First results from FATIMA within the DESPEC collaboration at FAIR-0

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On behalf of the DESPEC Collaboration for ISRP Kuala Lampur 2021

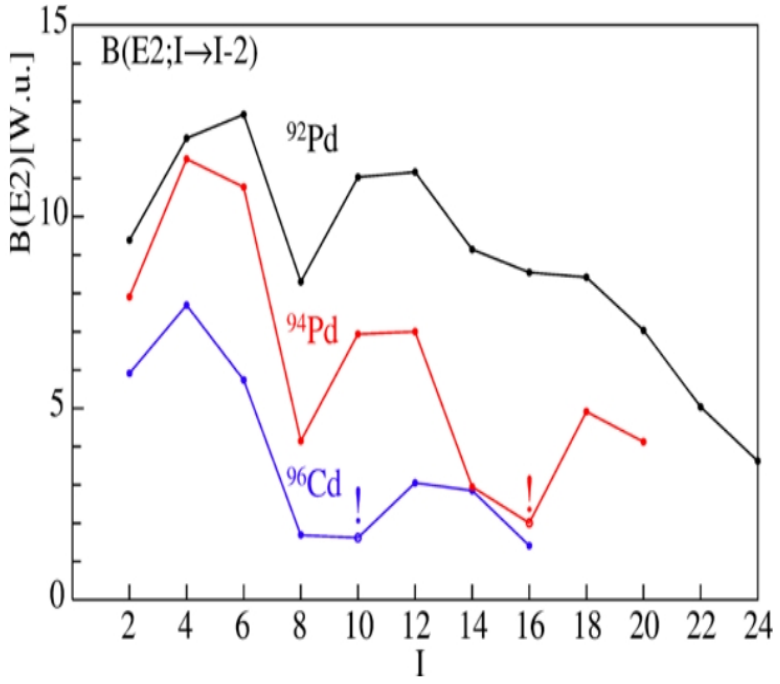
Context and Aims

Investigation into seniority around the A ~ 100 region ($g_{9/2}$ subshell):

- ^{96}Pd (N = 50) is a classic case for seniority – 2 proton hole resulting in an energy staggered 2^+, 4^+, 6^+, 8^+ yrast cascade
- ^{92}Pd (N = 46) behaves differently to what is expected if one carries out shell model calculations based on seniority
- Exists as a result of the T = 0 pn pairing from 4 extra valence neutrons
- ^{94}Pd exists at a transition point between these two interesting cases

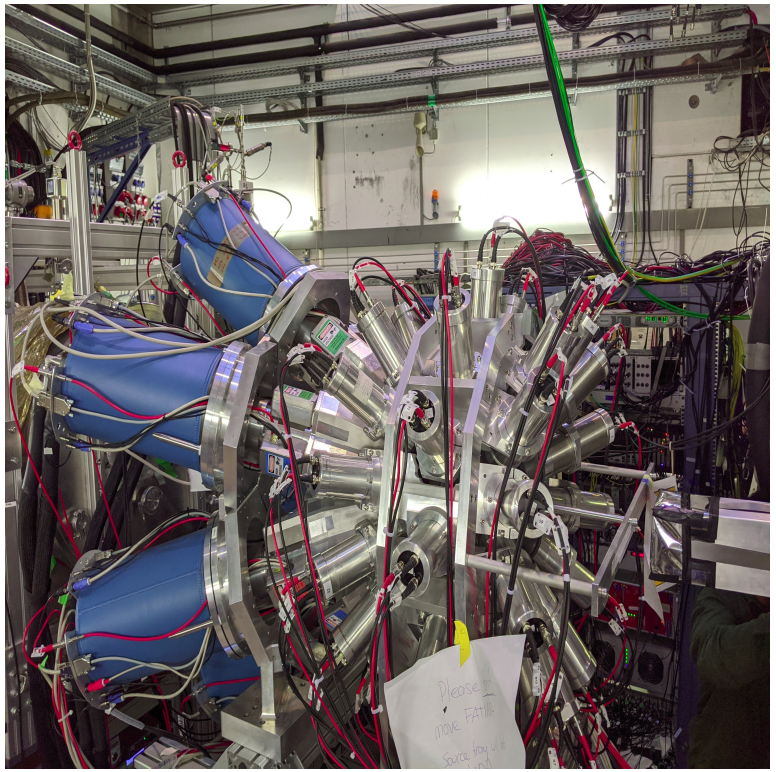
- A large drop is seen in B(E2) in the $8^+ \rightarrow 6^+$ transition in ^{94}Pd when carrying out SM calculations in a pure $vg_{9/2}$ state

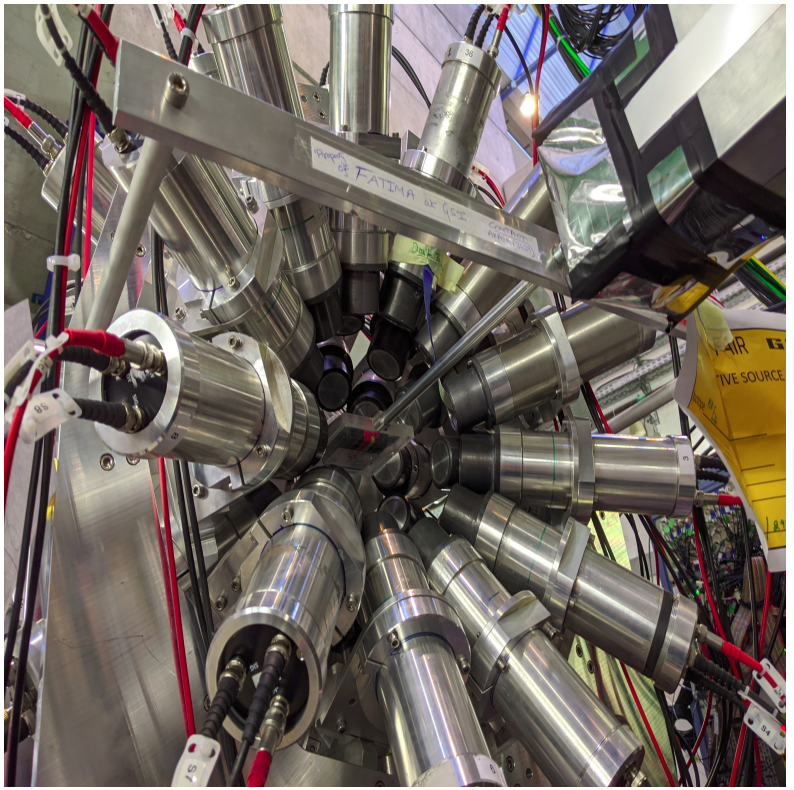
- Aim – Extract a B(E2) value for this transition and others to verify the shell model calculations by measuring the lifetimes of the Yrast band states in ^{94}Pd as well as validate a novel GEANT4 Simulation



Experimental Details

- ^{124}Xe Primary fragmentation beam at 850MeV/Nucleon
- FRS used to steer fragments of interest to the focal plane detectors
- 110 hours of usable data collected over a 1 week period
- “Time stitched” events using the white rabbit clock to generate detector correlated events

