Spherical designs and application to the radiative capture case

WS PARIS (Krakow Oct 14-16, 2009)

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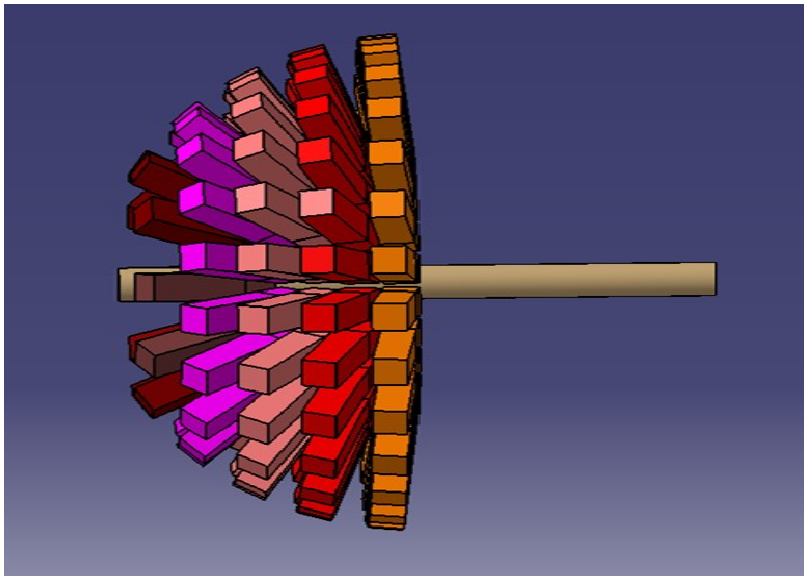
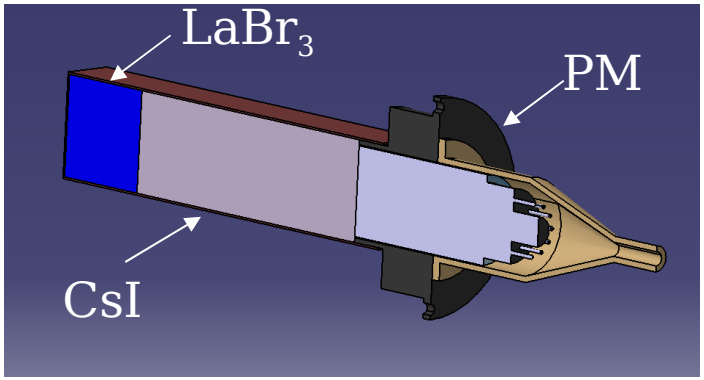
Designs

Basic structure :

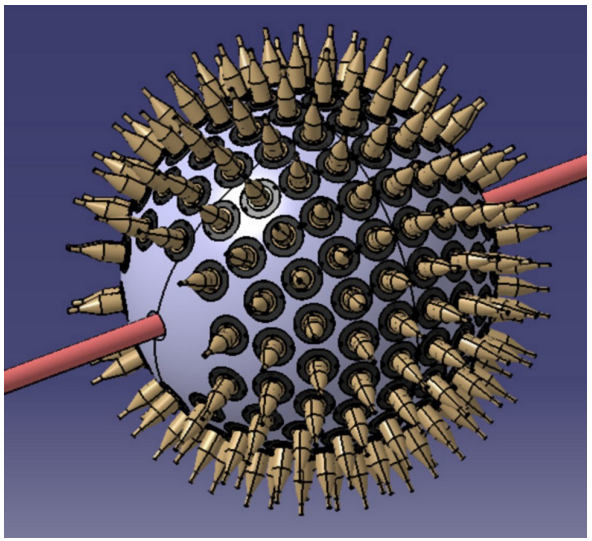
- 200 telescopes $LaBr_3$-CsI
- Internal radius : 25 cm
- 10 rings



