Alpha cluster structures in ^{212}Po: status of E693 data analysis

Álvaro FERNÁNDEZ

Instituto de Estructura de la Materia (IEM) - CSIC

June, the 28th - 2019

Motivation

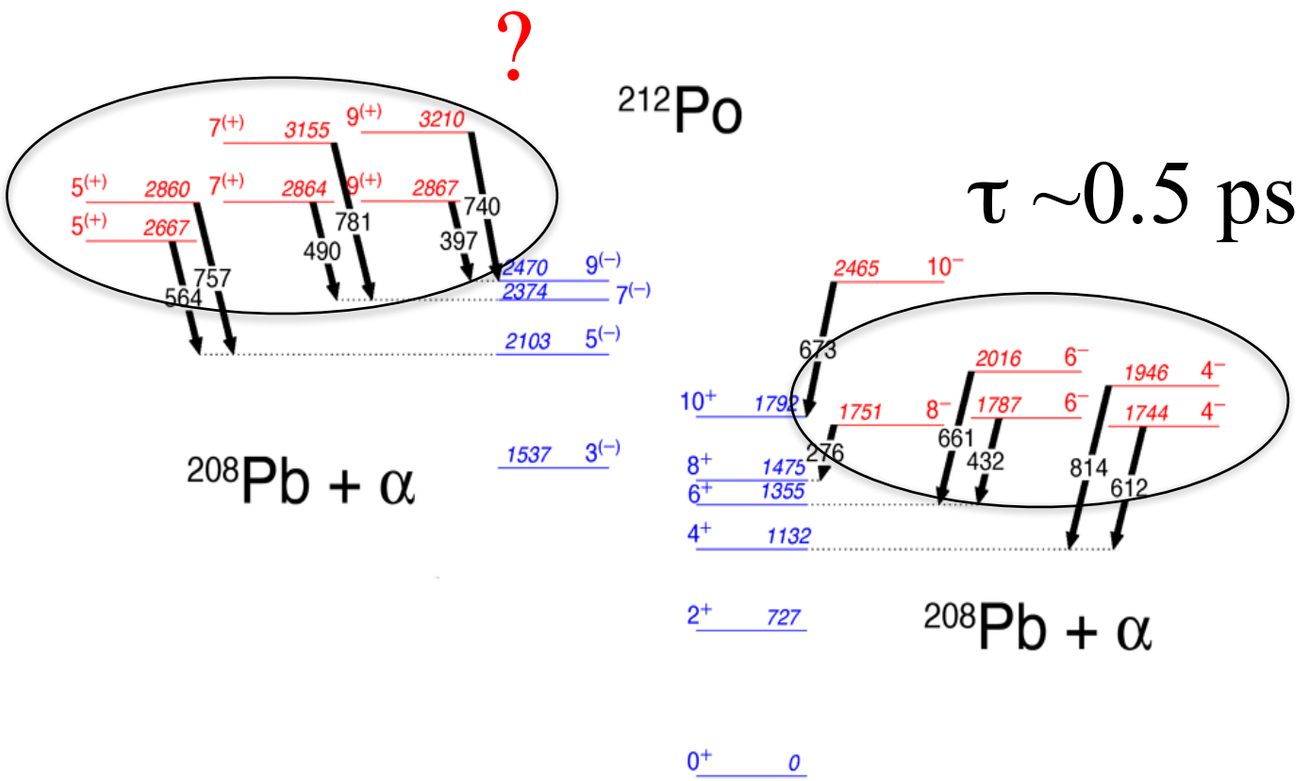
First fingerprints (~80's-90's) of α-clustering found in lifetimes of 6^+ & 8^+ and g.s. α decay width

EUROBALL experiment (2010)

$$^{18}\mathrm{O} + {}^{208}\mathrm{Pb} \longrightarrow {}^{212}\mathrm{Po} + {}^{14}\mathrm{C}$$

Normal kinematics, v/c ~ 1%, thick target

- Doublets with odd-spin, positive parity and even spin, negative parity
- Decay with large E1 strength
- Cannot be reproduced by low-lying SM configurations, interpreted as states having large amounts of alpha clustering



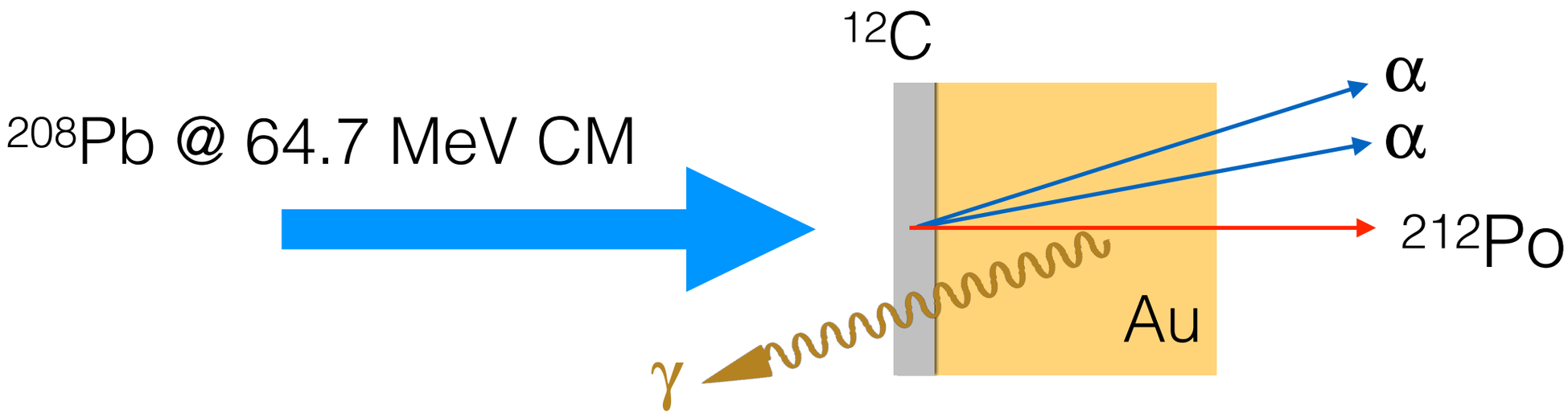
Astier et al., Eur. Phys. J. A (2010) **46**: 165-185

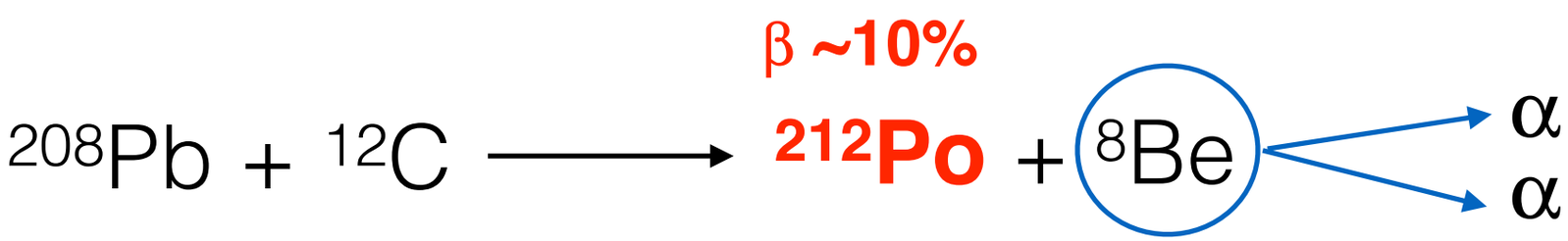
Experiment E693

Aim

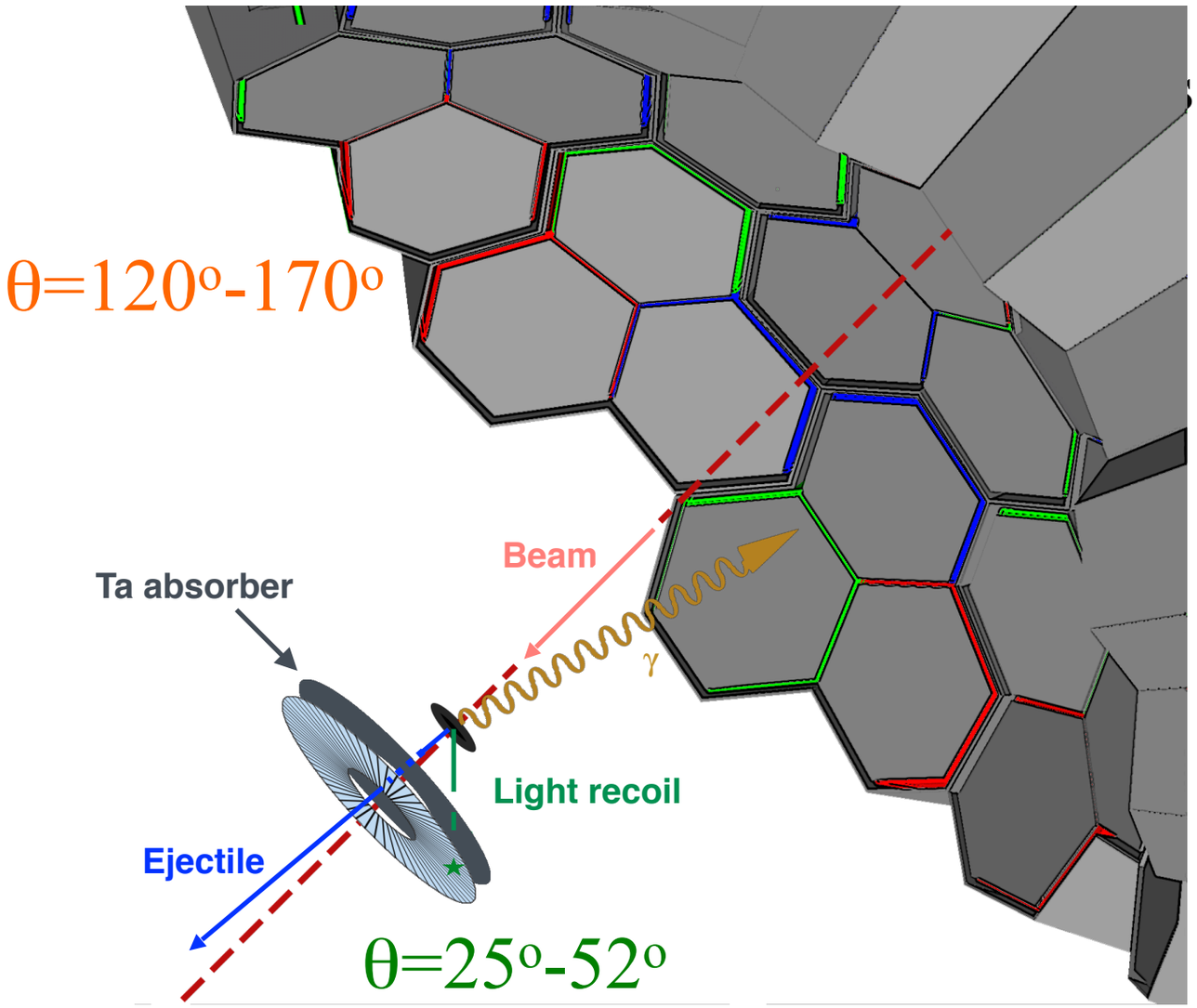
- Extension of ^{212}Po level scheme (thin target)
- Measurement of additional, in particular shorter, lifetimes (thick target)