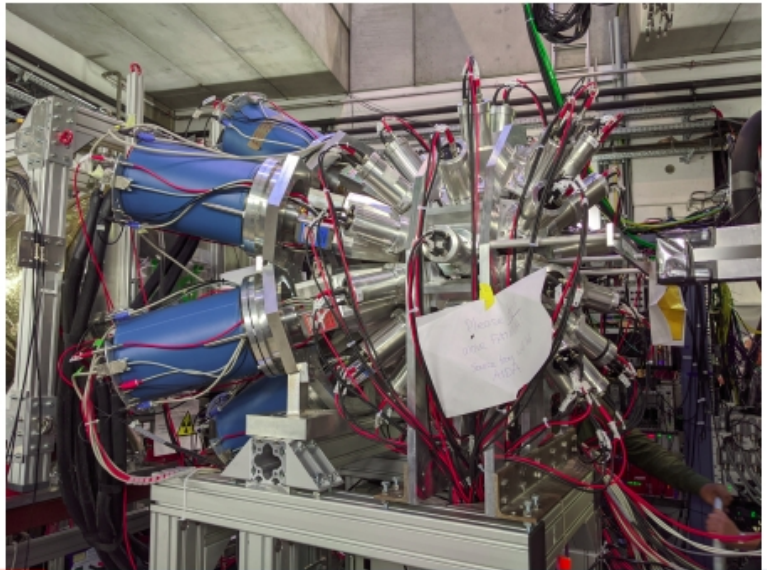


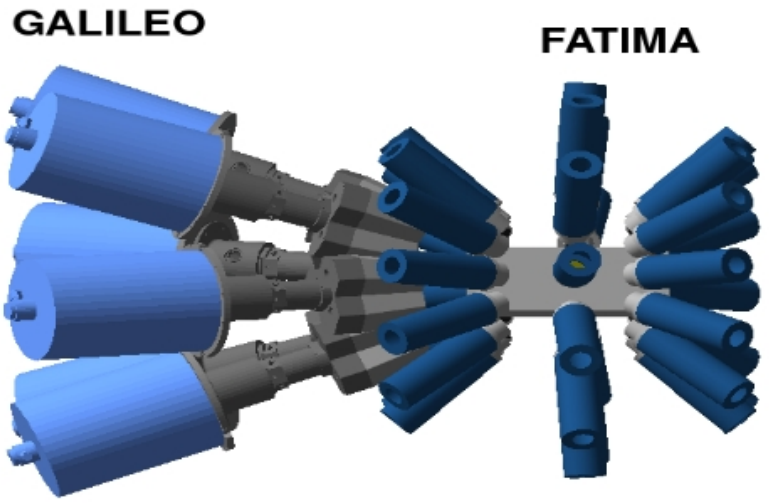


DEcay SPECtroscopy (DESPEC) @ GSI

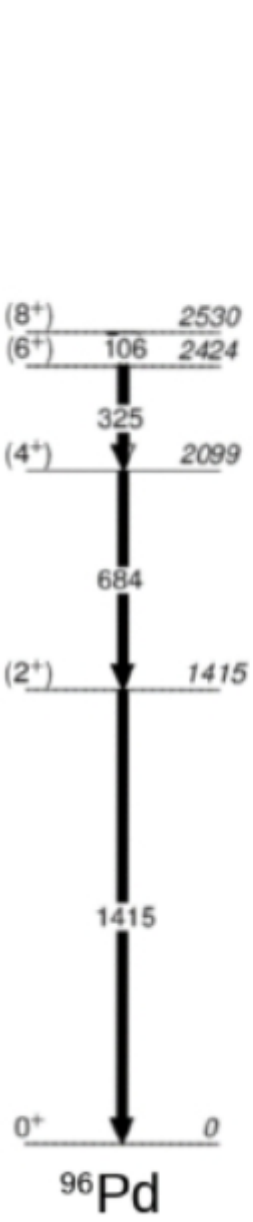
Collection of detectors composed of:

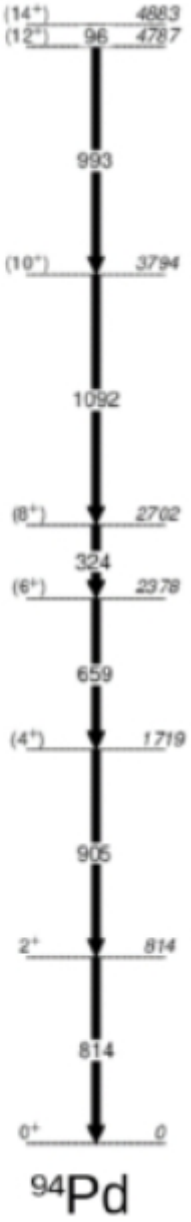
- AIDA: 3 Double Sided Silicon Strip Detectors for implant and beta decay identification
- bPlast: Plastic scintillation detector
- DEGAS: 6 Triple clustered HPGe
- Fatima: 36 $LaBr_3(Ce)$ detectors
- White Rabbit: Common clock between detectors for event building