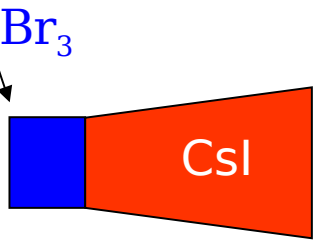
- Design 222-226

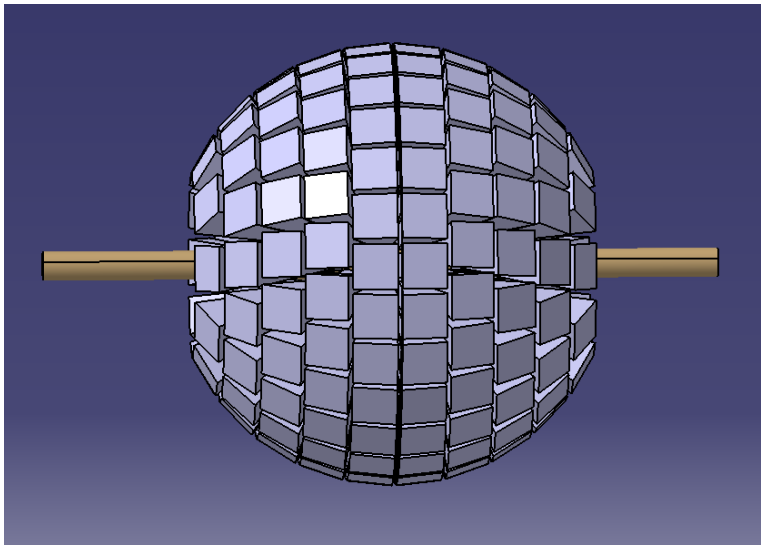


Module + PM

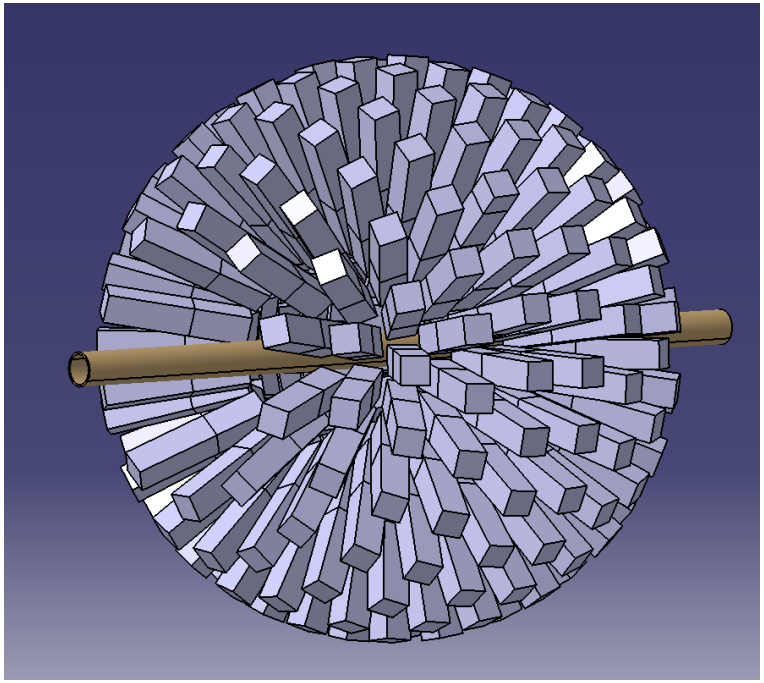


- Design 222-tapered

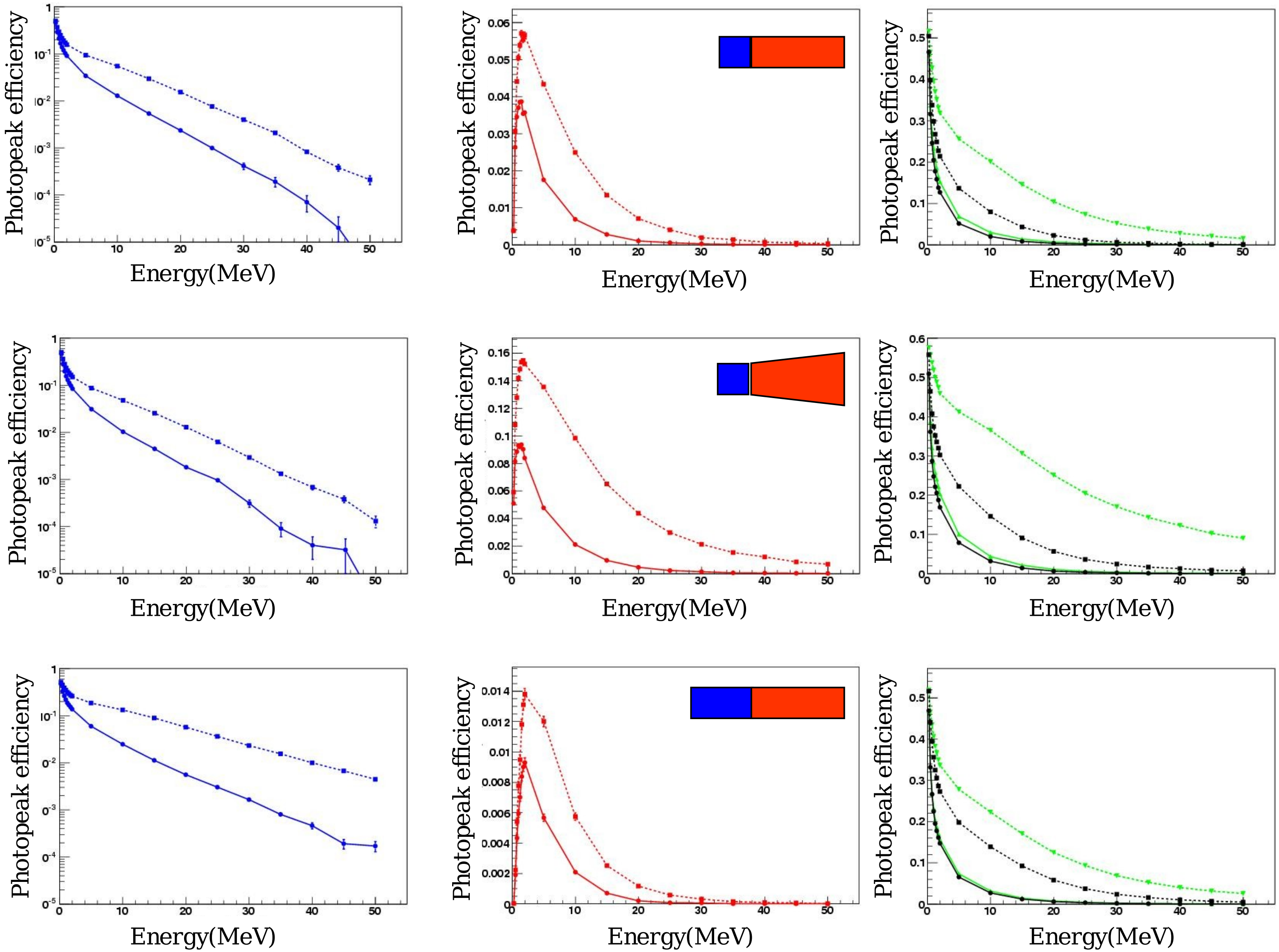




- Design 224-226

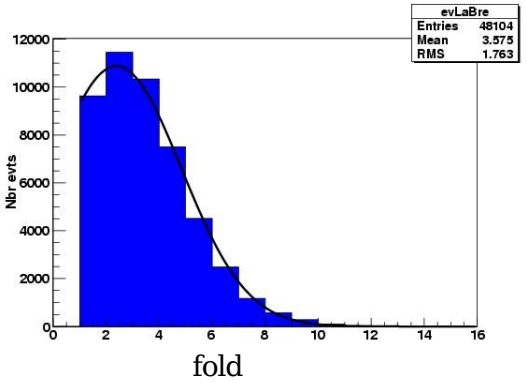


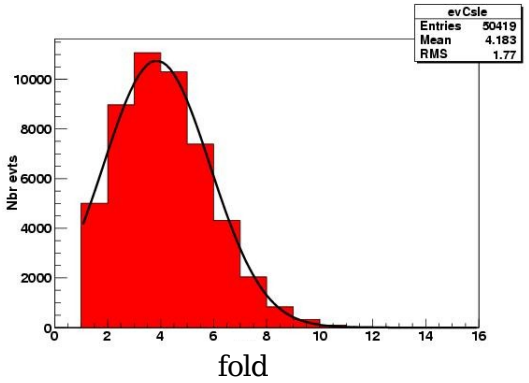
