Installation of NEOPTOLEMOS, the new sum spectrometer for cross section measurements of capture reactions at the TANDEM Accelerator Laboratory of NCSR "Demokritos"

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Outline

- 4π Summing NaI detector
- Installation of NEOPTOLEMOS at the Tandem Accelerator Laboratory of NCSR "Demokritos"
- Characteristics of the new experimental setup
- Conclusions-Future plans

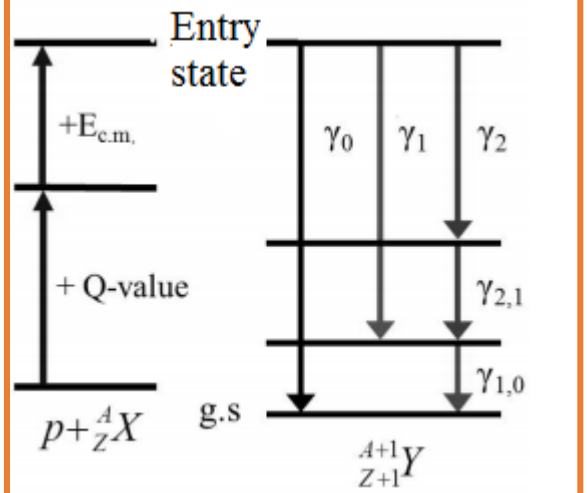
4π Summing NaI detector

Cross section of capture reactions

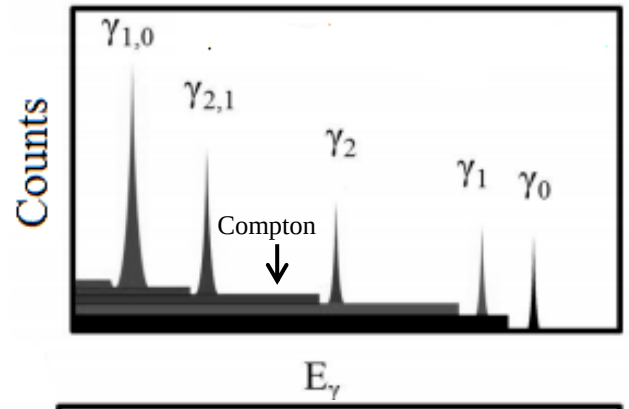
$$\sigma_T = \frac{A\,Y}{N_A\,\xi}$$

A: atomic weight in amu ξ: target thickness

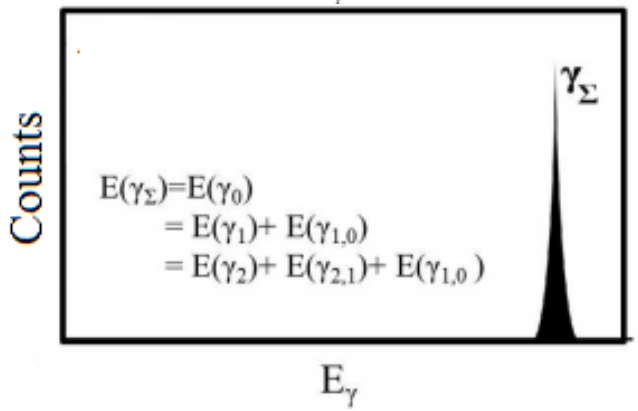
N_A: Avogadro number Y: reaction yield



