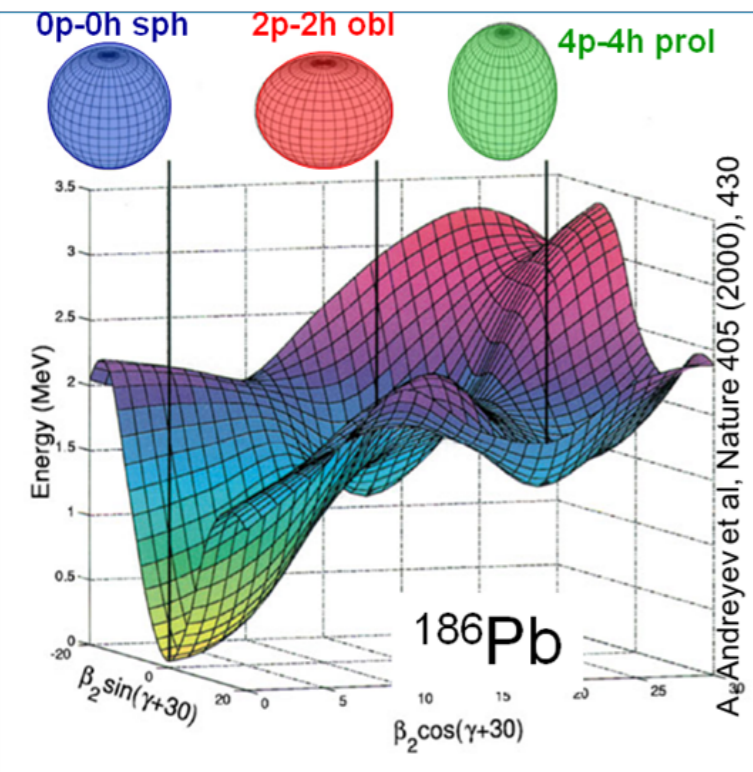


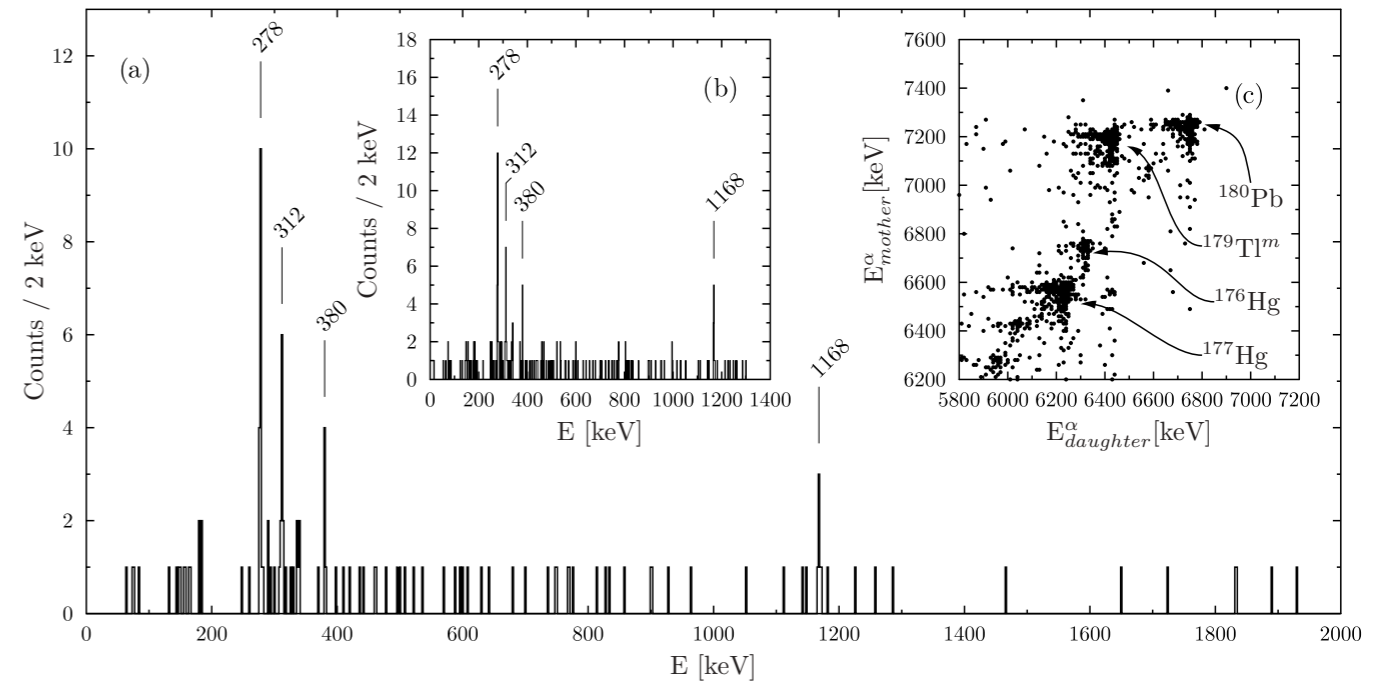
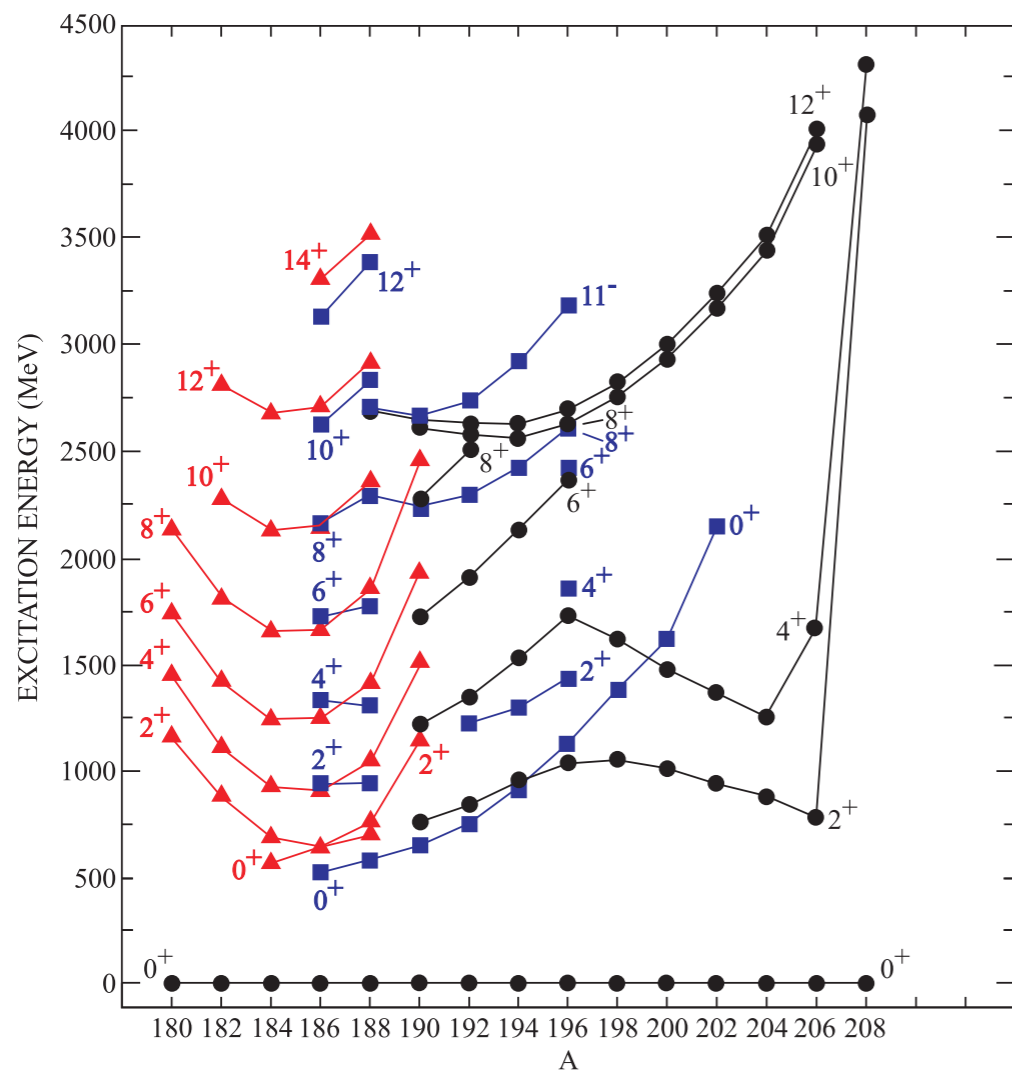
***Shape coexistence in the light  
radon nuclei***

David Jenkins  
*University of York*

Presented by Liam Gaffney  
*KU Leuven*

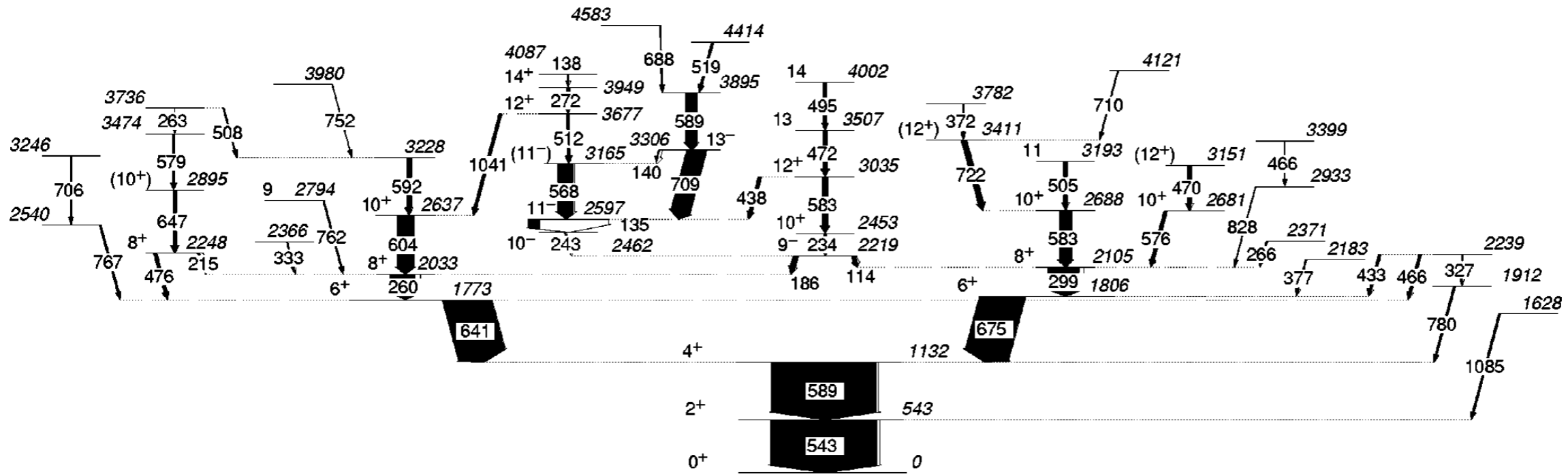


## Shape coexistence around Z=82

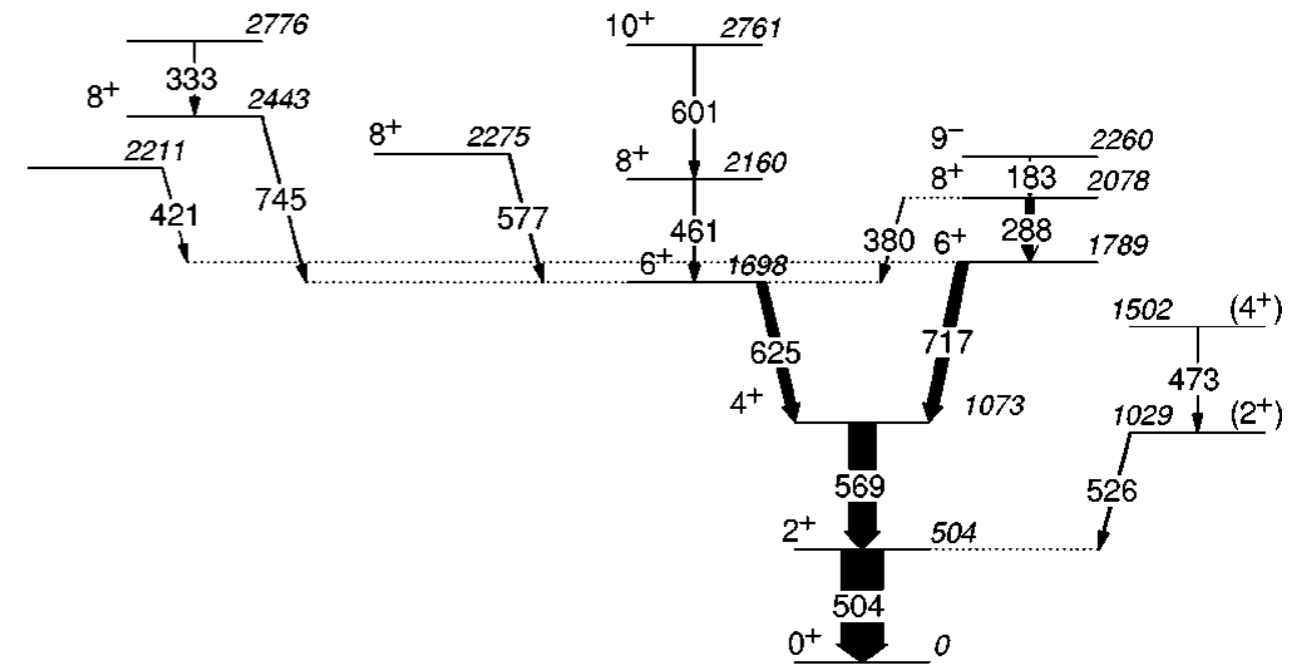
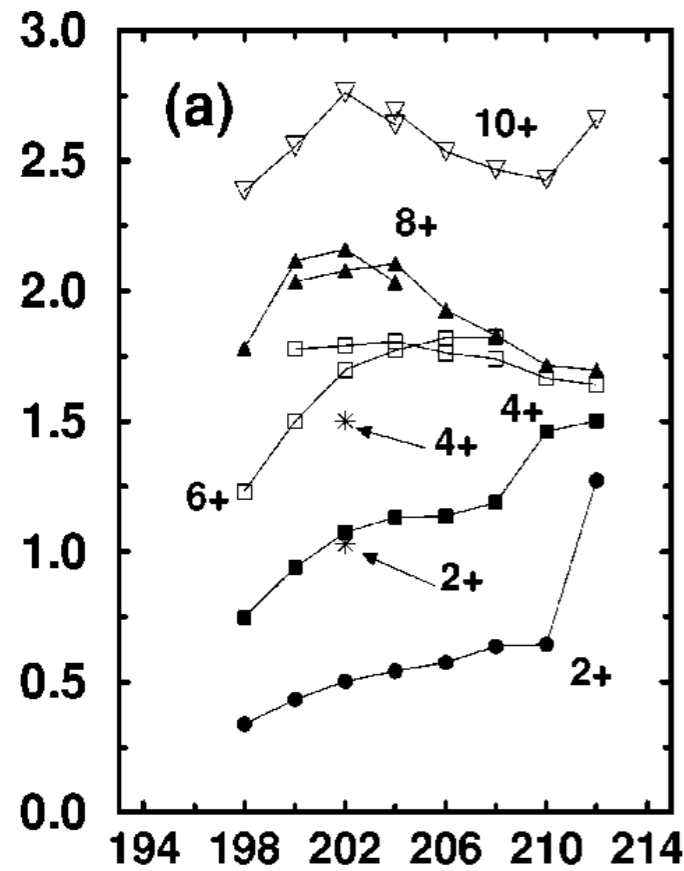


First identification of excited states in  $^{180}\text{Pb}$   
P. Rahkila, D. G. Jenkins et al.,  
Phys. Rev. C **82**, 11303 (2010)

# Light radon nuclei



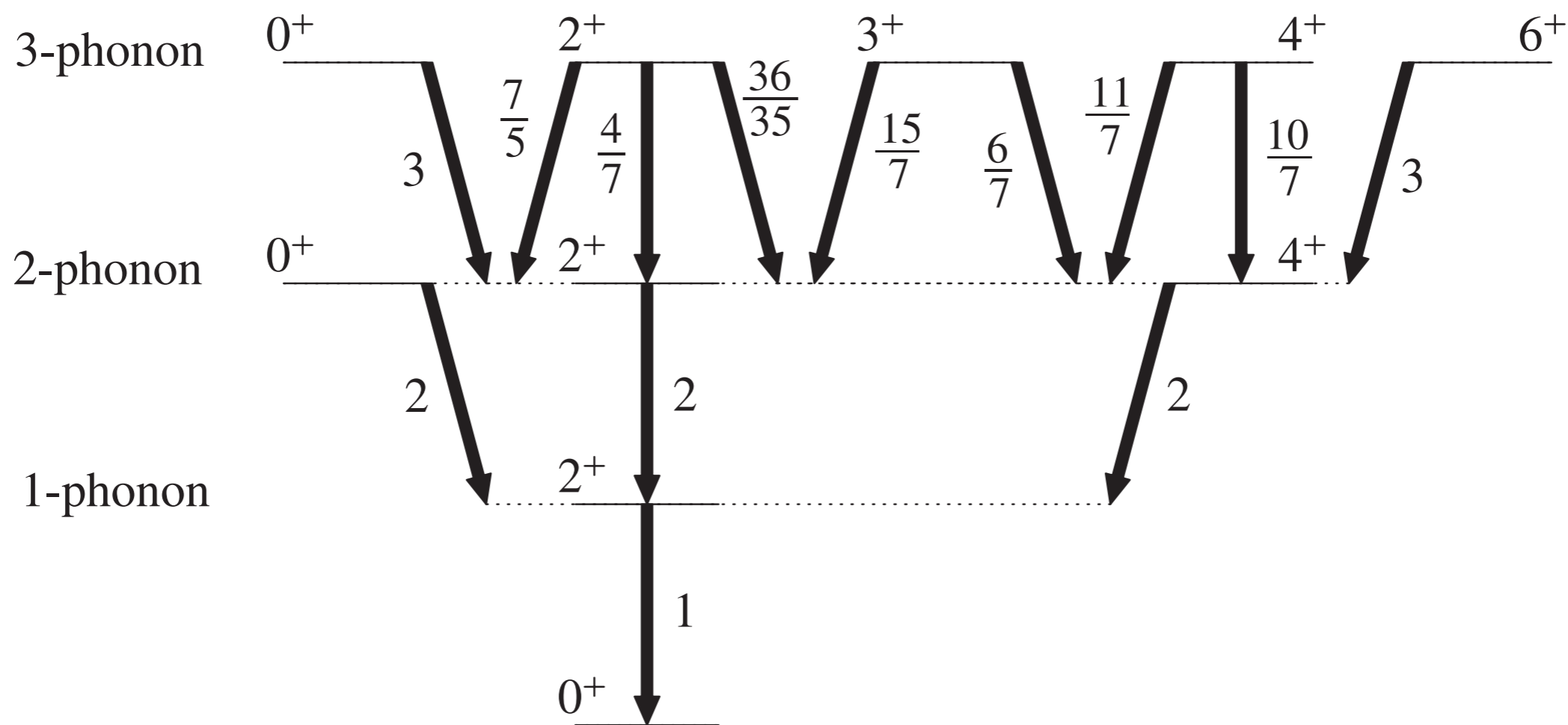
$^{204}\text{Rn}$



$^{202}\text{Rn}$

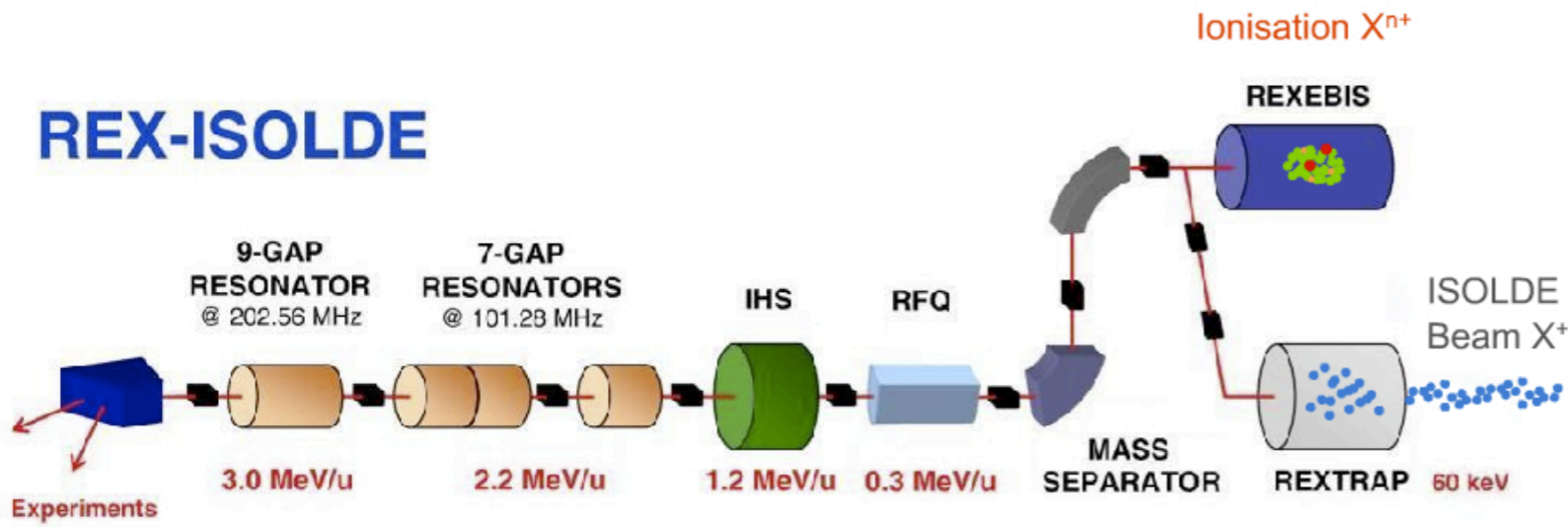
D.J. Dobson et al.,  
PRC 66 064321 (2002)

