NESCOFI@BTF

Numerical simulation

1) Summary of 2012 activities

2) Final design of CYSP

3) Simulation of active detectors

4) Foreseen activities for 2013

1) Summary of 2012 activities

Published papers

1) J.M. Gómez-Ros, R. Bedogni, M. Moraleda, A. Esposito, A. Pola, M.V. Introini, G. Mazzitelli, L. Quintieri, B. Buonomo. *An extended energy range multidetector neutron spectrometer*. Nucl. Inst. Meth. A 677, 4-9 (2012).

1) R. Bedogni, J.M. Gómez-Ros, A. Esposito, A. Gentile, M. Chiti, L. Palacios-Pérez, M. Angelone, L. Tana. *Workplace testing of the new Single Sphere neutron Spectrometer based on Dysprosium activation foils (Dy-SSS)*. Nucl. Inst. Meth. A 684, 105-108 (2012).

2) R. Bedogni, J.M. Gómez Ros, A. Gentile, A. Esposito, A. Pola, M.V. Introini. *Testing a newly developed single-sphere neutron spectrometer in reference monochromatic fields from 147 keV to 14.8 MeV*. Nucl. Inst. Meth. A (accepted)

Projects support

1) NESCOFI@BTF (INFN, Commissione Scientifica Nazionale 5, Italy, 2011-2013)

1) Stays during 2013 (4 periods, 40 days) : AIC-D-2011-0717 (MICINN, Spain) + FAI (Italy).

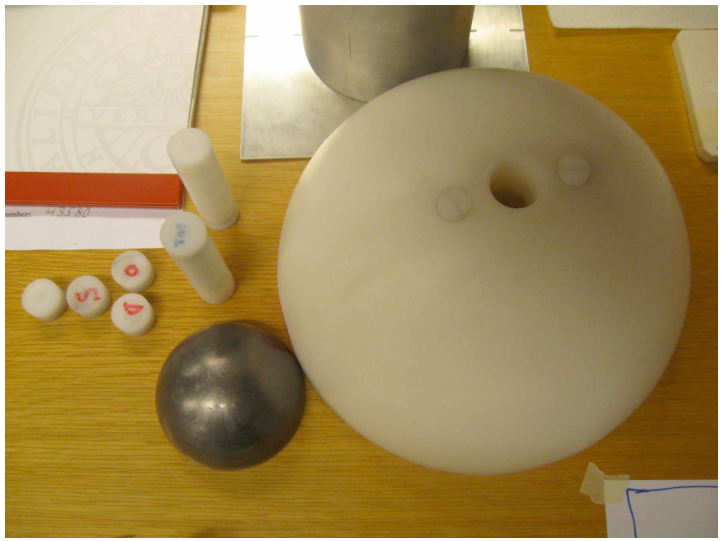
Computing resources

1) CPU computing time (Ciemat EULER cluster – 256 blades, 2 x Intel Xeon 5450 quadcore 3.0 GHz, 2048 cores)

2) MCNP5 (v1.50) and MCNPX 2.6 licenses

1) Summary of 2012 activities

Fig. 1. Schematic view of the spectrometer showing the arrangement of the activation foils detectors along three perpendicular axes, as well as the inner lead layer.



