

Study of proton-induced excitations of ^{208}Pb using the KRATTA, LaBr_3 and PARIS setup at CCB IFJ PAN



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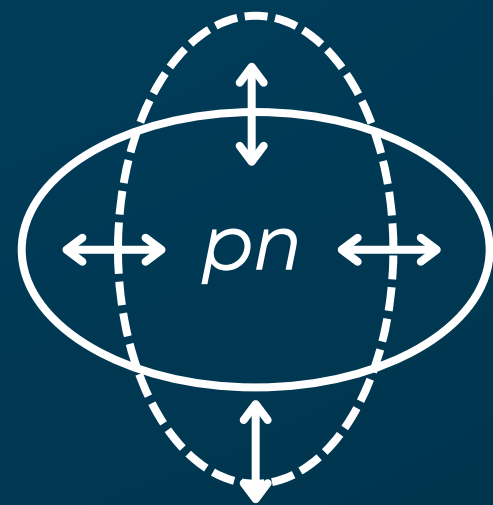
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γ decay of the ISGQR in ^{208}Pb

ISGQR

IsoScalar Giant
Quadrupole Resonance

$$L = 2, \Delta S = 0, \Delta T = 0$$



Why ^{208}Pb ?

- Existing benchmark for ISGQR γ decay
- Previous measurements with heavy ions and protons
- Validation of the experimental method
- Reference for studies of other nuclei

Why measure its γ decay?

Rare but structure-sensitive decay channel

$$B_\gamma \sim 10^{-4}$$

Branching ratios to the ground and excited states carry information on the ISGQR structure

1989

$^{208}\text{Pb}(^{17}\text{O}, ^{17}\text{O}'\gamma)$ @ 381 MeV
Beene et al.

2022

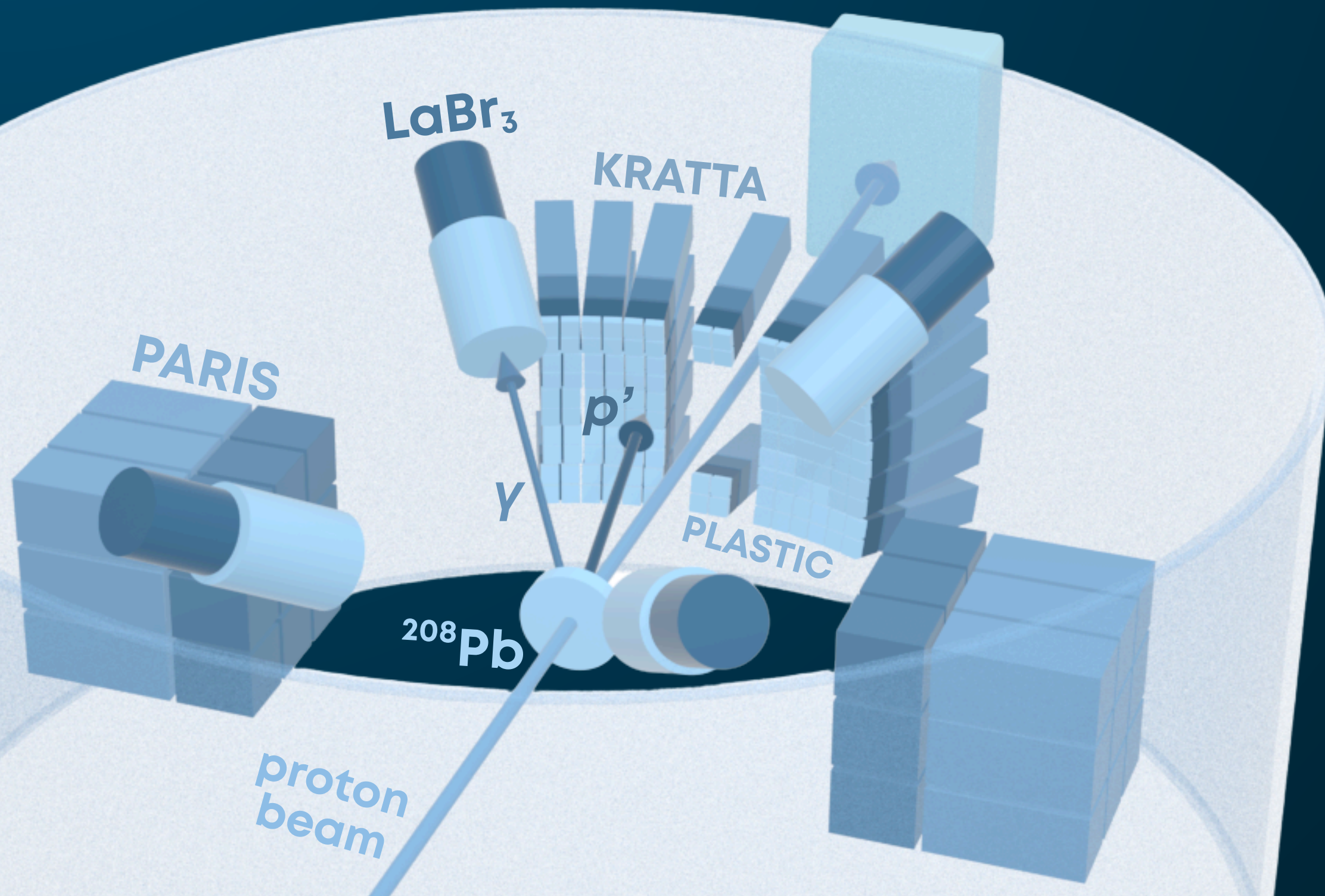
$^{208}\text{Pb}(p, p'\gamma)$ @ 85 MeV
Wasilewska et al.

