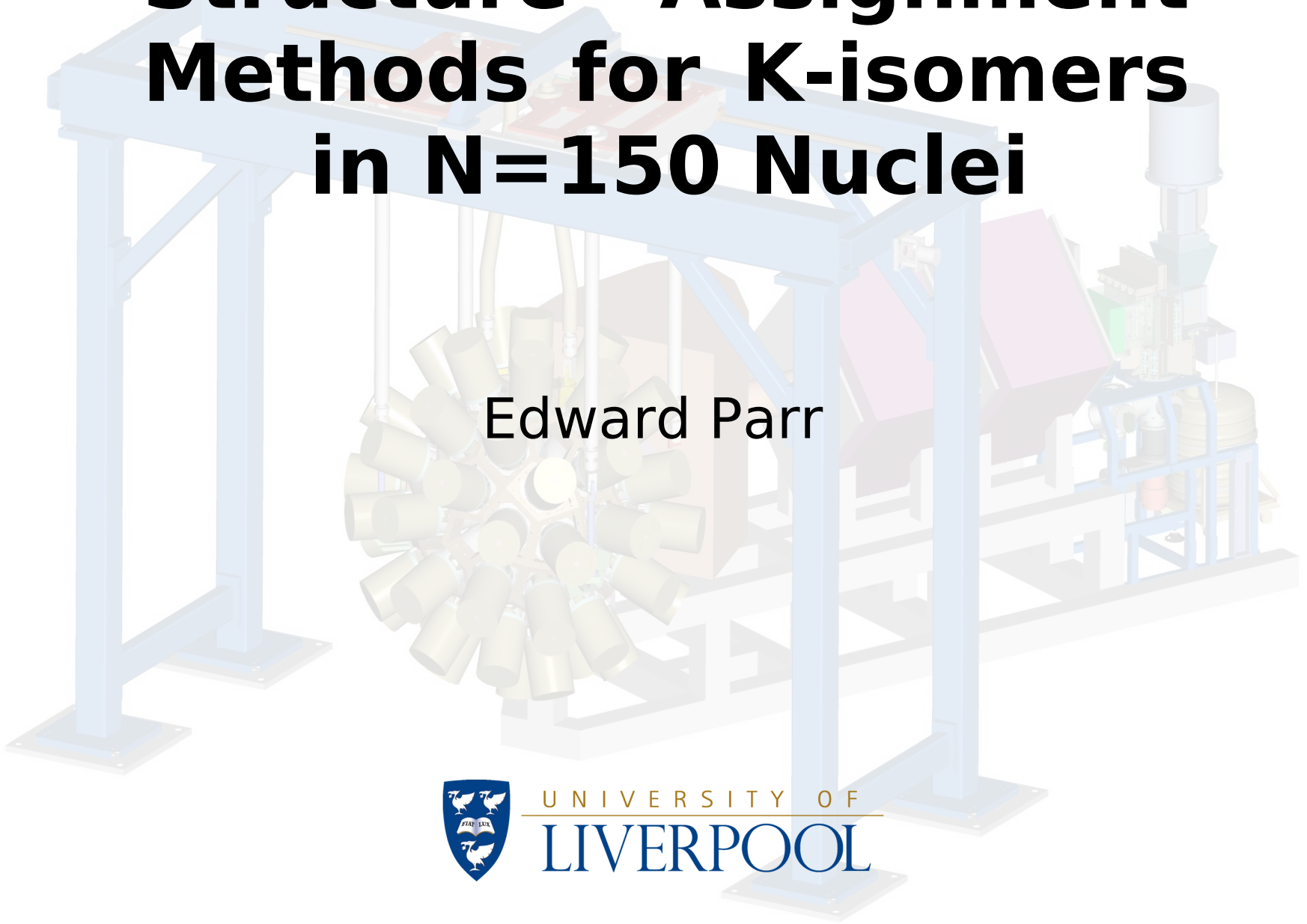
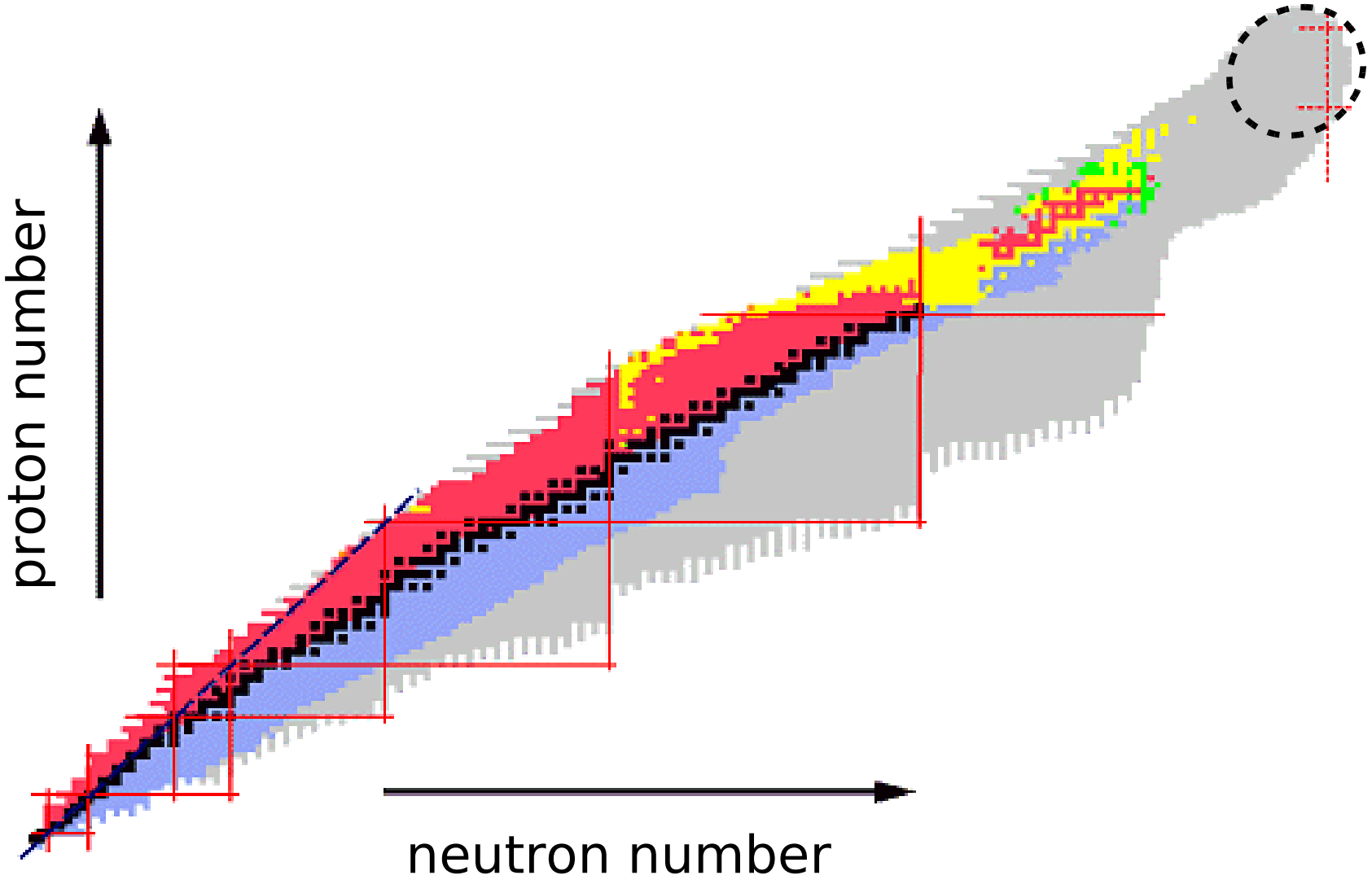
Structure Assignment Methods for K-isomers in N=150 Nuclei

Edward Parr



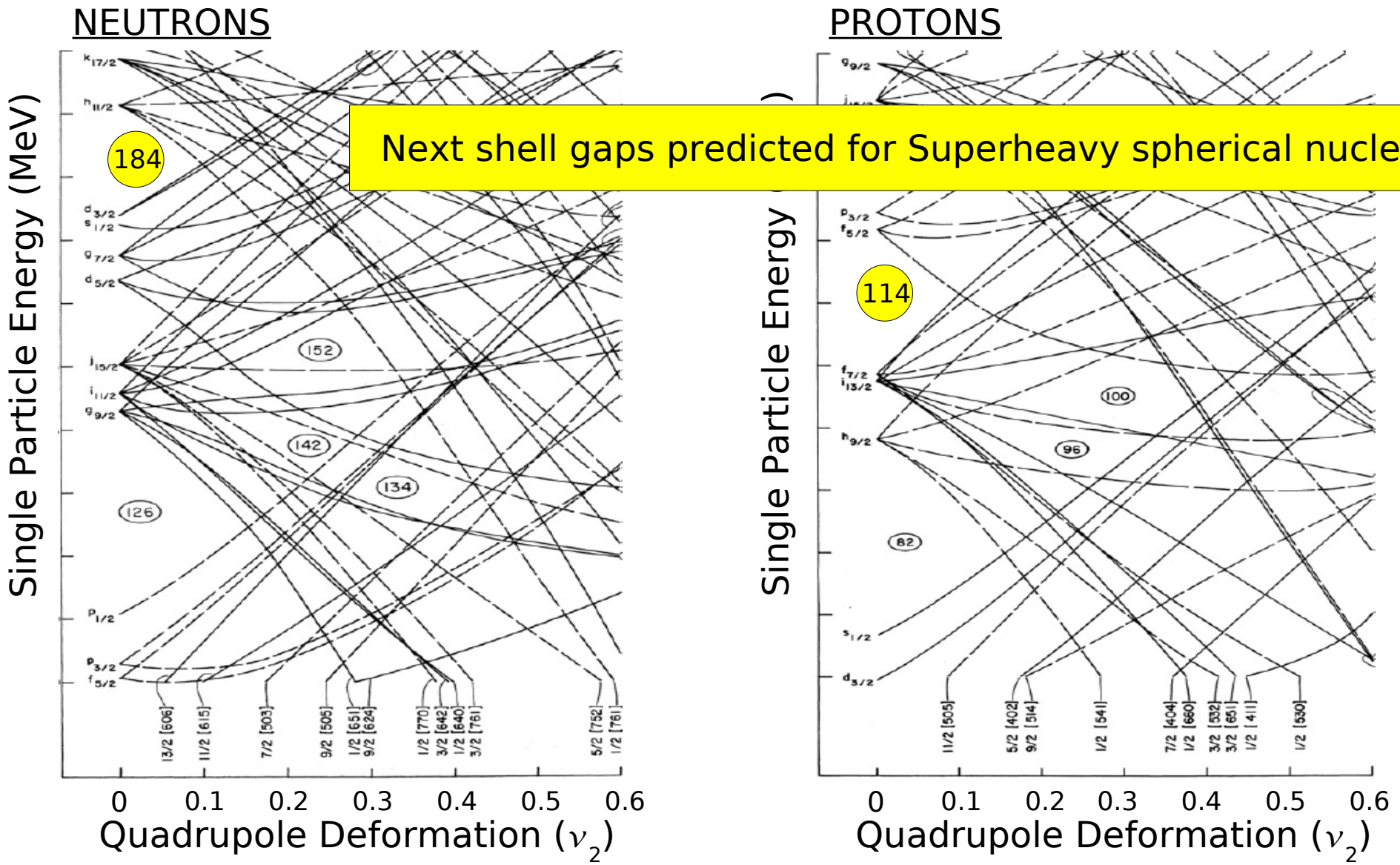
UNIVERSITY OF LIVERPOOL

Motivation in Superheavies



•Island of increased stability has long been predicted on nuclear landscape

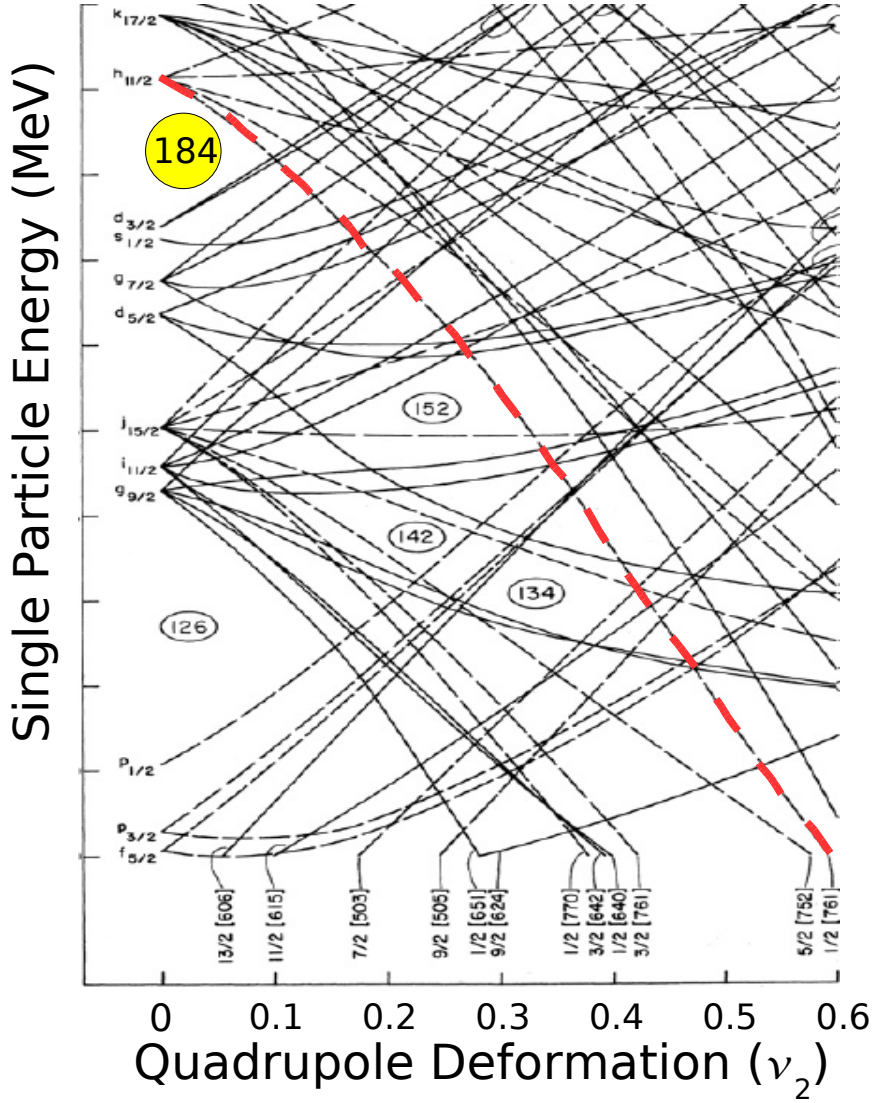
Motivation in Superheavies



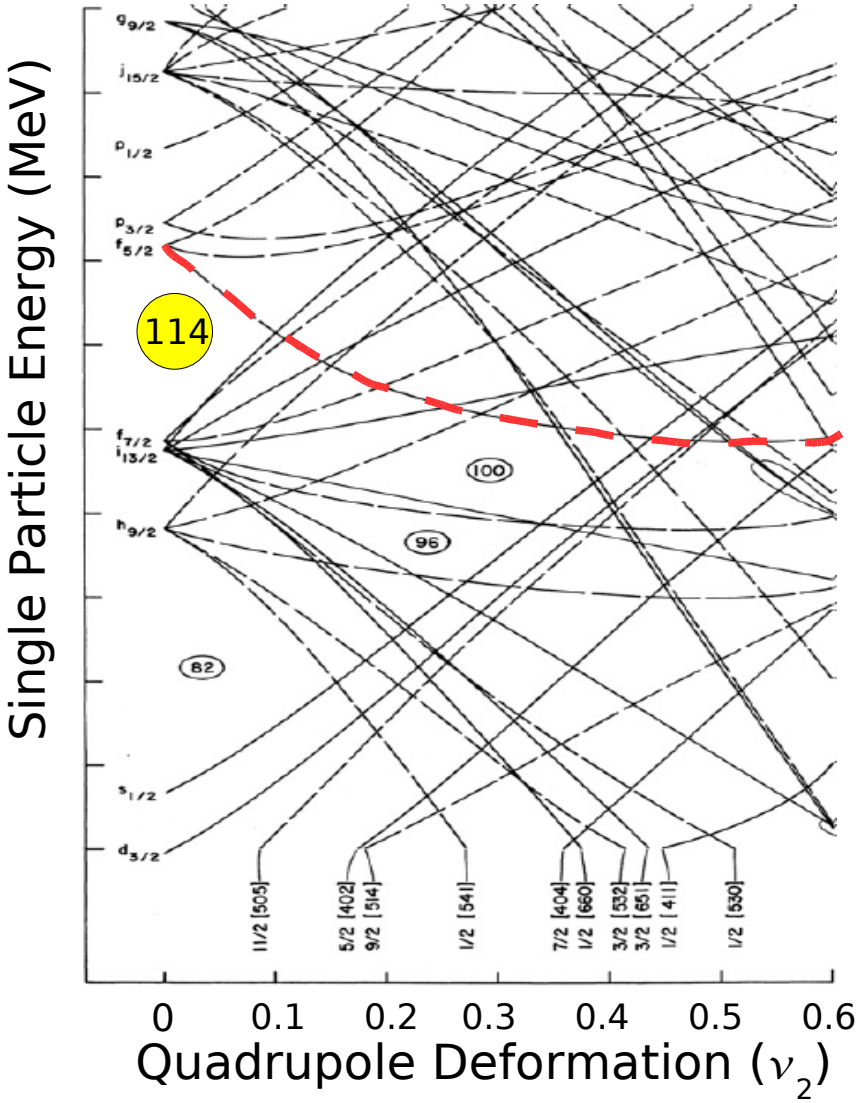
- Cross section to produce these nuclei is too low

Motivation in Superheavies

NEUTRONS



PROTONS



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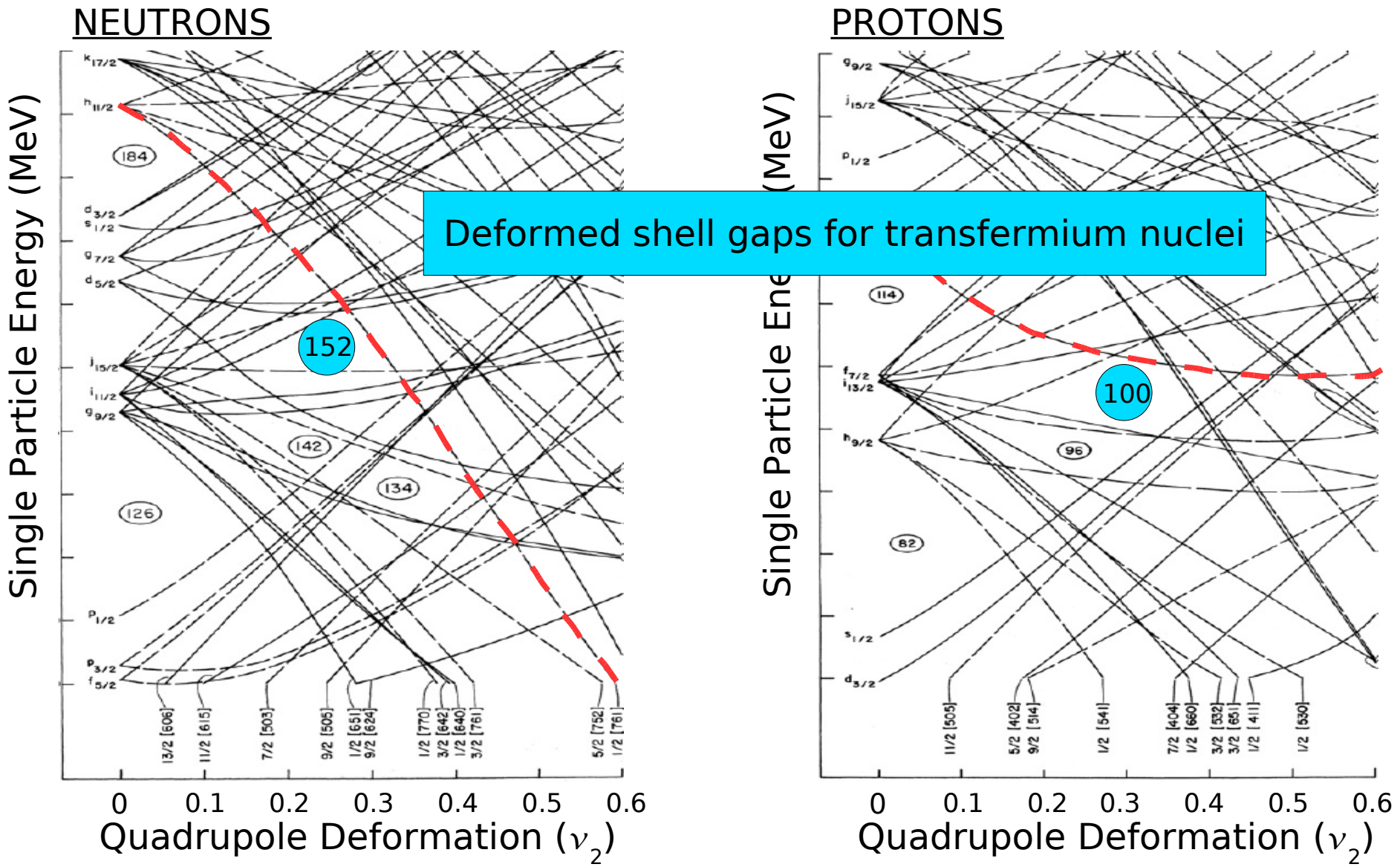
Motivation in Superheavies

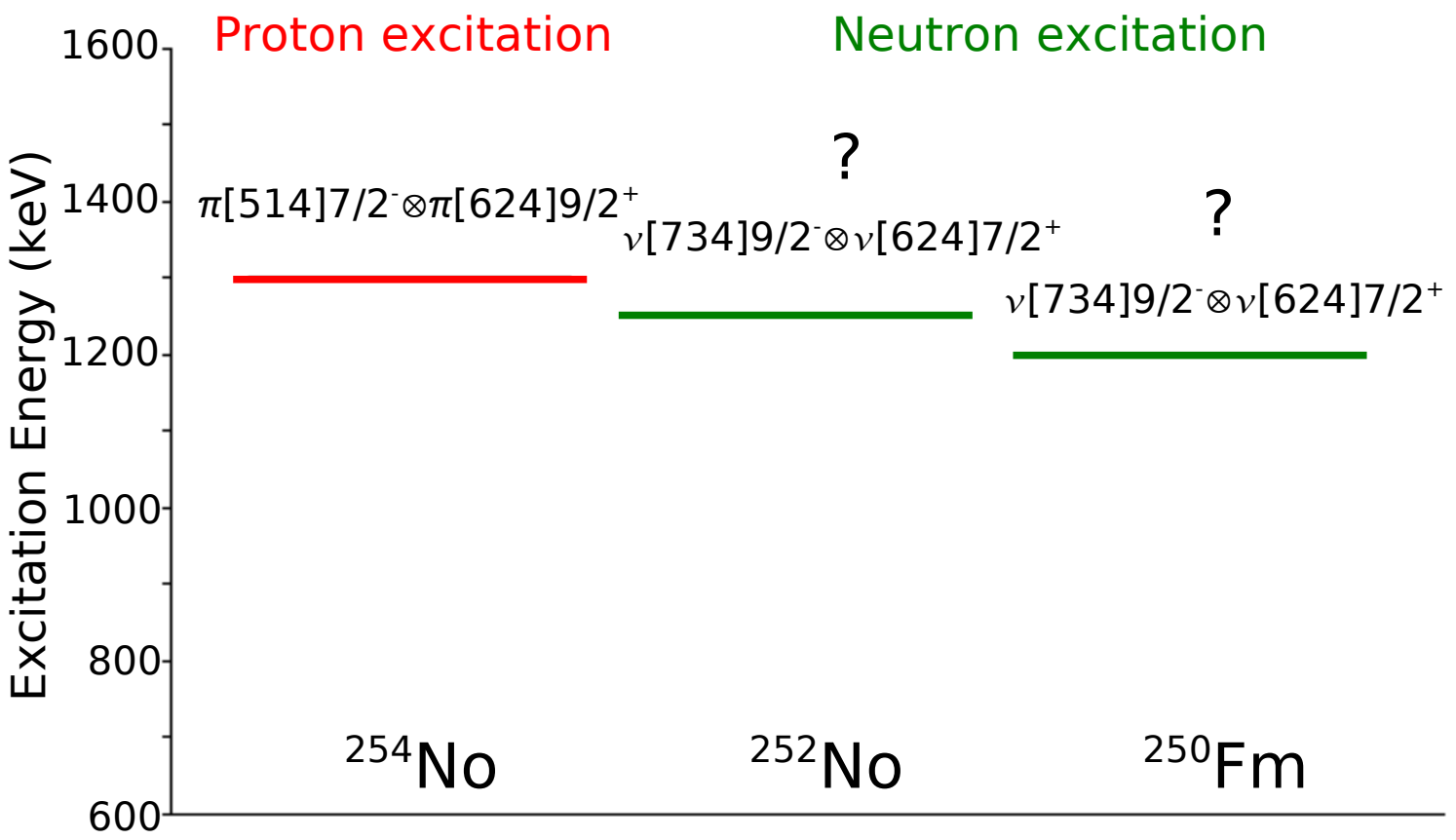


- Cross sections of nb→μb, production is experimentally viable

K-Isomer particle states

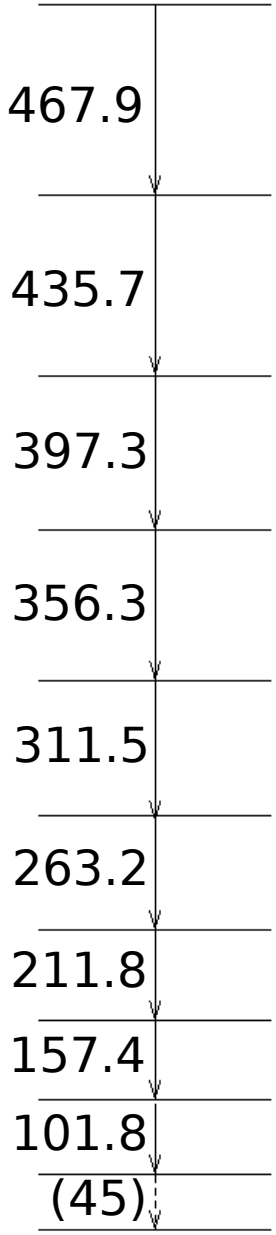
•Theoretical results of energy levels in this region conflict

K-Isomer particle states



- Theoretical results of energy levels in this region conflict
- Study K-isomer structures to infer single particle excitations into these levels

Recoil-Decay Tagging Events



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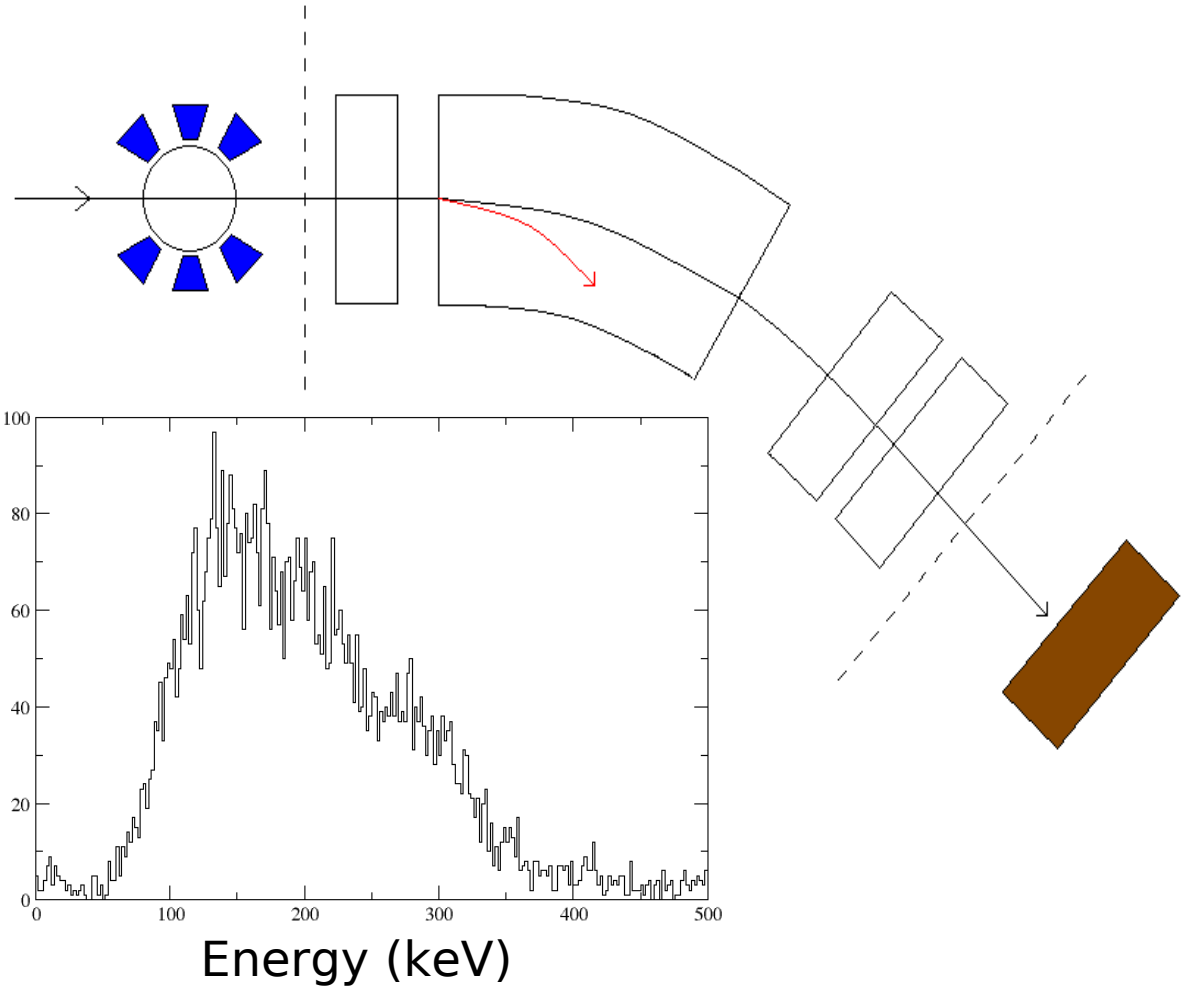
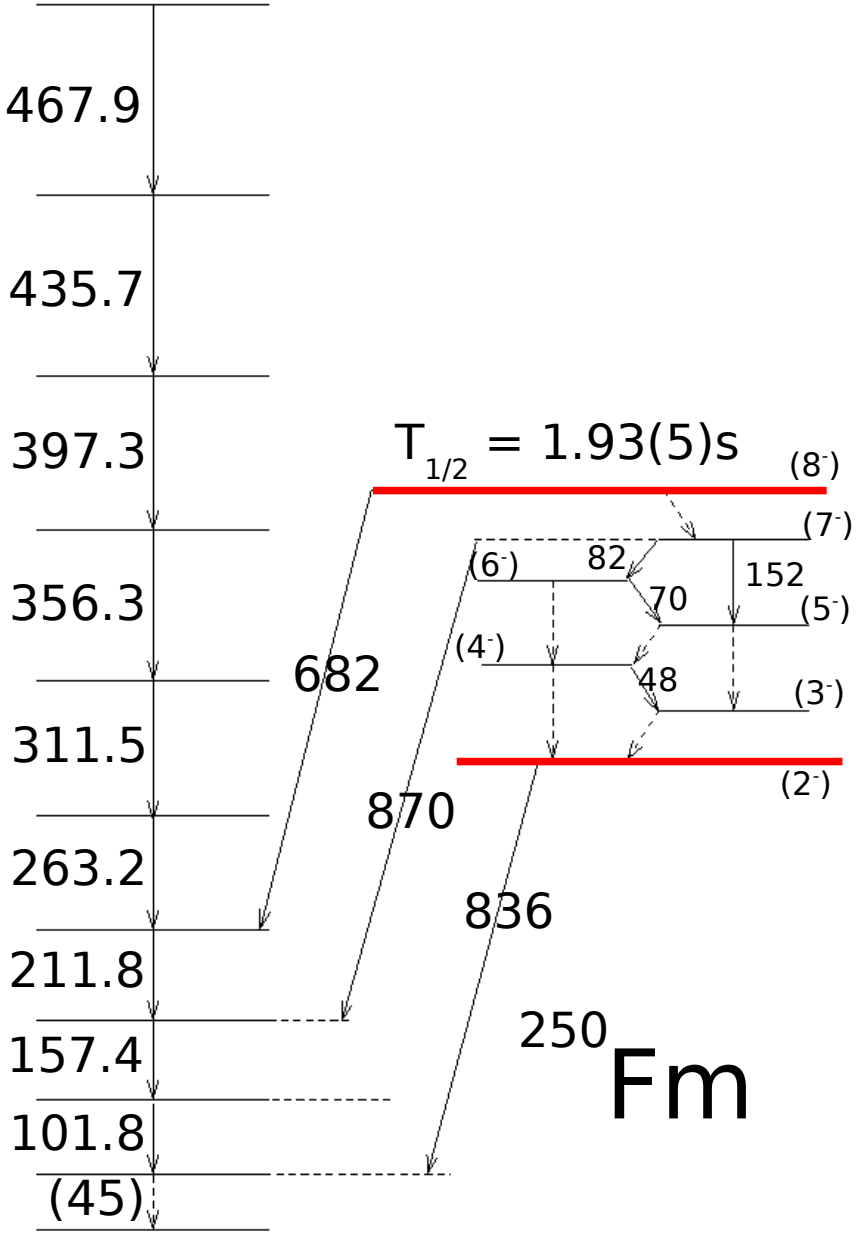
^{250}Fm



- Isomeric events decay in focal plane
- Lower order transitions are highly converted

