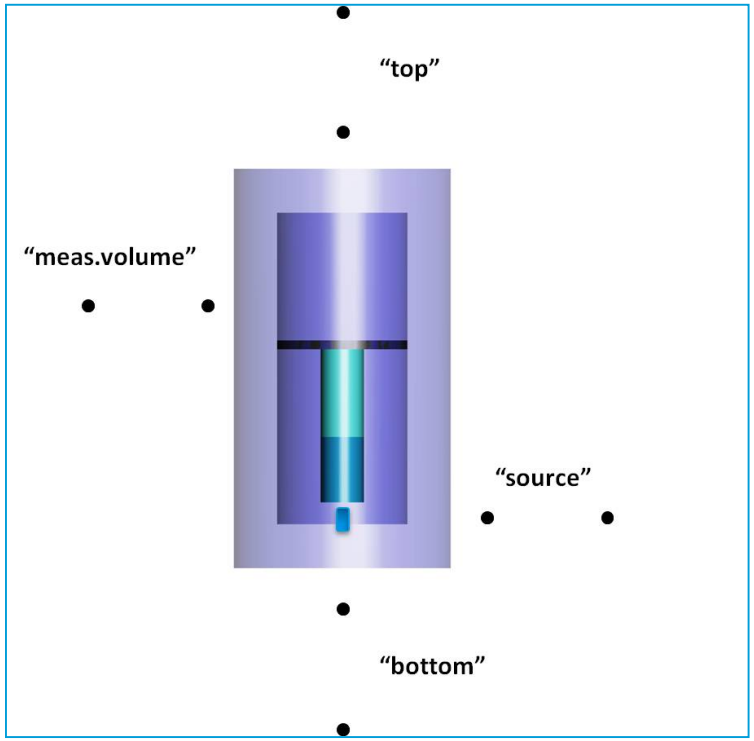




pos(cm)	gamma dose rate
0	1.4 ±23%
3	1.5 ±24%
6	1.5 ±24%
9	1.5 ±23%
12	1.6 ±22%

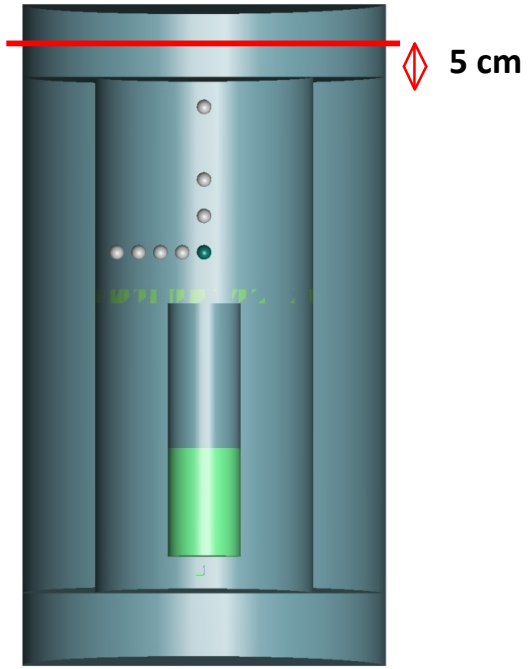
Mean dose rate: 1.5 μSv h^{-1}

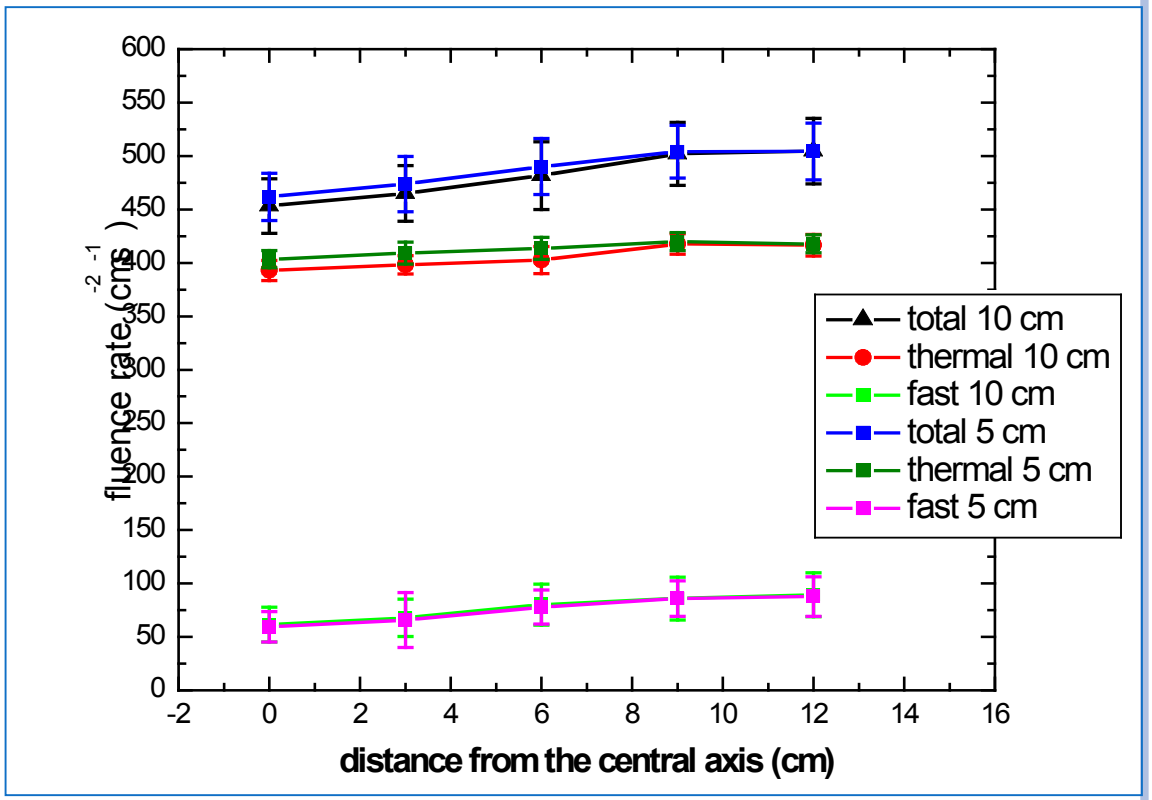
Dose rate outside the facilty



	distance	
dose rate N (μSv/h)	**10 cm**	**100 cm**
bottom	257.6 ±11%	10.5 ±52%
source	90.9 ±19%	5.7 ±62%
meas.volume	7.9 ±54%	5.7 ±58%
top	1.5 ±85%	0.2 ±99%
dose rate G (μSv/h)		
bottom	5.2 ±16%	0.22 ±35%
source	2.6±21%	0.18±39%
meas.volume	0.96 ±32%	0.19 ±34%
top	0.33 ±38%	1.5 ±99%

Top h=5 cm instead of 10 cm





	Top h=10 cm		Top h=5 cm	
	distance		distance	
dose rate N (μSv/h)	10 cm	100 cm	10 cm	100 cm
bottom	257.6 ±11%	10.5 ±52%	242.7 ±11%	10.1 ±51%
source	90.9 ±19%	5.7 ±62%	88.4 ±17%	5.3 ±58%
meas.volume	7.9 ±54%	5.7 ±58%	7.1 ±57%	4.8 ±62%
top	1.5 ±85%	0.2 ±99%	2.9 ±66%	0.3 ±99%
dose rate G (μSv/h)				
bottom	5.2 ±16%	0.22 ±35%	5.3 ±14%	0.22 ±38%
source	2.6±21%	0.18±39%	2.6±19%	0.17±39%
meas.volume	0.96 ±32%	0.19 ±34%	0.97 ±28%	0.18 ±45%
top	0.33 ±38%	1.5 ±99%	0.5 ±29%	0.4 ±40%

Design of the facility