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

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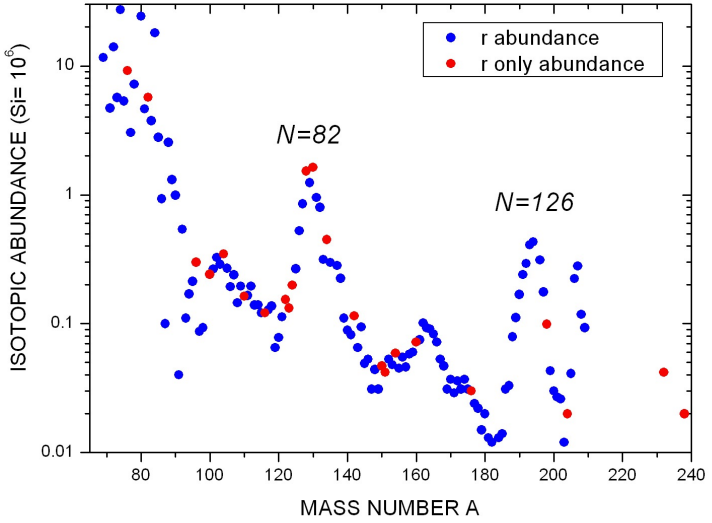
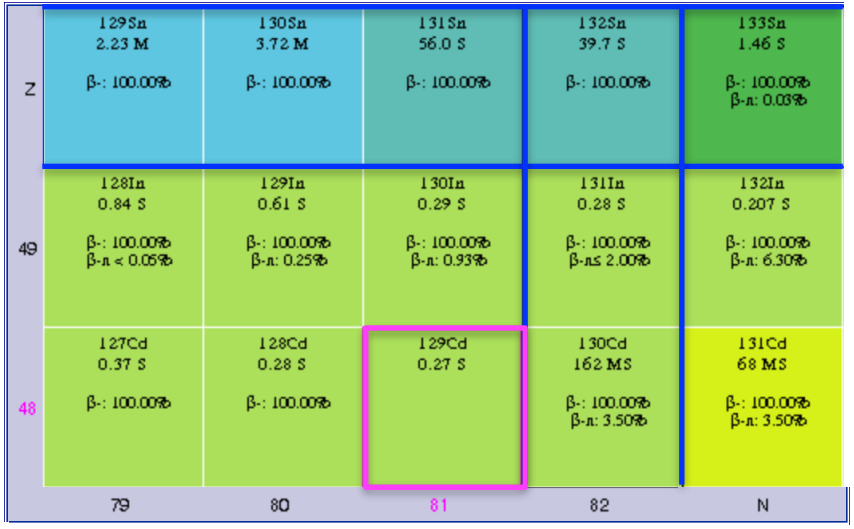
May 30th, 2017

Motivation

^{129}Cd

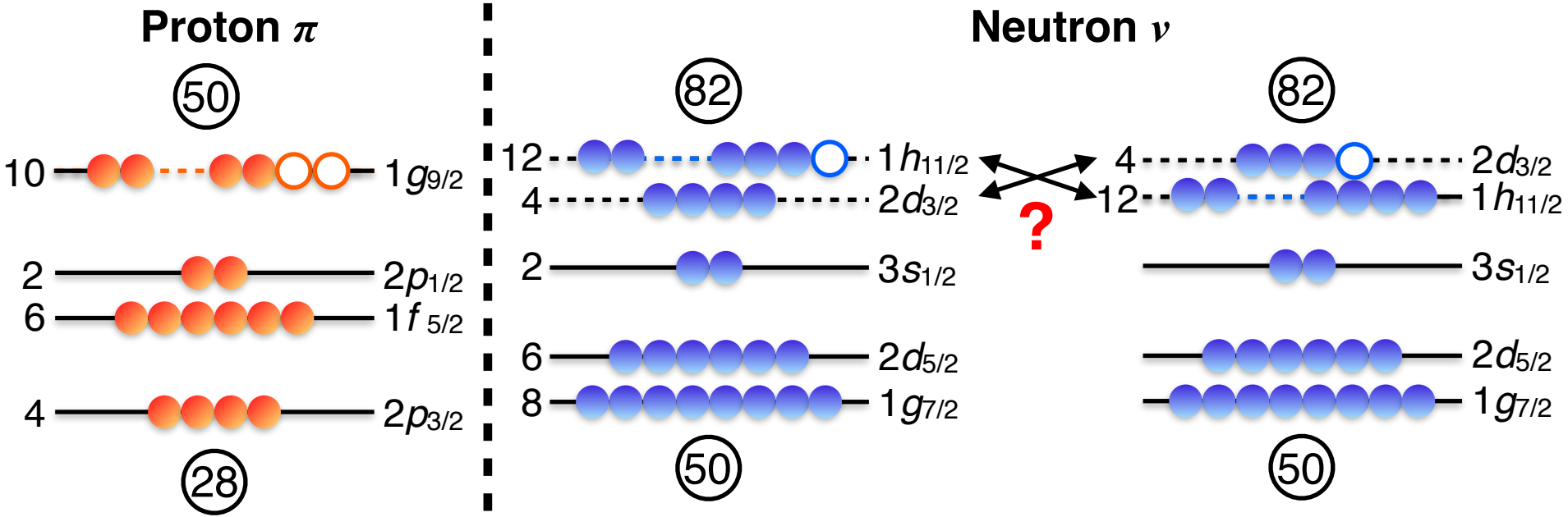
- ^{129}Cd: Below doubly magic ^{132}Sn
  - ➡ 2π-hole and 1ν-hole relative to ^{132}Sn
    - Single particle states
  - ➡ r-process abundance peak at A ≈ 130