Decay scheme of compound nucleus produced in capture reaction

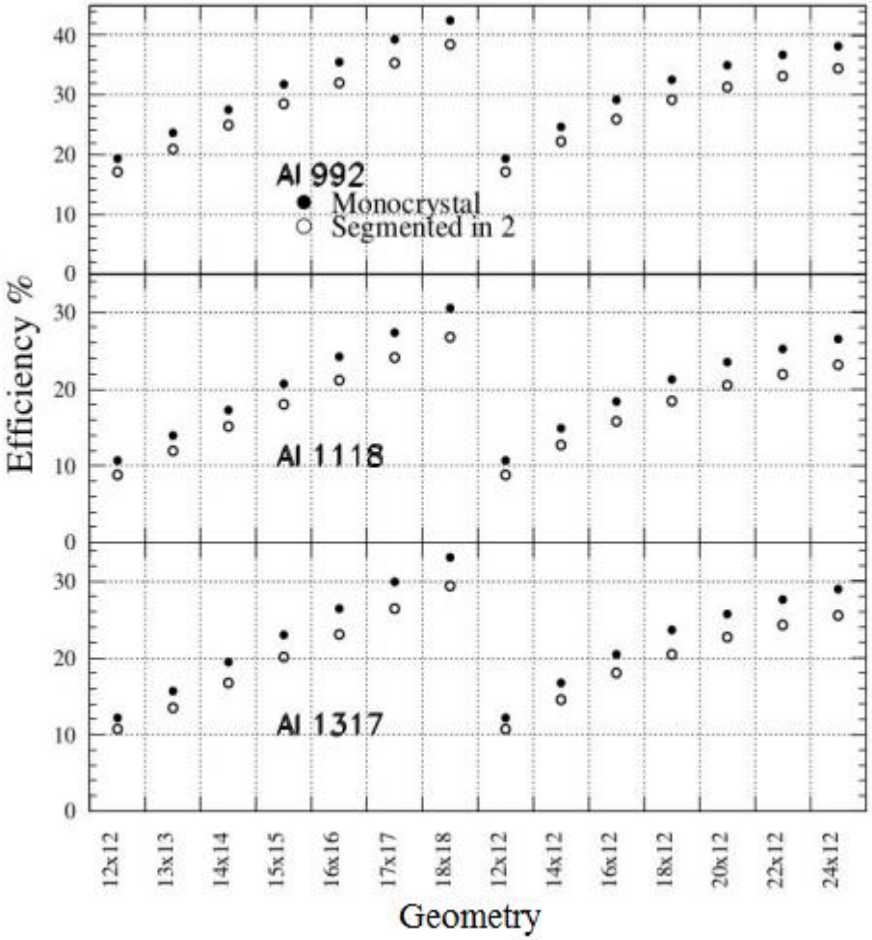


HPGe or small volume NaI

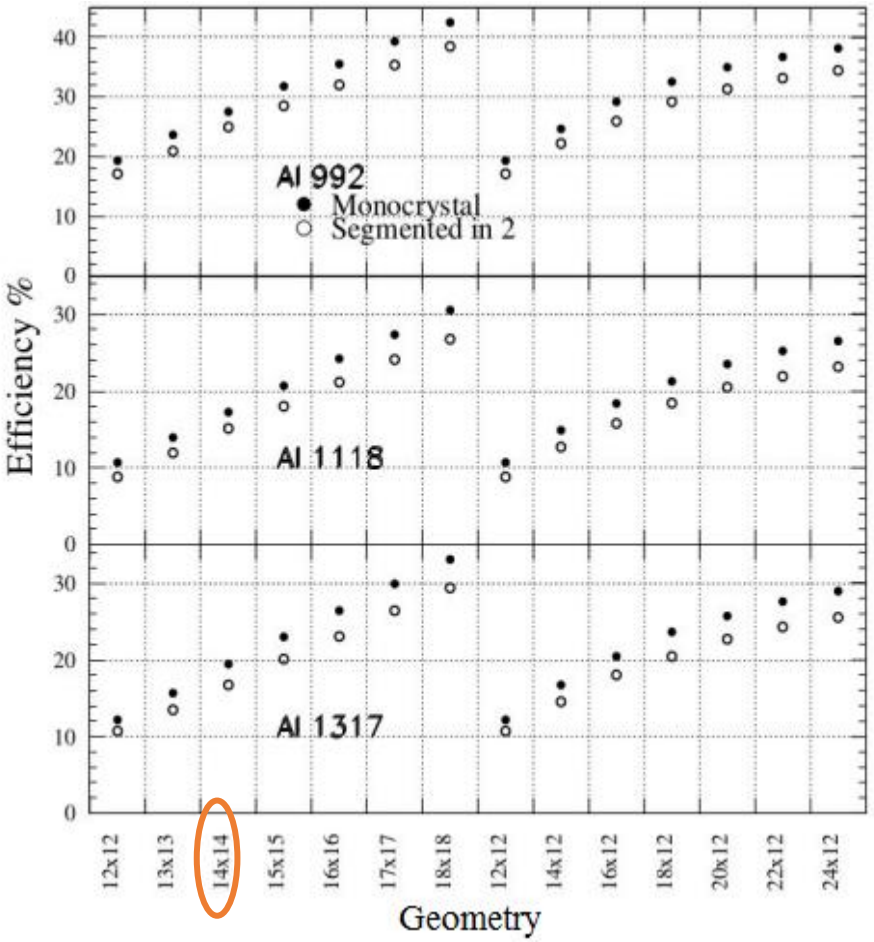


4π summing NaI detector

New 4π NaI detector at TANDEM Laboratory

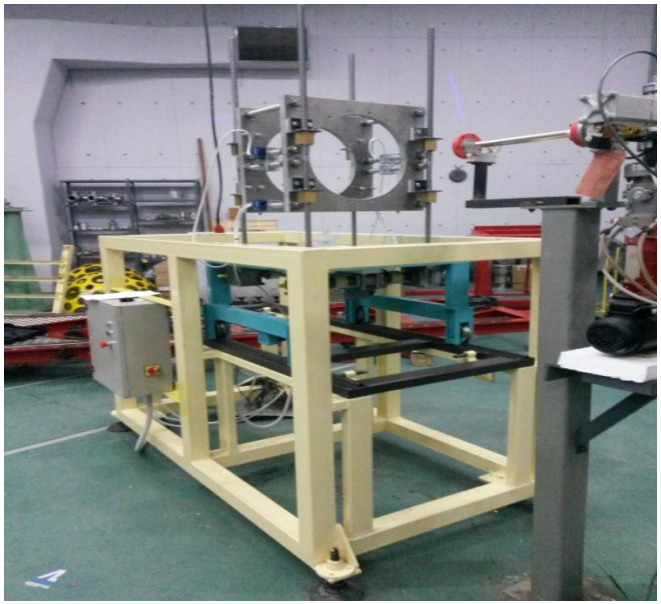


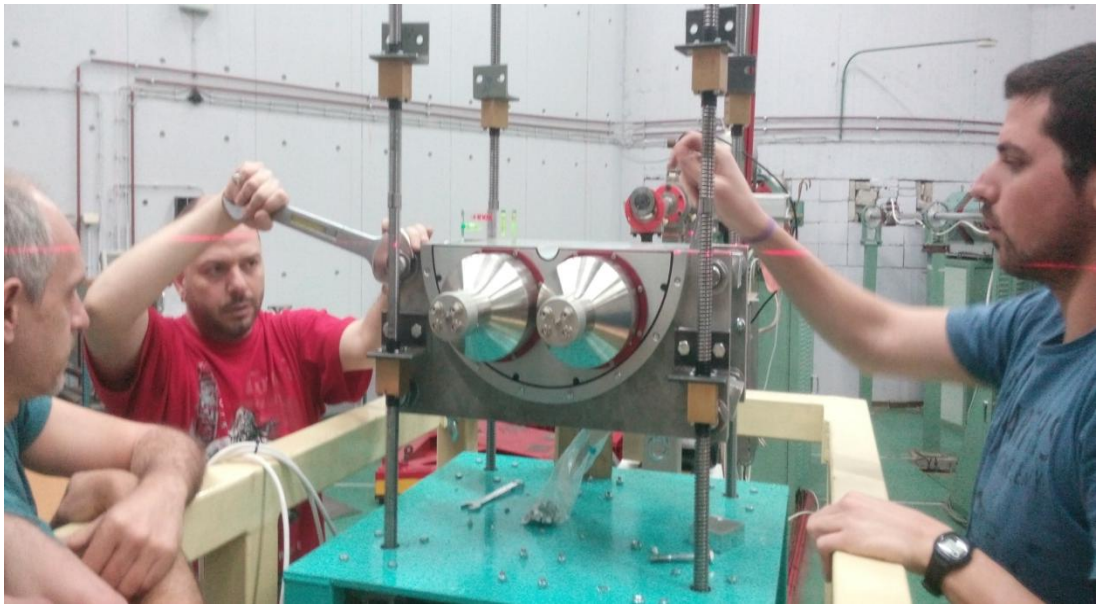
New 4π NaI detector at TANDEM Laboratory