- CVS diamond target for intensities and level scheme extension - 60 h, 30-60 enA
- Backed target (optimized for τ~0.3 ps) - 50 h, 15-30 enA

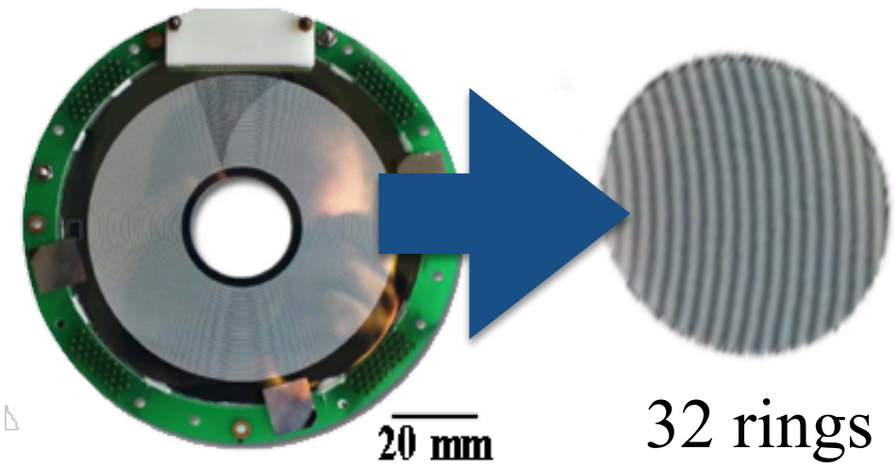


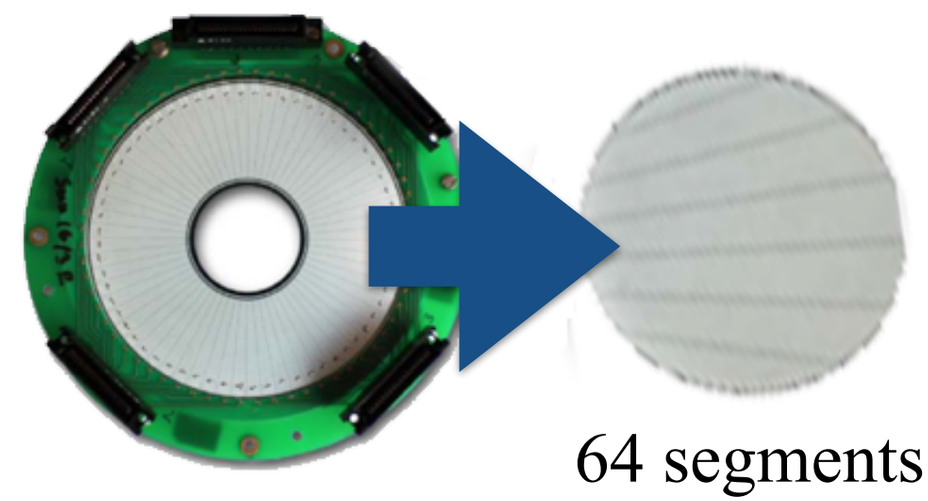


Setup



Si-DSSSD (300 μm)



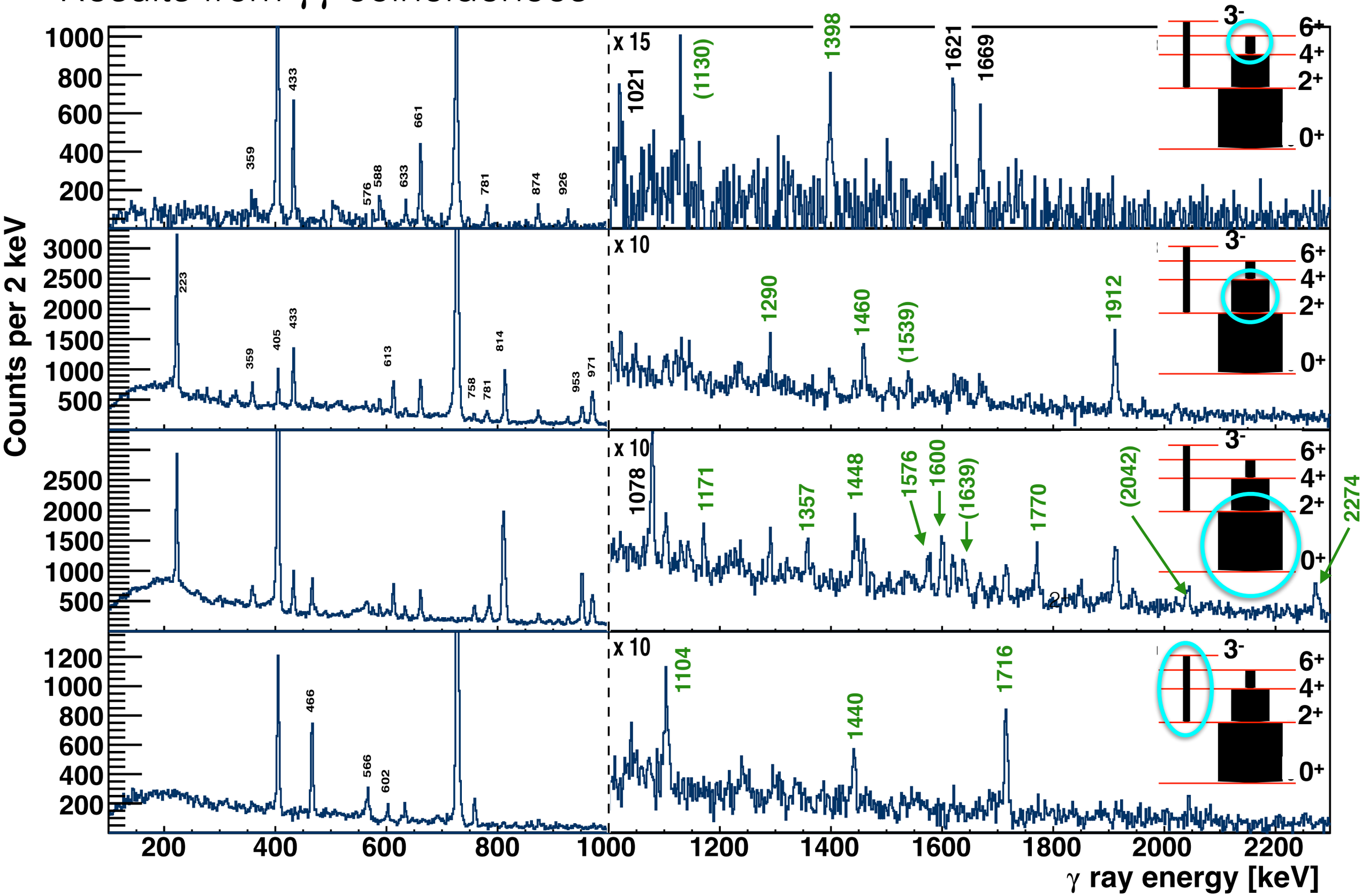


$$^{208}\mathrm{Pb} + {}^{12}\mathrm{C} \longrightarrow {}^{212}\mathrm{Po} + {}^{8}\mathrm{Be}$$

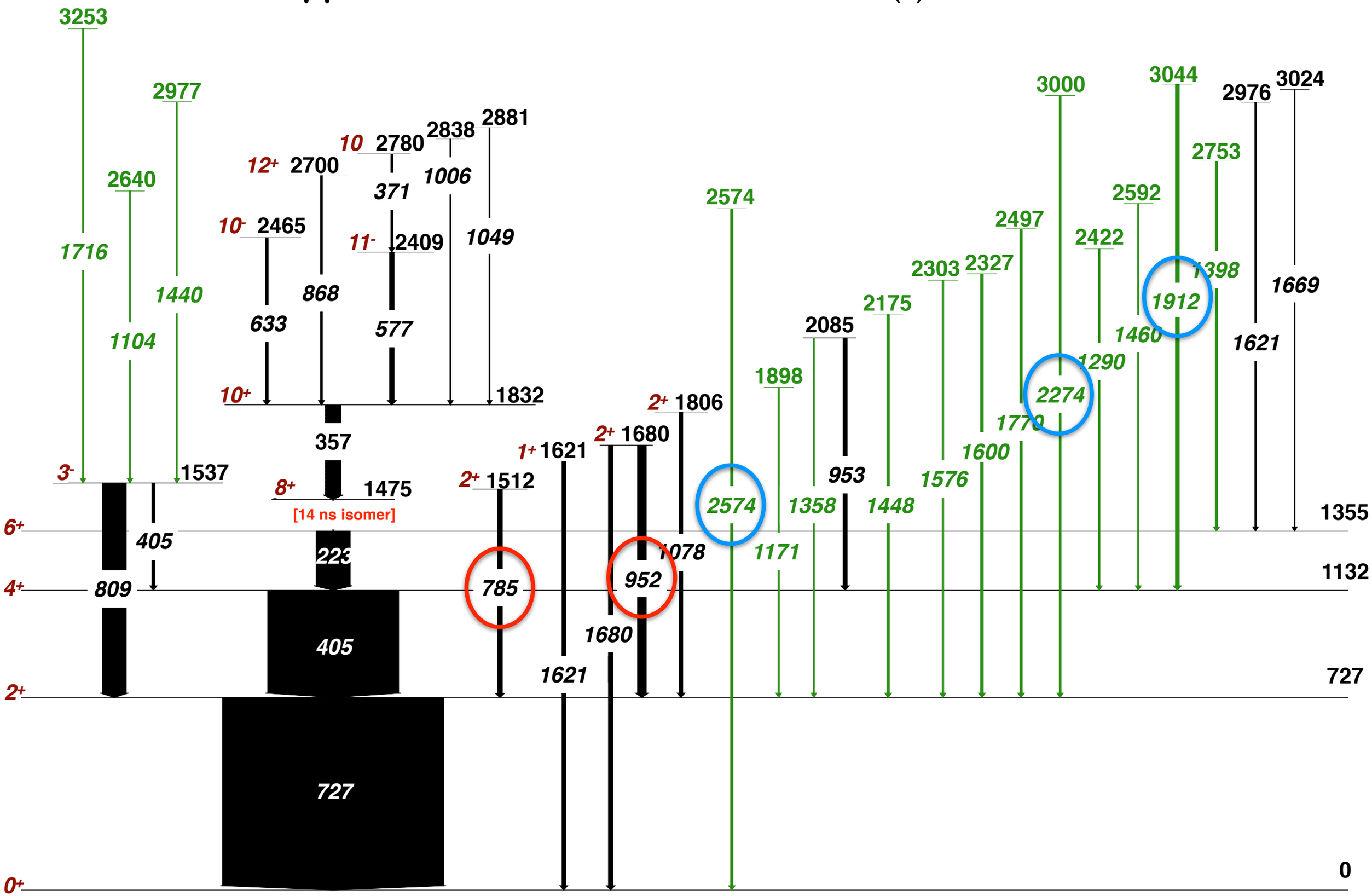
Trigger: pγγ

High rate of elastic ^{12}C recoils expected => need to protect the DSSSD with a multilayered Ta absorber