J.M. Gómez-Ros et al. Nucl. Inst. Meth. A 677 (2012) 4-9

1) Summary of 2012 activities

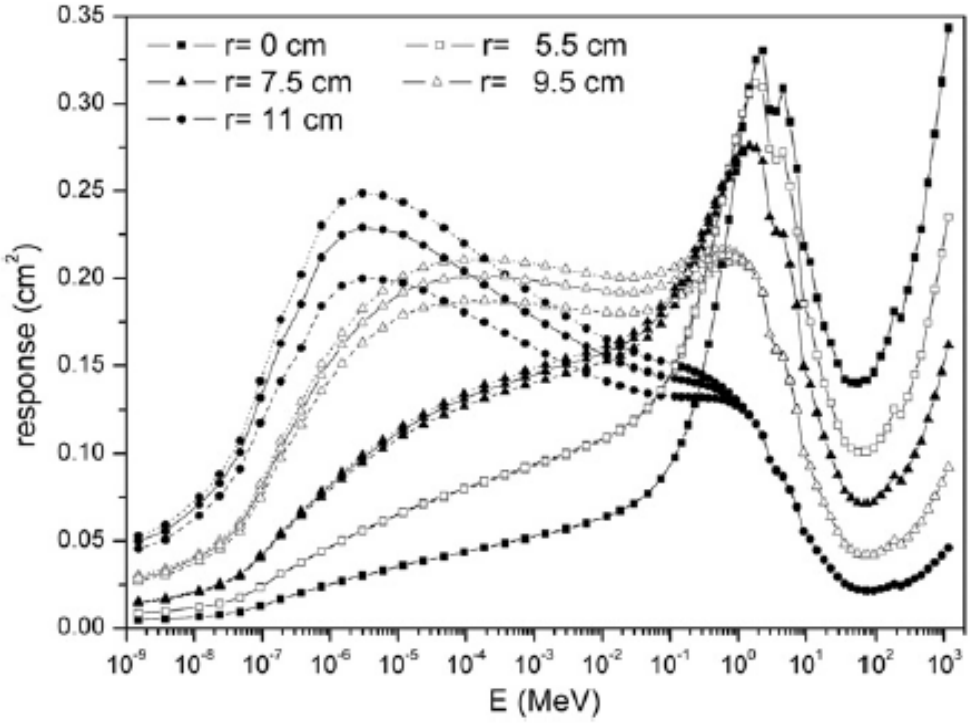
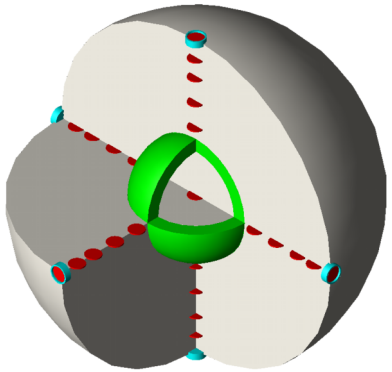


Fig. 2. Energy response functions to monoenergetic incident neutrons, averaged over the detectors located at the same distance from the centre, for three different irradiation geometries: along the (1 0 0) axis (dashed lines), isotropic (continuous lines), and along the (1 1 1) axis (dotted lines). The response functions have been calculated for radial distances 0, 5.5, 7.5, 9.5 and 11 cm.



The response functions have been calculated for radial distances:
0, 5.5, 7.5, 9.5, 11 cm, considering three different irradiation geometries:

- along the (1 0 0) axis
- isotropic
- along the (1 1 1) axis

J.M. Gómez-Ros et al. Nucl. Inst. Meth. A 677 (2012) 4-9

1) Summary of 2012 activities

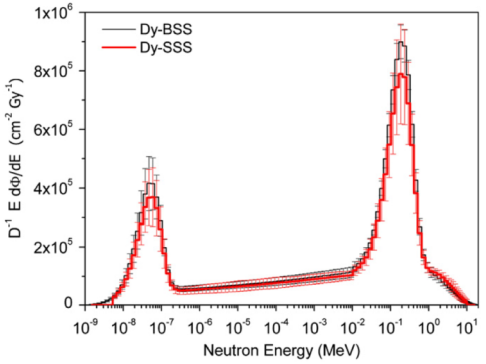


Fig. 3. Reference neutron spectrum (Dy-BSS) and Dy-SSS unfolded spectrum in the point of test at 150 cm from the isocenter. The spectra are normalised to the unit absorbed dose to water at the isocenter and are reported in equi-lethargy representation.

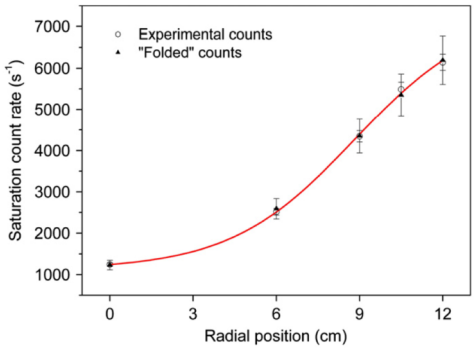


Fig. 4. Comparing the experimental C_r values with the "folded" C_{rf} values obtained by folding the spectrometer response matrix ($M^{ISO}(r, E)$) with the unfolded spectrum.

Table 2
Comparing the Dy-BSS (regarded as reference instrument) and the Dy-SSS in terms of spectrum-integrated quantities in the photo-neutron field of the 15 MV medical Linac. The fluence rate is referred to an accelerator output of 500 MU min^{-1}.