# Expected structure and transition strengths for a vibrational nucleus



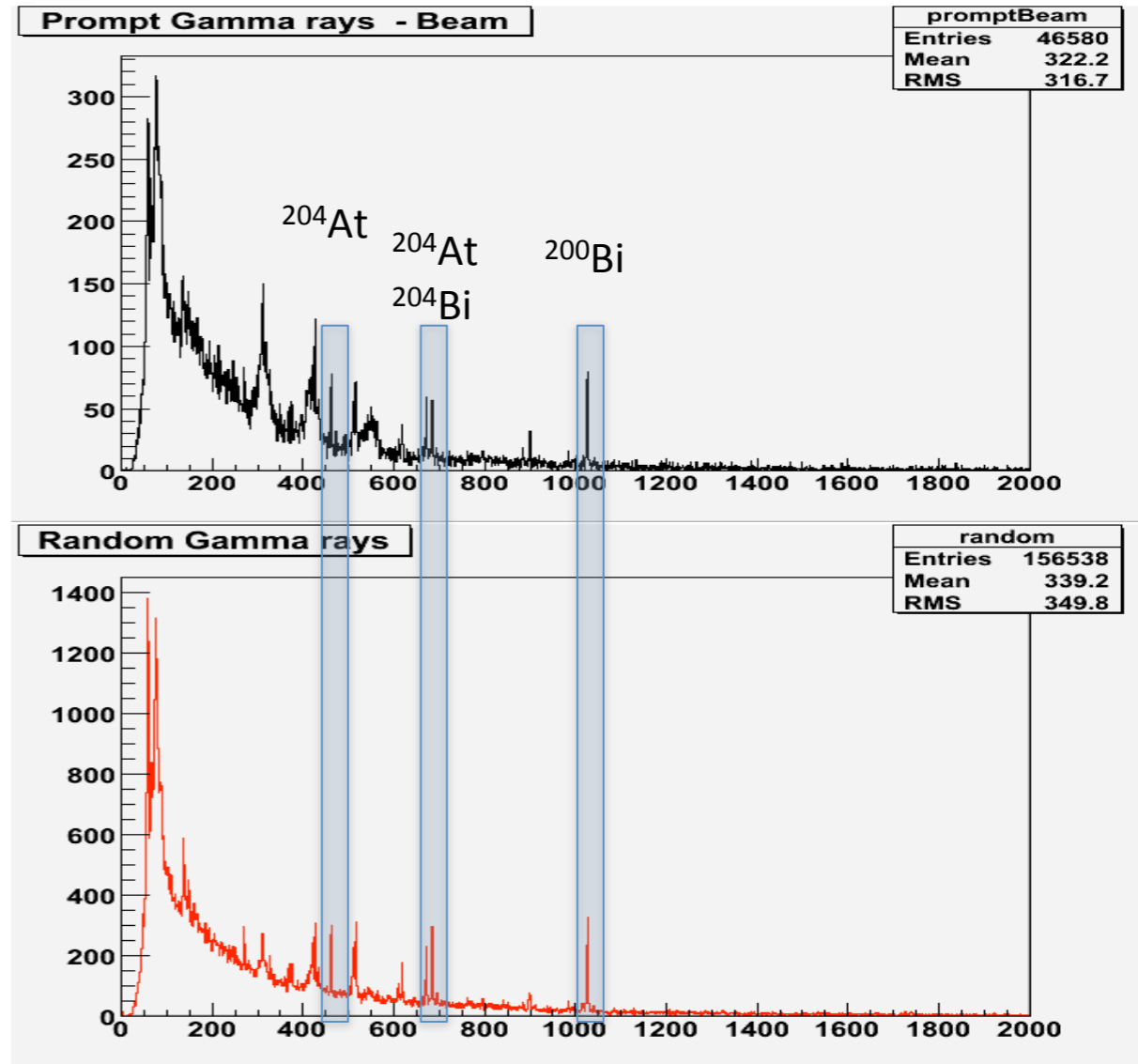
# REX-ISOLDE

## REX-ISOLDE



Bunching

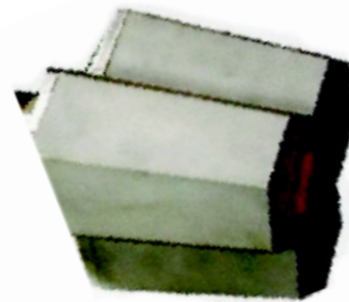
	Energy	Hours
$^{204}\text{Rn}$	2.9 MeV / u	69
$^{202}\text{Rn}$	2.9 MeV / u	16
$^{202}\text{Rn}$	2.28 MeV / u	26





# Experimental setup

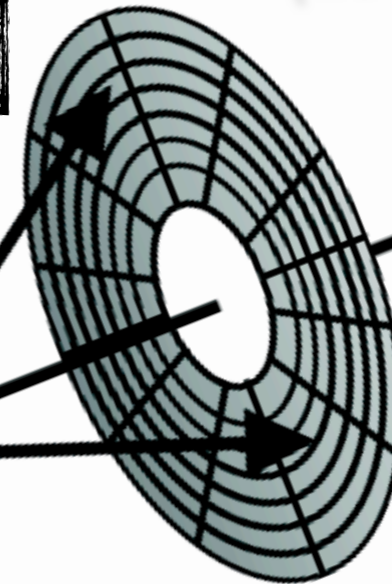
2008:  
x7 Miniball clusters  
x19 cores in total



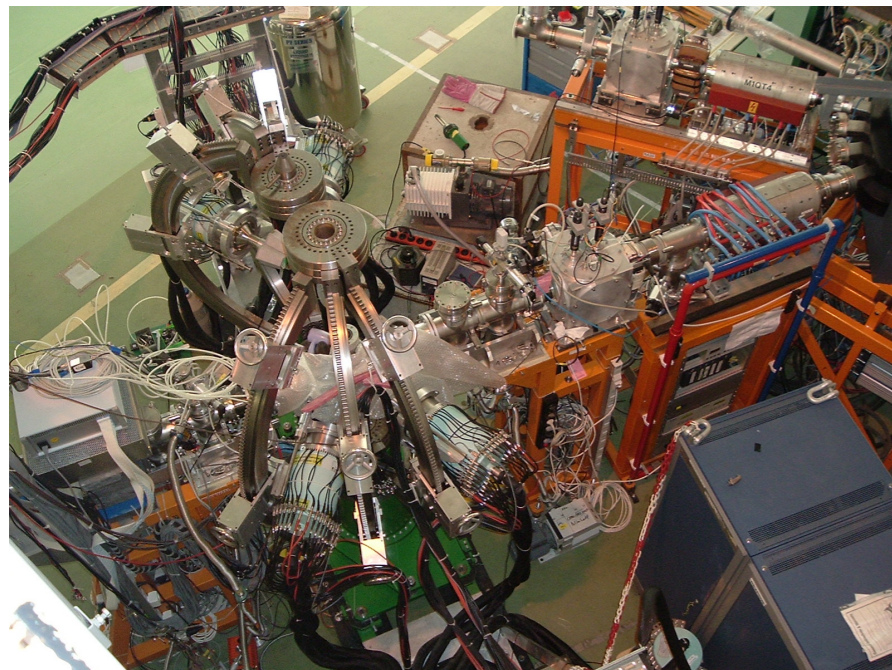
$^{109}\text{Ag}$   
 $1.9 \text{ mg cm}^{-2}$   
 $4.0 \text{ mg cm}^{-2}$

$^{120}\text{Sn}$   
 $2.0 \text{ mg cm}^{-2}$

CD detector  
( $16^\circ$ - $53^\circ$ )

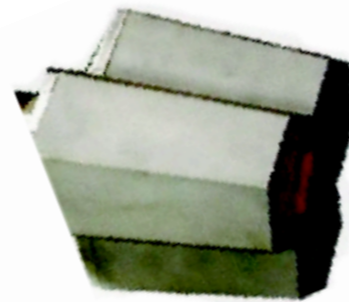


$^{202,204}\text{Rn}$  from  
REX-ISOLDE



# Experimental setup

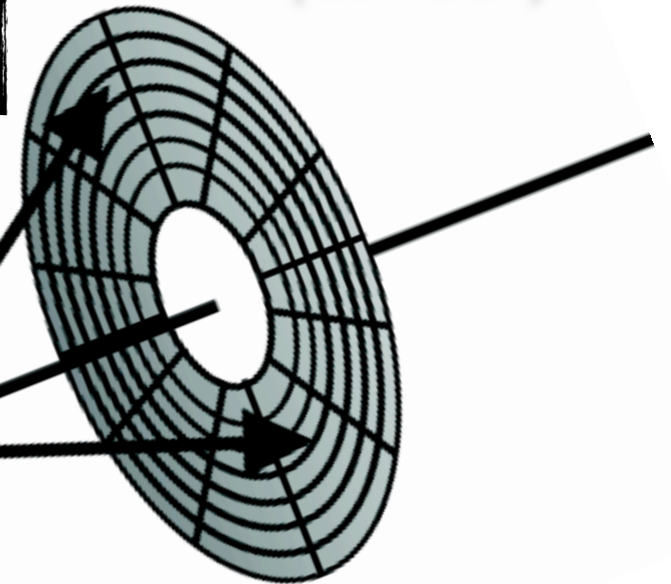
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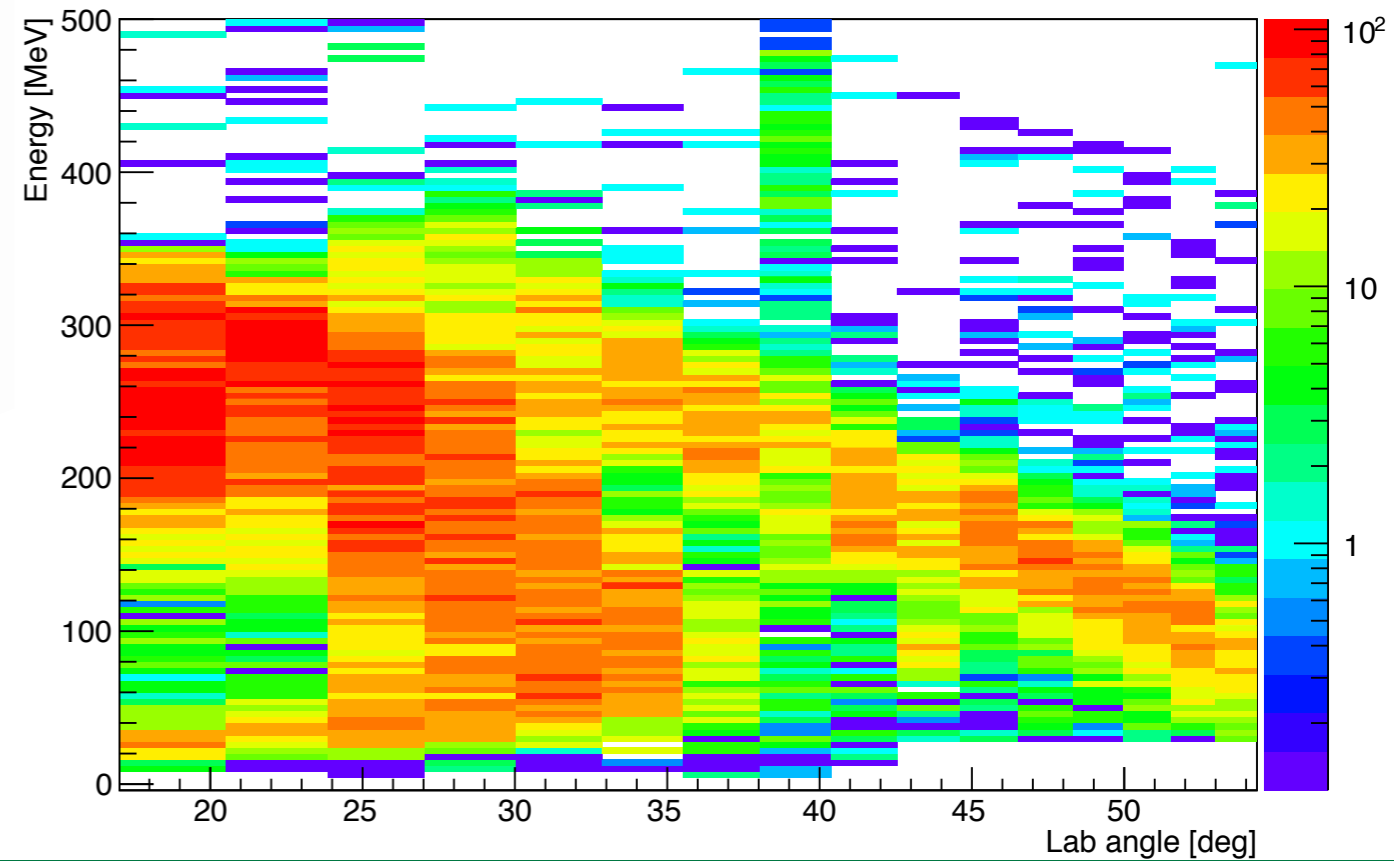
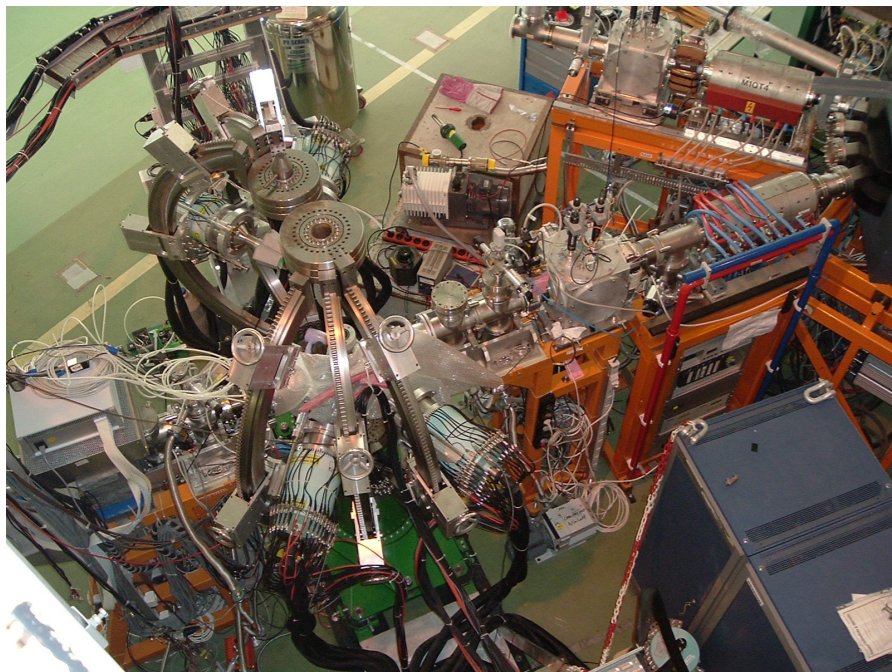
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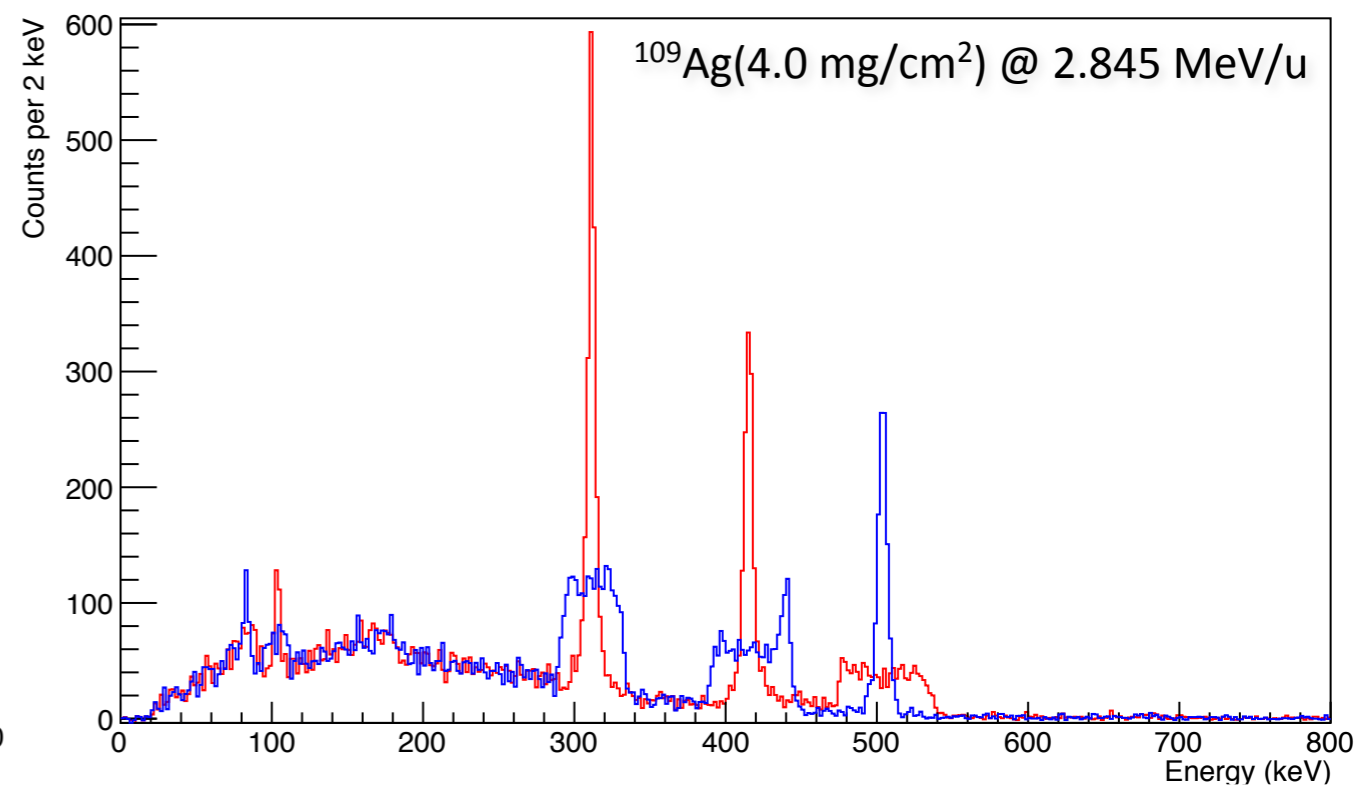
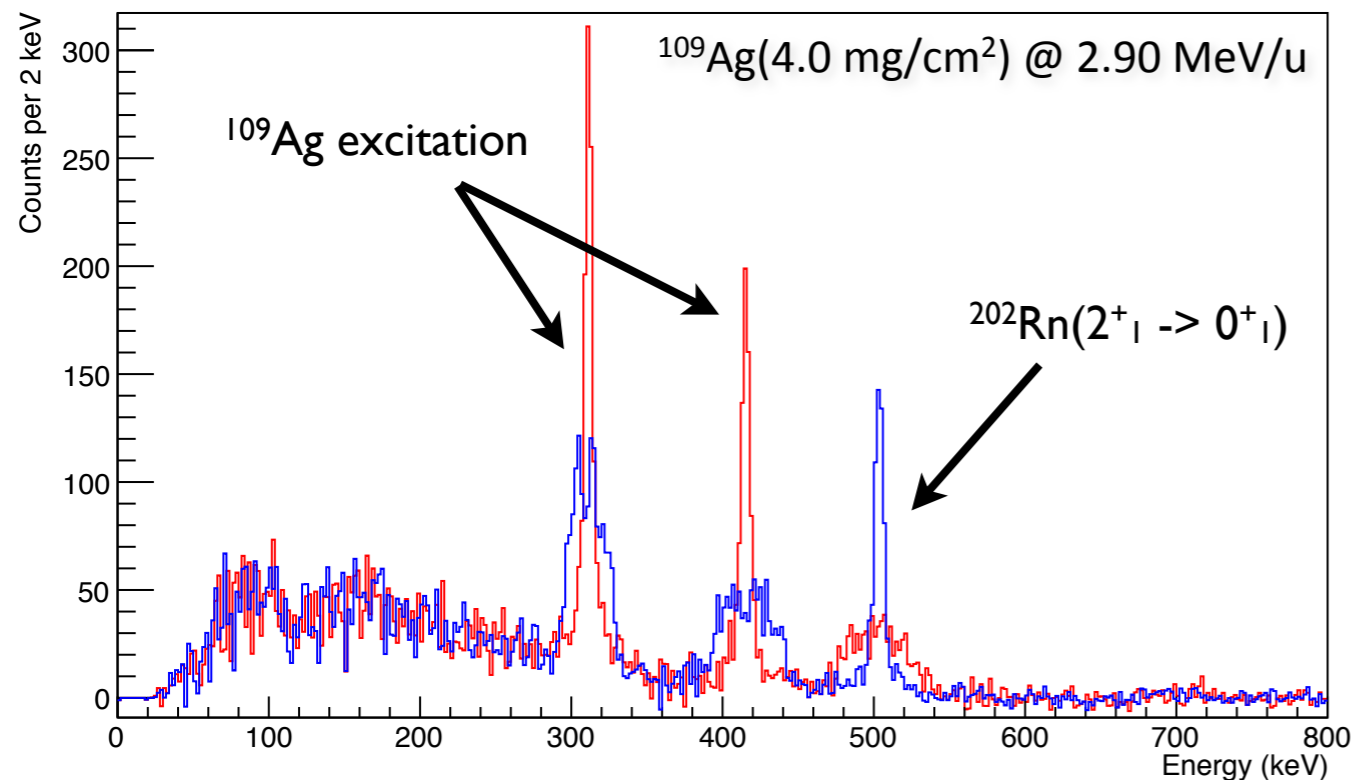
$^{202,204}\text{Rn}$  from  
REX-ISOLDE





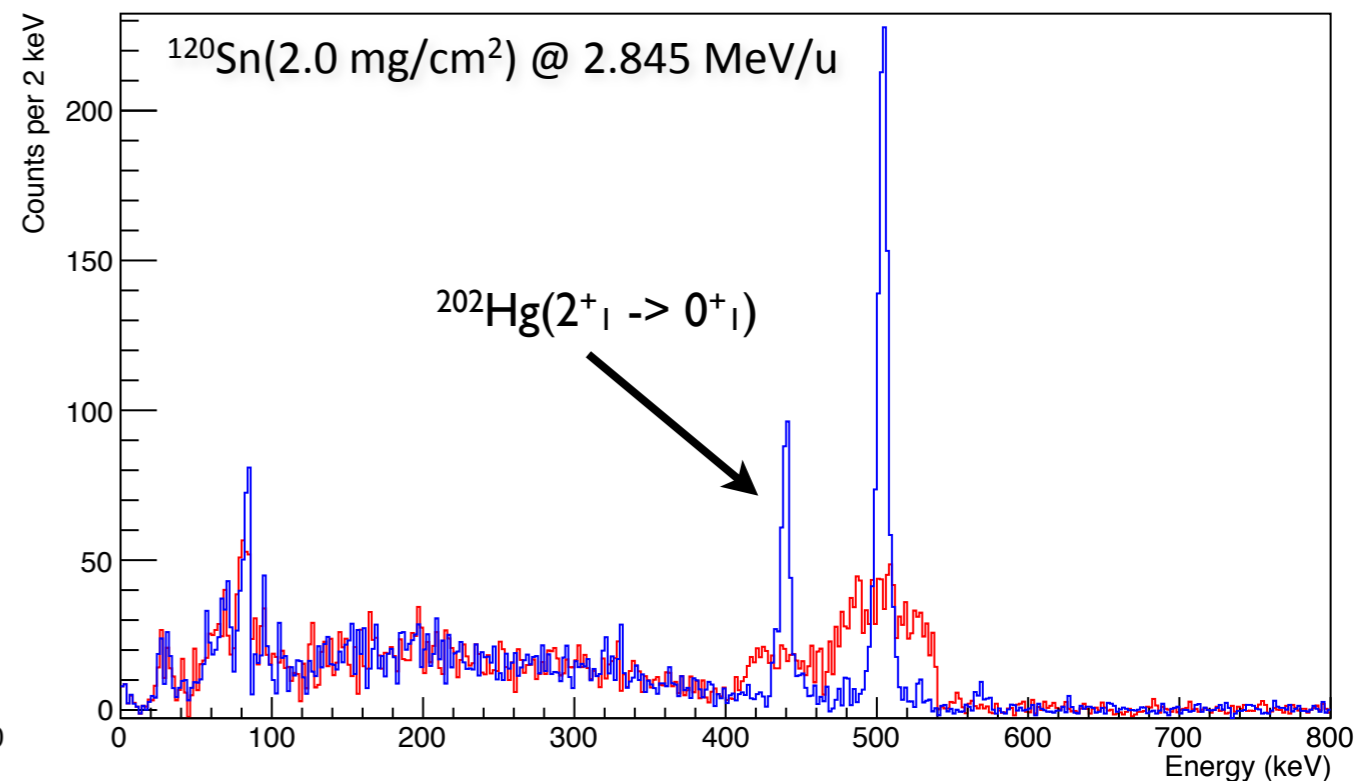
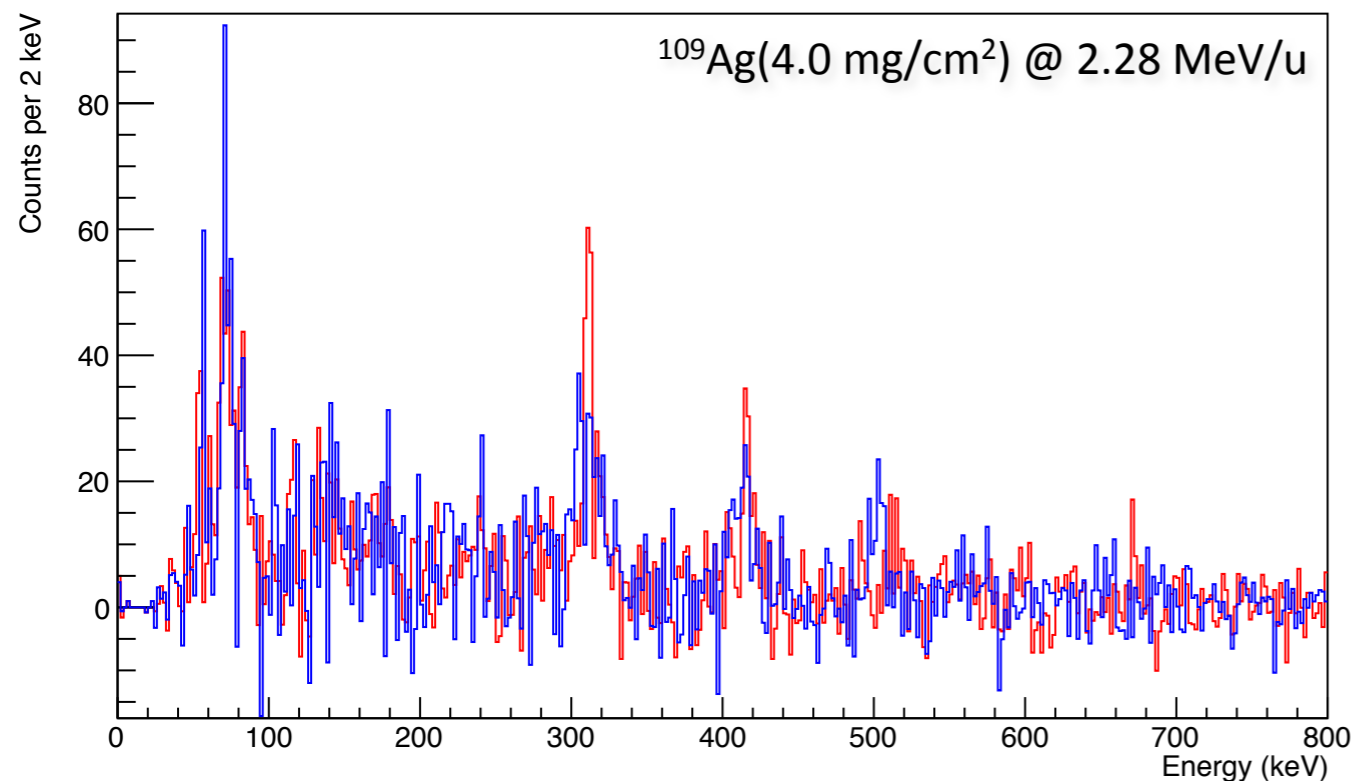
Rn projectile  
Ag/Sn target