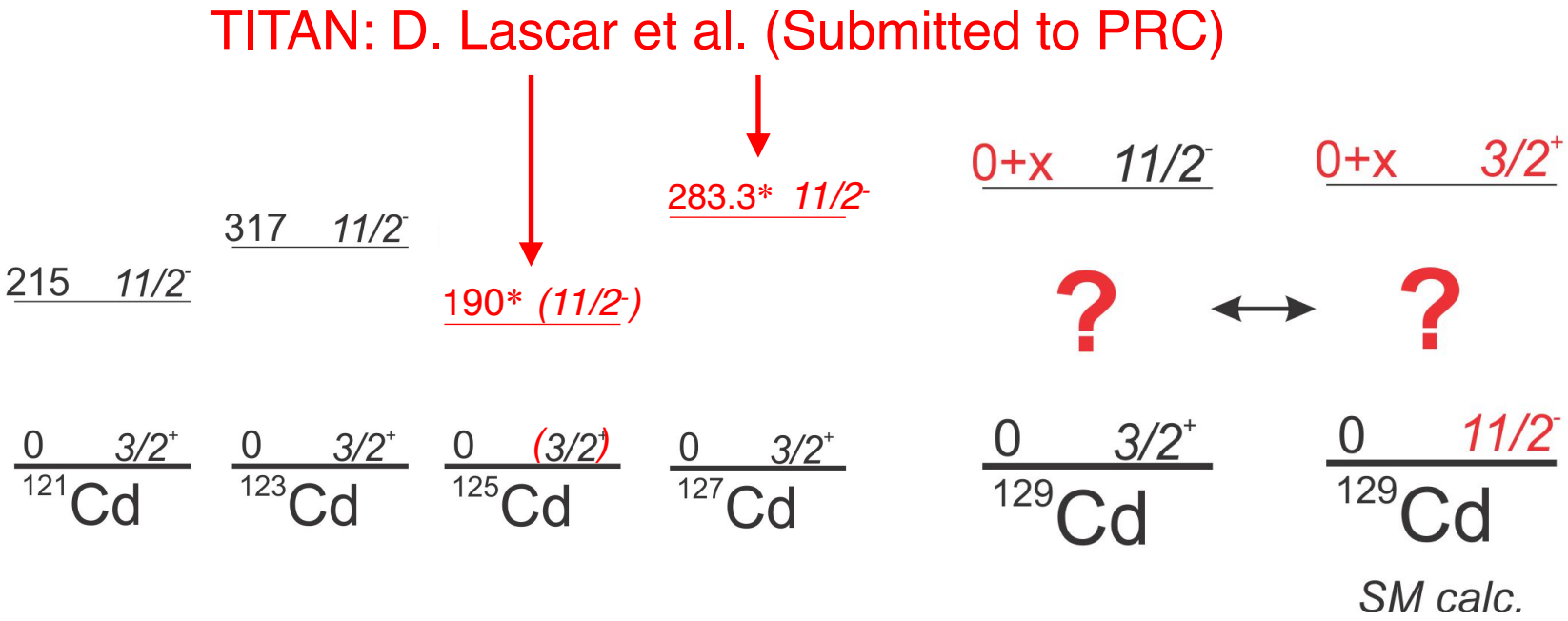


^{129}Cd Open Question

- Spin and parity of the ground state

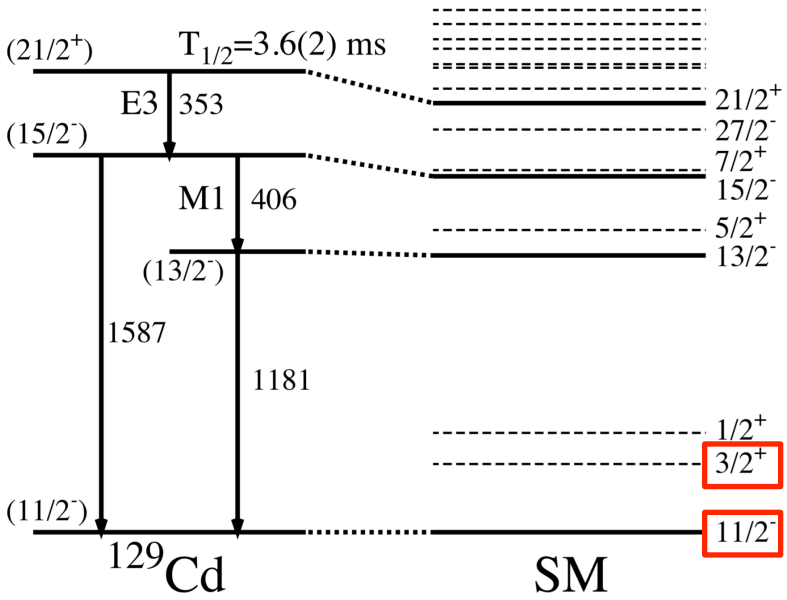


Odd - A Cd Isotopes

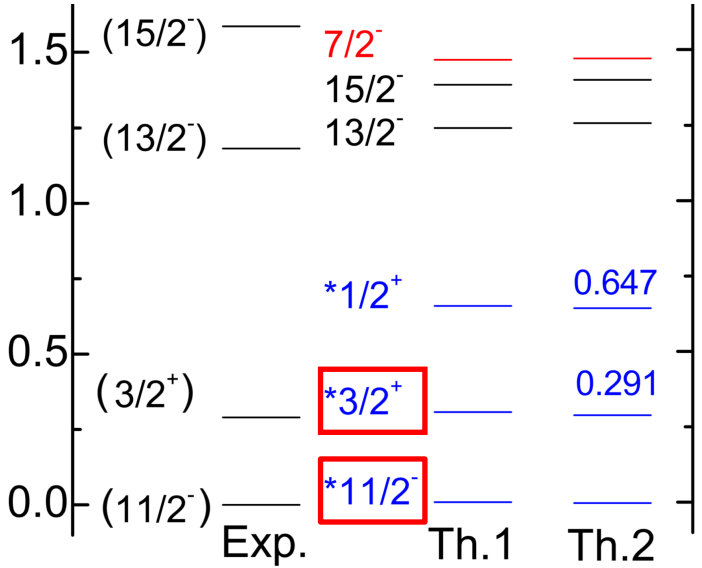


^{129}Cd Shell Model Calculation

- Two recent SM calculations suggest 11/2$^-$ GS



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



Wang et al., PRC 95, 01134(R) (2017)