GEANT4 simulation : efficiency

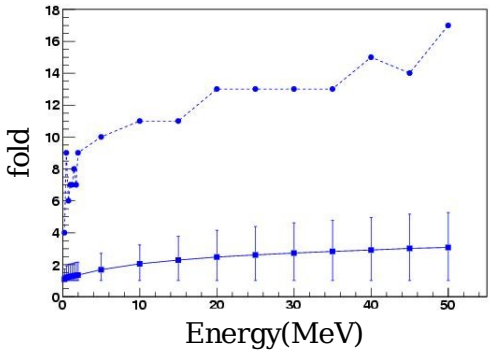


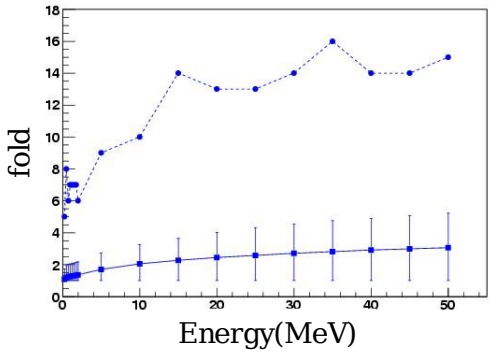
GEANT4 simulation : fold

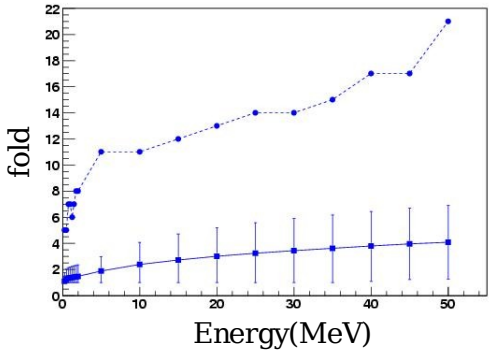
100 000 γ
50 MeV

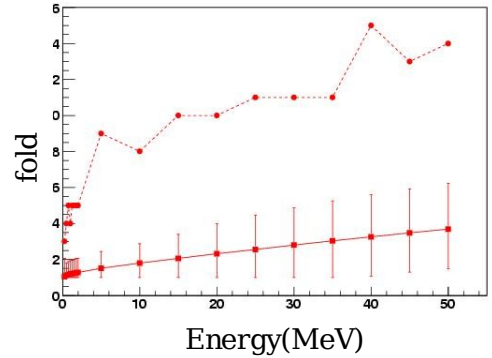


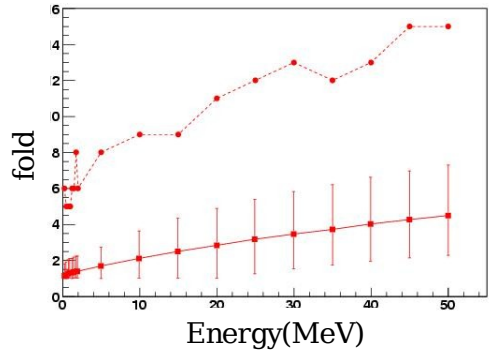


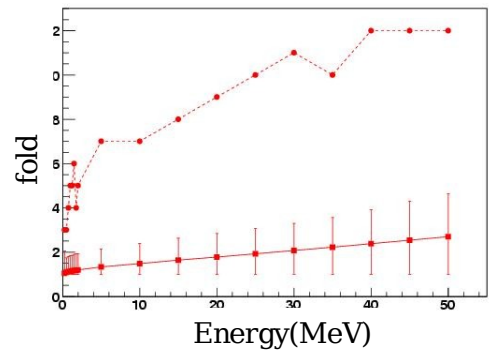