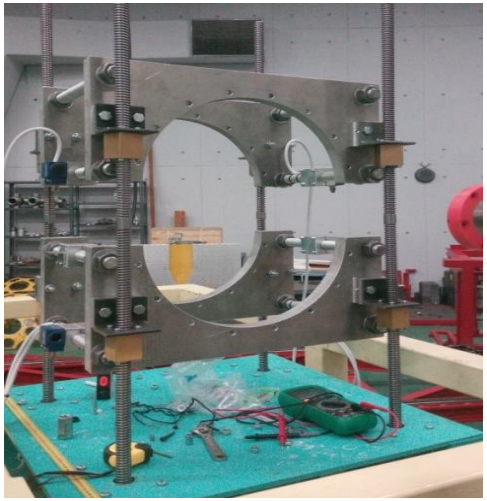


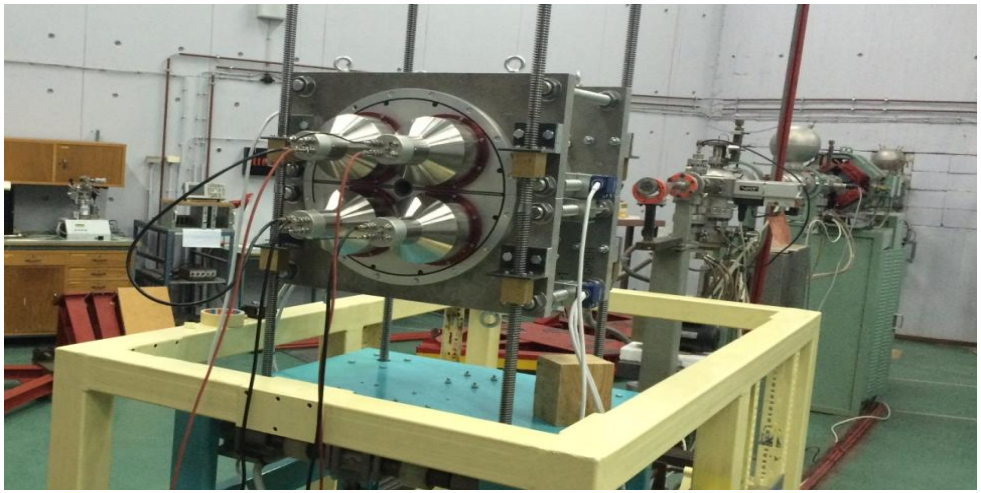
14×14 inches NaI, axially segmented in two (top, bottom)

