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Decay Spectroscopy of ^{129}Cd with the GRIFFIN Spectrometer at TRIUMF

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Feb 16th, 2018

NSERC CRSNG IsoSiM

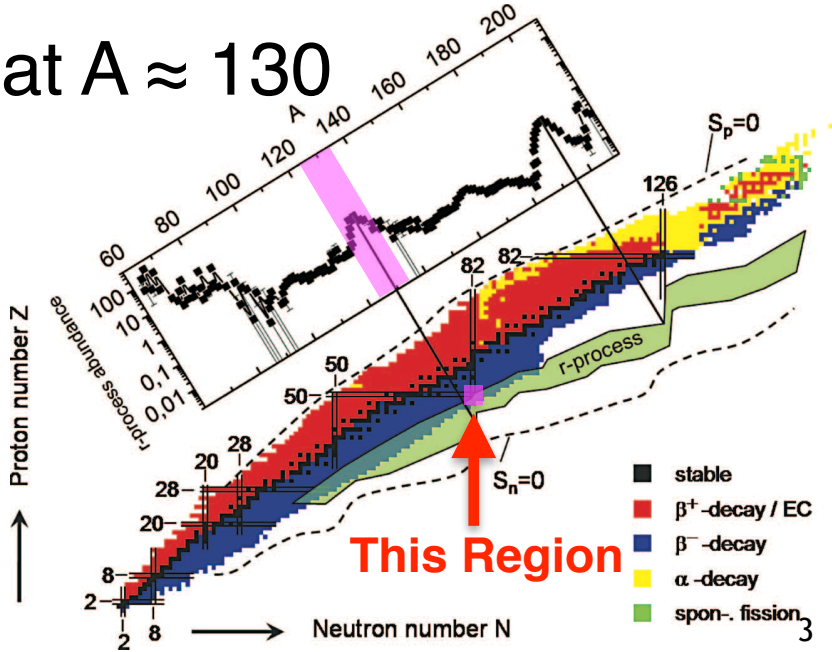
CINP ICPN Canadian Institute of Nuclear Physics / Institut canadien de physique nucléaire

Motivation

Parent Nucleus: ^{129}Cd

- ^{129}Cd: Below doubly magic ^{132}Sn
  - ➡ 2π-hole and 1ν-hole relative to ^{132}Sn
    - ▸ Interest in nuclear structure
  - ➡ r-process abundance peak at A ≈ 130

R. Kruecken
Contemp. Phys. 52 (2):101-120



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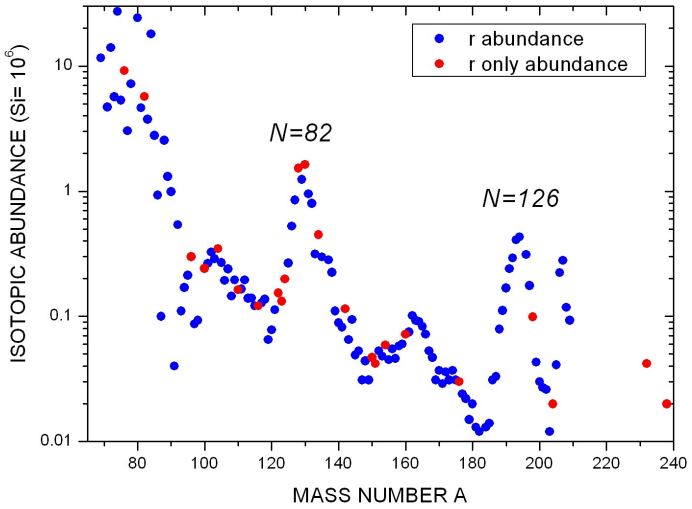
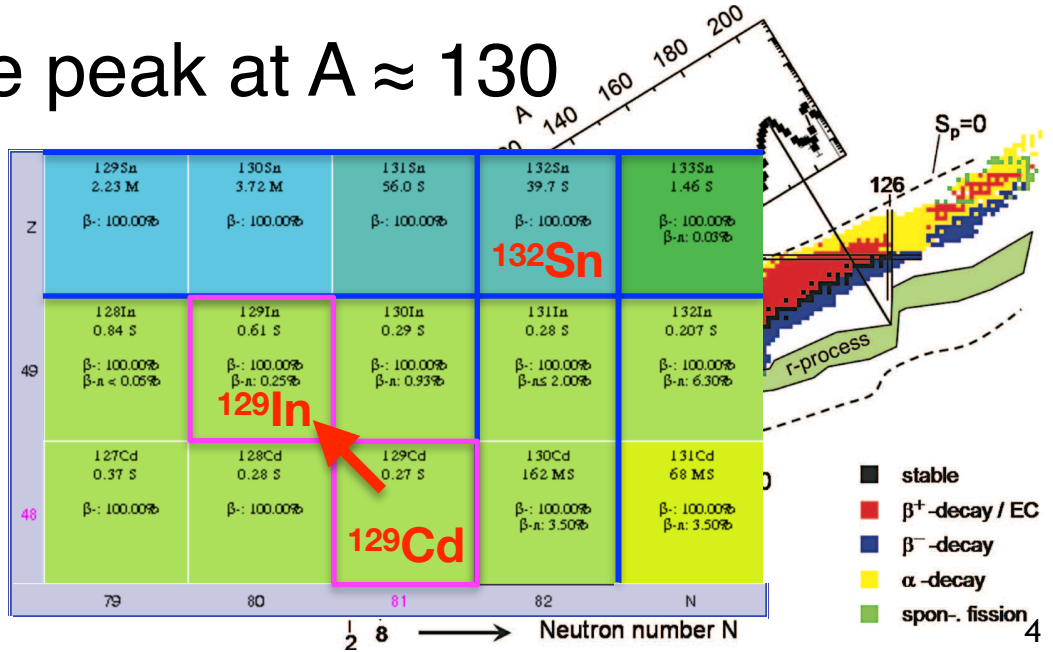
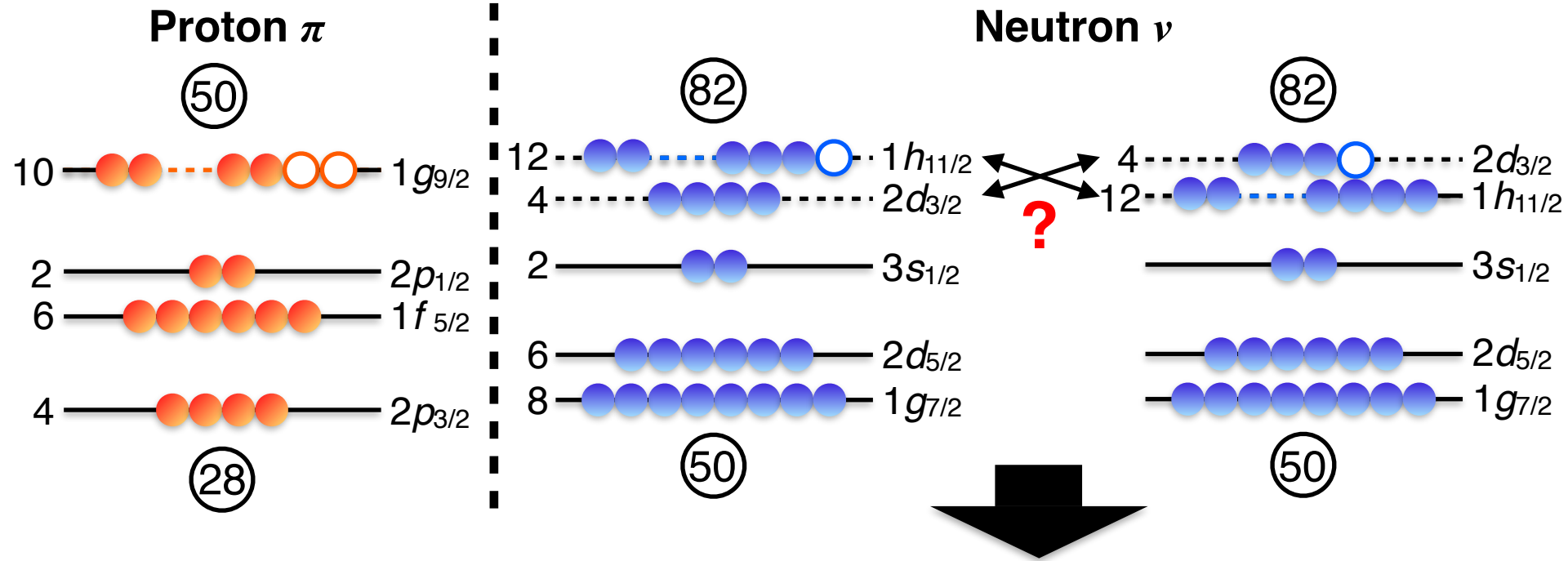




