Signatures of triaxiality in low-spin spectra of ^{86}Ge

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for the SEASTAR collaboration

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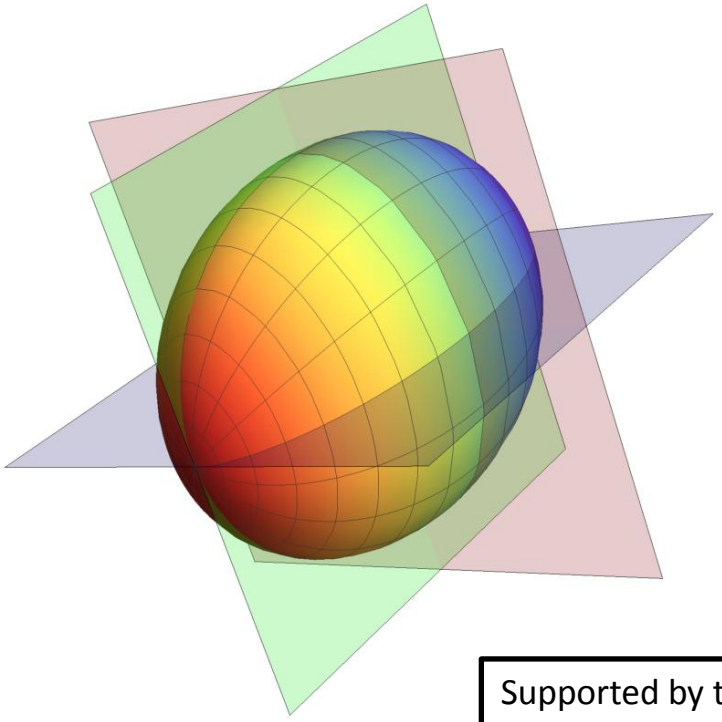

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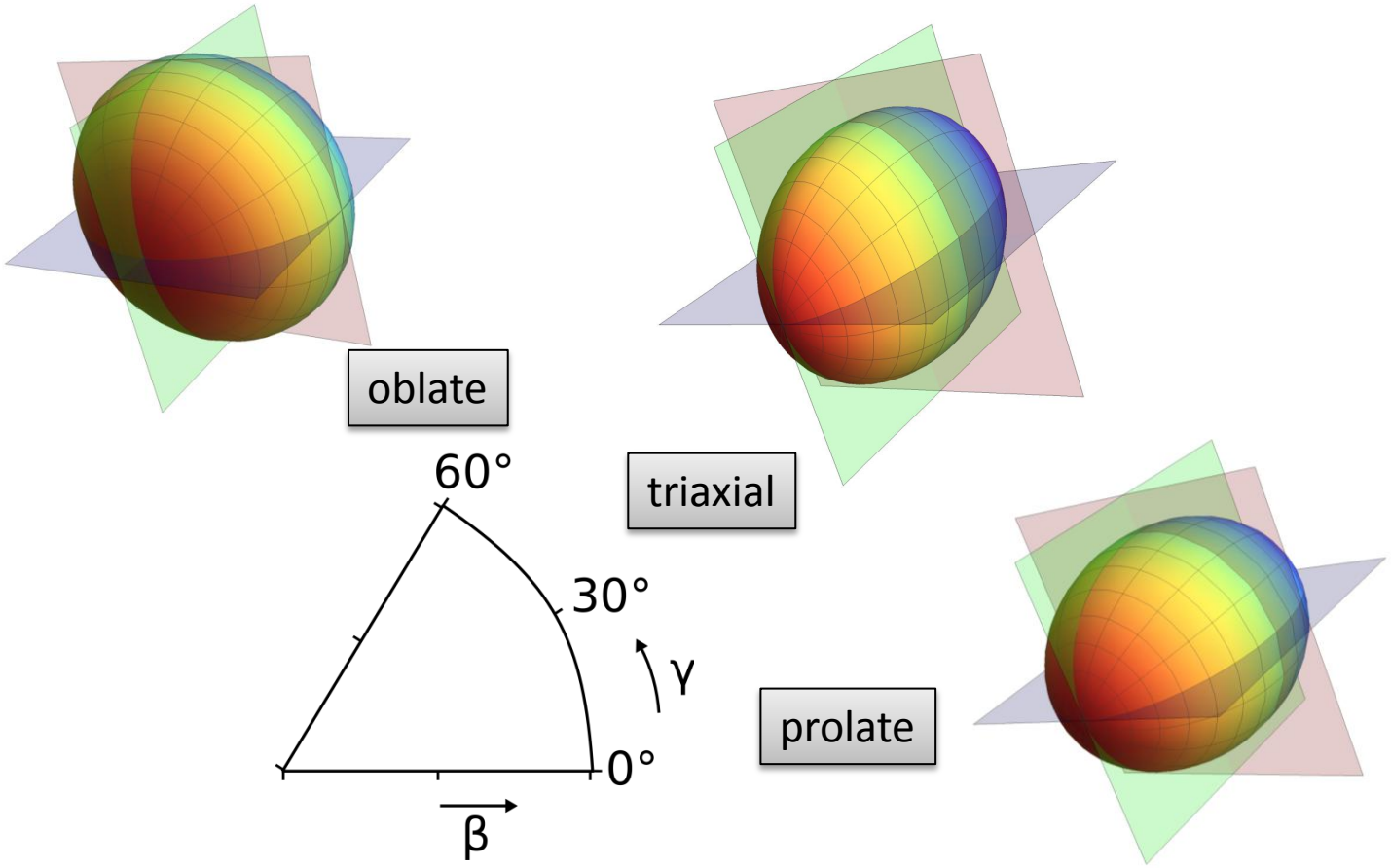
and NuSTAR DA under grant No. 05P12RDFN8