time

$^{208}\text{Pb}(p, p'\gamma)$ @ 155 MeV
this work

Experimental setup at CCB IFJ PAN

$^{208}\text{Pb}(p,p'\gamma)$, $E_p = 155 \text{ MeV}$



KRATTA

- 32 telescopes
- $\theta \approx 8^\circ - 26^\circ$
- scattered proton identification
- proton energy and scattering angle

4 $\text{LaBr}_3(\text{Ce})$ detectors

- $\theta \approx 45^\circ$
- high energy & timing resolution
- precise γ -ray spectroscopy

2 PARIS clusters

- $\theta \approx 90^\circ$
- high efficiency for high-energy γ rays

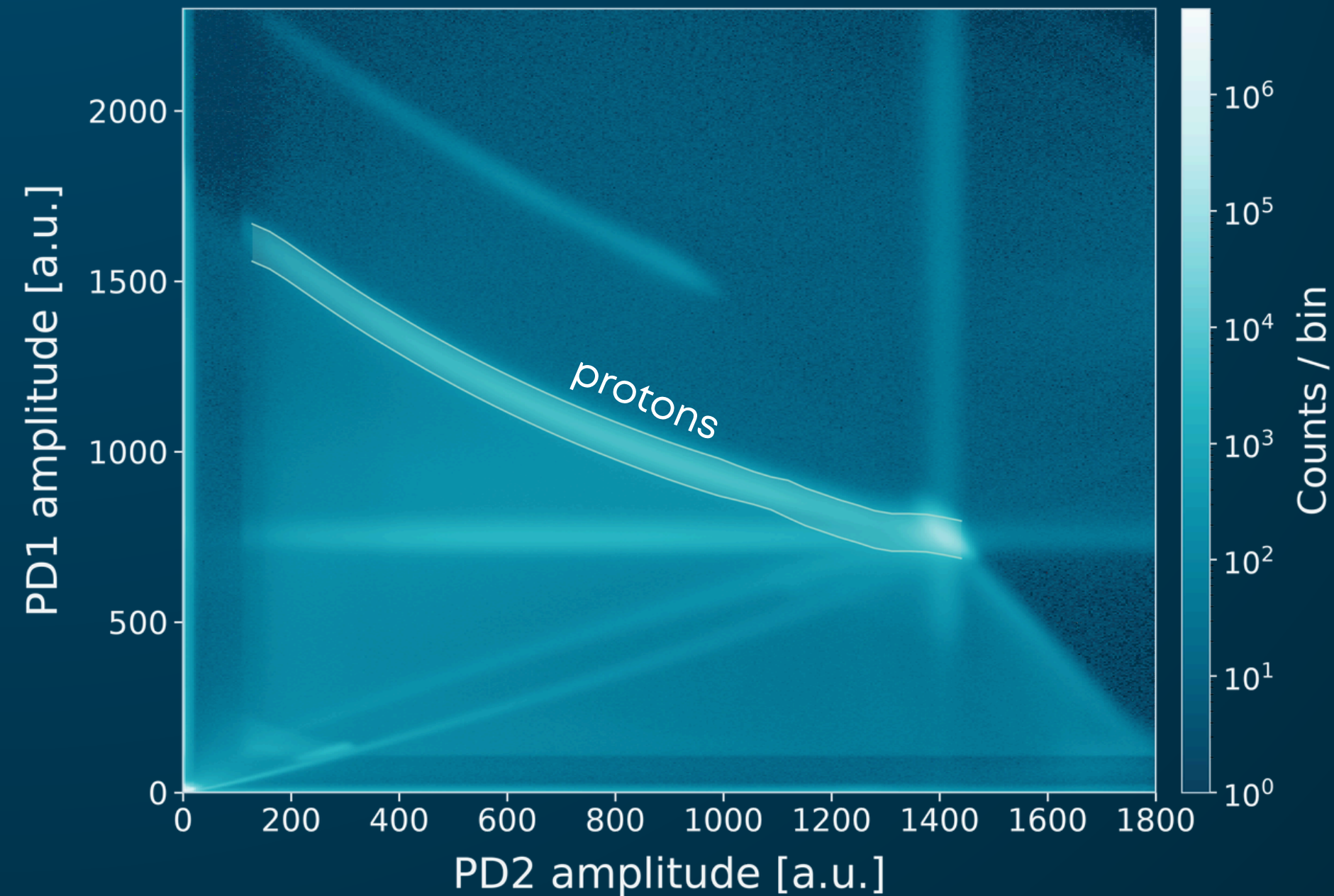
$p' \rightarrow \text{KRATTA} \rightarrow E_x$