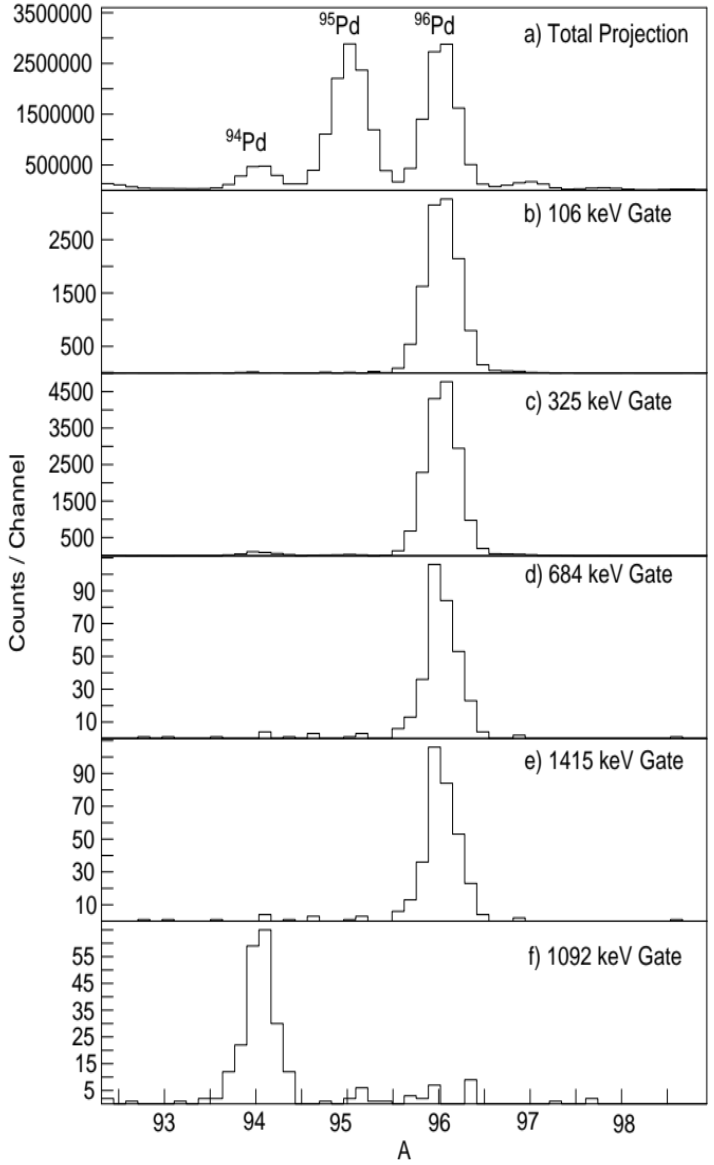




Reverse Gated PID

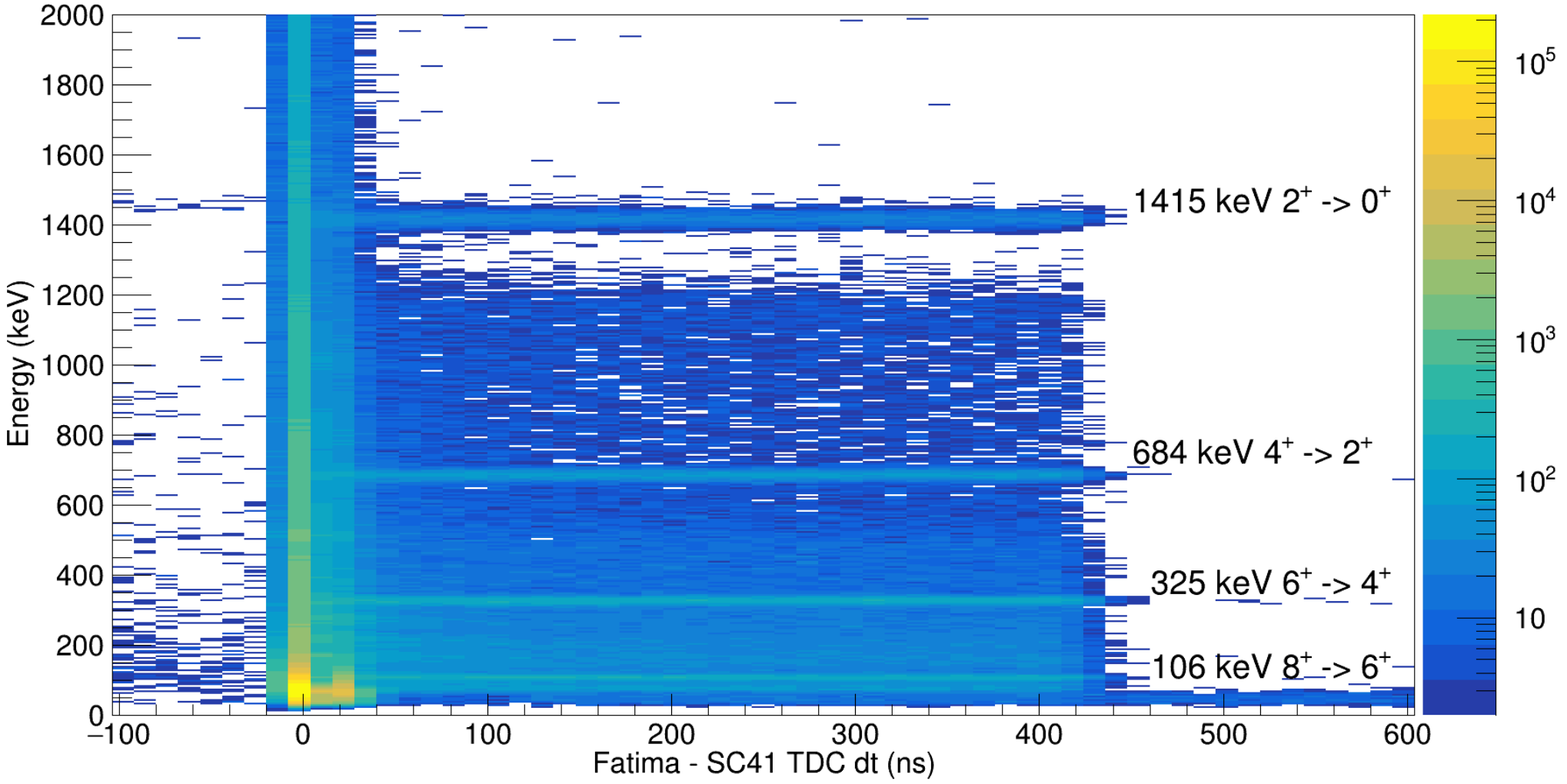




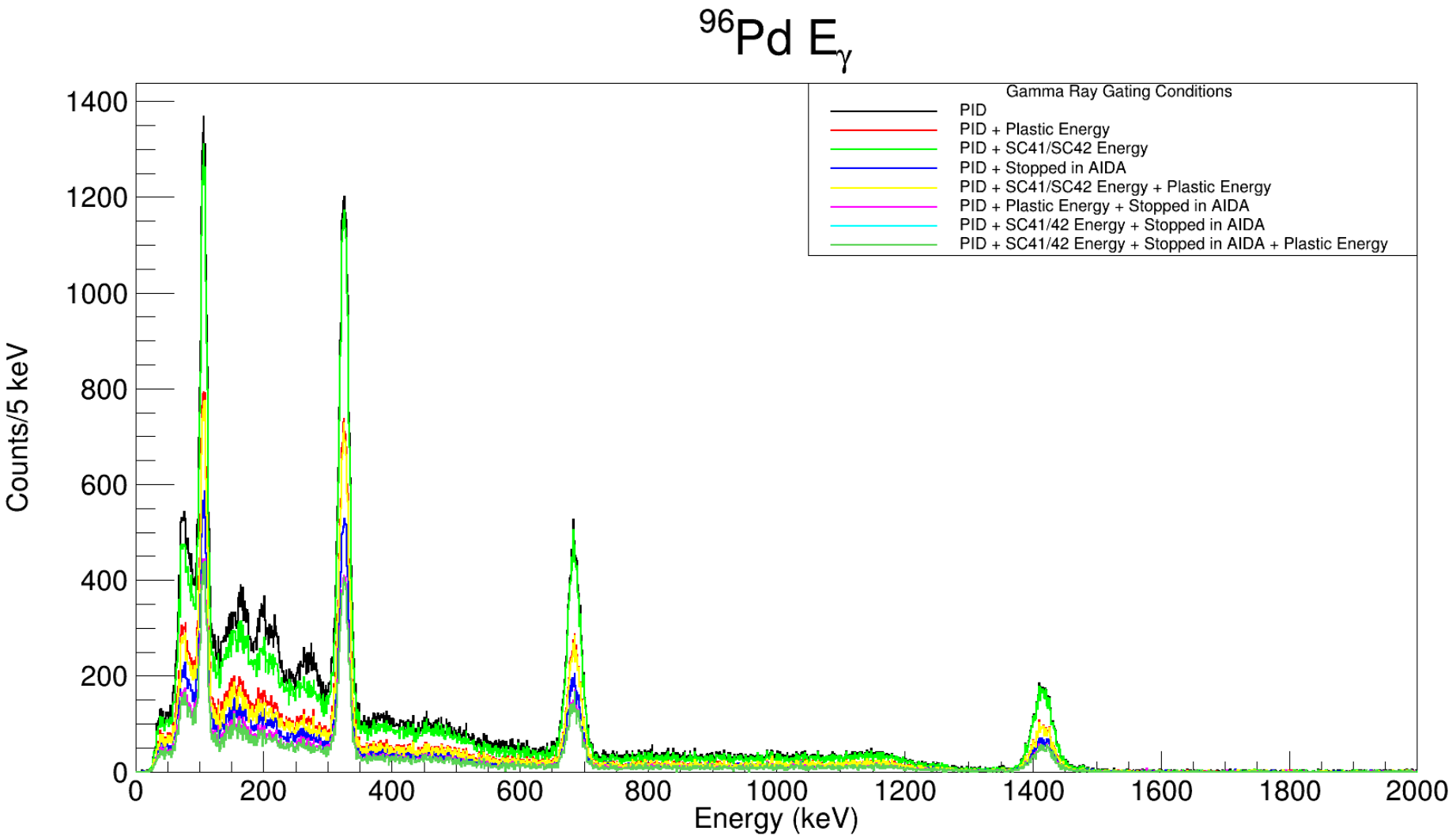


- These plots show the reverse gamma-ray gated Z = 46 projections of the Z vs A/Q (corrected for Q) PID matrix
- Background subtraction was carried out by gating on the peak as