Quantity	Dy-BSS	Dy-SSS
$\dot{\phi}$ (cm^{-2} s^{-1})	$(3.18 \pm 0.10) \times 10^5$	$(2.9 \pm 0.2) \times 10^5$
ϕ/D (cm^{-2} MU^{-1})	$(3.82 \pm 0.14) \times 10^4$	$(3.5 \pm 0.3) \times 10^4$
$H^*(10)$/D (mSv Gy^{-1})	0.383 ± 0.018	0.36 ± 0.04
Fluence fractions		
E < 0.4 eV	22.0%	21.3%
0.4 eV < E < 10 keV	21.8%	22.2%
E > 10 keV	56.2%	56.5%

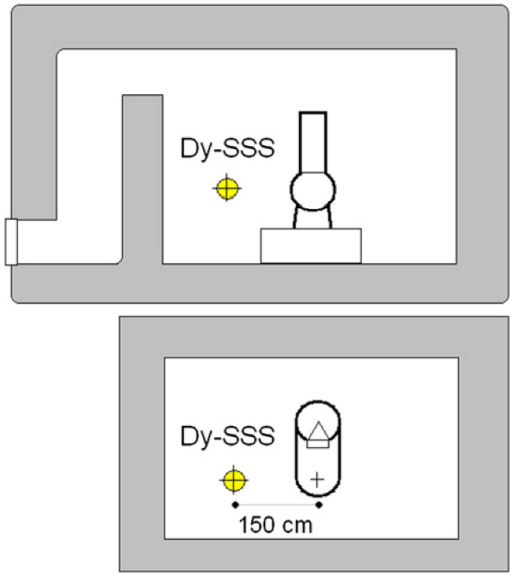
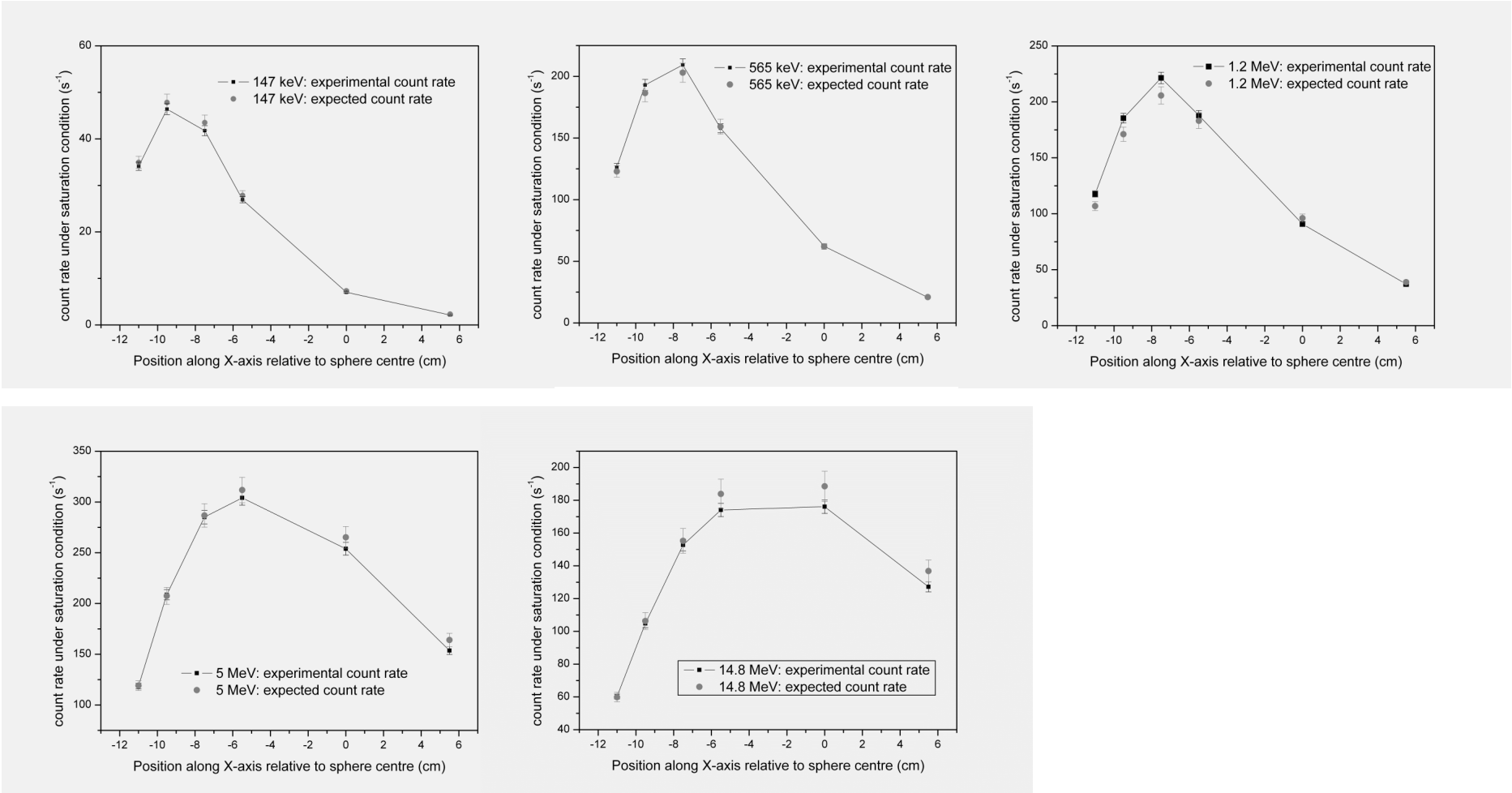