$\gamma \rightarrow \text{PARIS} + \text{LaBr}_3 \rightarrow E_y$

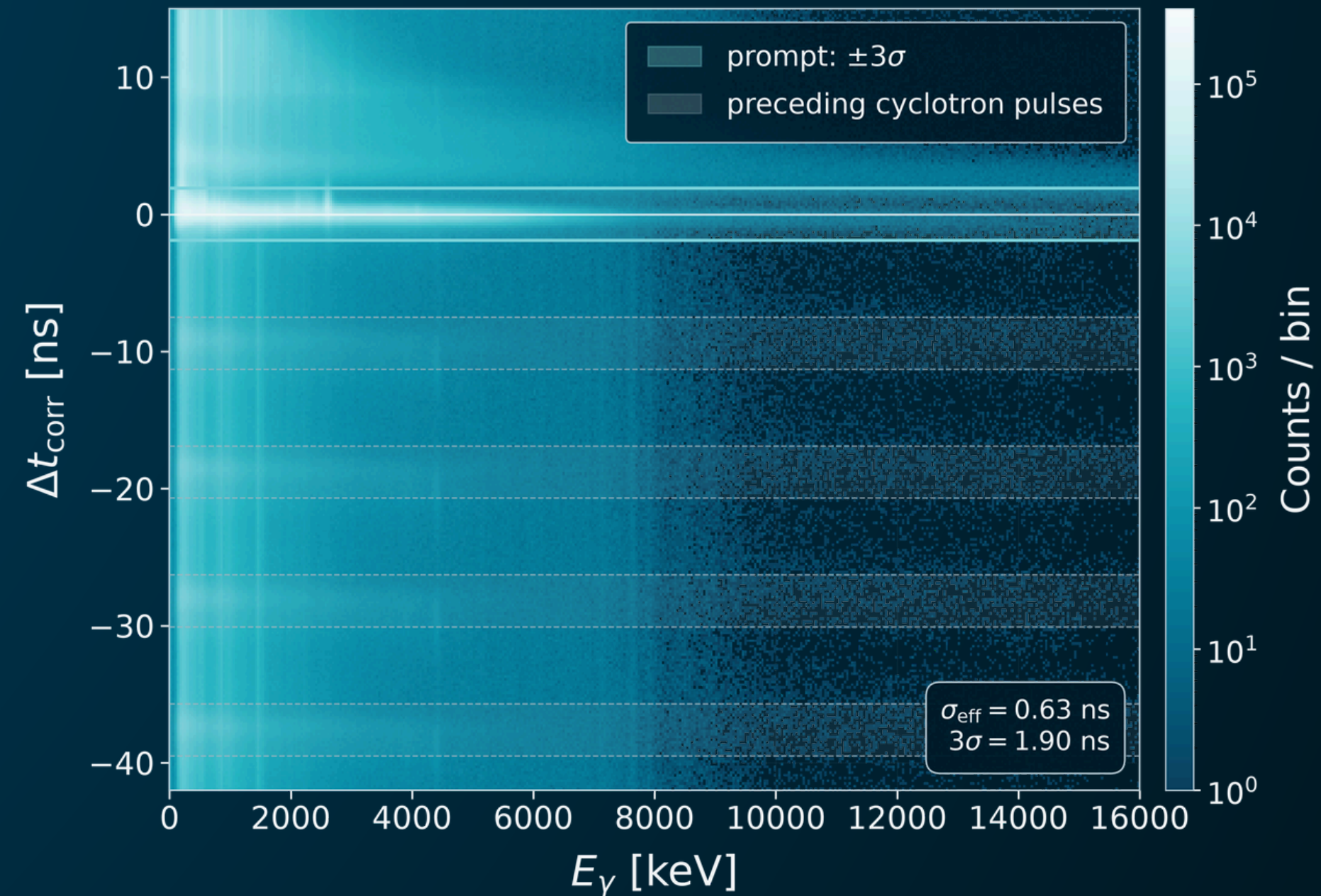