Recoil-Decay Tagging Events



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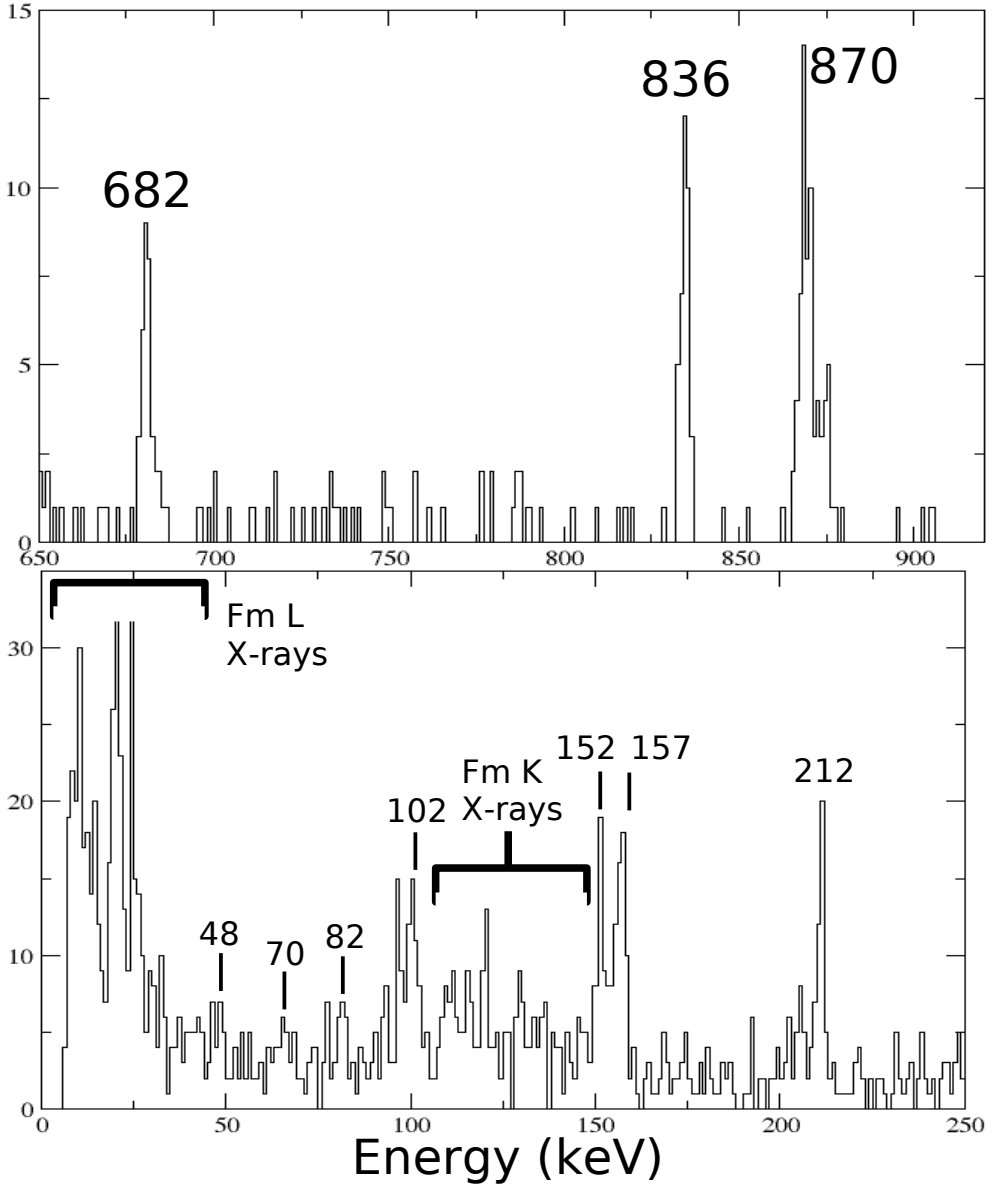
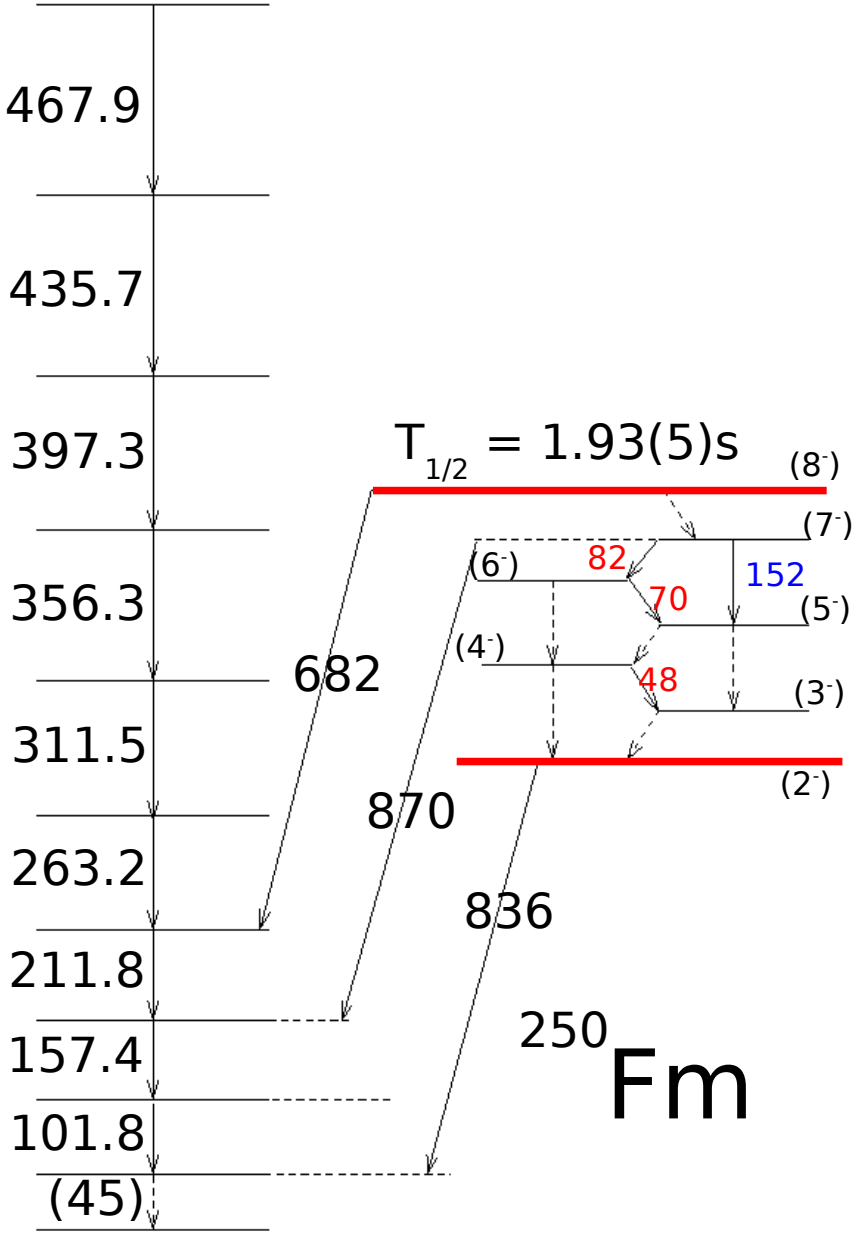
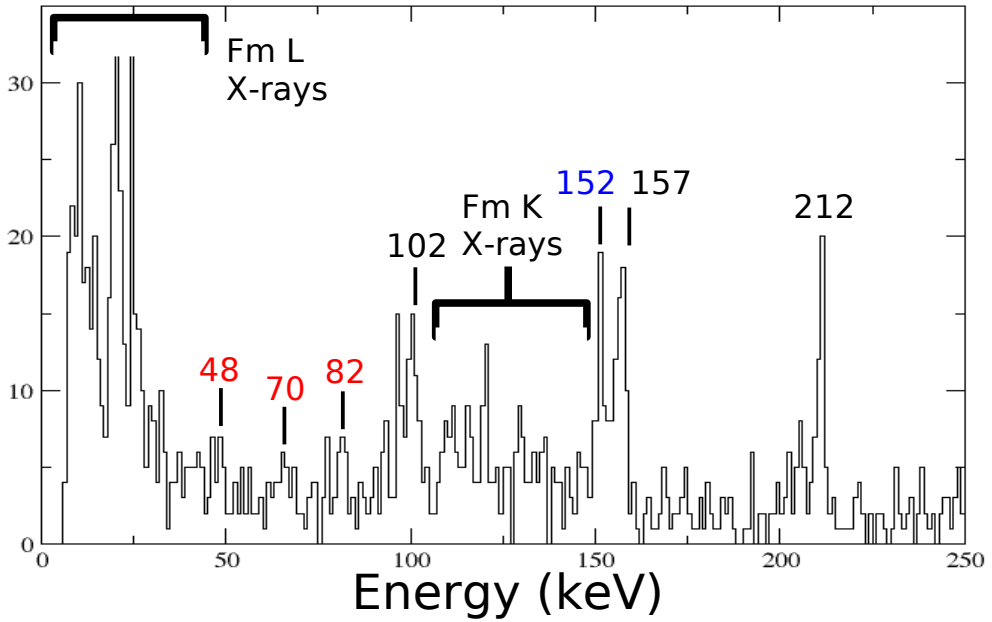


•Focal plane spectra give transitions from decaying isomeric state

Conventional Isomeric Assignment



- $R = I(\Delta I=1)/(\Delta I=2) \propto (g_K - g_R)^2$



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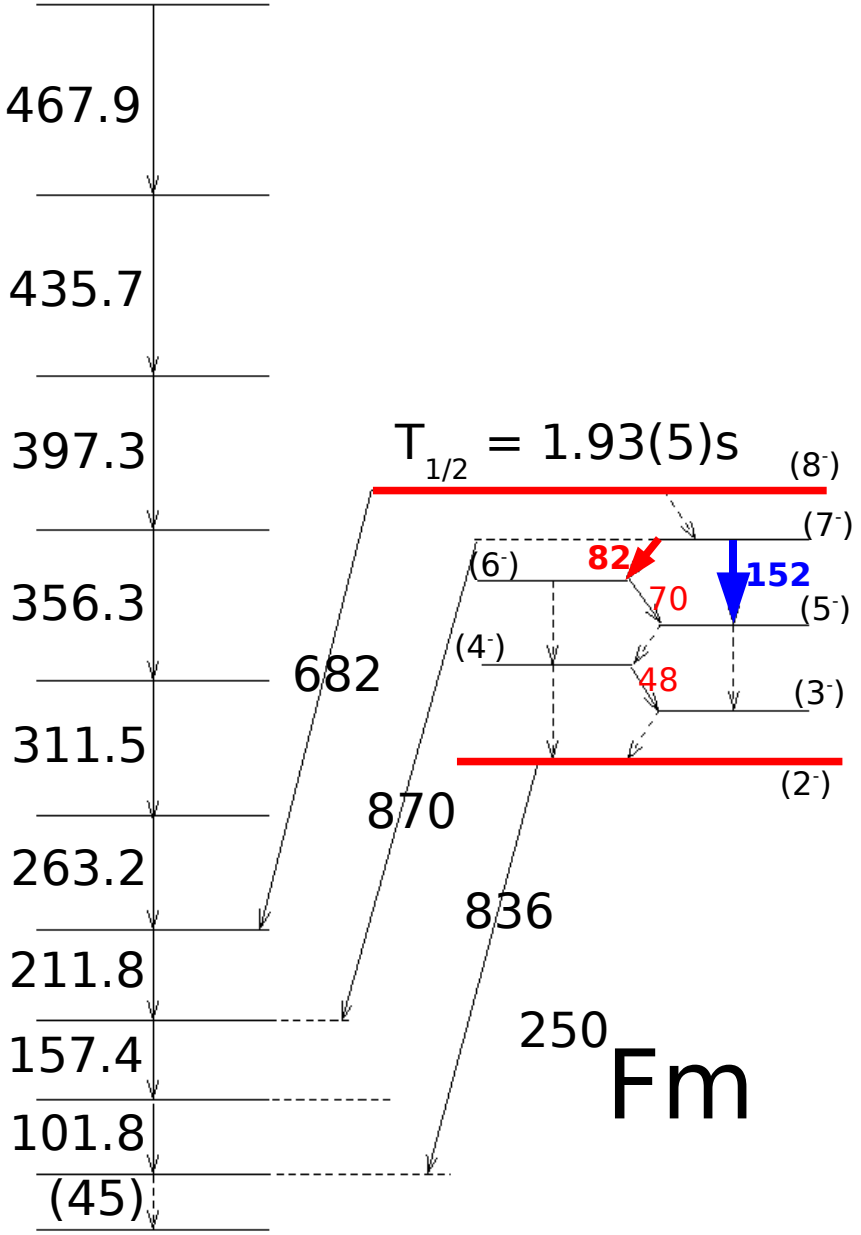
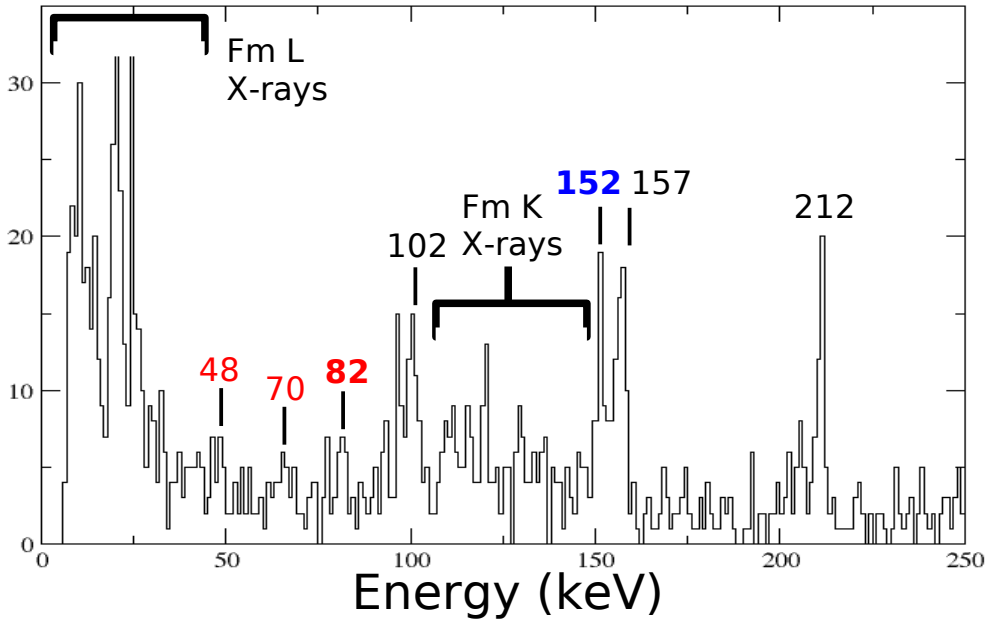
Conventional Isomeric Assignment



- $R = I(\Delta I=1)/(\Delta I=2) \propto (g_K - g_R)^2$
- $R_{exp}\,(I^{\pi} = 7^-) = \underline{0.25}^{+0.29}_{-0.16}$



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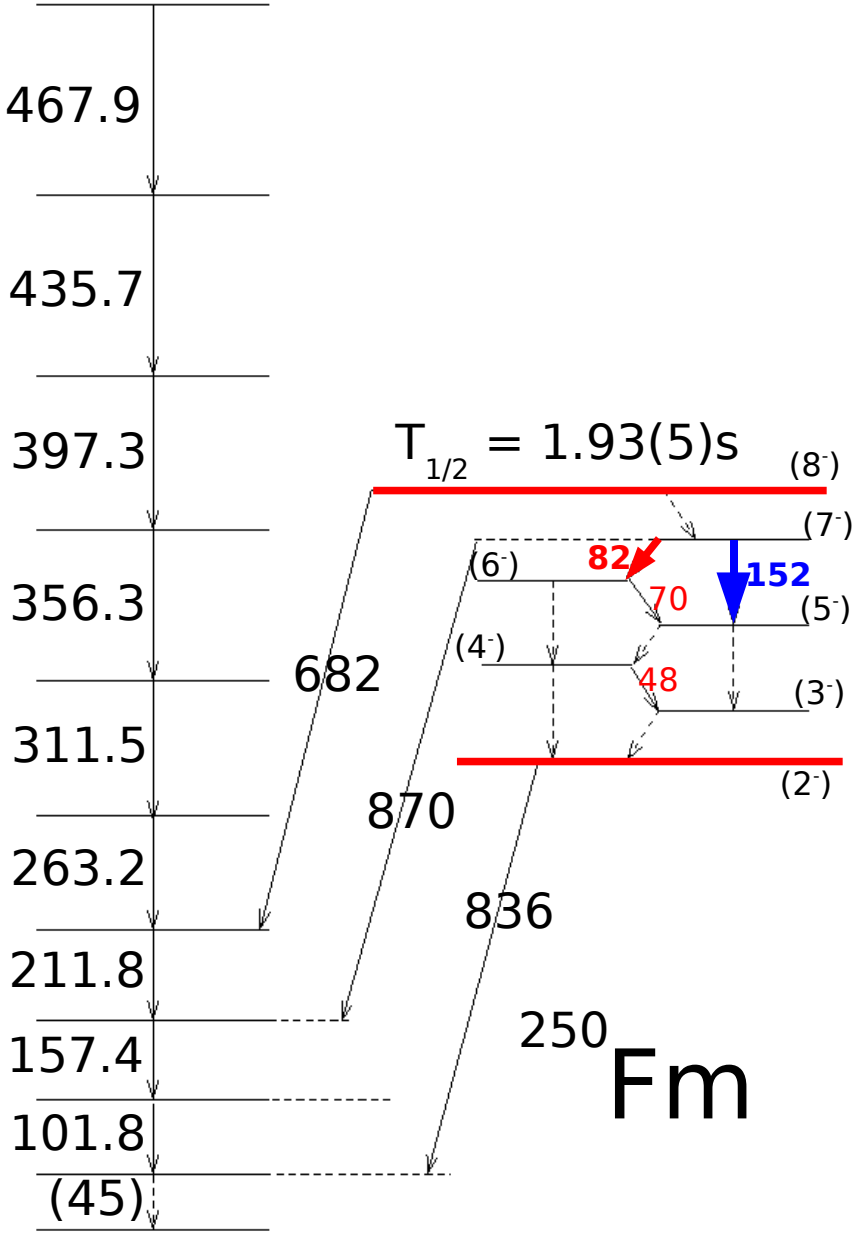
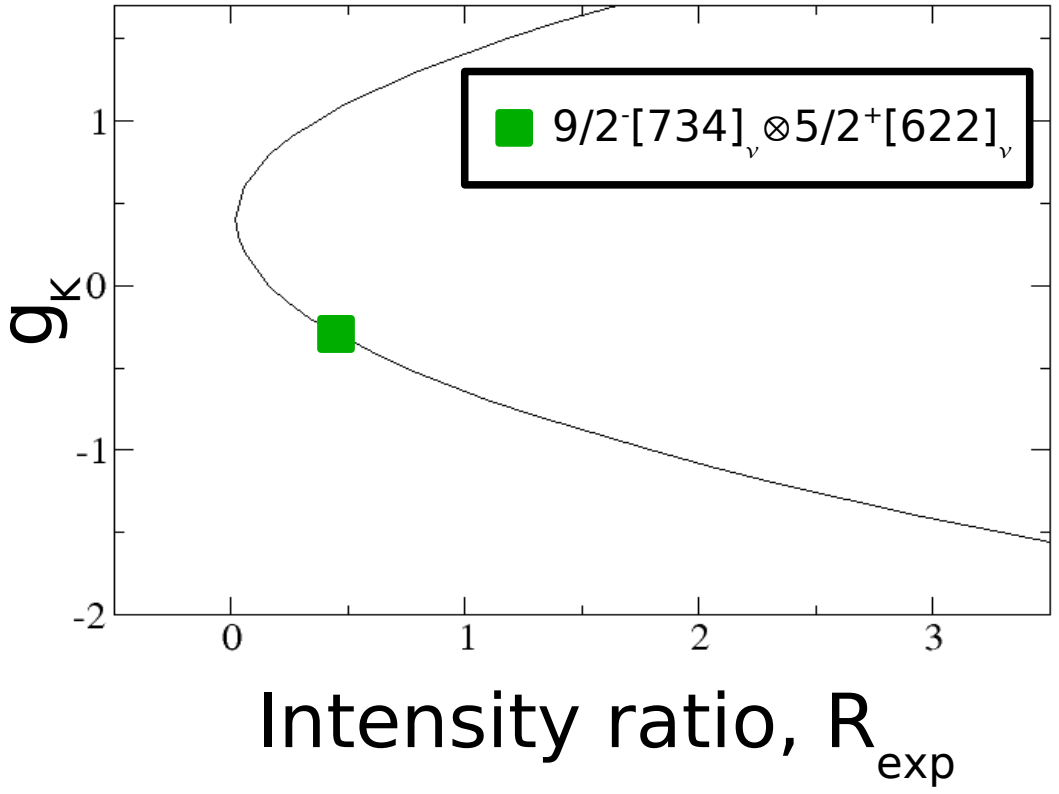
Conventional Isomeric Assignment



- Find R as function of g_K factor



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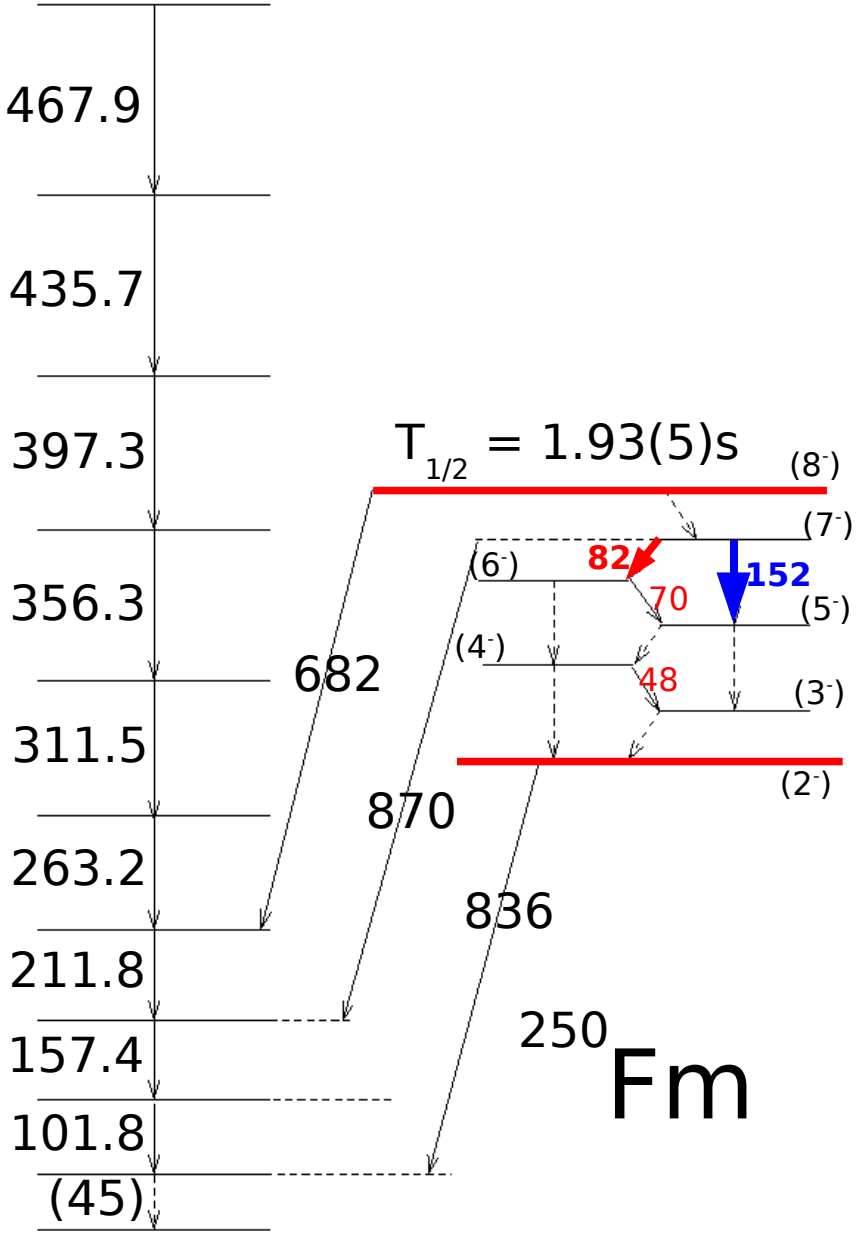
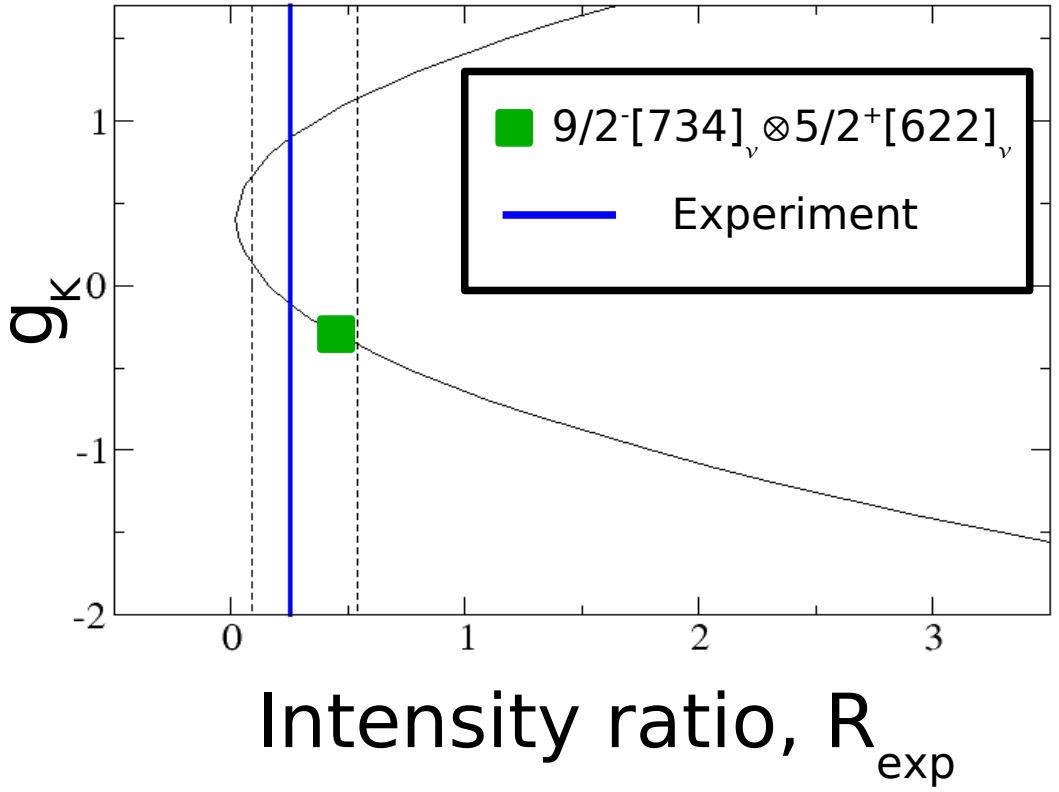
Conventional Isomeric Assignment



- Find R as function of g_K factor
- Compare R_{exp} to assign structure



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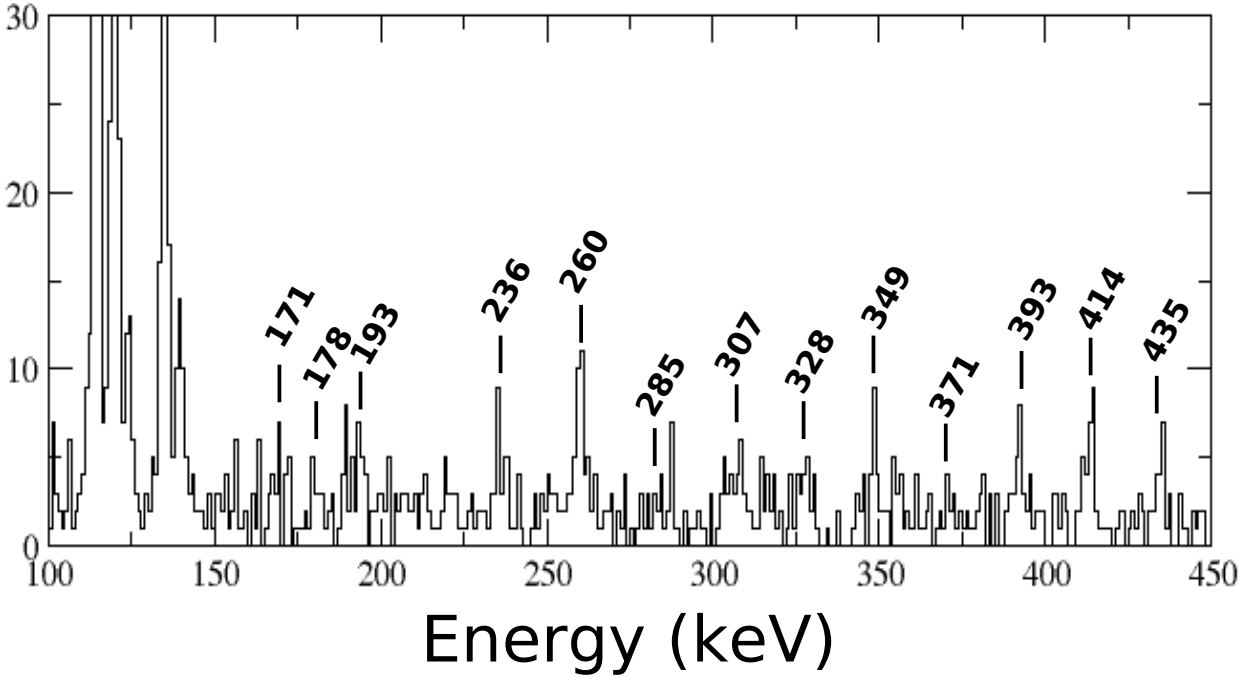
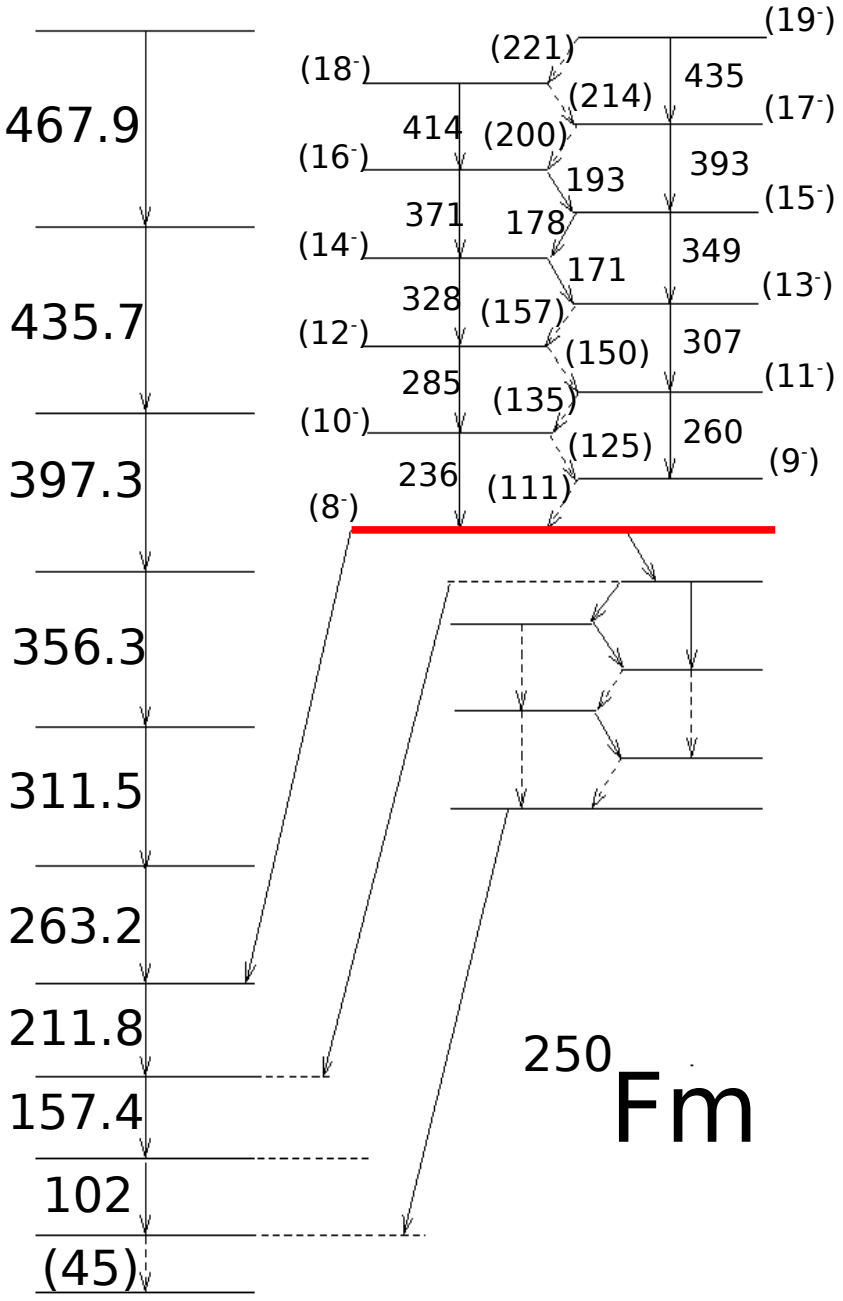
Assignment Problems

- Apply to inbeam ^{250}Fm data

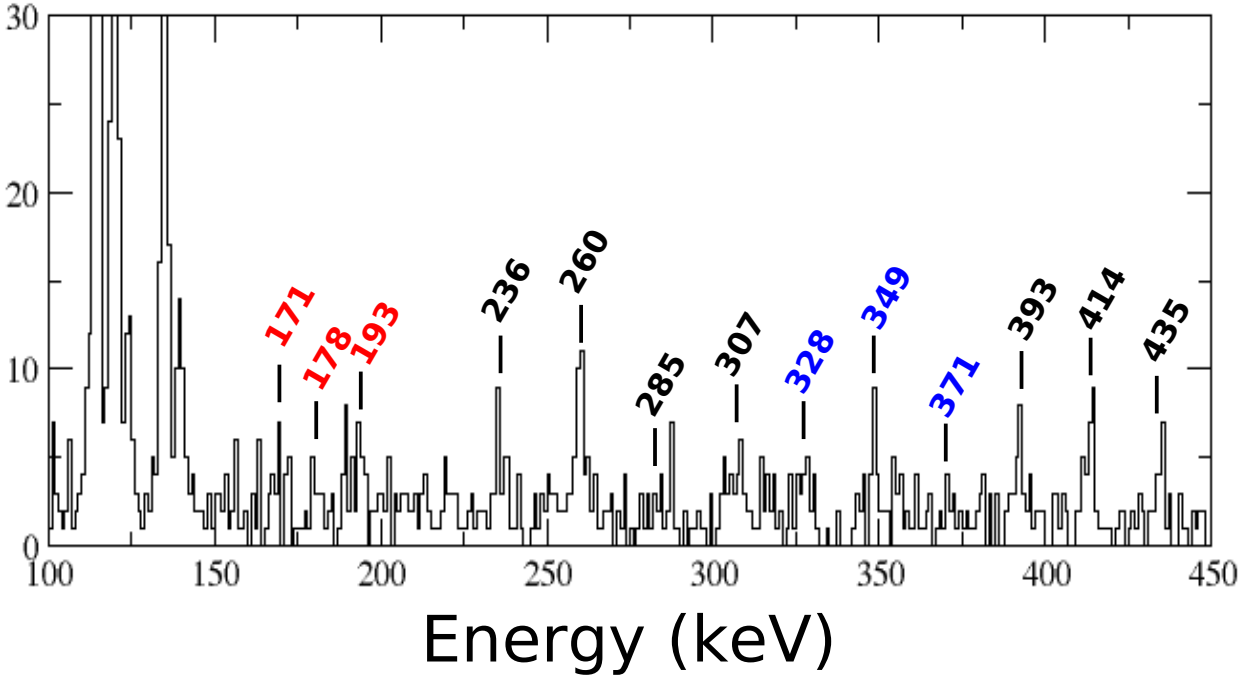


D. Rostron, Thesis (2009)

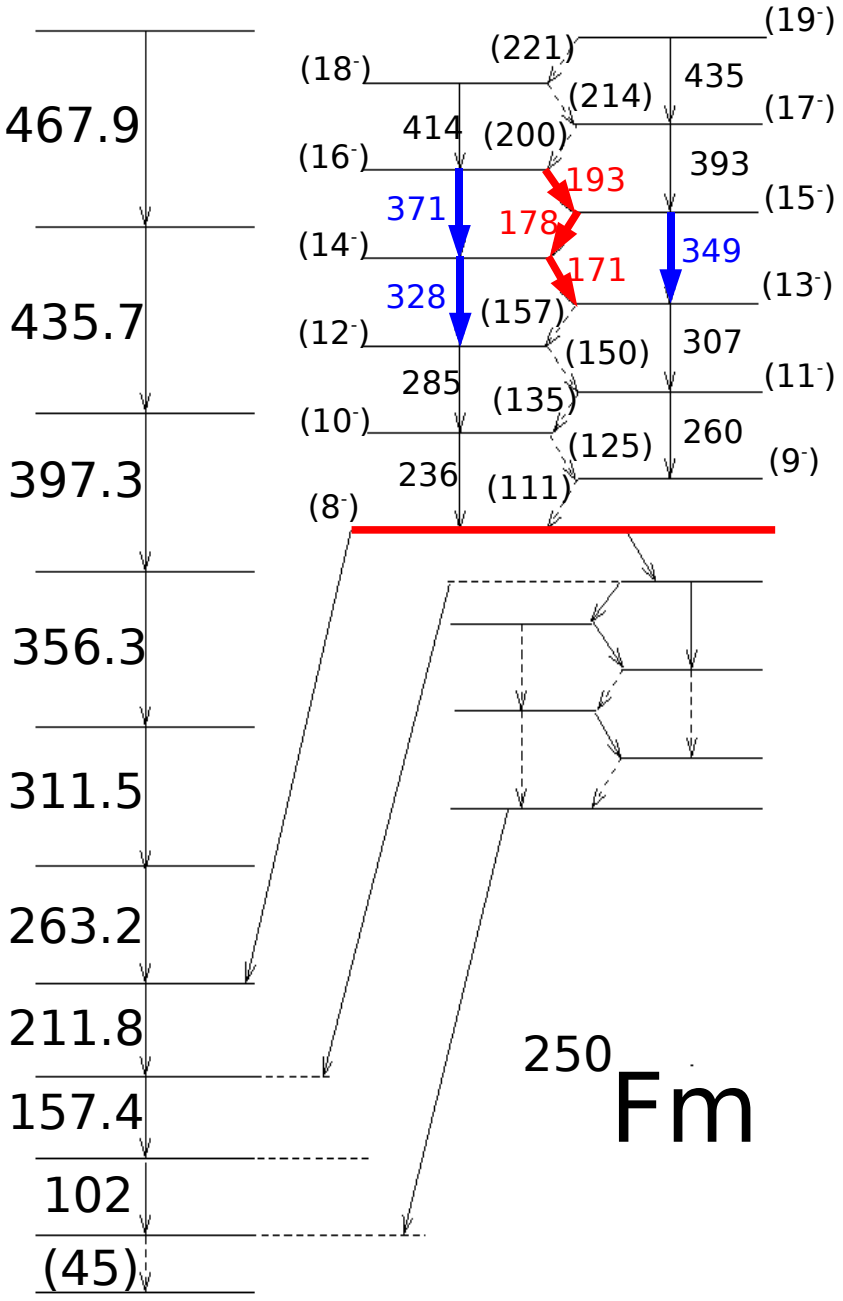


Assignment Problems

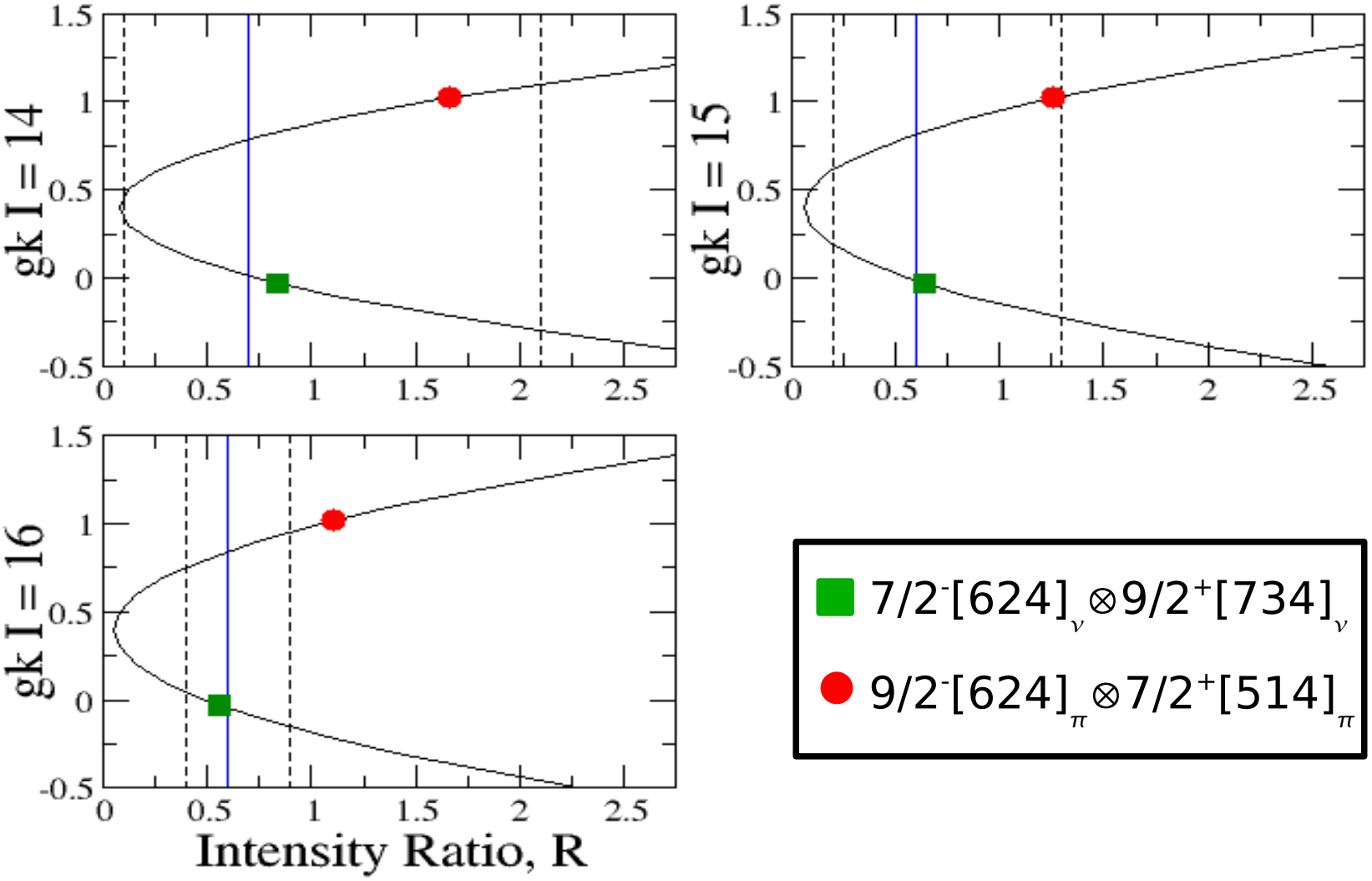
- Apply to inbeam ^{250}Fm data
- 3 R_{exp} values from $I^{\pi} = 14^-, 15^-$ and 16^-