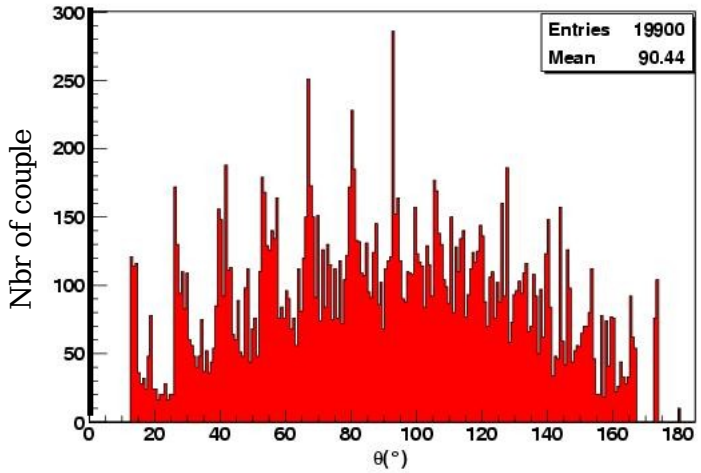


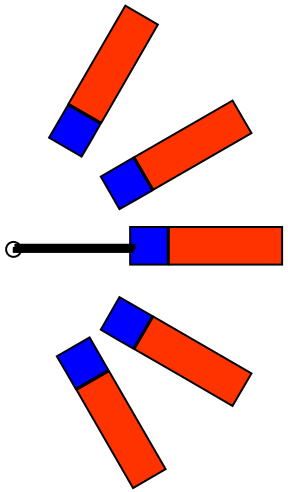


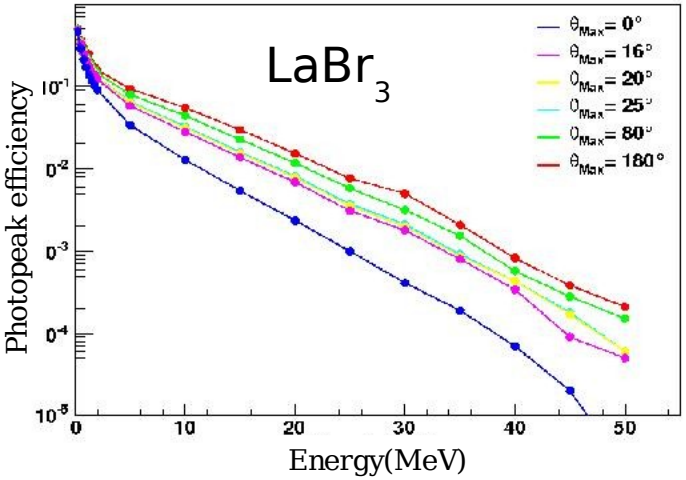


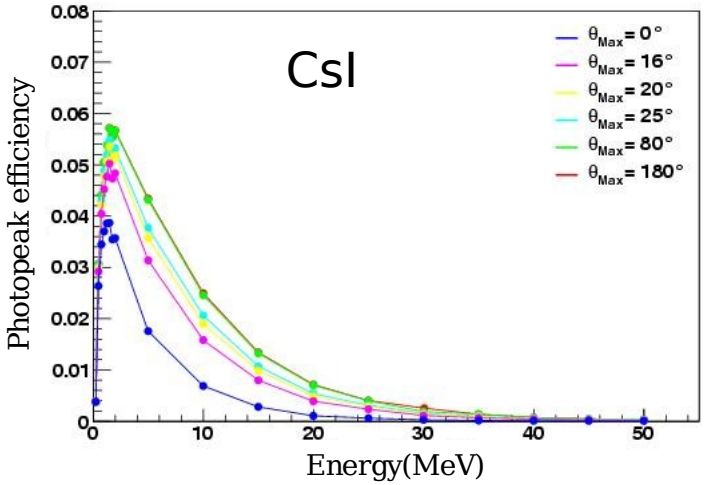


GEANT4 simulation : Addback









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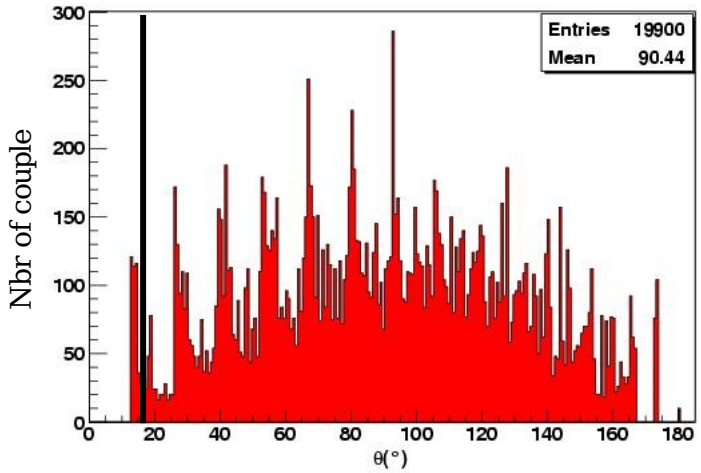