Introduction

Deformation: breaking of the axial symmetry of the Bohr Hamiltonian

Simplest quadrupole deformations in the ground state which can be considered



Introduction

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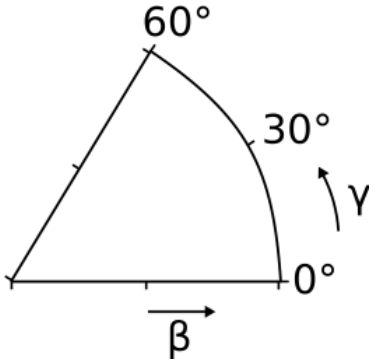
Triaxiality in the ground state is not rare:

- Many ϒ-soft nuclei are known
- A<100: only ^{76}Ge *Y. Toh et al., Phys. Rev. C 87, 041304(R) (2013)*



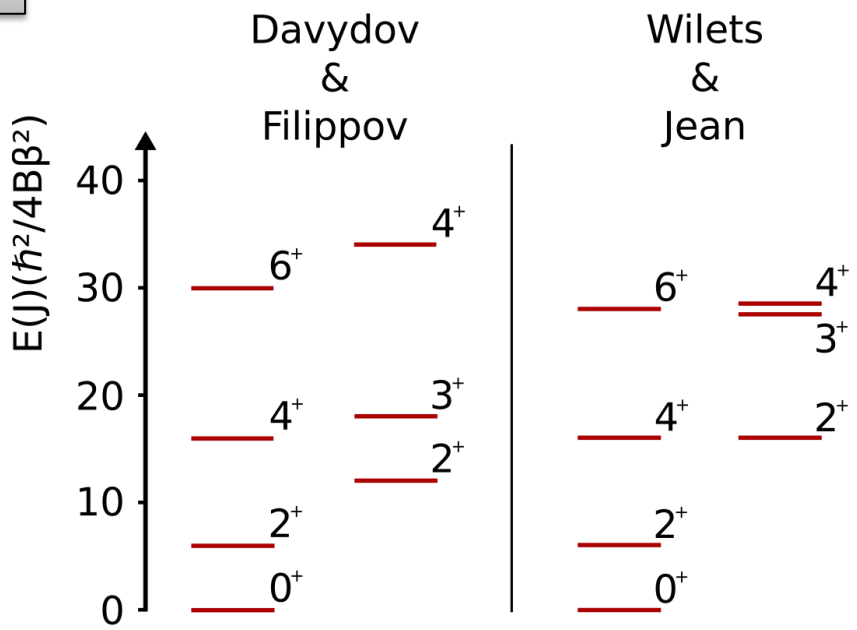
Difference between rigid triaxial and ϒ-soft nuclei