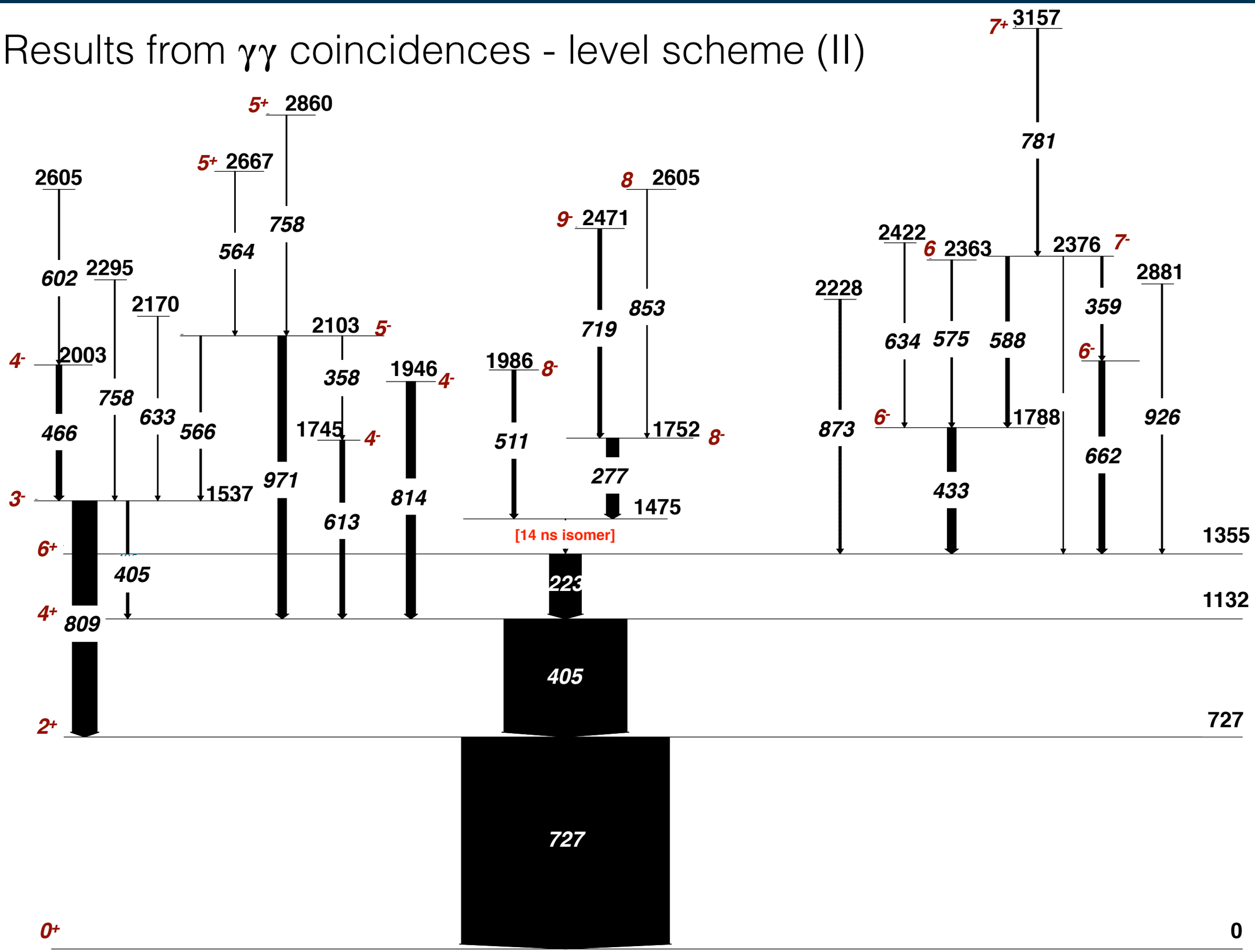
Results from γγ coincidences



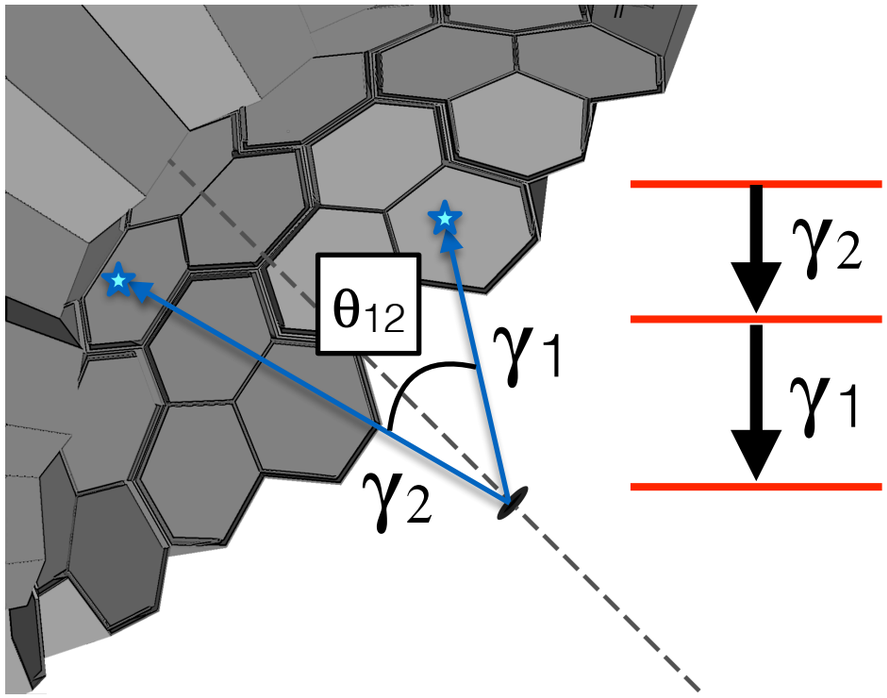
Results from γγ coincidences - level scheme (I)



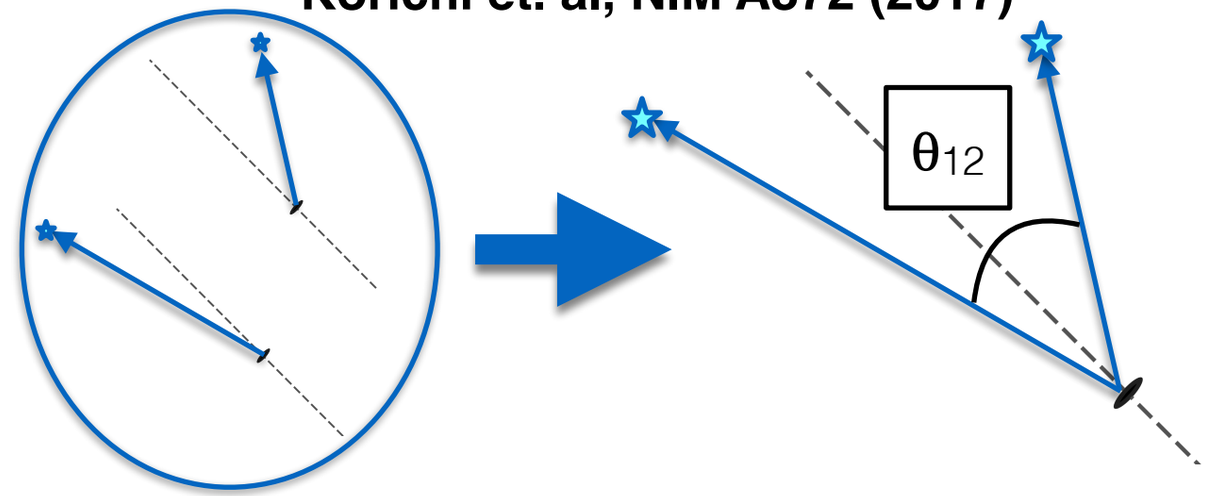
Results from γγ coincidences - level scheme (II)



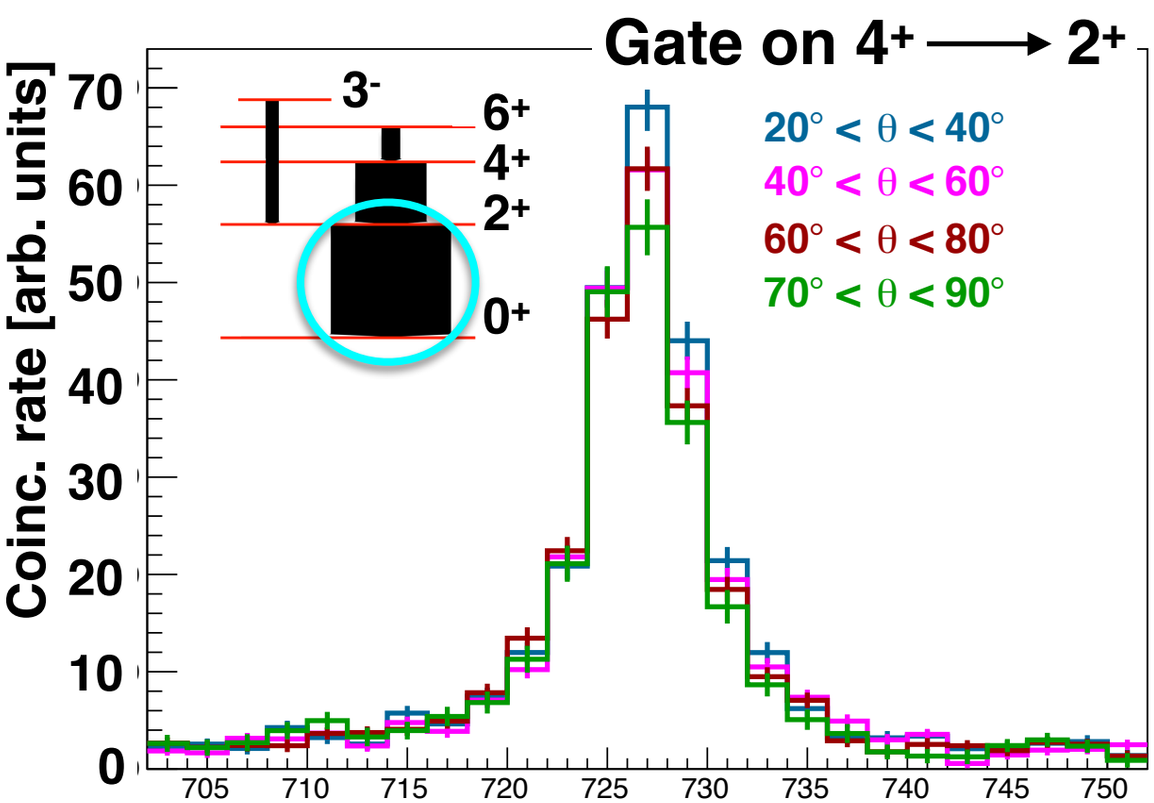
Angular correlations - event mixing technique