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

- Both have similar half lives

$$\begin{cases} T_{1/2}(11/2^-) = 147(3)\ \text{ms} \\ T_{1/2}(3/2^+) = 157(8)\ \text{ms} \end{cases}$$

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

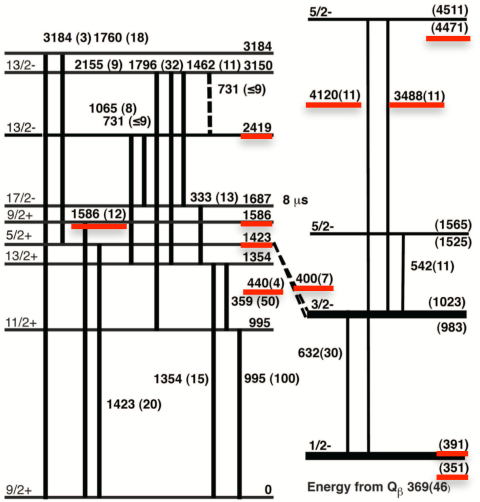
$$\begin{cases} T_{1/2}(11/2^-) = 155(3)\ \text{ms} \\ T_{1/2}(3/2^+) = 146(8)\ \text{ms} \end{cases}$$

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

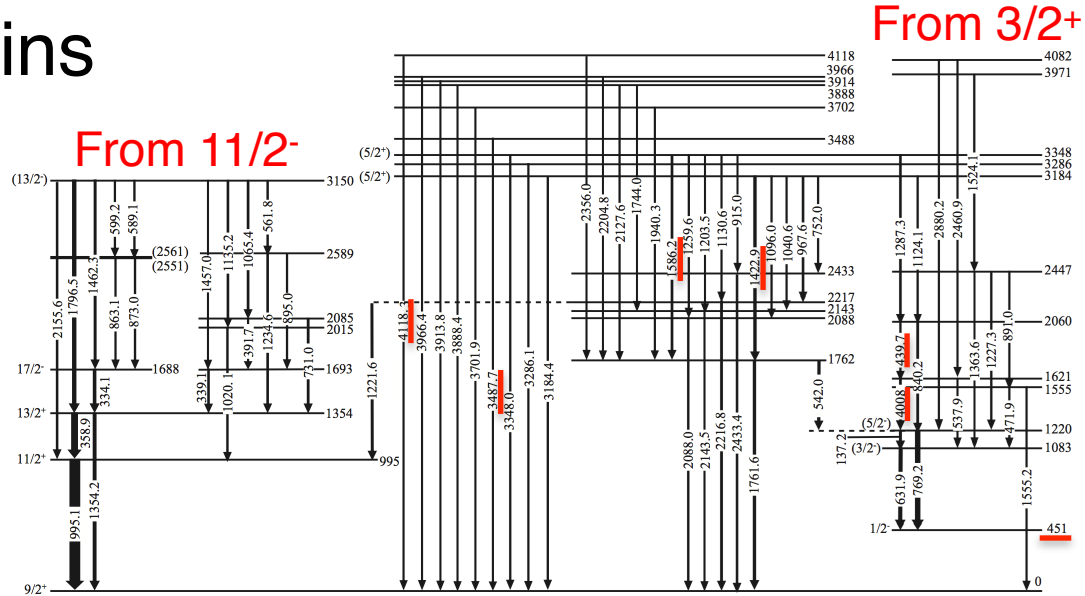
- Isomeric Transition (IT) between the two states is highly suppressed (M4)
- Need direct mass measurement and laser spectroscopy to determine the order
- Two states populate different states in ^{129}In via β-decay

Previous work on the β-decay of ^{129}Cd

- Previous Results
  - ➡ Discrepancy between two level schemes
  - ➡ Unassigned spins



^{129}In



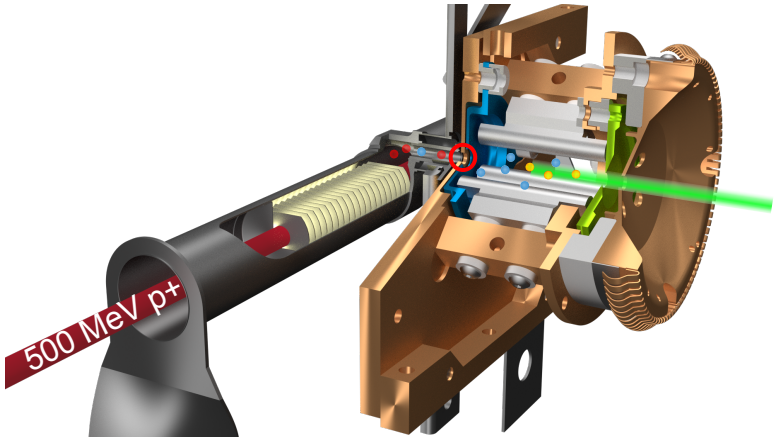
ISOLDE: O. Arndt et al., Acta Phys. Pol. B40, 437 (2009).