# Doppler corrected spectra - $^{202}\text{Rn}$



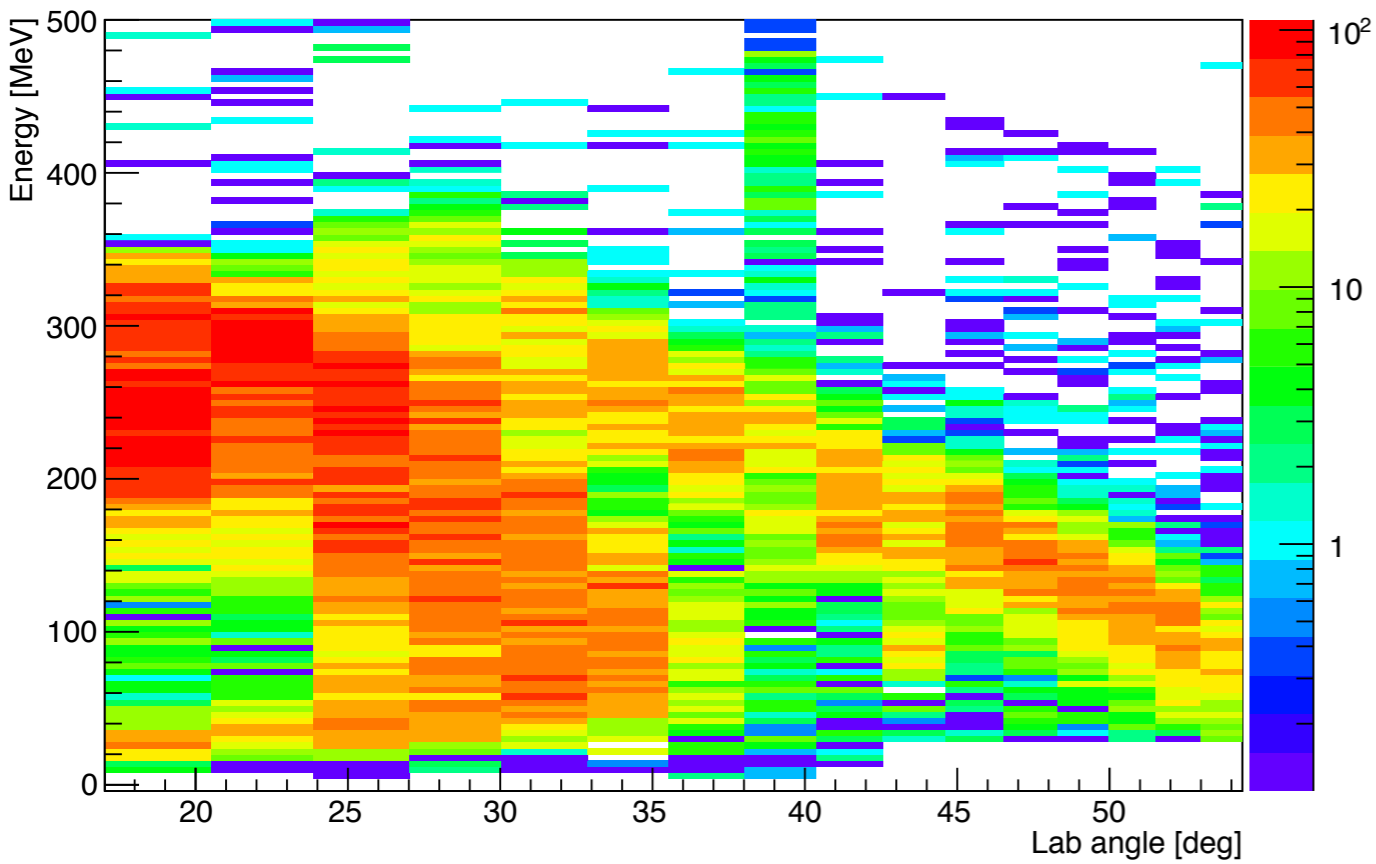
↓ 2008 ↑

↓ 2010 ↑



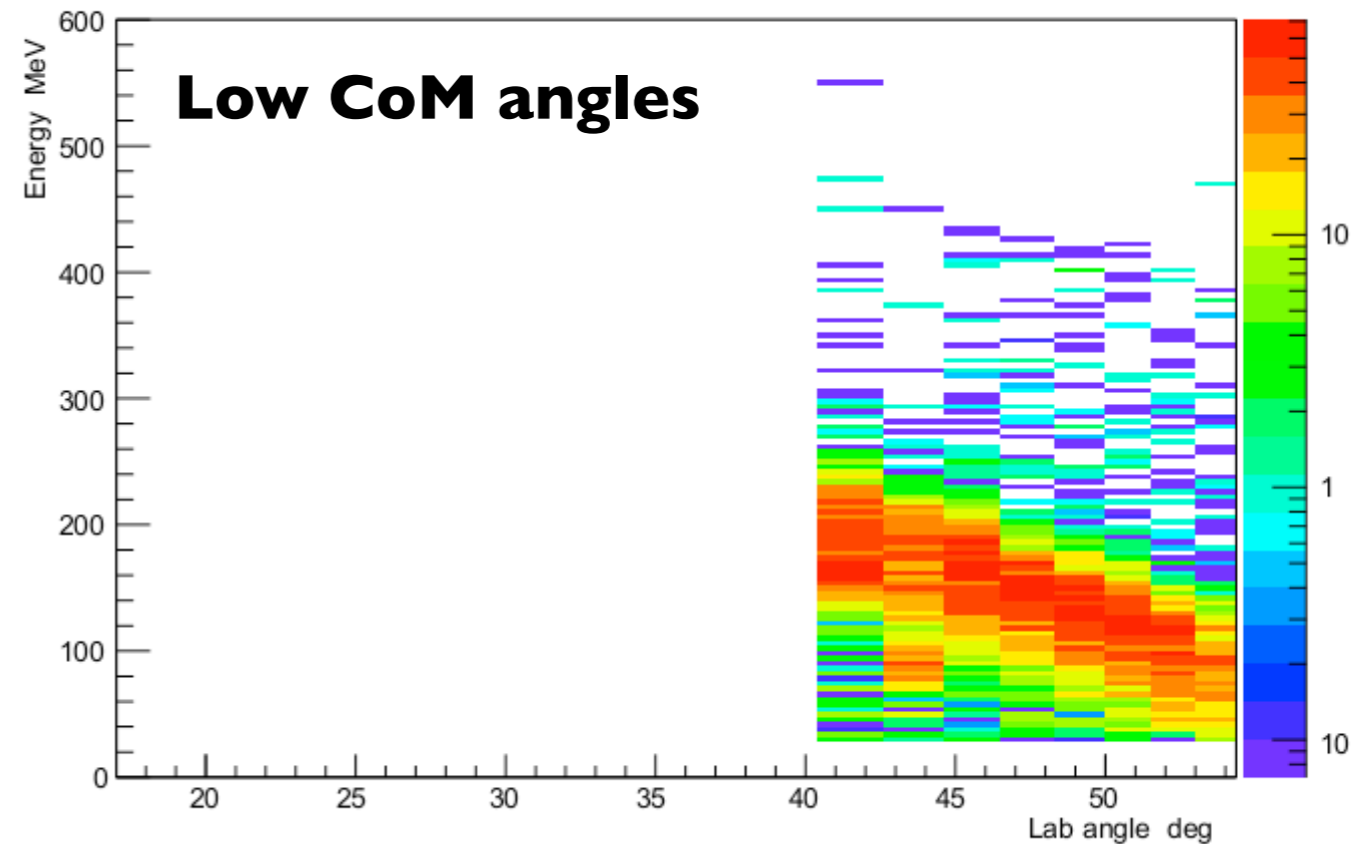
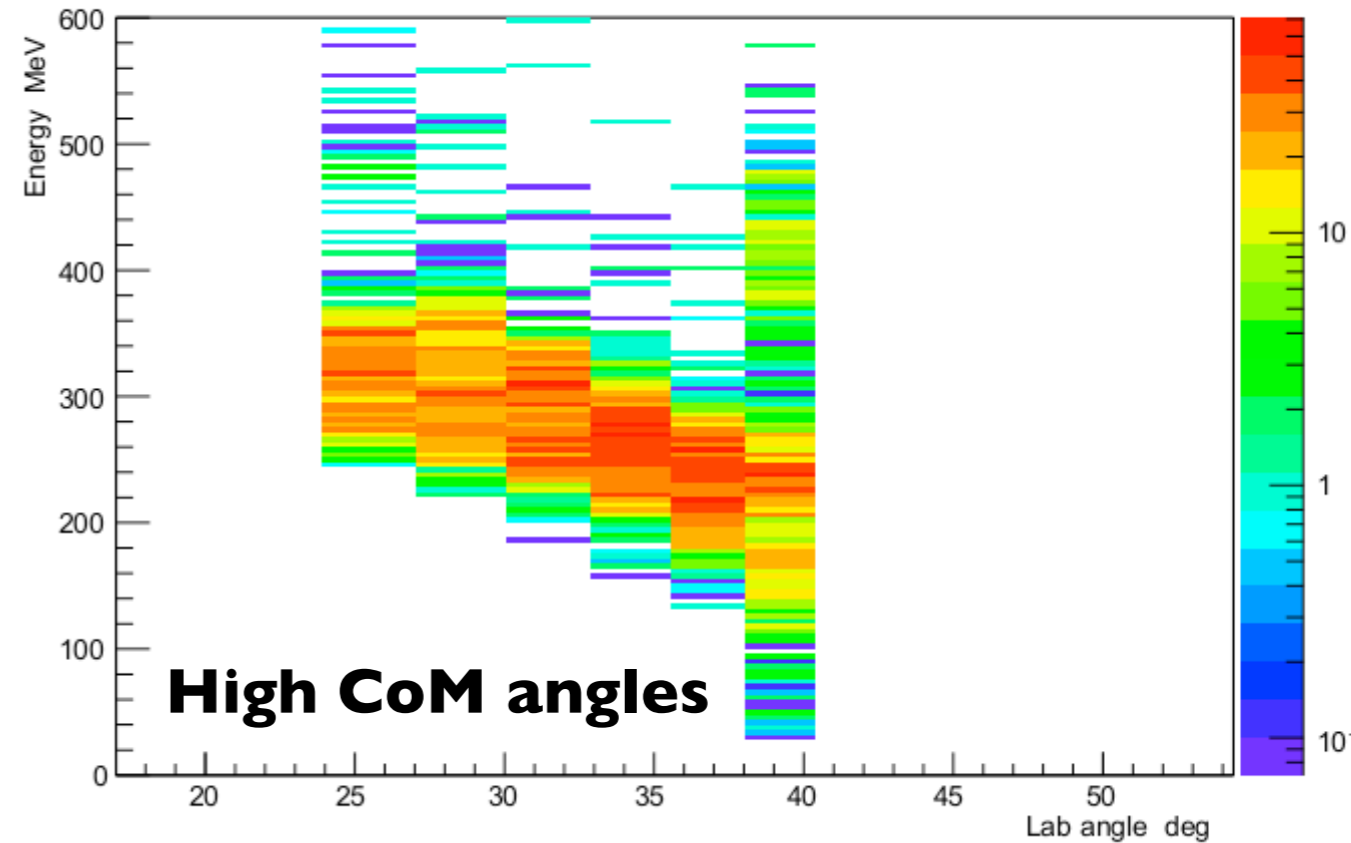
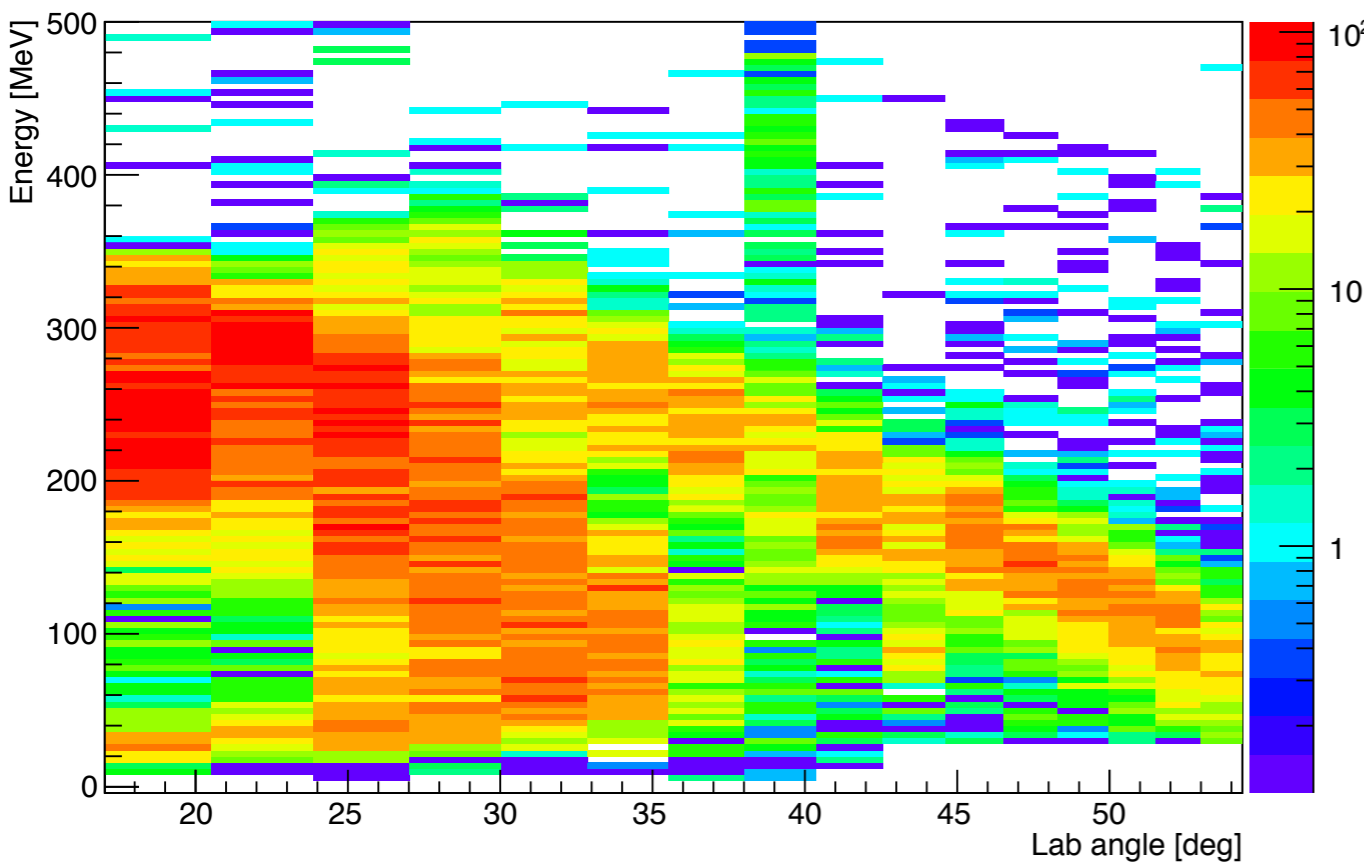