^{129}Cd Open Question

- Ground state configuration



Ground state & 1st excited state (isomeric)

^{129}Cd: 11/2$^-$ and 3/2$^+$

- Both states have similar half lives

$T_{1/2}(11/2^-) = 147(3)$ ms

$T_{1/2}(3/2^+) = 157(8)$ ms

[Results from this campaign]

R. Dunlop et al., PRC **93**, 062801(R)(2016)

$T_{1/2}(11/2^-) = 154(2)$ ms

$T_{1/2}(3/2^+) = 146(8)$ ms

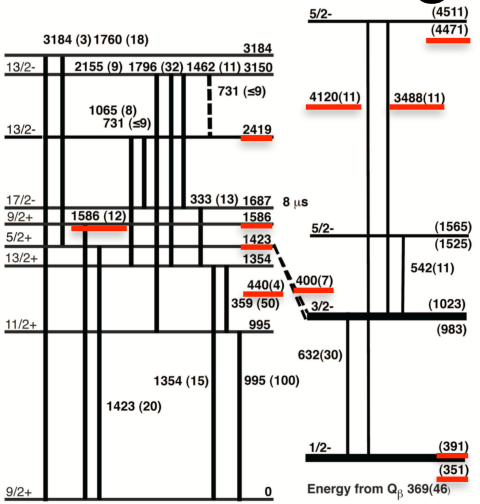
[Previous results from EURICA]

J. Taprogge et al., PRC **91**, 054324 (2015)

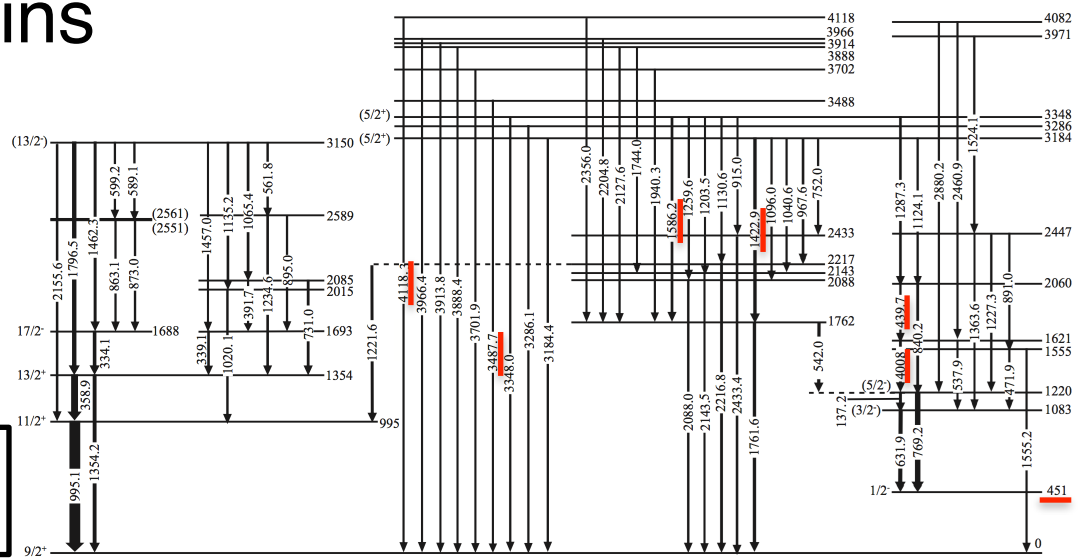
- Laser spectroscopy is necessary for detailed study
- Two states populate different excited states in ^{129}In via β-decay

β-decay of ^{129}Cd

- Previous Results on ^{129}Cd Decay
  - ➡ Discrepancy between two level schemes
  - ➡ Unassigned spins



^{129}In



ISOLDE: O. Arndt et al., Acta Phys. Pol. B40, 437 (2009).