D. Rostron, Thesis (2009)



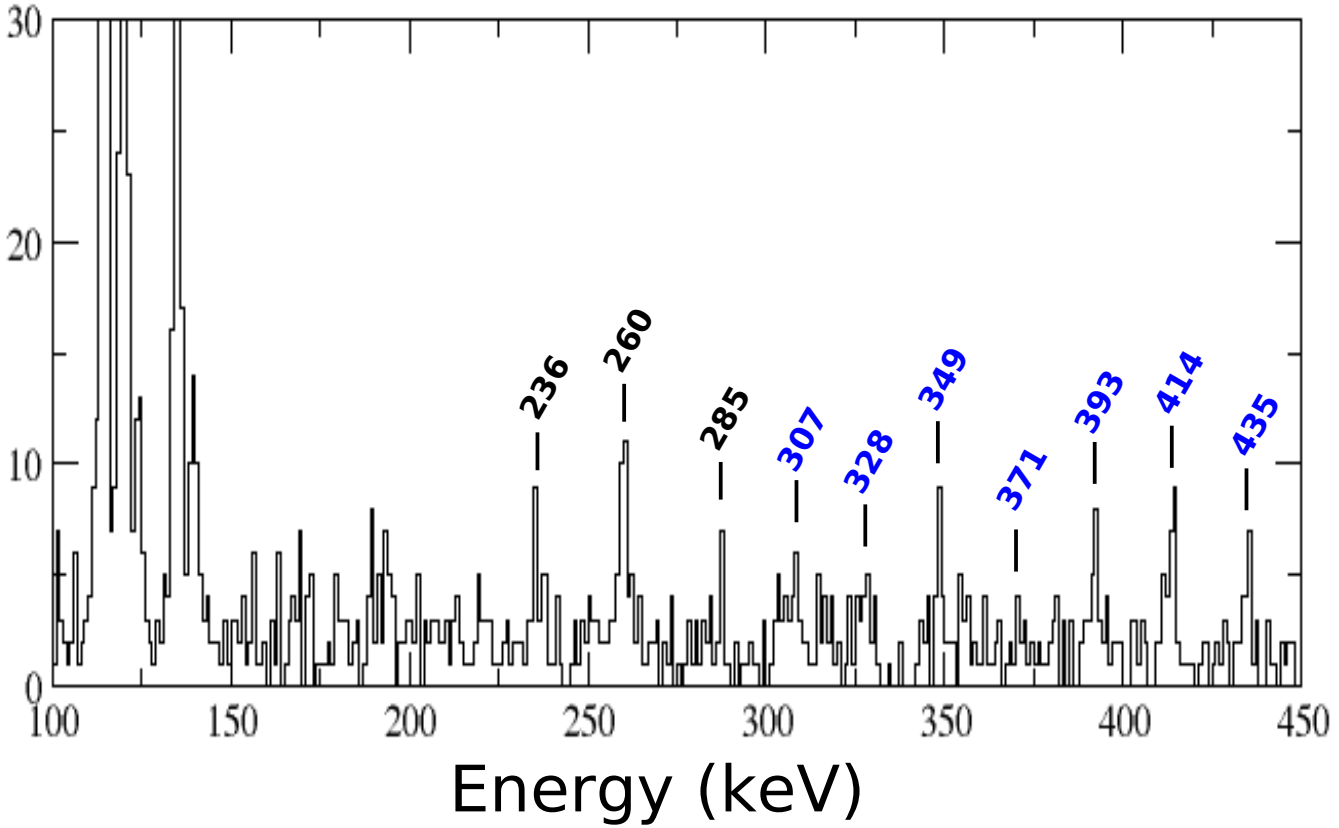
Assignment Problems

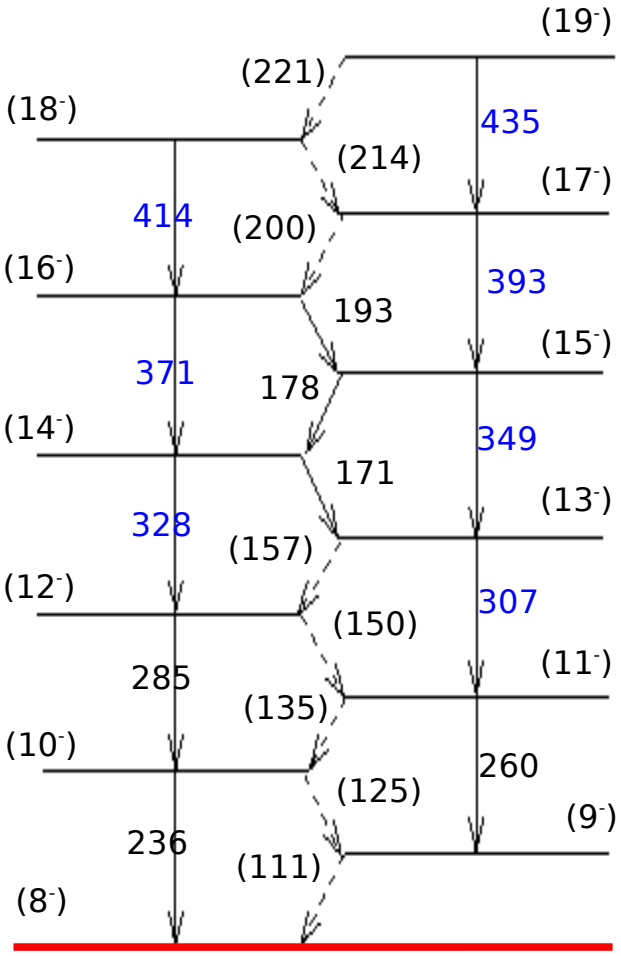


- Two possible structures and statistics too low to distinguish

Proposed Assignment Method

- Find intensities of 7 E2 peaks

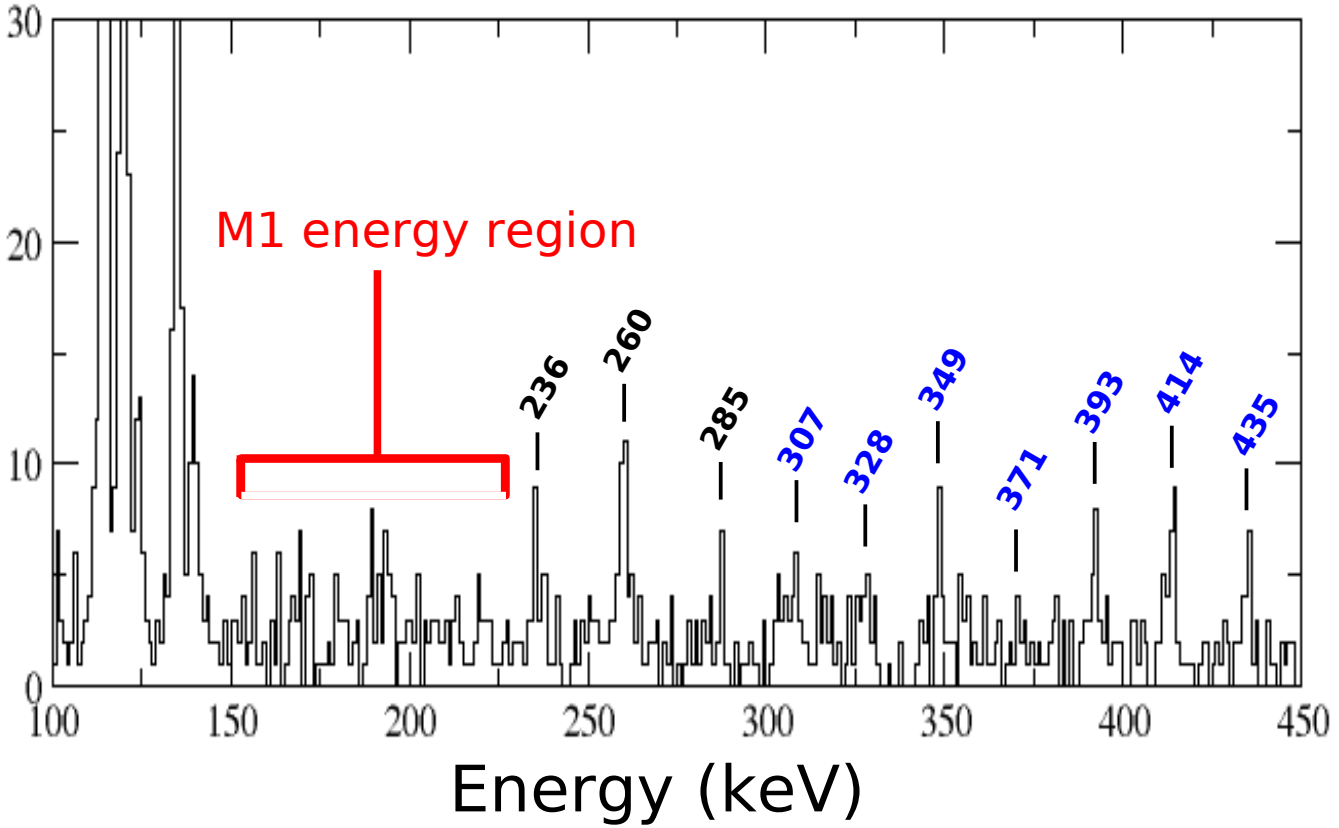


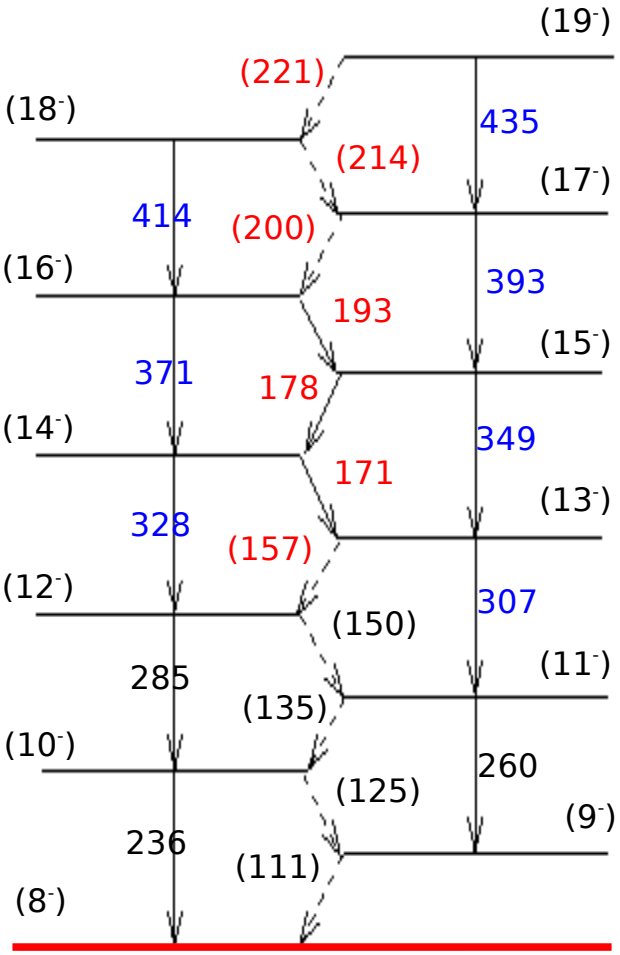


Proposed Assignment Method

- Find intensities of 7 E2 peaks

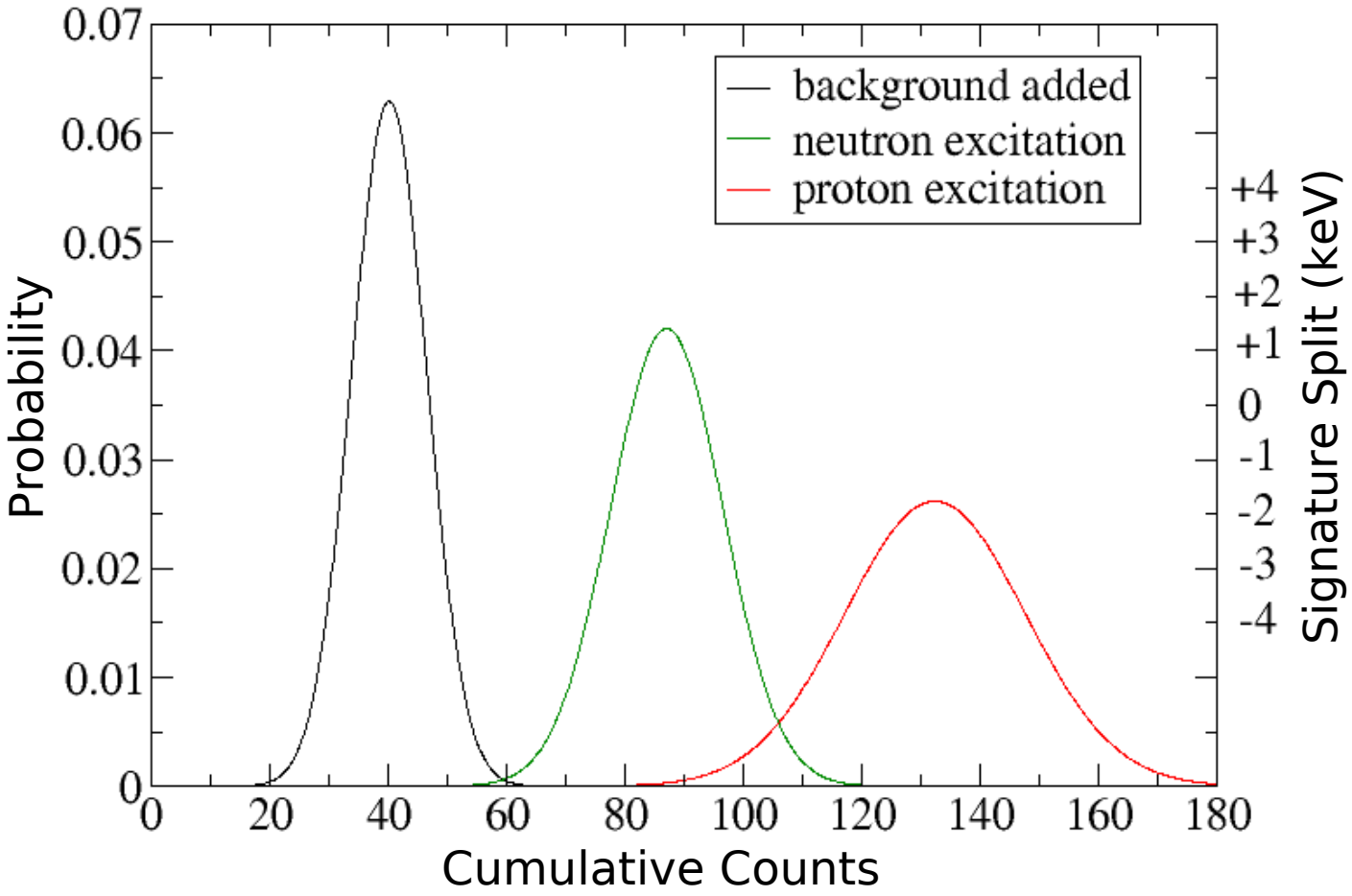
- Assuming either possible isomer structure find expected number of total counts over M1 energies

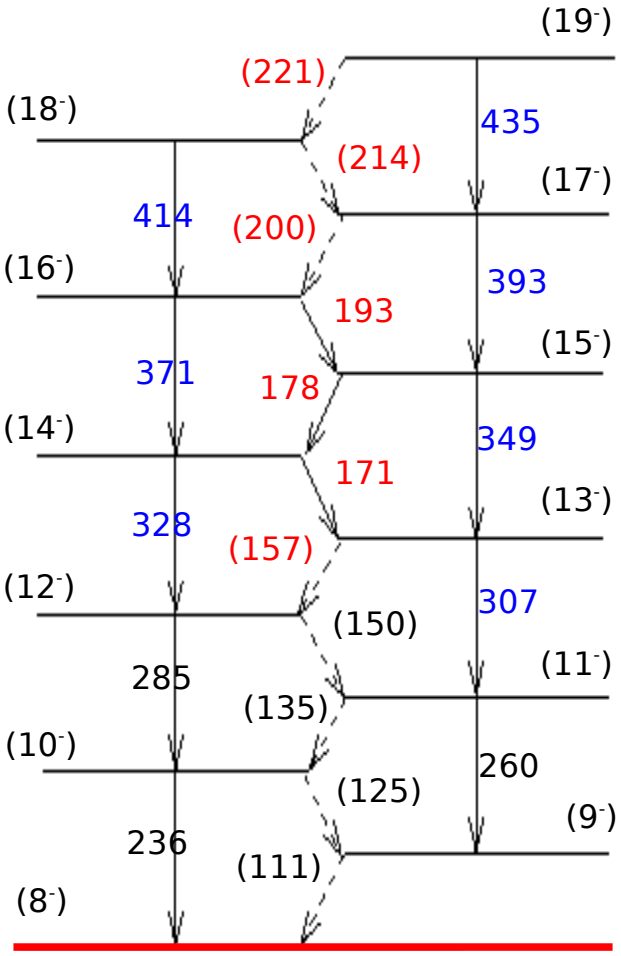




Proposed Assignment Method

- Gives probability distribution for counts across 7 peak ranges

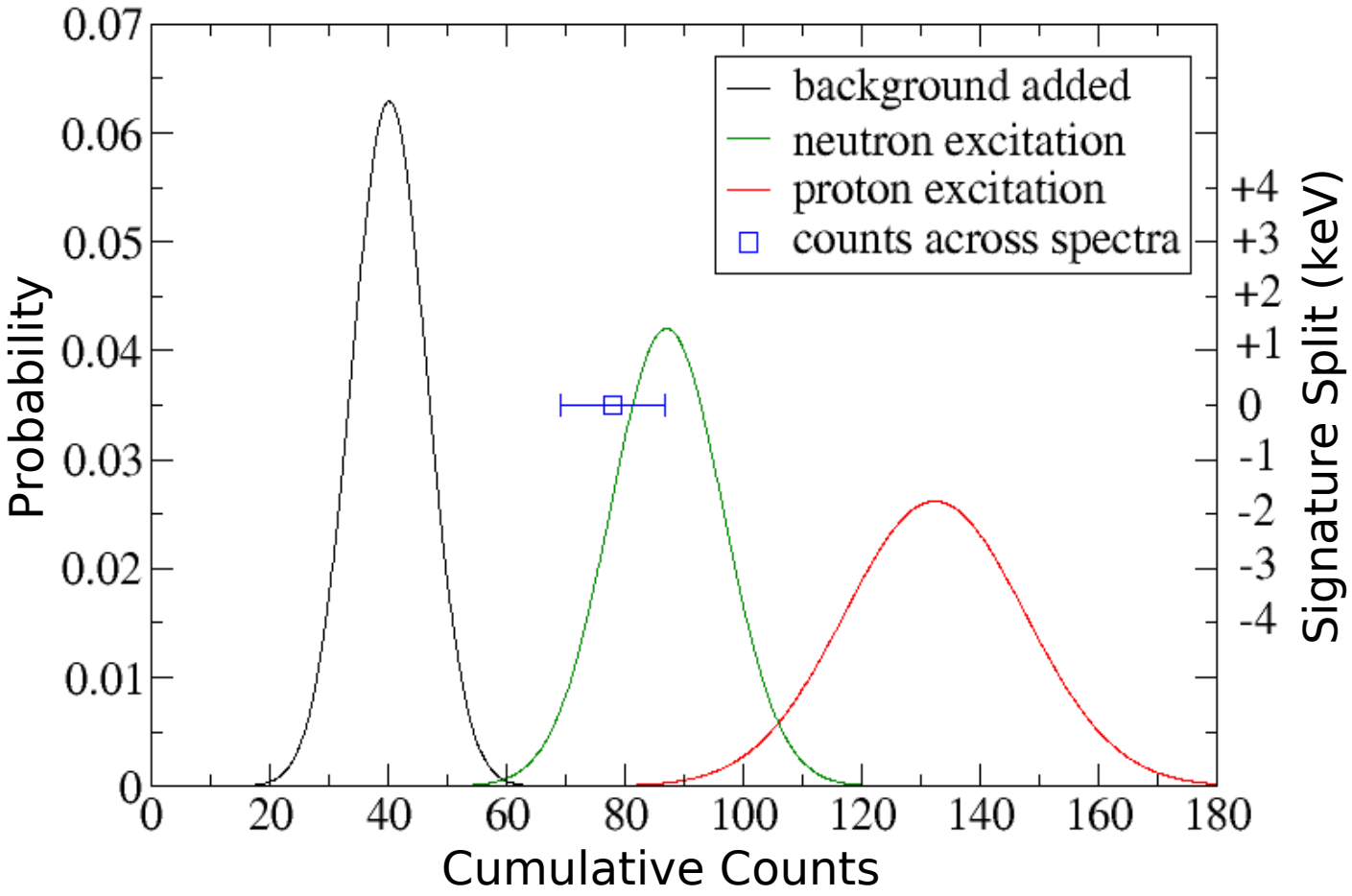


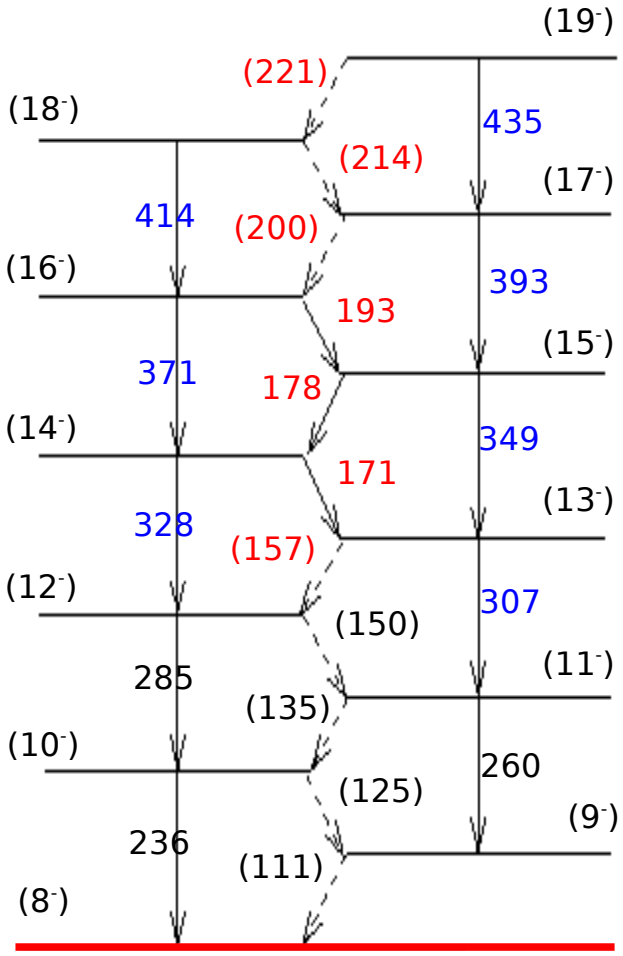


Proposed Assignment Method

- Gives probability distribution for counts across 7 peak ranges

- Add a signature splitting to ranges and find experimental number of counts





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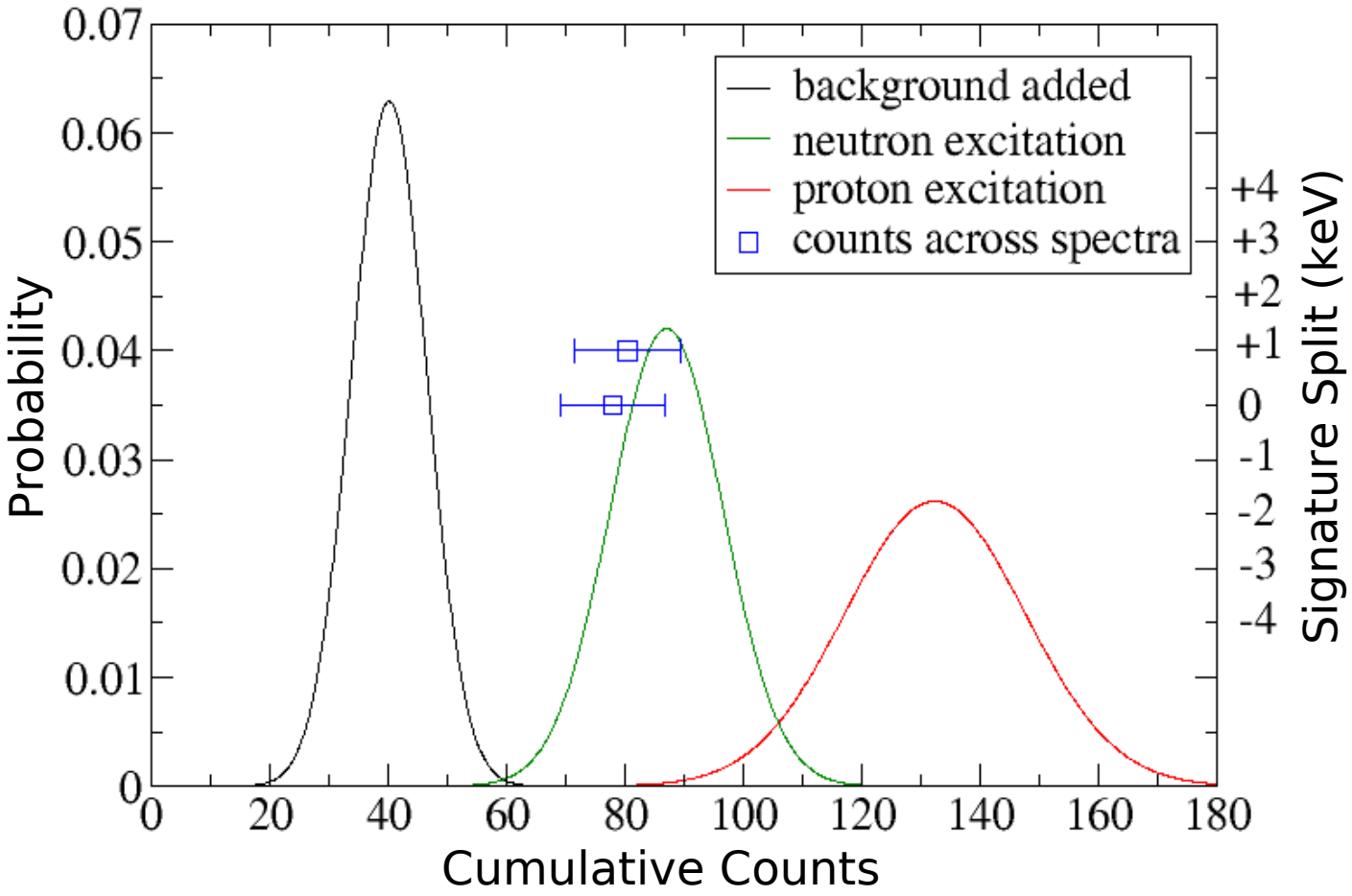

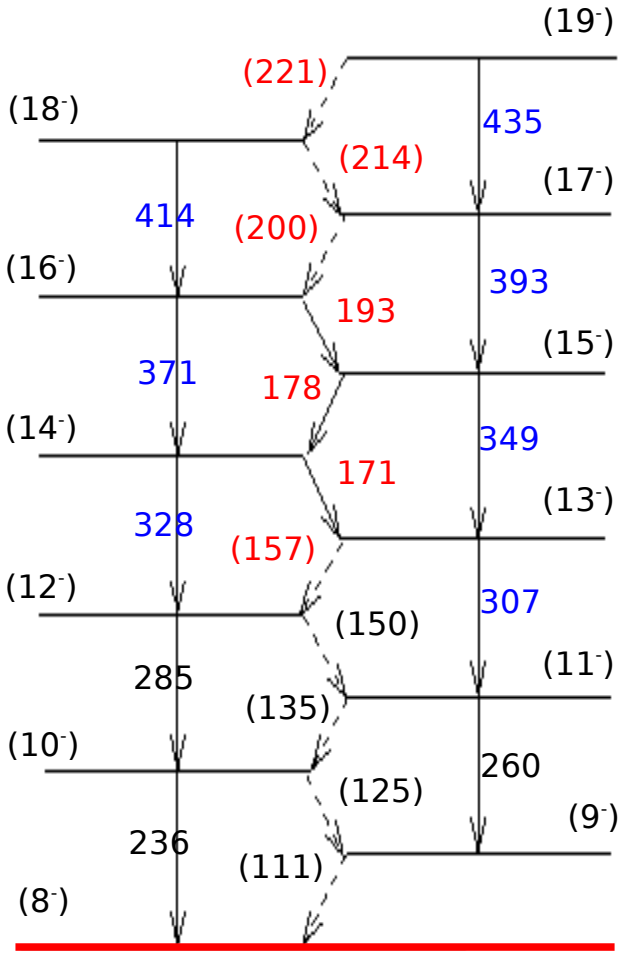

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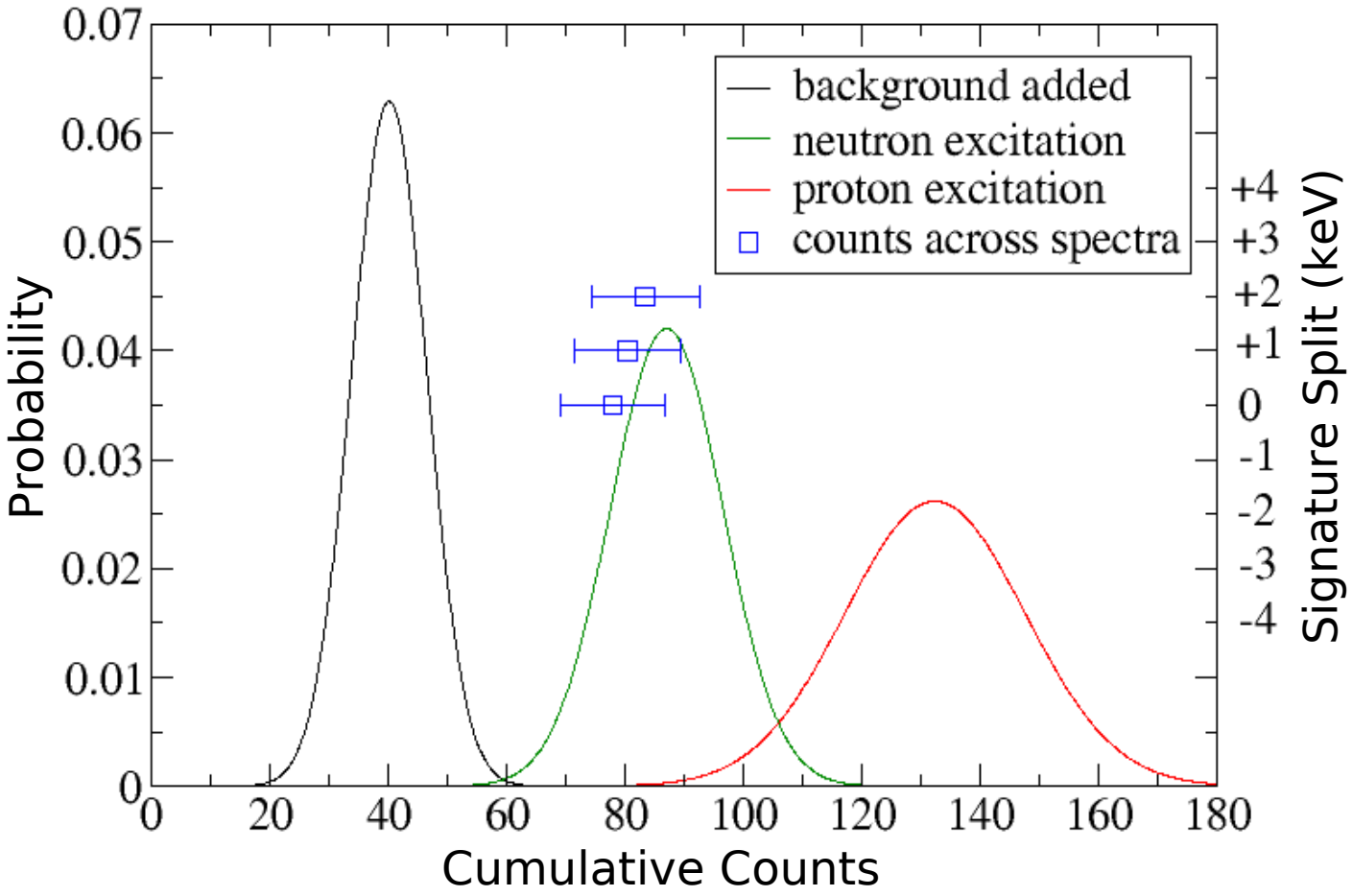