Fig. 2. The 15 MV Varian CLINAC DHX medical accelerator of the Ospedale S. Chiara (Pisa), the treatment room and the location of the point of test. The spectrometer is located 150 cm laterally with respect to the isocenter. Dimensions of the room are approx. 8 m × 6.7 m × 3 m (height).Upper part: view from top; lower part: lateral view.

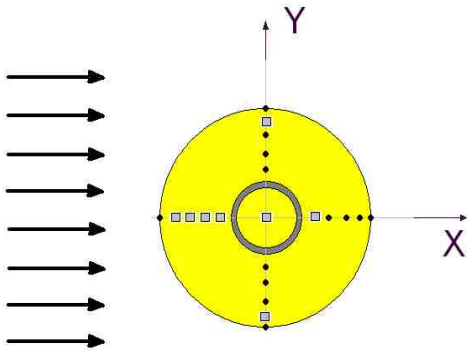
R. Bedogni et al. *Workplace testing of the new Single Sphere neutron Spectrometer based on Dysprosium activation foils (Dy-SSS).* Nucl. Inst. Meth. A 684, 105-108 (2012).

1) Summary of 2012 activities



R. Bedogni et al. ***Testing a newly developed single-sphere neutron spectrometer in reference monochromatic fields from 147 keV to 14.8 MeV.*** **Nucl. Inst. Meth. (accepted)**

1) Summary of 2012 activities



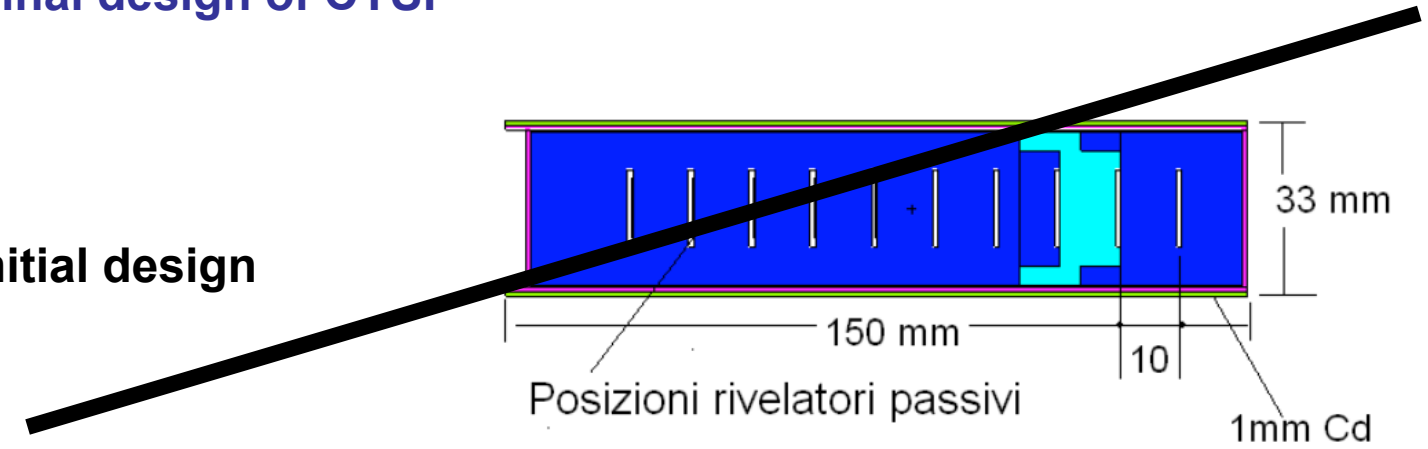
	147 ke V	565 keV	1.2 M eV	5.0 M eV	14.8 M eV
Y = -11.0	0.137	0.148	0.138	0.132	0.143
Y =11.0	0.139	0.138	0.146	0.141	0.142
X=-11.0	0.131	0.138	0.148	0.134	0.135
X=-9.5	0.130	0.139	0.145	0.135	0.132
X=-7.5	0.129	0.138	0.144	0.133	0.132
X=-5.5	0.130	0.133	0.138	0.13 1	0.127
X=0	0.128	0.134	0.127	0.128	0.125
X=5.5	0.123	0.132	0.128	0.125	0.125
F_E	0.130± 0.004	0.137± 0.004	0.138± 0.005	0.132± 0.004	0.131± 0.006

Table 1. Value of $F_{i,E}$, obtained for every mono-chromatic energy and for the eight selected measurement positions.