EURICA: J. Taprogge et al. PLB 738 (2014)

Goals of This Study

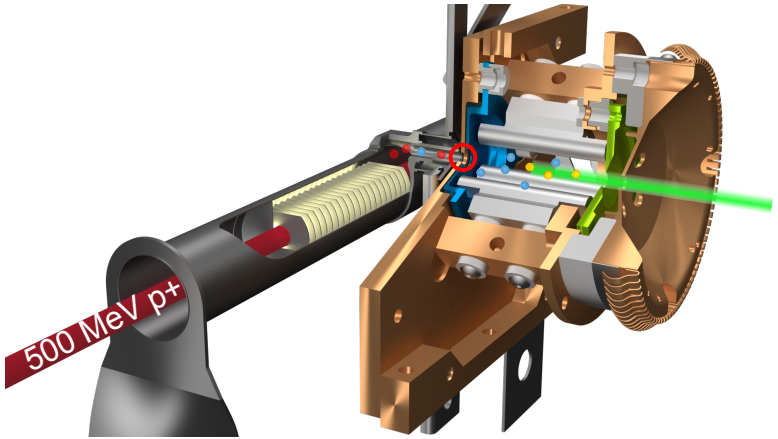
- Detailed study of ^{129}In nuclear structure
  - ➡ Resolve the discrepancy of level schemes
  - ➡ Search for new transitions and excited states
  - ➡ Improved precision on experimental values
  - ➡ Spin assignment by γ-γ angular correlation

  - ➡ Shell Model Calculation

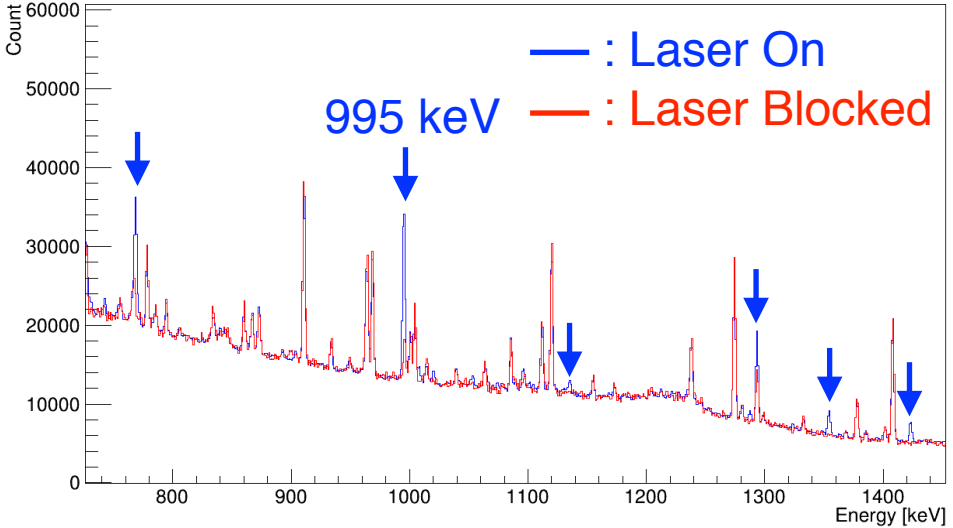
Experiment and Analysis

IG-LIS: Ion Guide Laser Ion Source

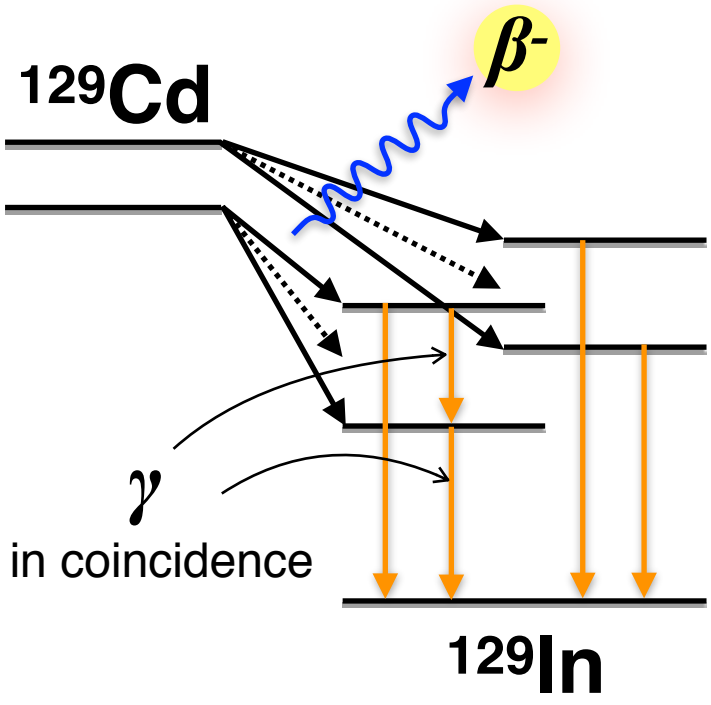
- **IG-LIS** - Isotope selective ionization and suppression of surface-ionized species (e.g. Cs, In)
  - ➡ Cleaner beam
  - ➡ Laser on/ blocked spectrum to identify transitions



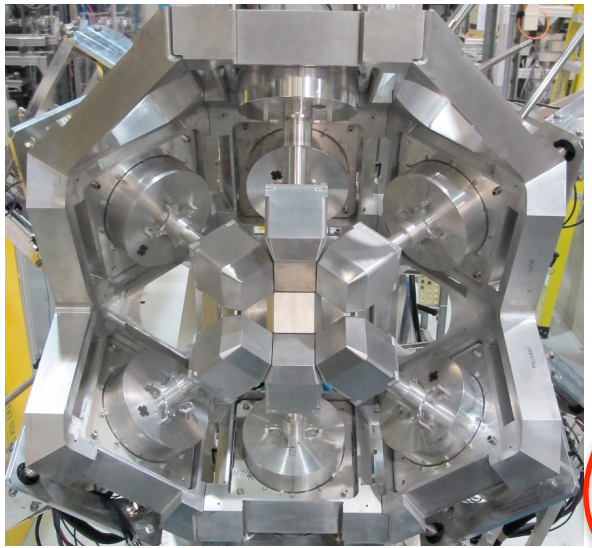
From H. Heggen.
ISAC Operators Talk. Feb 6, 2014



Detectors

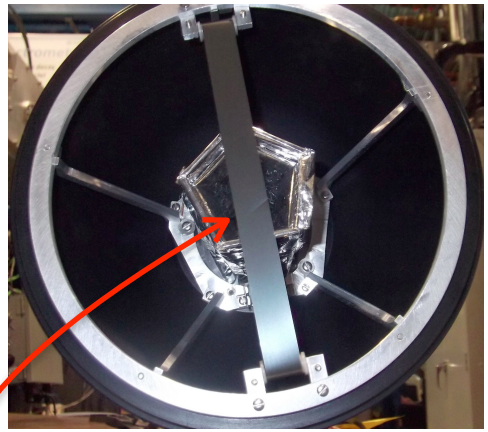


γ rays ← β-tagging



GRIFFIN

Gamma-**R**ay **I**nfrastructure **F**or **F**undamental **I**nvestigations of **N**uclei