well as the peak width slightly higher in energy and subtracting one from the other
- Results are shown for all transitions in ^{96}Pd and the 1092 keV transition in ^{94}Pd

^{96}Pd PID Gated E vs dt



^{96}Pd PID Gated Gamma-rays



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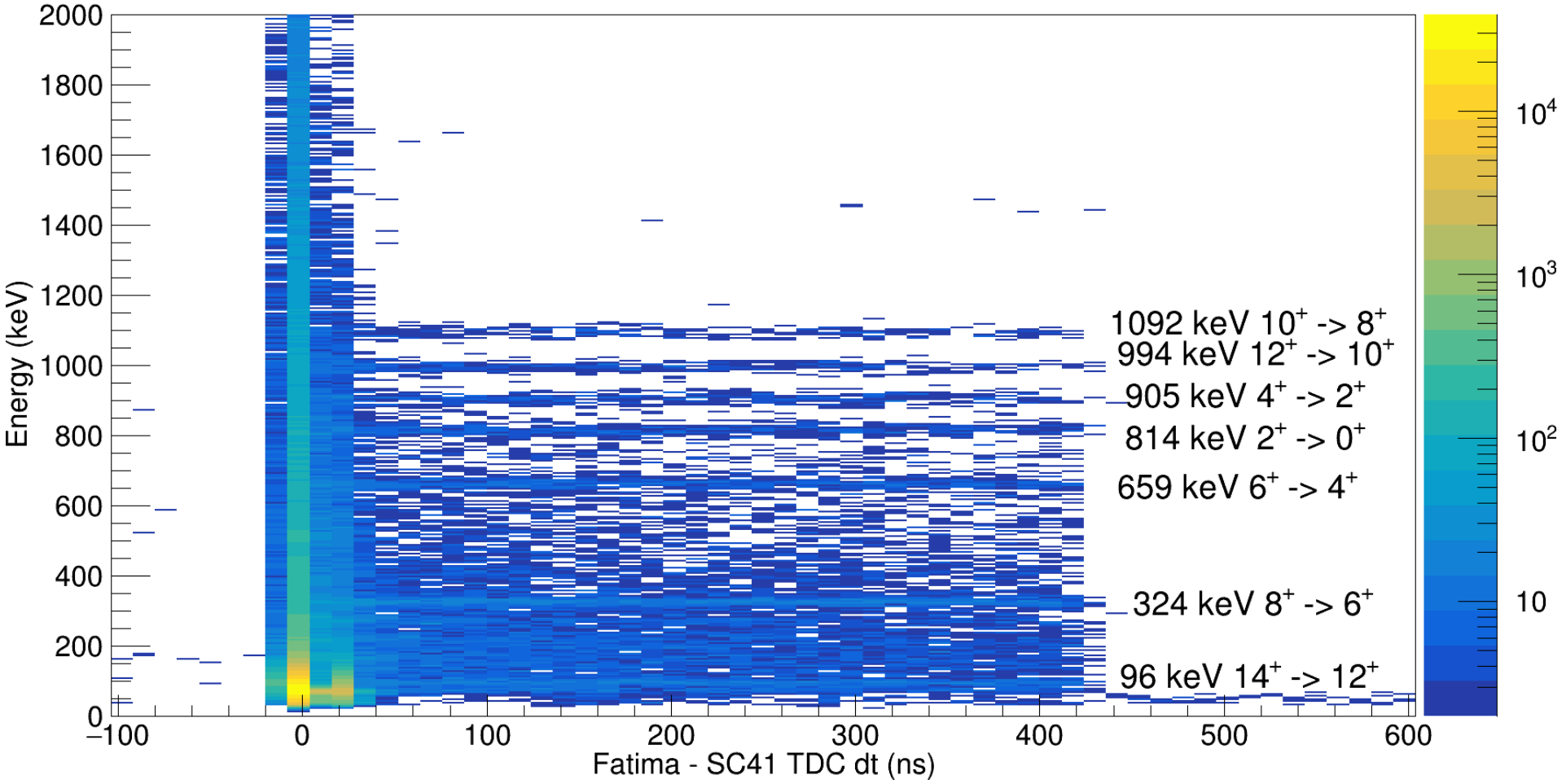