# Data segmentation: Angular cuts



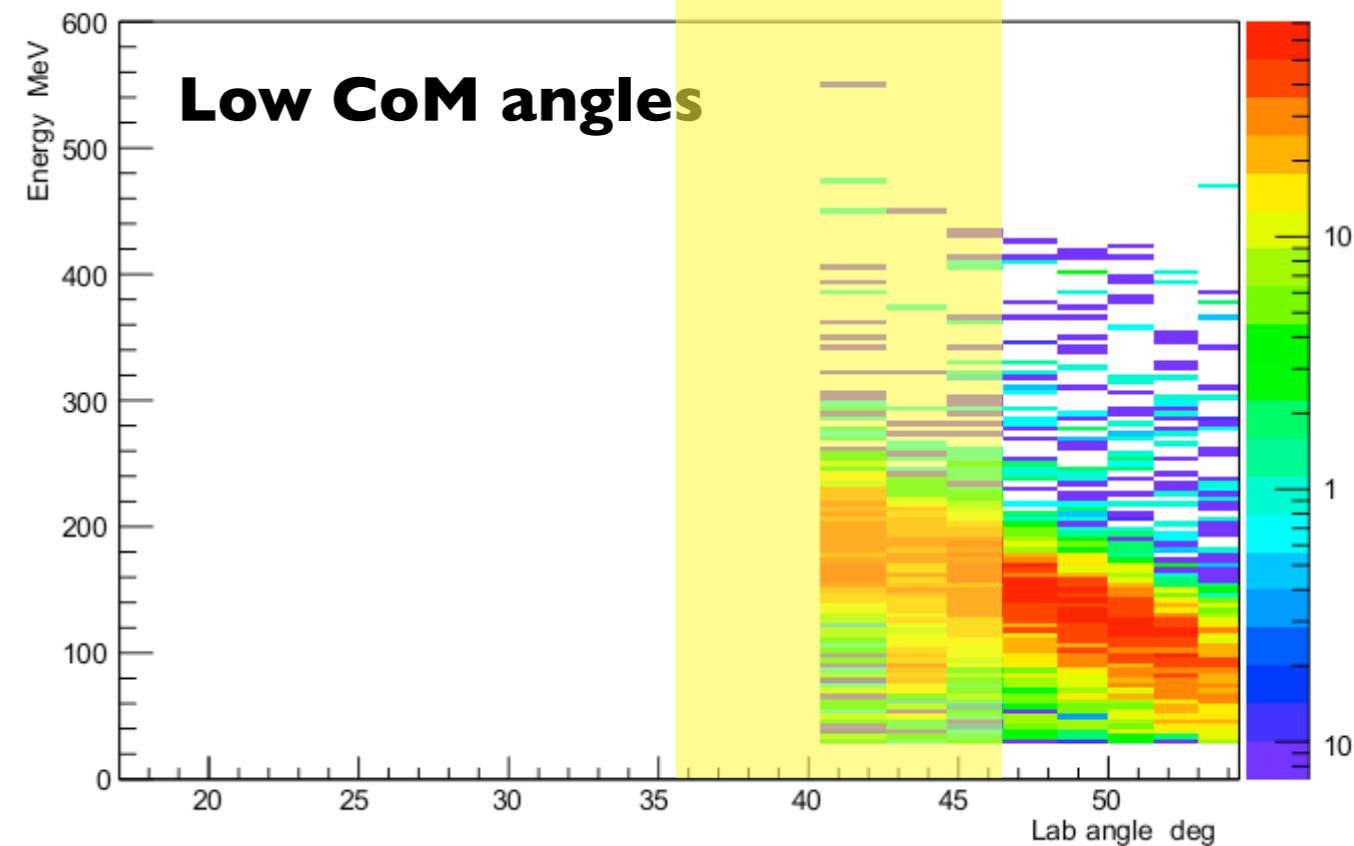
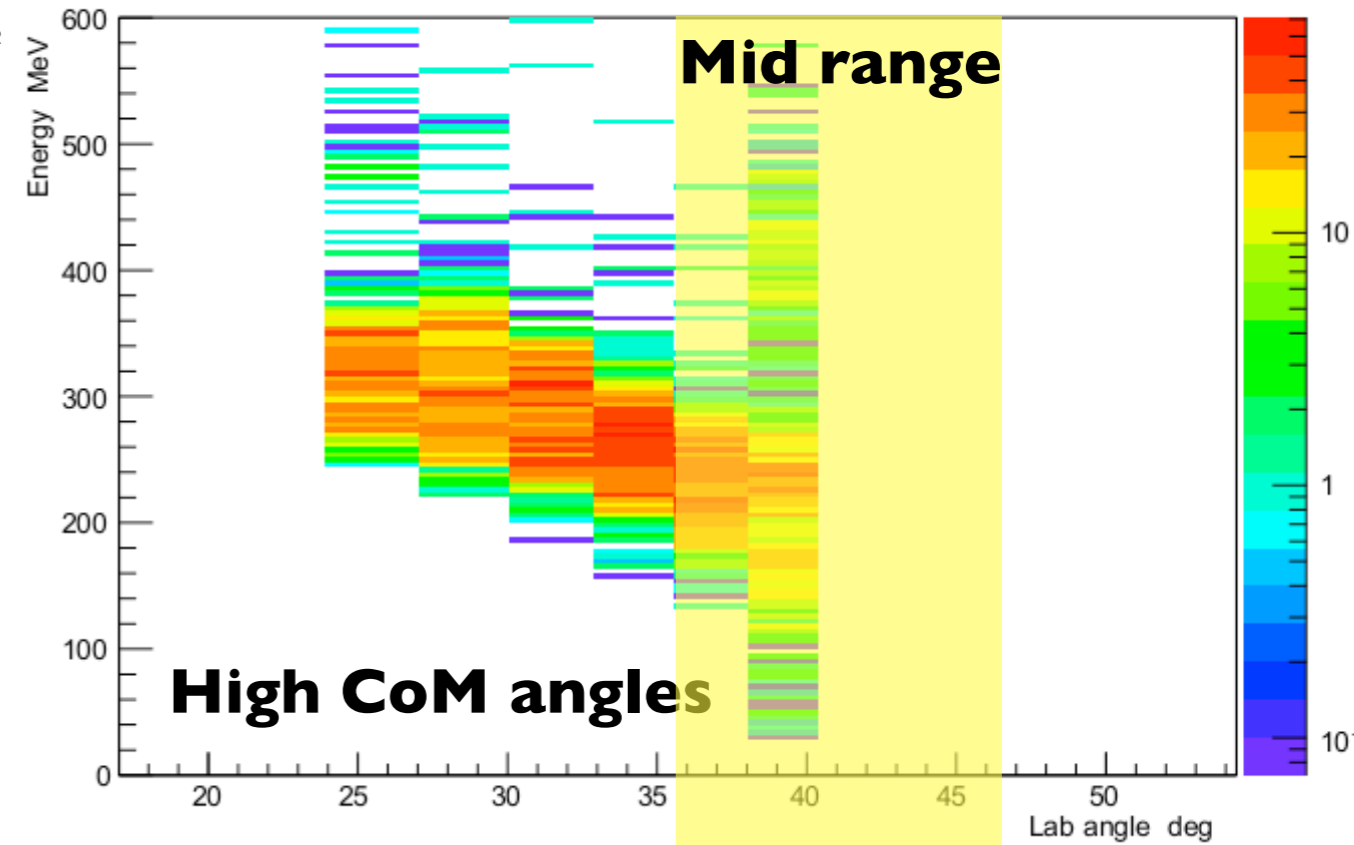
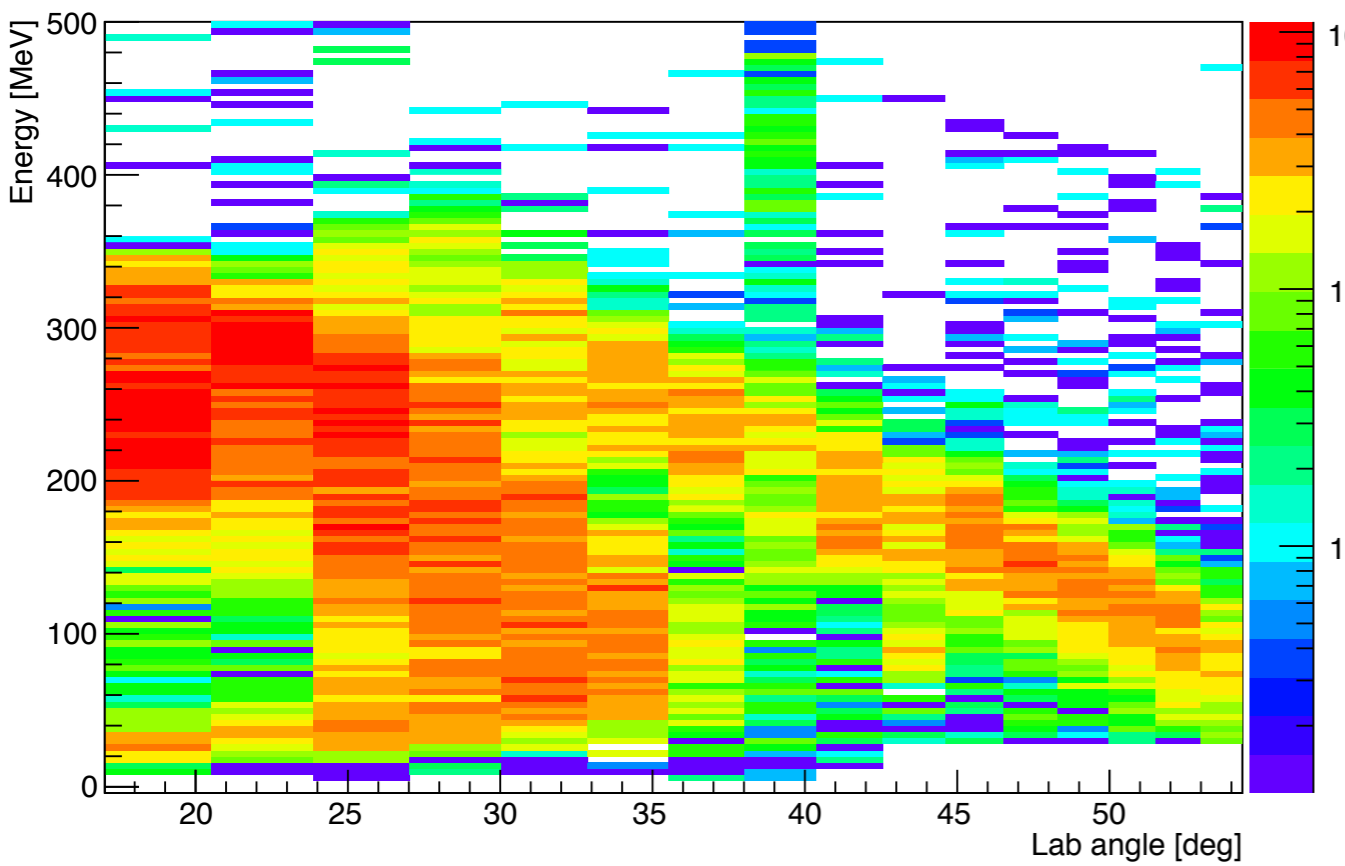
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- Balance between sensitivity and statistical uncertainty.
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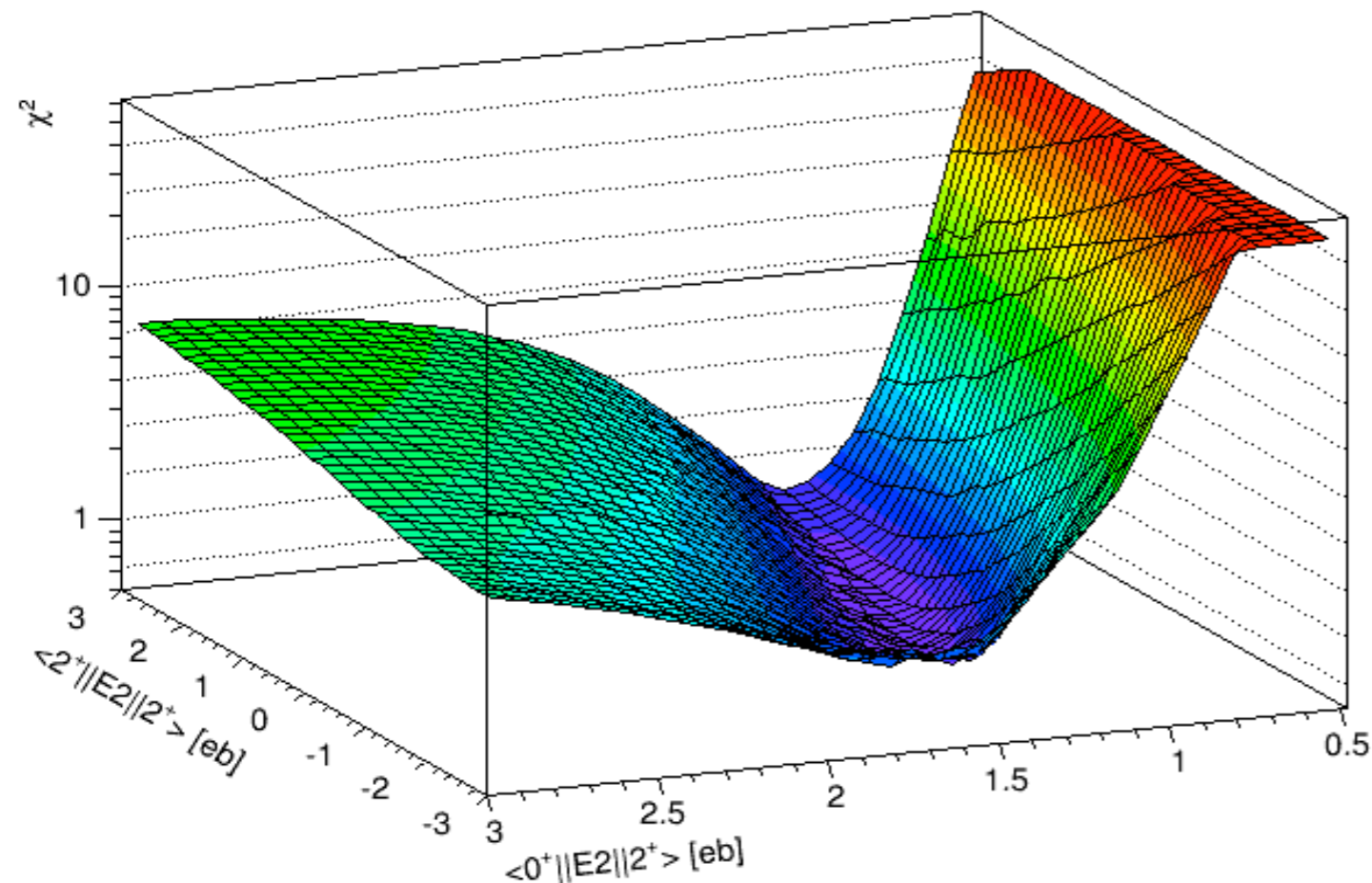


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# Results: Gosia2 calculations - $^{202}\text{Rn}$

- Reproduce target AND projectile excitation simultaneously.
- Extract  $\chi^2$  or more accurately, Gosia's least-squares statistic, S.
- Vary both diagonal and transitional matrix elements to create a “chi-squared surface” plot.
- Error bars extracted with  $\chi^2 + I$  method.
  - valid if S (or  $\chi^2$ )  $\sim I$  and parameters have equal weight.

$\chi^2$  surface plot

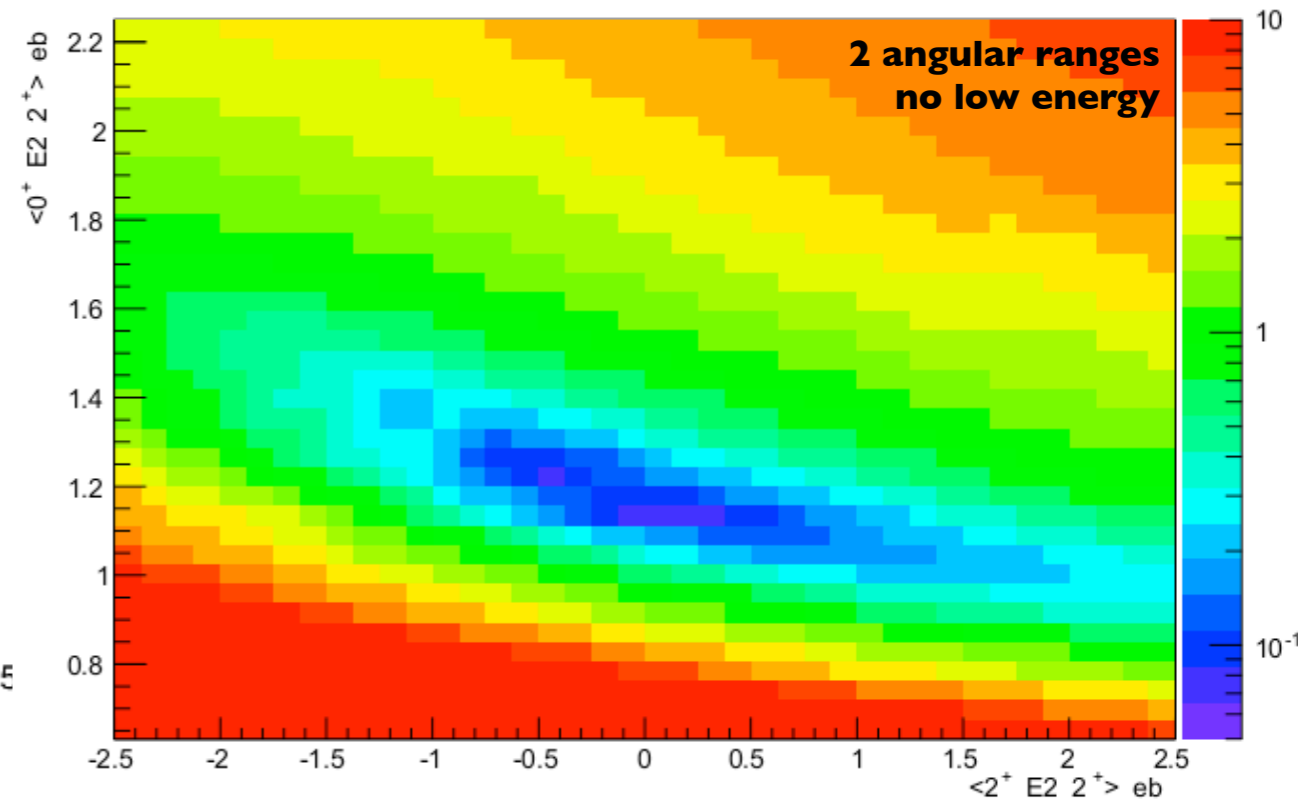
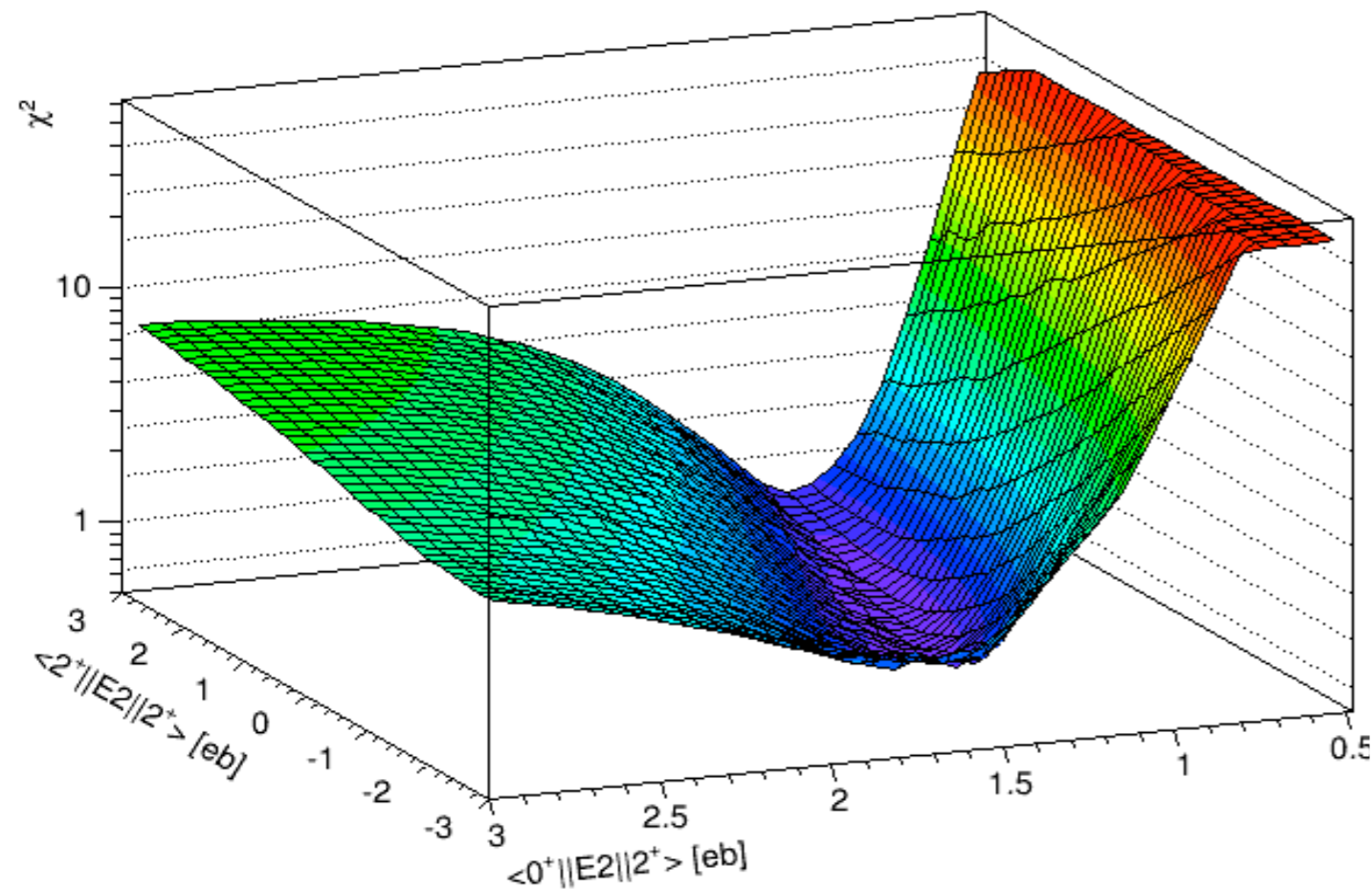