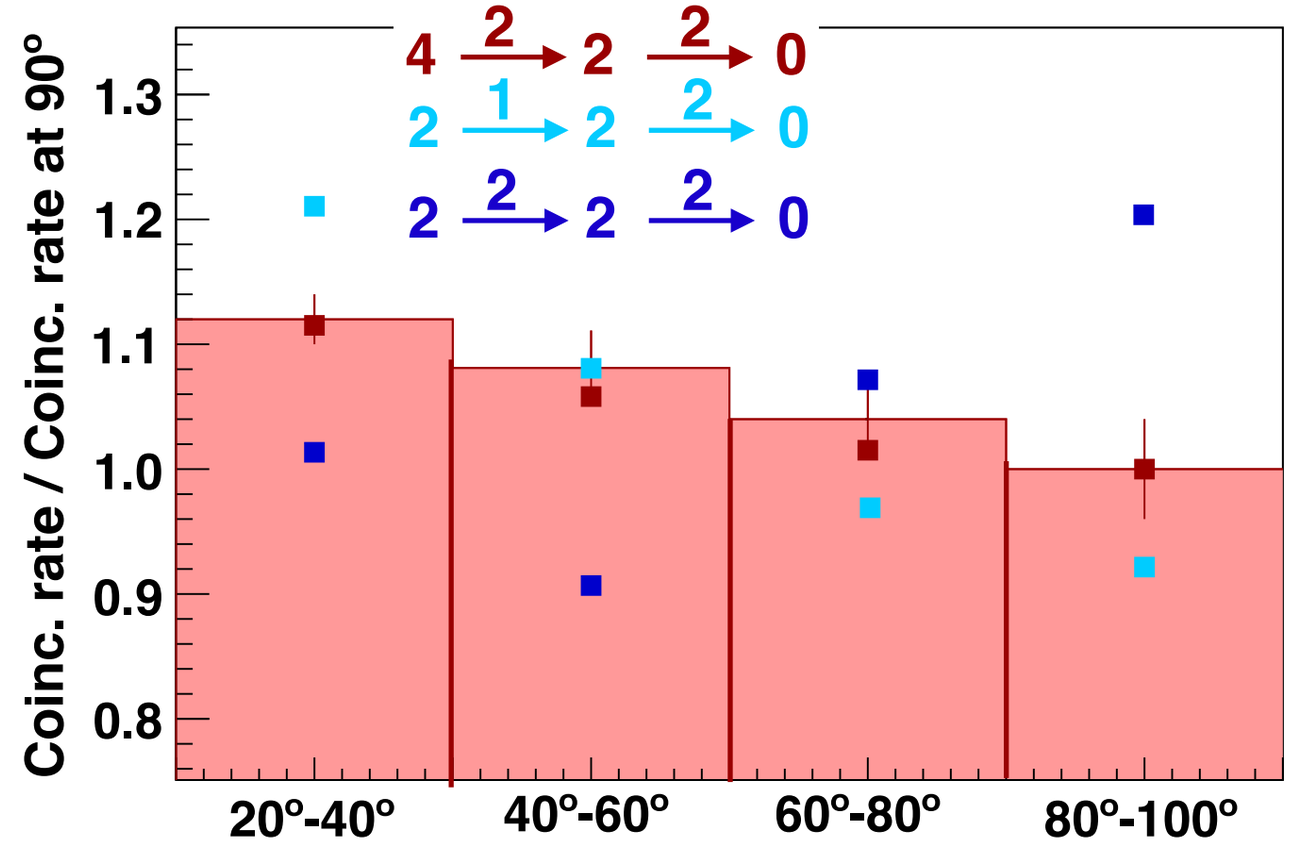


Smith et. al, NIM A922 (2019)
Korichi et. al, NIM A872 (2017)

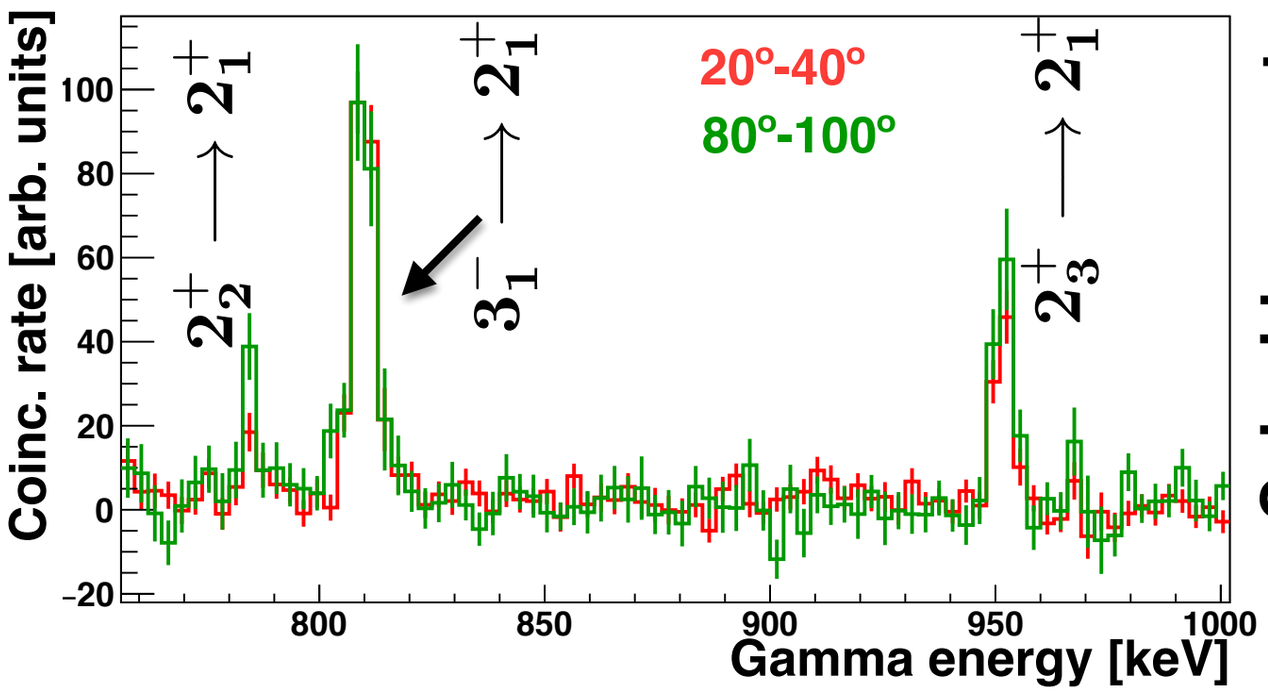


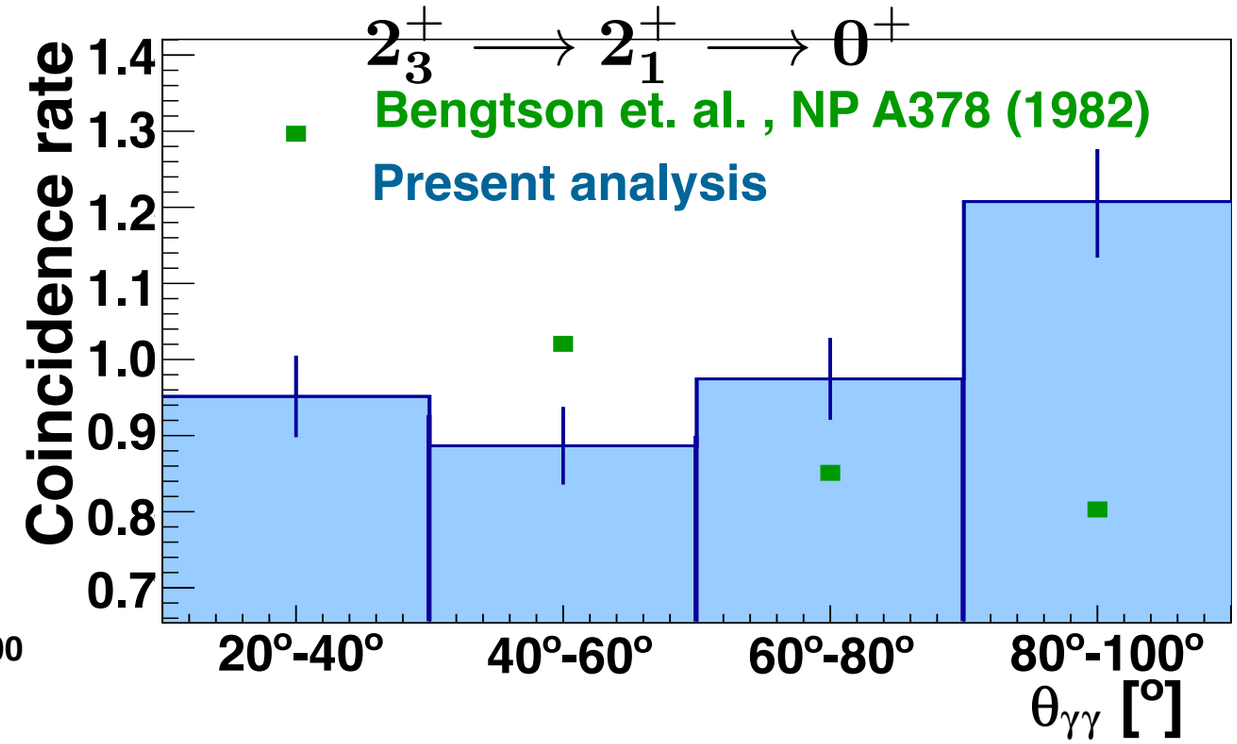
Uncorrelated γ's from ^{152}Eu source merged for calibrating $\theta_{\gamma\gamma}$