E_x - E_y correlations

Building proton-gamma coincidences

Proton identification

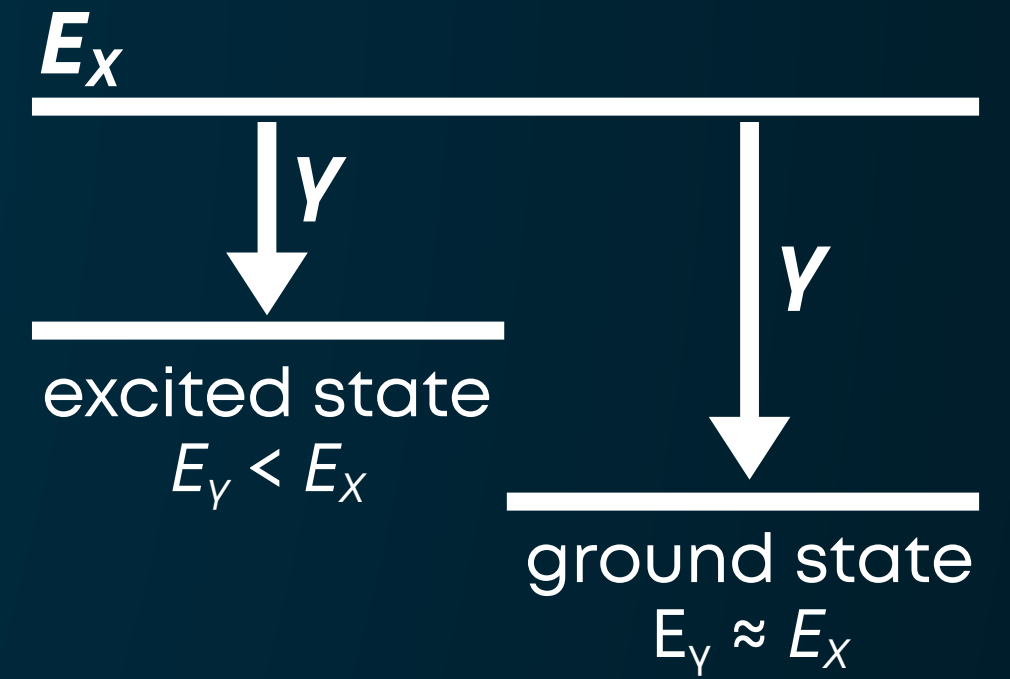
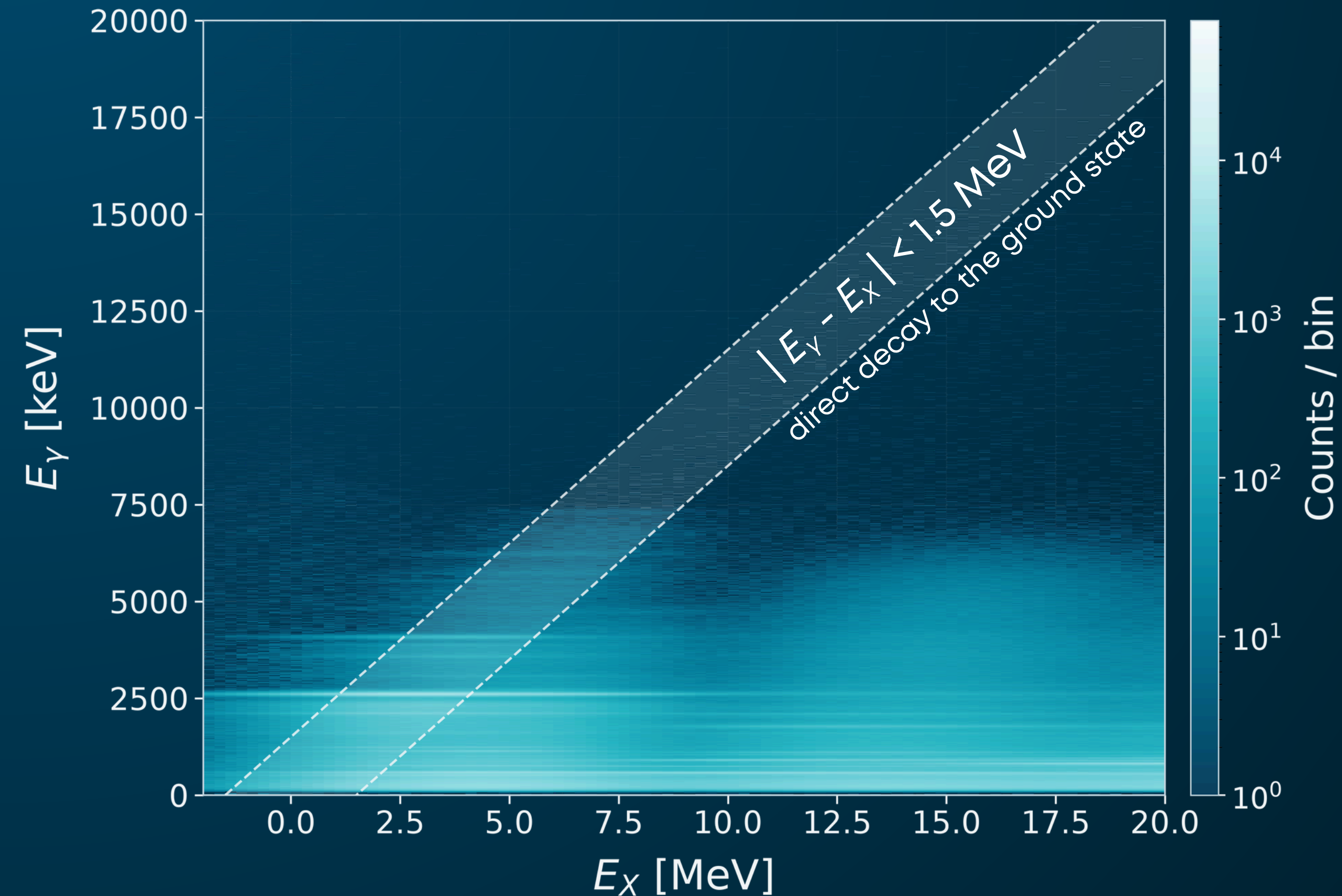