SCEPTAR

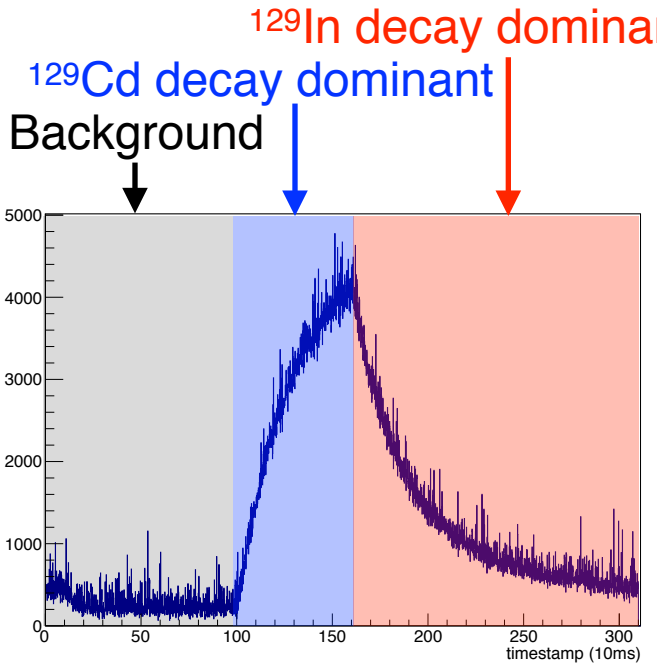
SCintillating **E**lectron-**P**ositron **T**agging **AR**ray