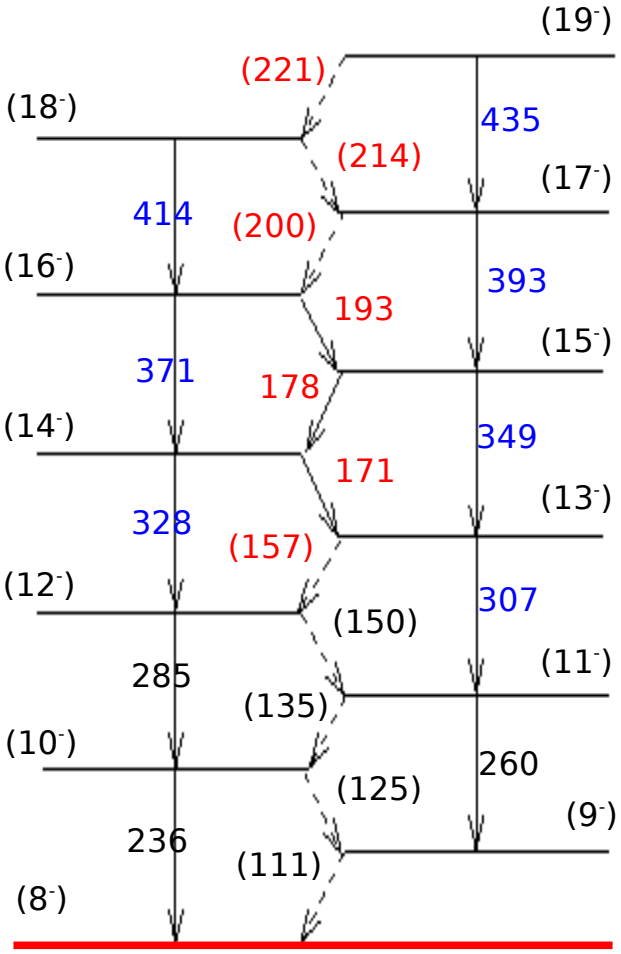

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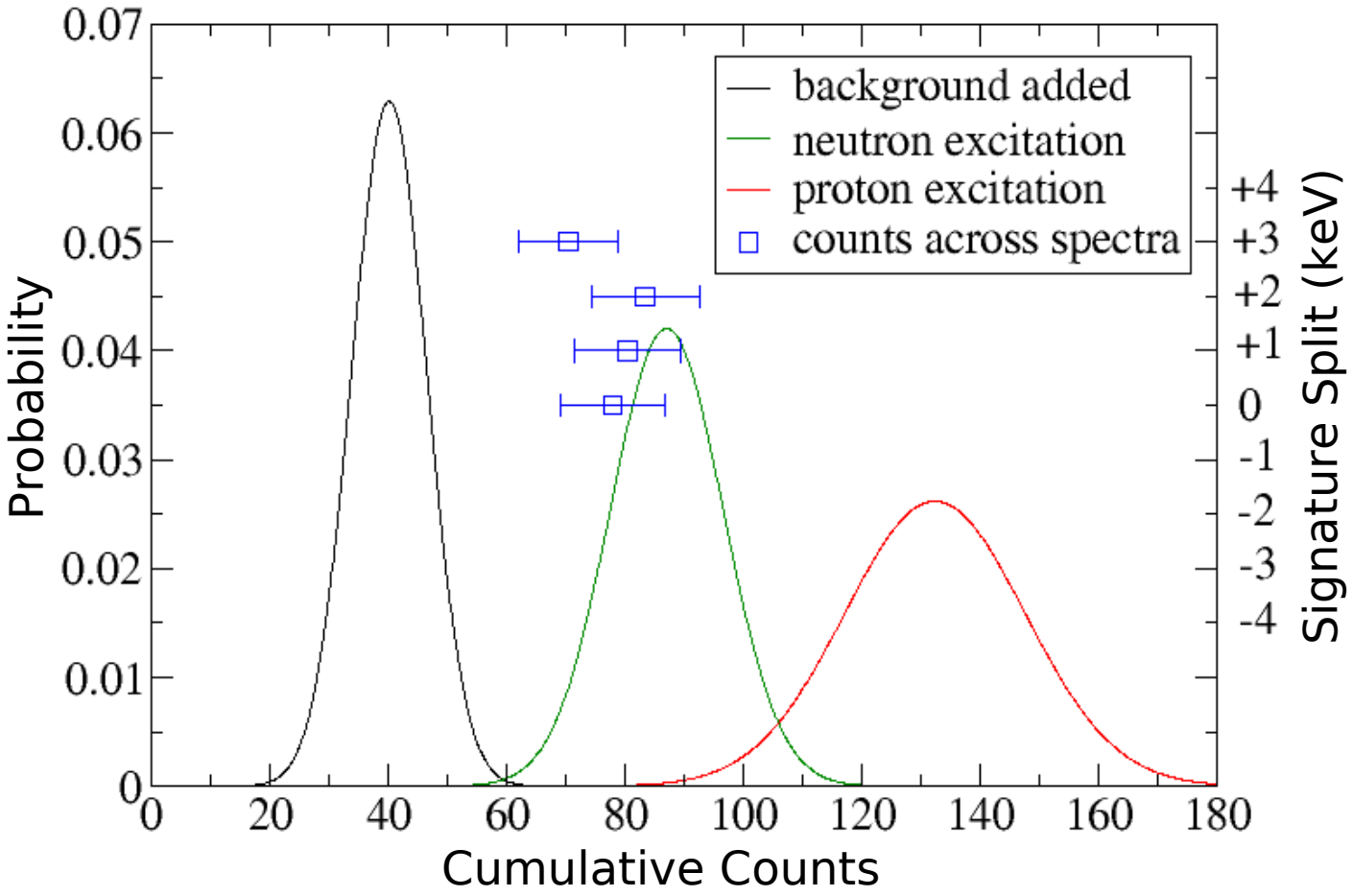

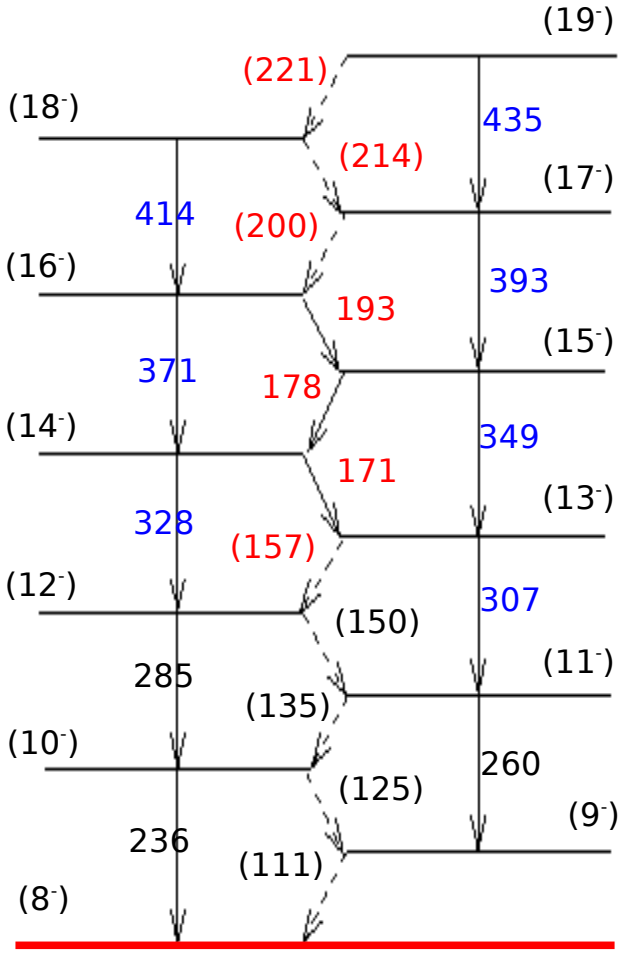

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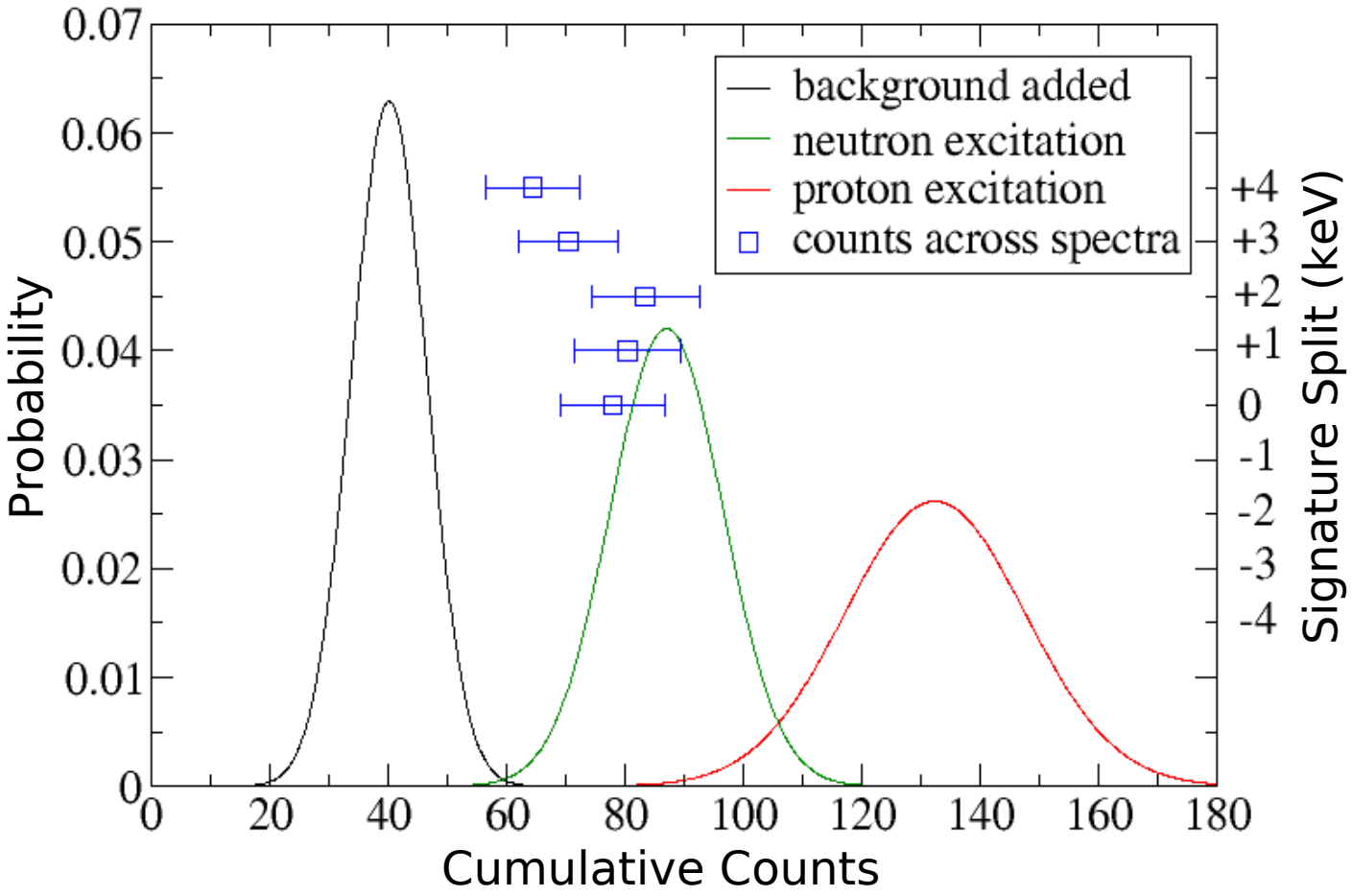

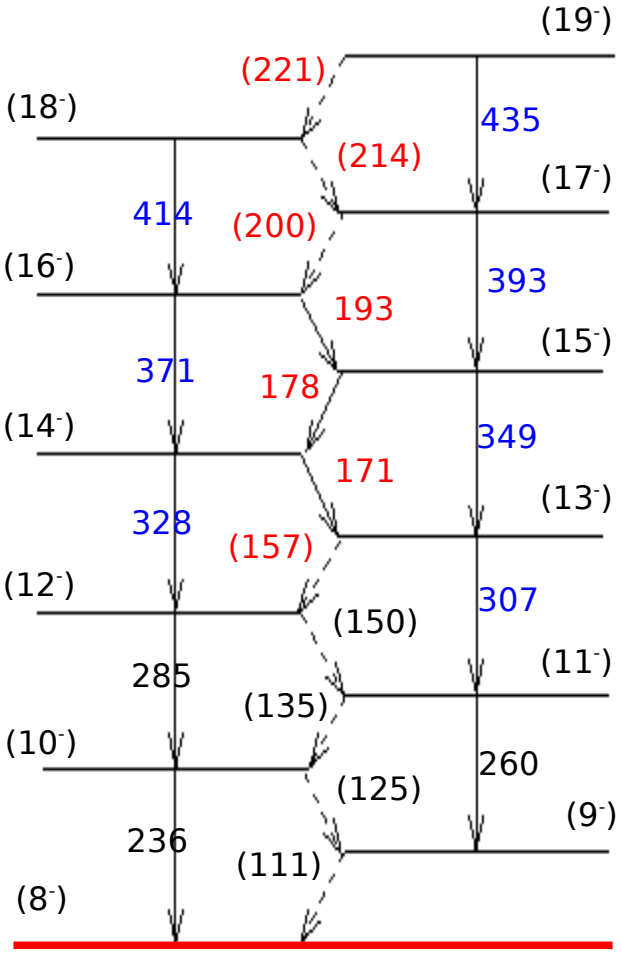

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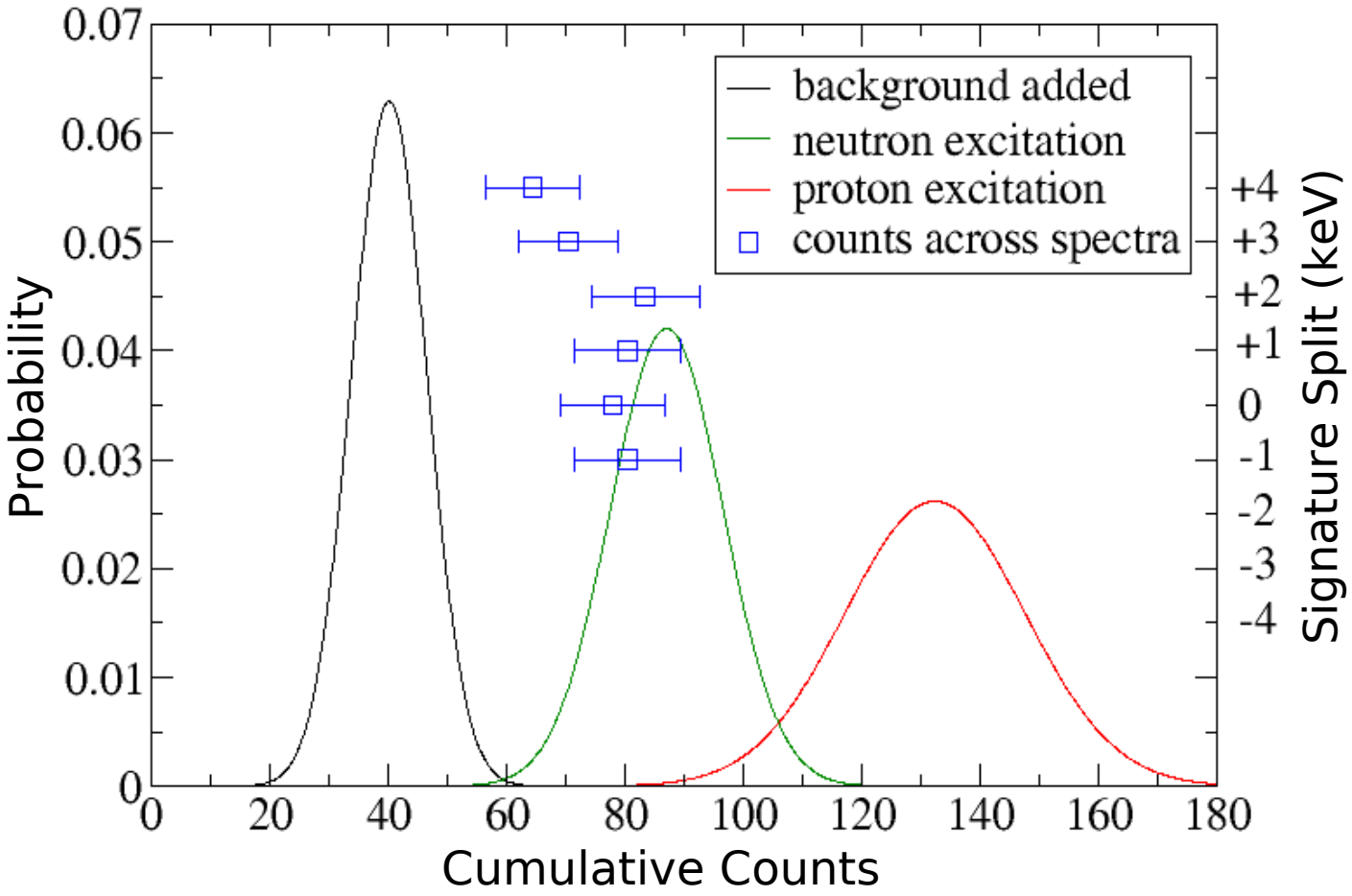

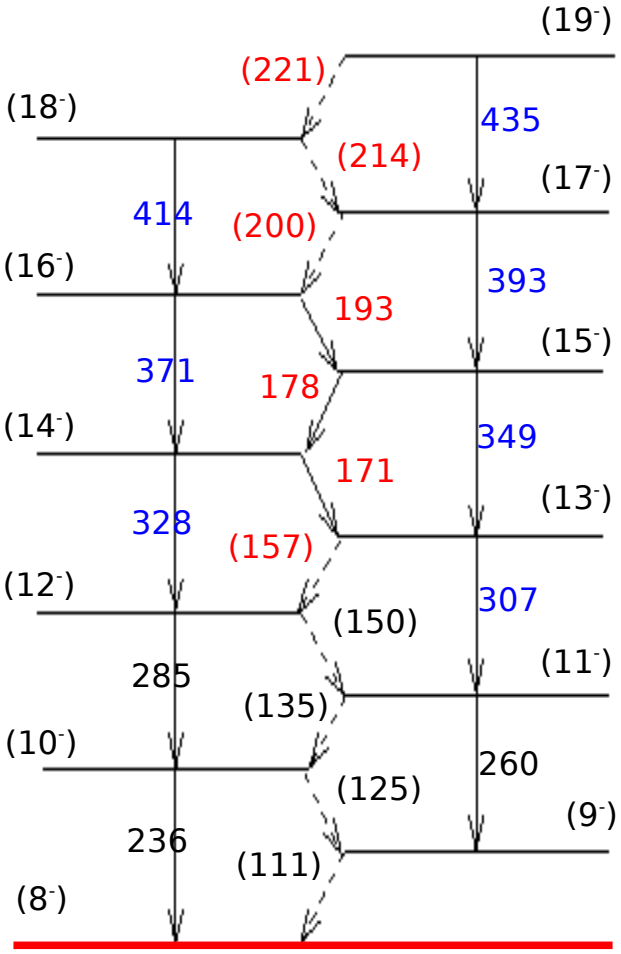

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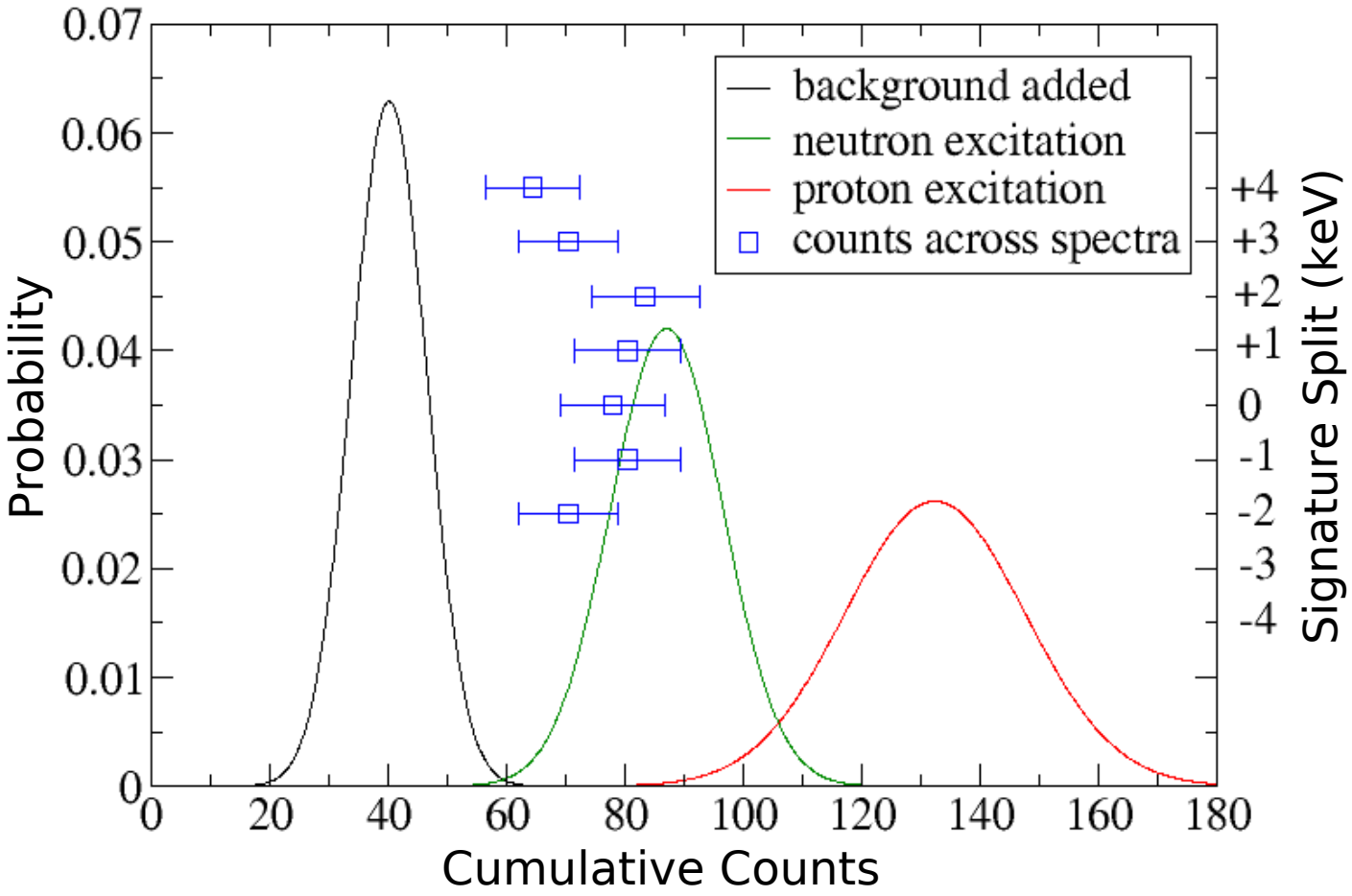

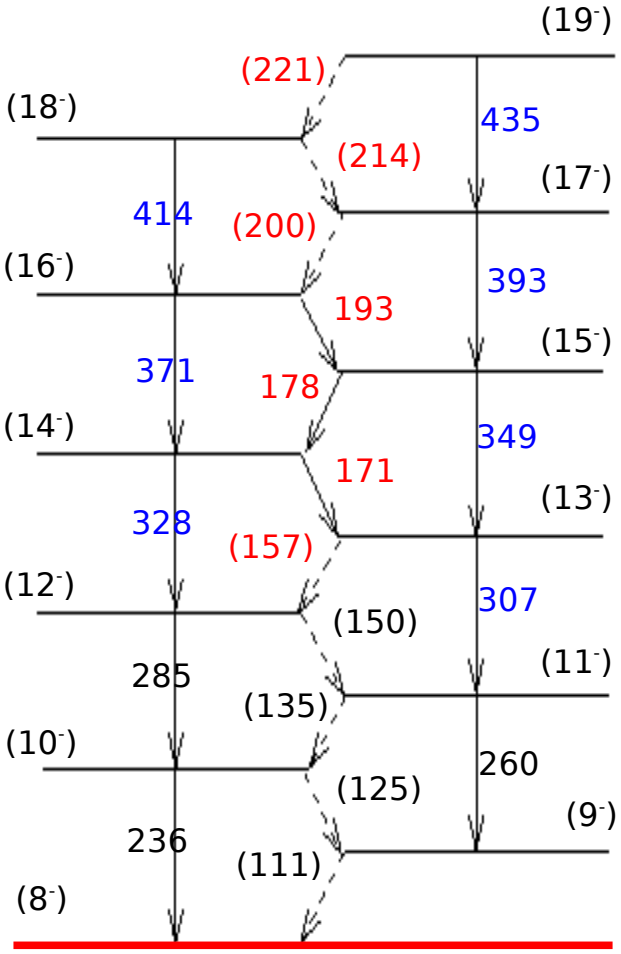

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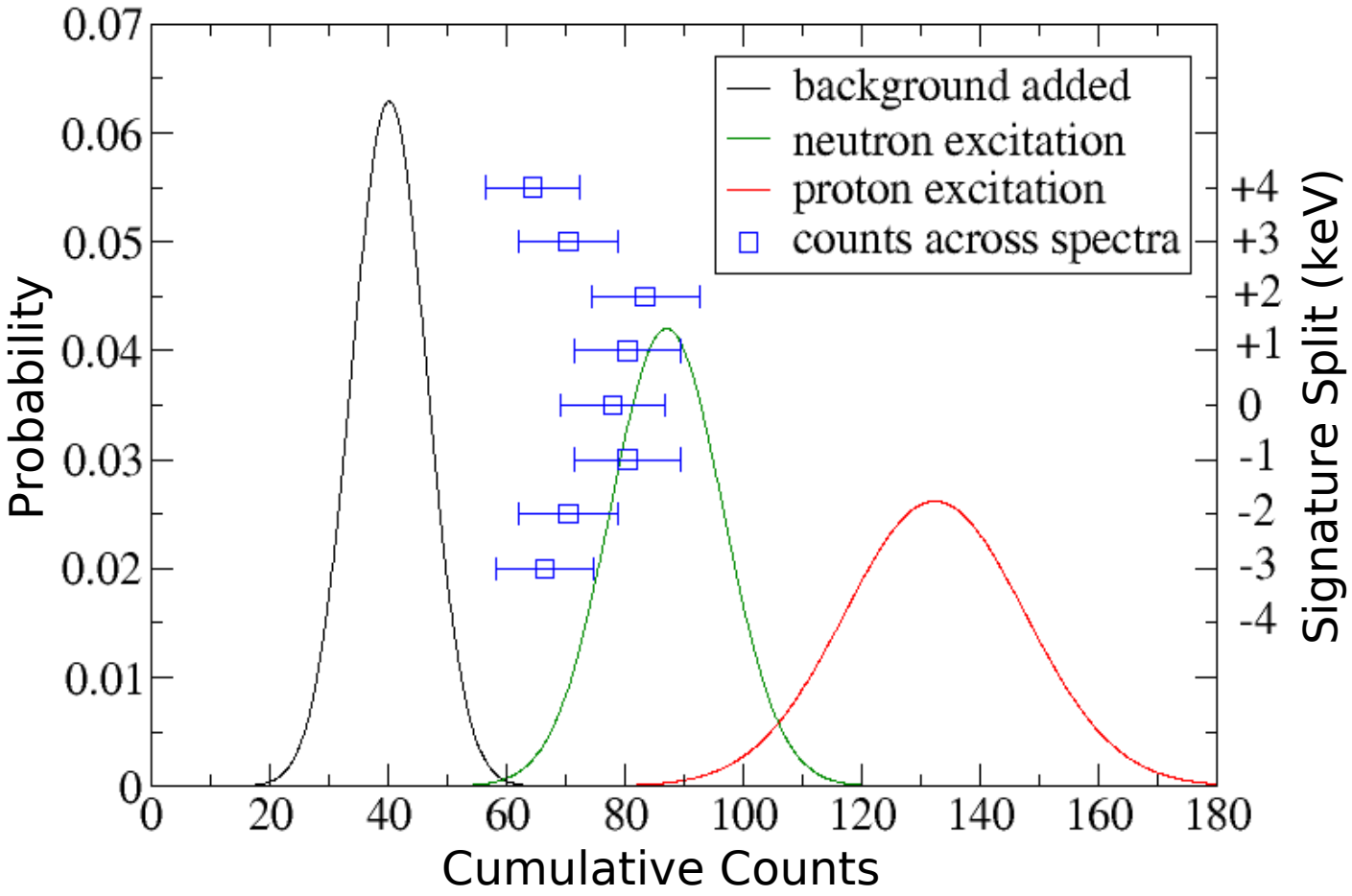
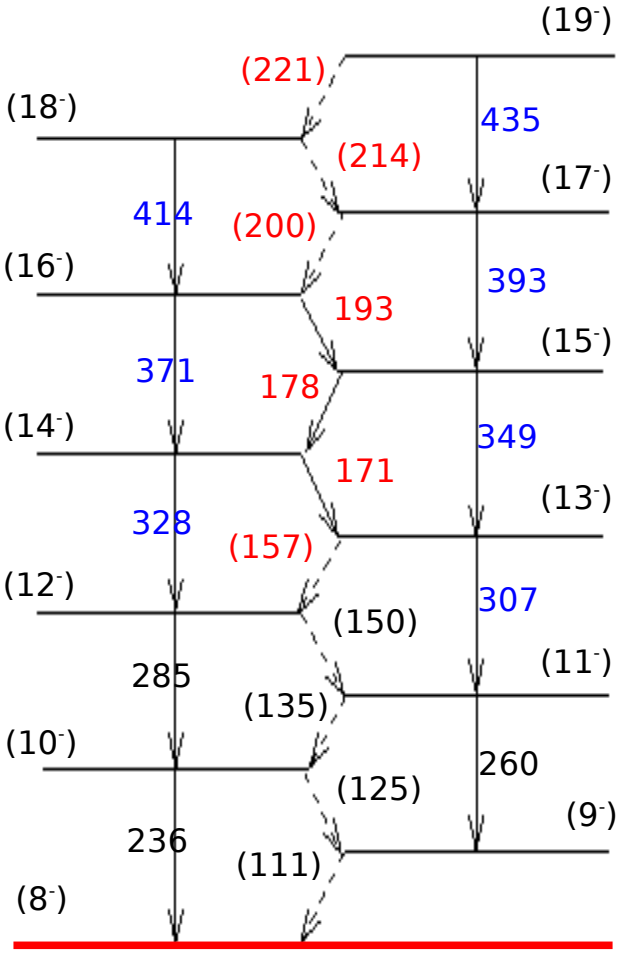
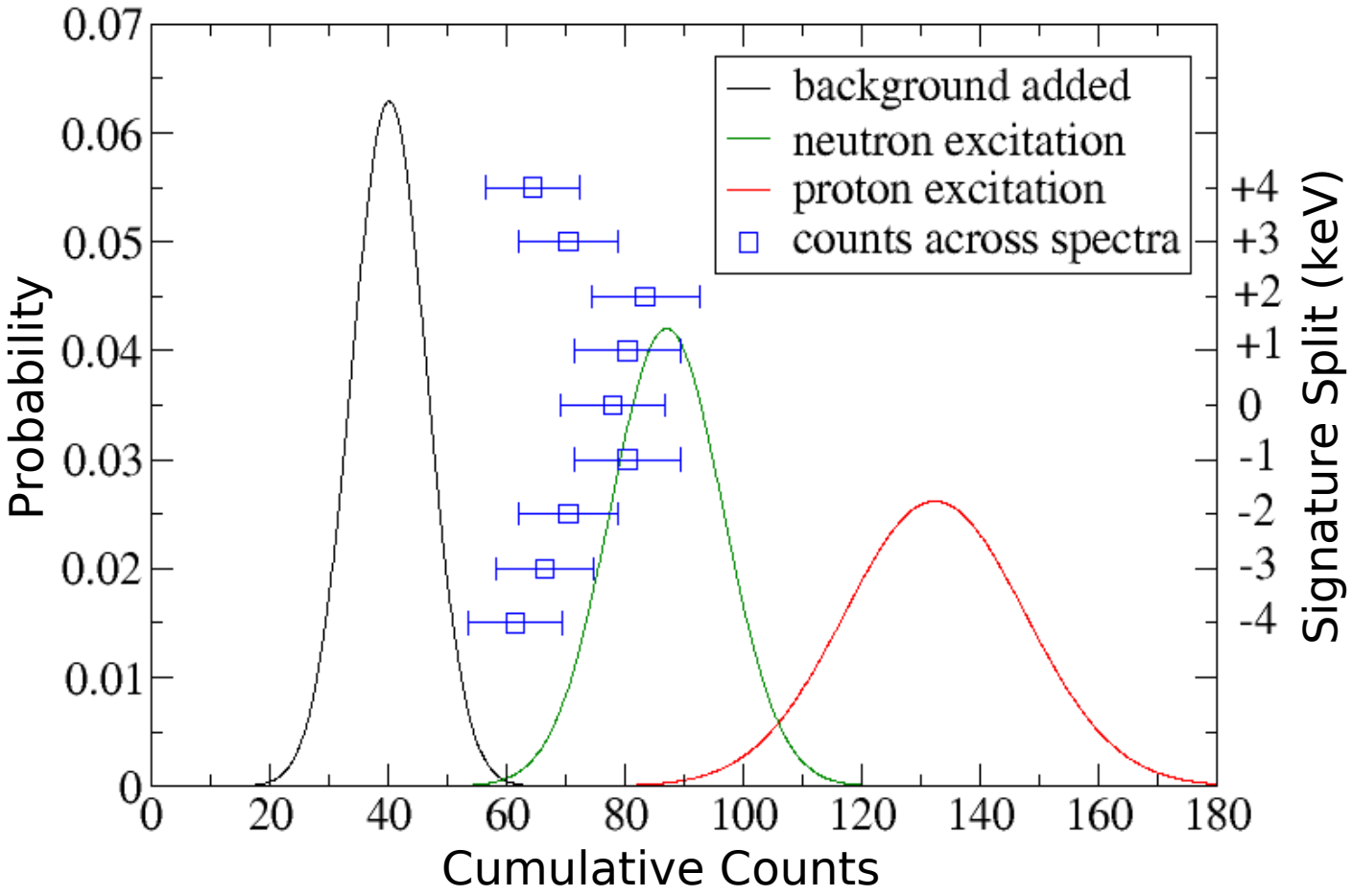
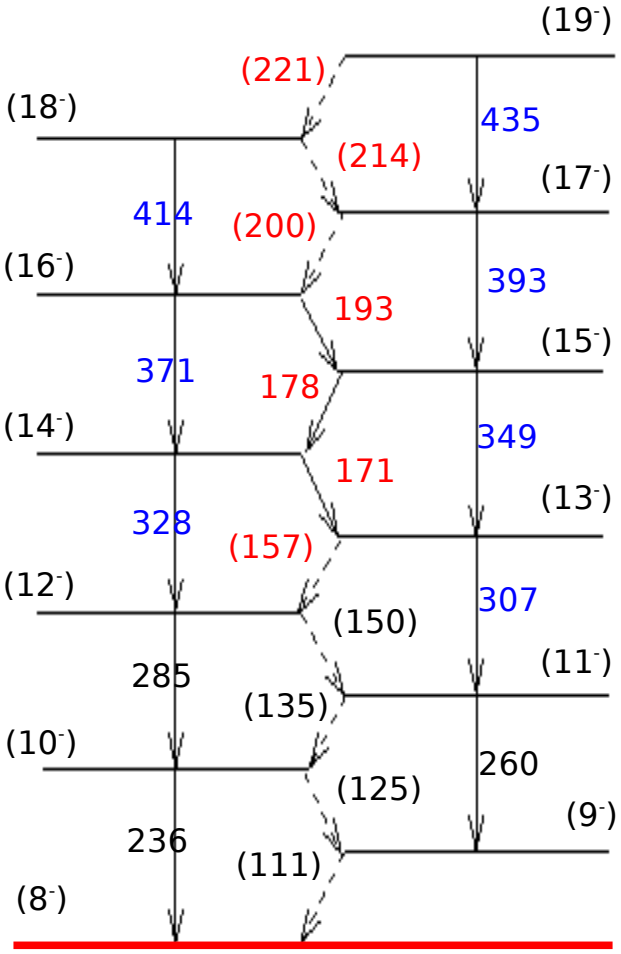




Proposed Assignment Method

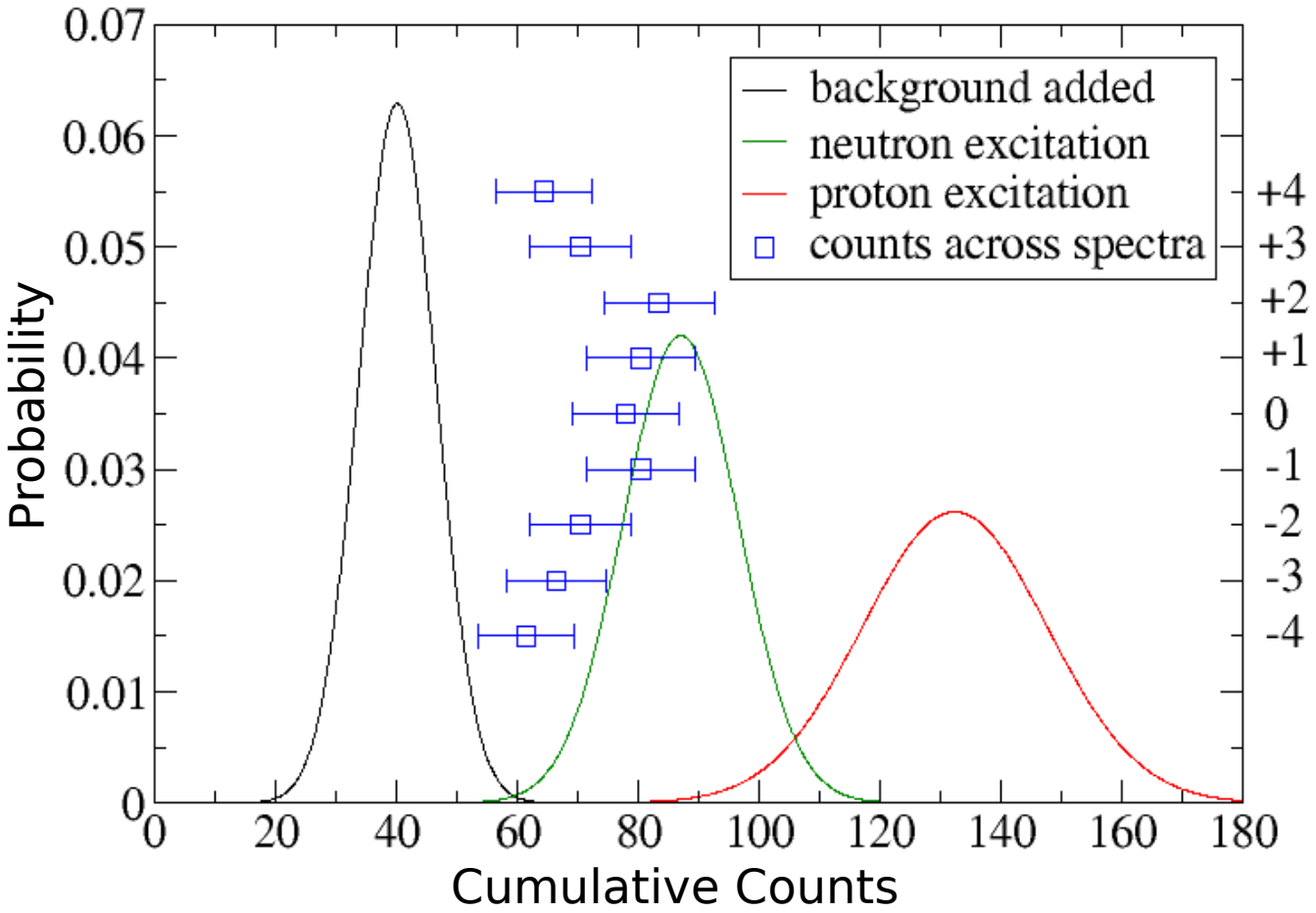
- Good agreeement with predicted neutron state