Location of 3^+_1 relative to the 2^+_2 & 4^+_2

- Staggering parameter:

$$S(4) = \frac{[E(4_2^+) - E(3_1^+)] - [E(3_1^+) - E(2_2^+)]}{E(2_1^+)}$$

- Positive for rigid triaxial rotor



N.V. Zamfir and R.F. Casten, Phys. Lett. B 260, 265-270 (1991)

Experimental setup

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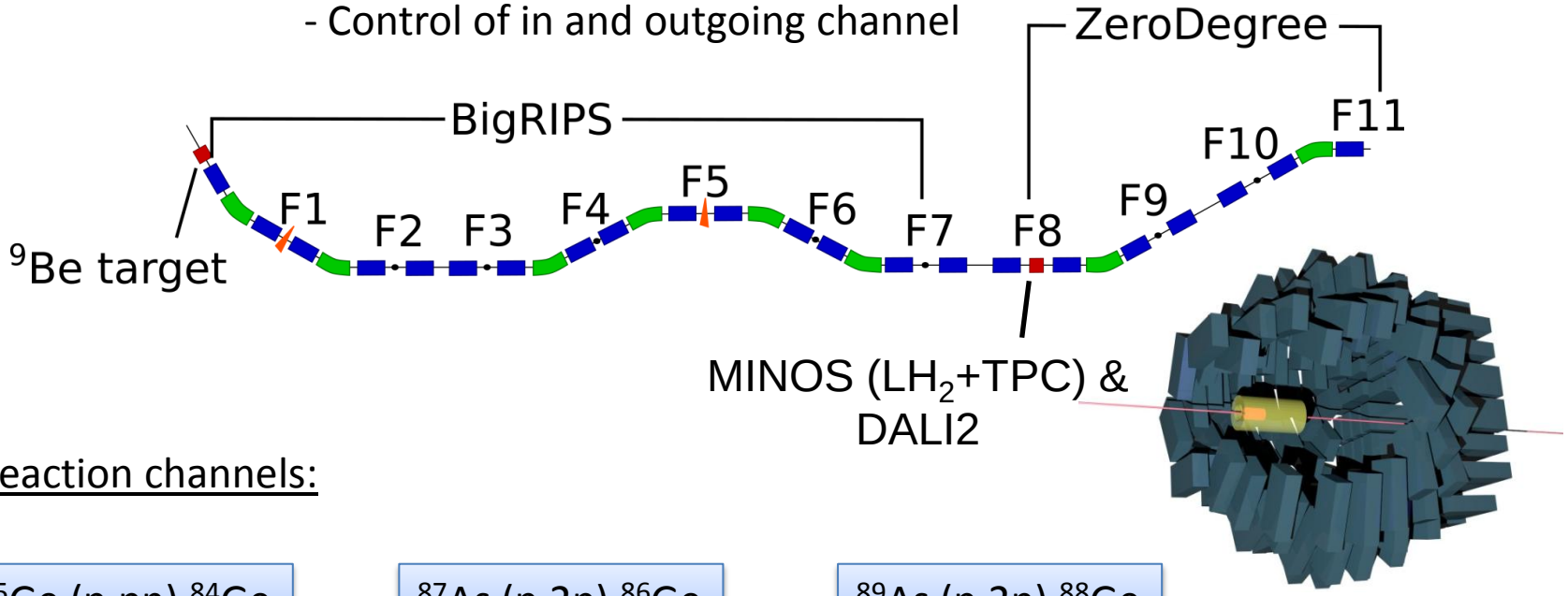
SEASTAR (**S**hell **E**volution **A**nd **S**earch for **T**wo-plus energies **A**t **R**IBF):

In-flight fission of ^{238}U at 345 MeV/u on ^{9}Be

Partical identification: $B\rho - \Delta E - B\rho$ *N. Fukuda et al., NIM B 317, 323-332, (2013)*