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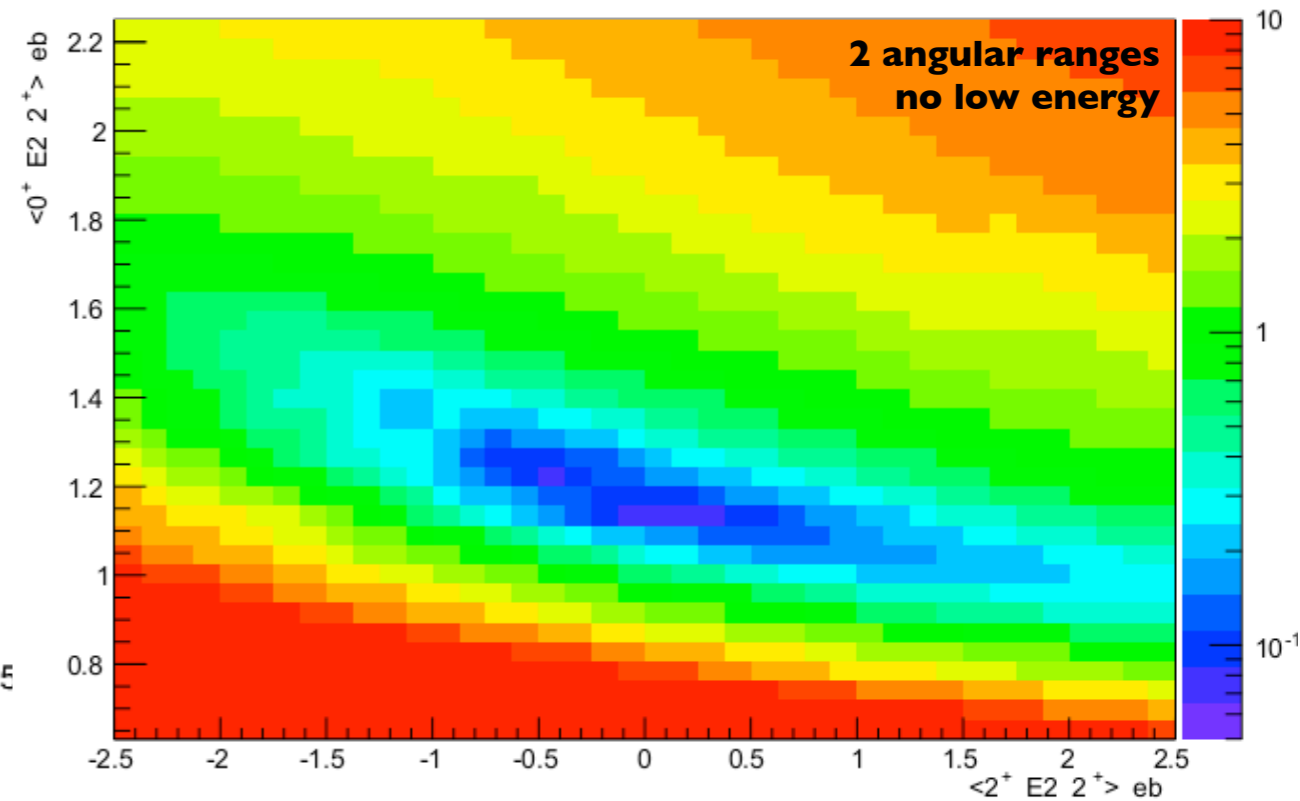
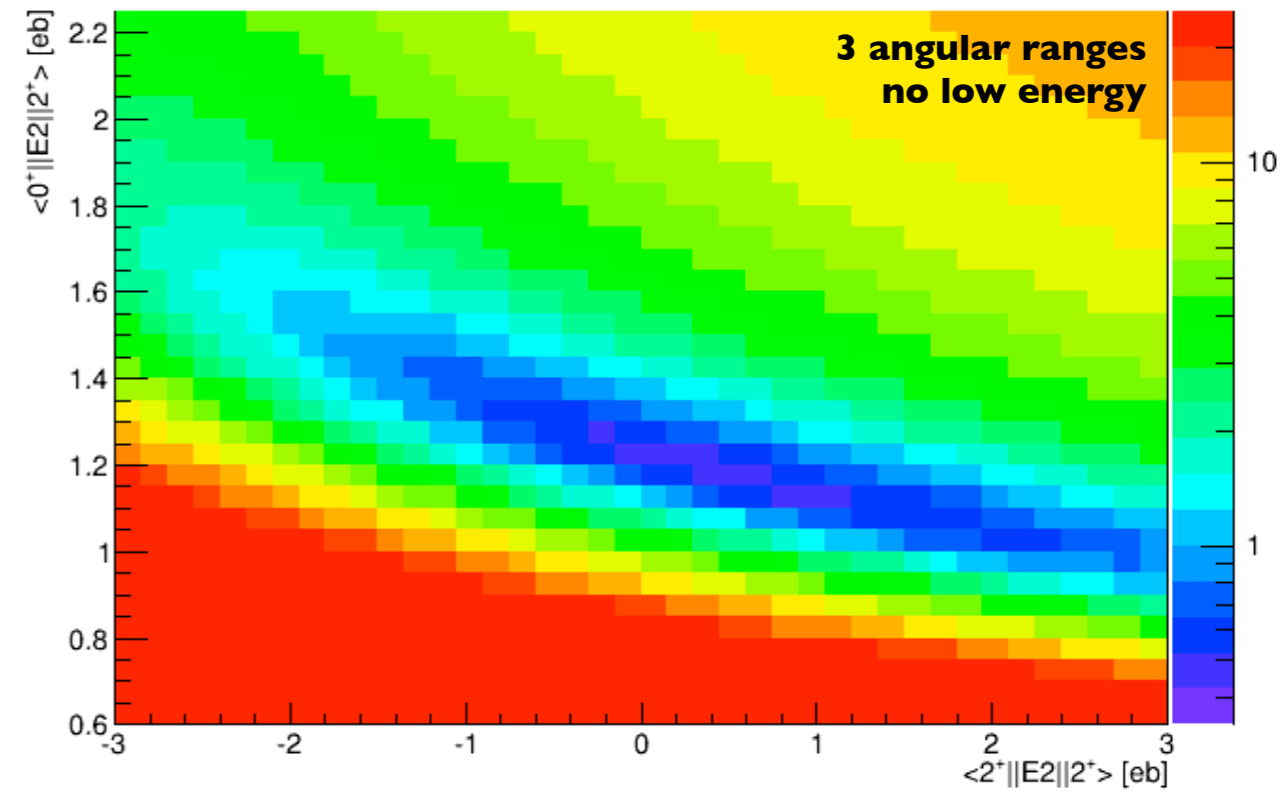
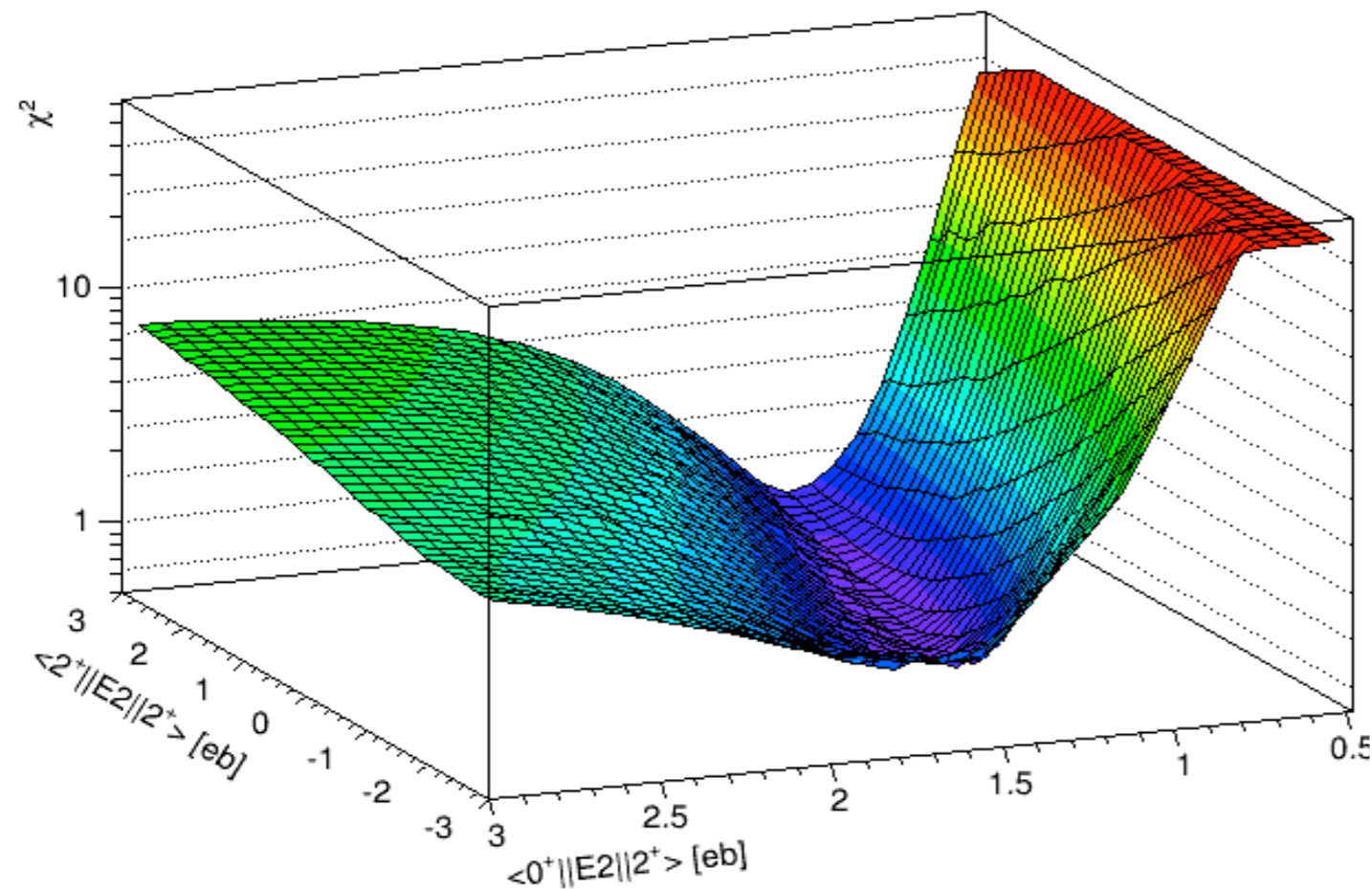
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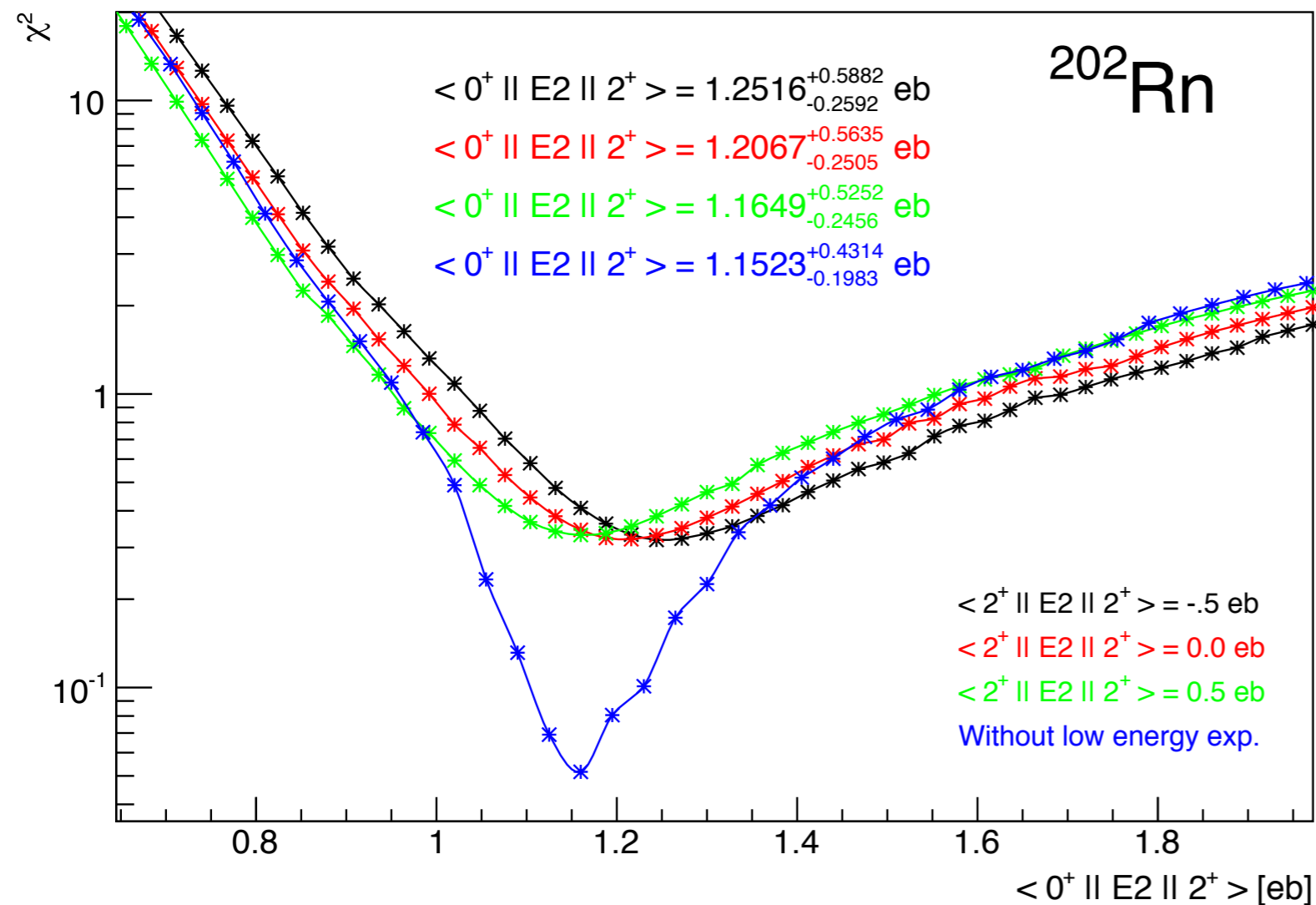
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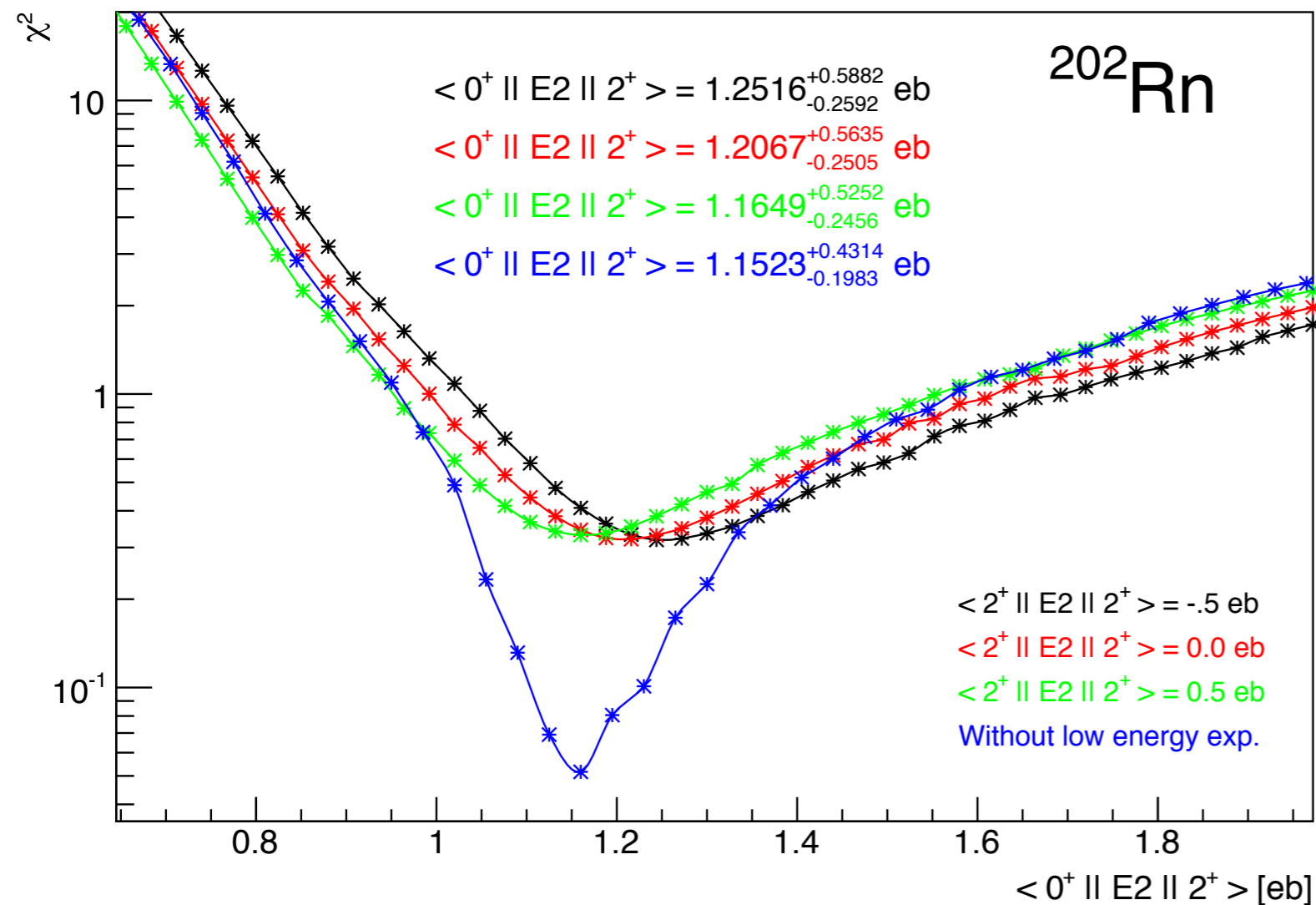


# Preliminary Results: Matrix elements - $^{202}\text{Rn}$



- Projection of 2 angular range data on  $\langle 2^+ || E2 || 2^+ \rangle$
- Reasonable limits of -0.5 eb and +0.5 eb.
- Low energy data included for these curves.
- When removed, a shift to lower values observed.
- Inconsistent? Why?

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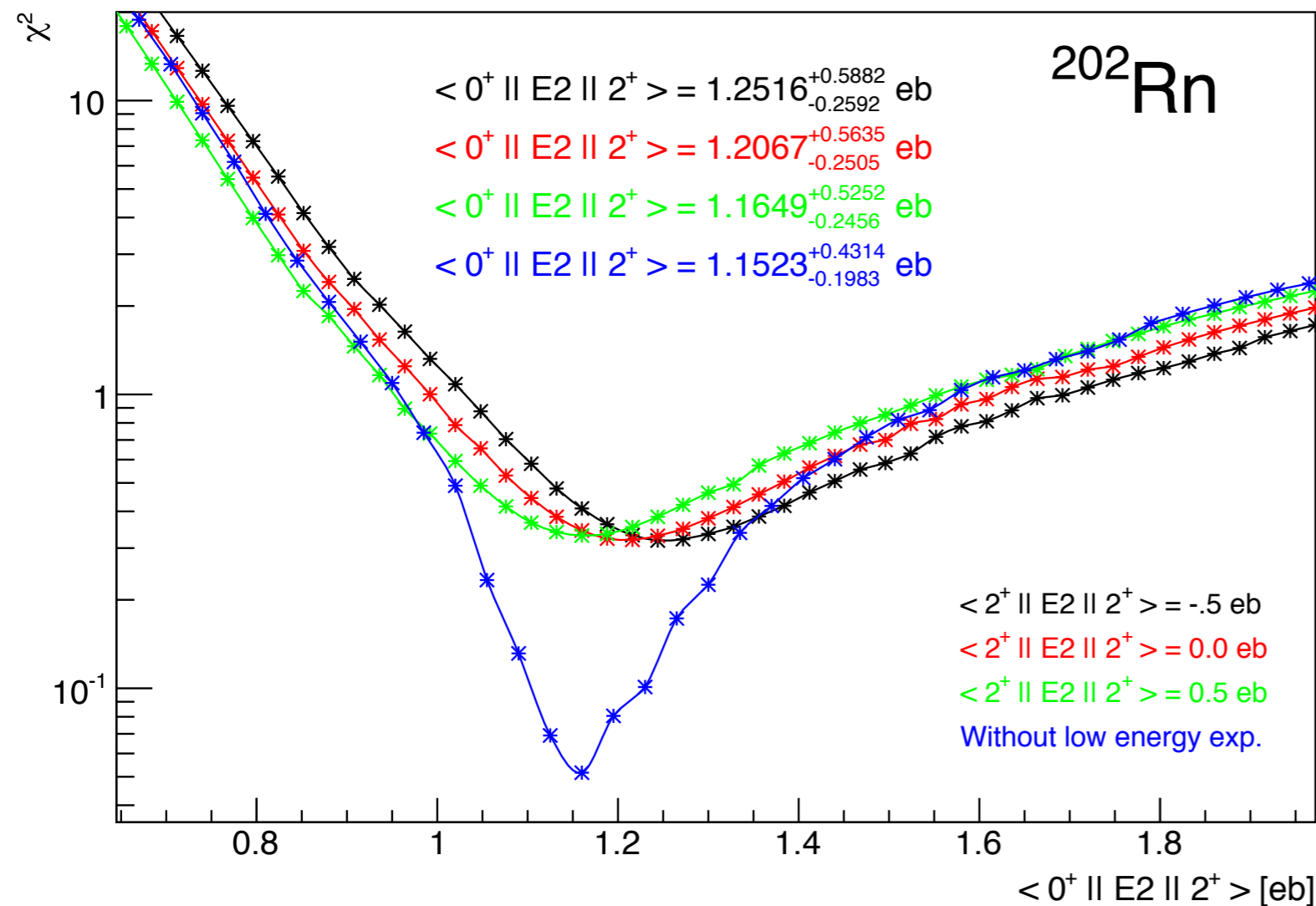


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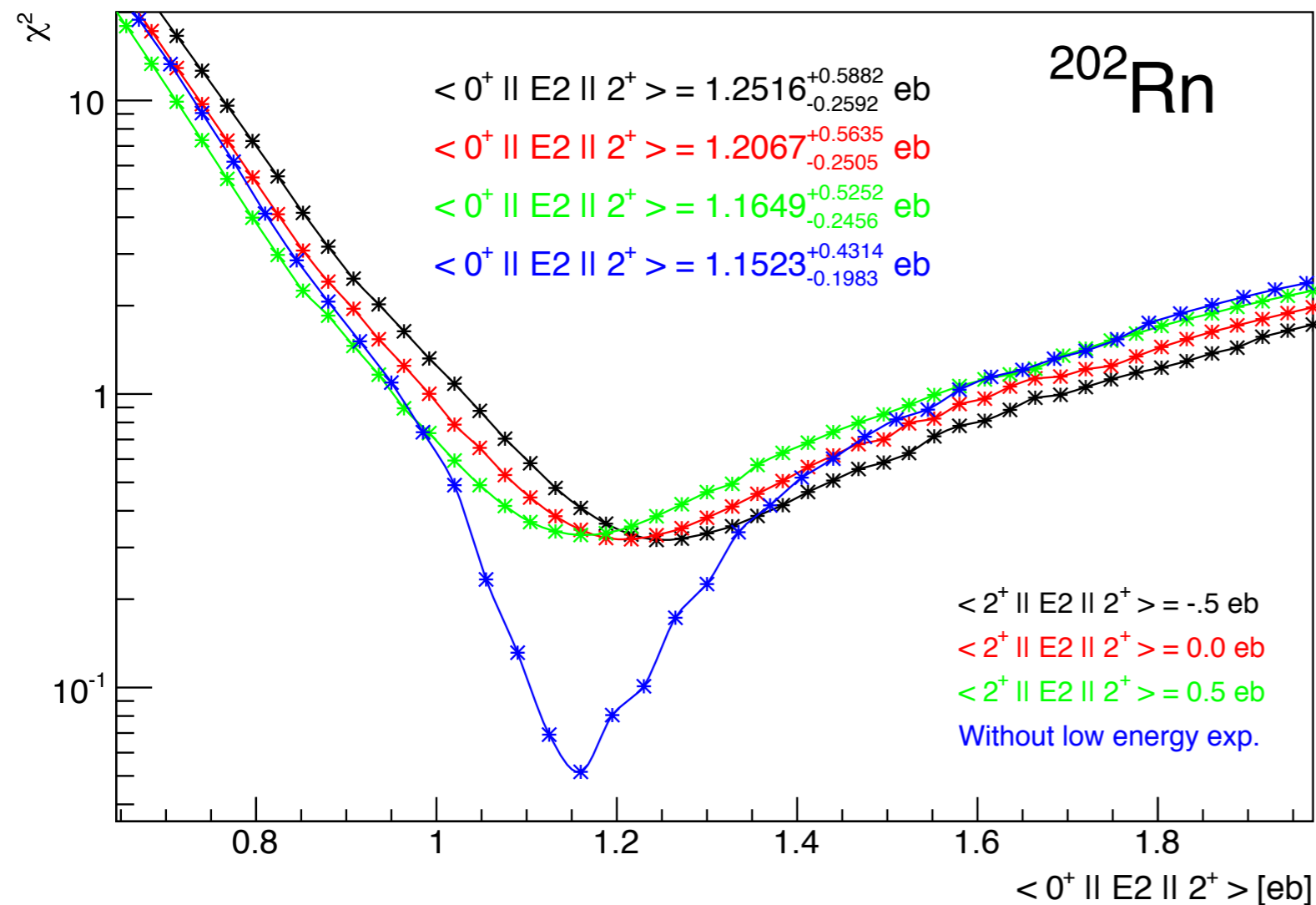


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$$B(E2; 2^+_1 \rightarrow 0^+_2) = 41^{+48}_{-15} \text{ W.u.}$$

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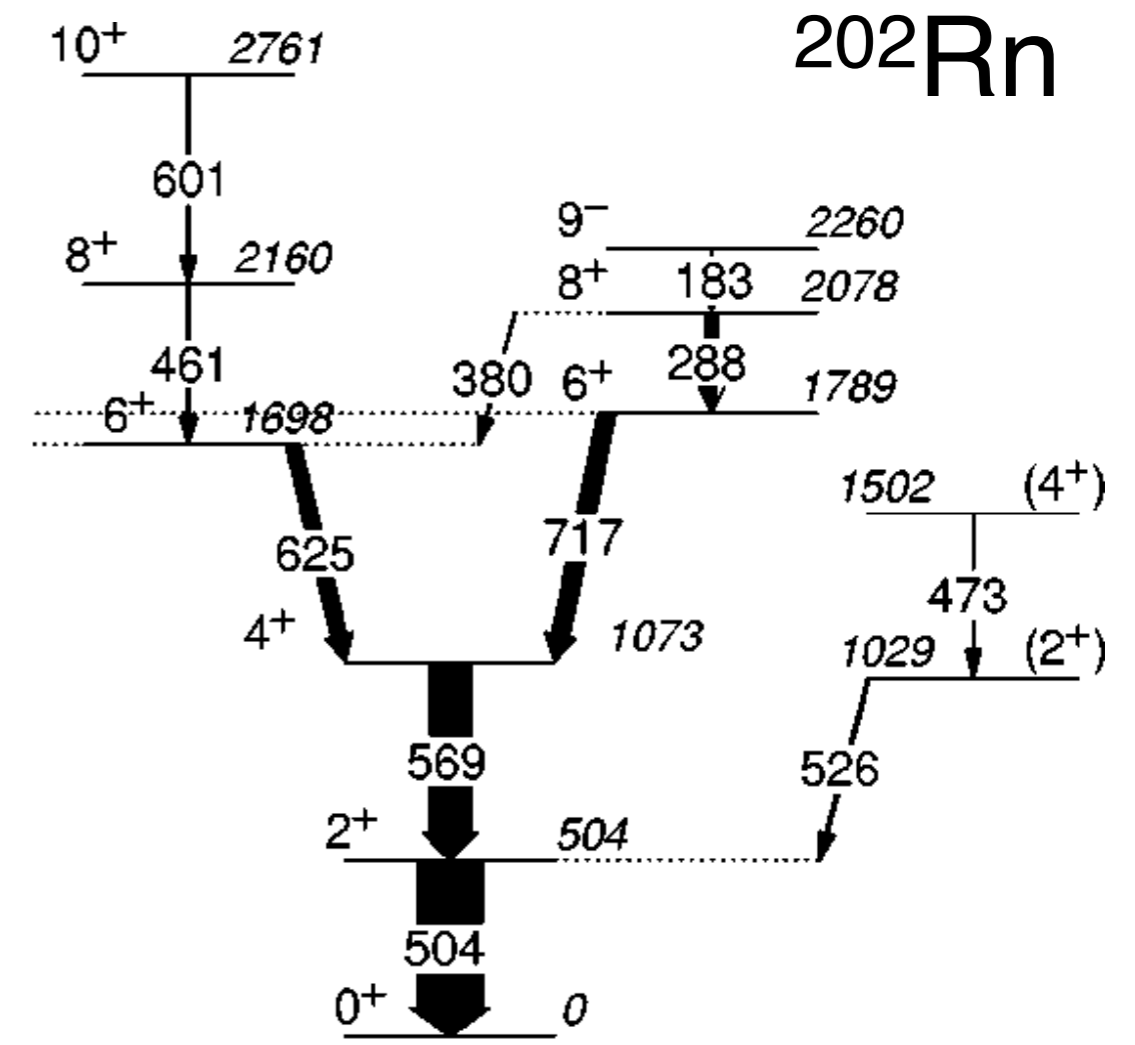
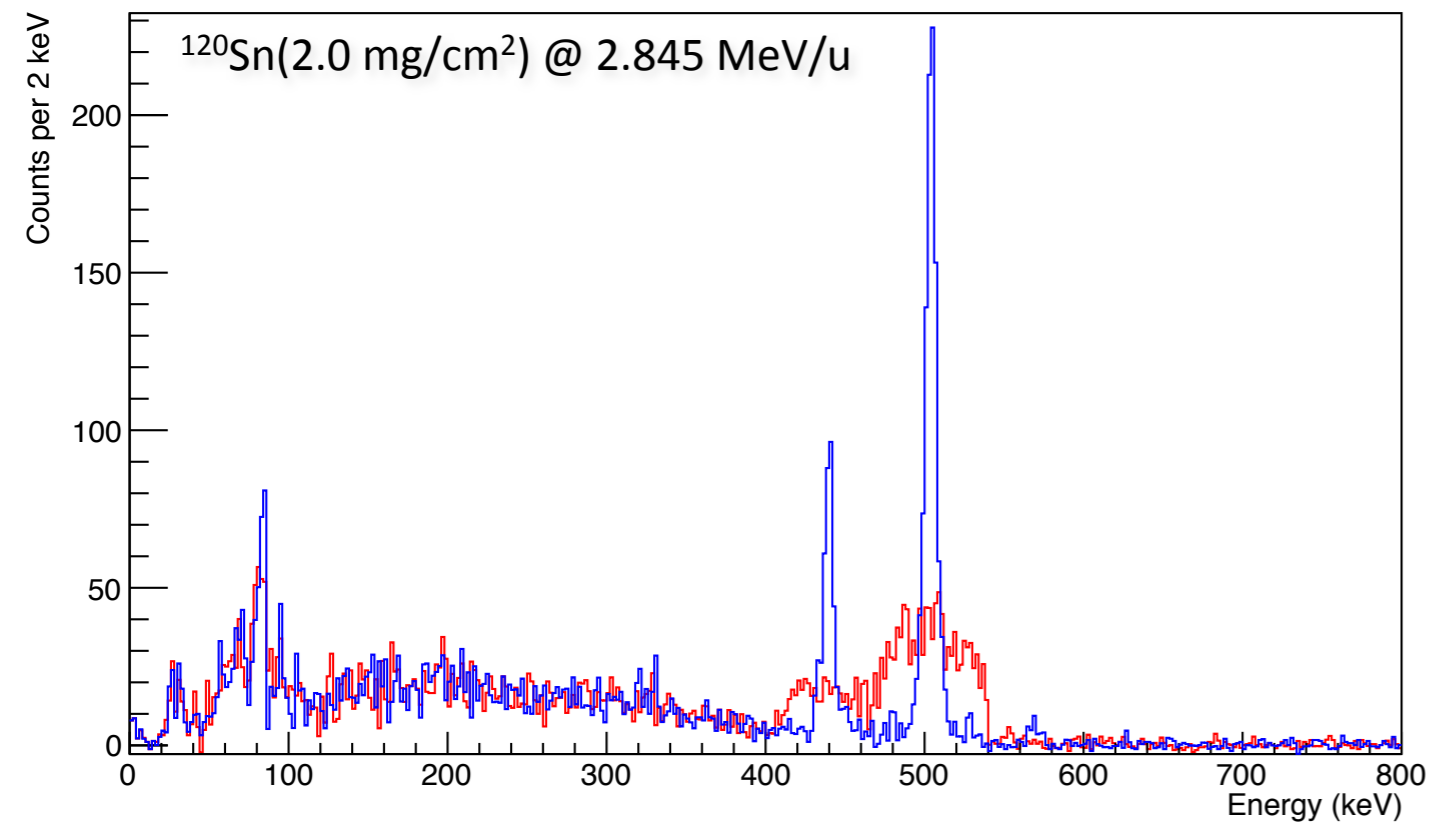