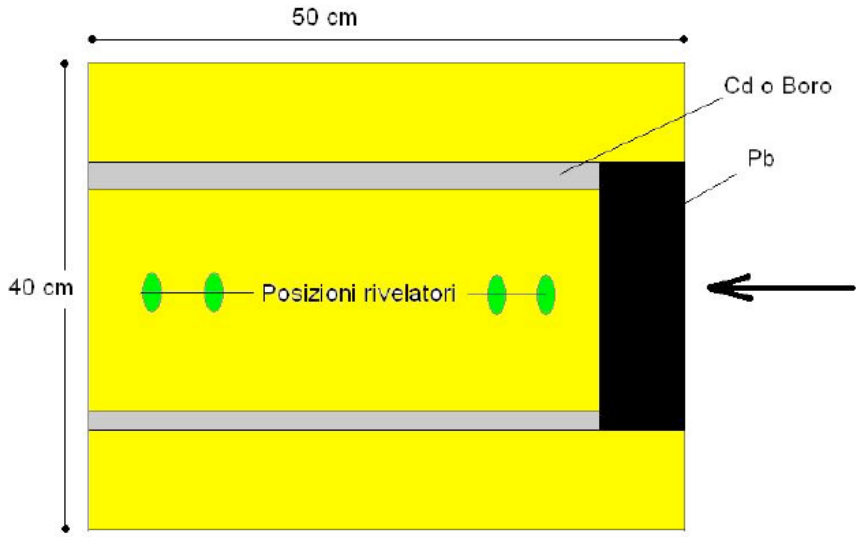
R. Bedogni et al. ***Testing a newly developed single-sphere neutron spectrometer in reference monochromatic fields from 147 keV to 14.8 MeV.*** **Nucl. Inst. Meth. (accepted)**