Installation of NEOPTOLEMOS



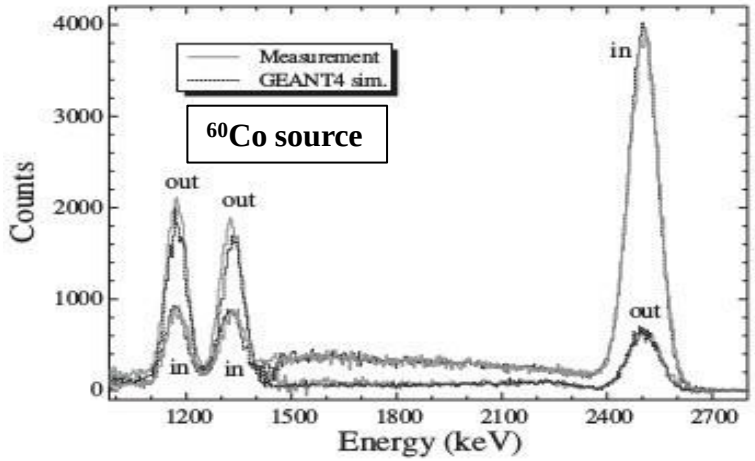




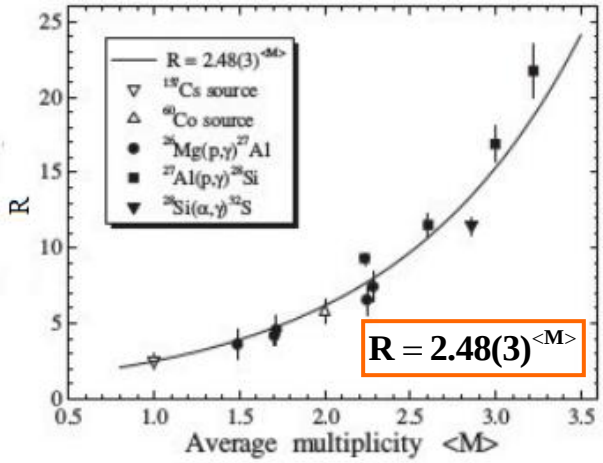


Summing efficiency determination

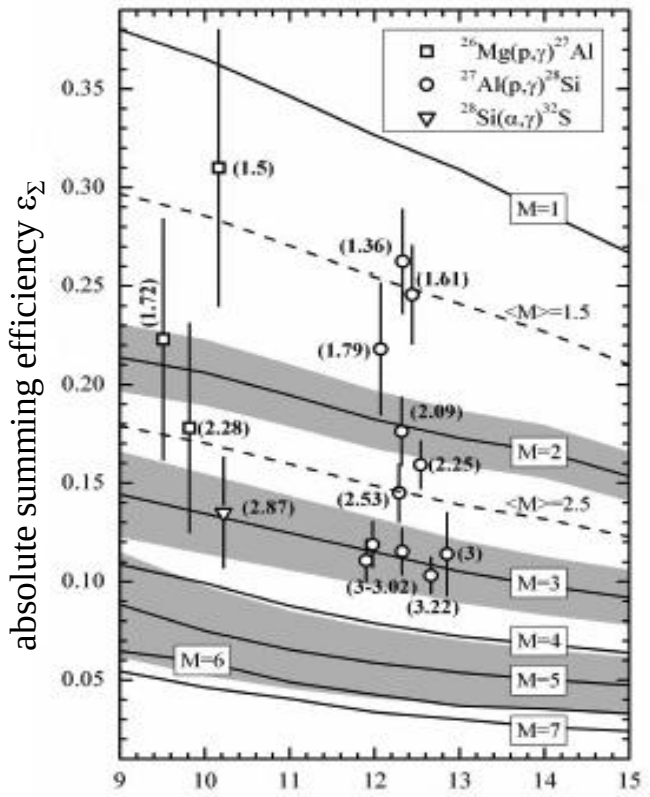
Summing efficiency → Energy of the sum peak, Average multiplicity



$$R = \frac{I_{in}^{*}}{I_{out}}$$



From experimental data and GEANT4 simulations:



*A. Spyrou et al., Phys. Rev. C 76, 015802 (2007)

Summing efficiency determination

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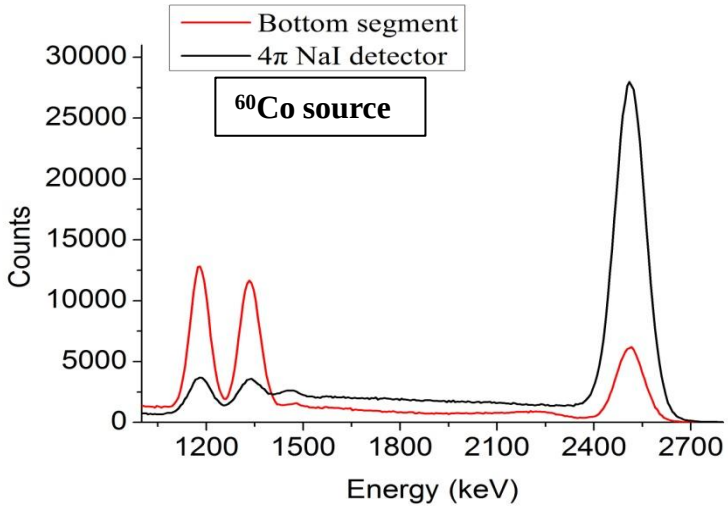
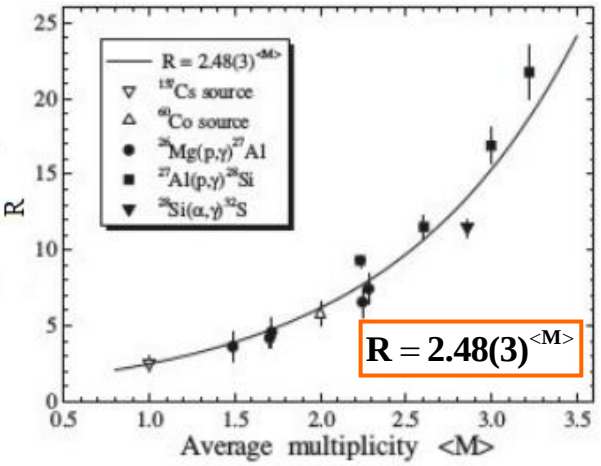