Moving Tape Collector

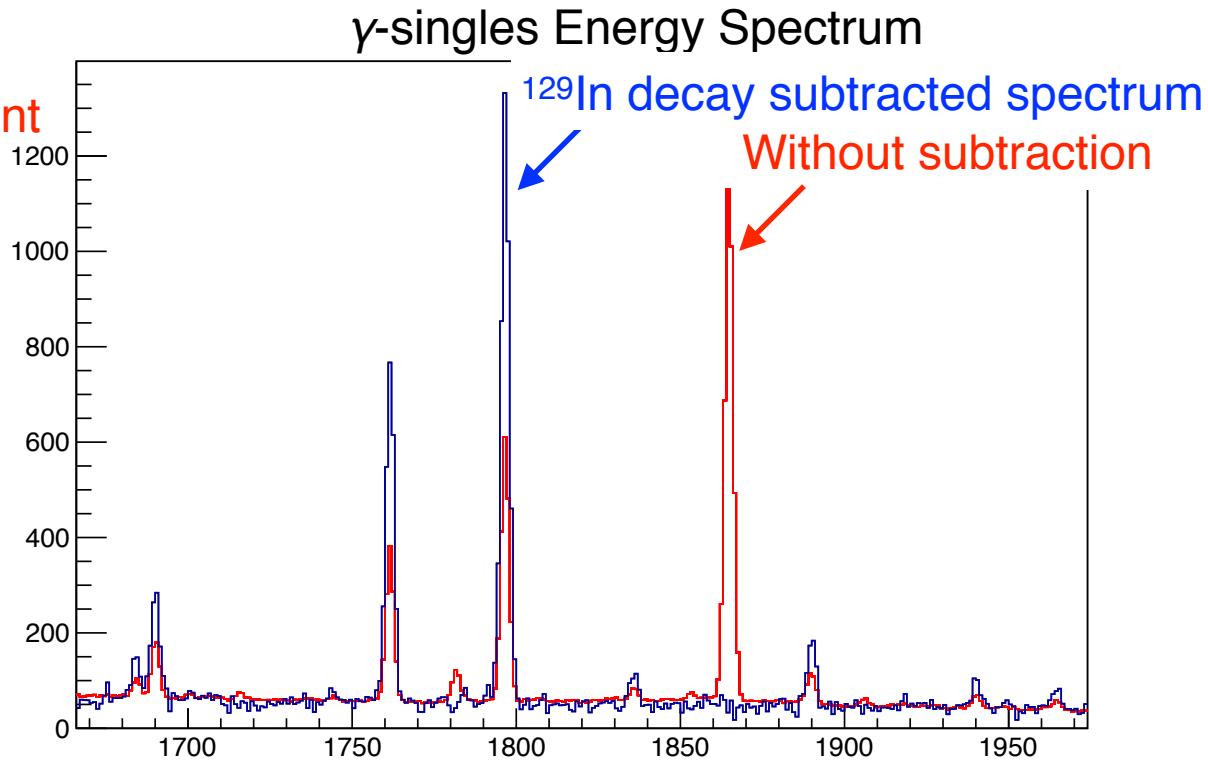
Data Collection

- Beam implanted on a moving tape collector

$T_{1/2}(^{129}\mathrm{Cd}) < T_{1/2}(^{129}\mathrm{In})$

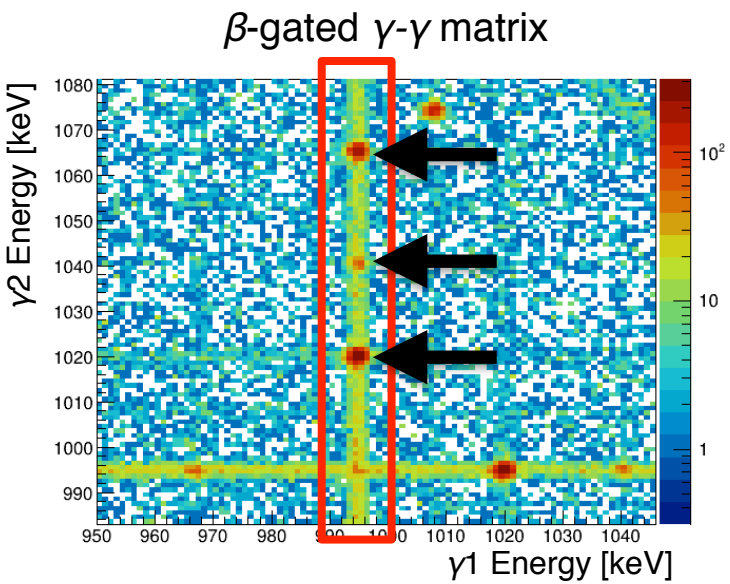


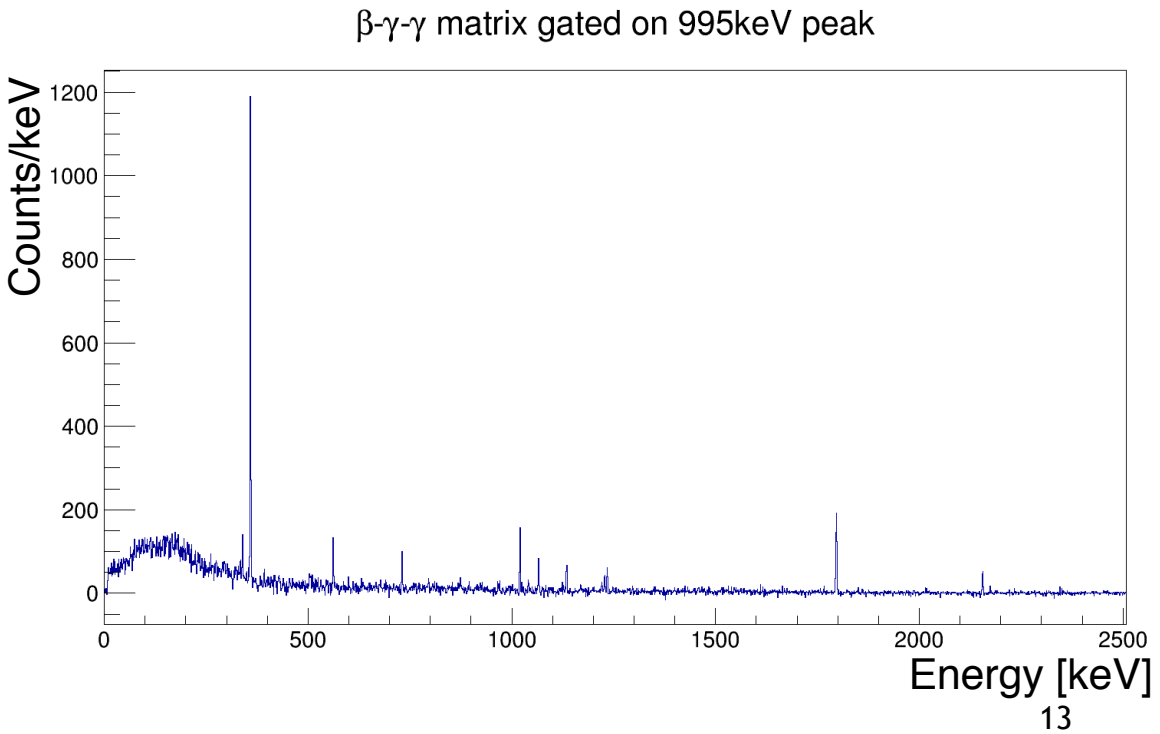
cycle structure of # of β



Coincidence Analysis

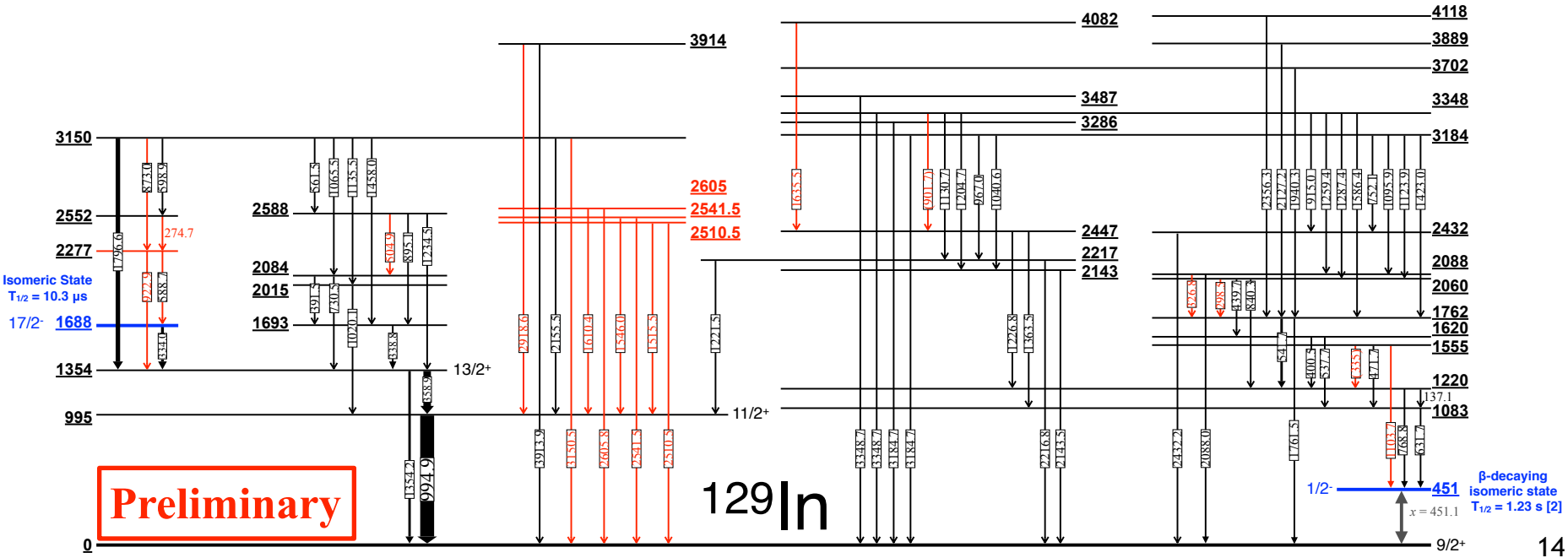
- Transitions in a cascade are (usually) coincidental
  - ➡ Gate on a transition





Level Scheme

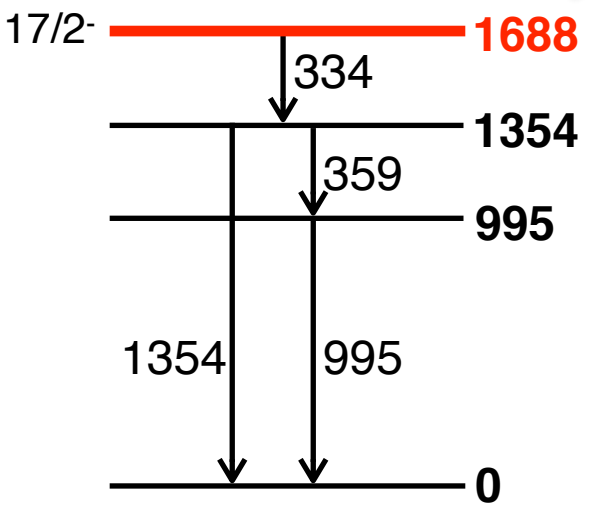
- New transitions observed & excited states established
- Generally agree with EURICA with improved uncertainties on intensities