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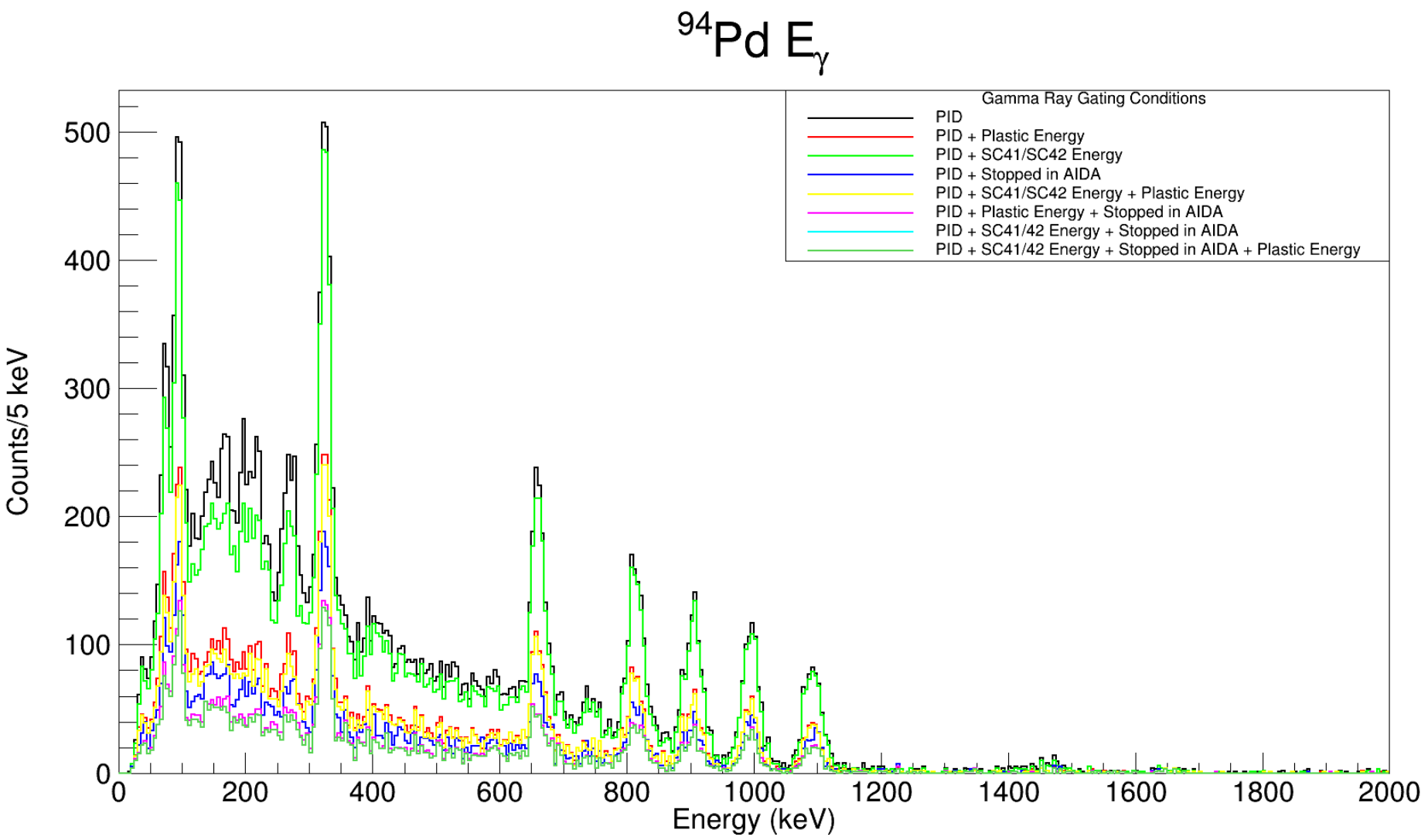
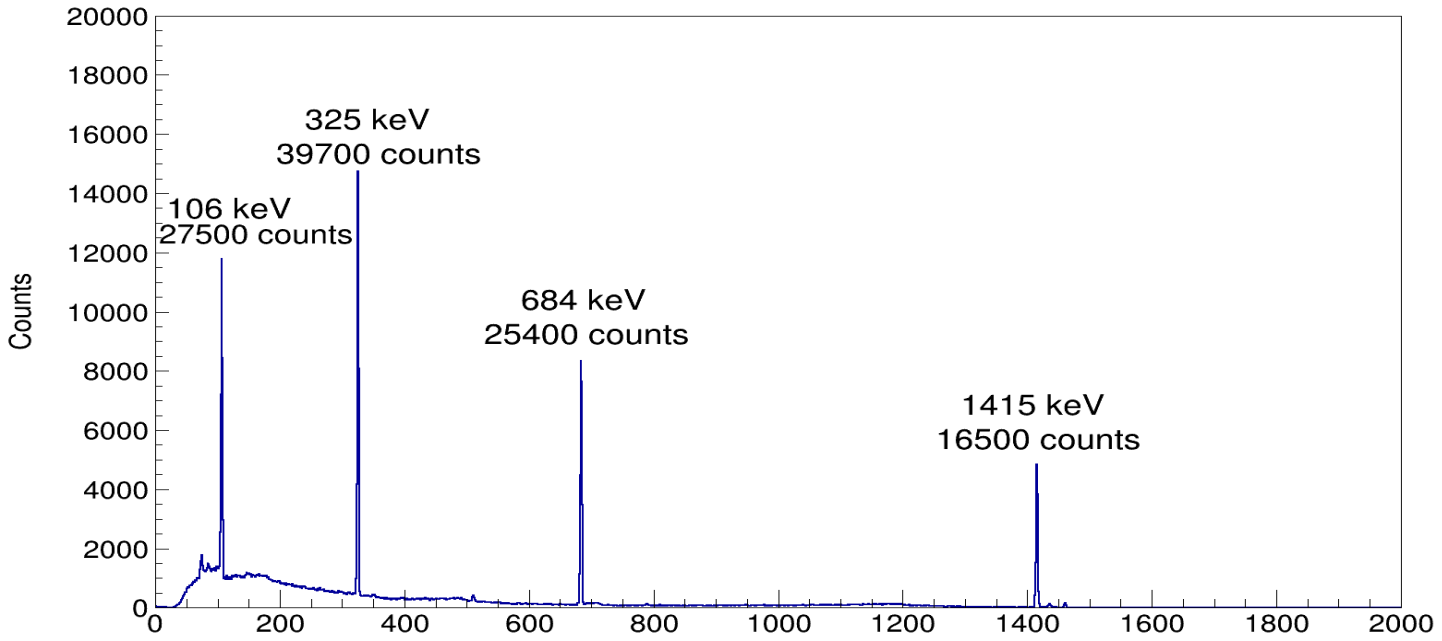
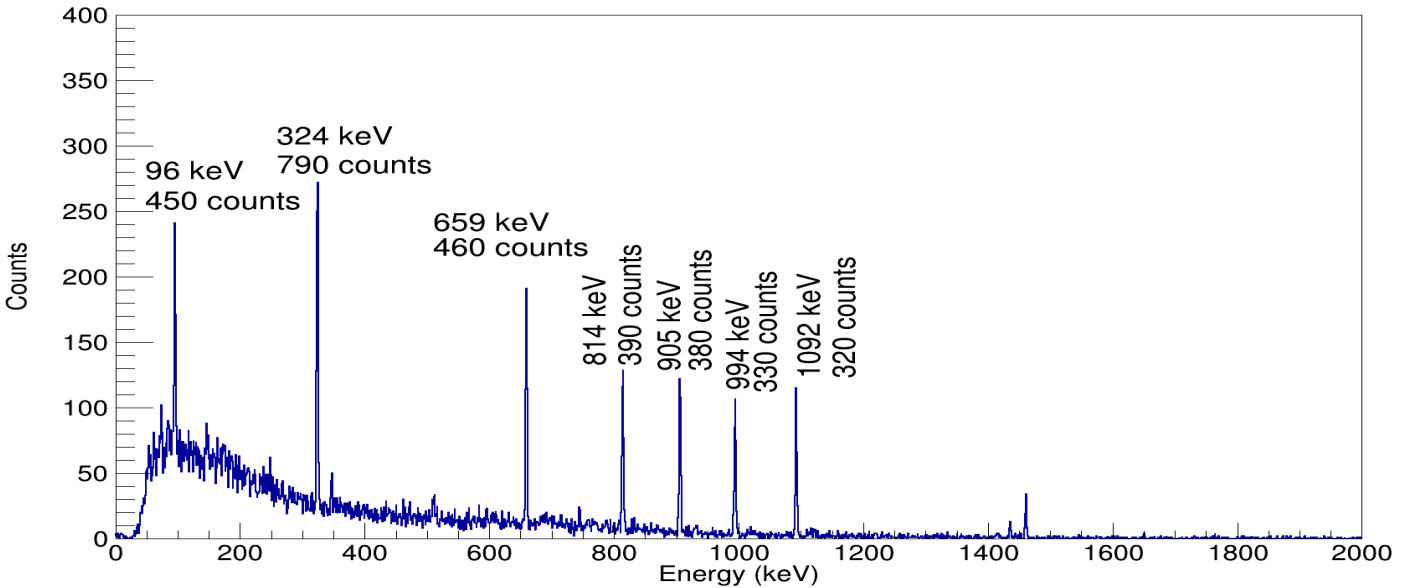
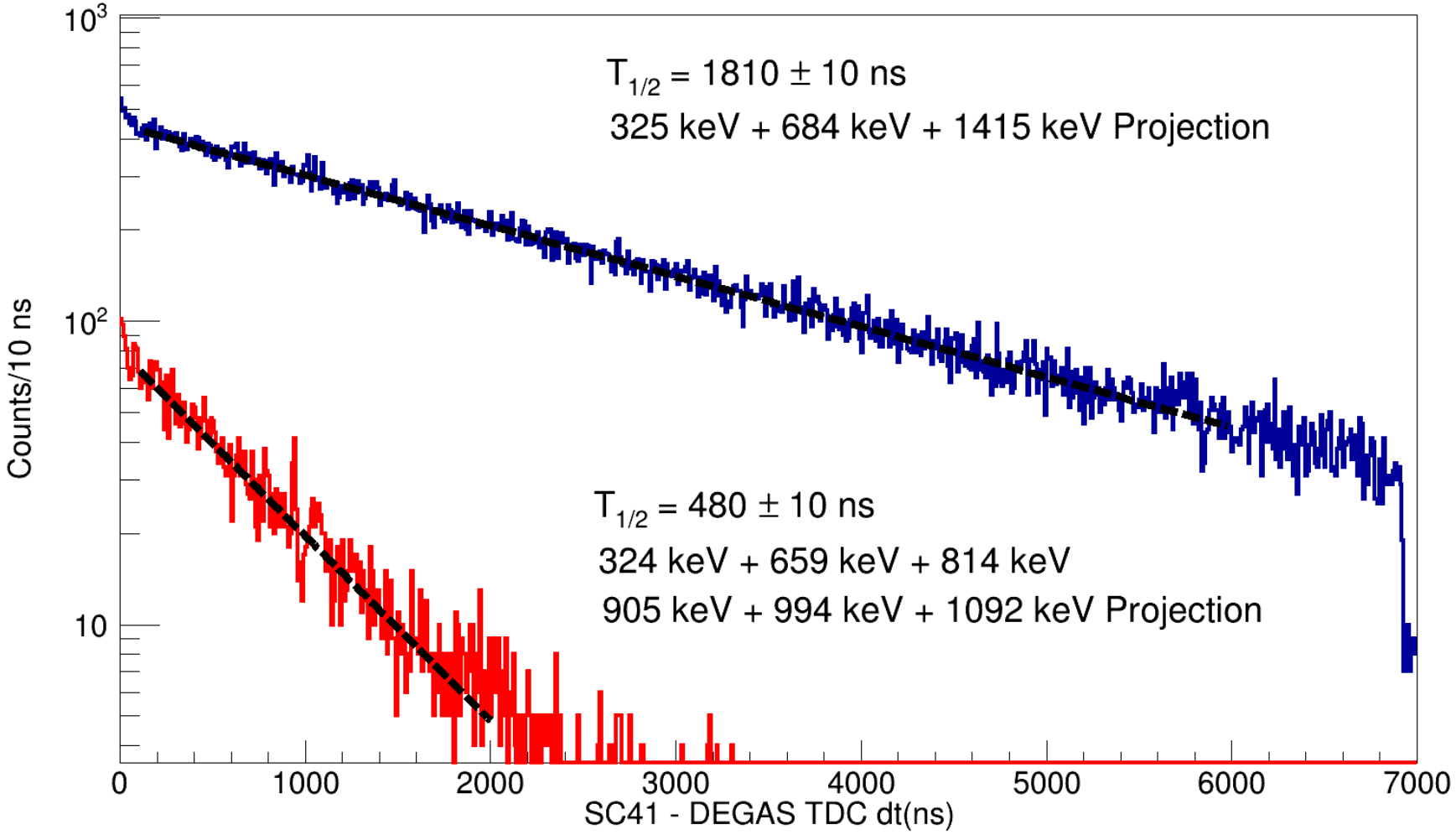