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

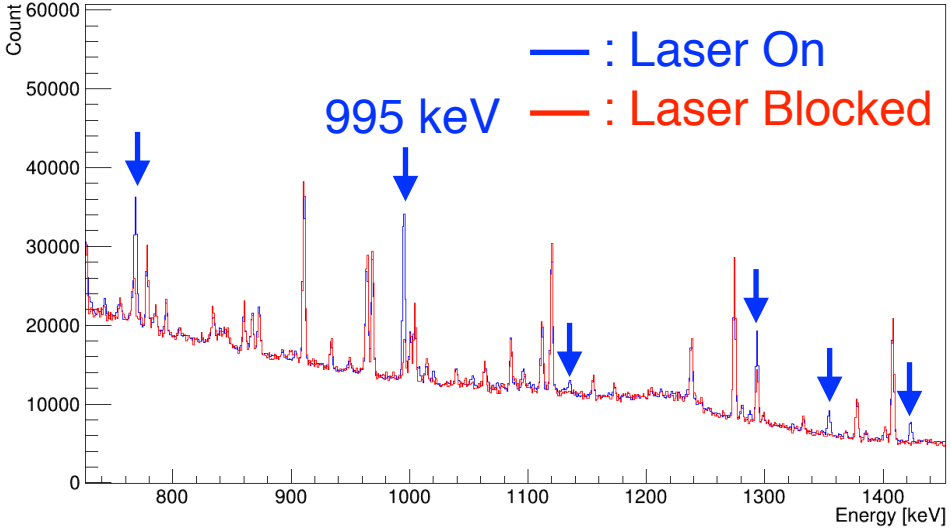
Experiment and Analysis

IGLIS: Ion Guide Laser Ion Source

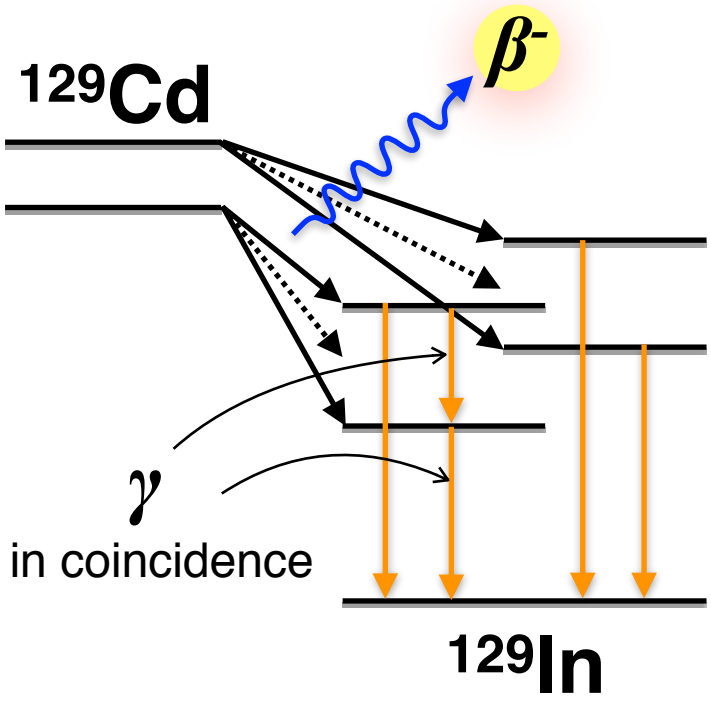
- **IGLIS** - Isotope selective ionization and suppression of surface-ionized species (e.g. Cs, In)
  - ➡ Cleaner beam
  - ➡ Laser on/ blocked spectrum to distinguish peaks



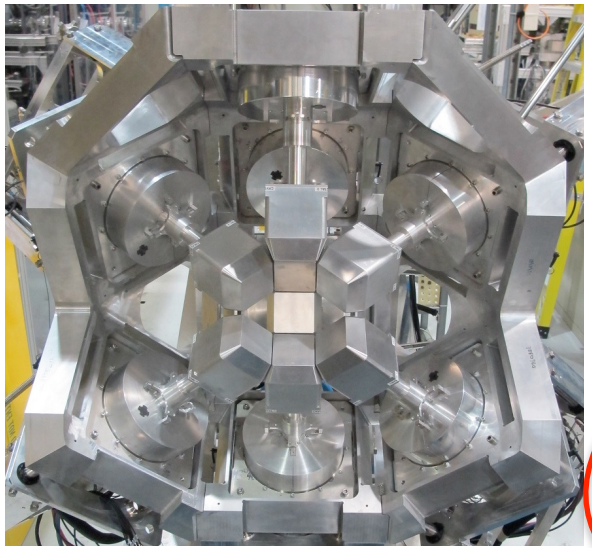
From H. Heggen.
ISAC Operators Talk. Feb 6, 2014