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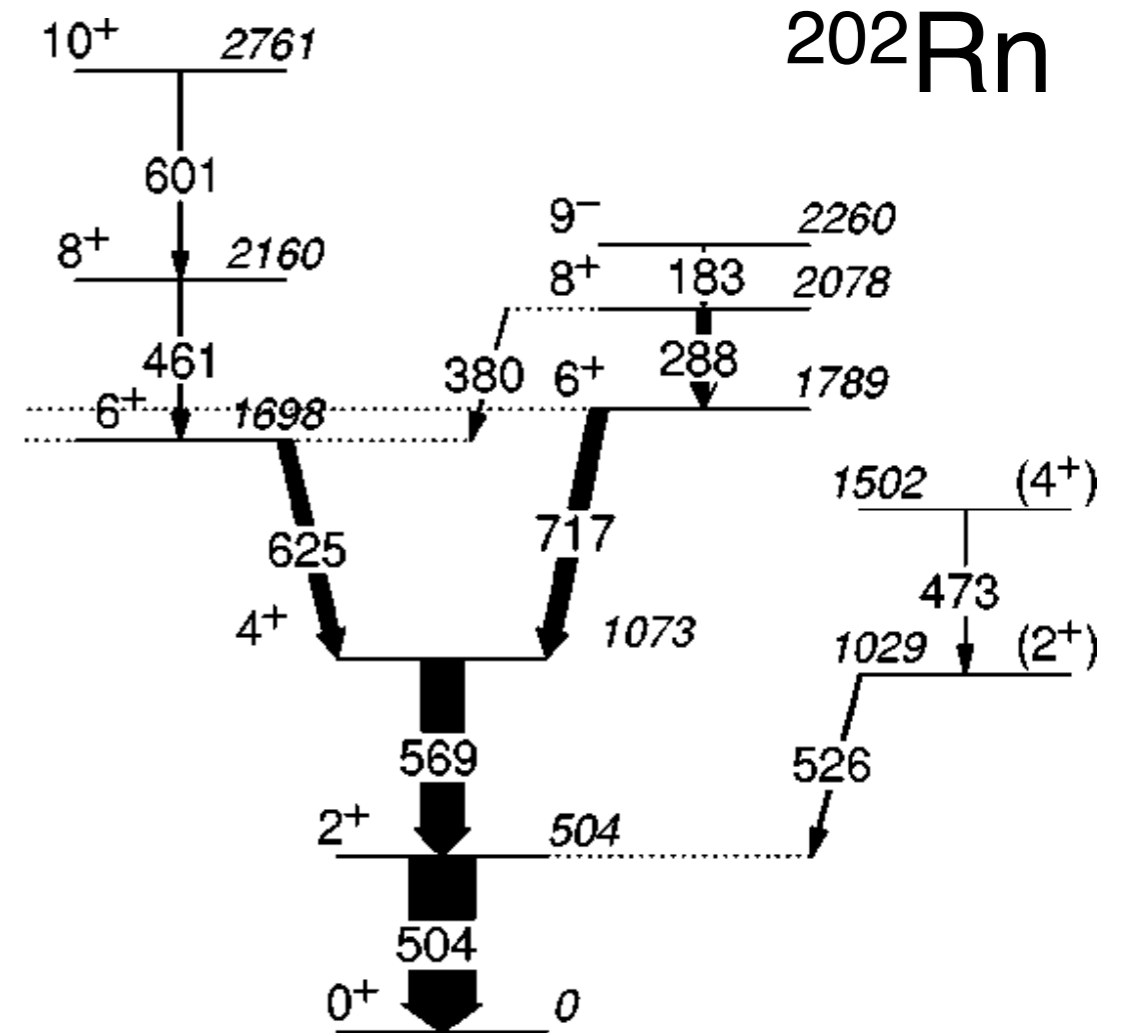
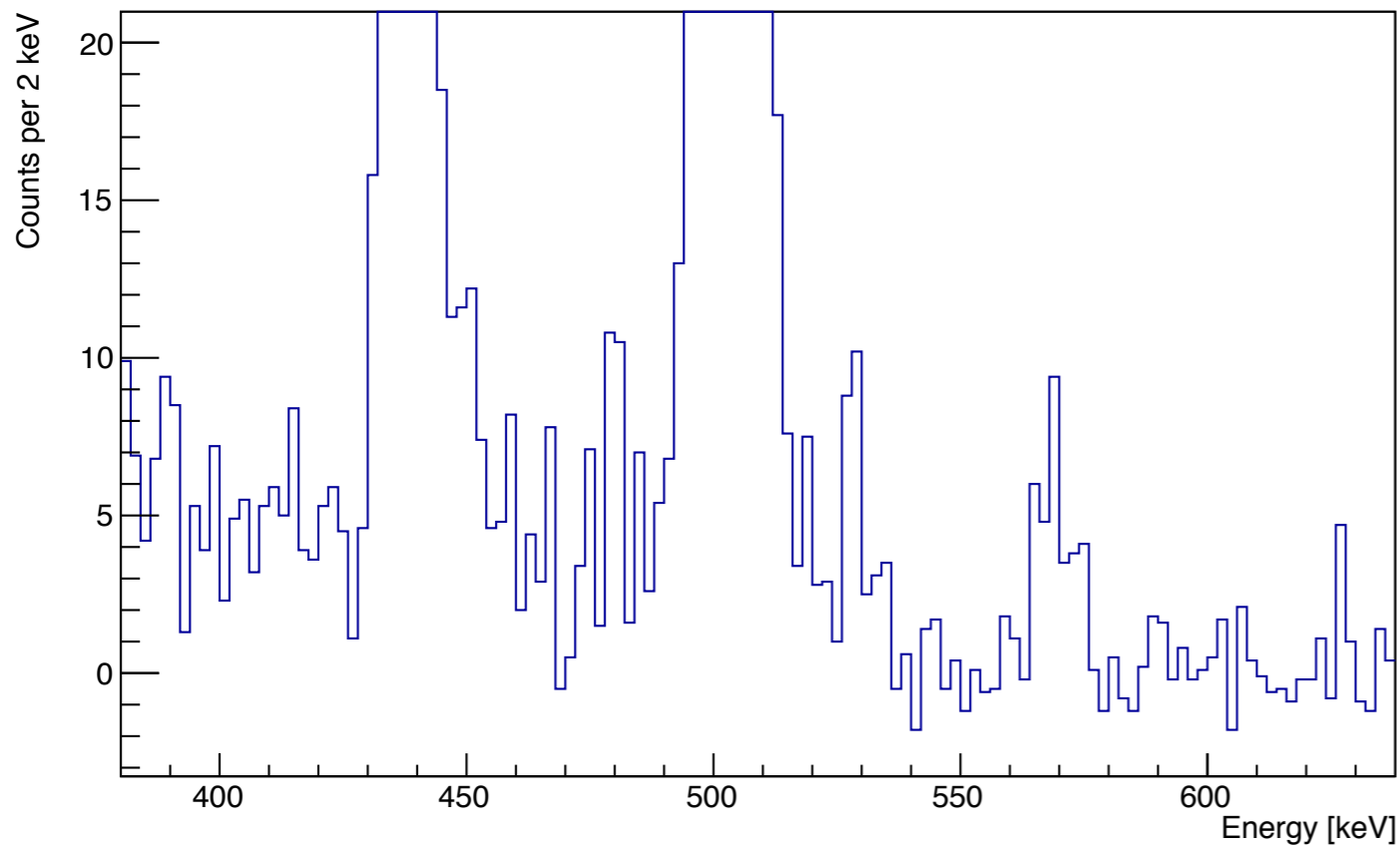
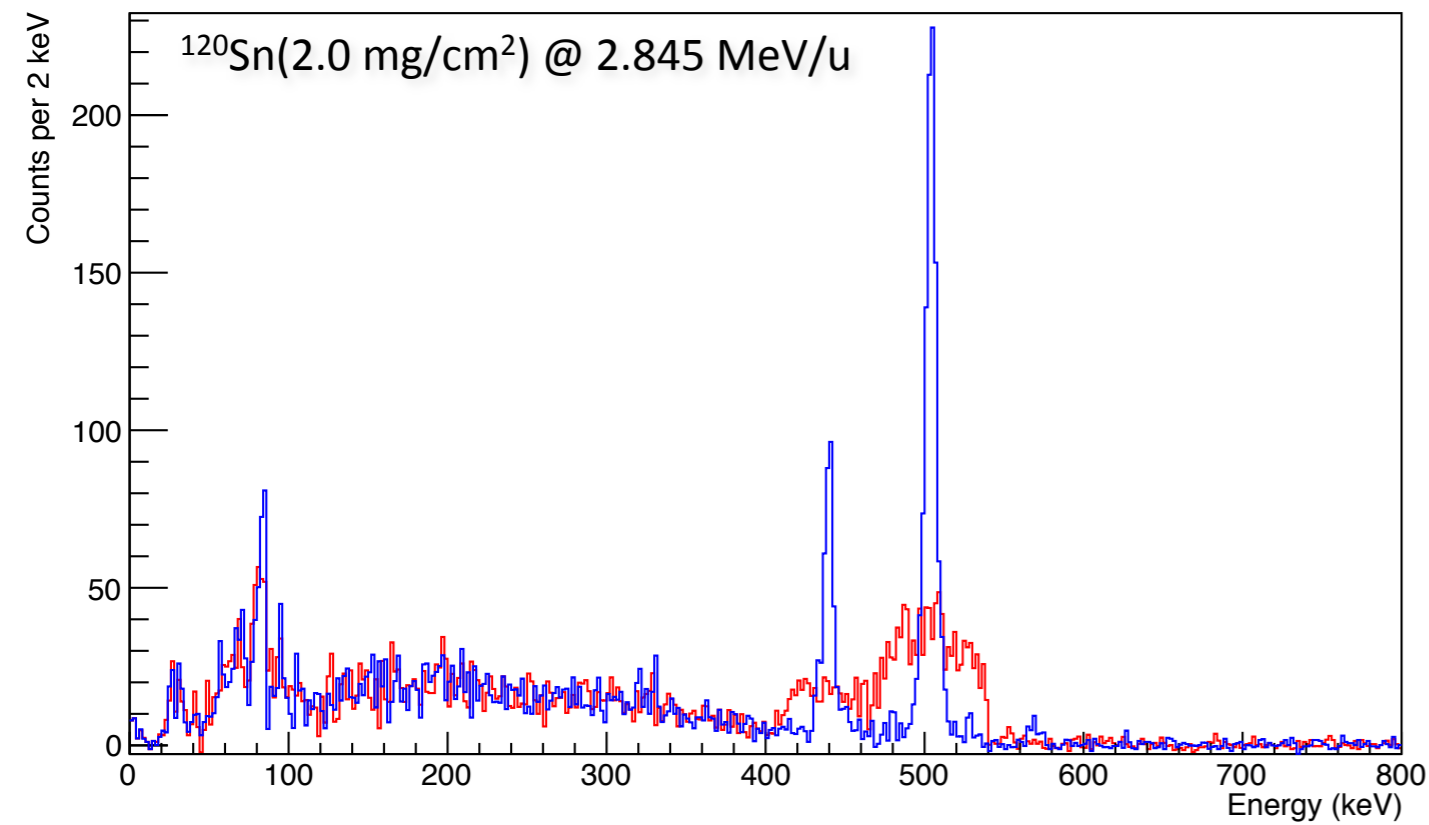
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$$B(E2; 2^+_1 \rightarrow 0^+_2) = 38^{+34}_{-12} \text{ W.u.}$$

# Second-order excitations?

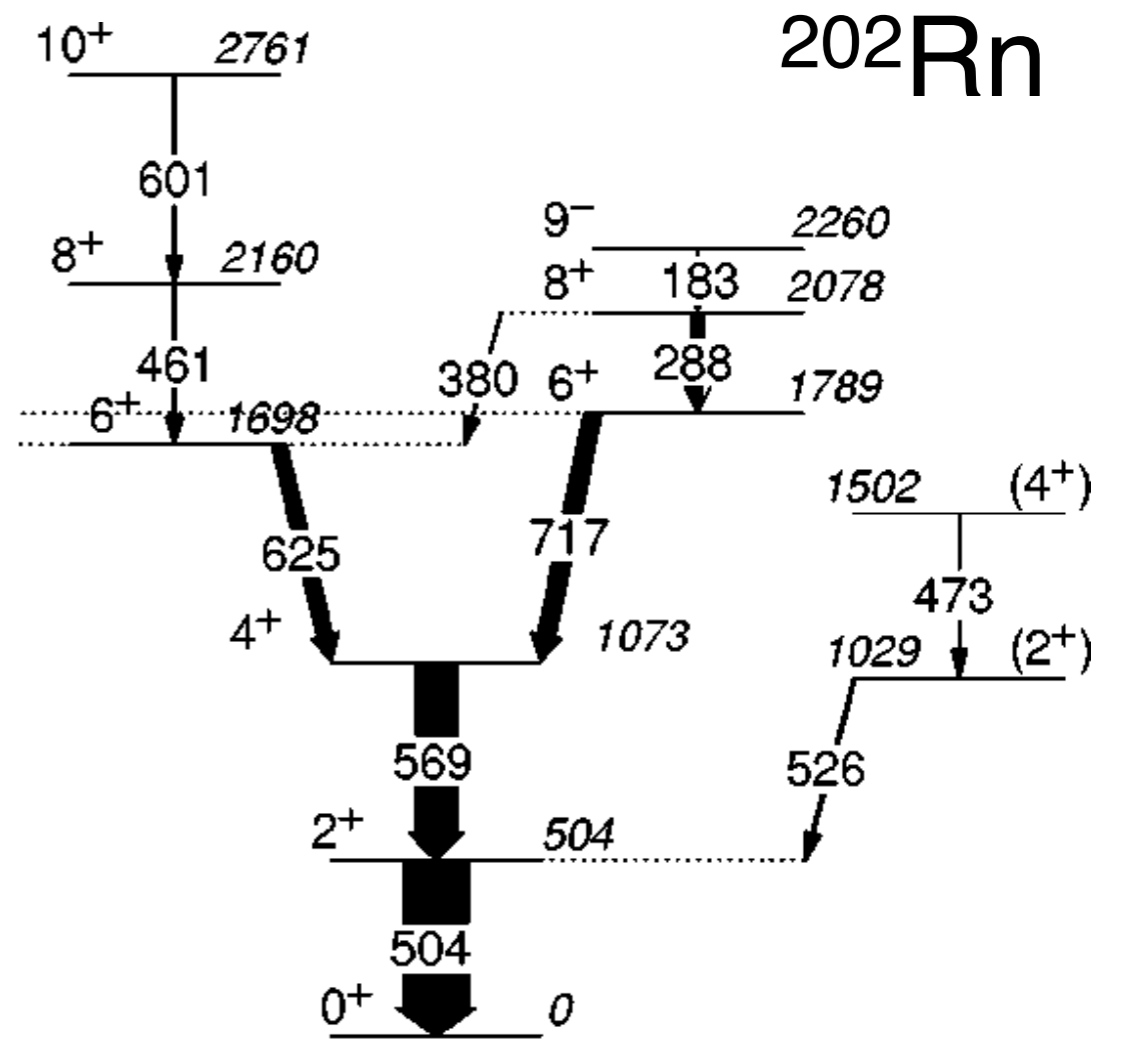
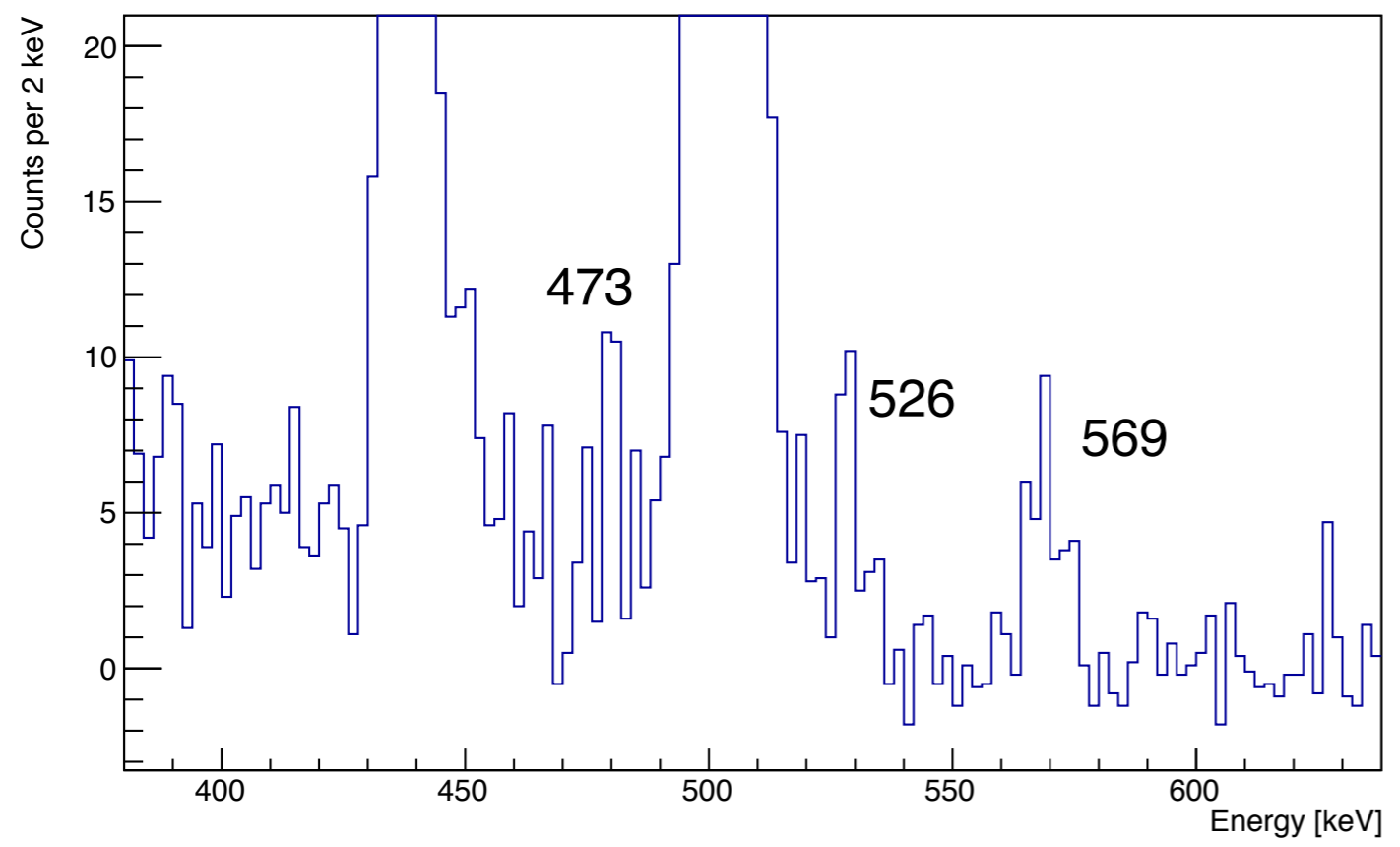
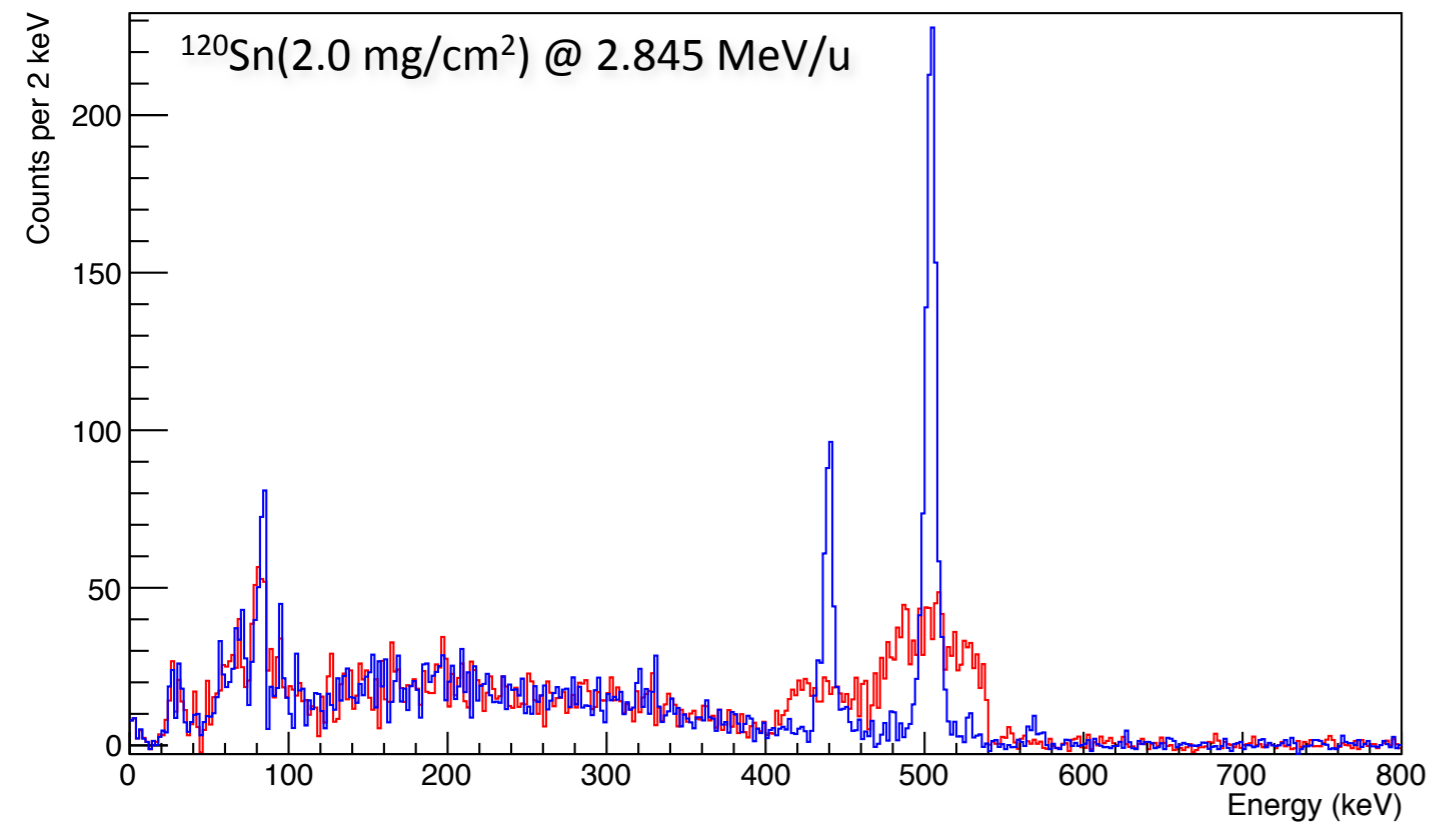