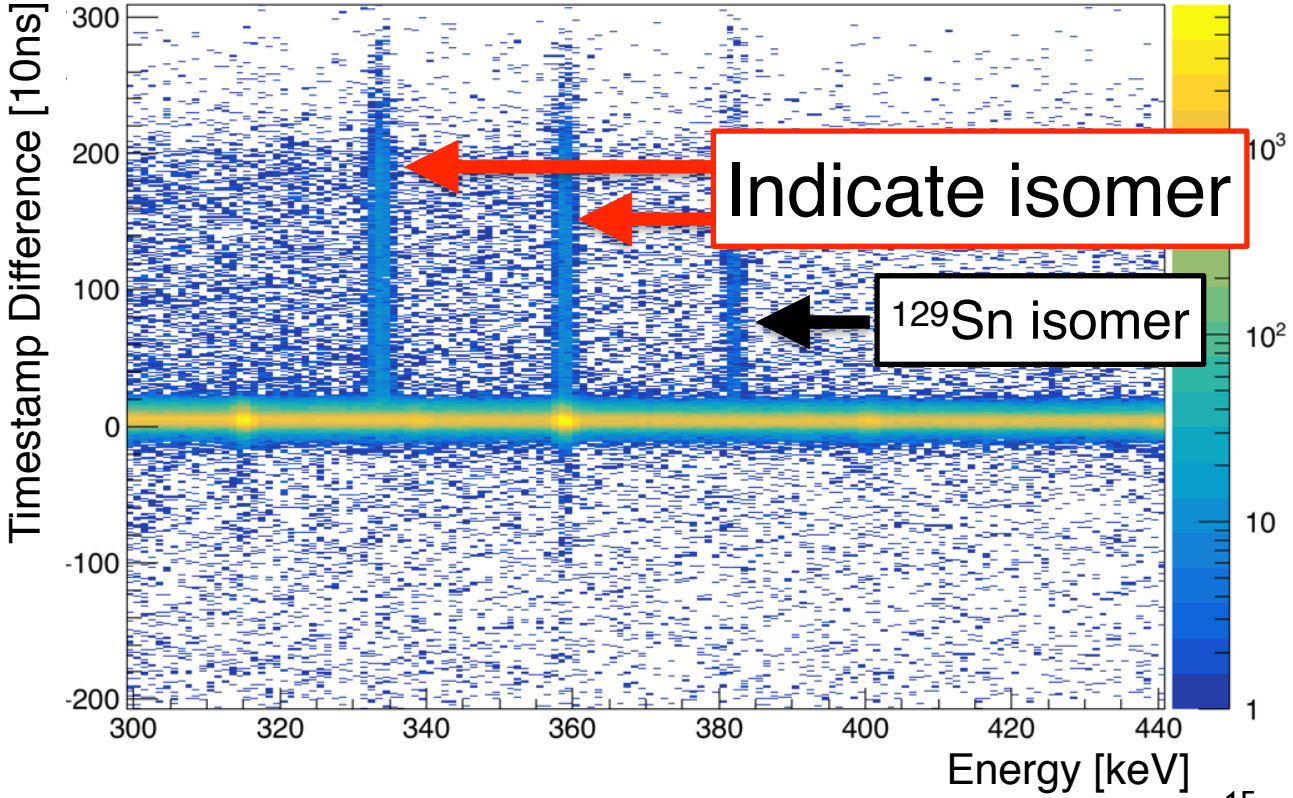
Isomer studies with GRIFFIN

Isomeric State

J. Genevey *et al.*,
Phys. Rev. C **67**, 054312 (2003).



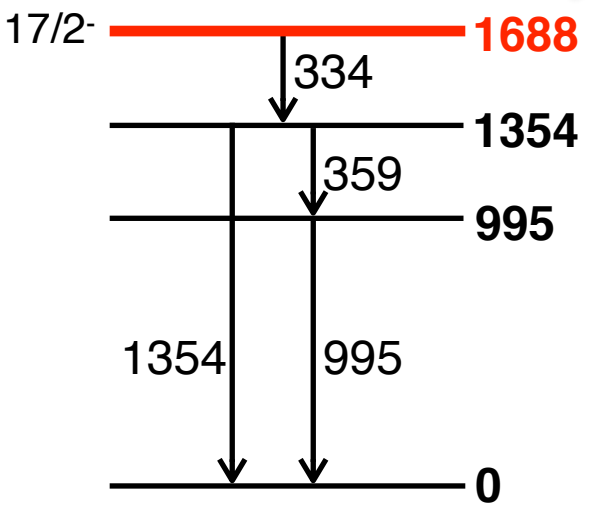
β^- and γ Time Difference



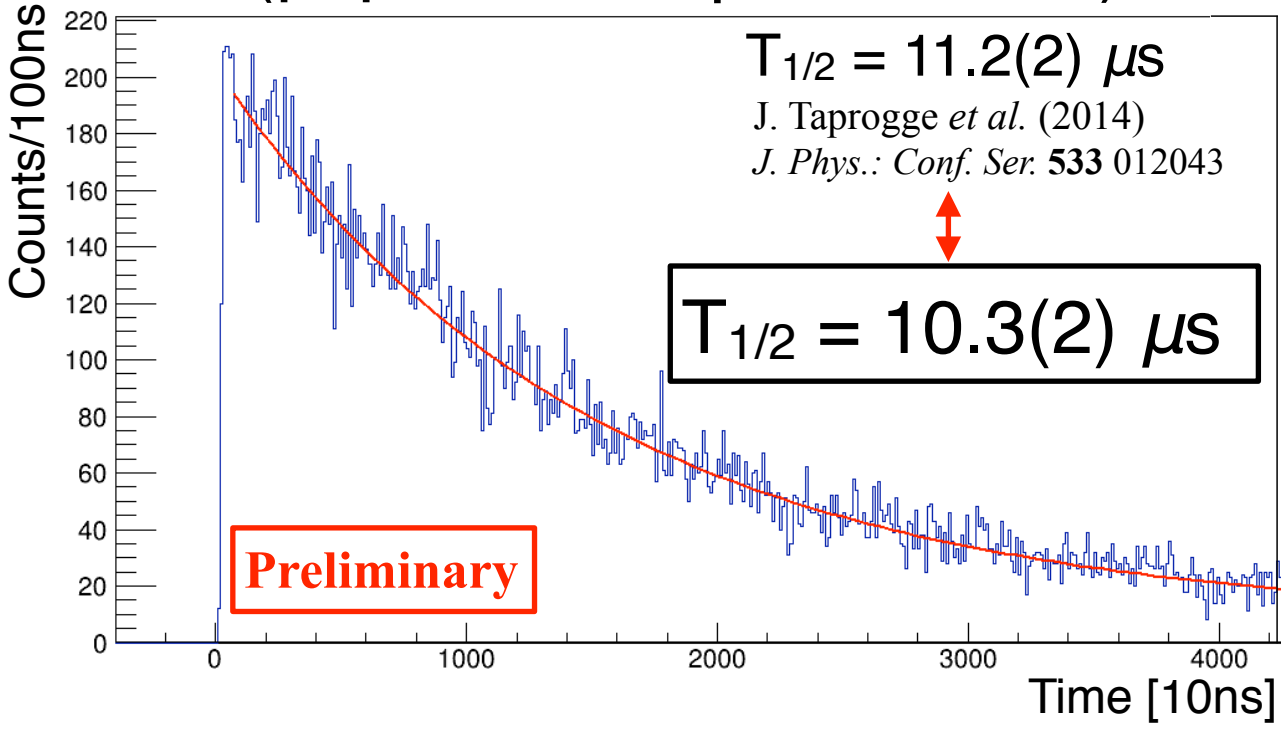
Isomer half-life

Isomeric State

J. Genevey *et al.*,
Phys. Rev. C **67**, 054312 (2003).



Decay of the Isomeric State
(β-γ timestamp difference)



Summary and Outlook

- New transitions and excited states observed
- Intensities obtained with improved precision

- Other experimental values to be determined
- Spin assignment by γ-γ angular correlation analysis
- Shell Model calculation

Acknowledgement

- **TRIUMF**
  I. Dillmann, R. Krücken, N. Bernier (Spokesperson), Y. Saito, G. C. Ball, R. Caballero-Folch, L. J. Evitts, A. B. Garnsworthy, G. Hackman, S. Hallam, J. Henderson, J. Lassen, R. Li, E. MacConnachie, M. Moukaddam, J. Park, O. Paetkau, P. Ruotsalainen, J. Smallcombe, J. K. Smith, and A. Teigelhöfer