DEGas Gamma-ray Spectra

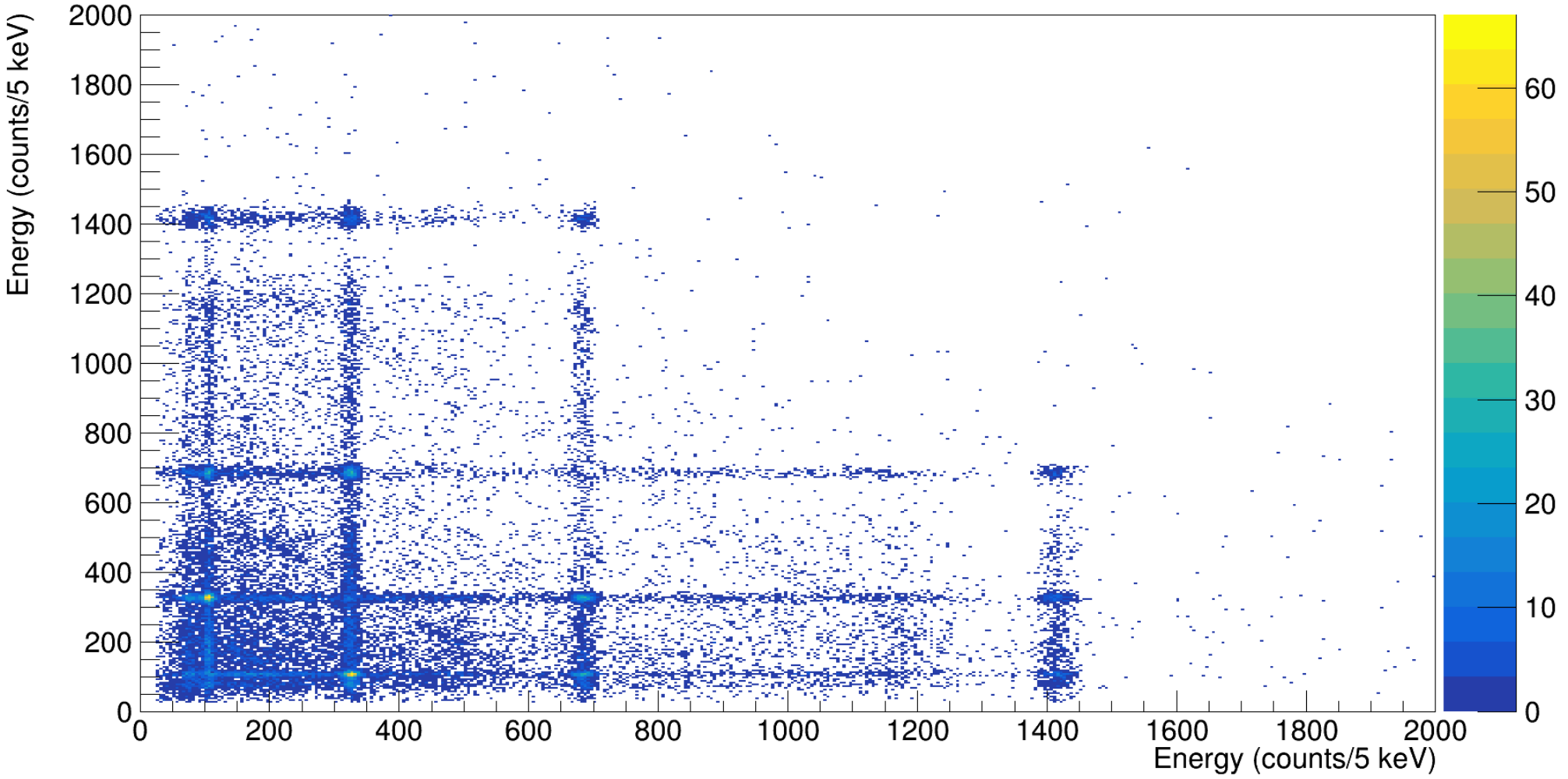




DEGas Timing Spectra



^{96}Pd PID Gated gamma-gamma Matrix