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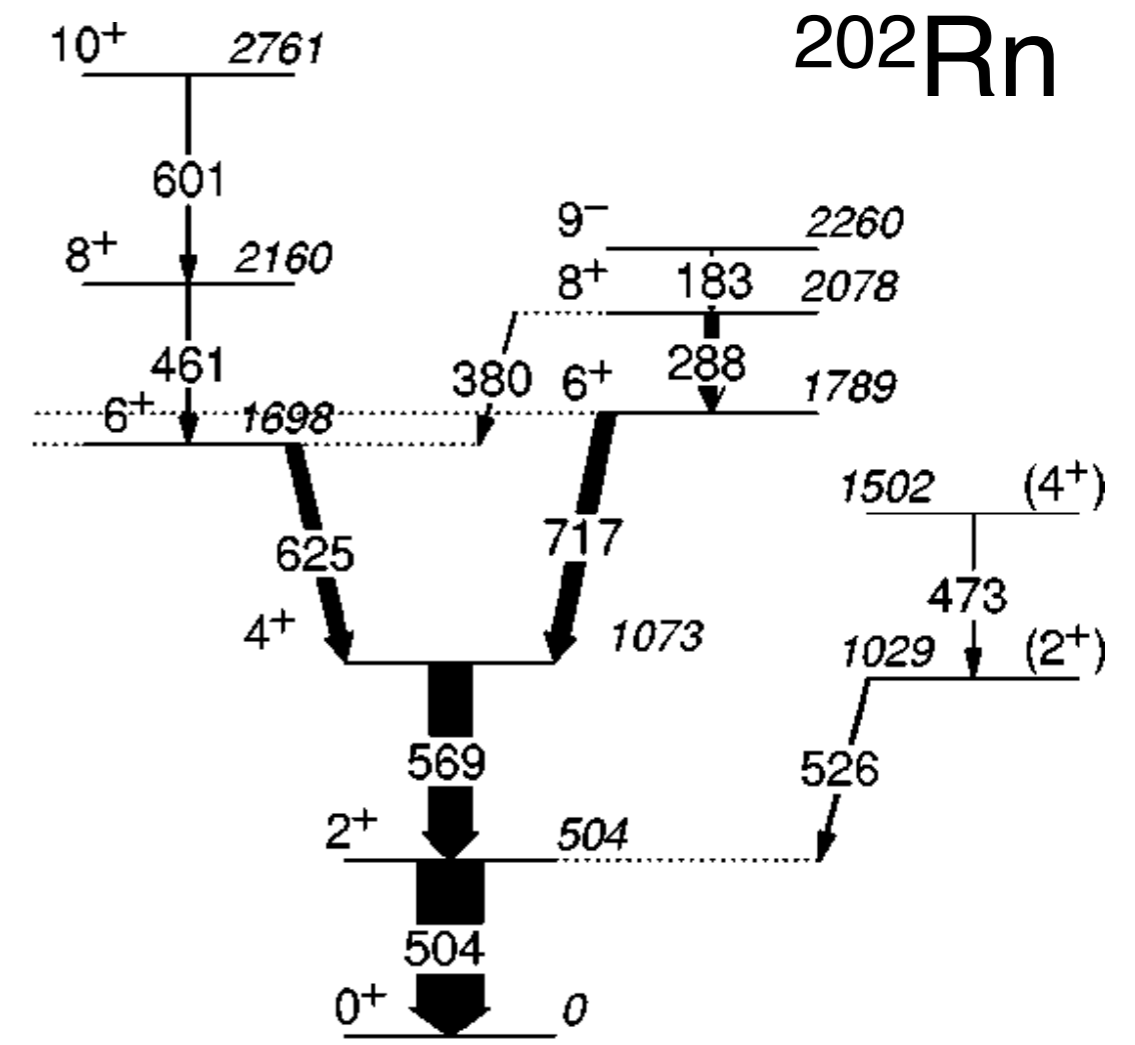
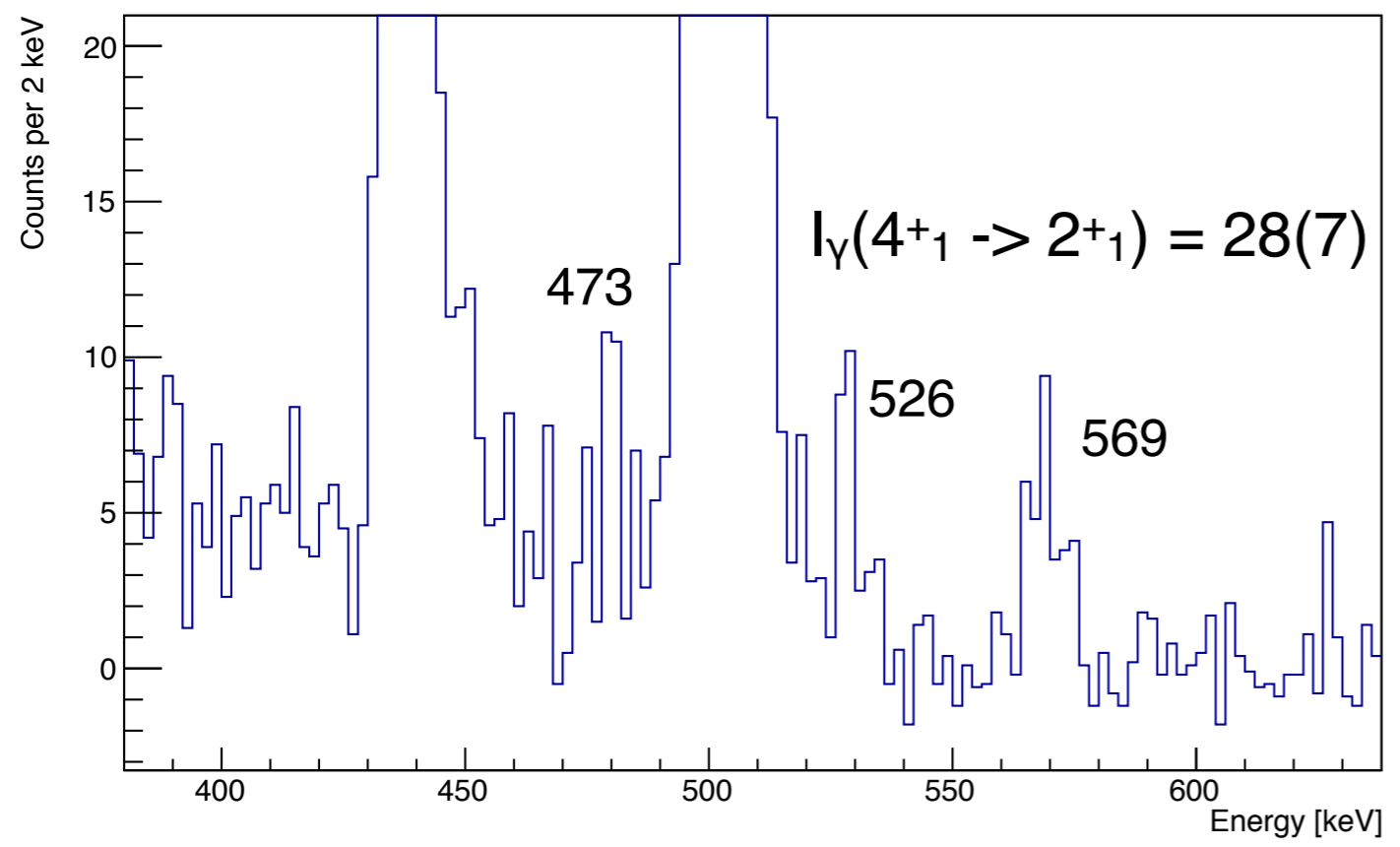
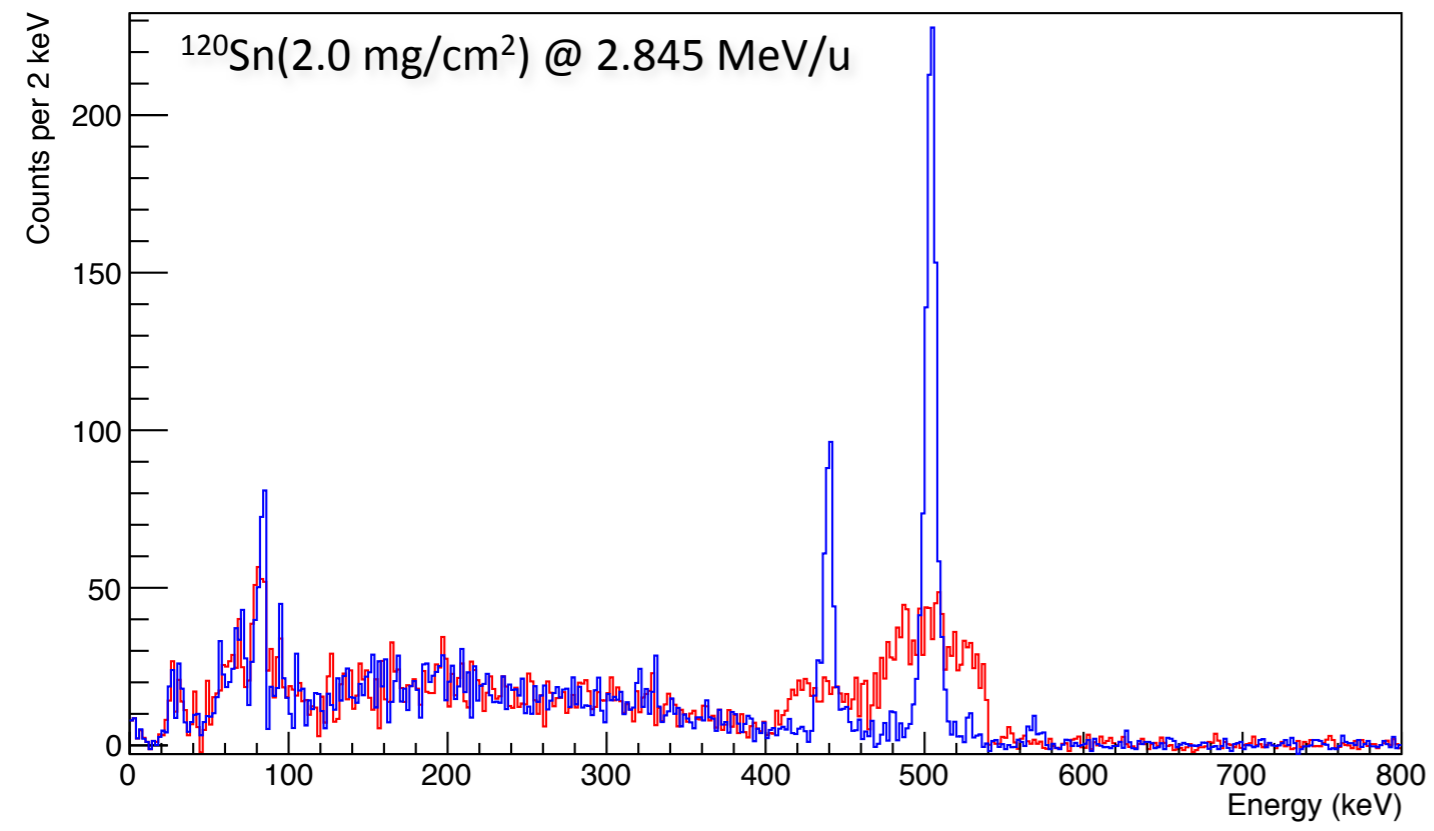




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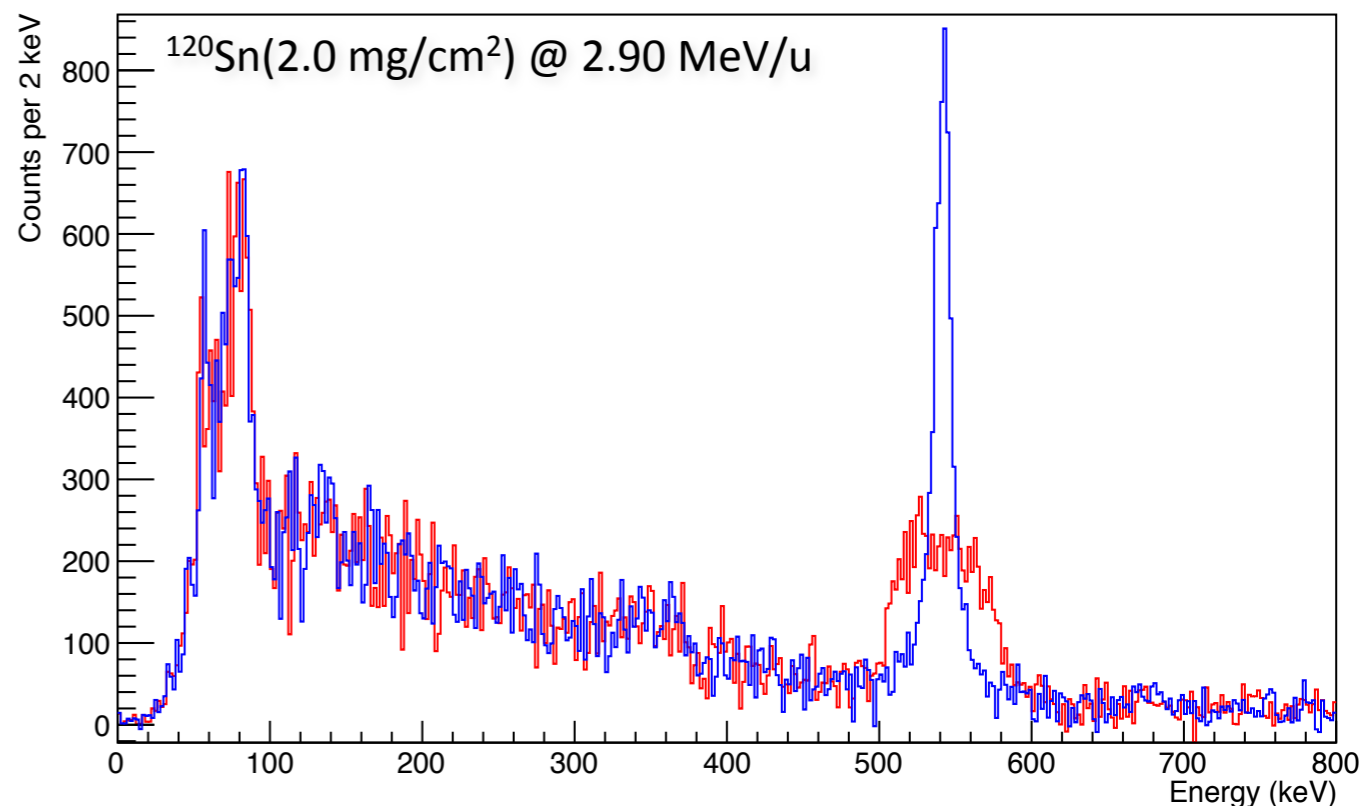
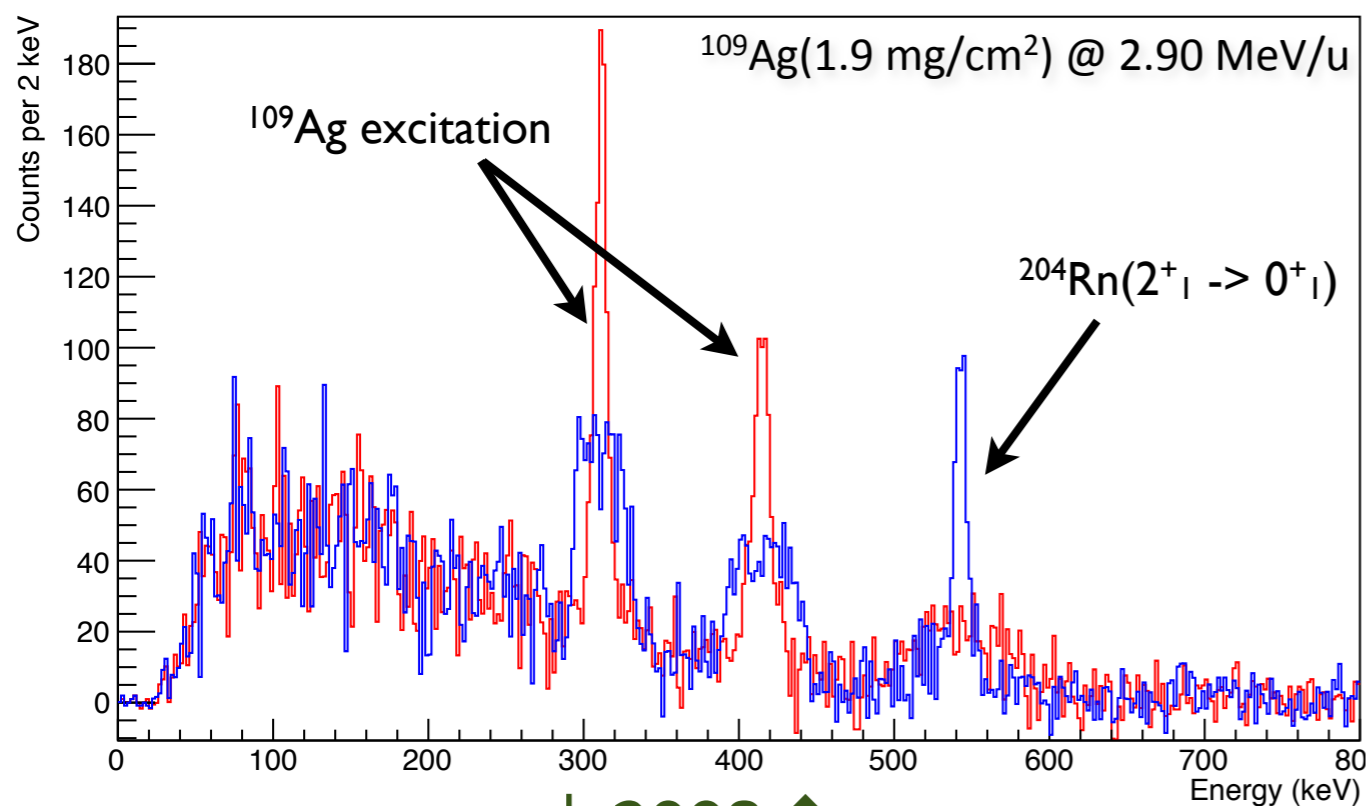


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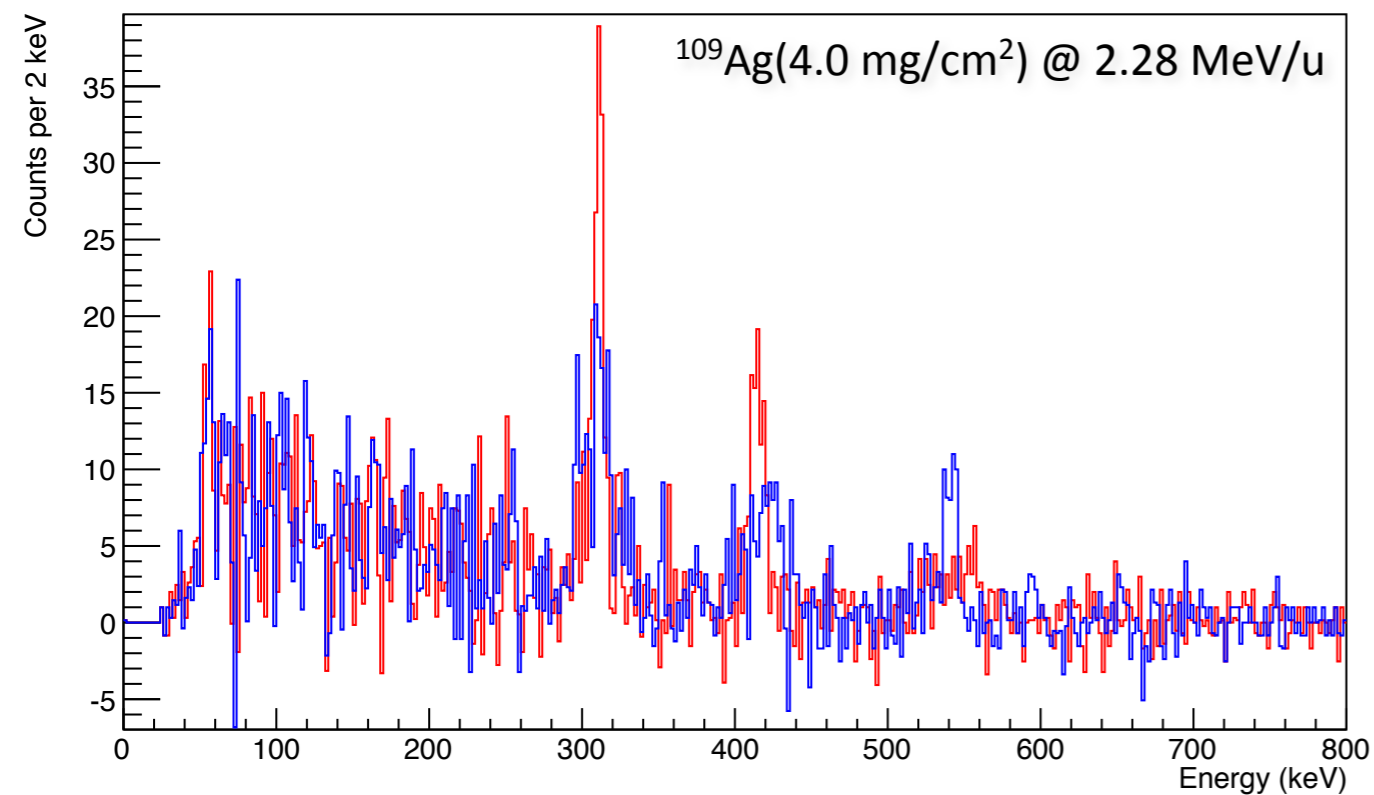