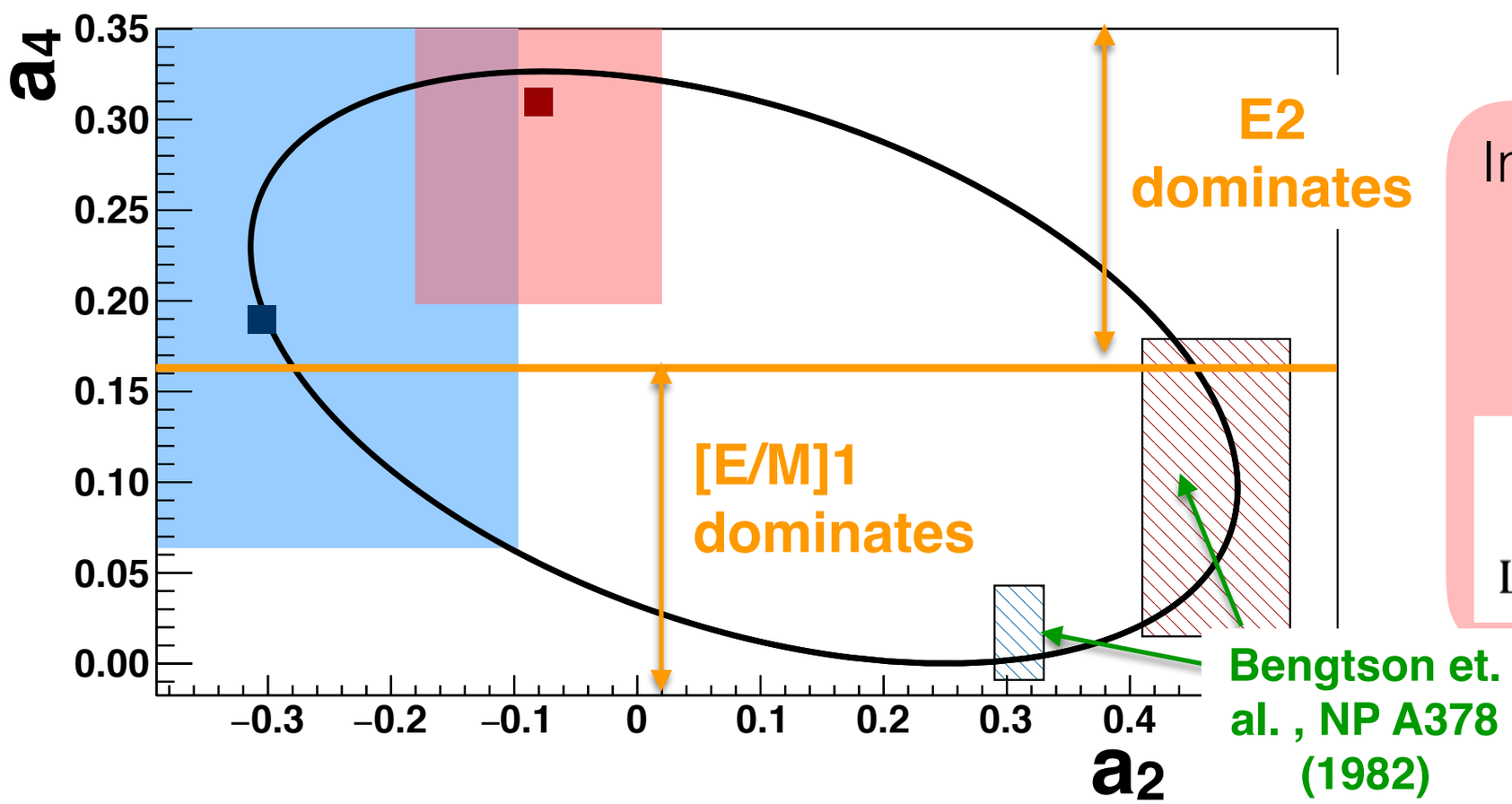




Results for multipolarity of $2_2^+ \longrightarrow 2_1^+$ and $2_3^+ \longrightarrow 2_1^+$ transitions





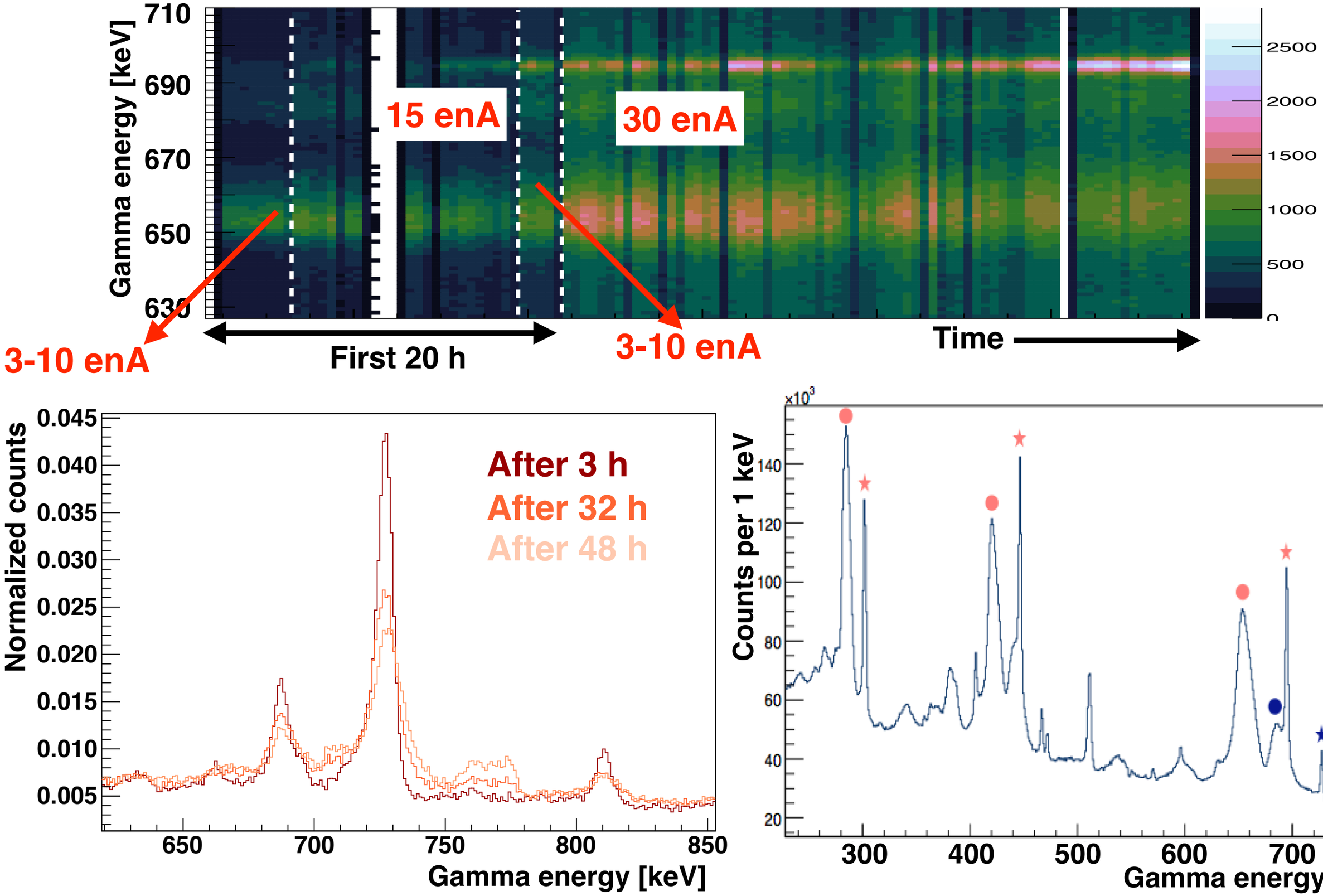


Interpreted in previous work as fragments of the MSS based on their sizeable M1 decay to the 2_1^+

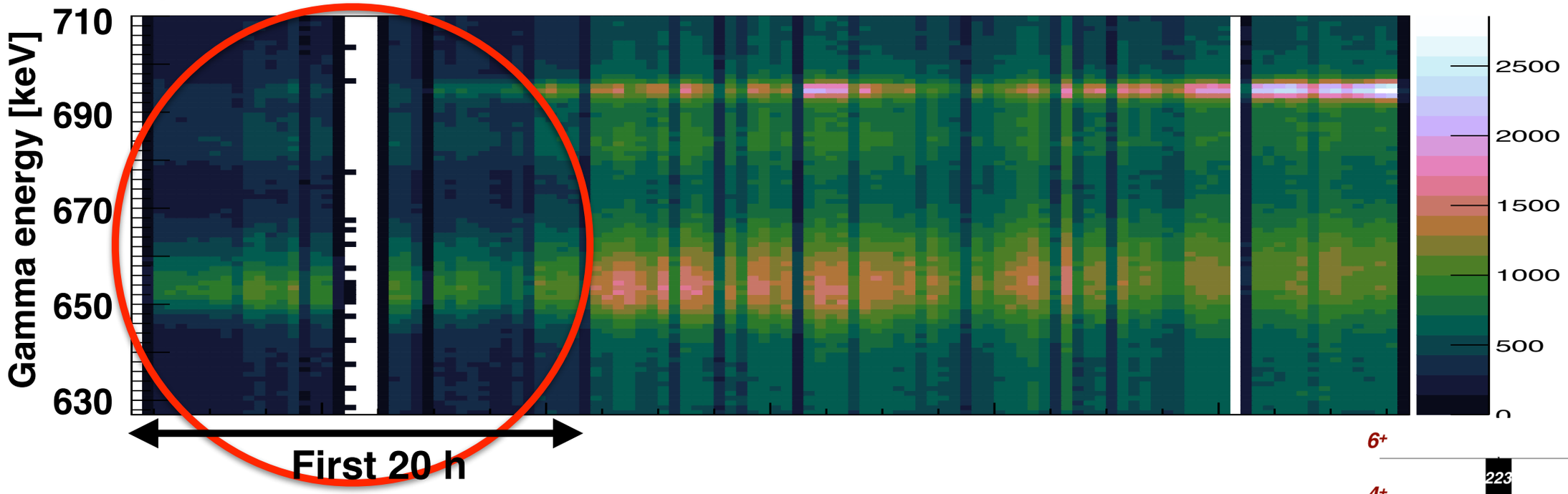
PHYSICAL REVIEW C **93**, 011303(R) (2016)

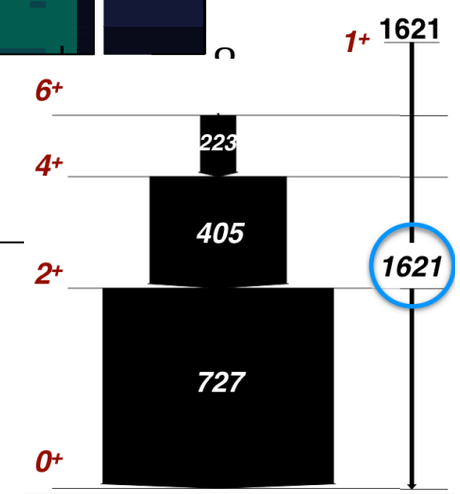
Low-lying isovector 2^+ valence-shell excitations of ^{212}Po