Prompt/random timing selection



Selected prompt proton- γ events are used to build the E_x - E_γ matrix

E_x - E_γ correlations

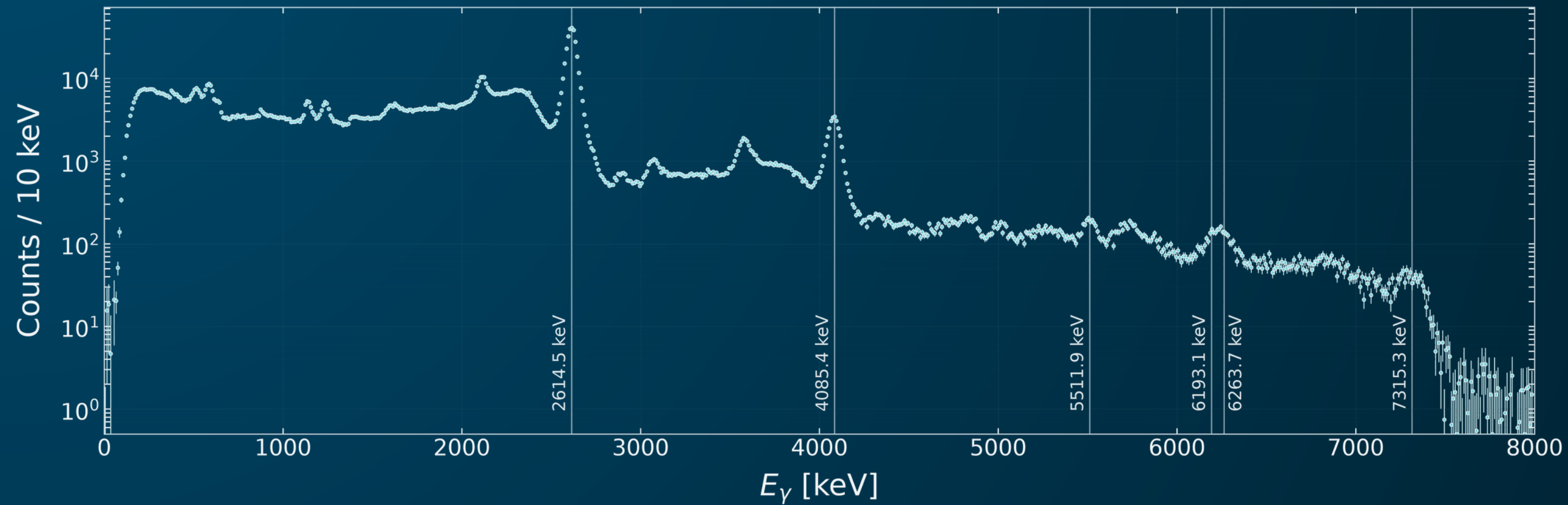


For each p' - γ coincidence:

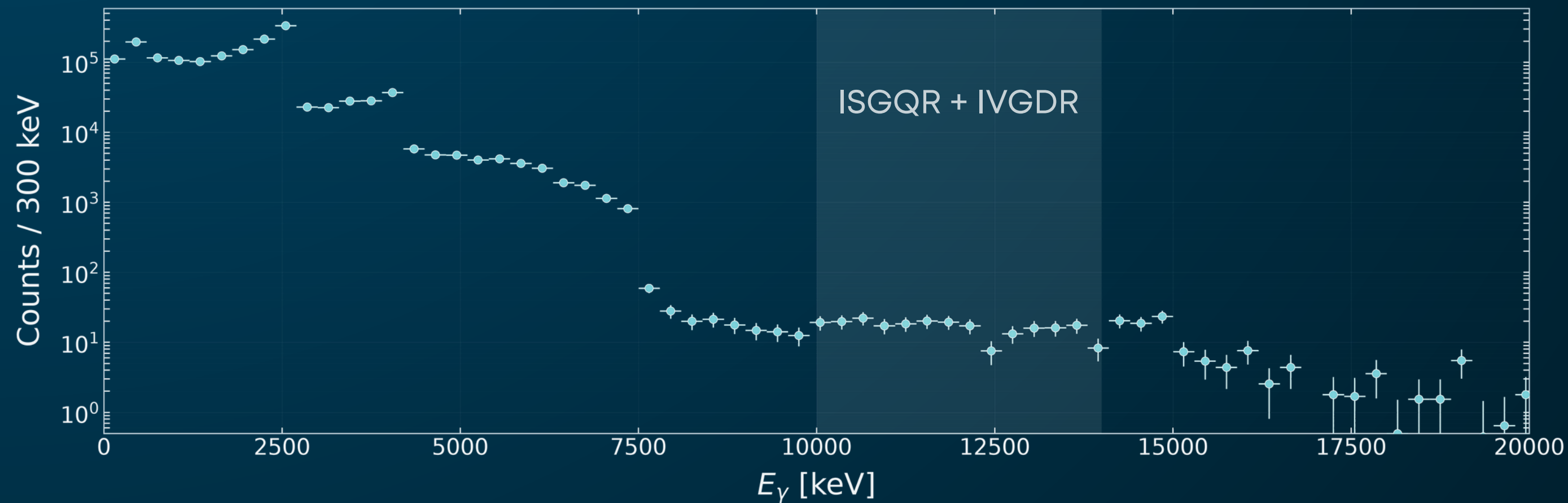
- E_x reconstructed from proton kinematics
- E_γ measured with PARIS/LaBr₃

Events close to $E_\gamma = E_x$ correspond to transitions directly to the ground state.

Search for ground state γ decay in ^{208}Pb



- the diagonal gate selects candidates for direct ground-state decay
- low-energy ^{208}Pb transitions are visible in the spectrum
- the ISGQR region overlaps with the IVGDR contribution at high E_γ



The analysis isolates the spectral region relevant for the ISGQR γ decay search.

Conclusions

- $^{208}\text{Pb}(p,p'\gamma)$ at 155 MeV was studied with the KRATTA, PARIS and LaBr₃ setup at CCB IFJ PAN
- proton identification and timing synchronization enabled the selection of prompt $p'\gamma$ coincidences
- calibrated proton and γ -ray information was combined into E_x - E_γ correlation matrices
- the diagonal selection isolates candidates for direct γ decay to the ground state
- known low-energy ^{208}Pb transitions are reproduced, supporting the consistency of the analysis chain

Outlook

- model the IVGDR contribution of the high energy γ -ray spectrum and subtract it to isolate the ISGQR component
- calculate ISGQR γ -ray spectrum based on measured excitation cross section and compare it with the experimental spectrum
- extract the ISGQR γ -decay branching ratio and compare it with previous measurements

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Thank you for your attention!

Questions?