Rn projectile  
Ag/Sn target

# Doppler corrected spectra - $^{204}\text{Rn}$

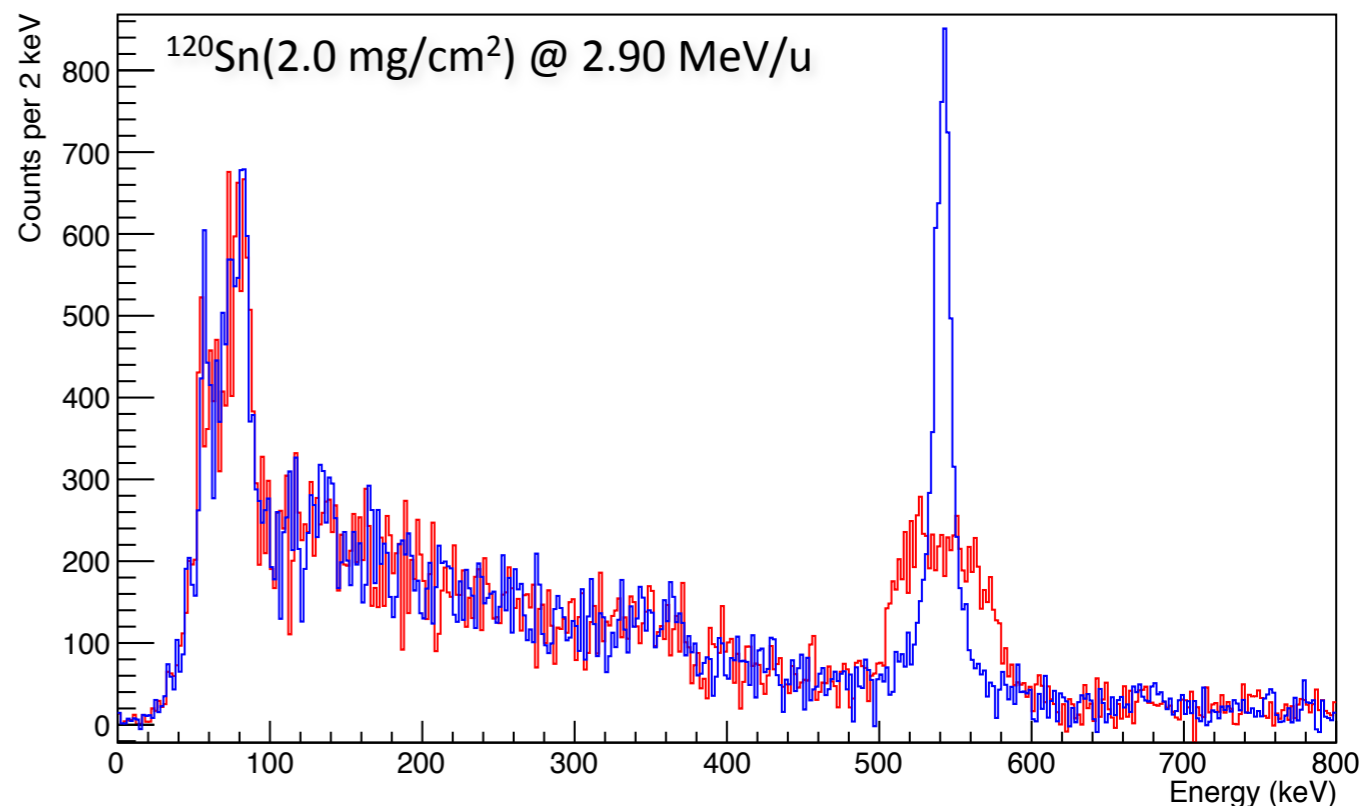
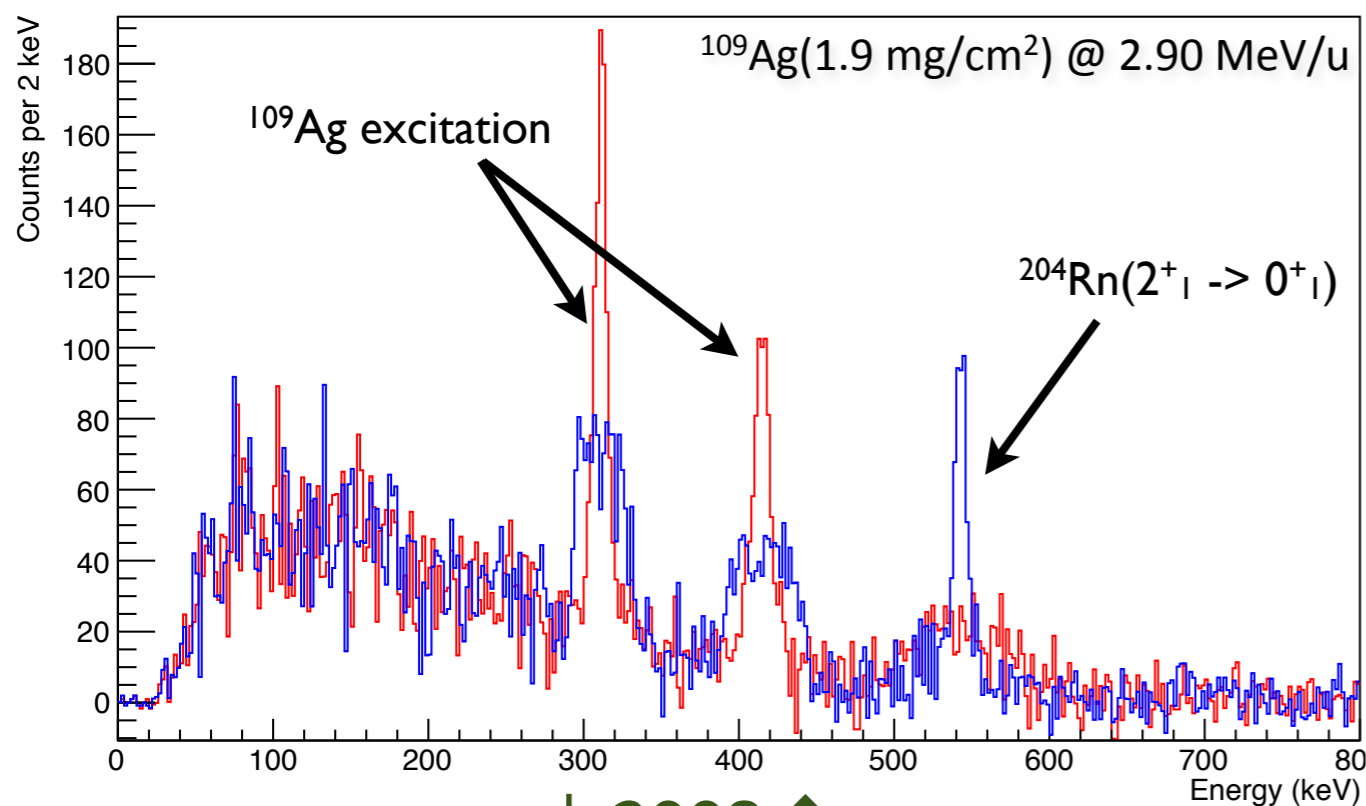


↓ 2008 ↑

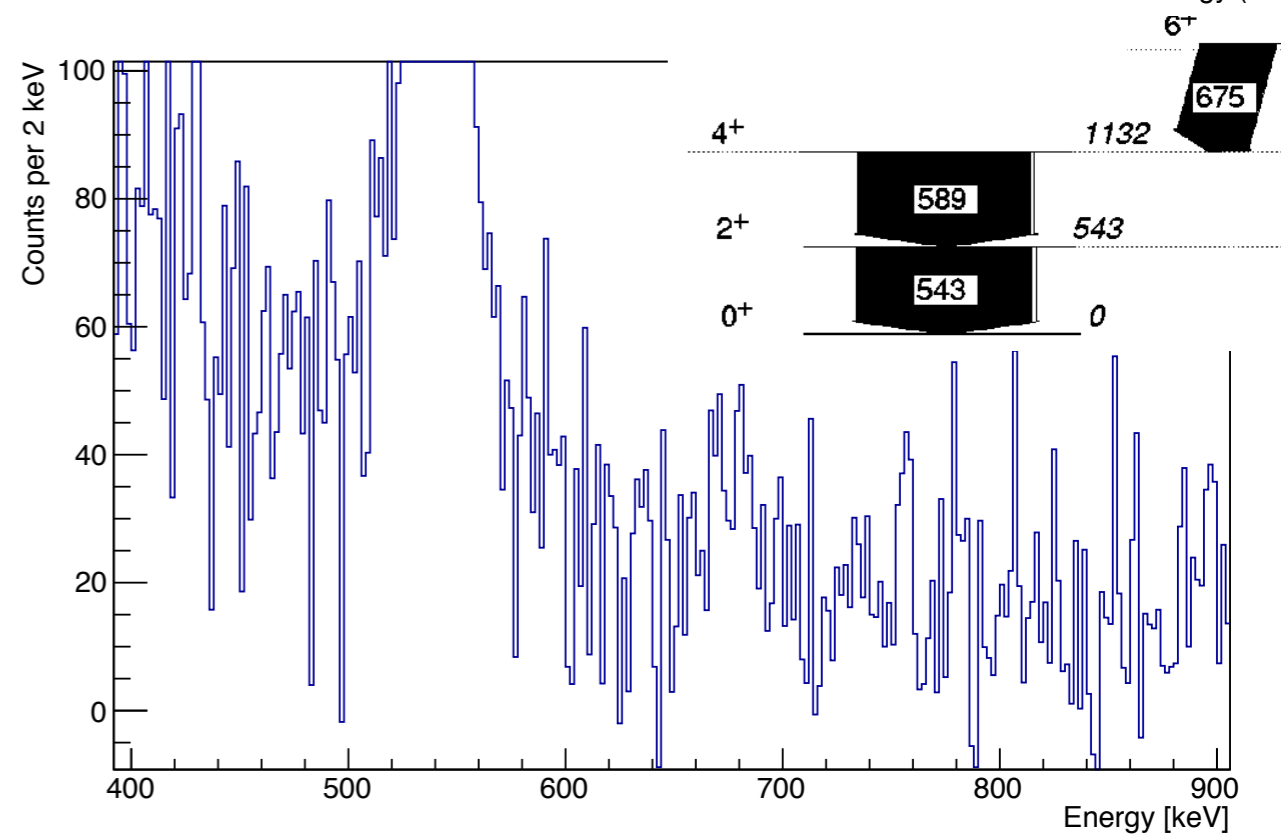
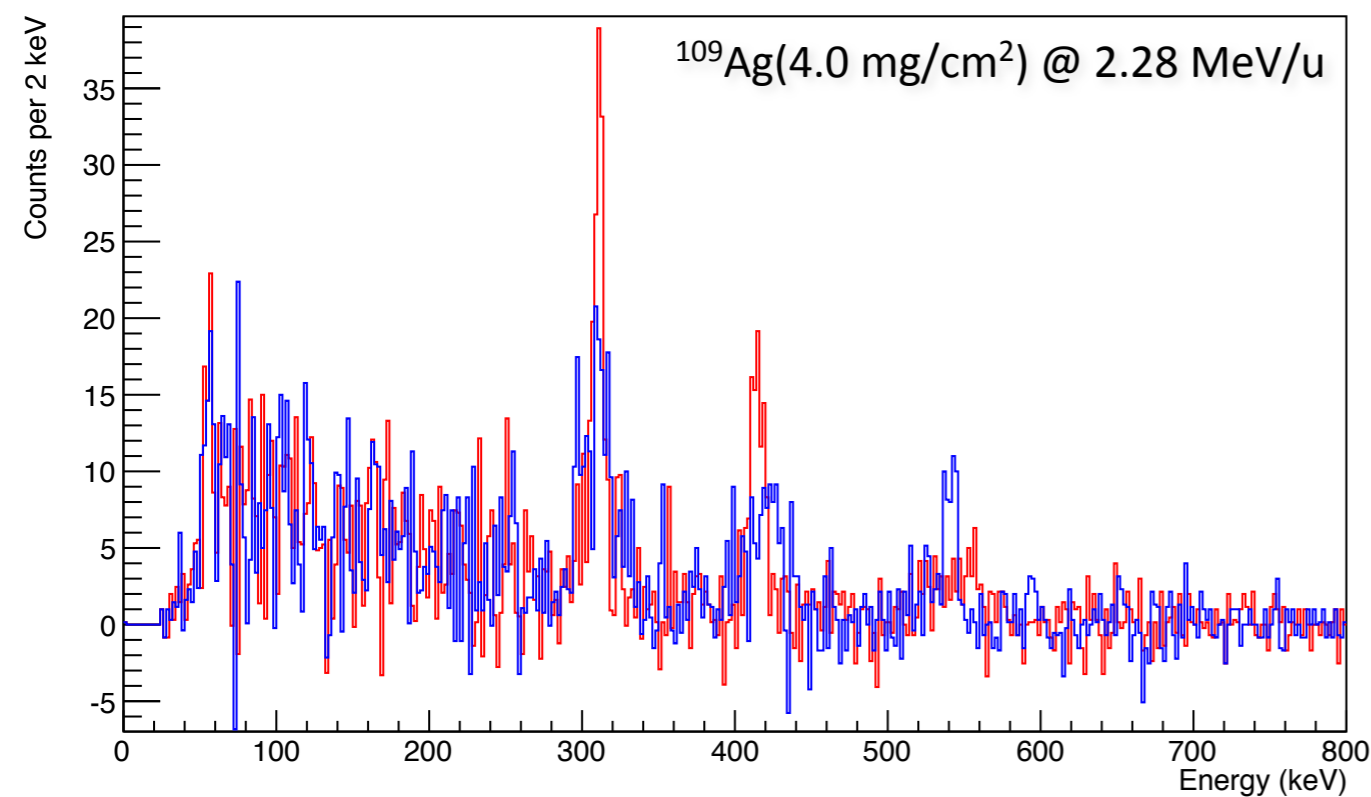


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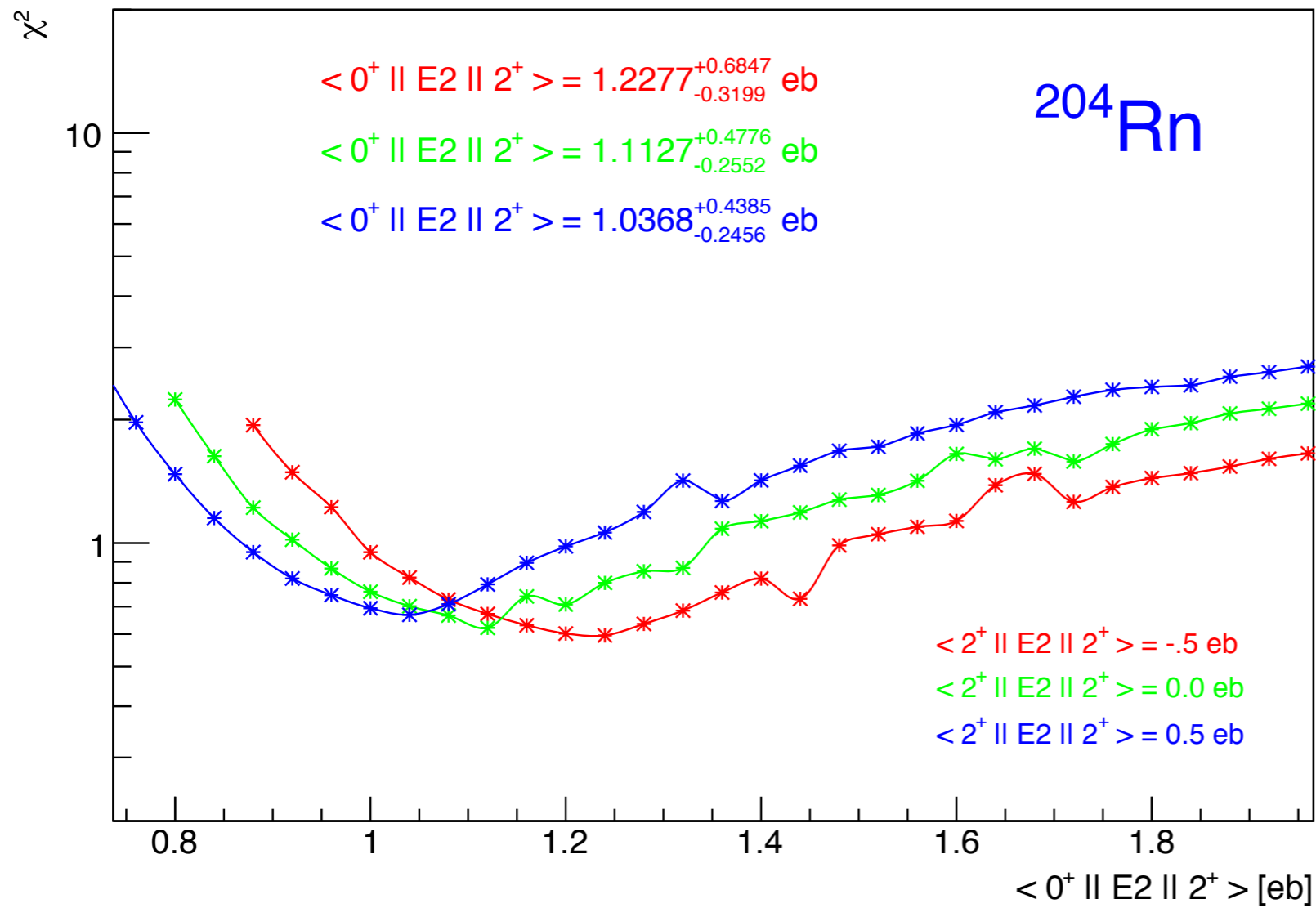
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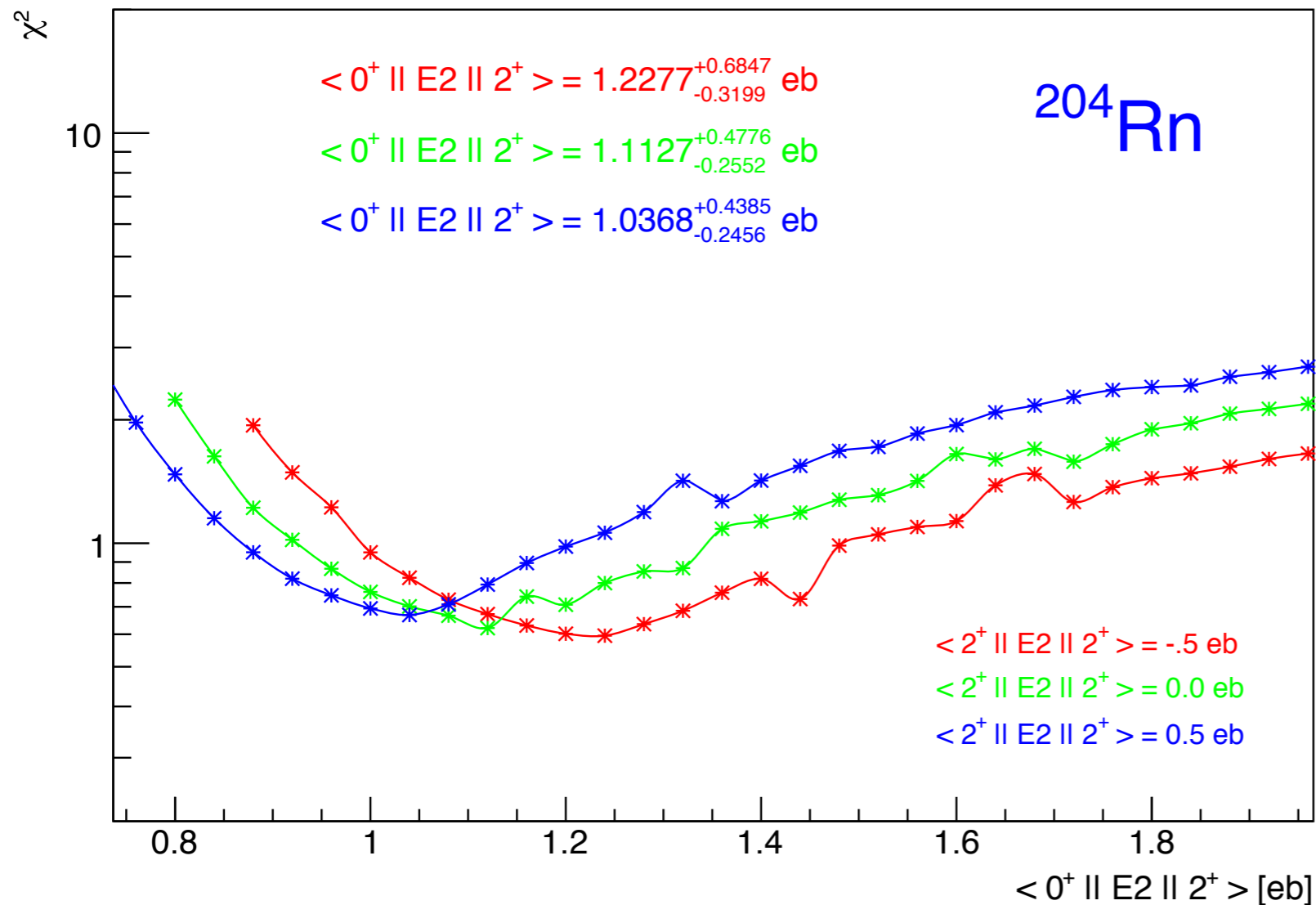
↓ 2008 ↑



# VERY Preliminary Gosia2 calculations - $^{204}\text{Rn}$



# VERY Preliminary Gosia2 calculations - $^{204}\text{Rn}$



$$B(E2; 2^+_1 \rightarrow 0^+_2) = 34^{+36}_{-14} \text{ W.u.}$$

very very preliminary



# Summary

- Extracted preliminary  $B(E2; 2^+_{1} \rightarrow 0^+_{1})$  values in  $^{202,204}\text{Rn}$ .
- Not enough sensitivity to quadrupole moment.

## To do:

- Subtract Hg contamination from 2010 runs.
- Try to add in  $2^+_{2}$  and  $4^+_{1}$  states for  $^{202}\text{Rn}$ , normalising to  $\langle 2^+_{1} || E2 || 0^+_{1} \rangle$

**Thank you!**

# ***Subtraction of Hg contamination... Worthwhile?***

- $^{202}\text{Hg}$  lifetime known to good precision...  $\tau = 39.33 \pm 0.32$  ps.
- Calculate integrated flux of Hg from known cross-section.
  - Uncertainty dominated by statistical error from  $\gamma$ -ray intensity.
- Calculate  $\gamma$ -ray intensity of  $^{109}\text{Ag}$  transitions from Hg excitation.
- Subtract from total to get  $^{202}\text{Rn}$  contribution -> Big error bar.

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Yes, of course it will be done, eventually...

# $2^+_2 \rightarrow 0^+_1? - {}^{202}\text{Rn}$

Target gated, background subtracted, Doppler corrected for scattered projectile