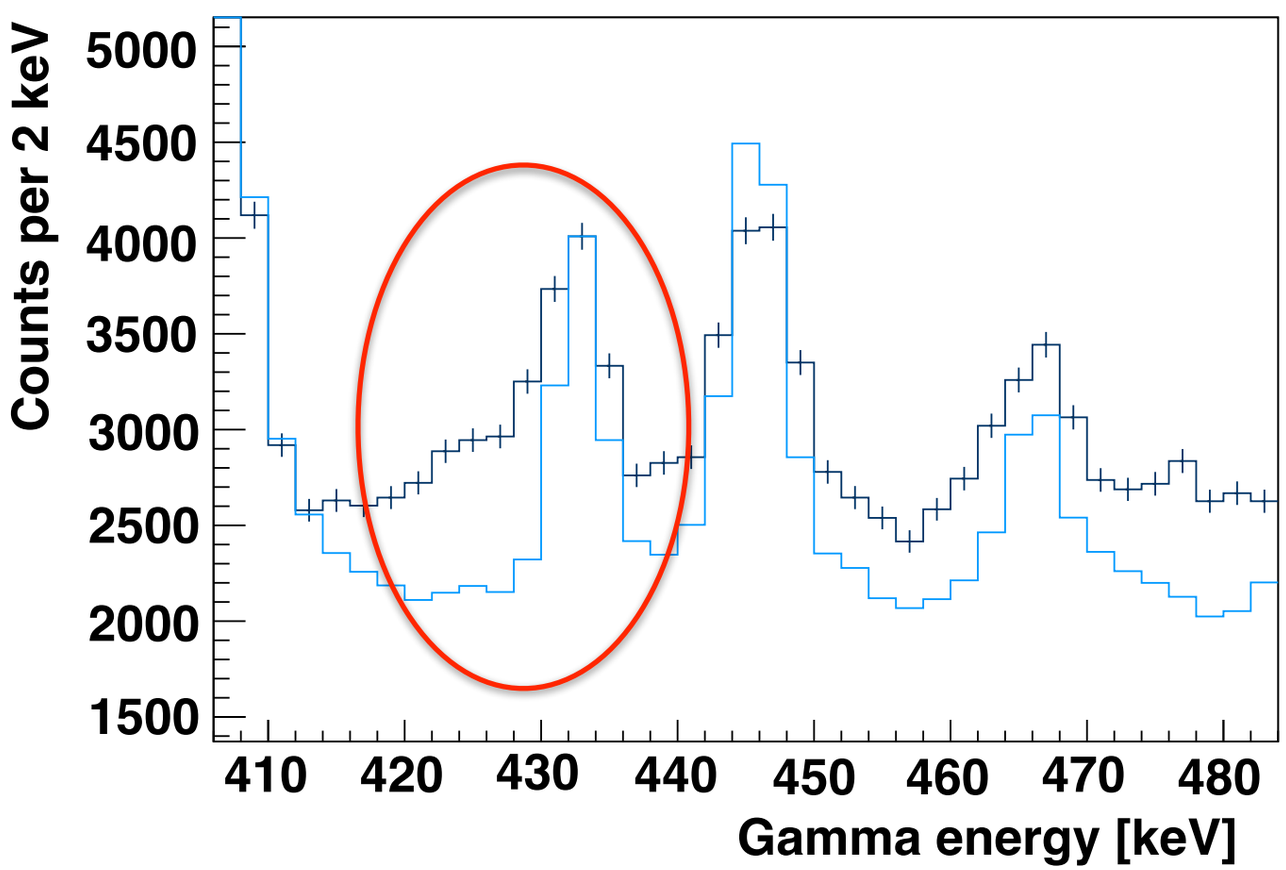
Thick target - data analysis

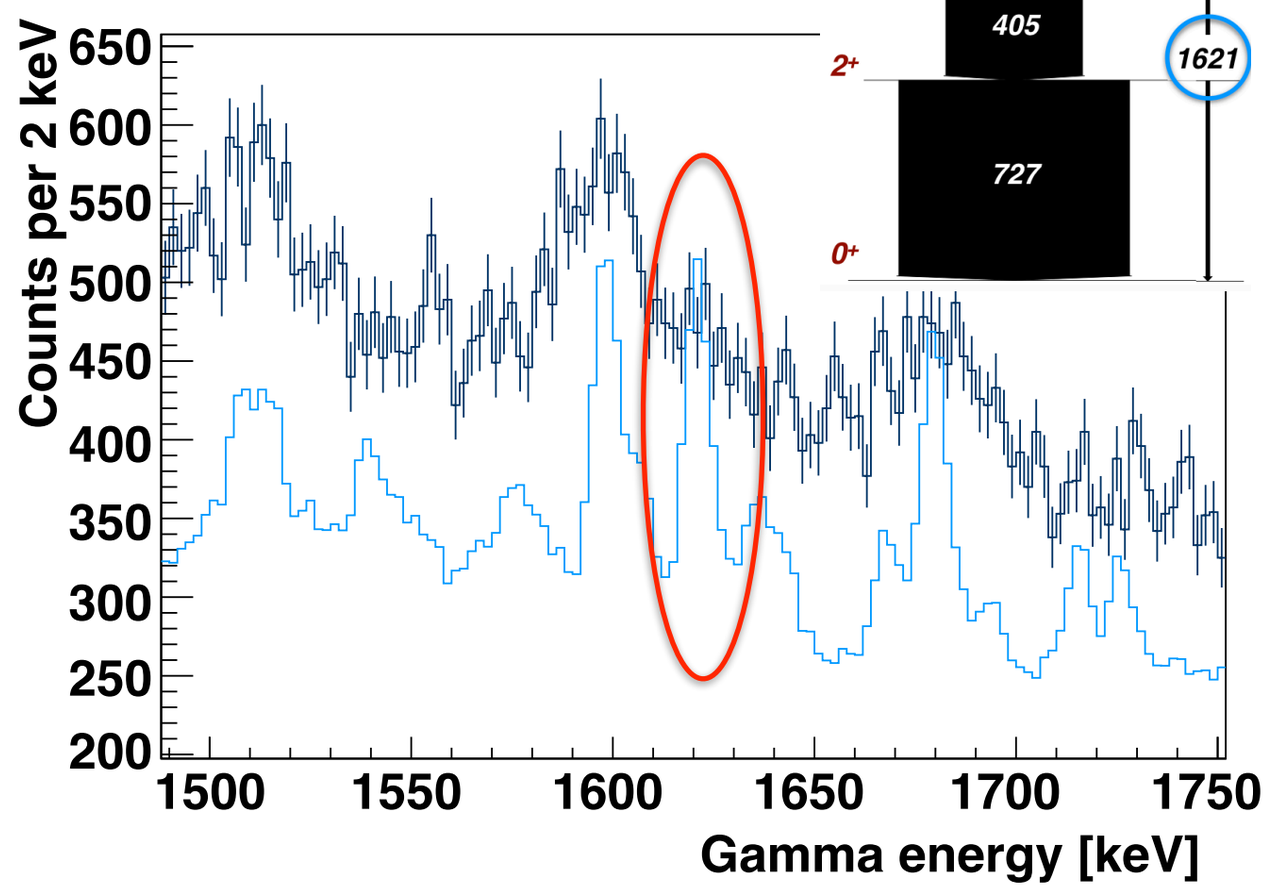


Thick target - data analysis

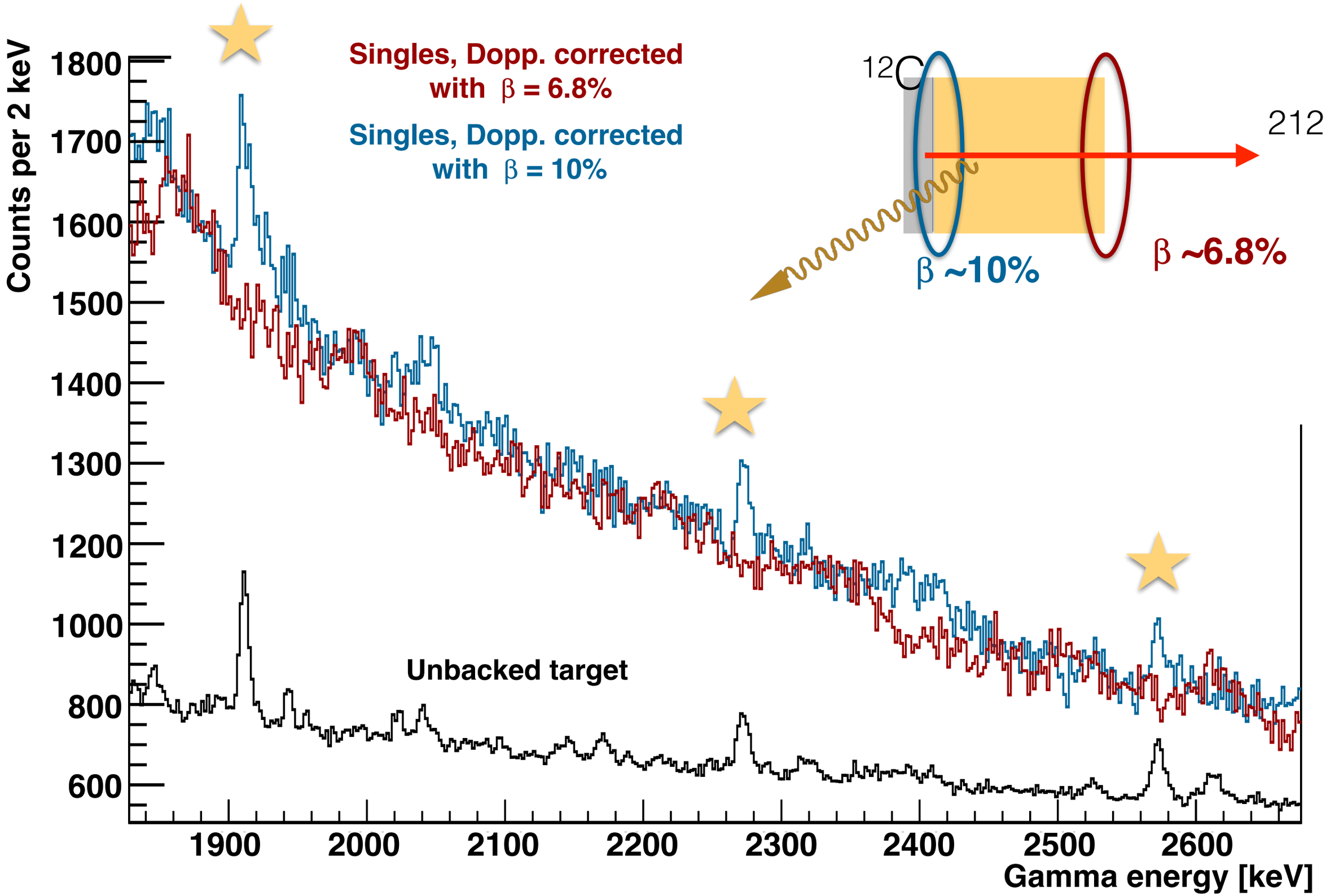




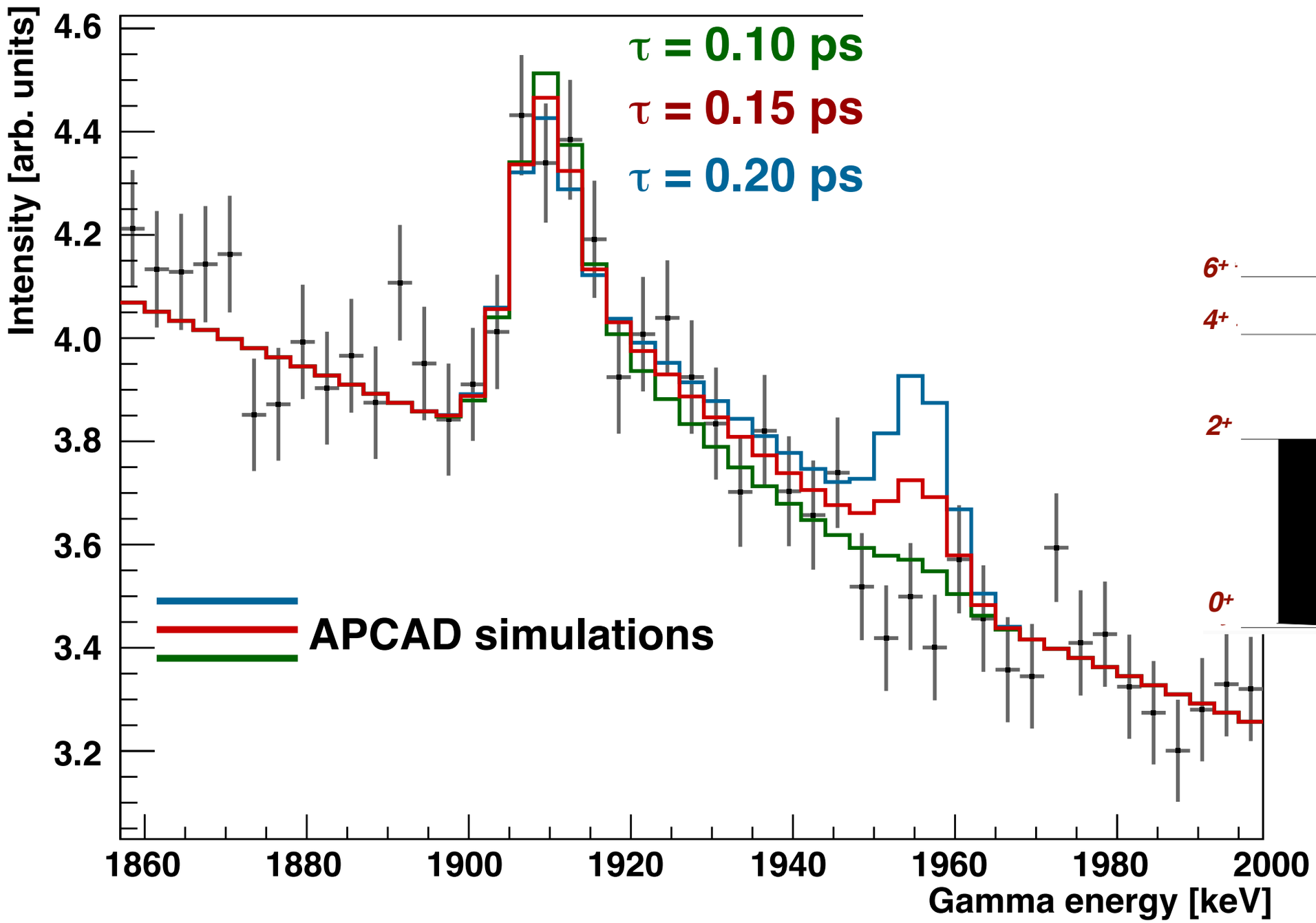


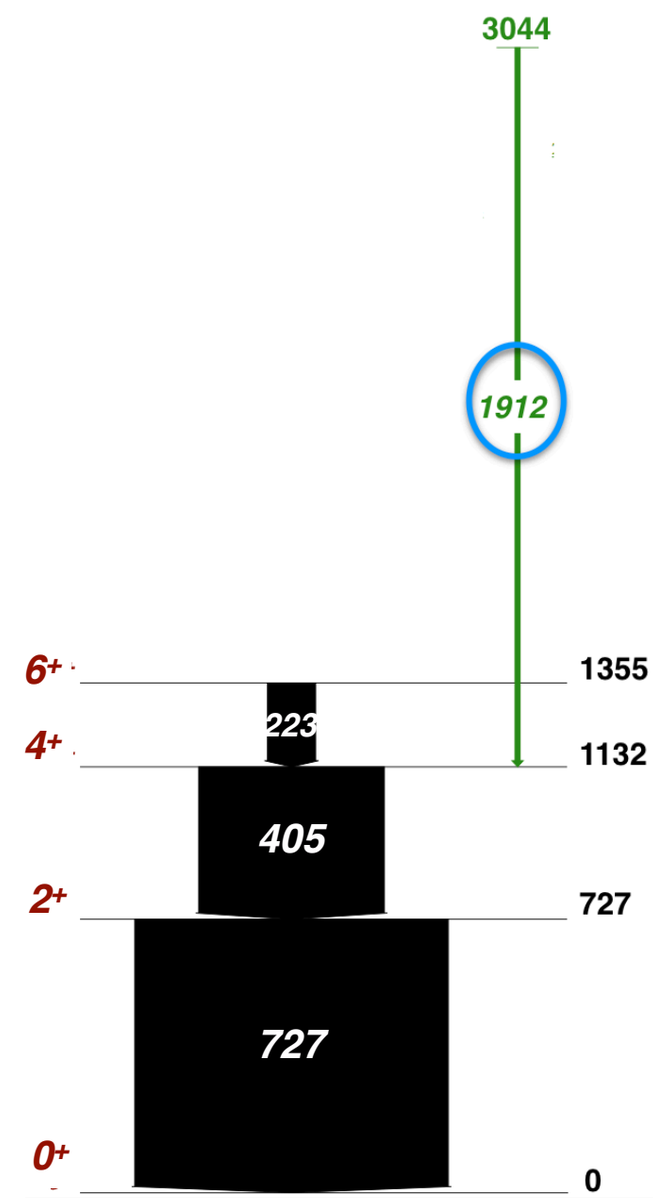


Thick target - short lifetimes

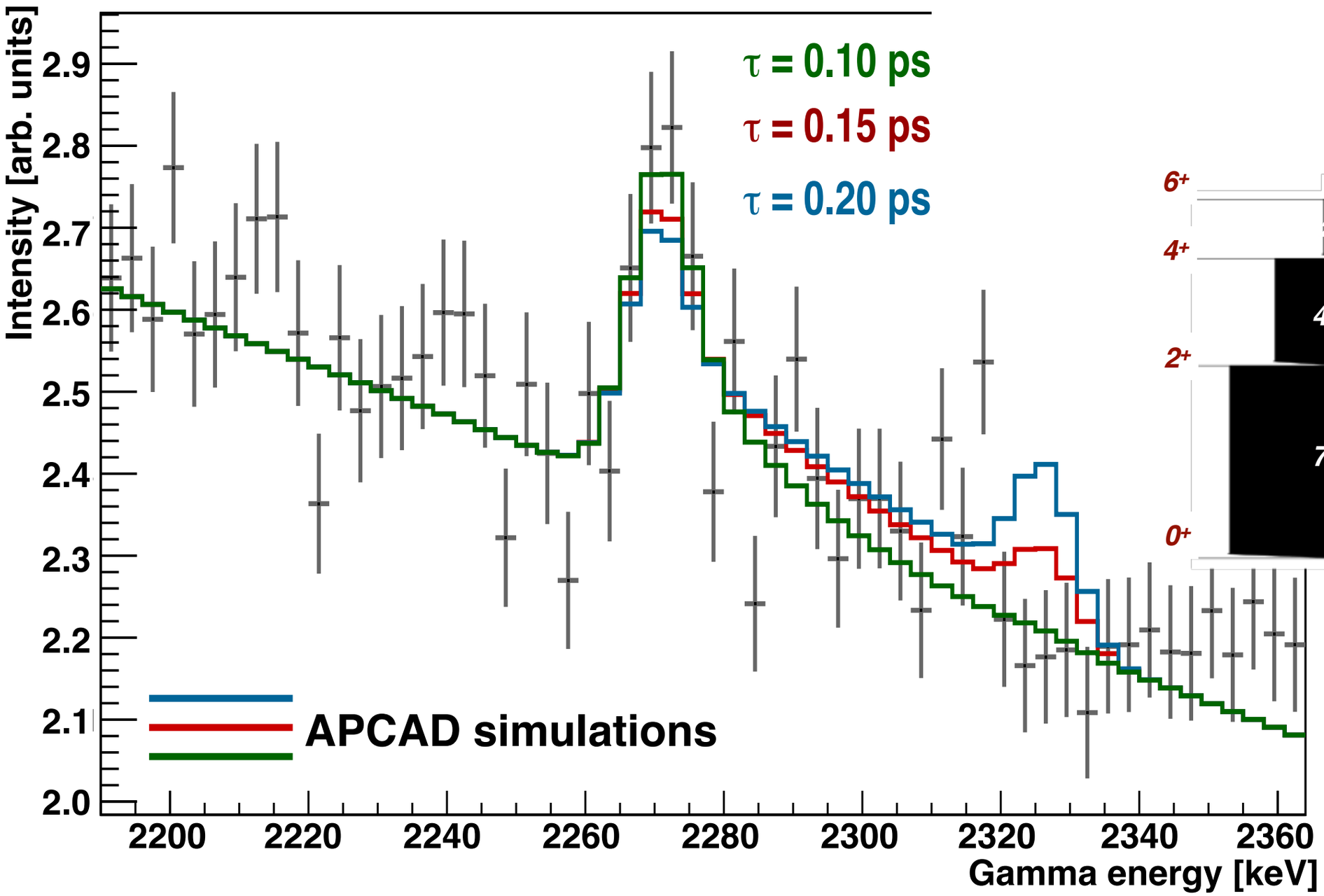


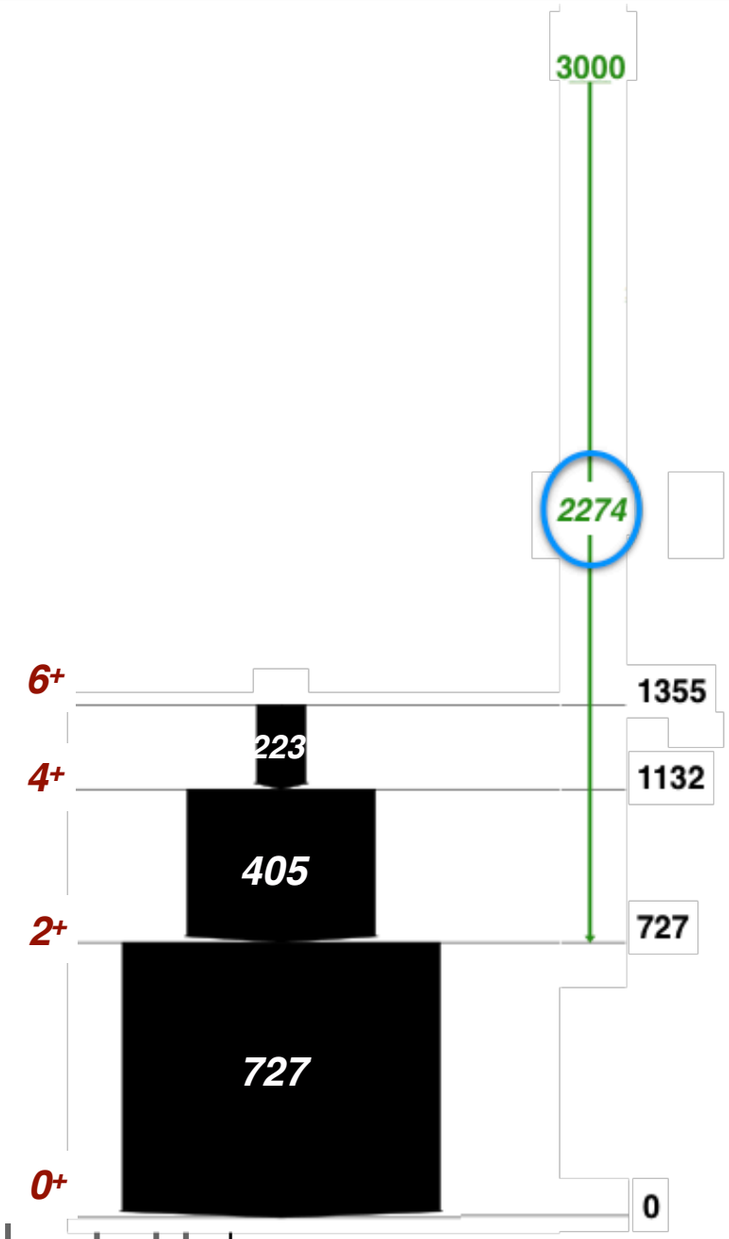
Thick target - upper limits for short lifetimes