$$R = \frac{I_{4\pi}}{I_{bottom}}$$



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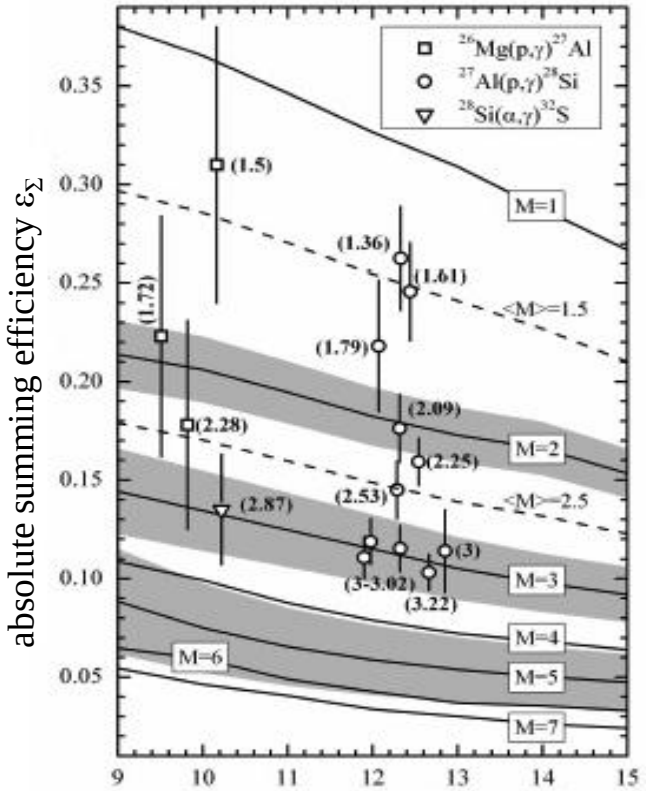
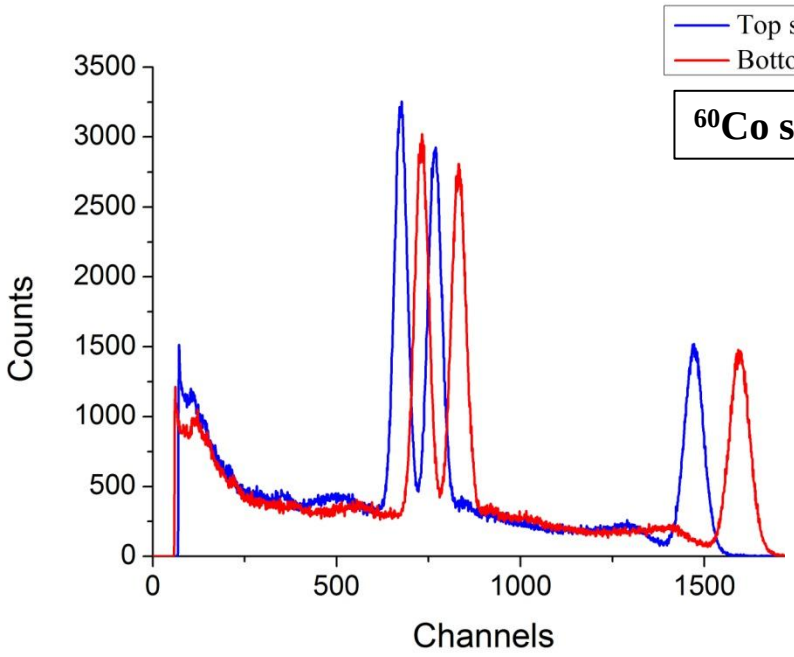
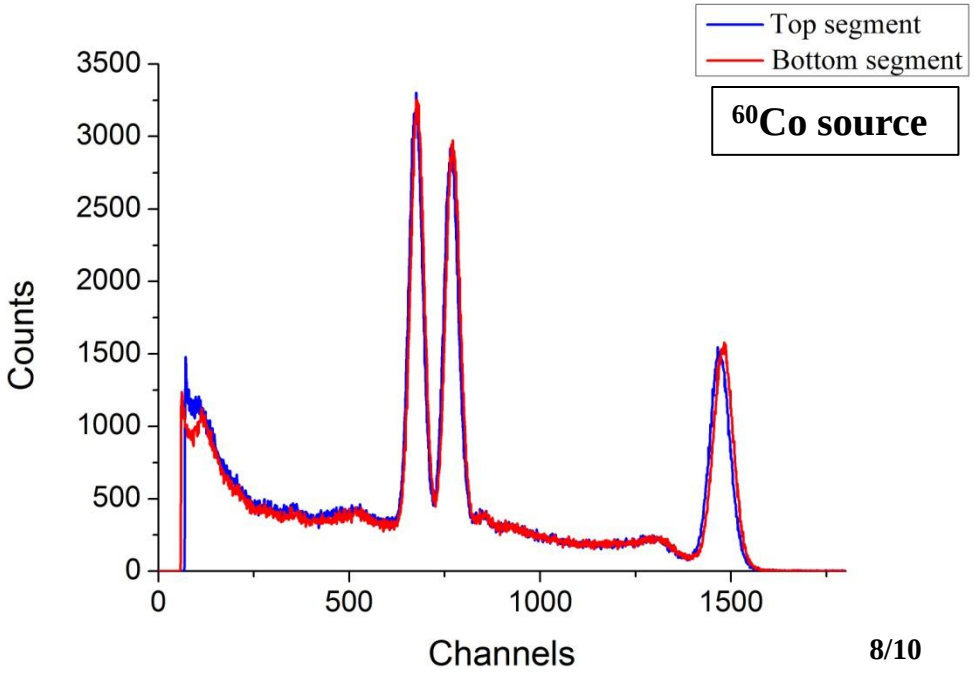