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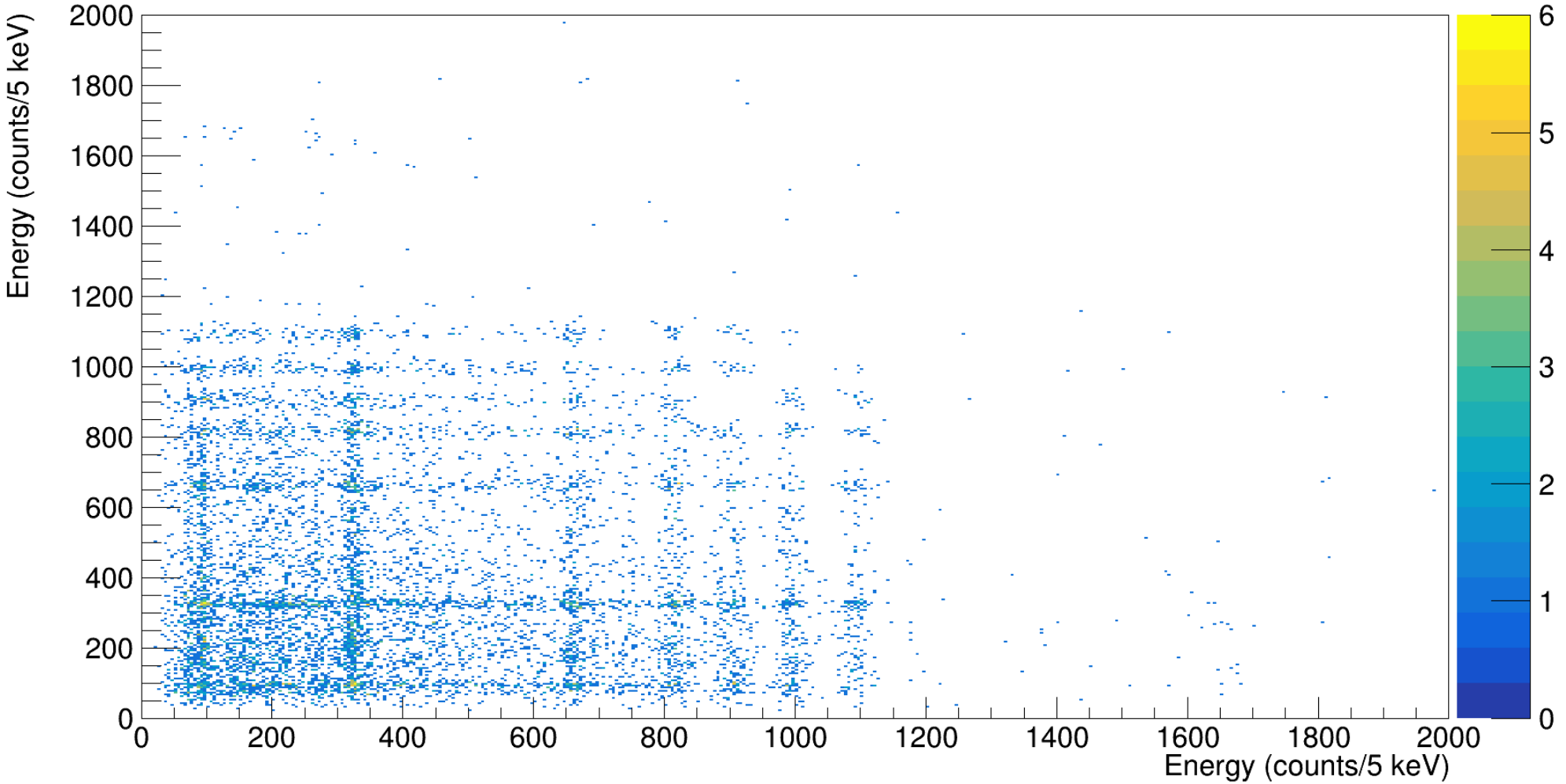
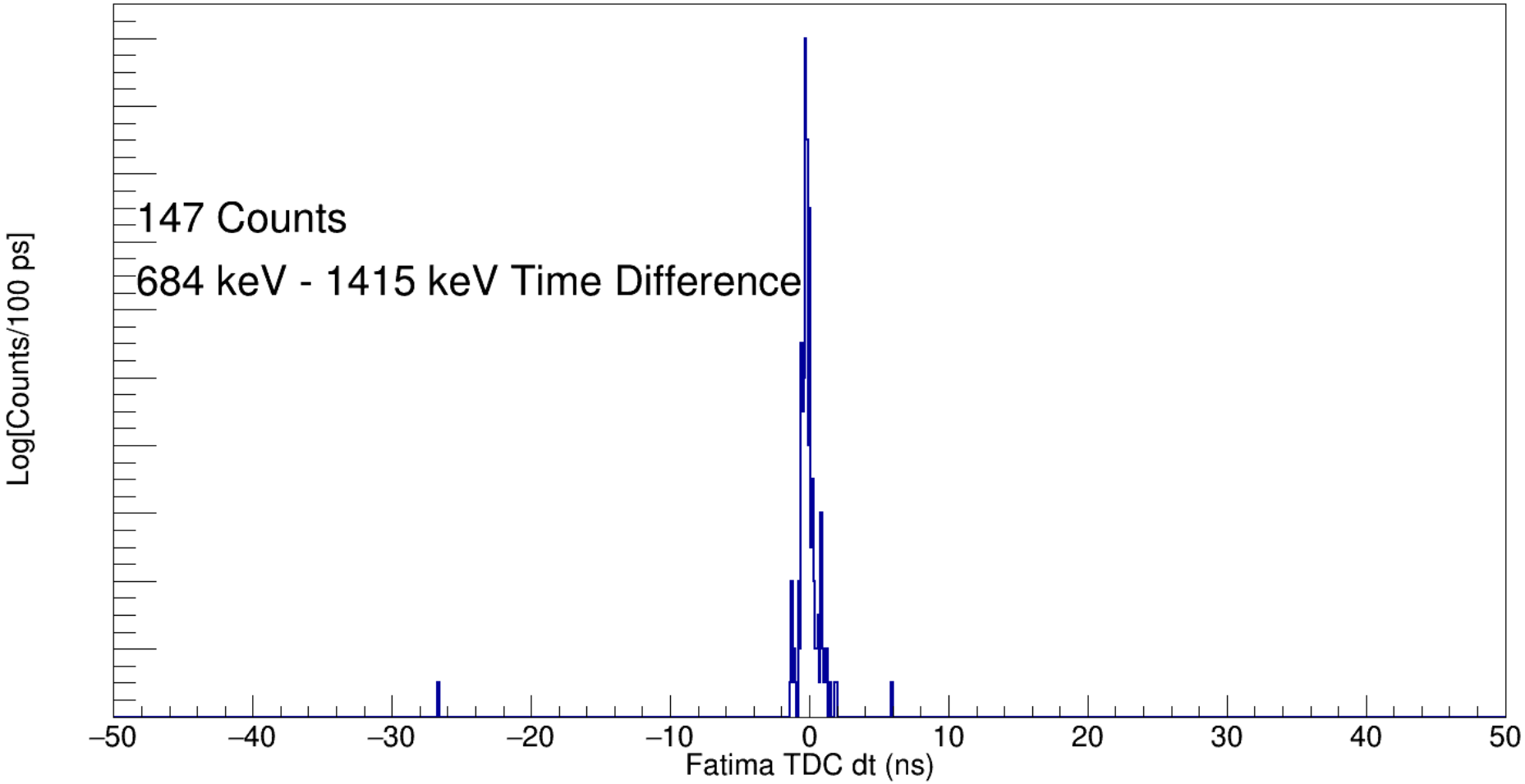
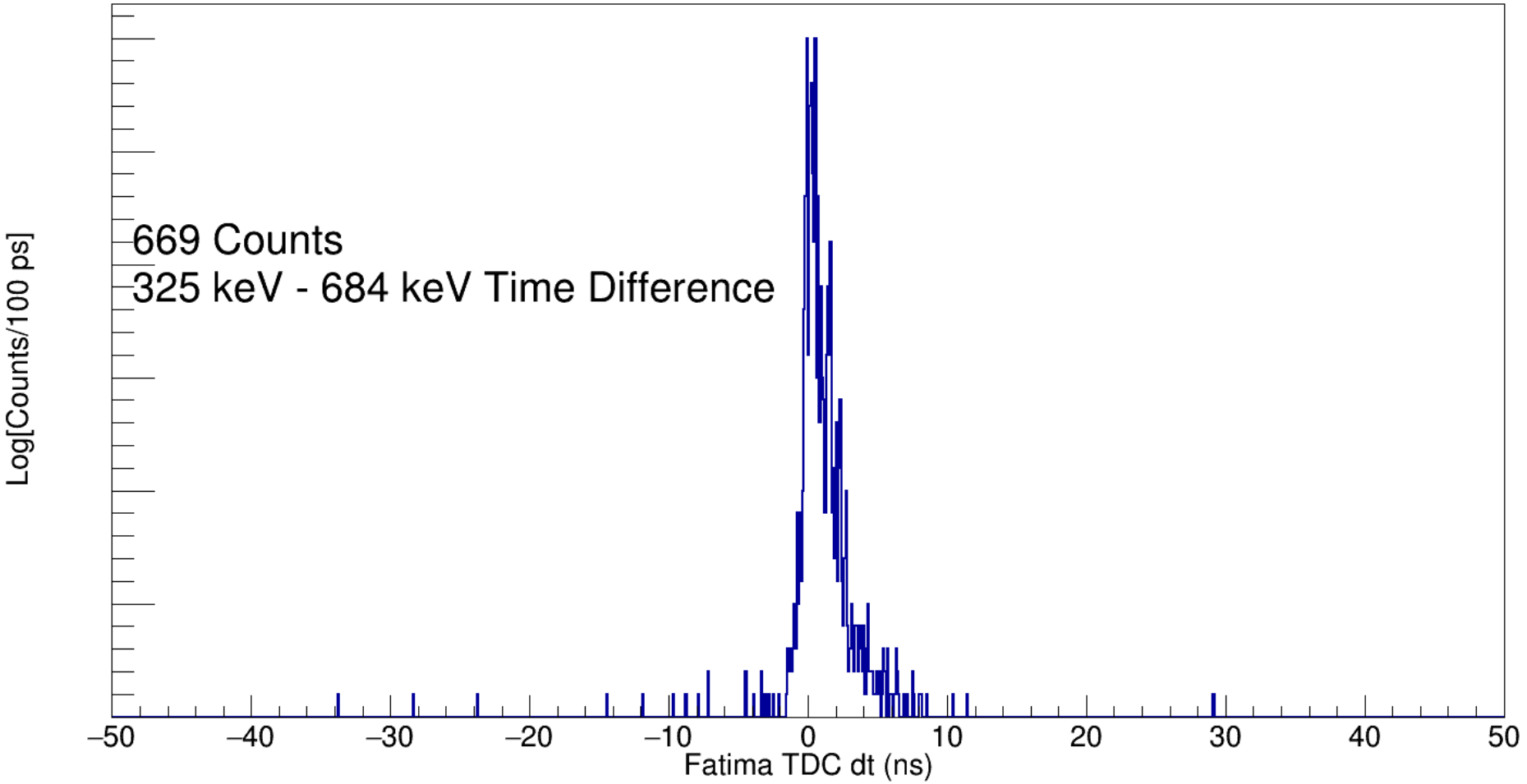