β-decay Spectroscopy of ^{129}Cd

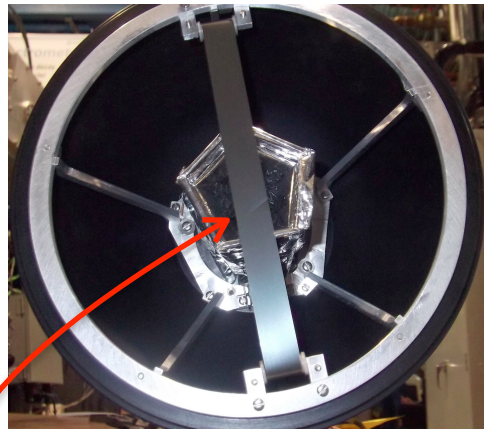


γ rays ⟵ β-tagging



GRIFFIN

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

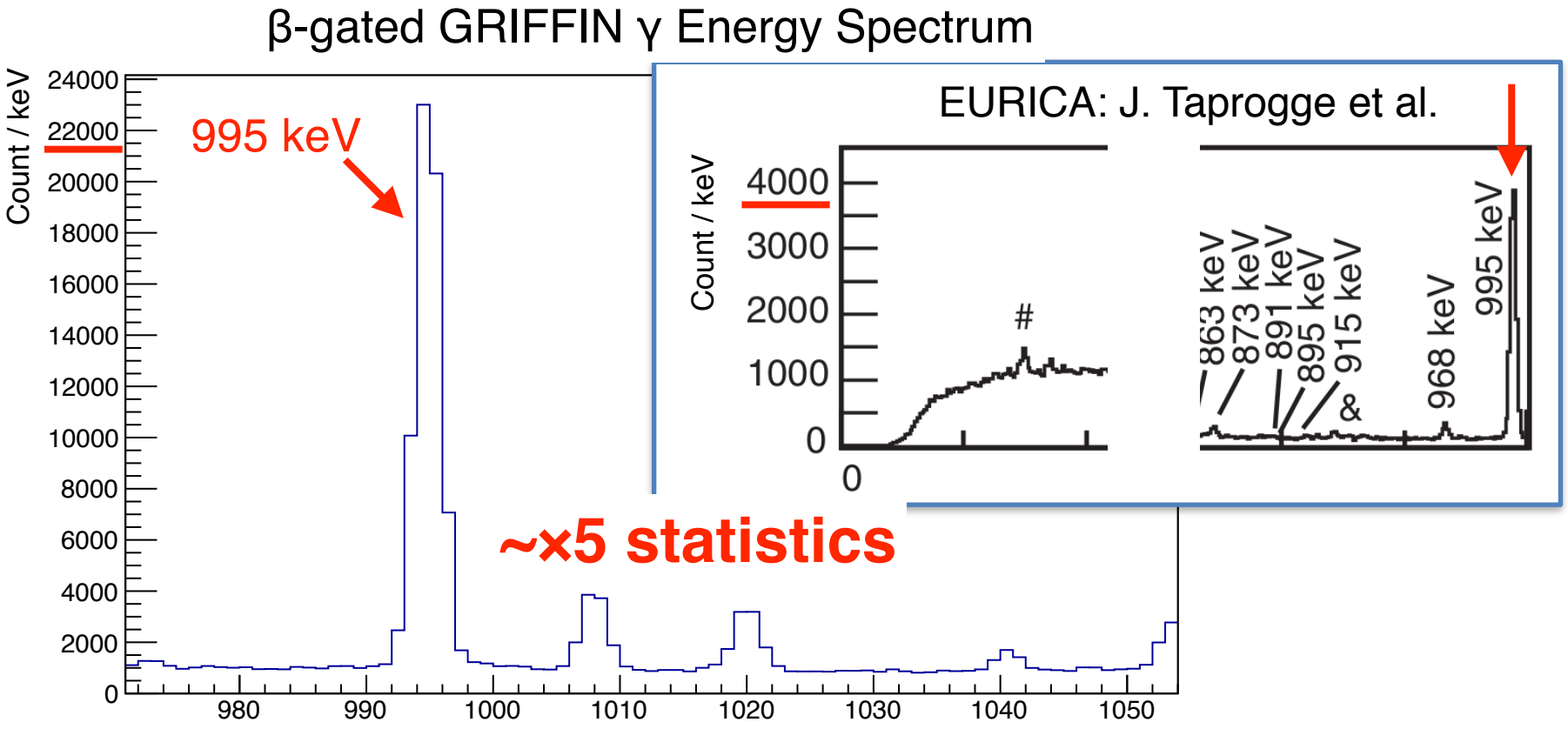


SCEPTAR

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

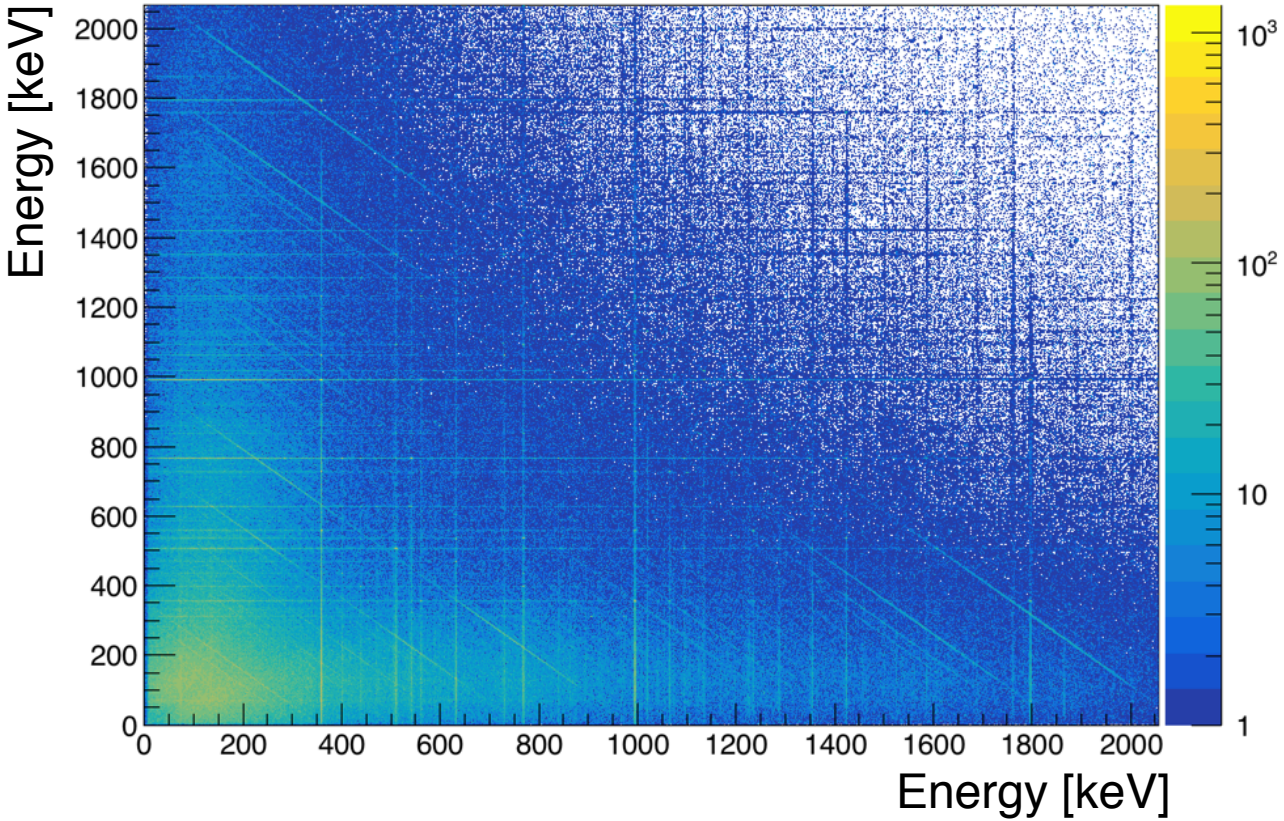
Moving Tape Collector

Statistics


β-gated GRIFFIN γ Energy Spectrum
Count / keV
995 keV