- Control of in and outgoing channel



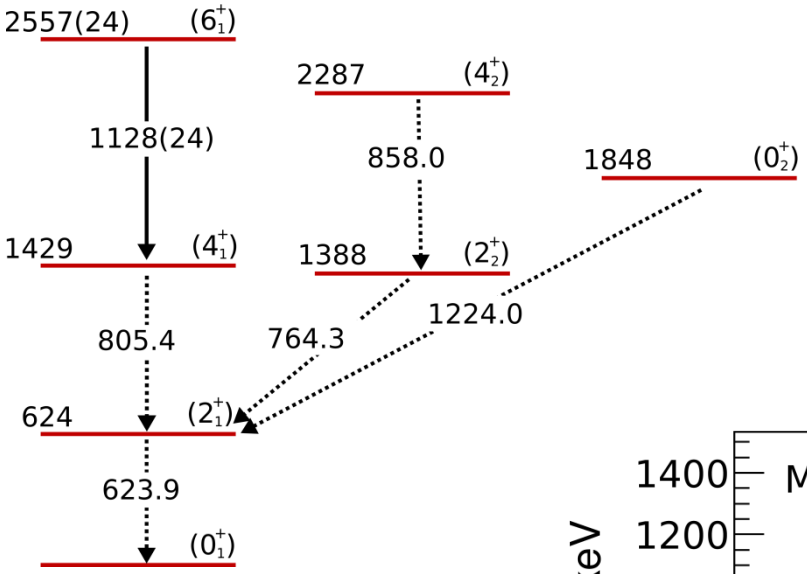
Main reaction channels:

^{85}Ge (p,pn) ^{84}Ge

^{87}As (p,2p) ^{86}Ge

^{89}As (p,2p) ^{88}Ge

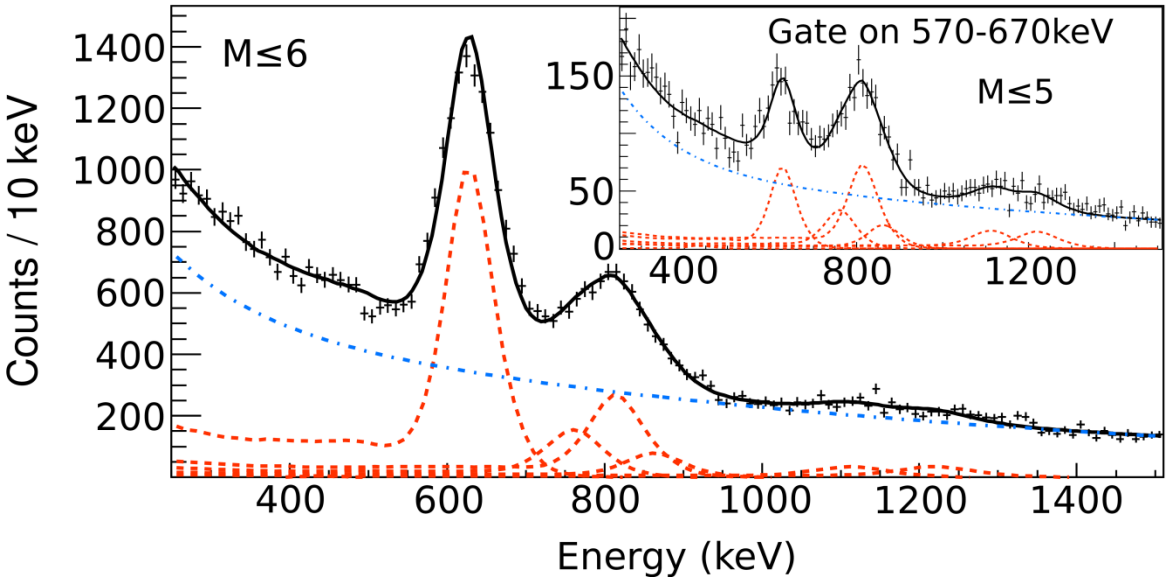
Energy spectrum ^{84}Ge



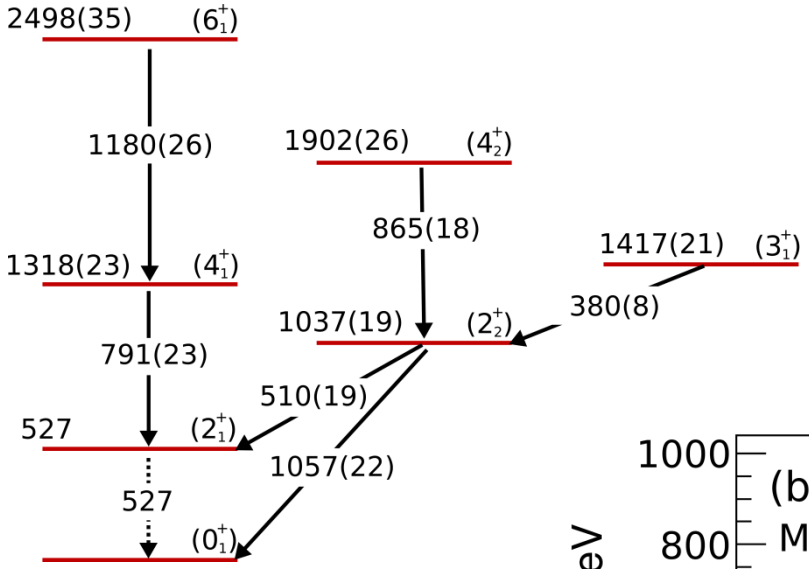
- Most transition energies known β-delayed spectroscopy

A. Korgul et al., Phys. Rev. C 88, 044330 (2013)
J.A. Winger et al., Phys. Rev. C 81, 044303 (2010)
K. Kolos et al., Phys. Rev. C 88, 047301 (2013)

- Serves as test case
- One new transition

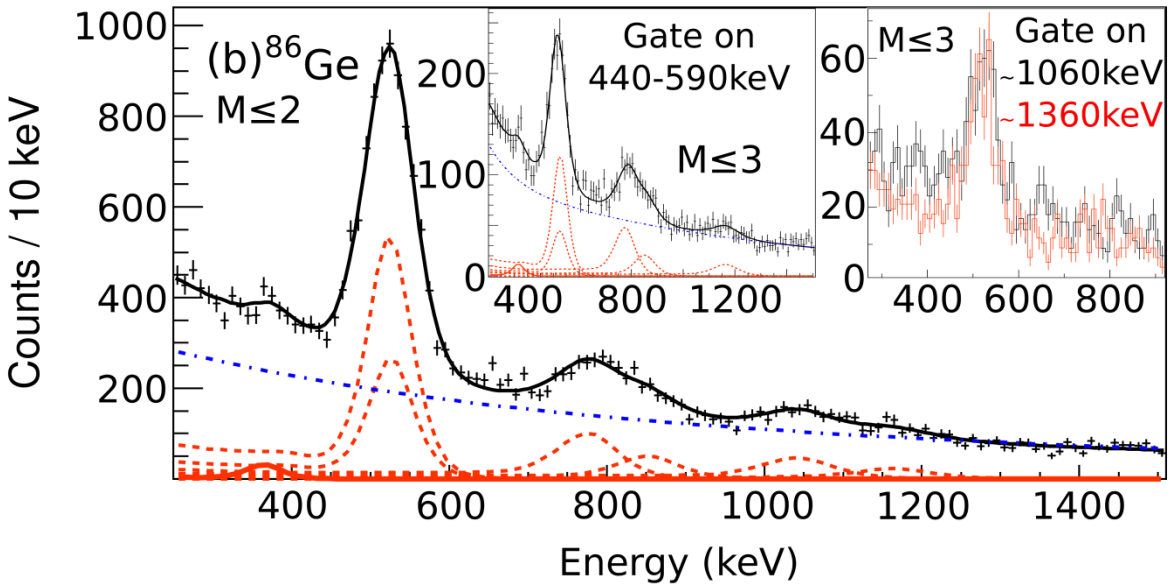


Energy spectrum ^{86}Ge



- 527 known from β-delayed spectroscopy

  K. Miernik et al., Phys. Rev. Lett. 111, 132502 (2013)
- Six new transitions
- Identification of the γ-band head
- Evidence for a γ-ray in coincidence to (2^+_2)