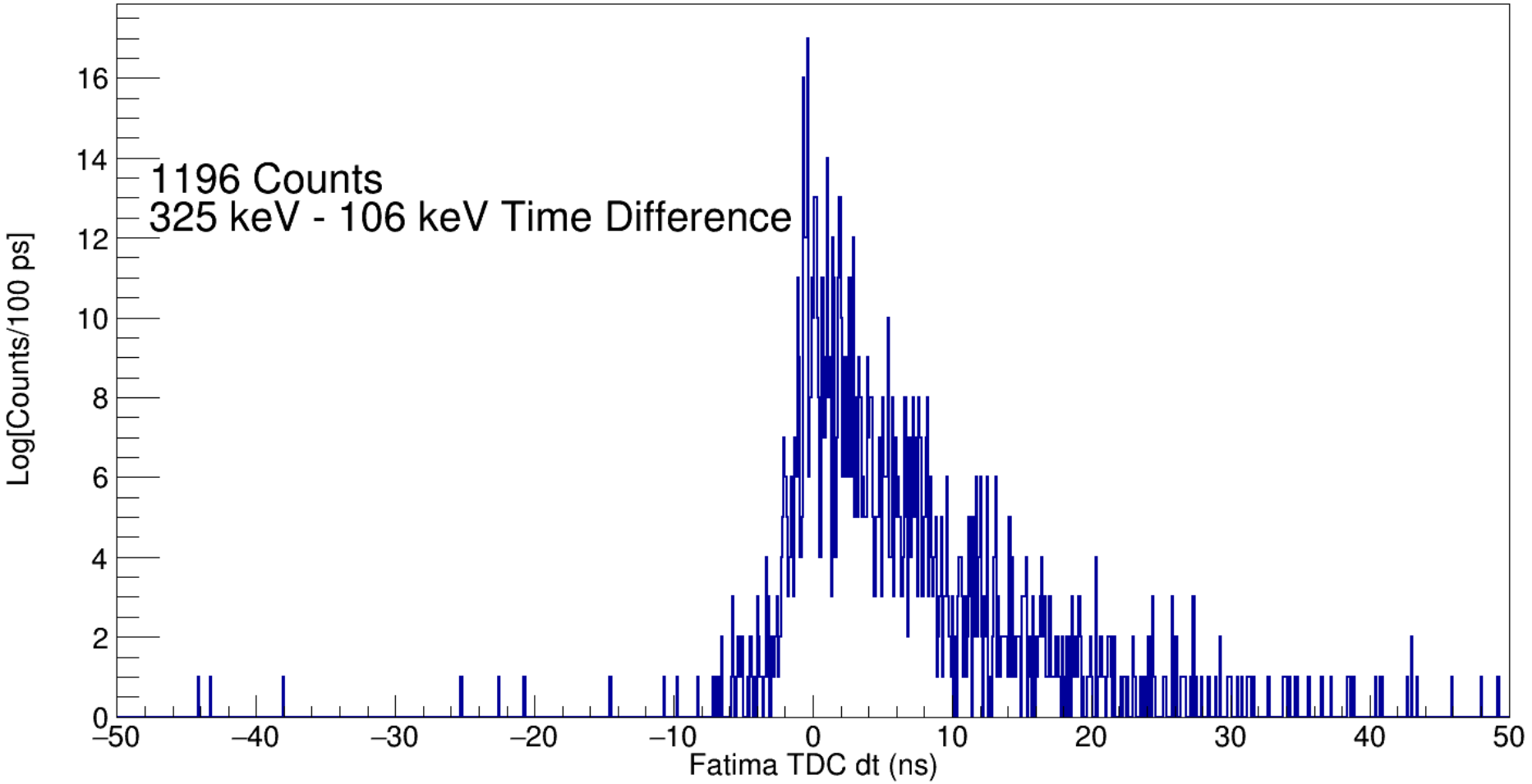
$^{96}Pd\ 2^{+}$ Lifetime



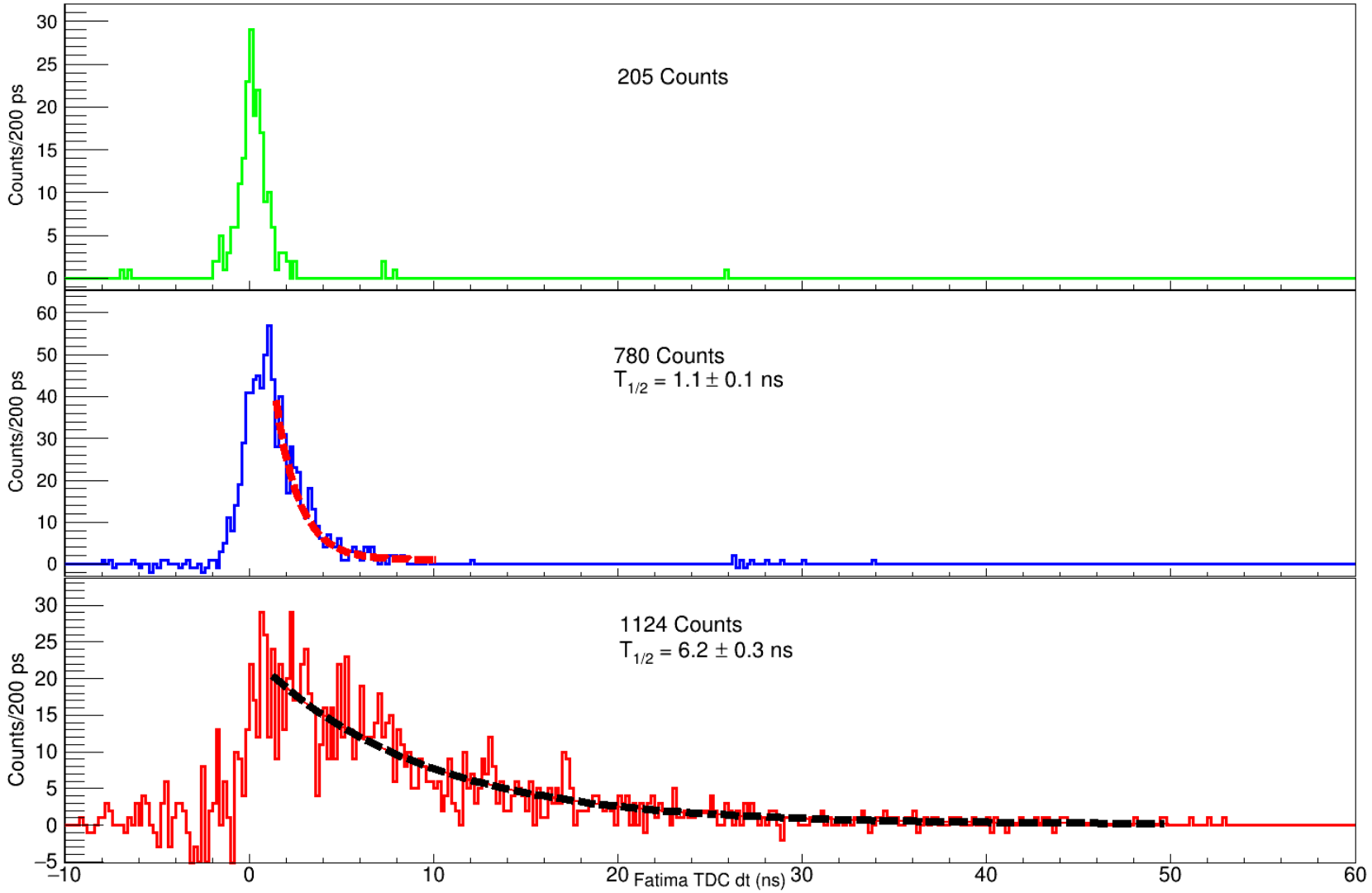
^{96}Pd 4^{+} Lifetime



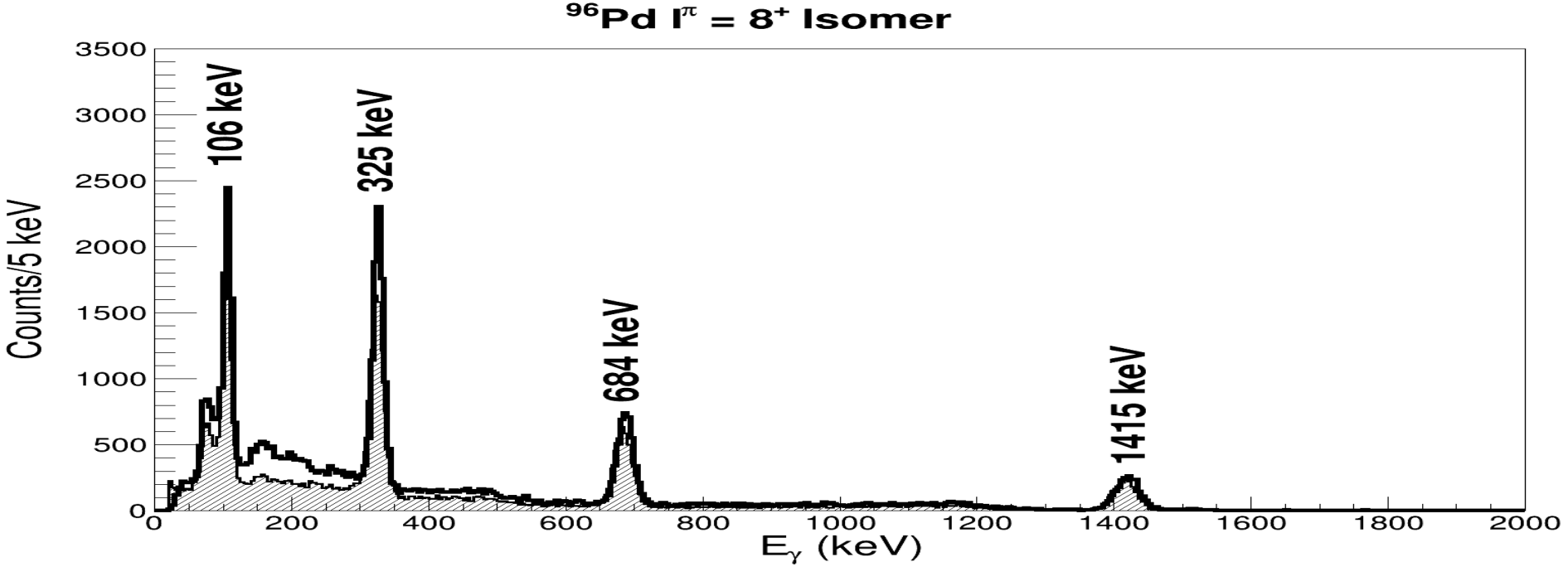
$^{96}Pd\ 6^{+}$ Lifetime

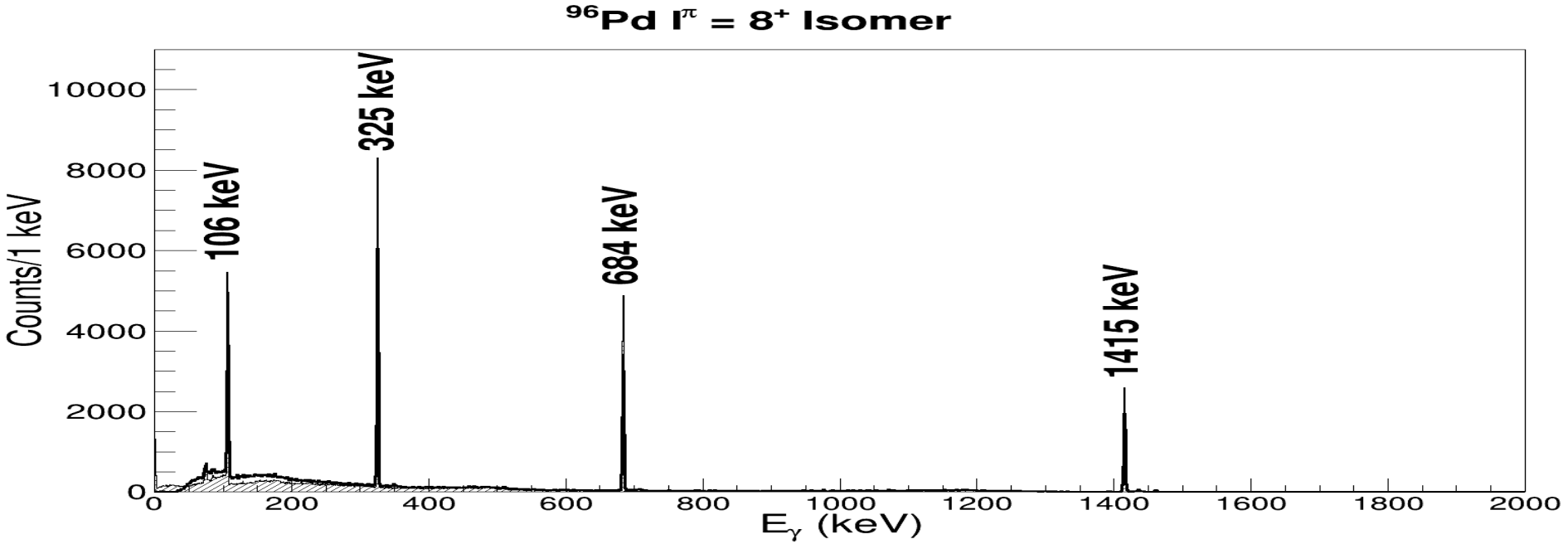


^{96}Pd Lifetimes



DESPEC Simulation





Conclusions

- Isomeric Ratios have been calculated for the 14^+ and 8^+ isomeric states in ^{94}Pd and ^{96}Pd which have been used to verify a novel GEANT4/NPTool Simulation
  - Proven the effectiveness of the DESPEC setup in attaining lifetimes through the case of ^{96}Pd
- ^{96}Pd yrast band lifetimes of the in have been extracted by using gamma ray time differences in the Fatima detector systems
- Further work to be done through including more detector systems in analysis as well as second and further order timing and energy corrections

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