- **Department of Physics, University of Guelph**
  R. Dunlop, V. Bildstein, C. E. Svensson, H. Bidaman, P. Boubel, C. Burbadge, M. R. Dunlop, P. E. Garrett, D. Kisliuk, A. D. MacLean, E. McGee, B. Olaizola, A. J. Radich, J. Turko, and T. Zidar
- **Instituto de Estructura de la Materia**
  A. Jungclaus
- **Department of Chemistry, Simon Fraser University**
  C. Andreoiu, F. Garcia, J. L. Pore
- **Department of Physics, Colorado School of Mines**
  S. Ilyushkin
- **Universidad Nacional Autónoma de México, Instituto de Ciencias Nucleares**
  E. Padilla-Rodal
- **Centre de Sciences Nucléaires et Sciences de la Matière**
  C. M. Petrache
- **Department of Physics, Florida State University**
  S. L. Tabor

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Thank you!
Merci!

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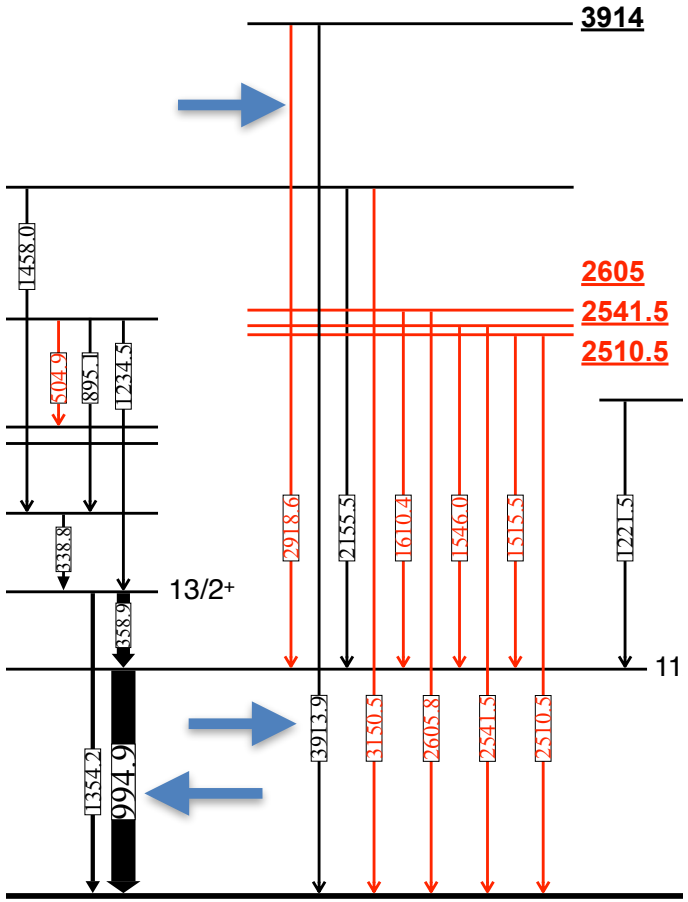
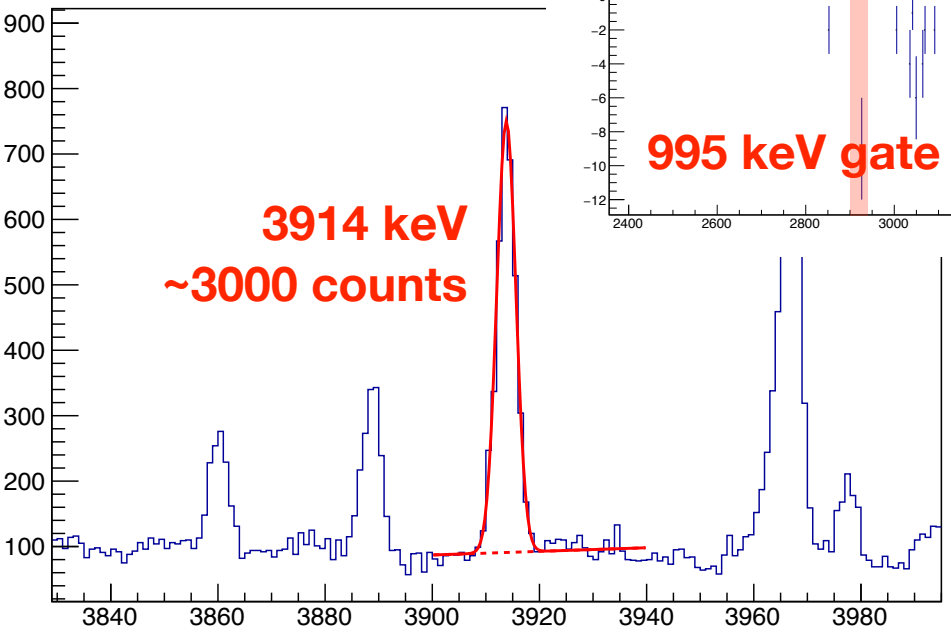
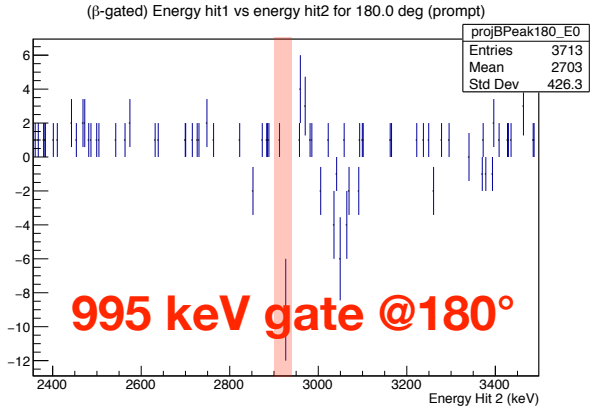
Summed Peak?