Energy spectrum ^{88}Ge

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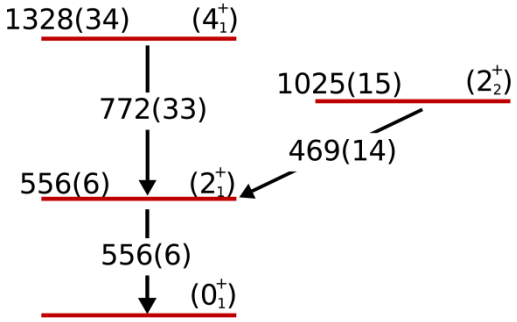
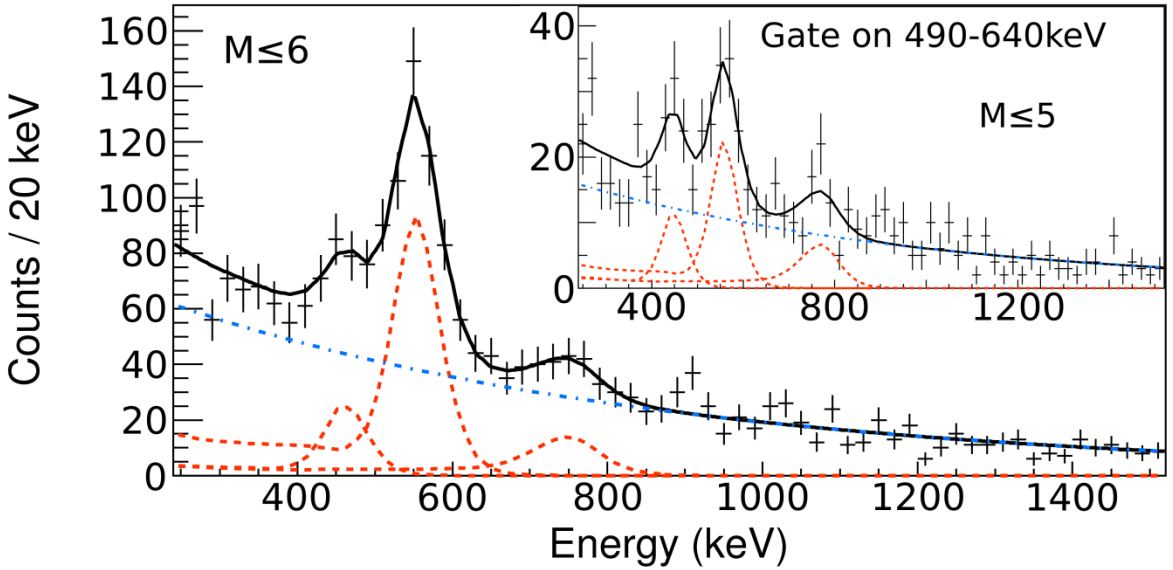
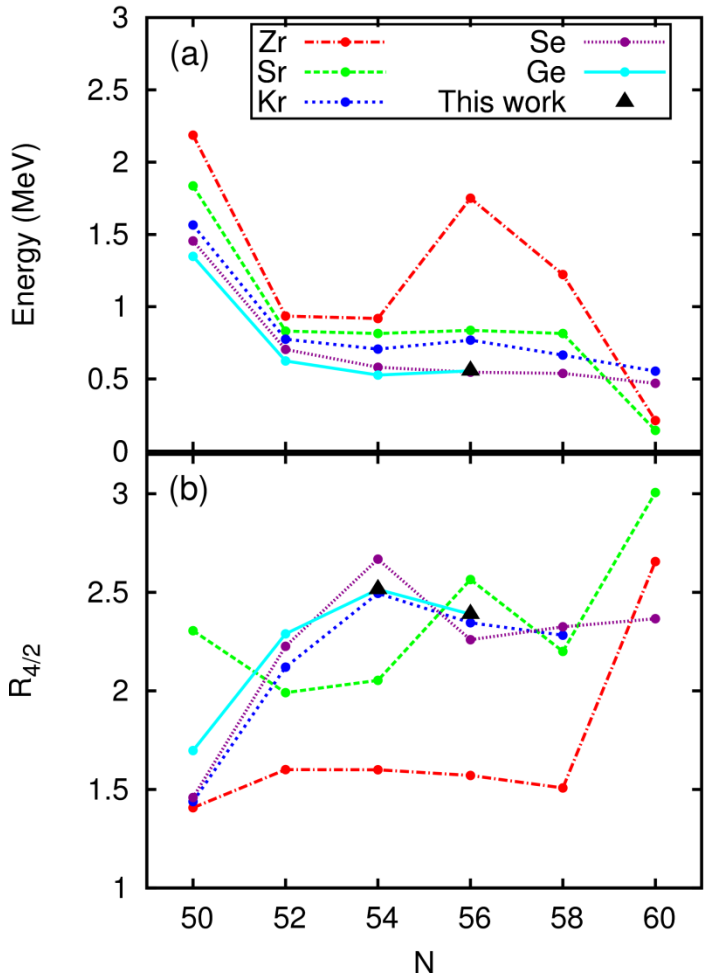
- First ϒ-ray spectroscopy of ^{88}Ge
- All transitions are new
- Clear coincidences to ($2^+_1 \rightarrow 0^+_1$)