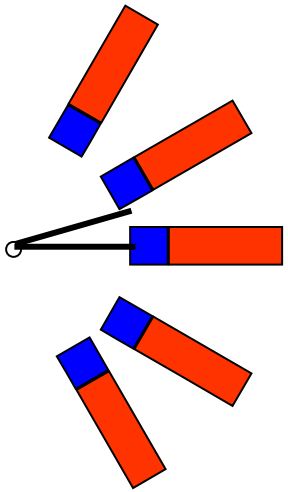

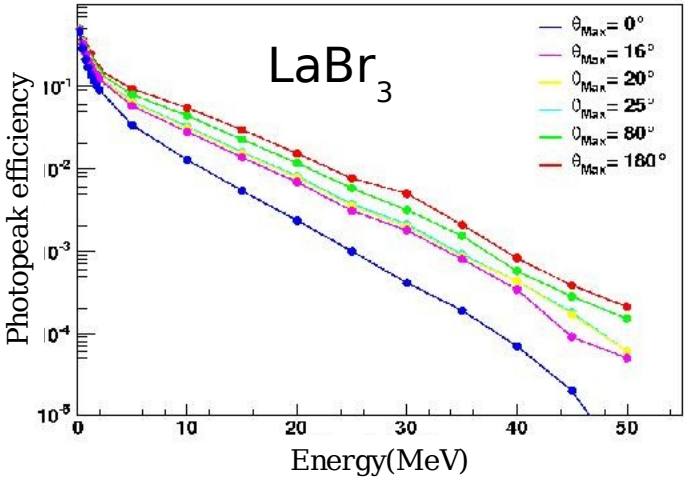

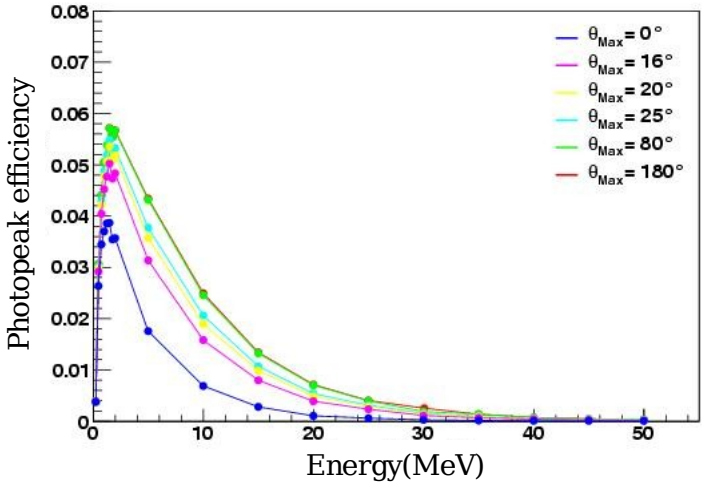

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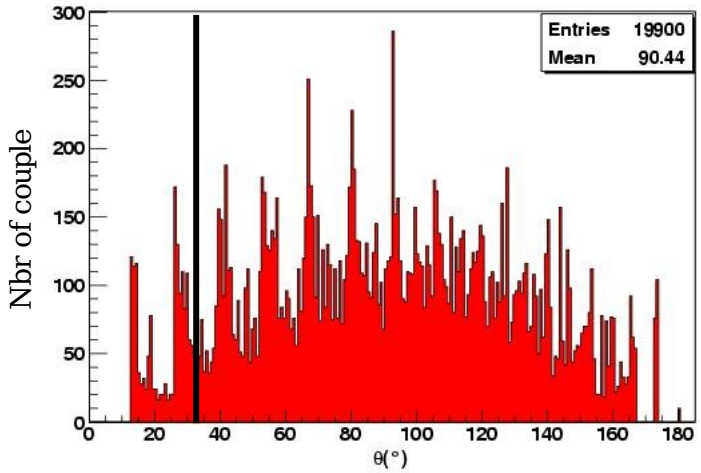
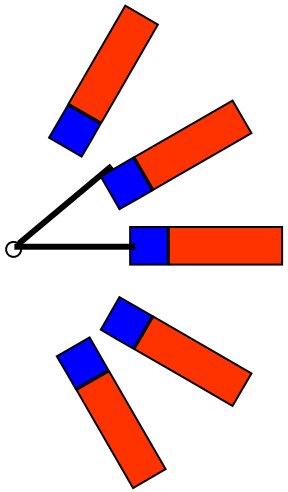
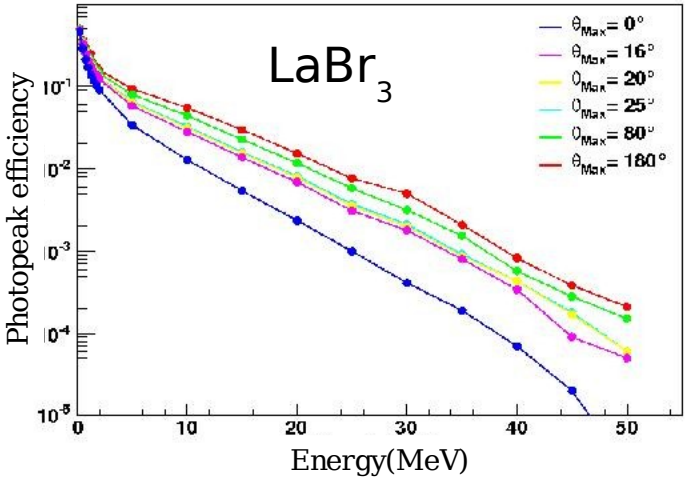
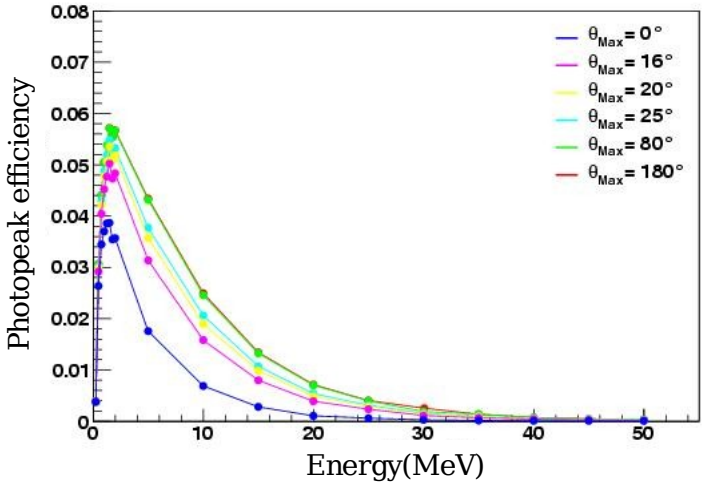
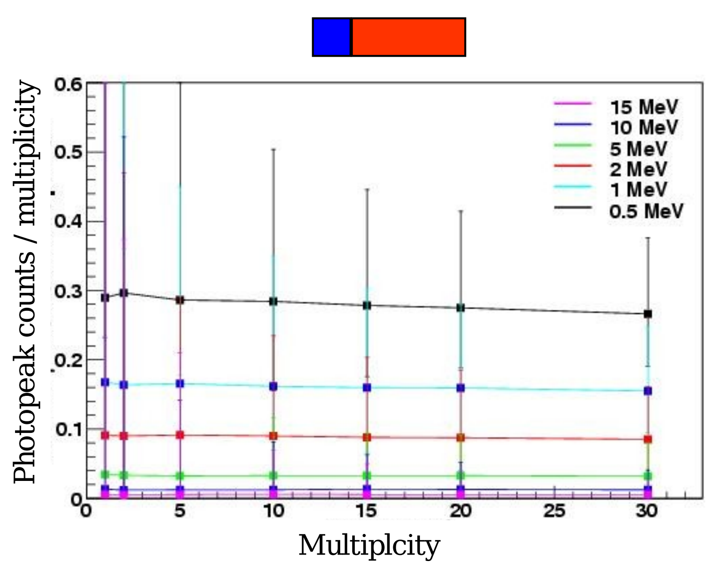