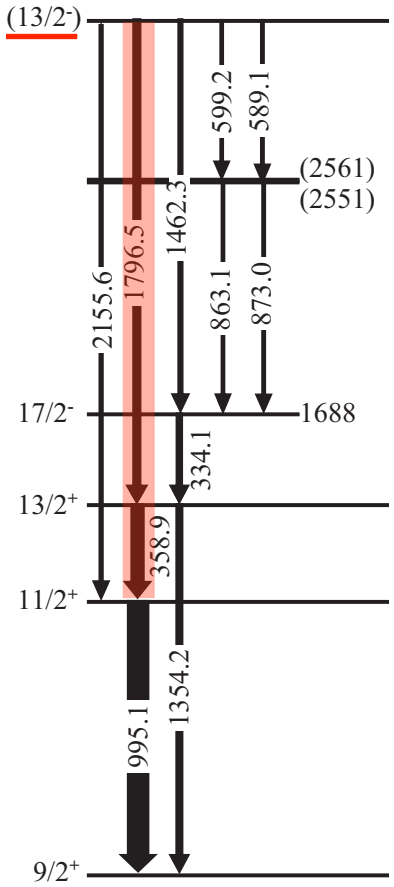


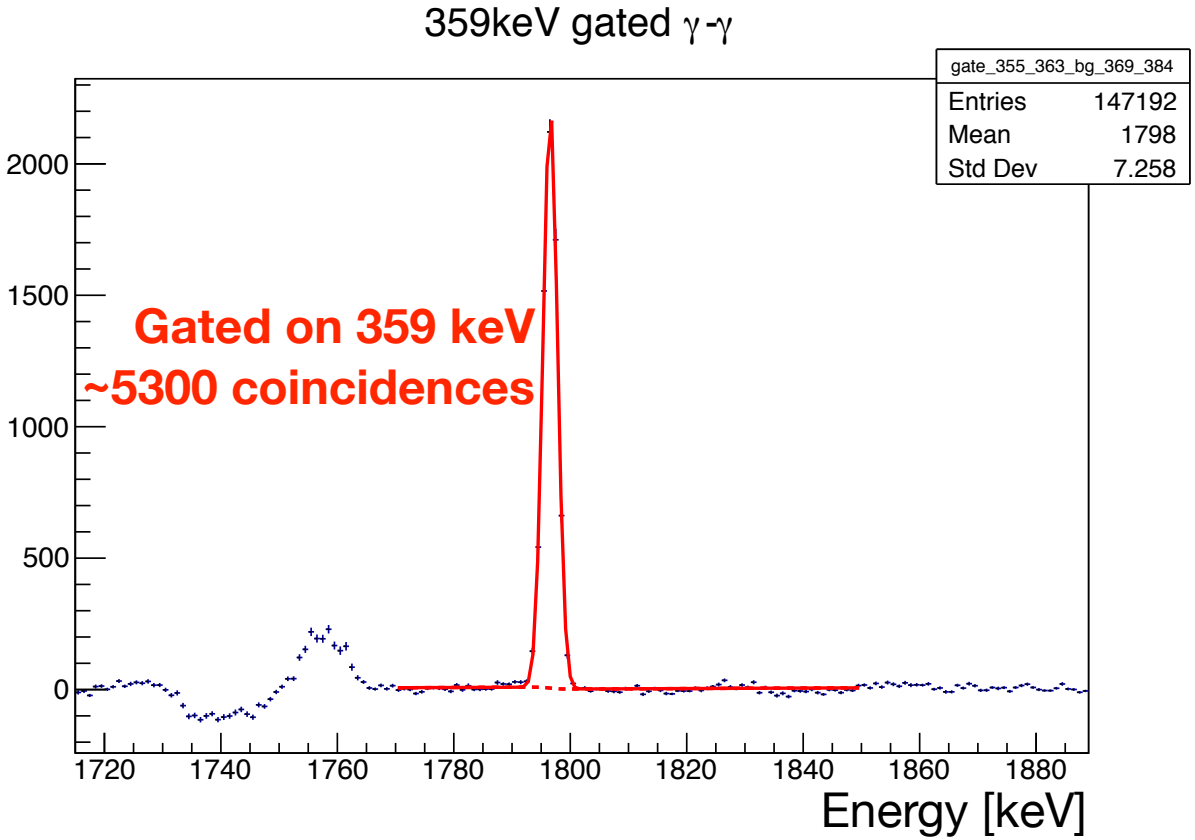
995 keV + 2919 keV = 3914 keV





possible γ-γ ang. correlation analysis





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