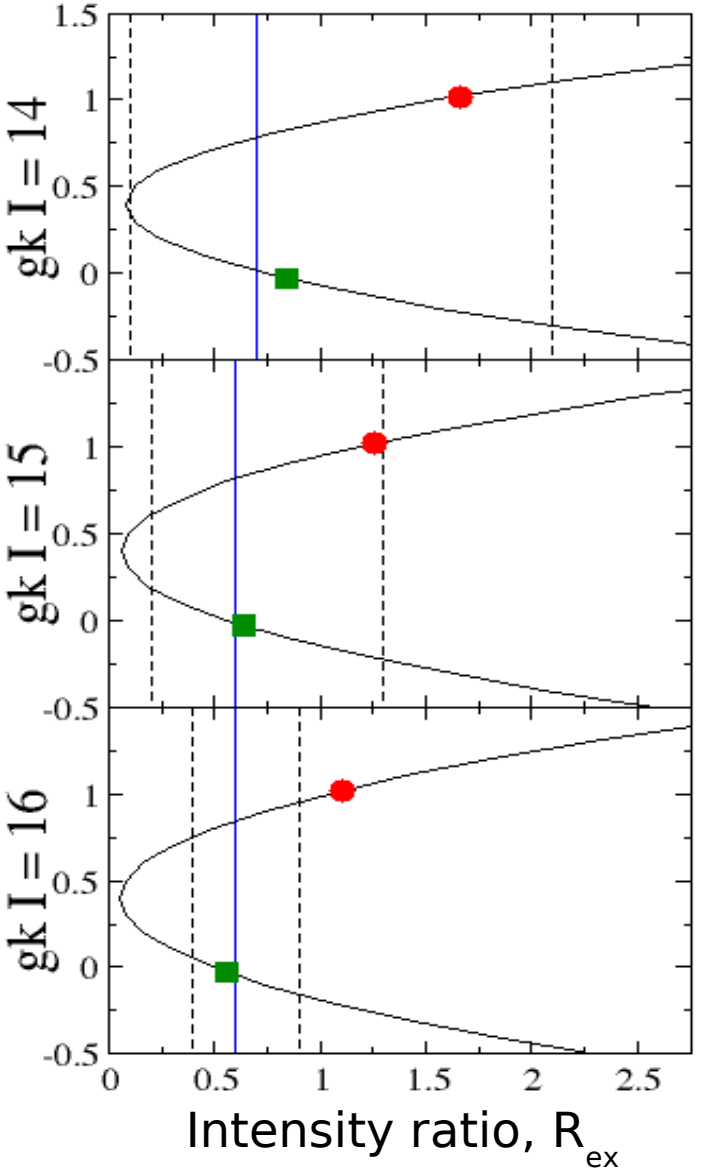




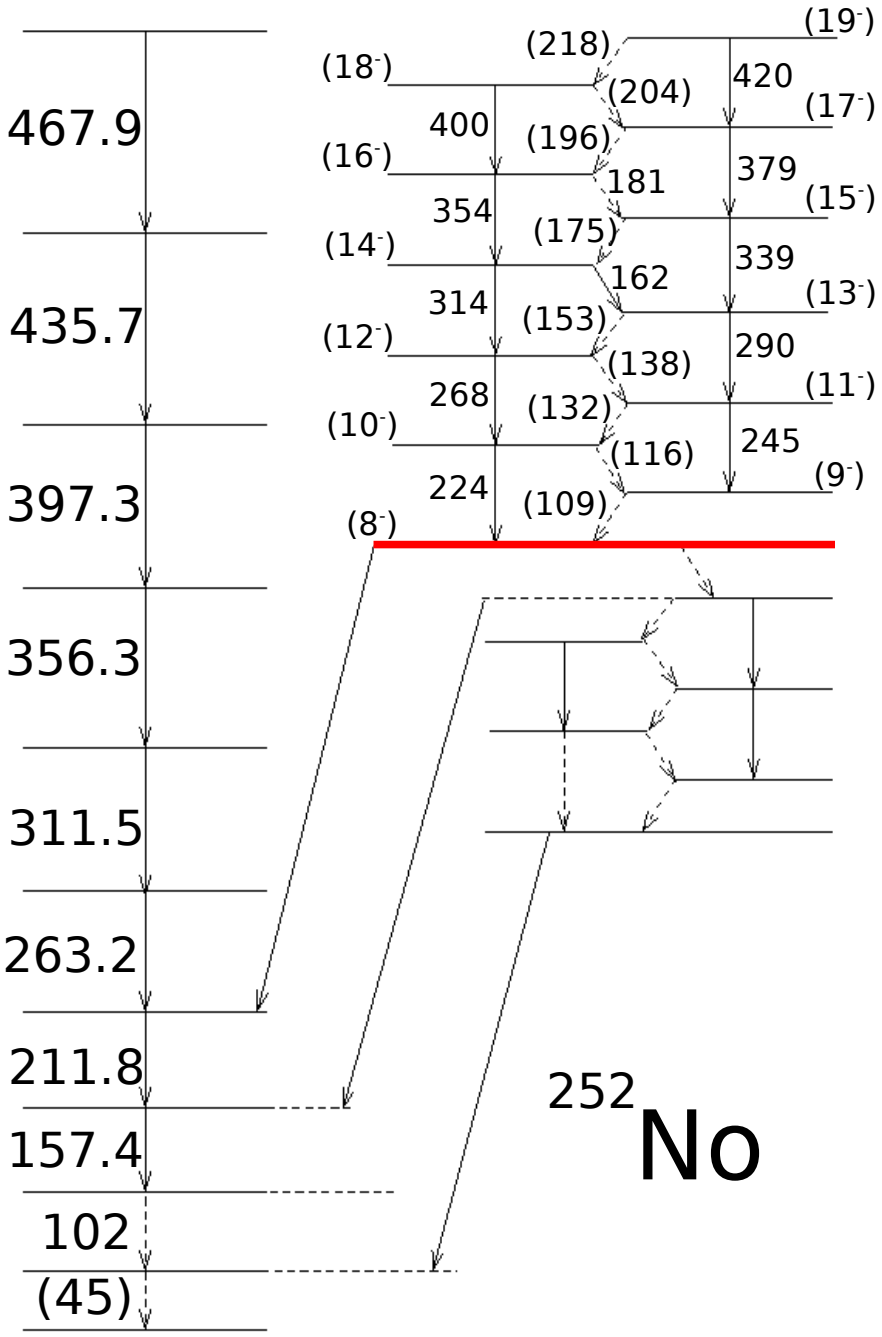
Proposed Assignment Method

- Good agreeement with predicted neutron state
- Compare with individual transition g_K results

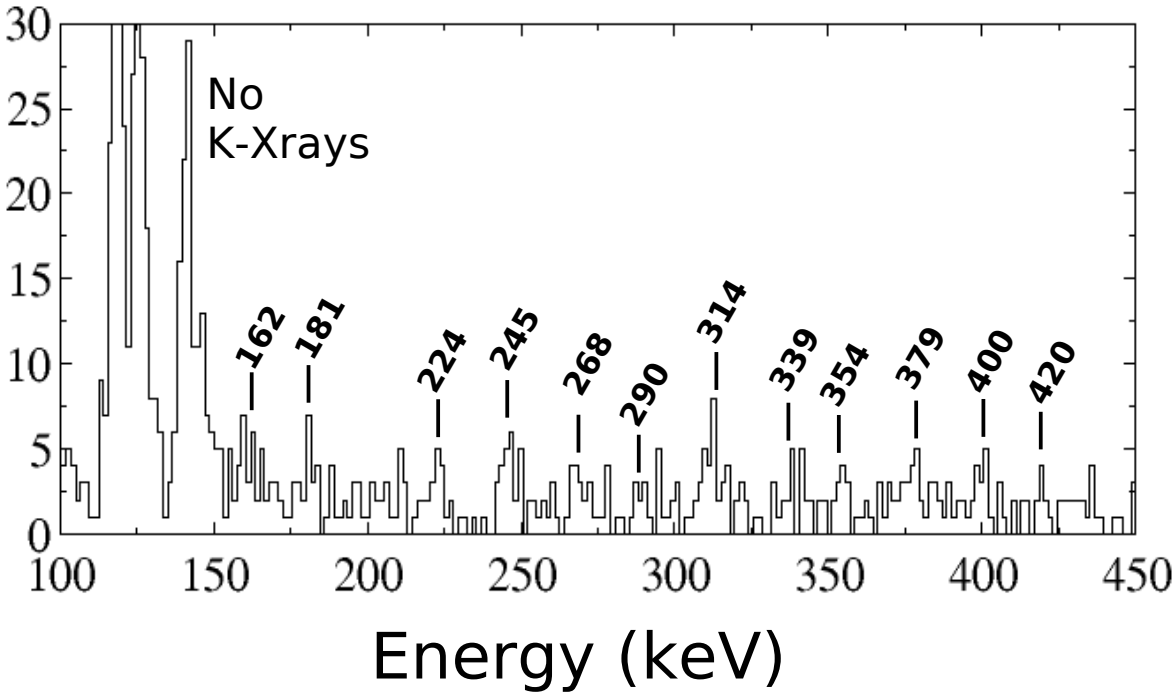




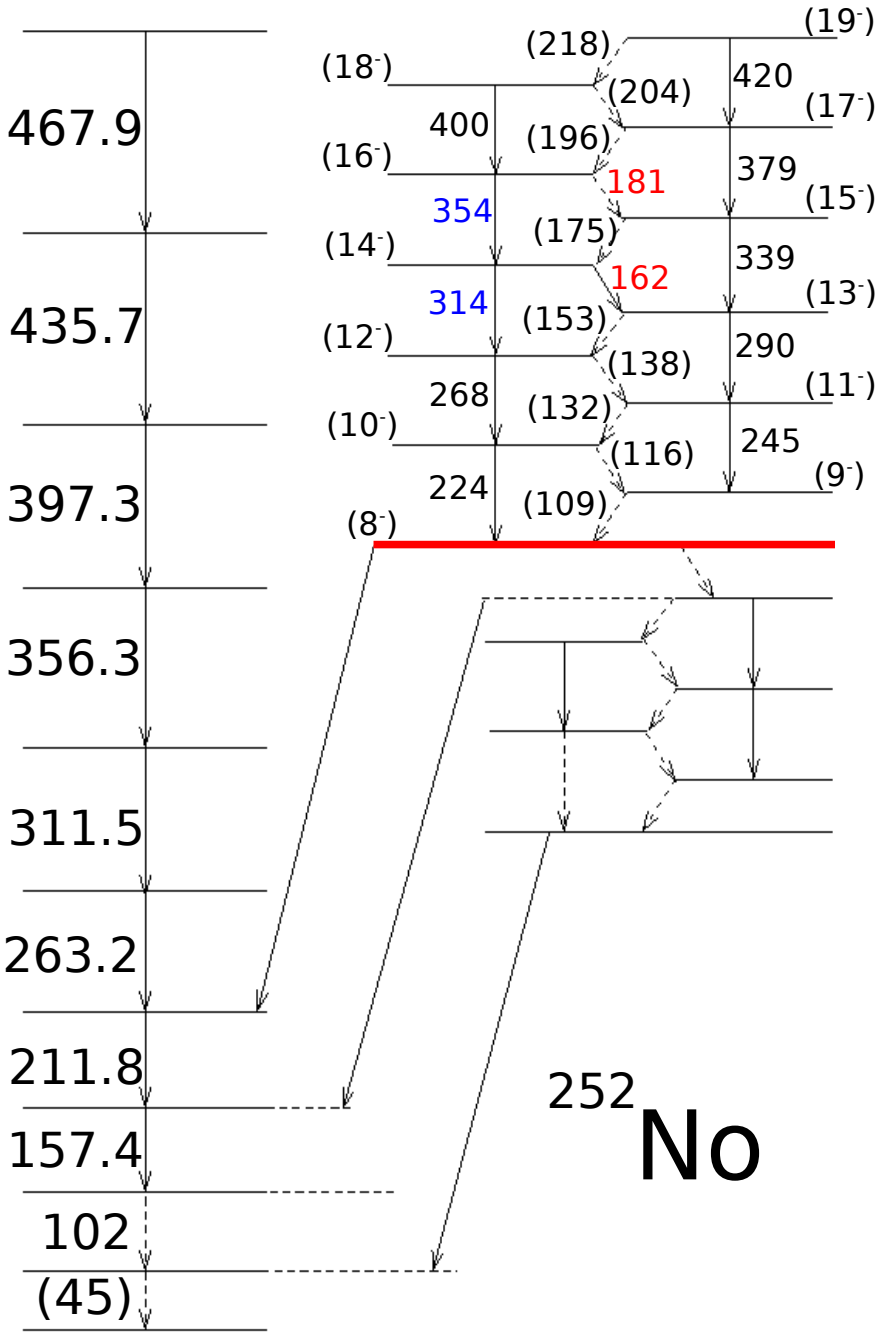
Applied to ^{252}No 8^{-} K-Isomer



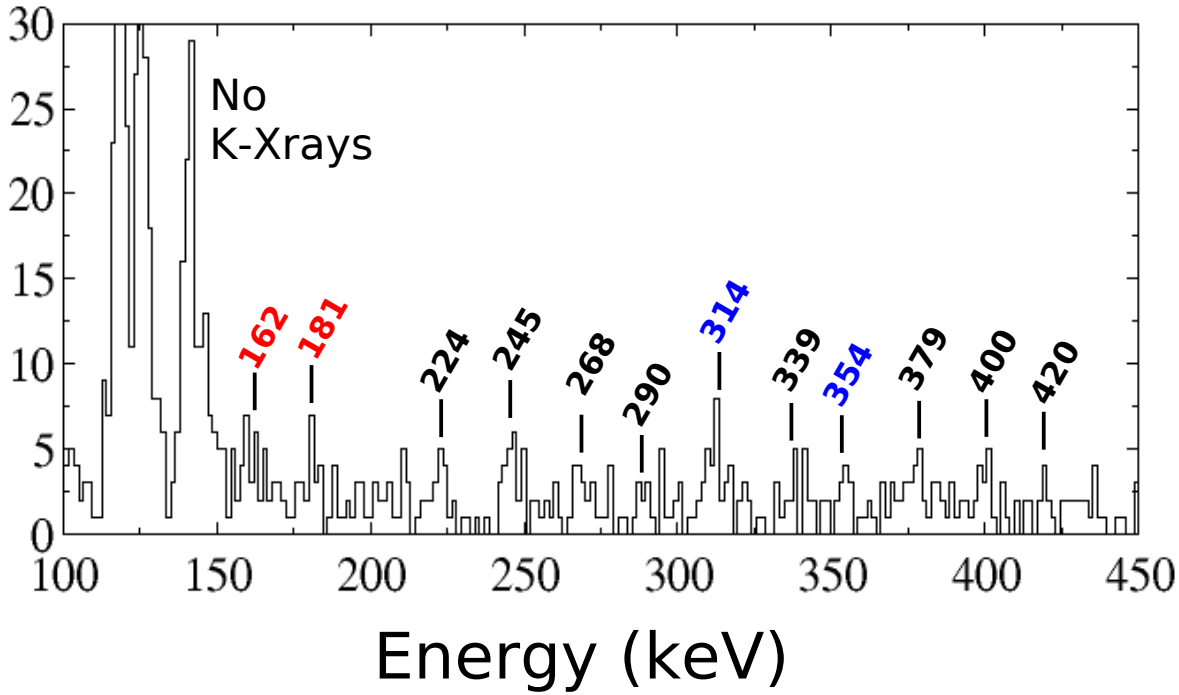
- Apply to inbeam ^{252}No data



Applied to ^{252}No 8$^-$ K-Isomer

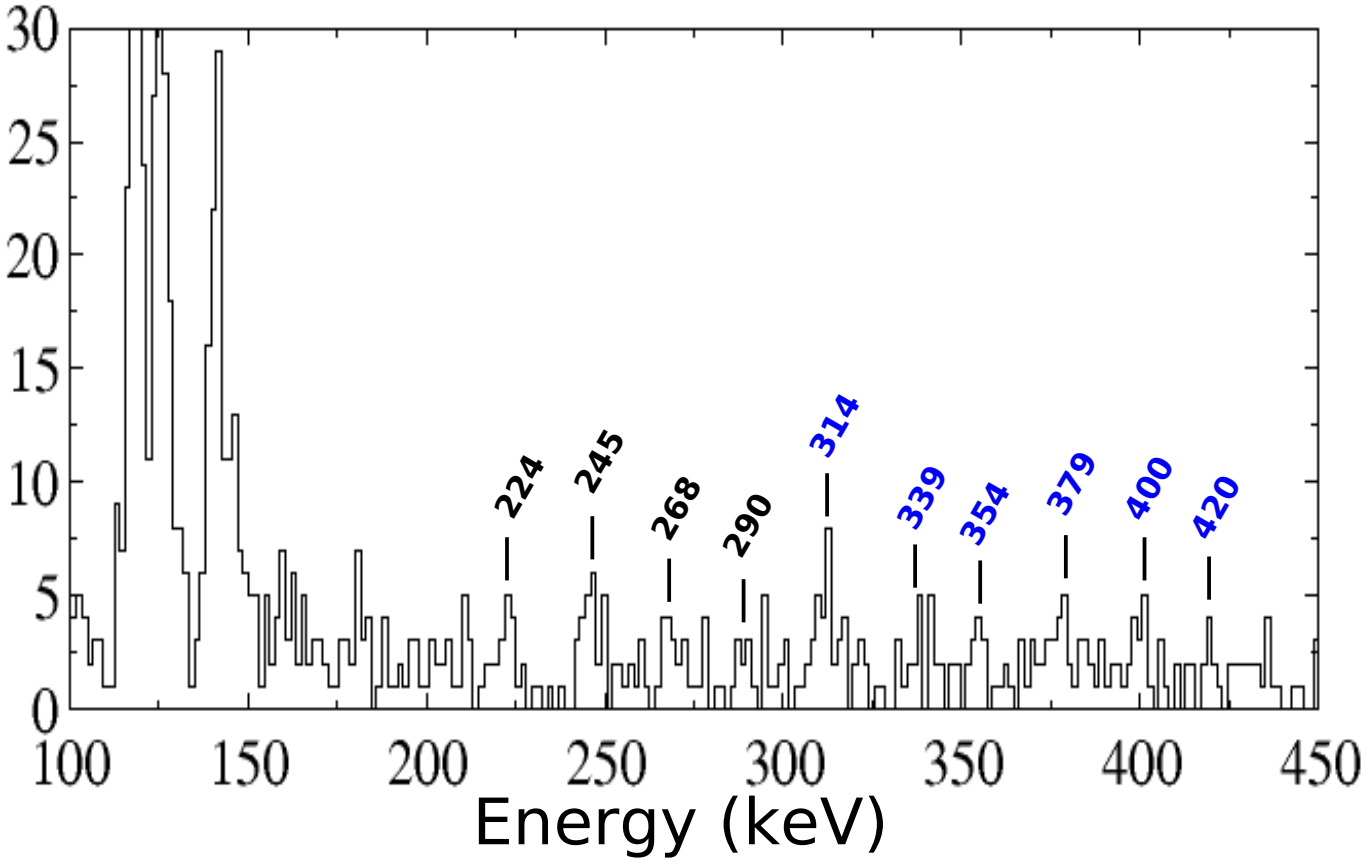


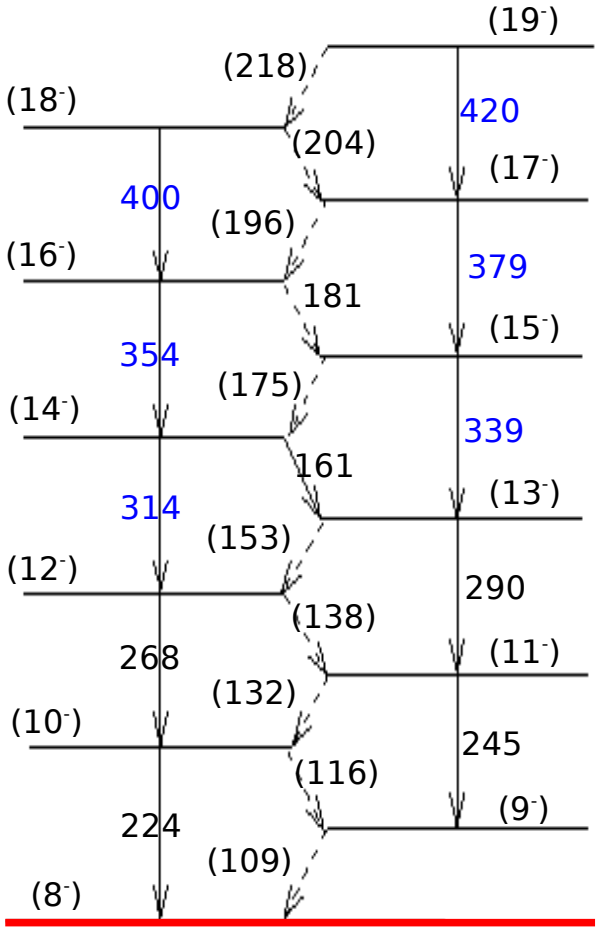
- Apply to inbeam ^{252}No data
- R_{exp} values and upper limits are inconclusive



Applied to ^{252}No 8^{-} K-Isomer

- Take intensities of 6 E2 peaks

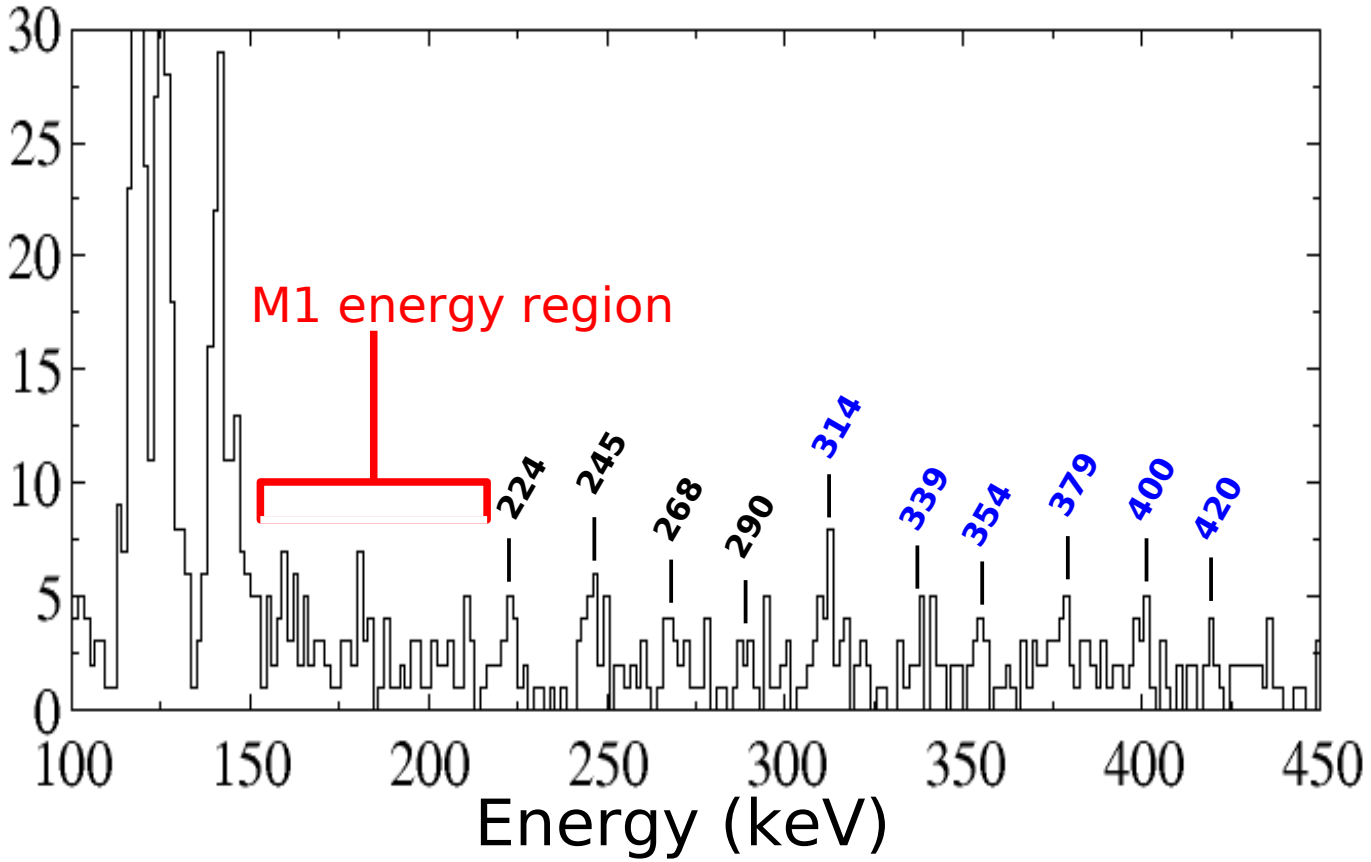


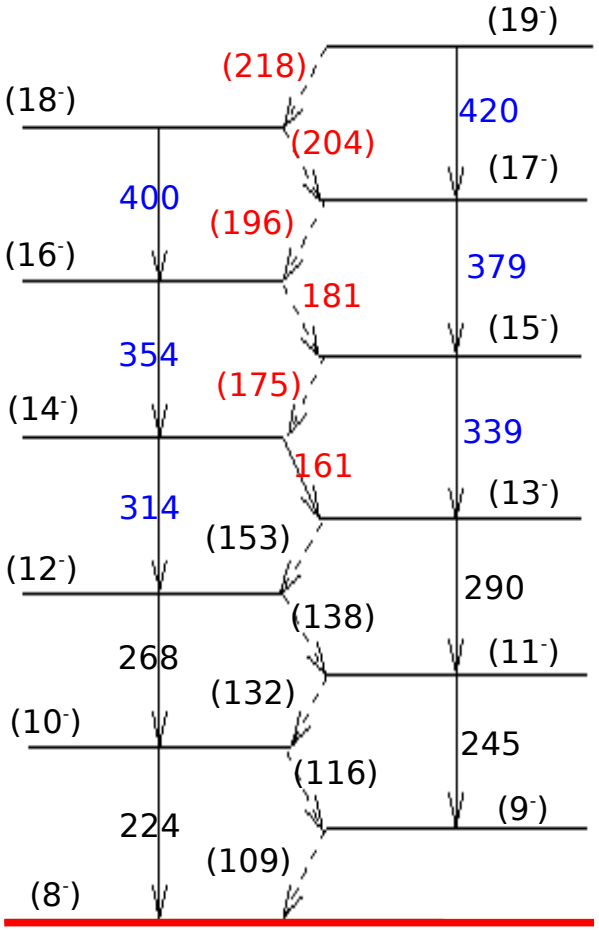


Applied to ^{252}No 8^- K-Isomer

- Take intensities of 6 E2 peaks

- Find expected number of counts across associated 6 M1 peaks assuming 2 possible structures





Applied to ^{252}No 8^- K-Isomer

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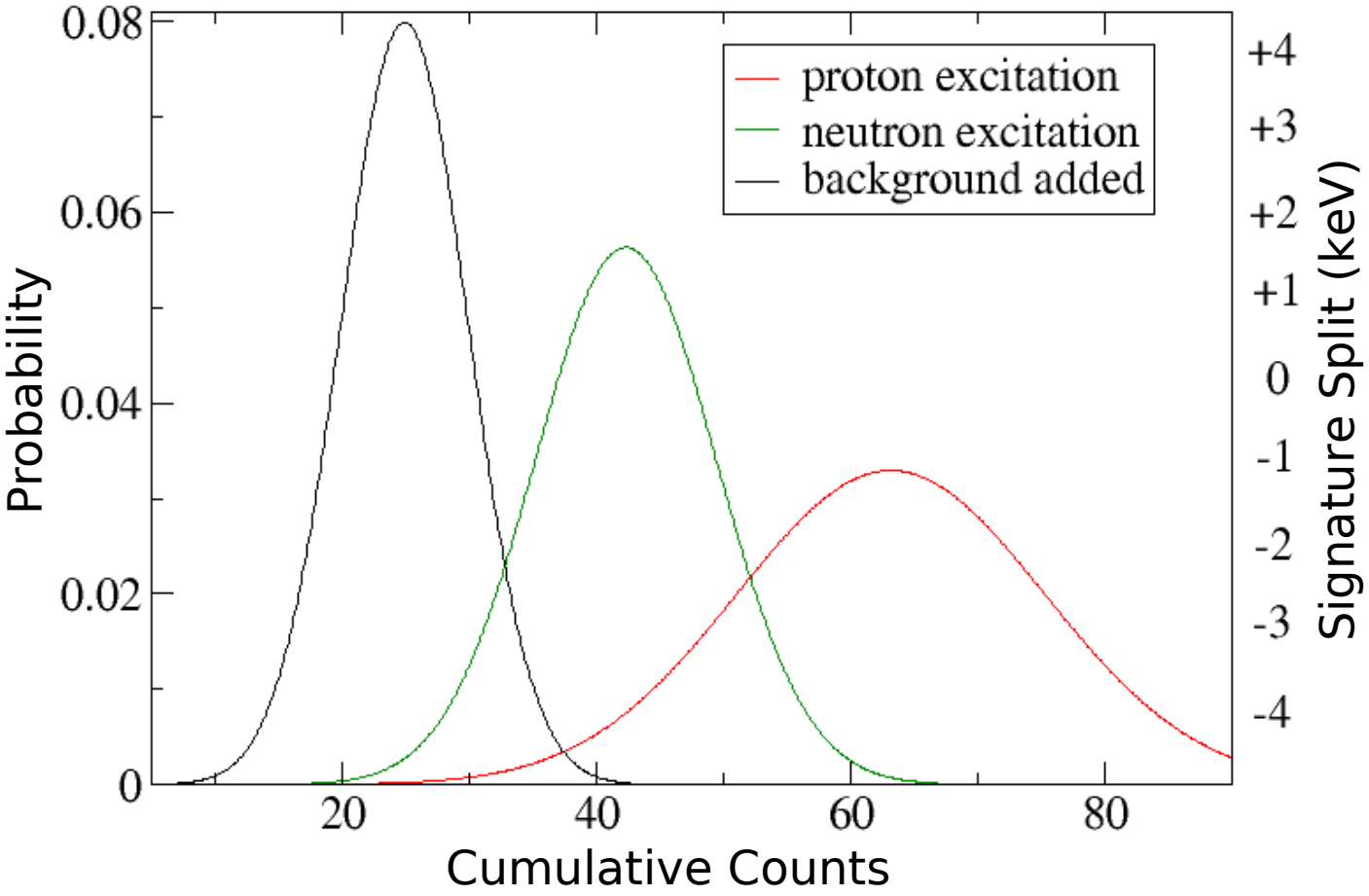

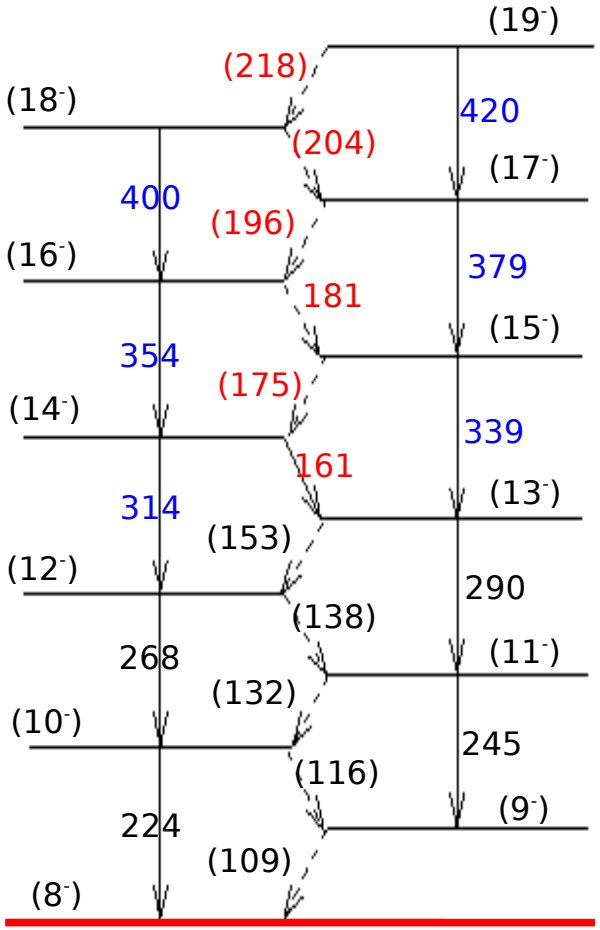

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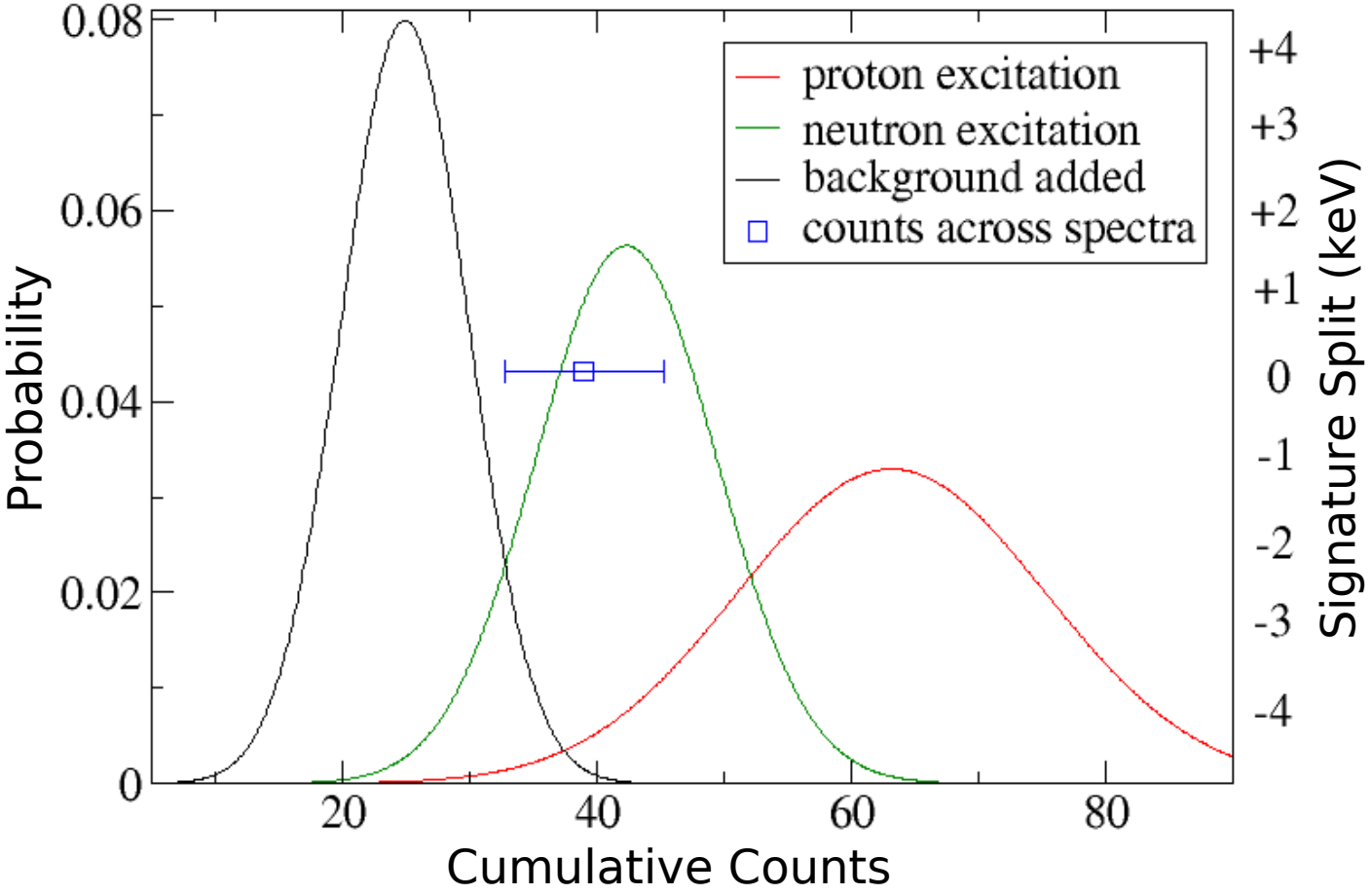