Thick target - upper limits for short lifetimes





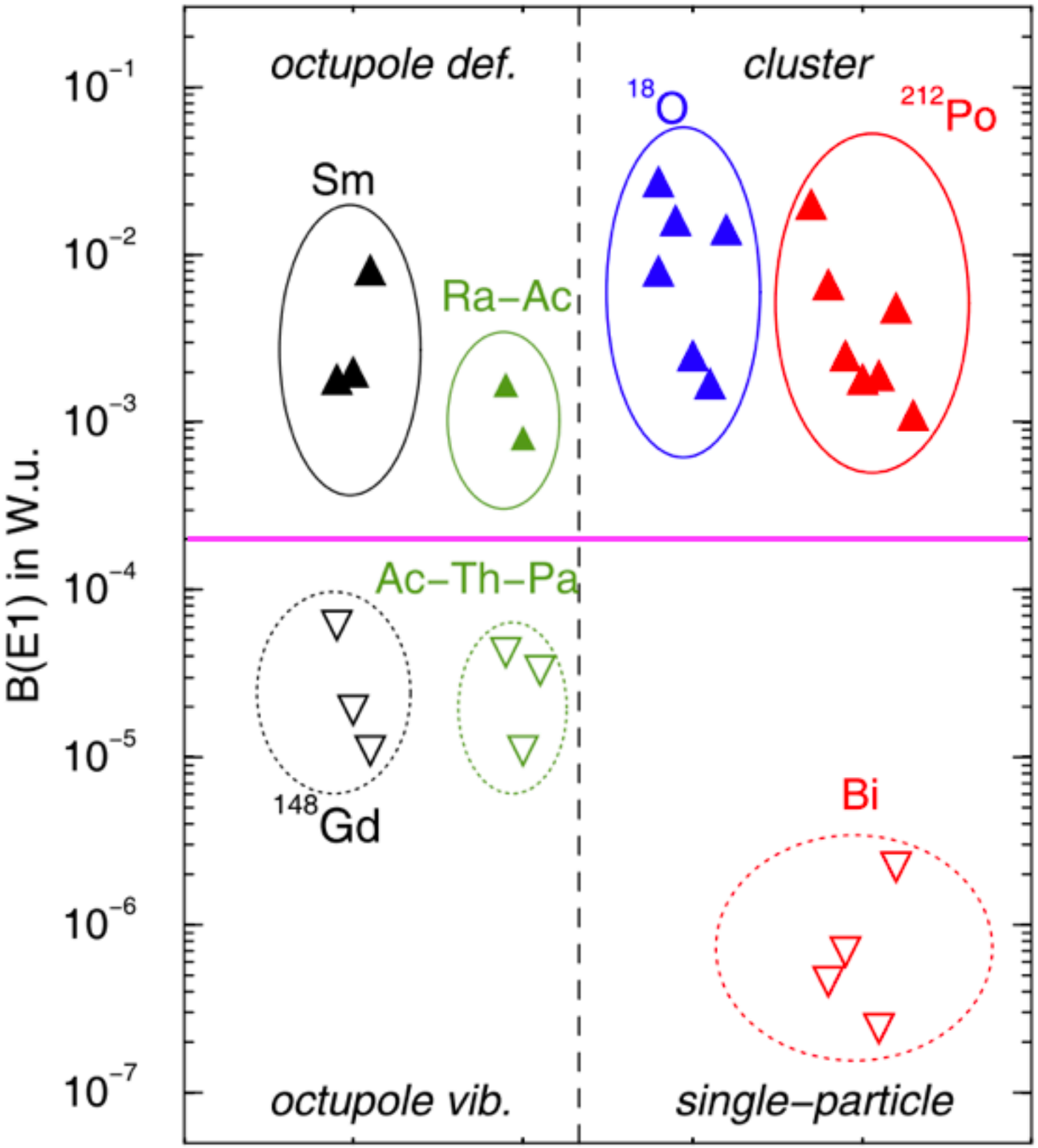
Conclusions

- **Determined level scheme and intensity pattern**
  → **New spectroscopic information obtained**

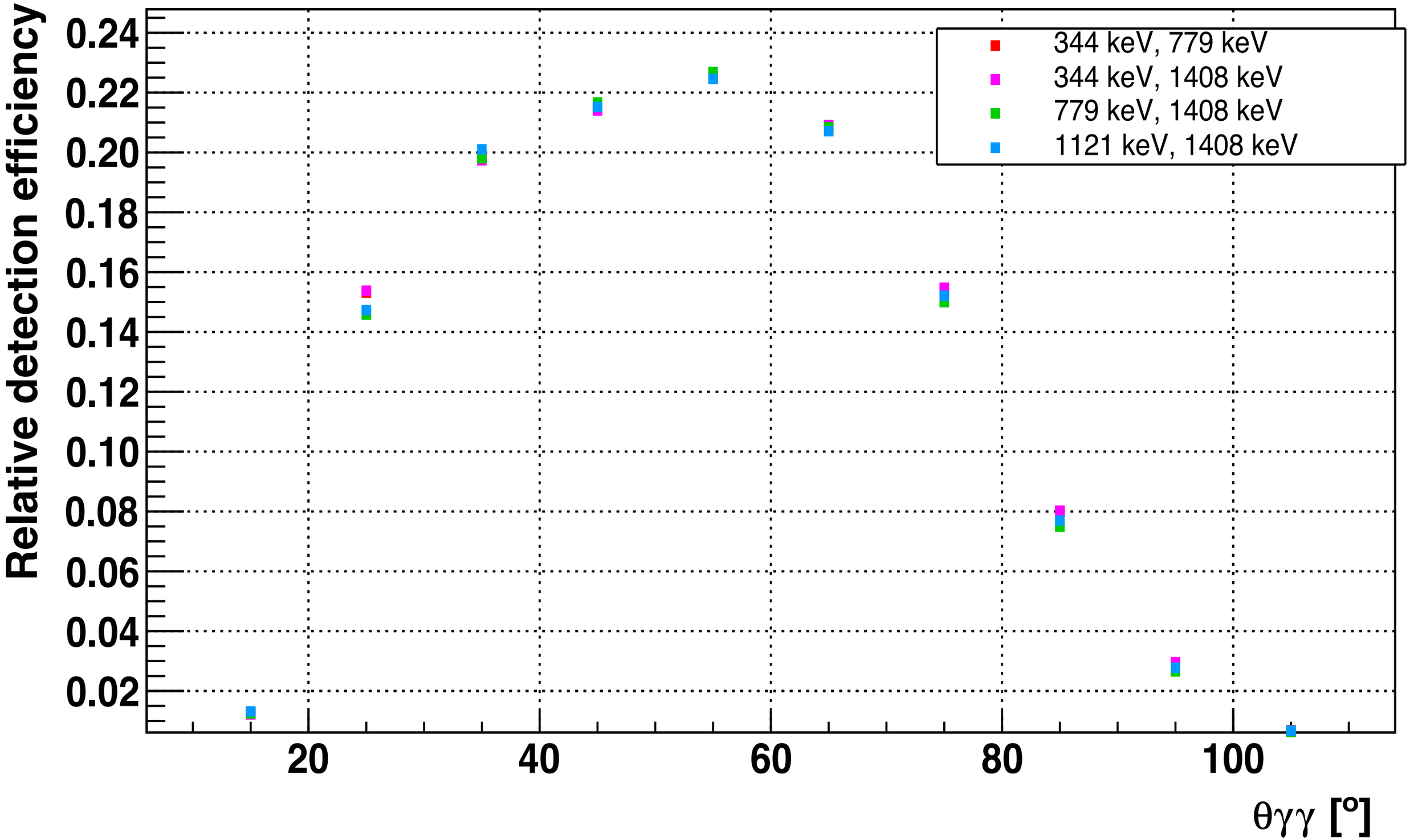
- **Are the 2_2^+ and 2_3^+ states really fragments of the MSS?**
  → **Interpretation not clear from the multipolarity of $2_2^+ \longrightarrow 2_1^+$ and $2_3^+ \longrightarrow 2_1^+$**

- **Found 3 short lived γ-ray transitions**
  → **Extracted upper limits**

Modified from Astier et al., Eur. Phys. J. A (2010) 46: 165-185



Lower limits for the B(E1) in this work


Relative detection efficiency
0.24
0.22
0.20
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
20
40
60
80
100
θγγ [º]
344 keV, 779 keV
344 keV, 1408 keV
779 keV, 1408 keV
1121 keV, 1408 keV