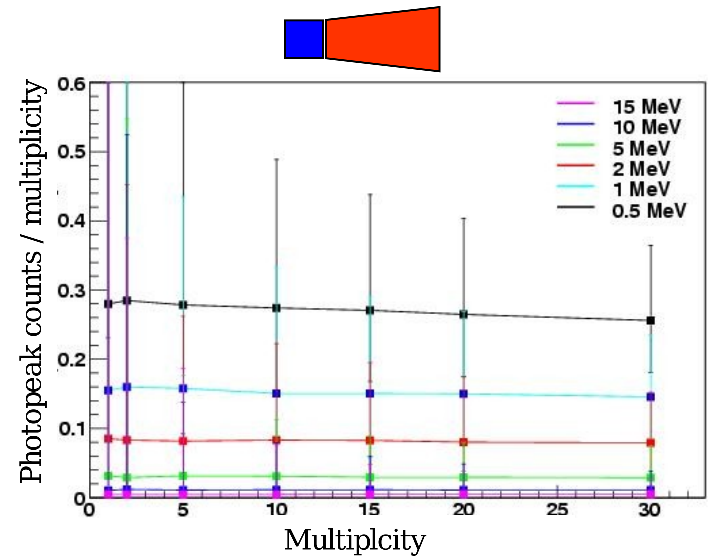


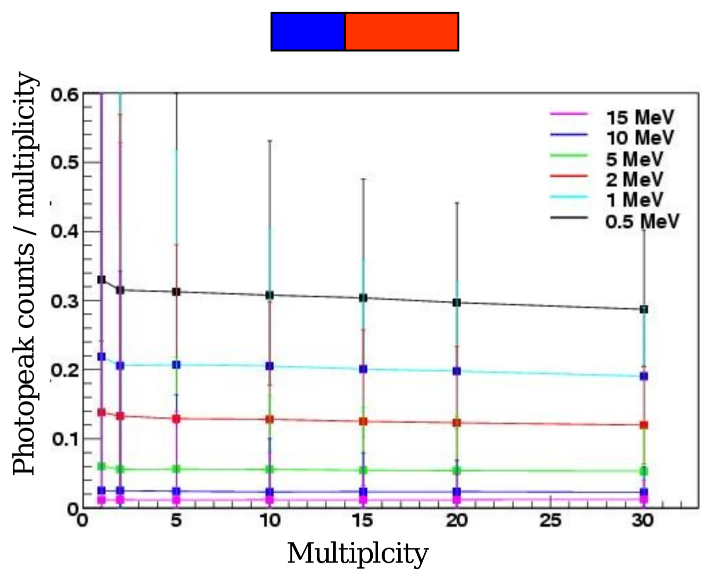




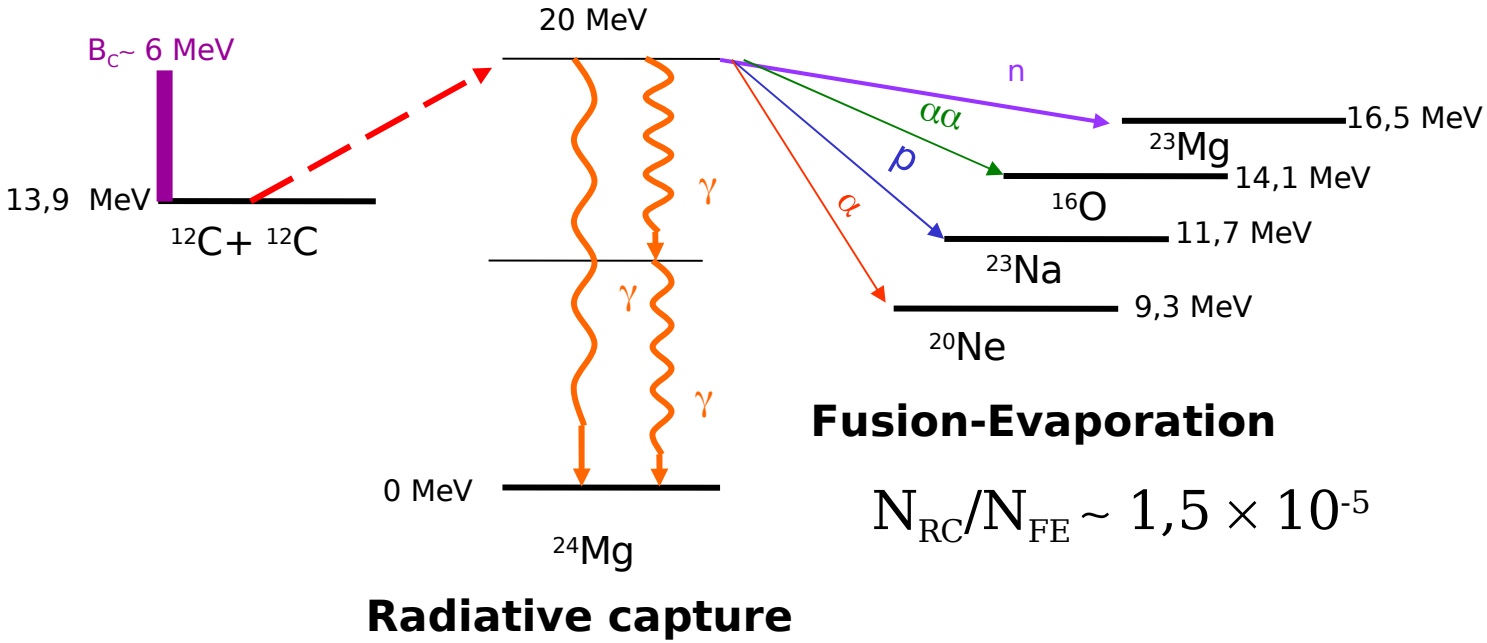
Multiplicity







Physics case: radiative capture $^{12}C(^{12}C,\gamma)^{24}Mg$

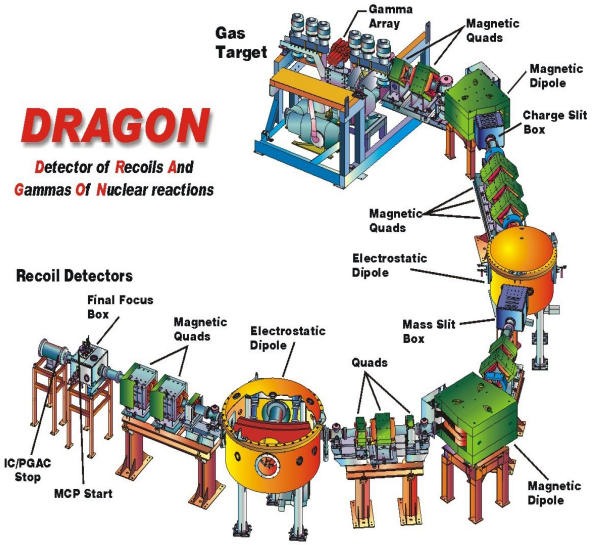


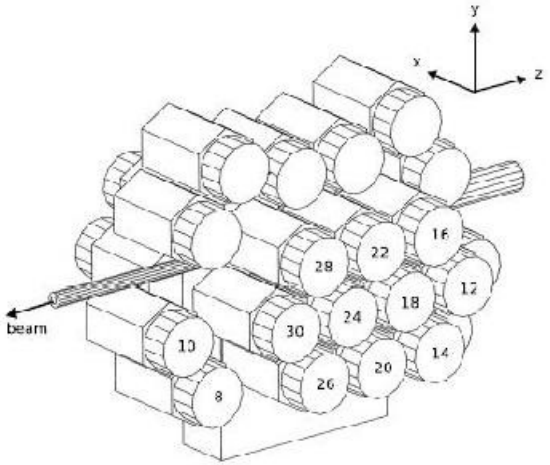
$N_{RC}/N_{FE} \sim 1{,}5 \times 10^{-5}$