2) Final design of CYSP

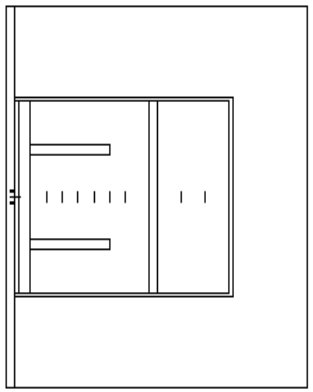
Initial design

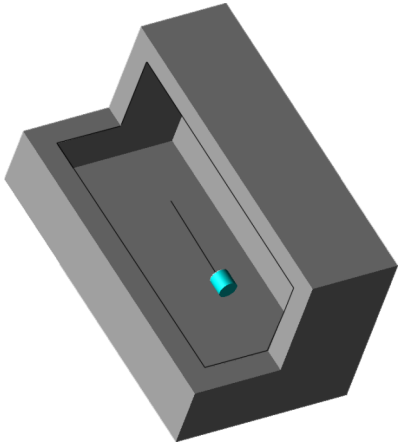


Improved design

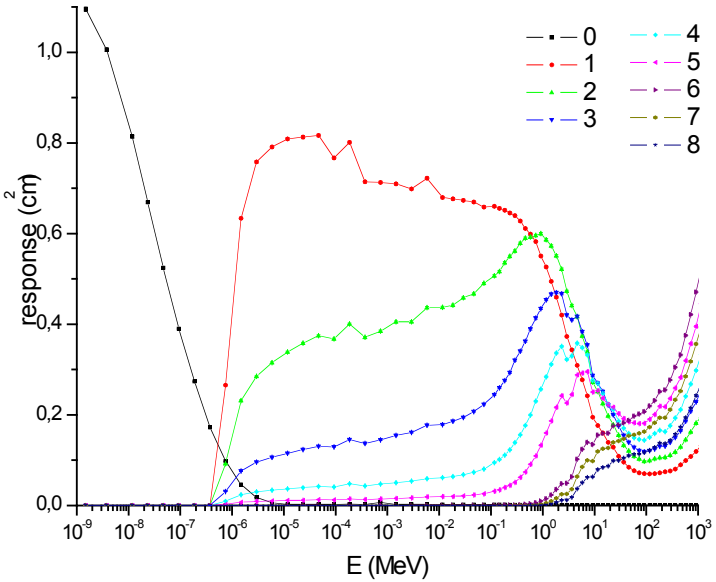


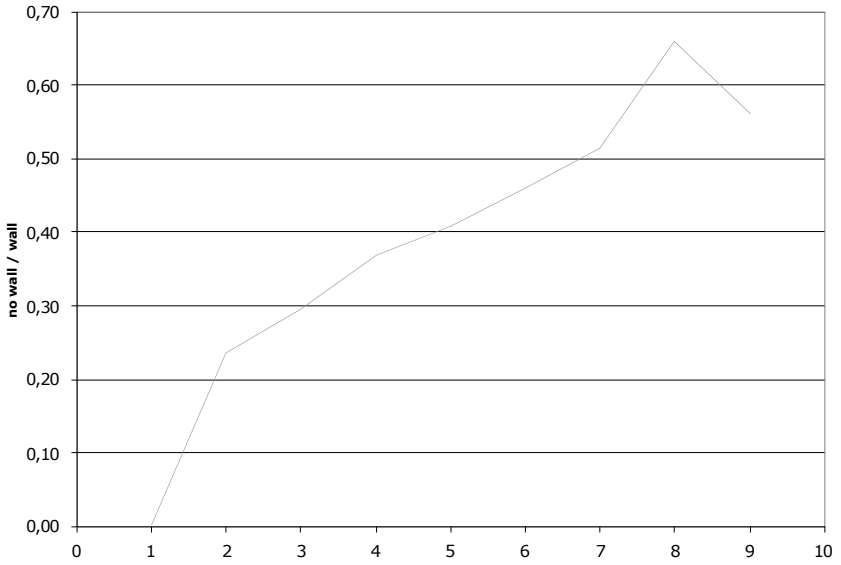
2) Final design of CYSP





Cyl 2





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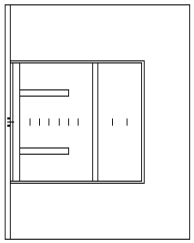
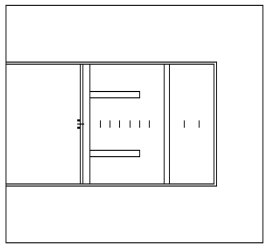
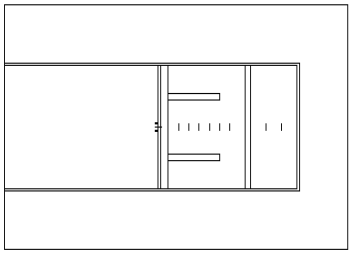


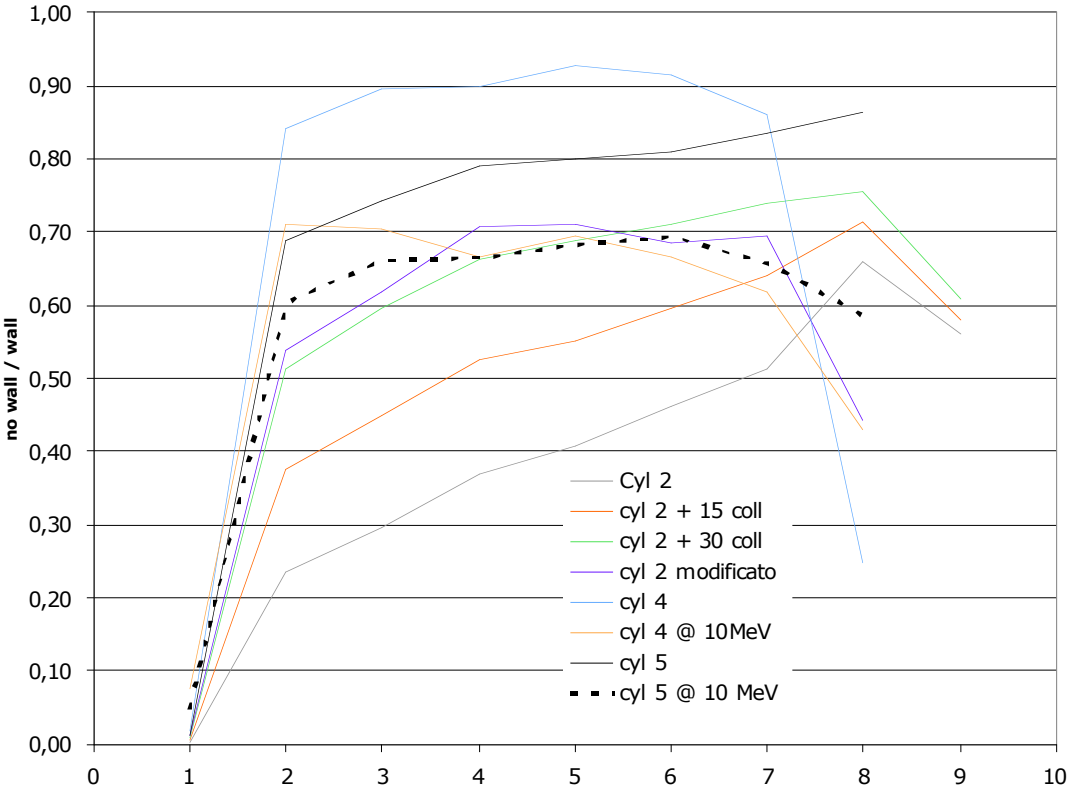
Cyl 2

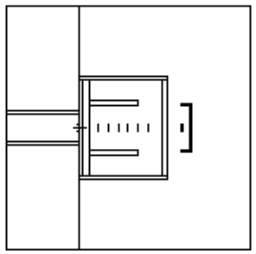


Cyl 2 + 15 cm coll.