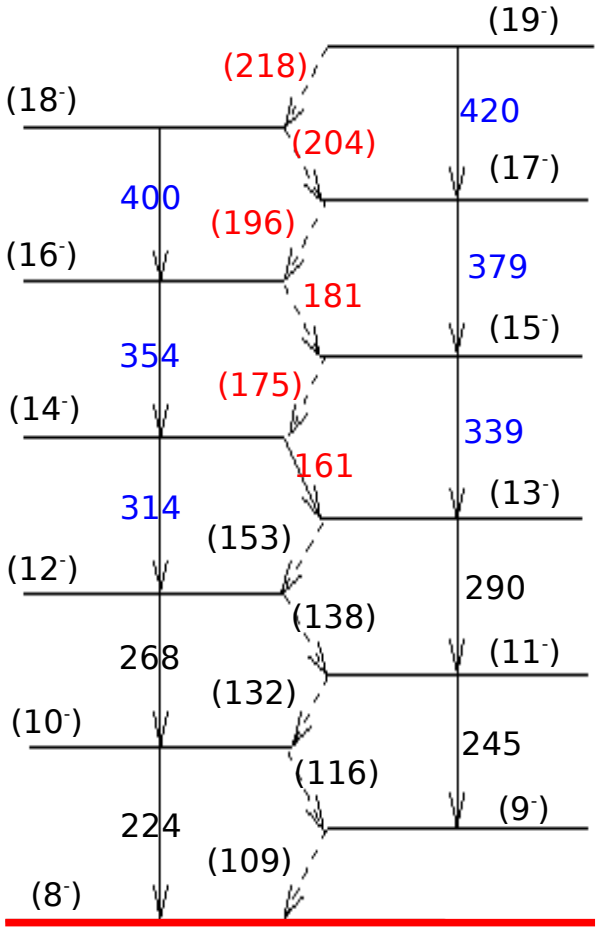

Applied to ^{252}No 8^- K-Isomer

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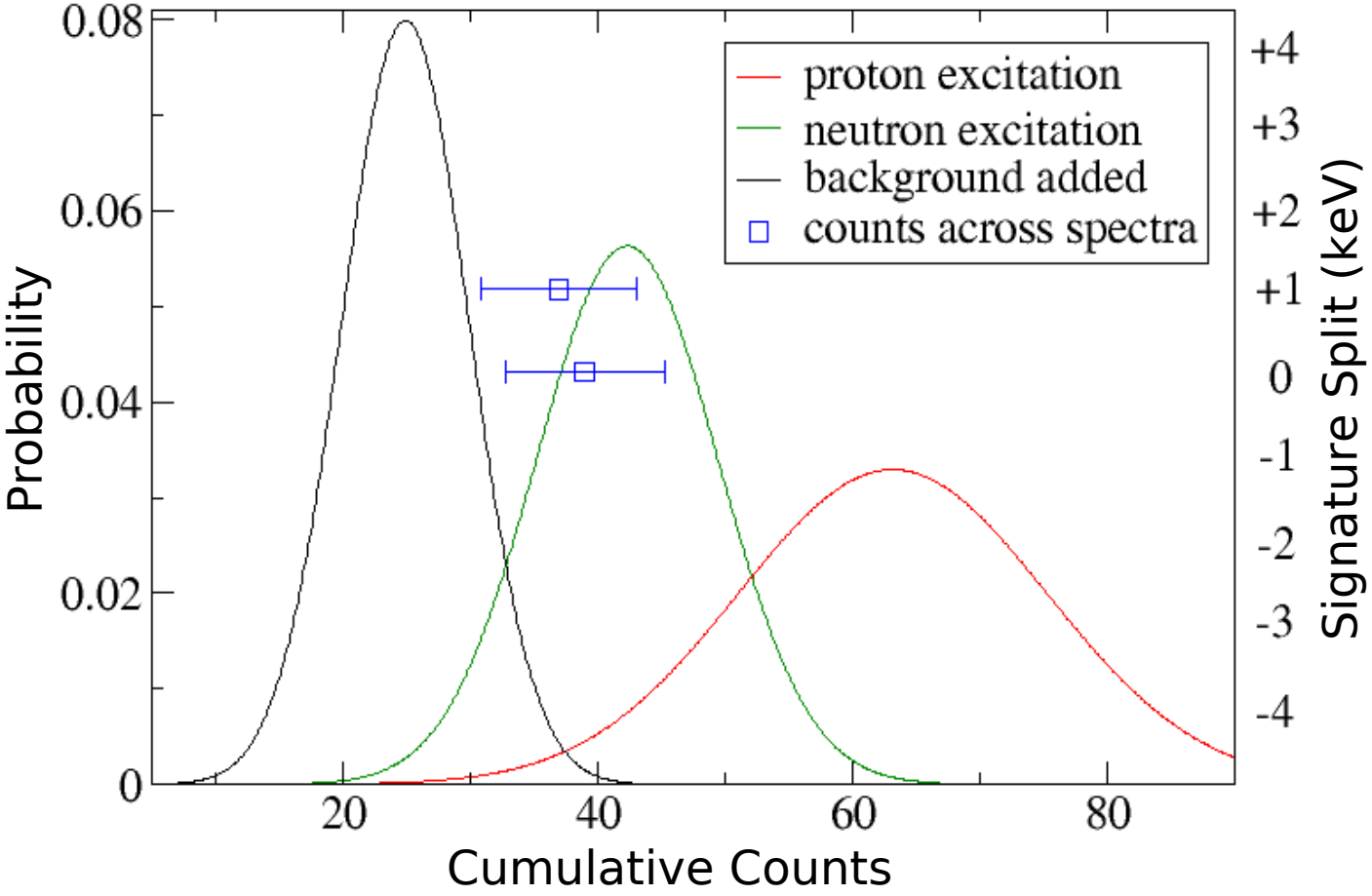

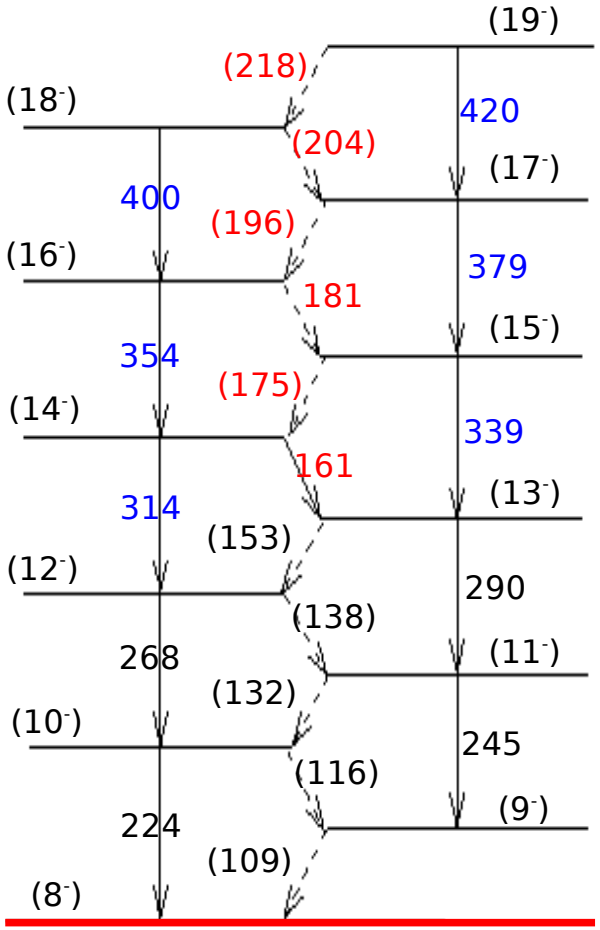

Applied to ^{252}No 8^- K-Isomer

- Take intensities of 6 E2 peaks
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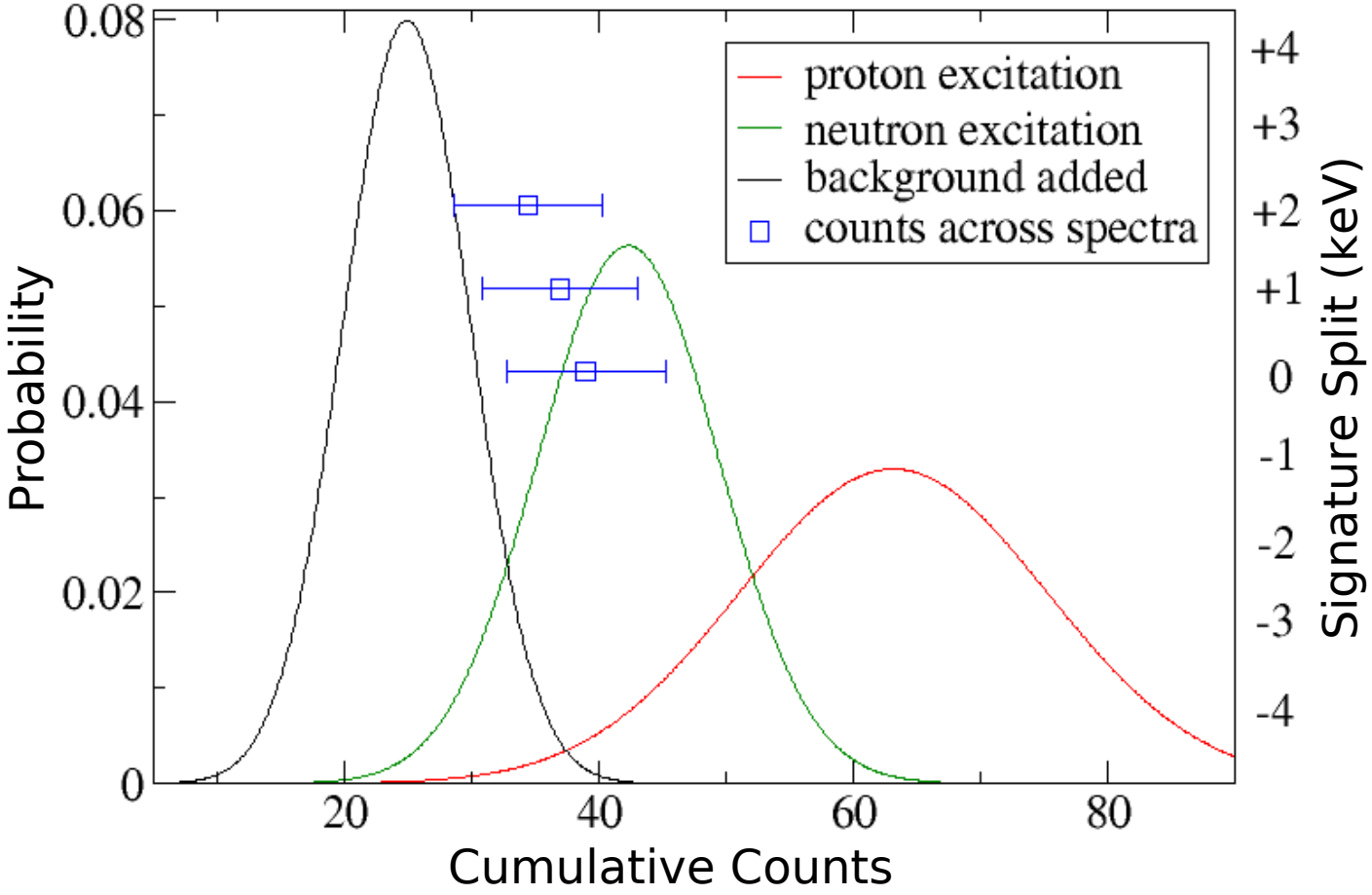

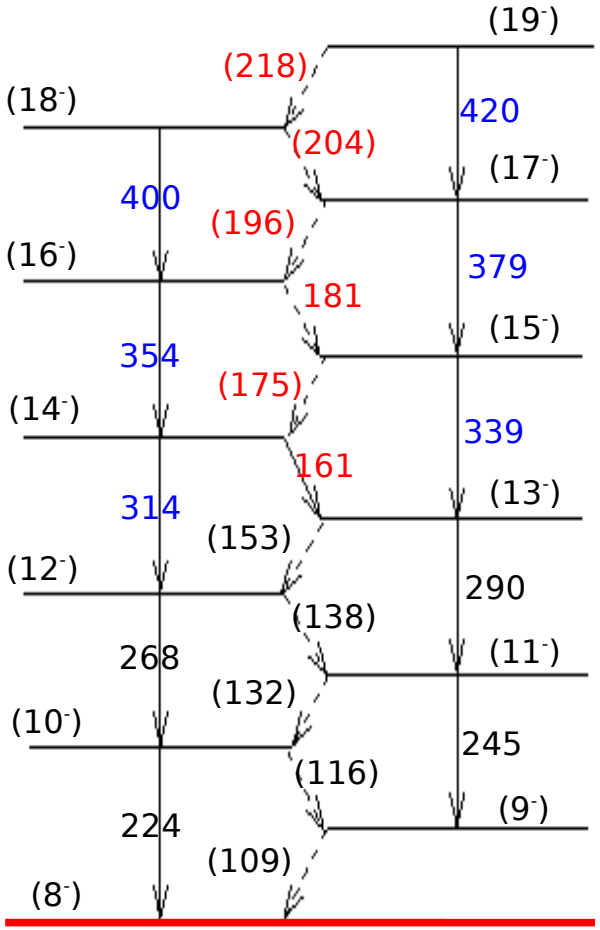

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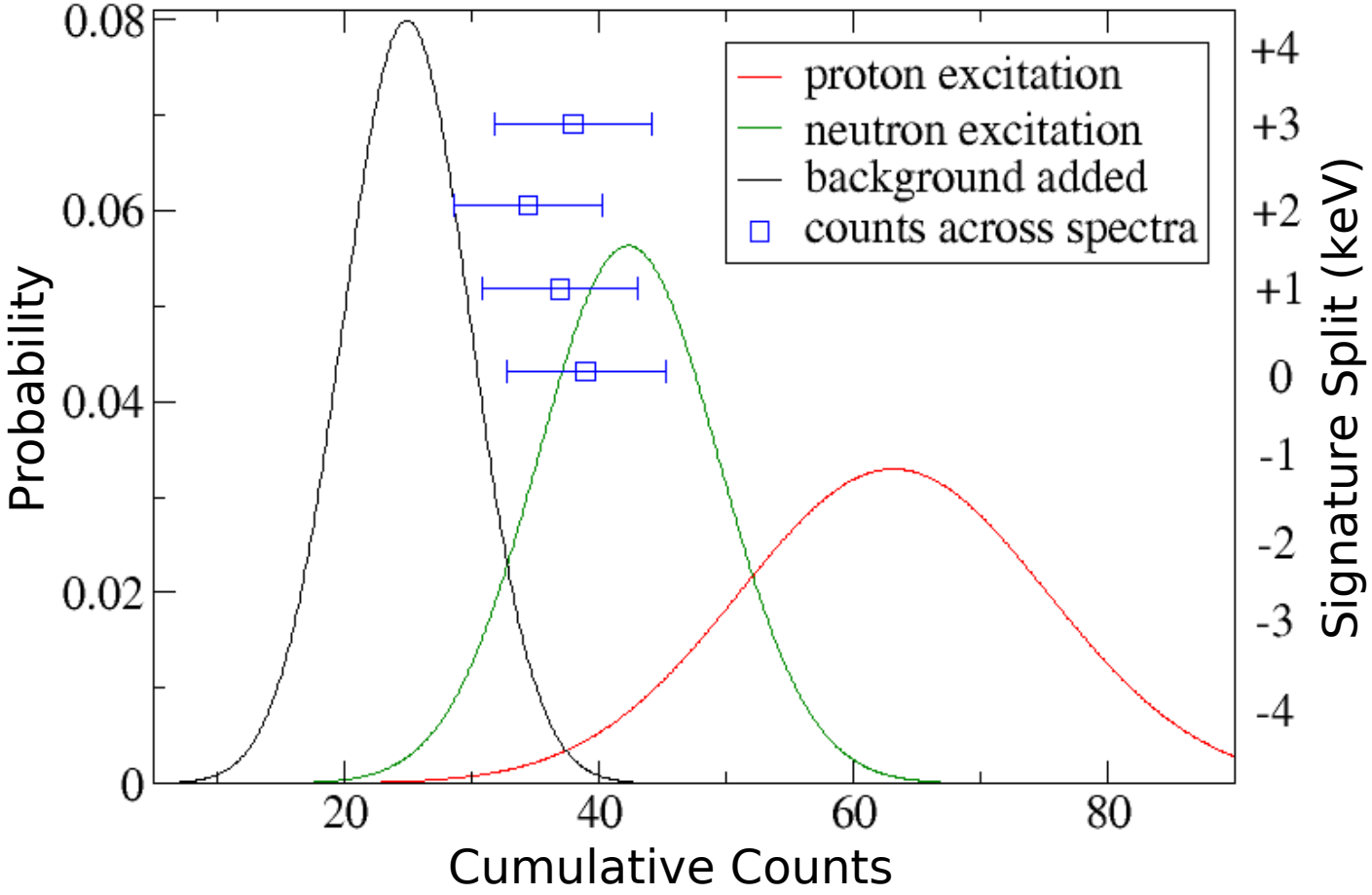

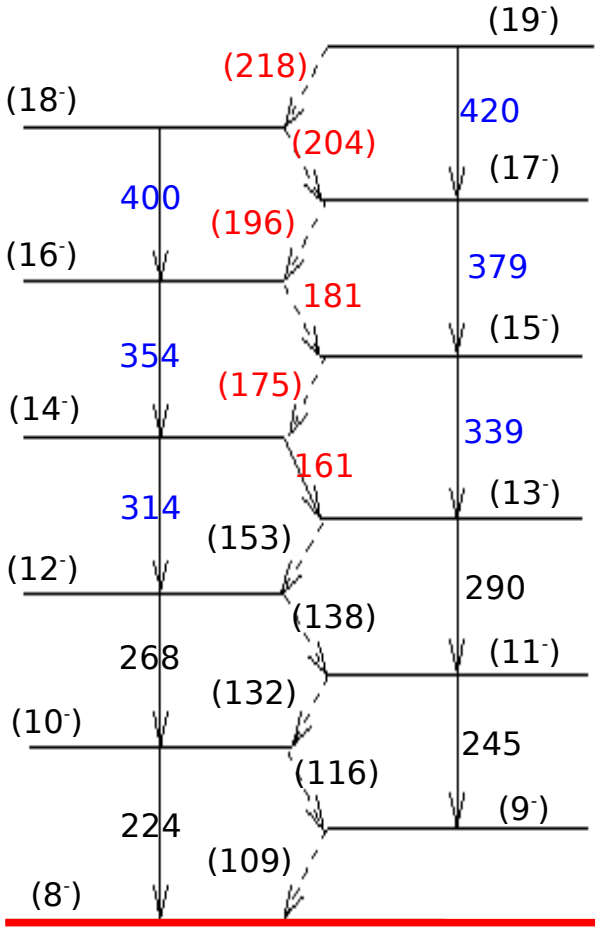

Applied to ^{252}No 8^- K-Isomer

- Take intensities of 6 E2 peaks
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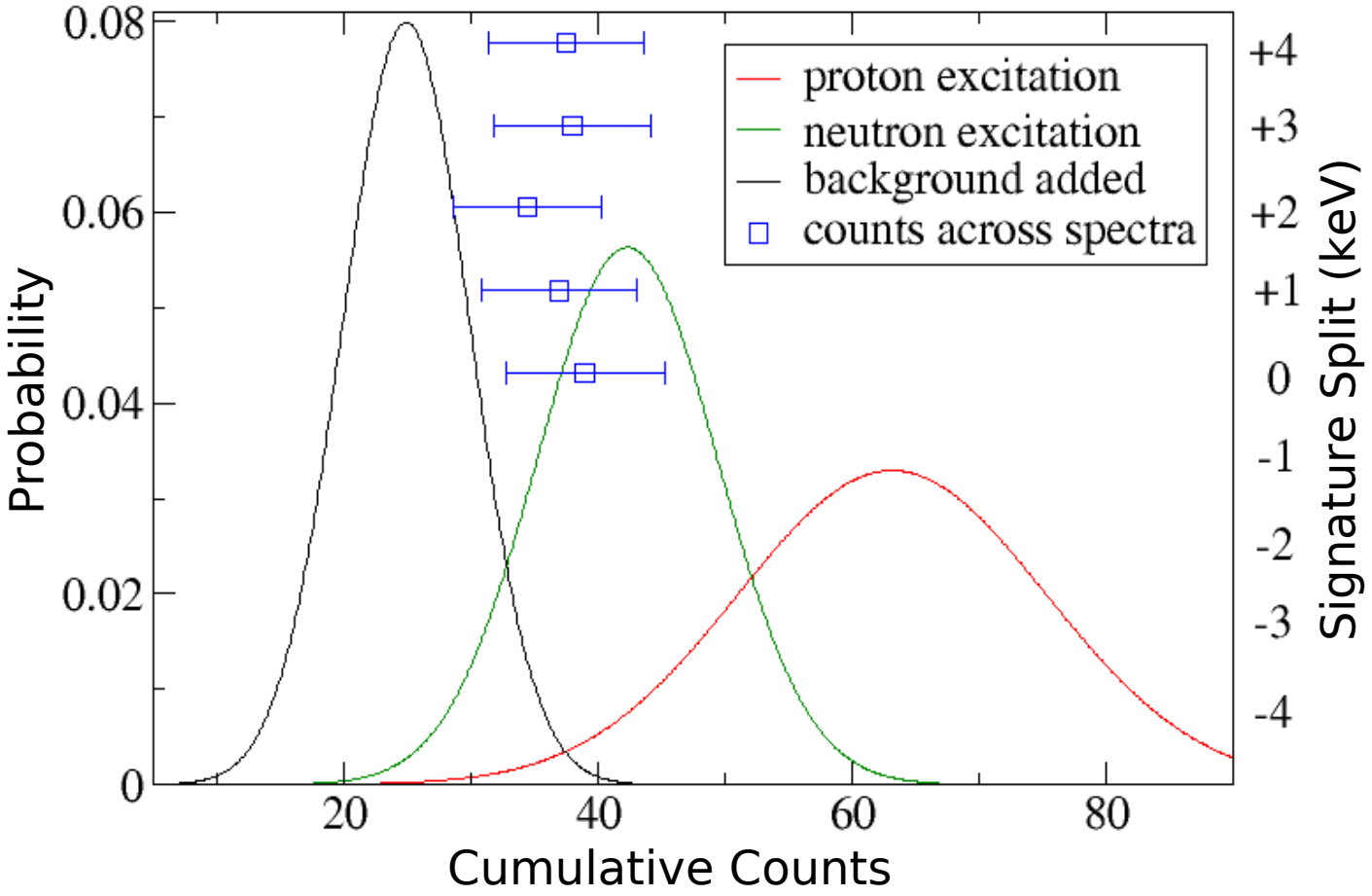

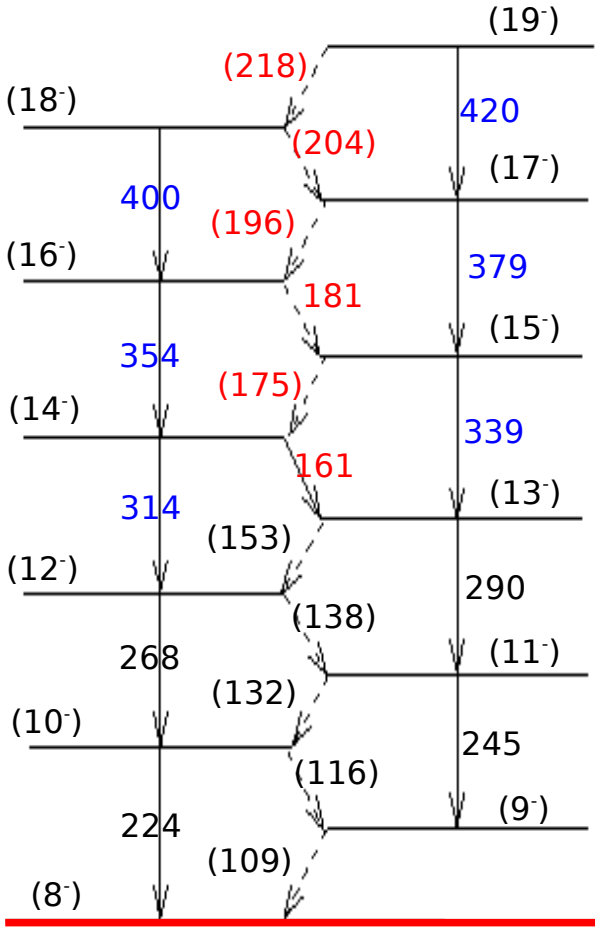

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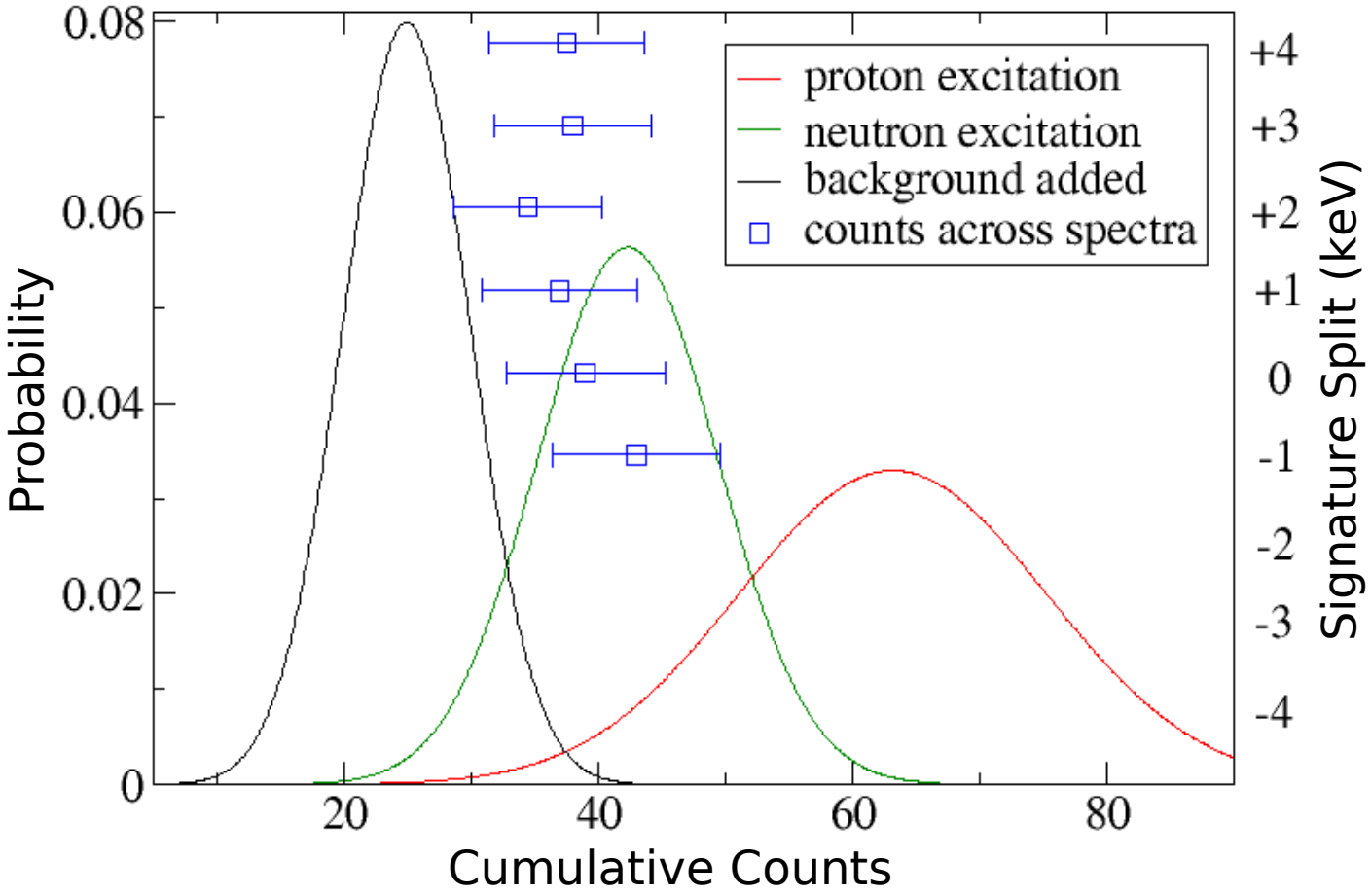

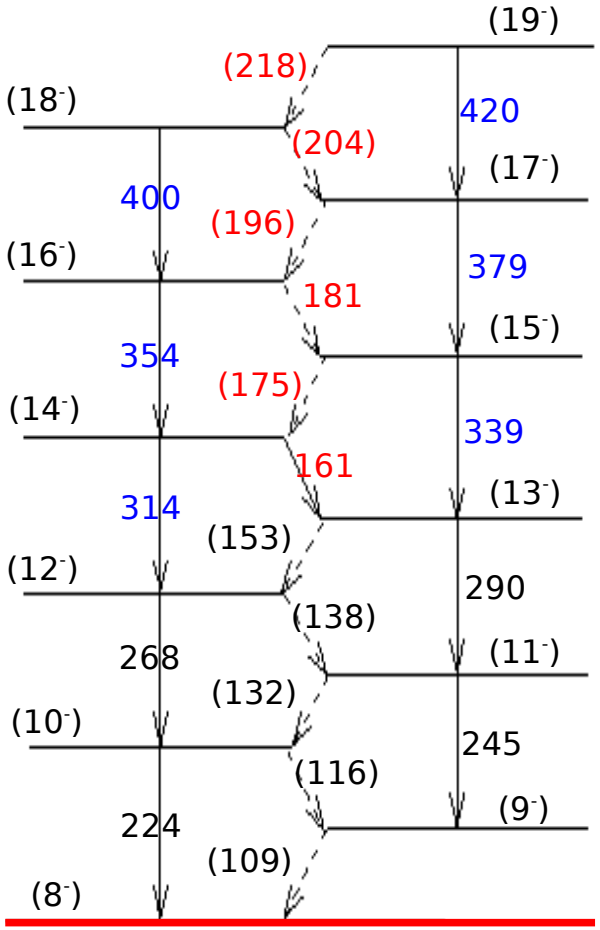

Applied to ^{252}No 8^- K-Isomer

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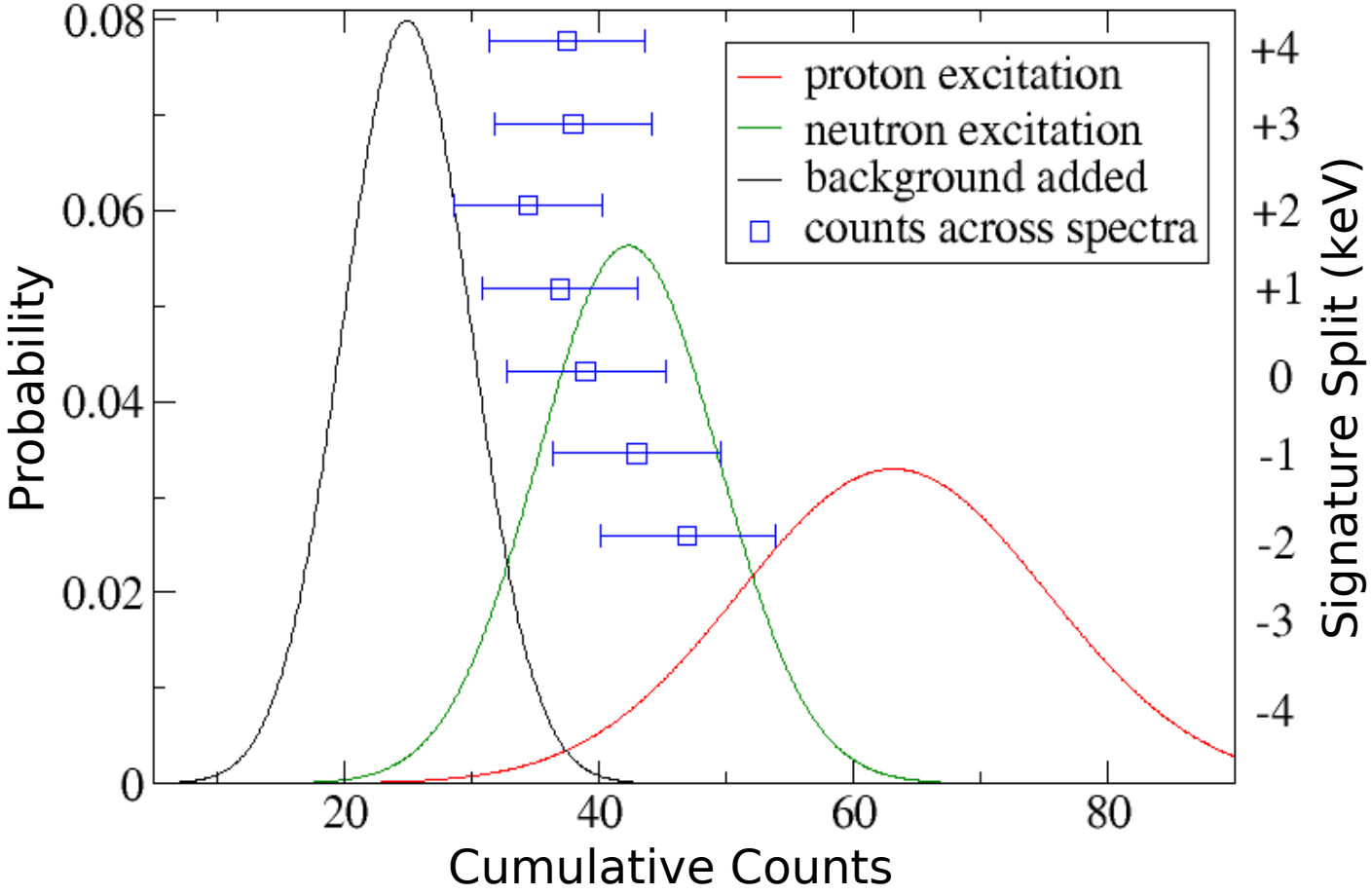