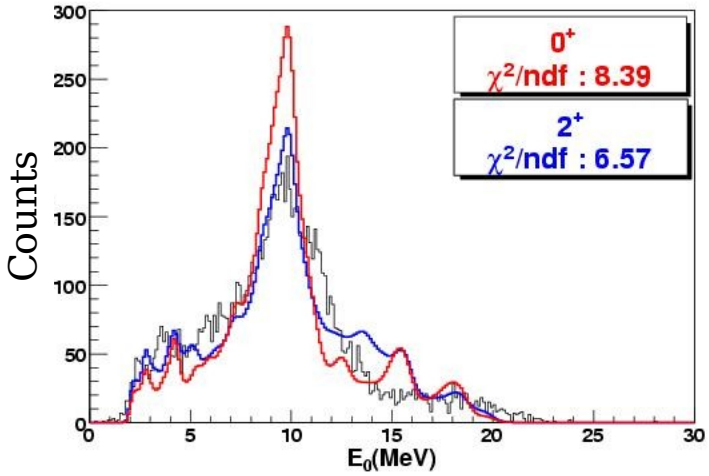
Selection of the radiative capture channel

- Detection of the recoil at 0° → $N_{RC}/N_{Beam} \approx 6{,}5 \times 10^{-12}$
- Calorimeter mode ($\sum E\gamma \sim 20$ MeV)

Our Triumf Results

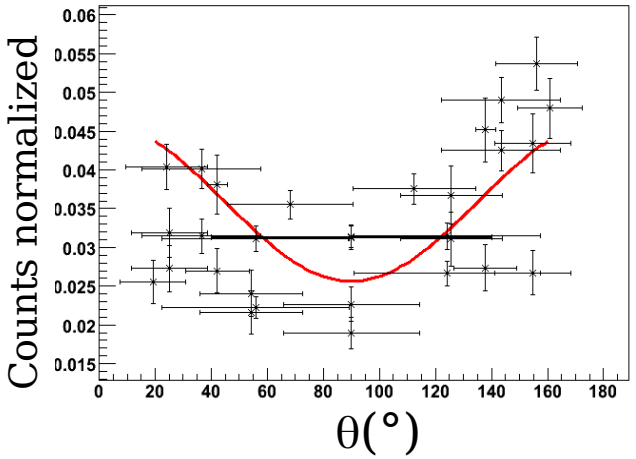






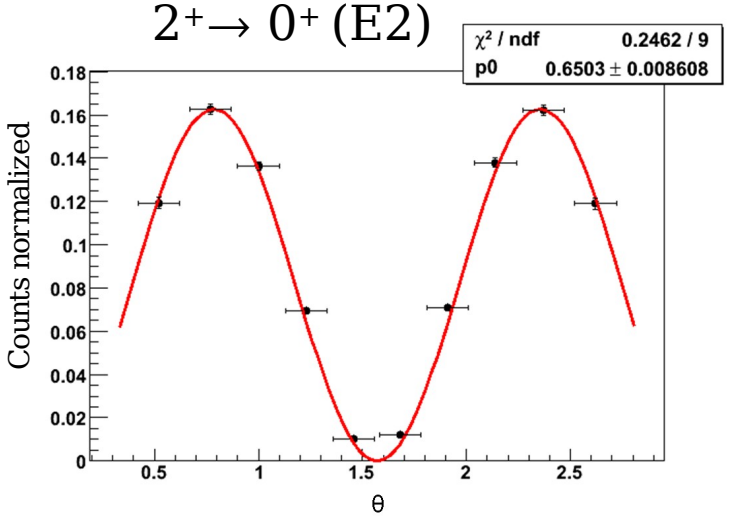
Resolution around 10 MeV …

Angular distribution

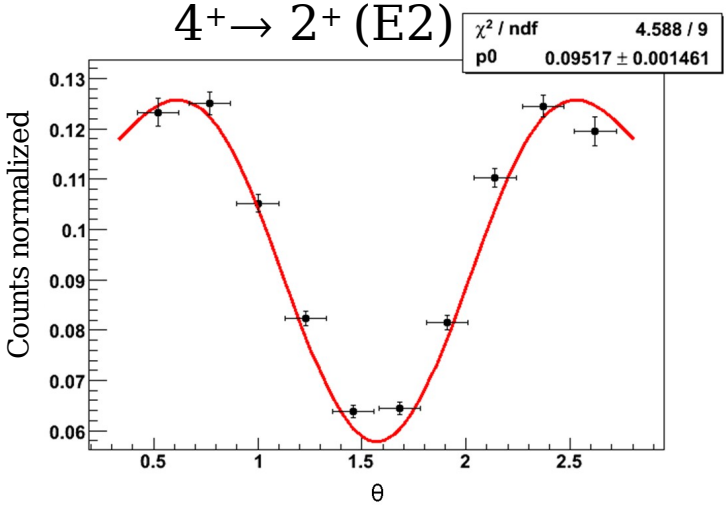


Angular distributions

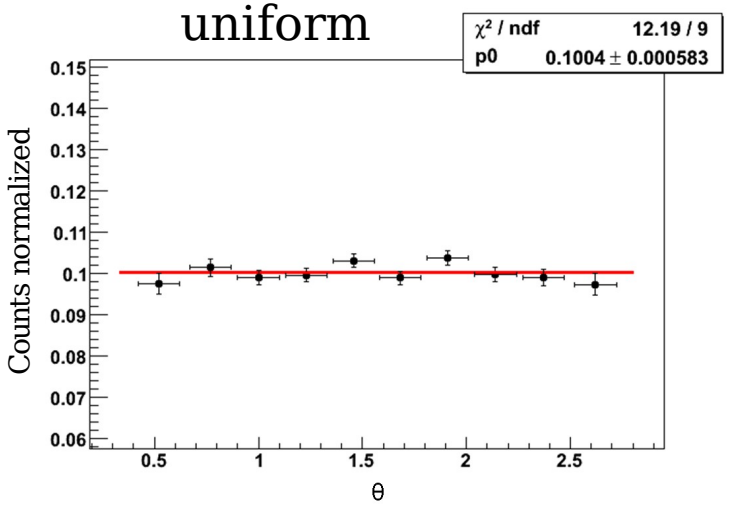
$2^+ \rightarrow 0^+$ (E2)



$4^+ \rightarrow 2^+$ (E2)



uniform



Simple algorithm:

- /Nbr of detector by rings
- Normalise to 1

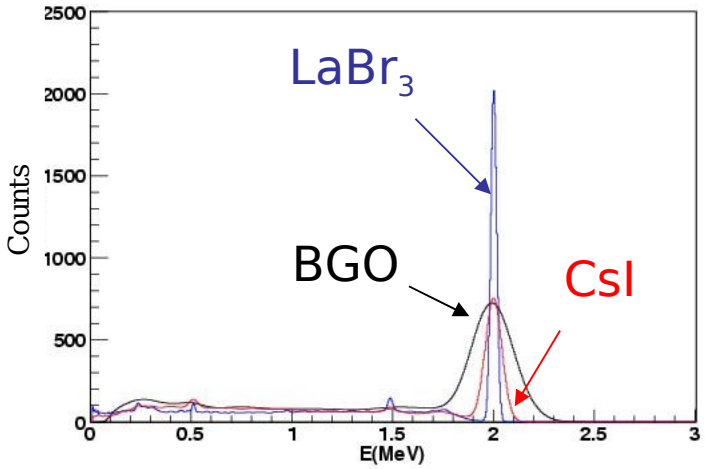
We can distinguish easily
E1 / E2 / uniform distributions
and even ≠ E2 transitions

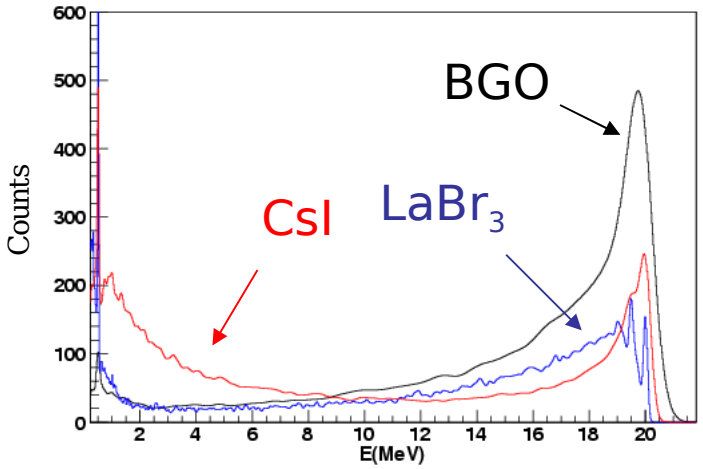
Resolution

Scintillators : FHWM = k √(E) $MeV^{1/2}$

Material	BGO	CsI	LaBr
k($MeV^{1/2}$)	0.173	0.068	0.024

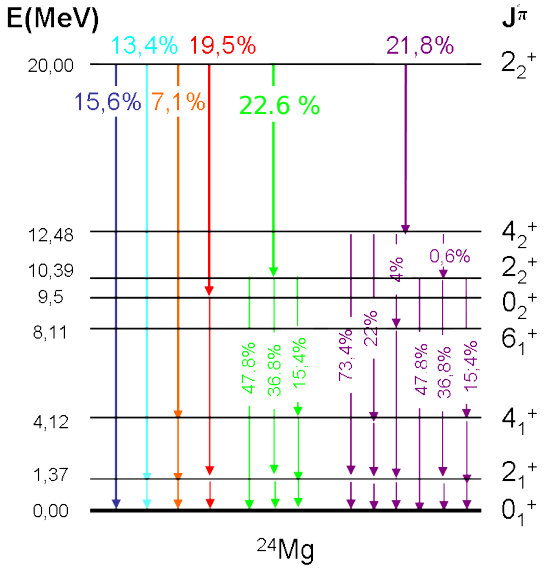
Simulation for 100 000 γ of 2 and 20 MeV

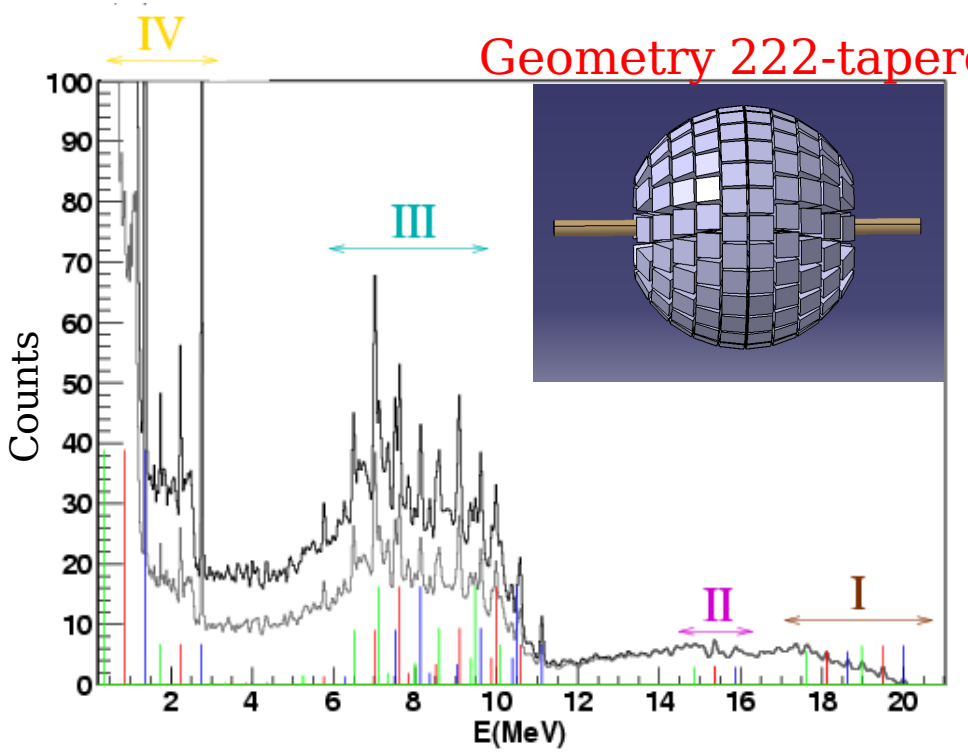




Radiative capture with PARIS

Radiative capture $^{12}C+^{12}C$: Scenario of a 2^+ resonant cluster state





Geometry 222-tapered

*D. Baye, P. Descouvemont, Nucl phys **A419** (1984) 397*

- Distinct peaks
- Efficiency > 50 % in the calorimeter mode ($\sum E_\gamma$>15 MeV)