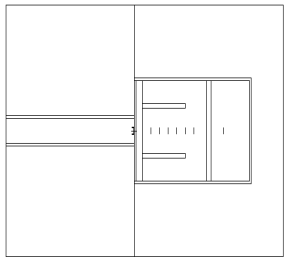


Cyl 2 + 30 cm coll.

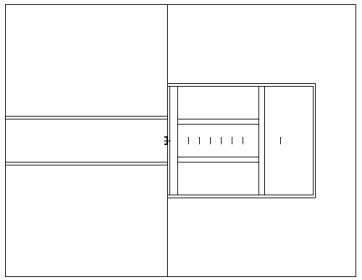




Cyl 2 mod.

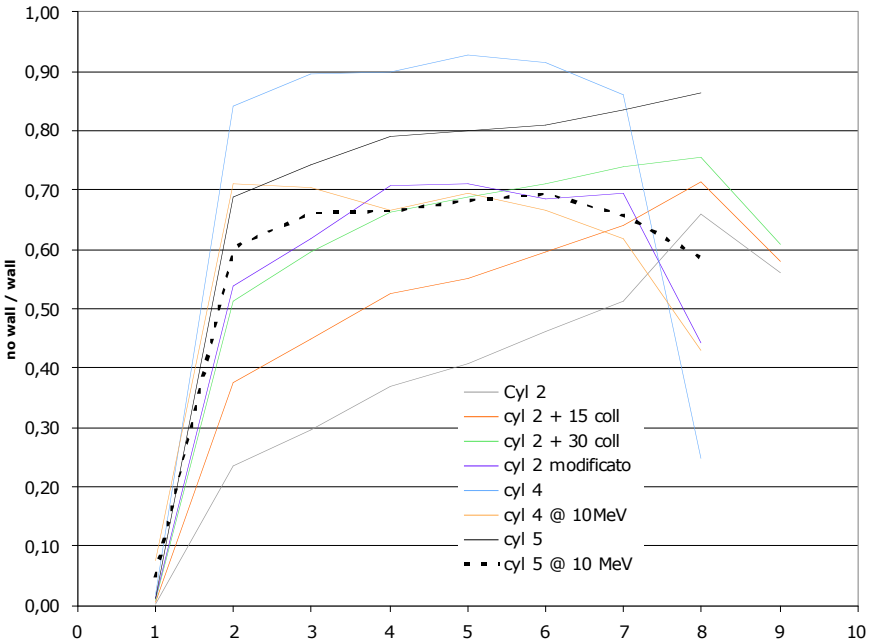


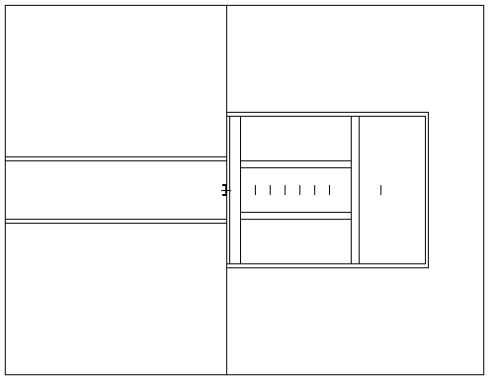
Cyl 4

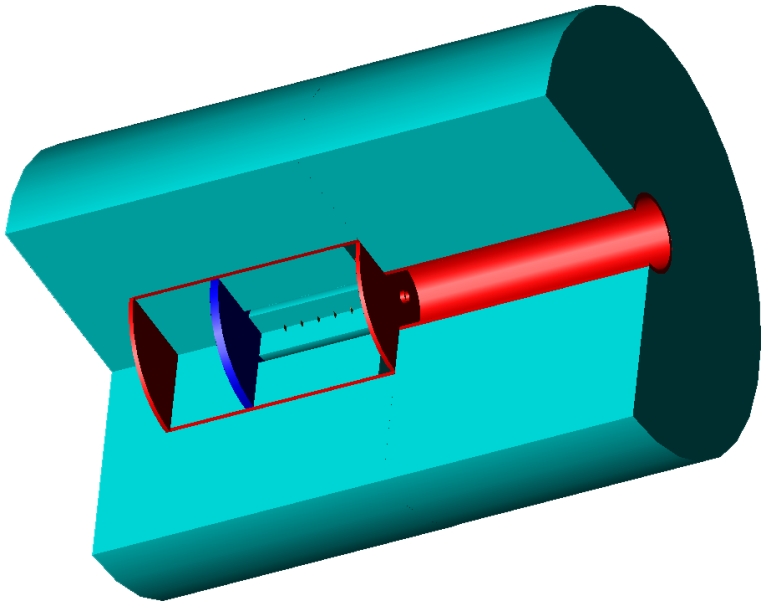


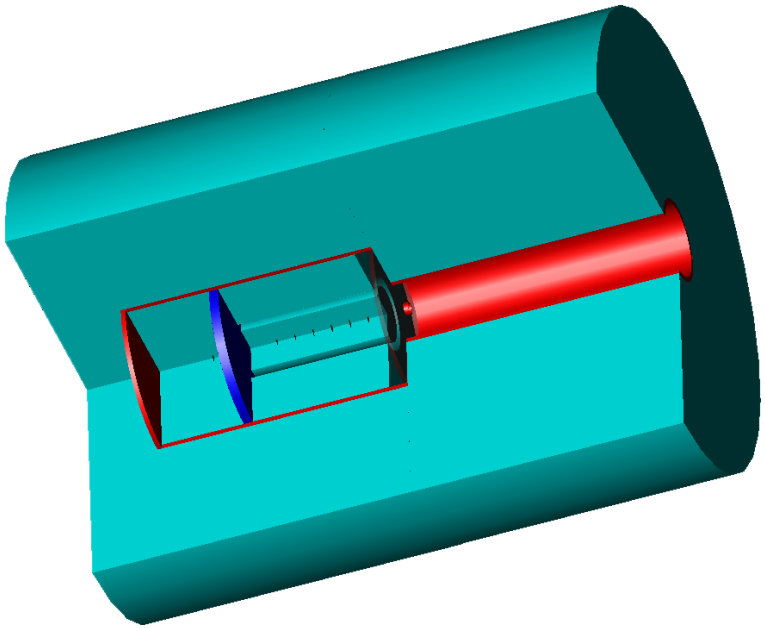
Cyl 5

2) Final design of CYSP



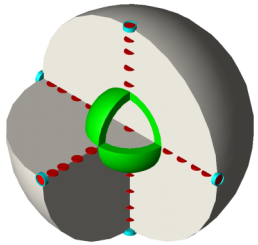


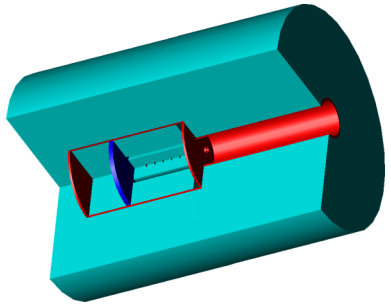




3) Simulation of (active) detectors

MCNP calculation of energy distribution of neutron fluence in the active volume of detectors





MCNP calculation of fluence related quantities:

$$\int dE \Phi_E f(E)$$

$f(E)=\Sigma_{(n,\alpha)}$	Macroscopic cross section of : $^{6}Li(n,\alpha)^{3}H$	➔	Neutron response of ^{6}Li doped TL detectors
$f(E)=\Sigma_{(n,\gamma)}$	Macroscopic cross section of : $^{164}Dy(n,\gamma)^{165}Dy$	➔	Neutron response of ^{164}Dy activation foils
$f(E)$=…	Macroscopic cross section of…	➔	Neutron response of …

4) Foreseen activities for 2013

Projects support

1) NESCOFI@BTF (INFN, Commissione Scientifica Nazionale 5, Italy, 2011-2013)

1) Coordinated project FIS2012-39104-C02 (MINECO, Spain, 2013-2015): *Dosimetría y espectrometría de neutrones en campos pulsados con detectores de estado sólido*: 65.000 €

2) Stay during 2013 (3 months) PRX12-00262 (MECD, Spain, 2013): 9.000 €. **(?)**

Conferences

1) NEUDOS12: 12th Neutron and Ion Dosimetry Symposium (Aix-en-Provence, France, June 3-7, 2013).

2) 3º Congreso Conjunto S.E.F.M. – S.E.P.R. (Caceres, Spain, June 18-21, 2013).

3) SSD17: 17th International Conference on Solid State Dosimetry (Recife, Brazil, September 22-27, 2013).