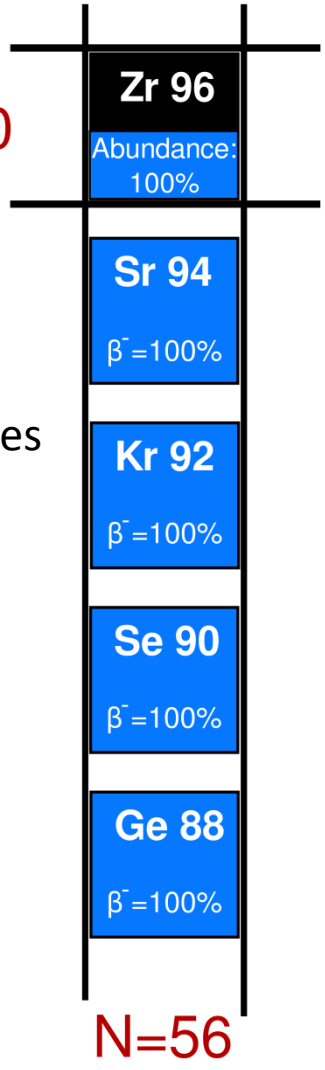


Systematics

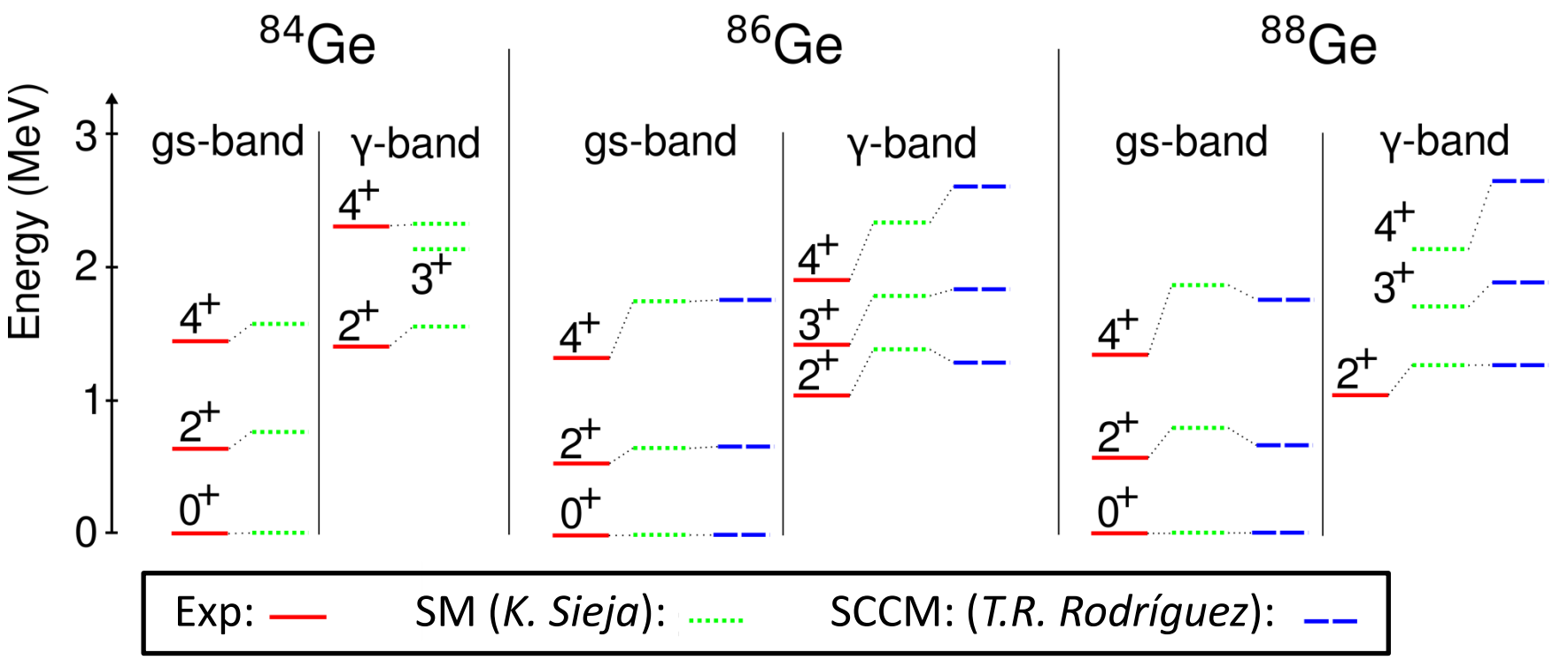


- Flat behavior of $E(2^+_1)$
- Slight increasement towards N=56
- $R_{4/2}$ ≈2.5 "ϒ-soft"; O(6) symmetry
- $R_{4/2}$ trend similar to Kr and Se isotopes
- Maximum of collectivity at N=54

$^{92+94}$Se:
C. Lizarazo – Wed. 10:20



Comparison to theory



K. Sieja et al., Phys. Rev. C 88, 034327 (2013)

- Spin assignment agrees with prediction from theory
- Energies overestimated systematically
- Similar relative energy distances predicted in the ϒ-band