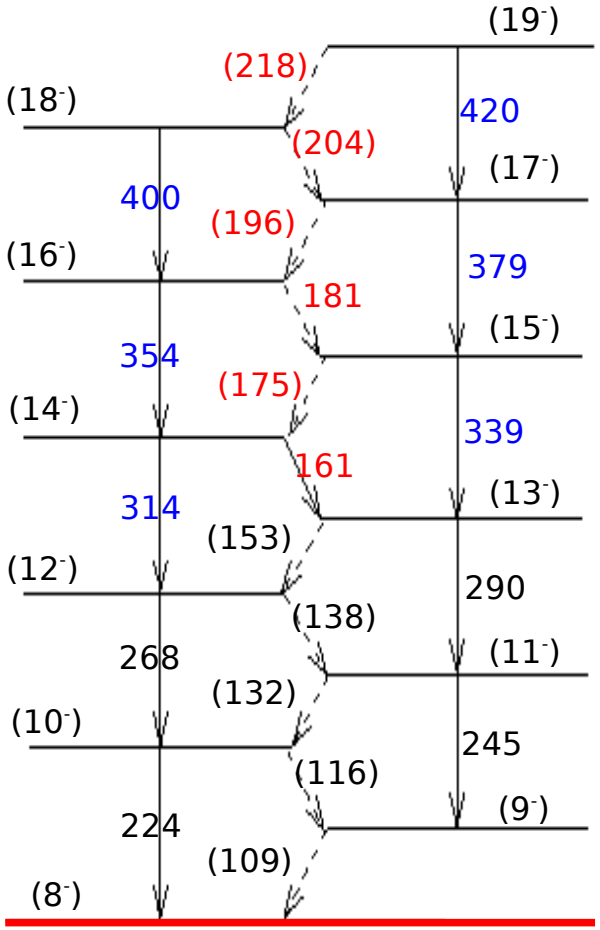

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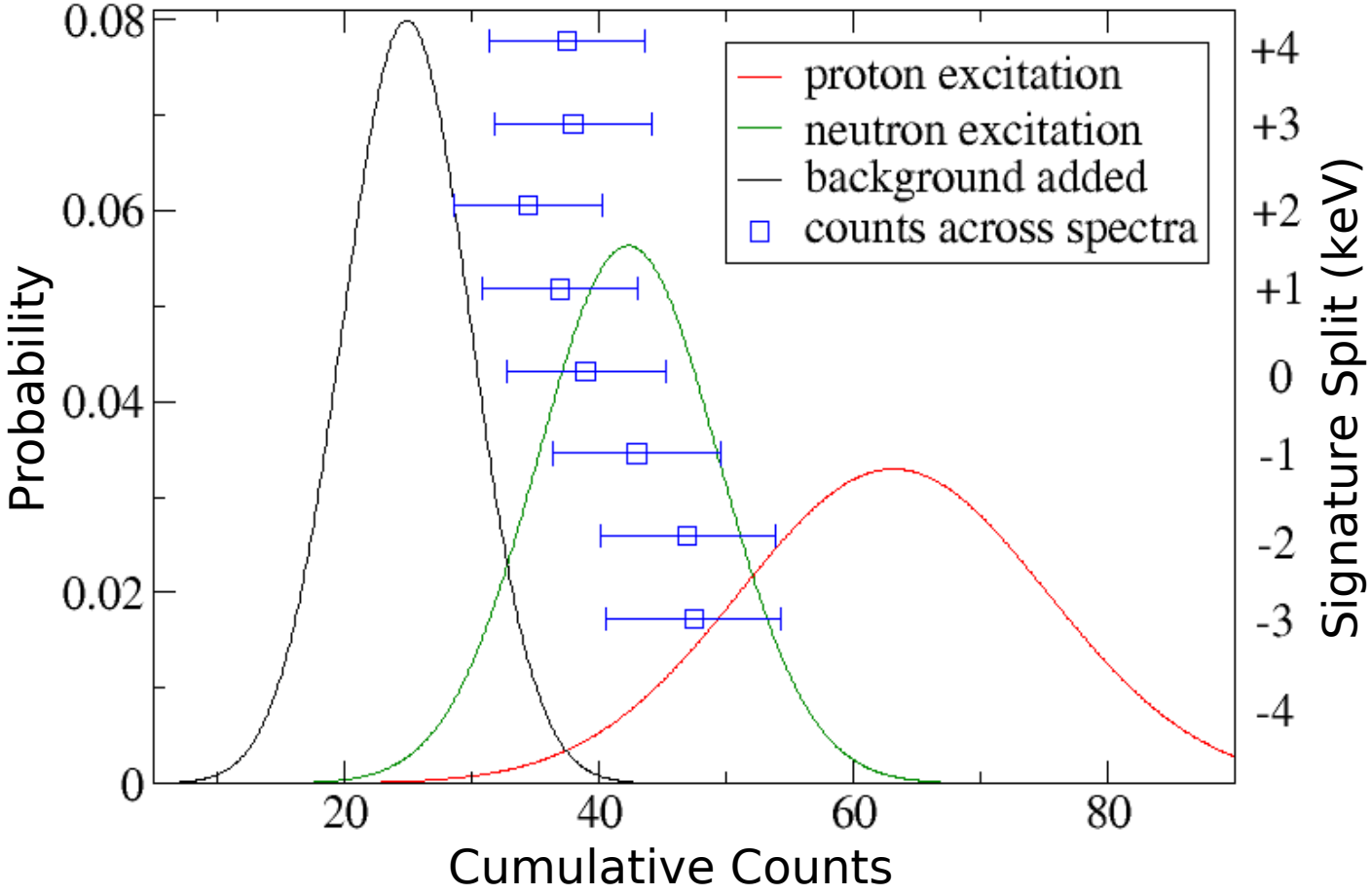
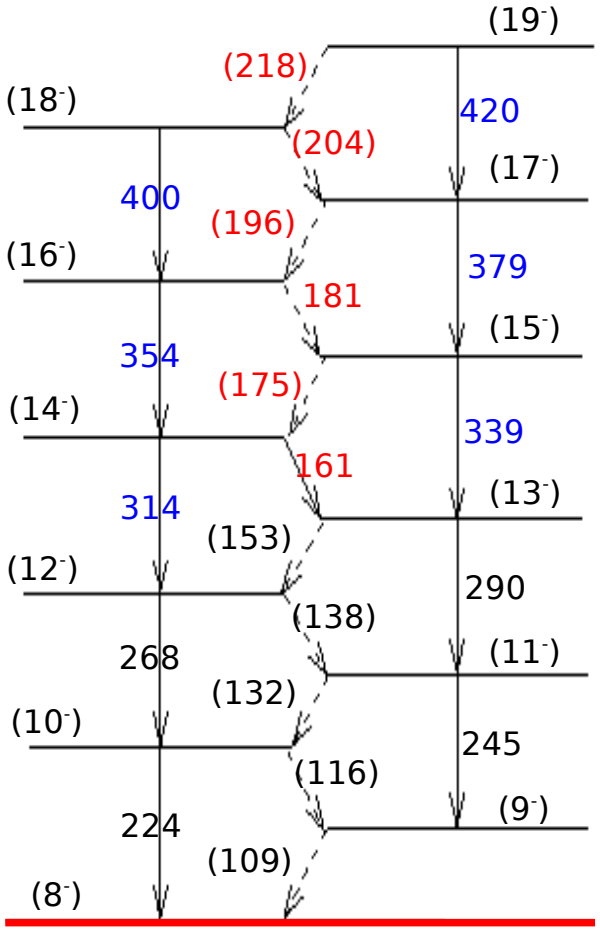
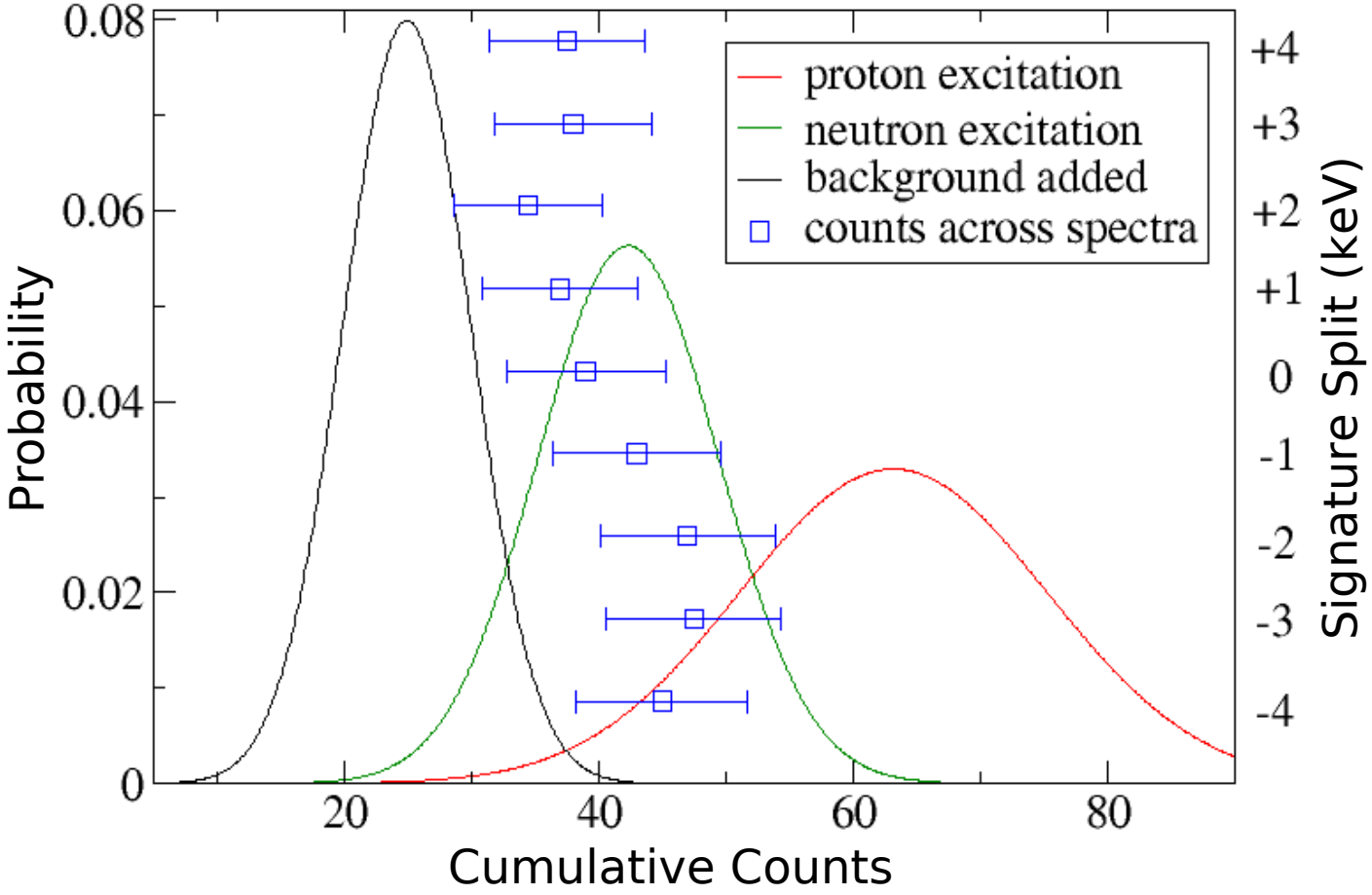
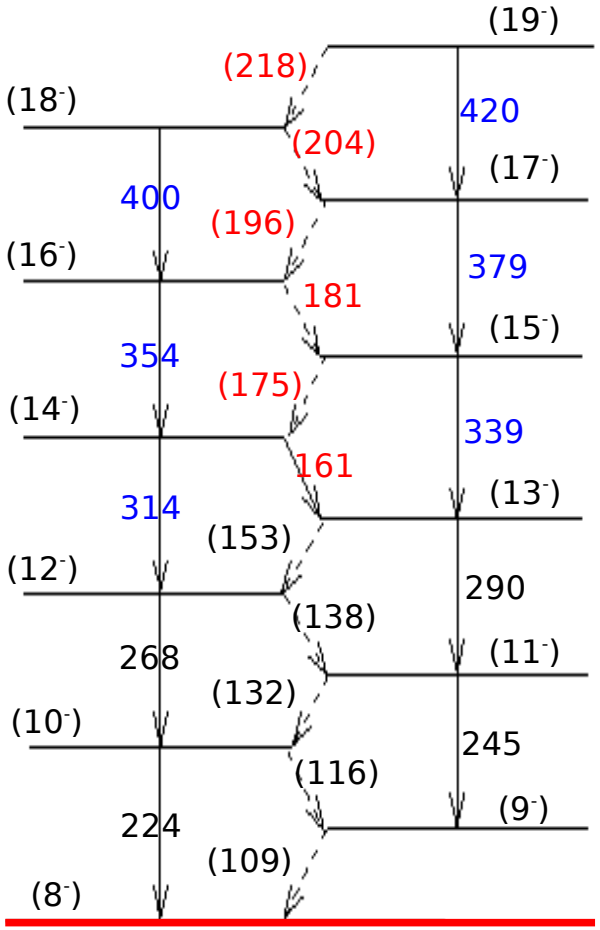




Applied to ^{252}No 8^- K-Isomer

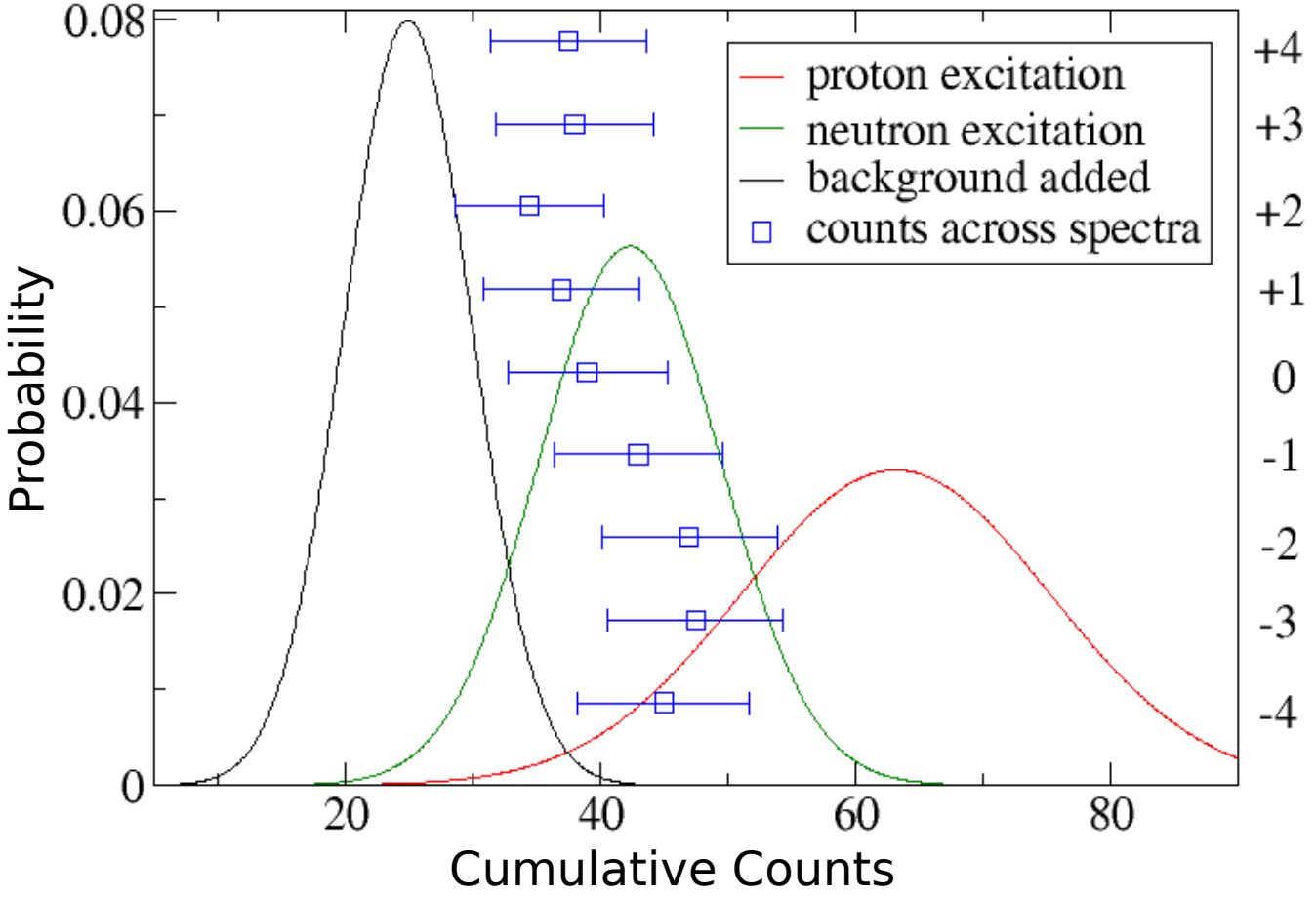
- Some agreement with predicted neutron state

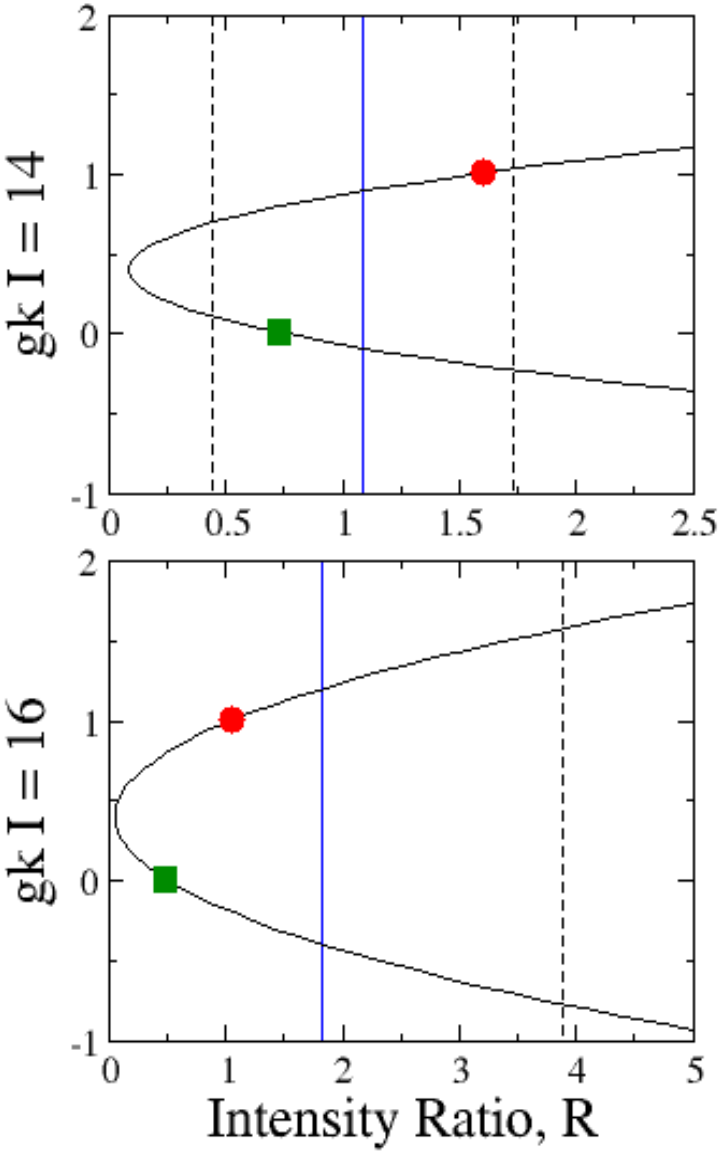




Applied to ^{252}No 8^- K-Isomer

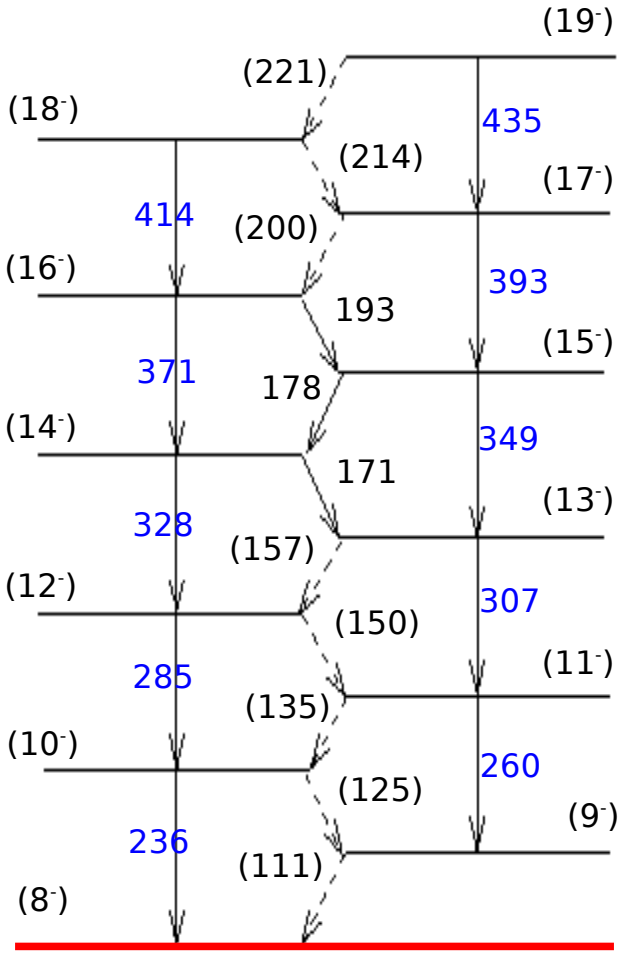
- Some agreement with predicted neutron state
- Compare with individual g_K method



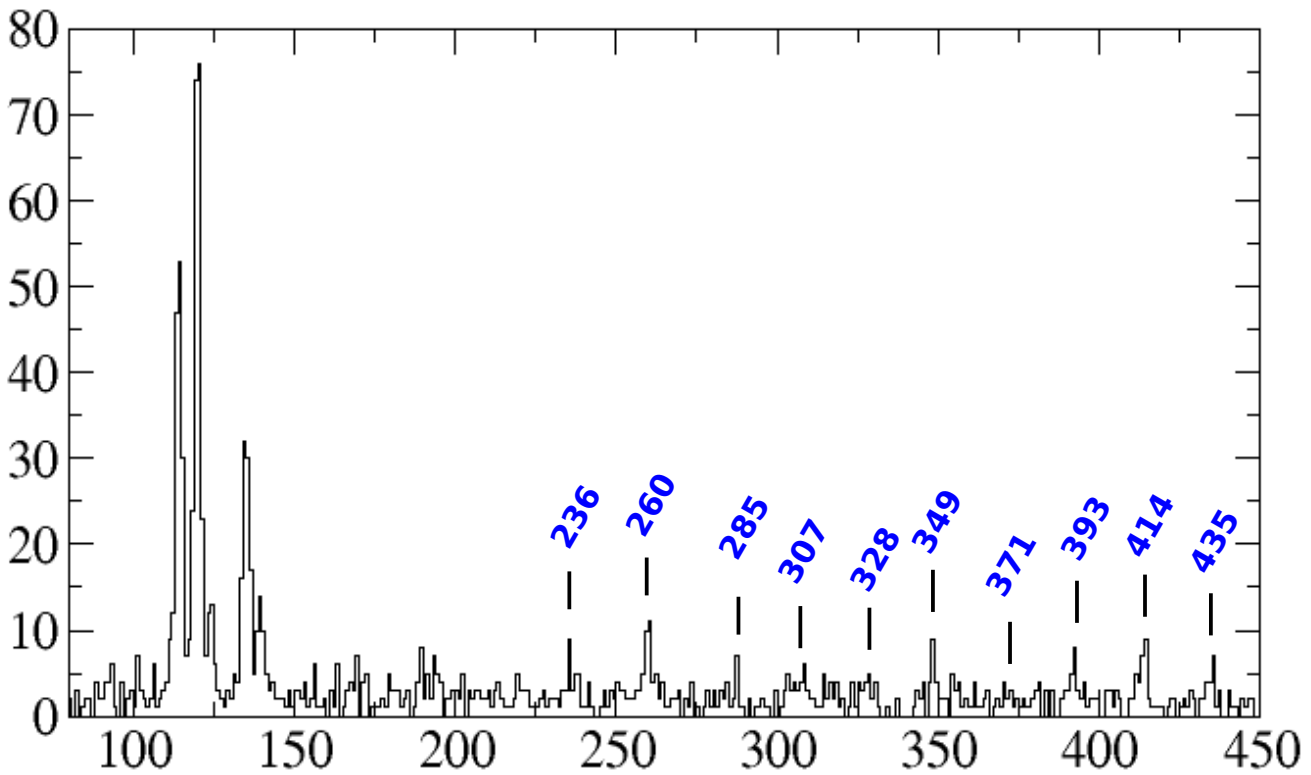


Expected X-ray Counts

- Consider all E2 transitions in rotational band

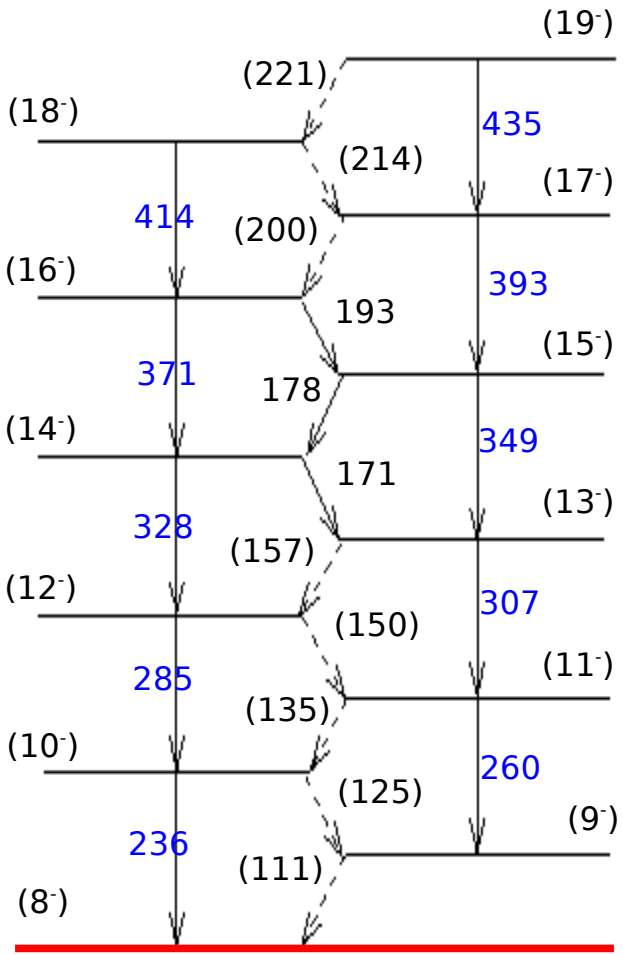


^{250}Fm

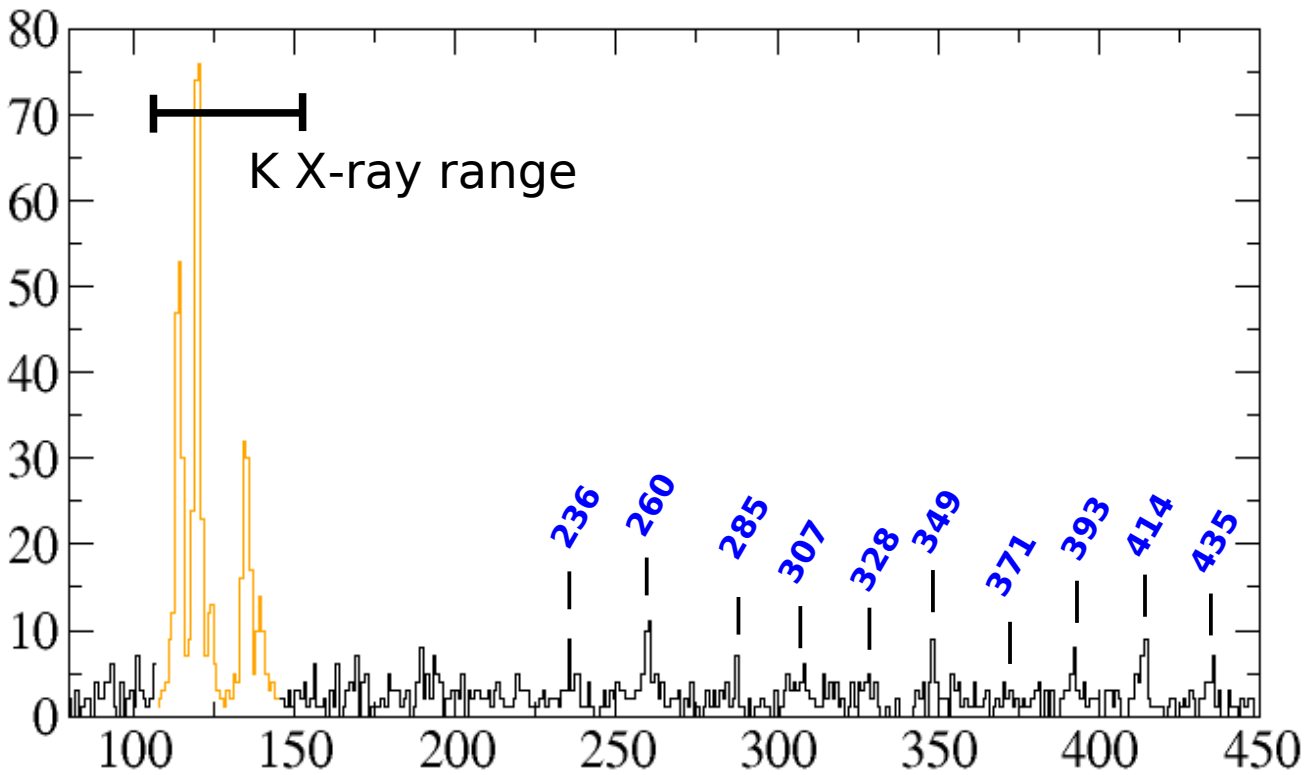


Expected X-ray Counts

- Consider all E2 transitions in rotational band
- Number of counts expected in range of K X-rays predicted for proton and neutron excitation

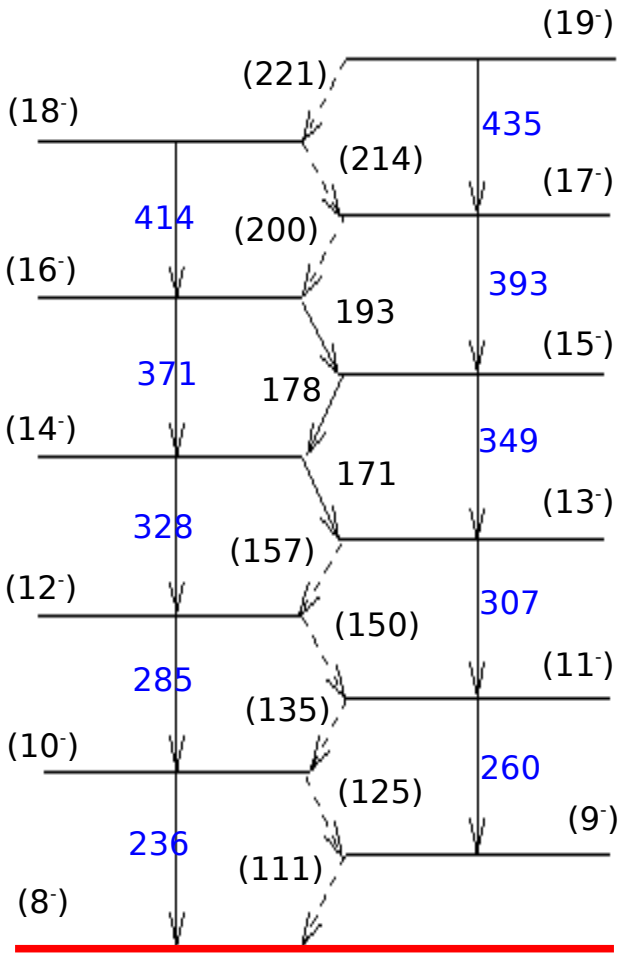


^{250}Fm

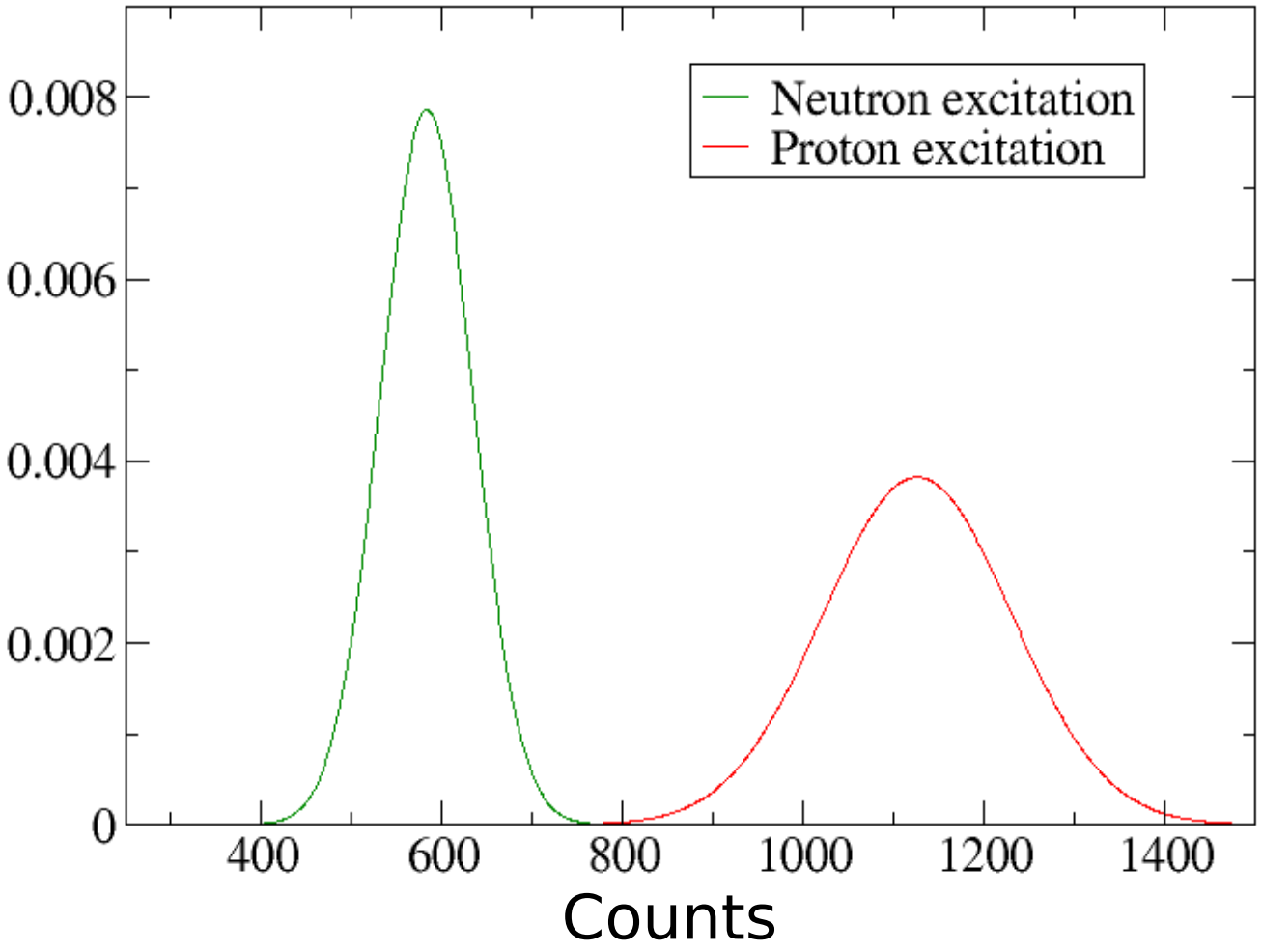


Expected X-ray Counts

- Consider all E2 transitions in rotational band
- Number of counts expected in range of K X-rays predicted for proton and neutron excitation

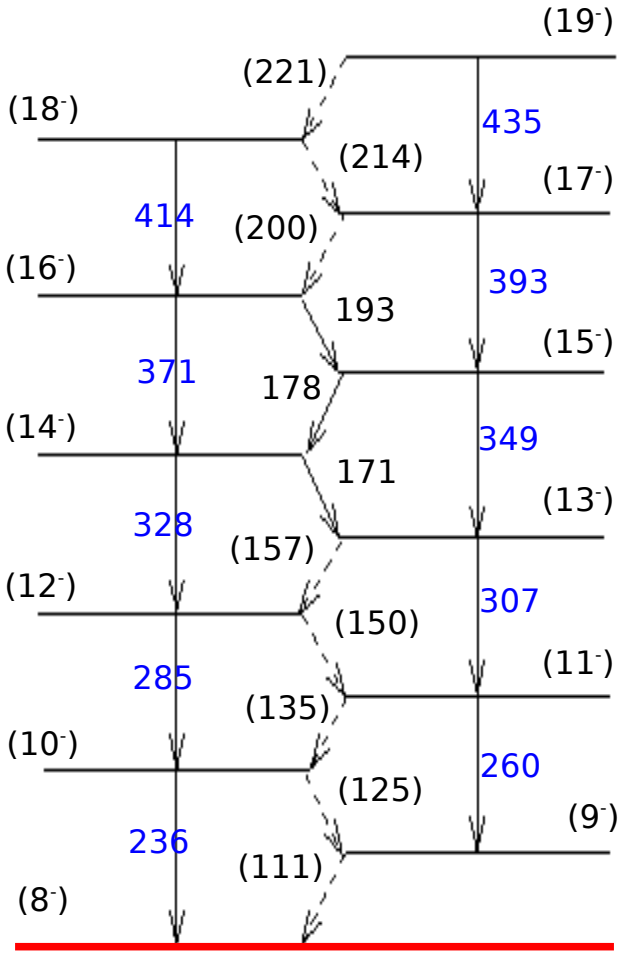


^{250}Fm

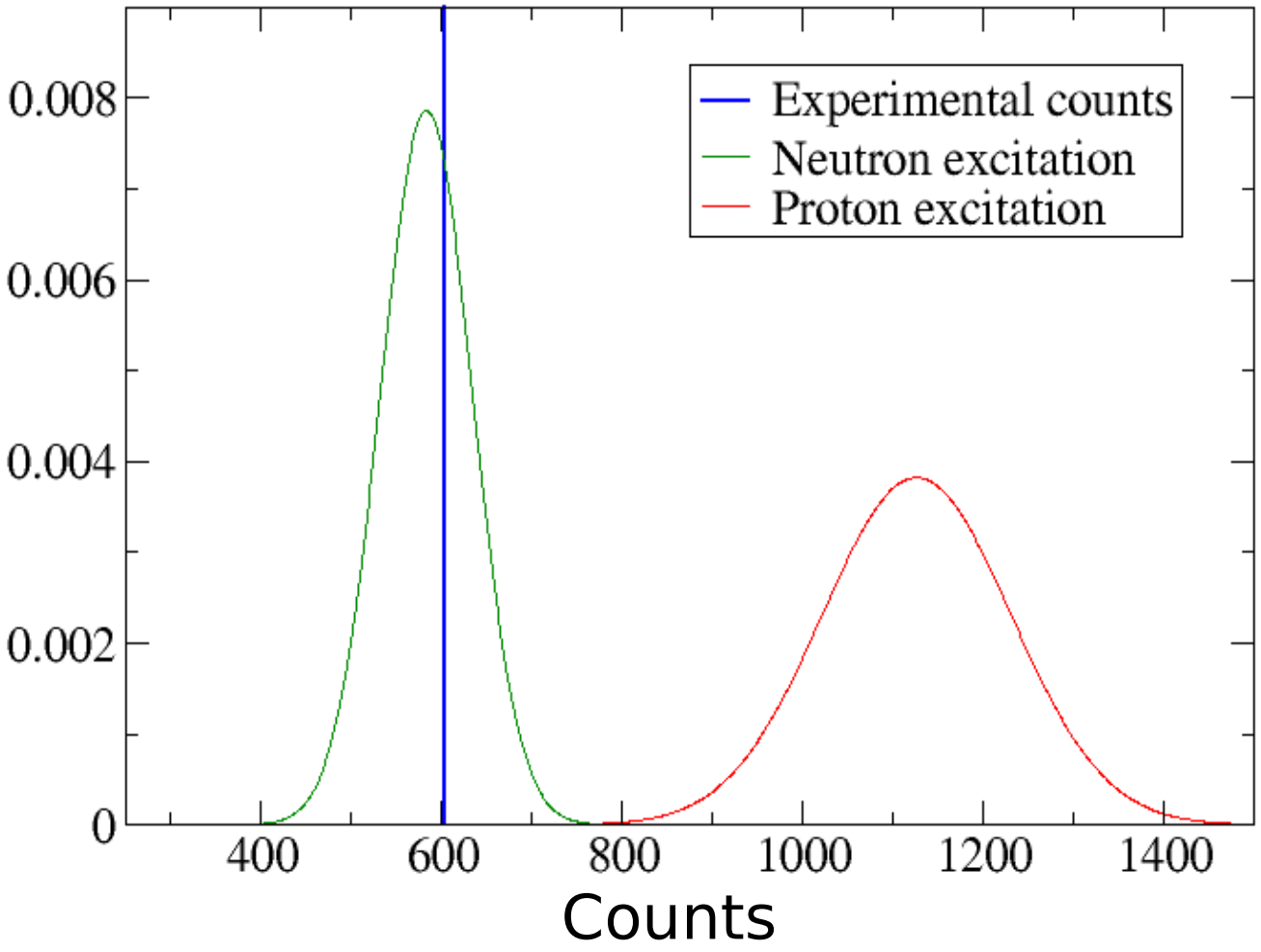


Expected X-ray Counts

- Experimental counts gives upper limit for X-rays from rotational band, neutron state assignment seen