Matching of the photomultipliers gain

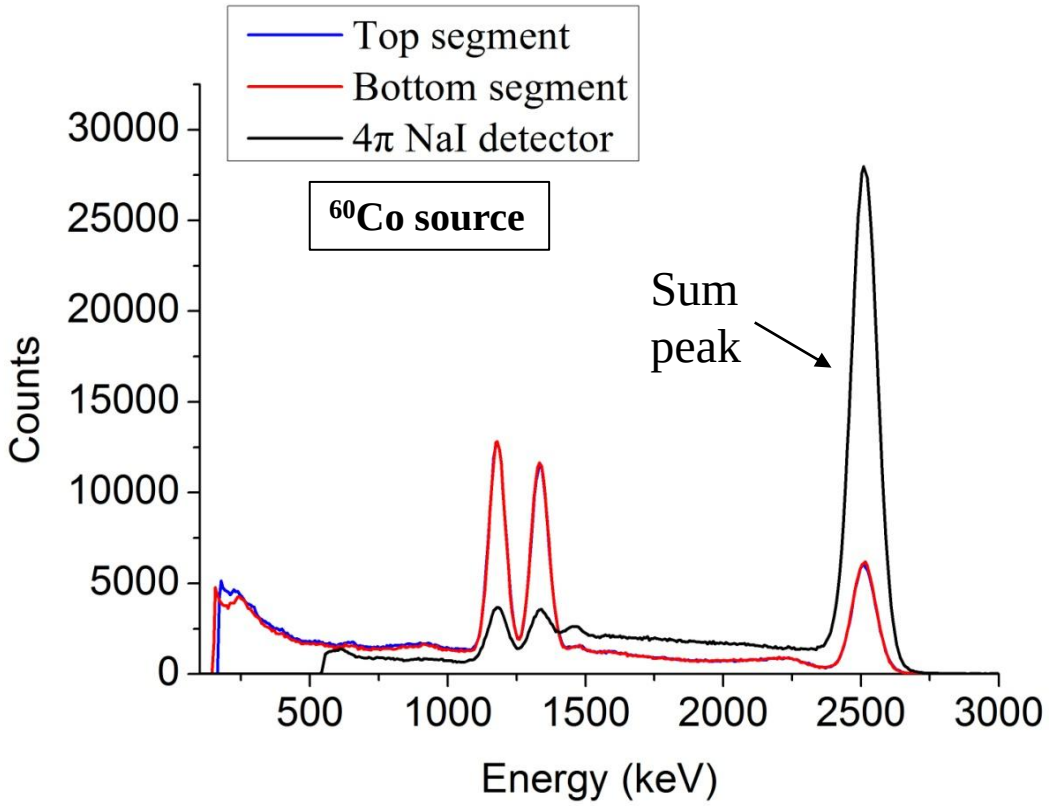


Before adjustment

After adjustment



Characteristics of the new 4π NaI detector



Resolution:
1332.5 keV → ~ 5.5%
Sum peak → ~ 4%

Efficiency of the sum peak → ~ 48%

Conclusions

- A new sum spectrometer at the TANDEM Accelerator Laboratory appropriate for astrophysical measurements
- Faster measurements
- Faster analysis procedure

Future Plans: Cross section measurements of proton capture reactions $^{66}Zn(p, \gamma)^{67}Ga$ and $^{72}Ge(p, \gamma)^{73}As$ have already scheduled.

Thank you for your attention