~×5 statistics
EURICA: J. Taprogge et al.
Count / keV
#
863 keV
873 keV
891 keV
895 keV
915 keV
968 keV
995 keV

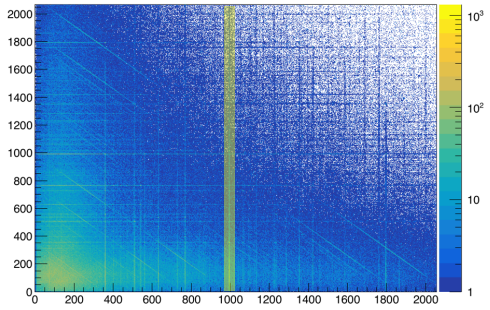
Coincidence Analysis

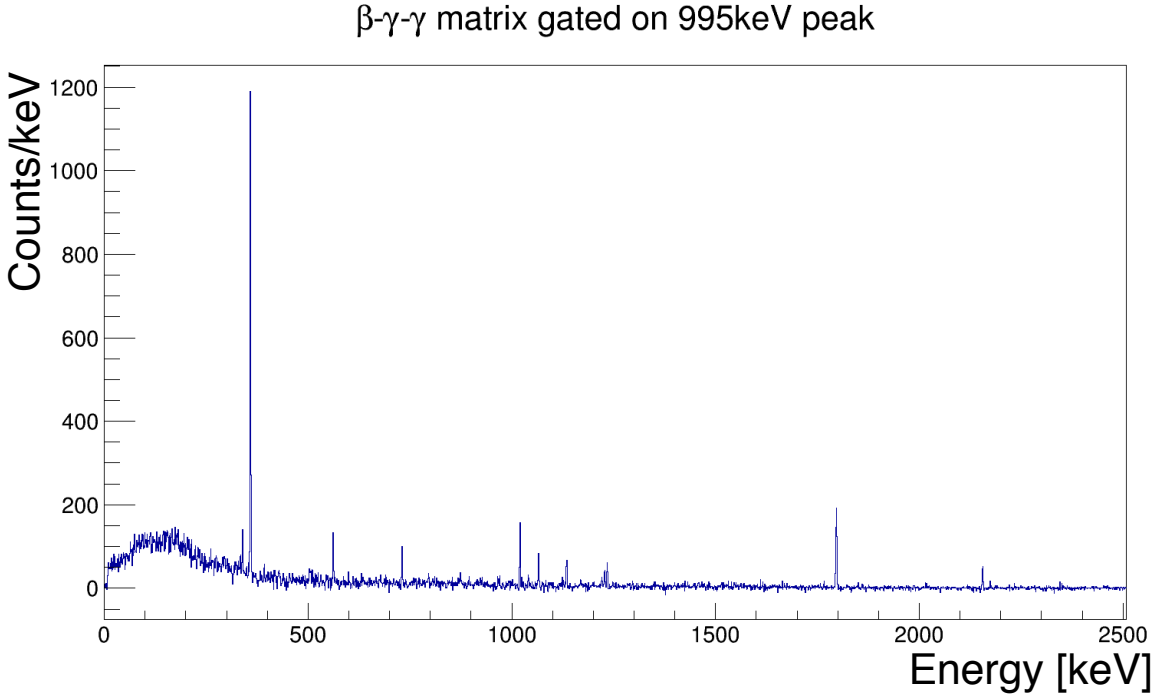
1. Build γ-γ coincidence matrix



Coincidence Analysis

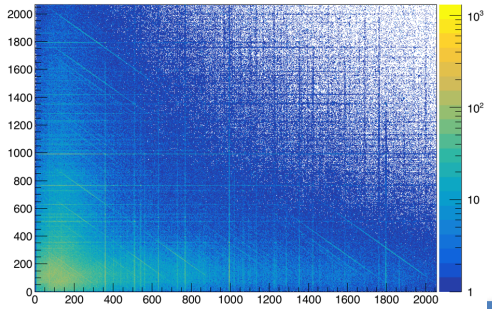
1. Build γ-γ coincidence matrix
2. Gate on a peak to see other peaks in coincidence