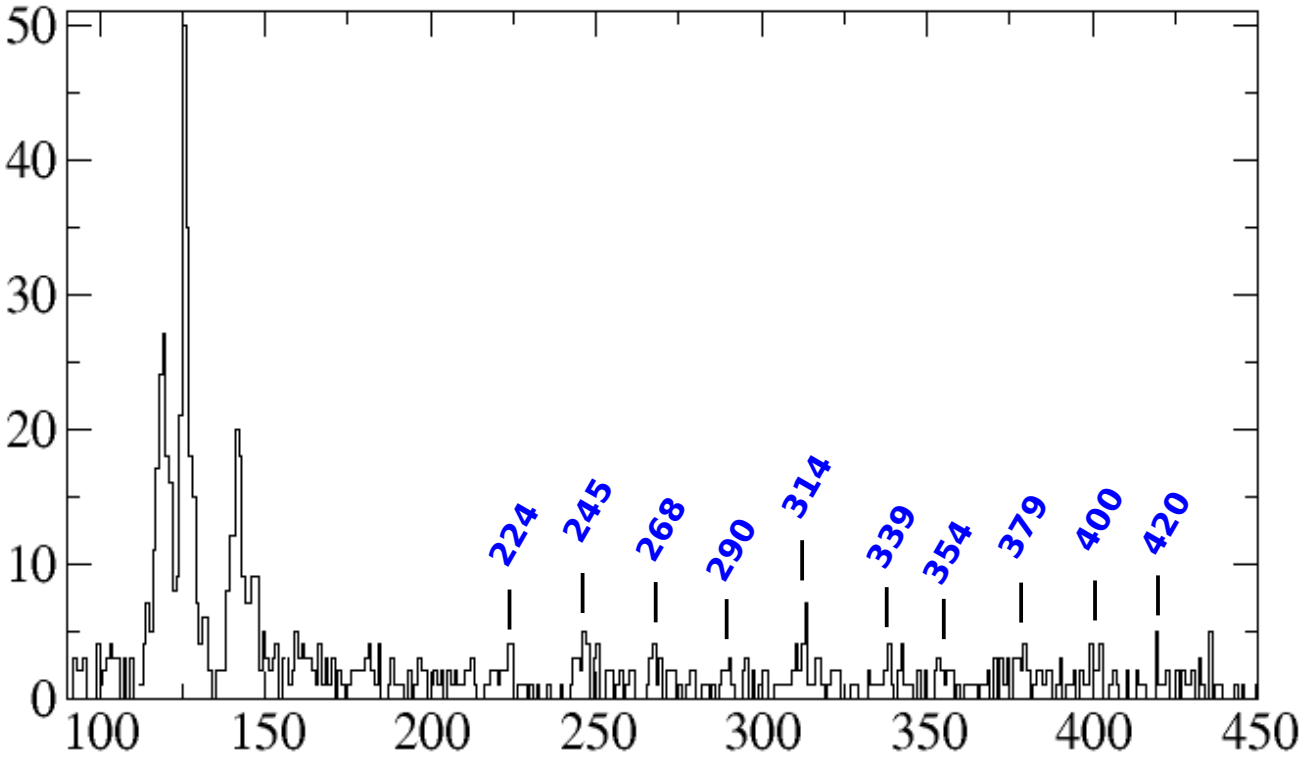


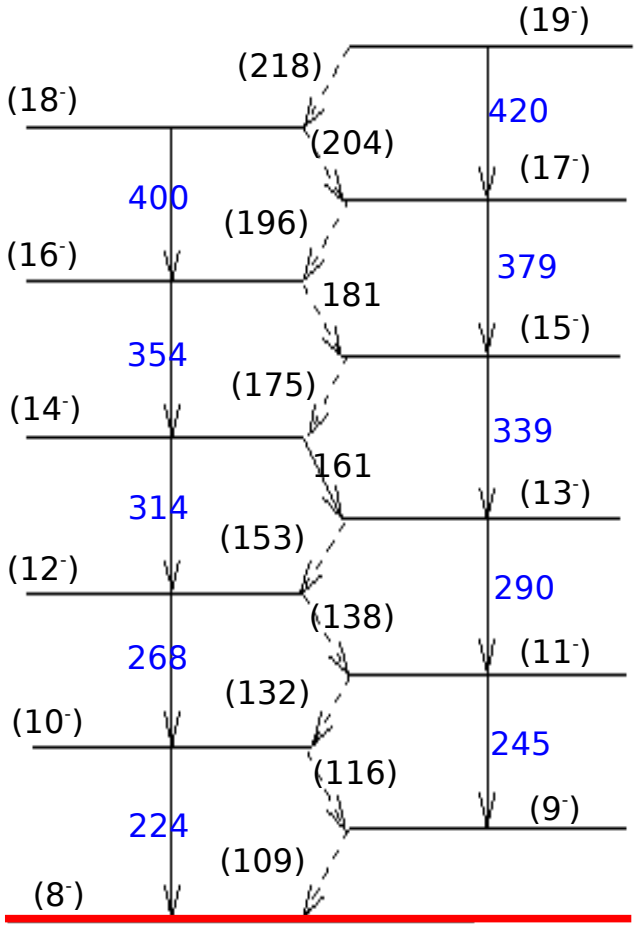
^{250}Fm



Expected X-ray Counts

- Apply to ^{252}No cumulating statistics for all E2 transitions

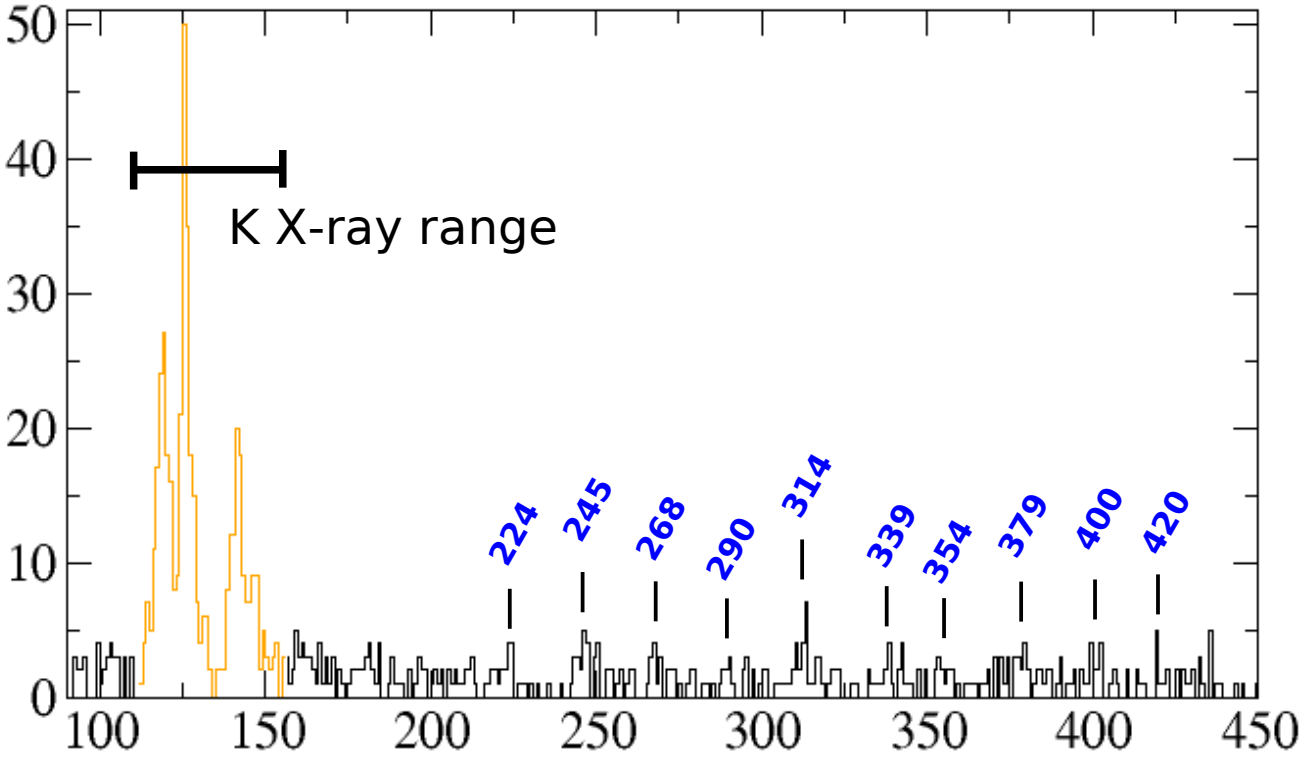


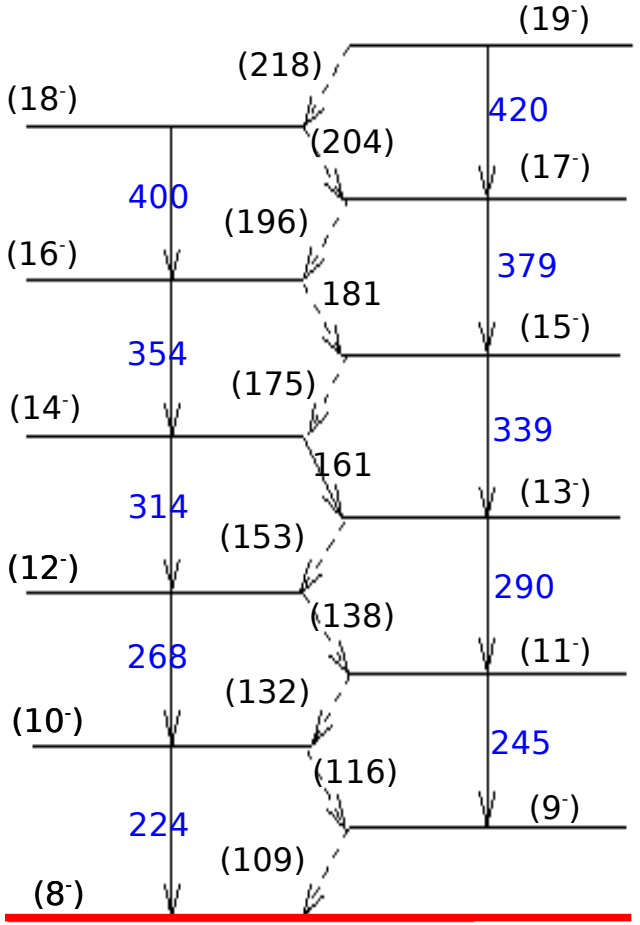


^{252}No

Expected X-ray Counts

- Apply to ^{252}No cumulating statistics for all E2 transitions
- Expected counts found for proton and neutron states

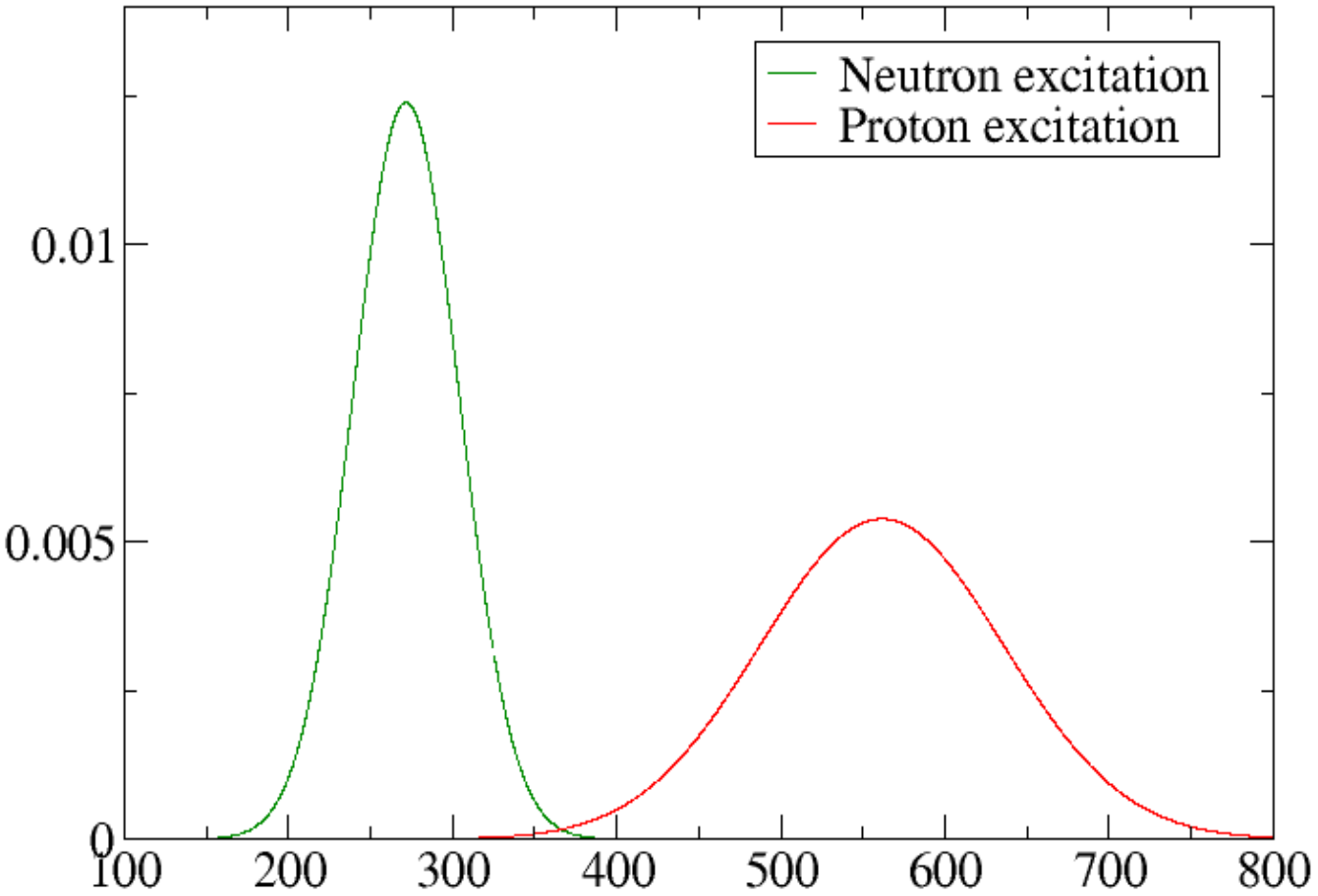


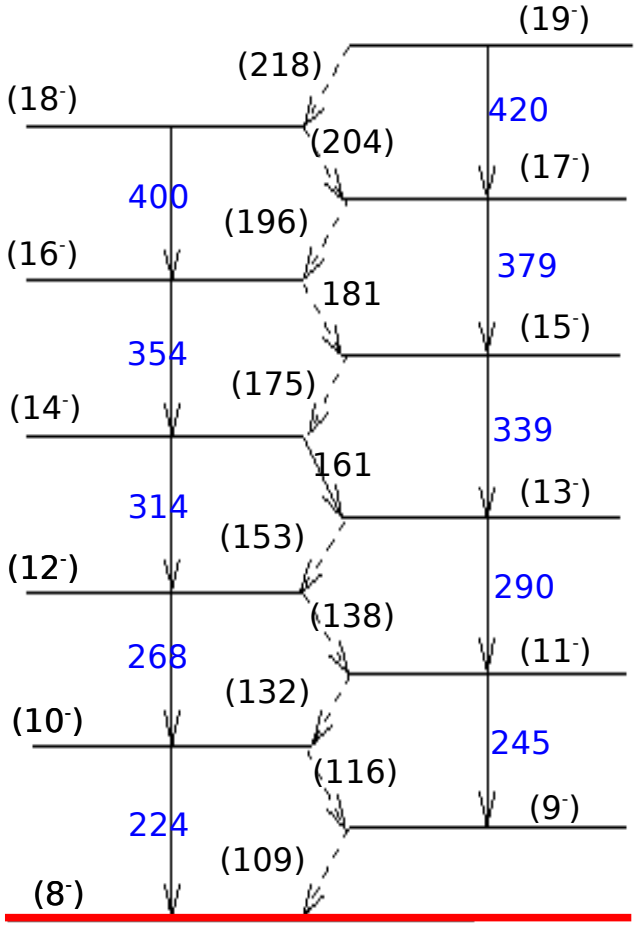


^{252}No

Expected X-ray Counts

- Apply to ^{252}No cumulating statistics for all E2 transitions
- Expected counts found for proton and neutron states

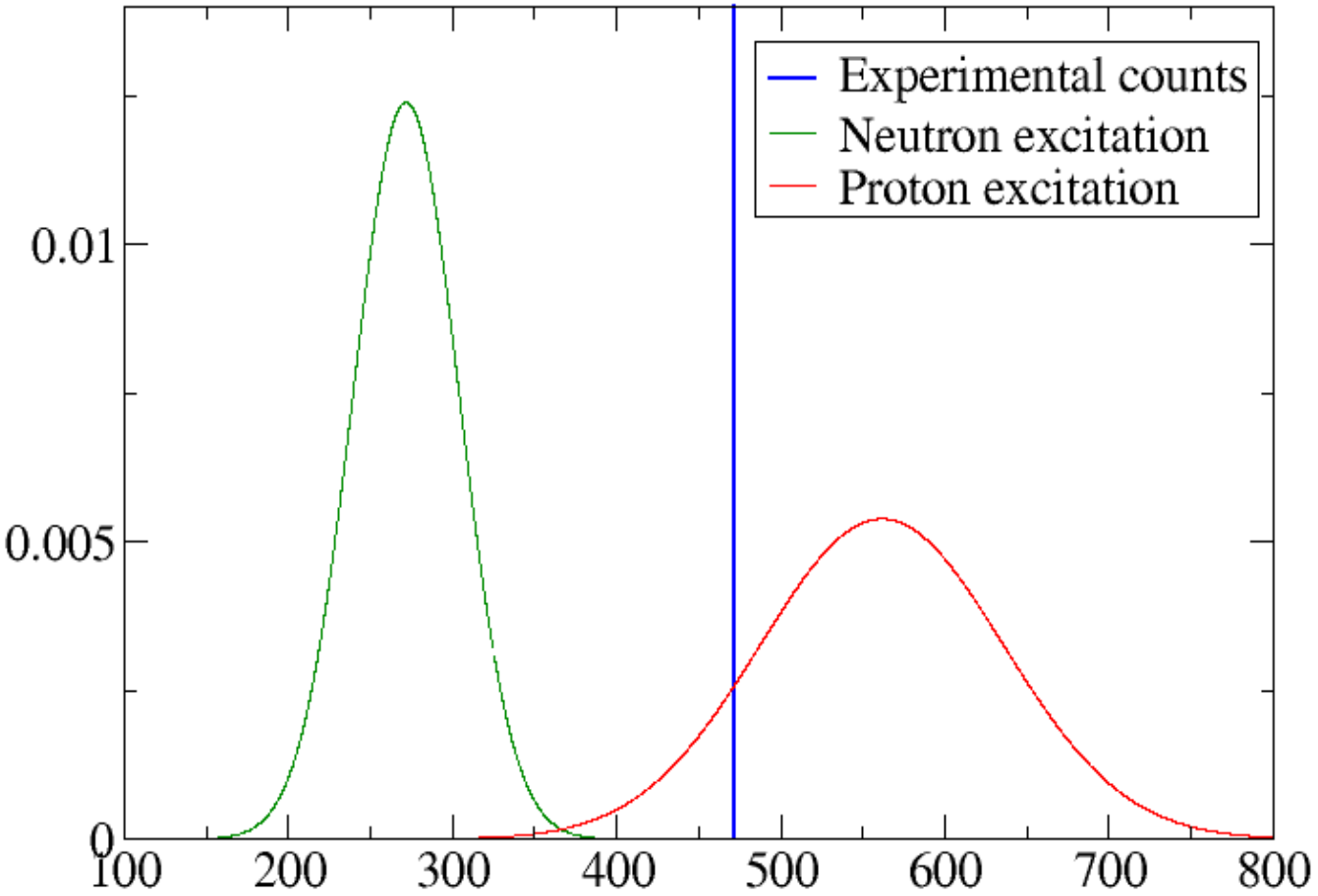


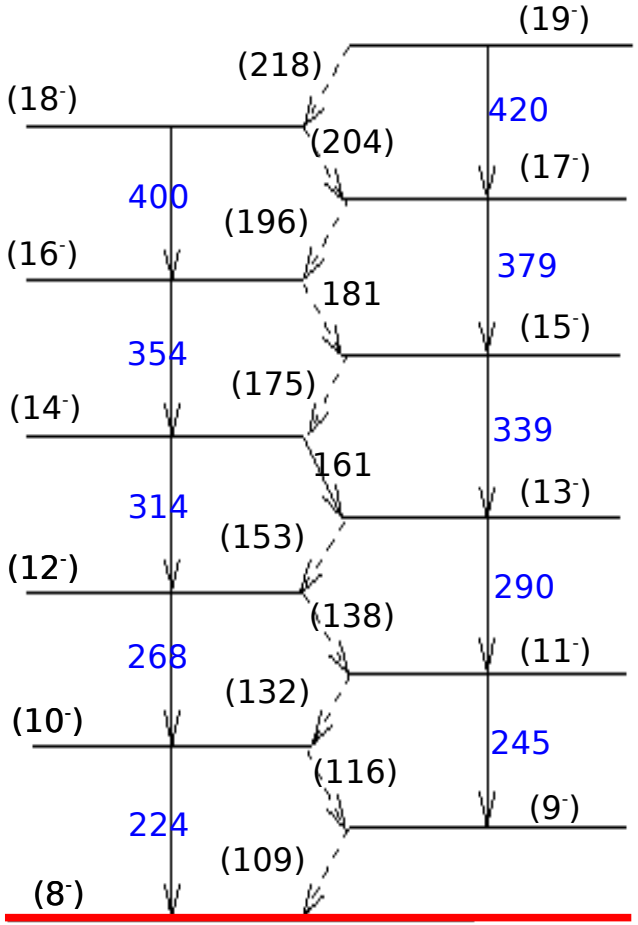


^{252}No

Expected X-ray Counts

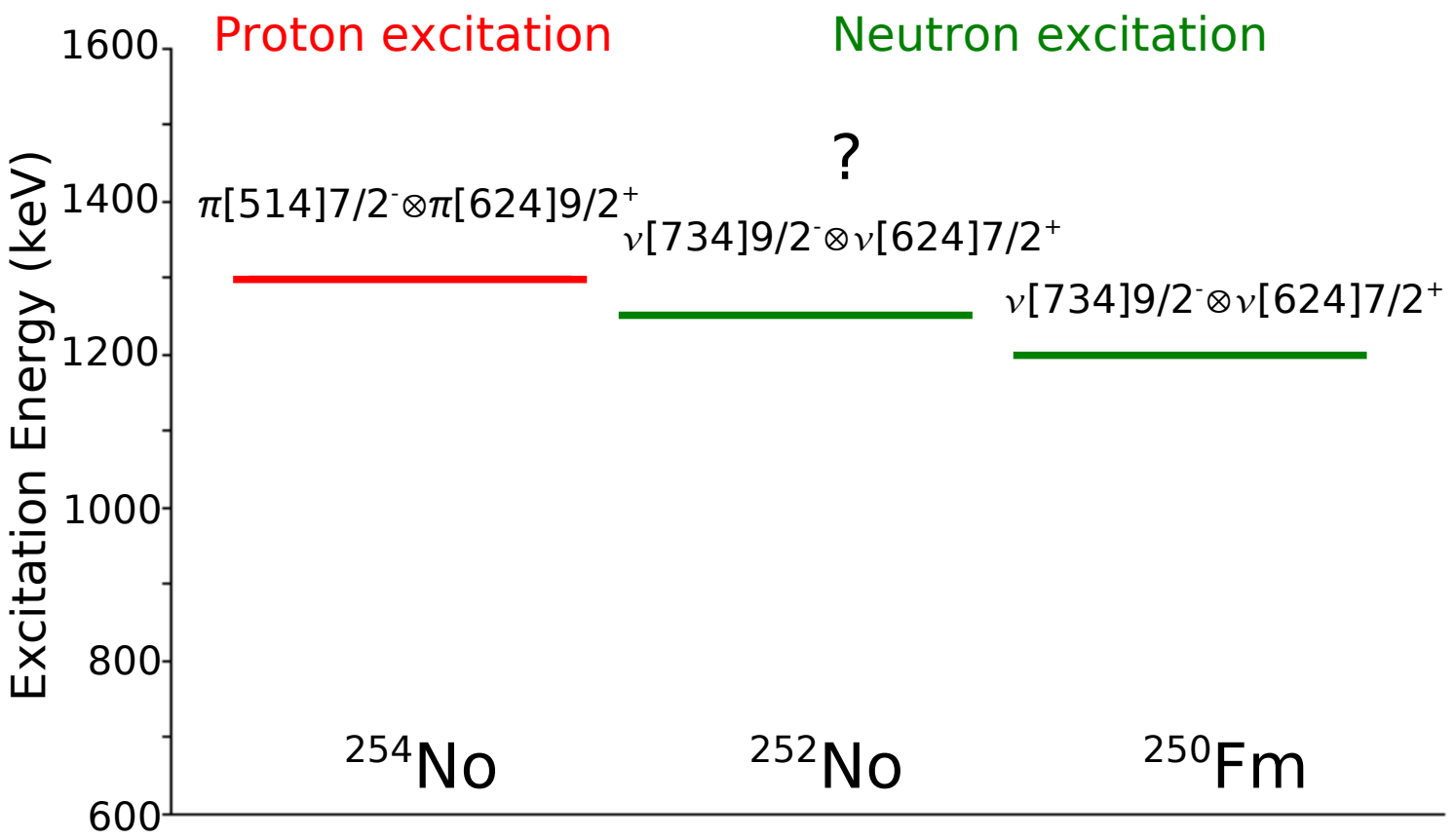
- Upper limit this time inconclusive
- Indication of side band with highly converted transitions





^{252}No

K-Isomer particle states



- Indications for confirmation of predicted K isomer structures
- Possible evidence for more excited states in ^{252}No

Collaborators

P.T. Greenlees, M. Leino, U. Jakobsson, P. Jones, R. Julin, S. Juutinen, S. Ketelhut, H. Kettunen, M. Nyman, P. Rahkila, J. Saren, C. Scholey, J. Sorri and J. Uusitalo
Department of Physics, University of Jyväskylä, Finland

R.-D. Herzberg, P.A. Butler, J. Pakarinen, D. Rostron, P. Papadakis, E. Parr, L.-L. Andersson
Department of Physics, University of Liverpool

B. Sulignano, Ch. Theisen, A. Drouart, A. Görgen, W. Korten, J. Ljungvall, A. Obertelli and M. Zielińska
DAPNIA/SPhN CEA-Saclay, France

S. Hofmann, D. Ackermann, F.P. Heßberger, S. Heinz and J. Khuyagbataar
GSI, Darmstadt, Germany

M. Venhart, S. Antalic
Department of Nuclear Physics and Biophysics, Comenius University, Bratislava, Slovakia

UNIVERSITY OF JYVÄSKYLÄ

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COMMISSARIAT À L'ÉNERGIE ATOMIQUE
DSM - DAPNIA
DIRECTION DES SCIENCES DE LA MATIÈRE

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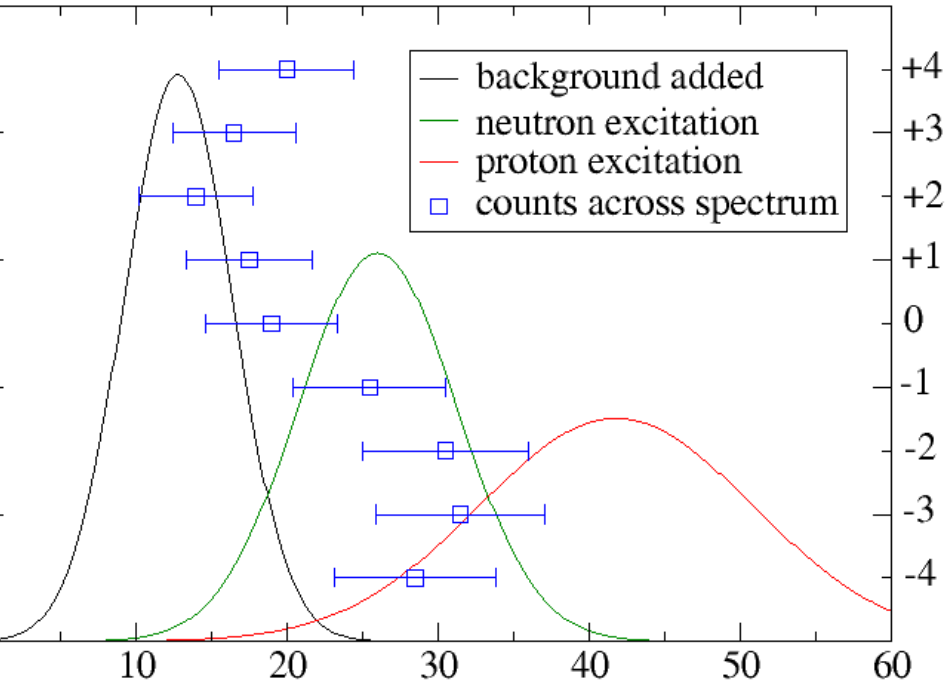
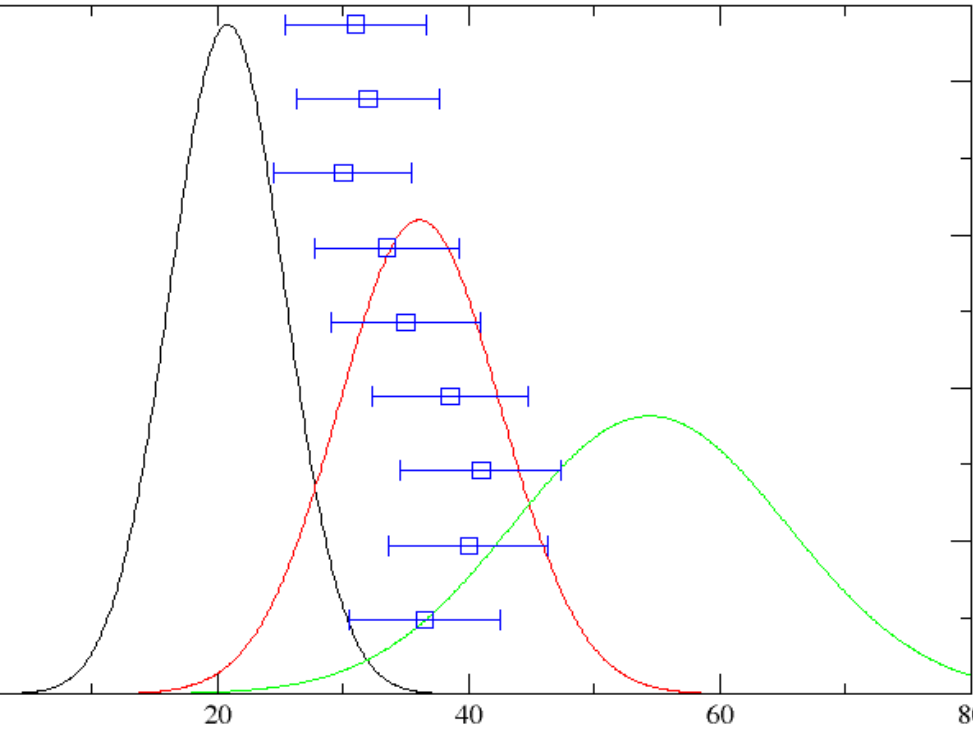
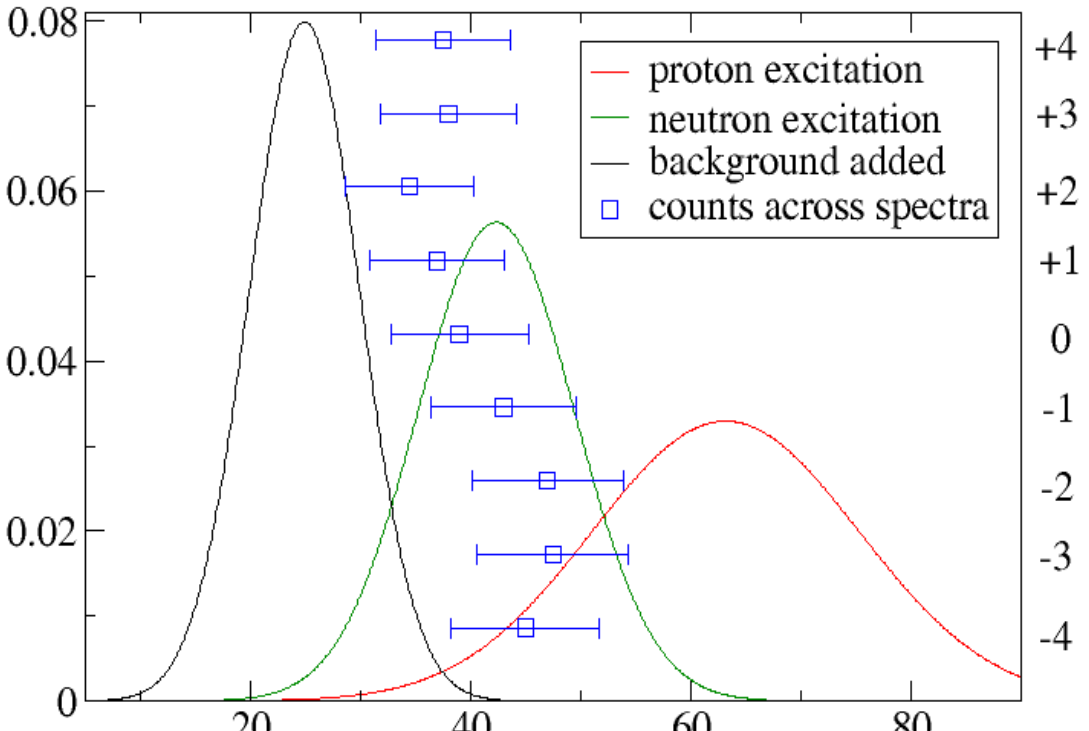
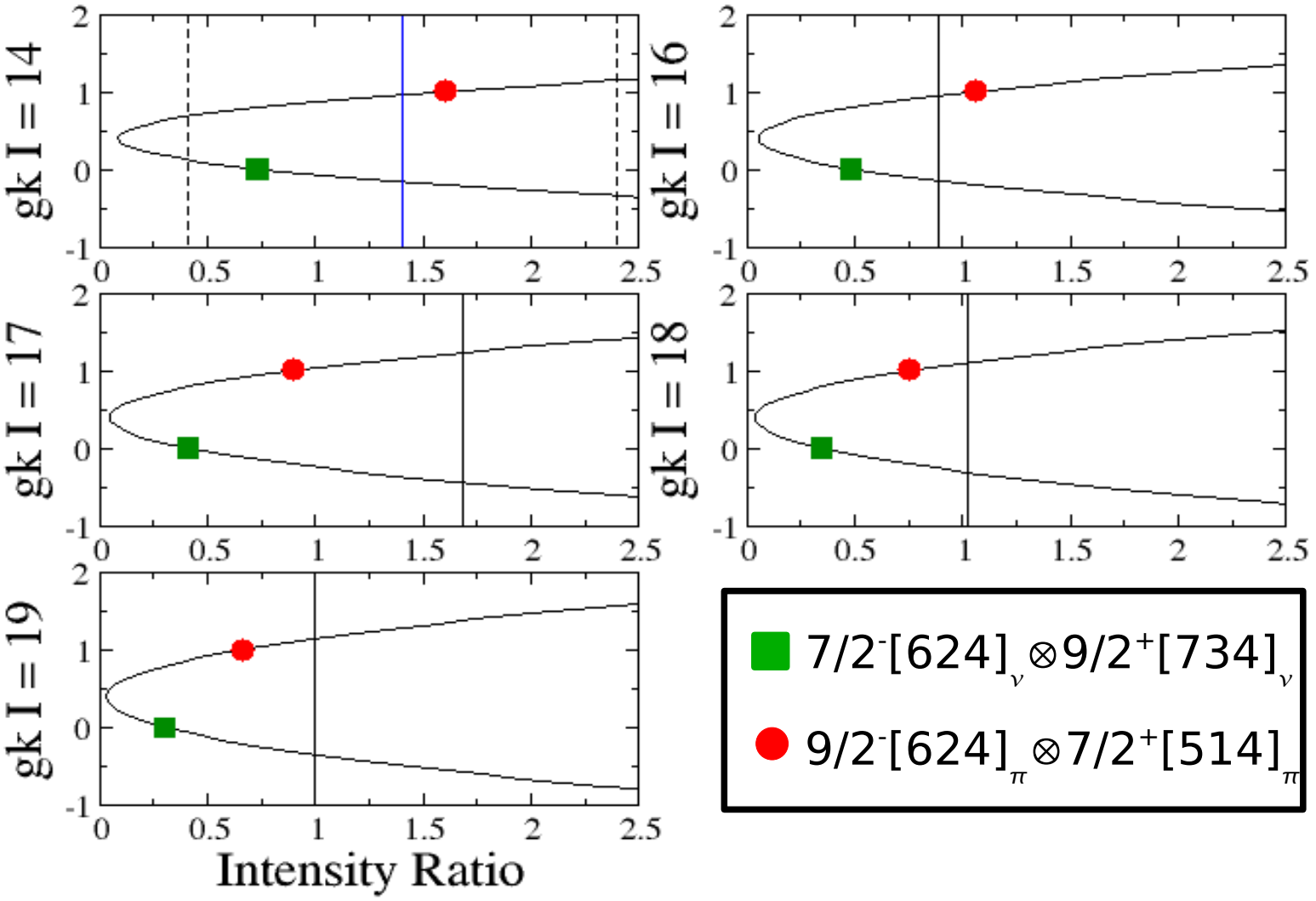

background added
neutron excitation
proton excitation
counts across spectrum
+4
+3
+2
+1
0
-1
-2
-3
-4
10
20
30
40
50
60


20
40
60


0.08
0.06
0.04
0.02
0
proton excitation
neutron excitation
background added
counts across spectra
+4
+3
+2
+1
0
-1
-2
-3
-4
20
40
60
80

Applied to ^{252}No 8^- K-Isomer



- Ratios are inconclusive for structure assignment