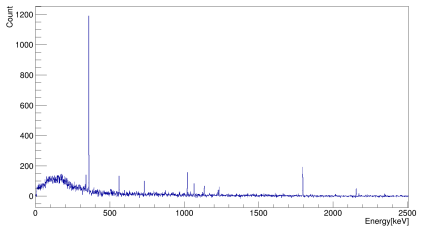


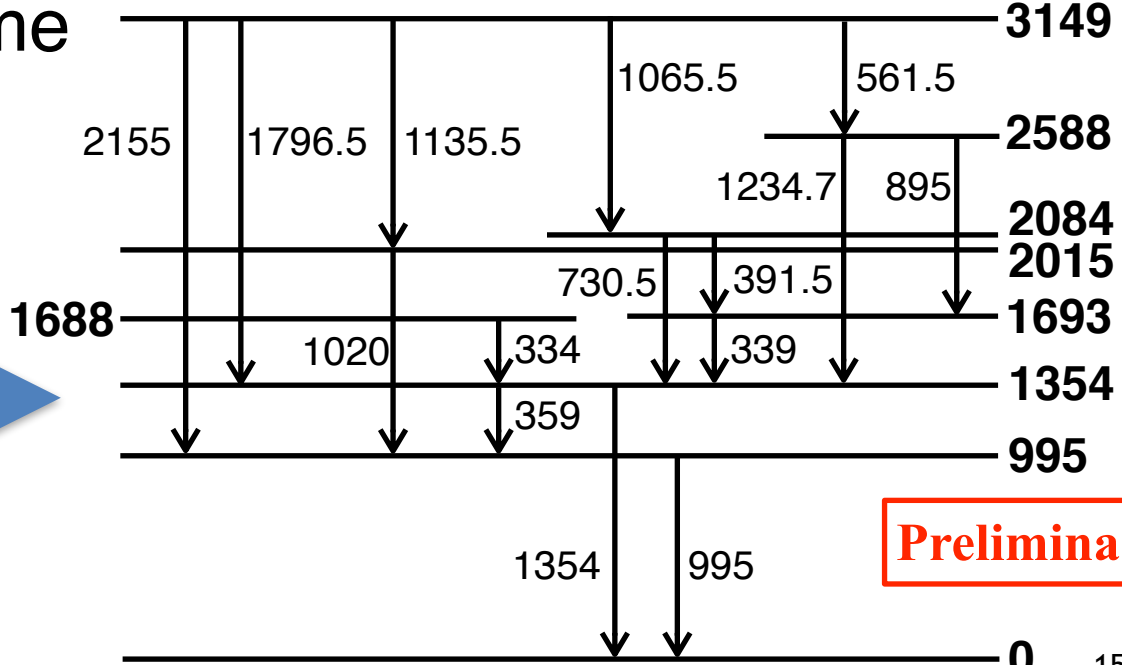


Coincidence Analysis

1. Build γ-γ coincidence matrix
2. Gate on a peak to see other peaks in coincidence
3. Build level scheme



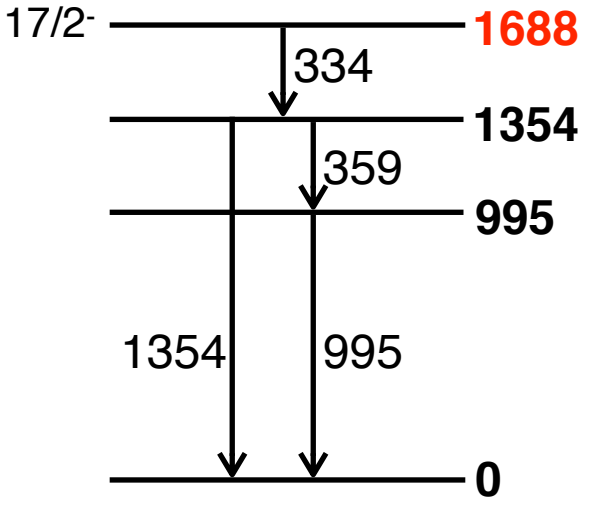




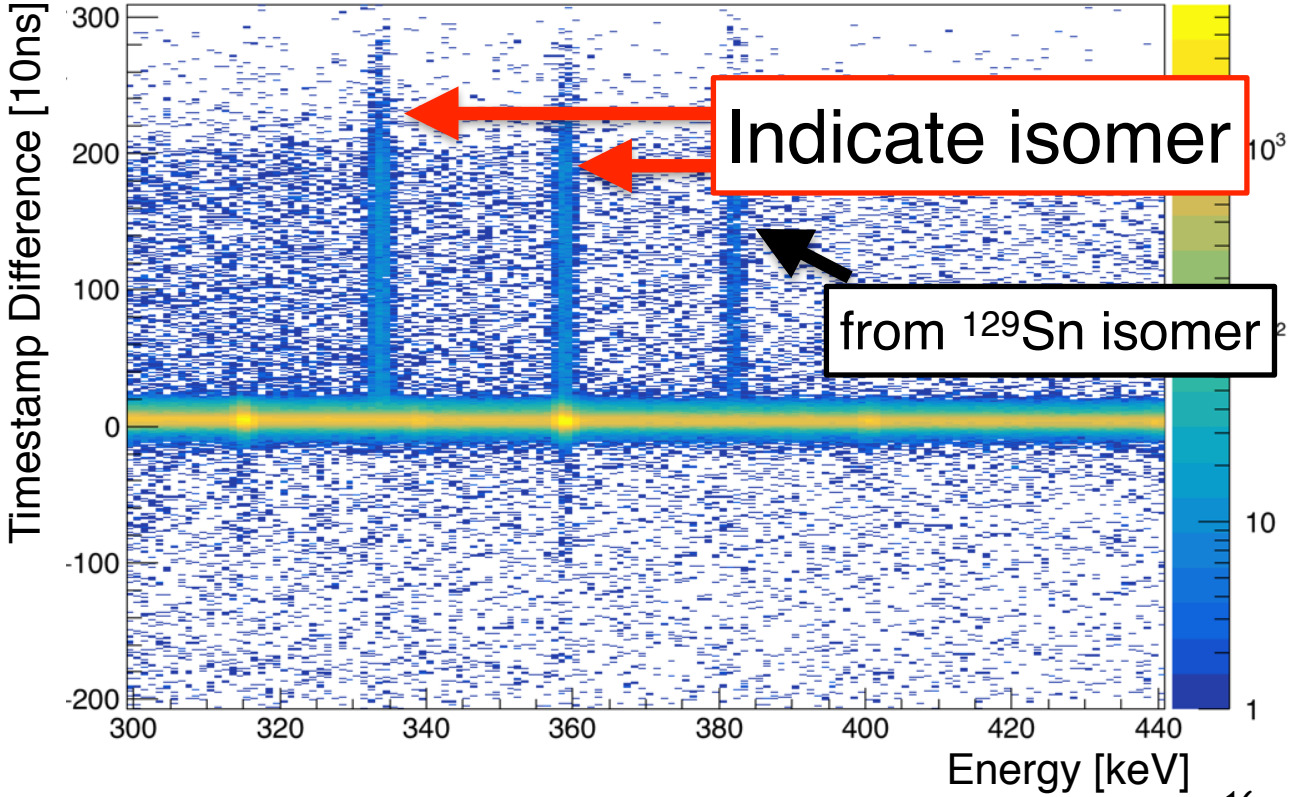
Isomer

Isomeric State

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



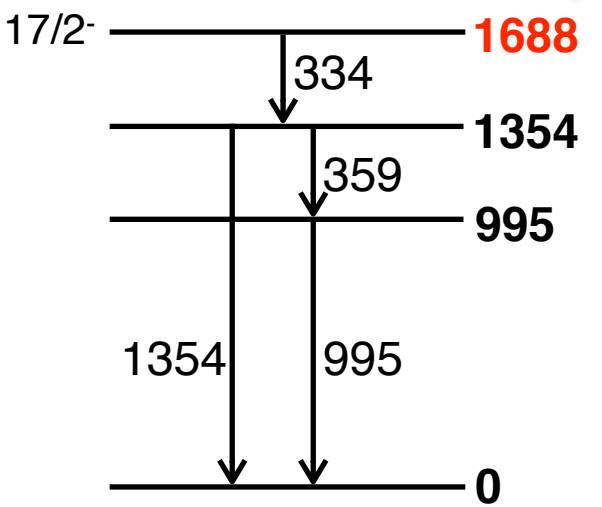
β^- and γ Time Difference



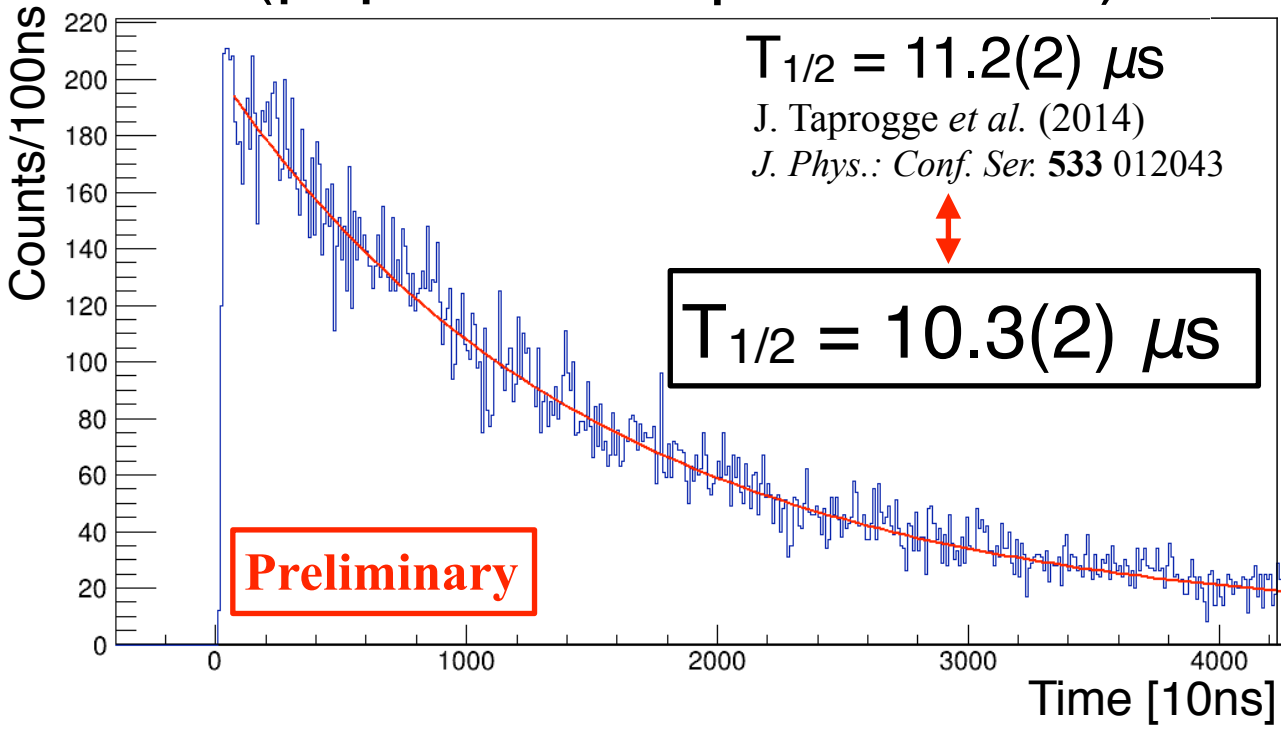
Isomer half-life

Isomeric State

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



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



Summary and Outlook

- So far mostly agree with EURICA results

- Further coincidence analysis to build my own level scheme
- Seek for weaker transitions and assign more spins to energy levels by exploiting high statistics

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**
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Thank you!
Merci!

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