Shape of ^{86}Ge

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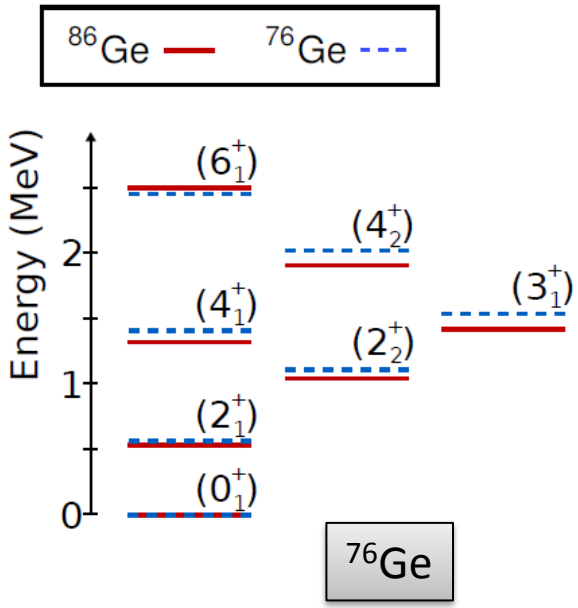
Staggering parameter:

$$S(4) = \frac{[E(4_2^+) - E(3_1^+)] - [E(3_1^+) - E(2_2^+)]}{E(2_1^+)}$$



positive S(4) ⇒ 3^+_1 closer to 2^+_2 ⇒ Triaxial rigidity

N.V. Zamfir and R.F. Casten, Phys. Lett. B 260, 265-270 (1991)

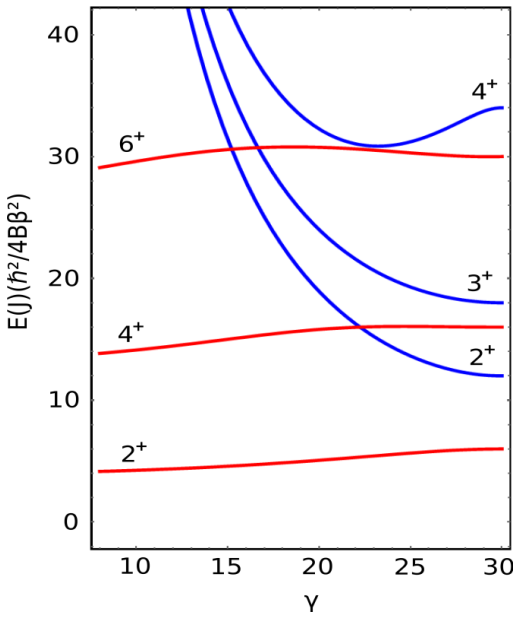
- Low-spin spectra of ^{76}Ge and ^{86}Ge are very similar
- ^{76}Ge known to have triaxial shape
- Triaxial rigidity stronger in ^{86}Ge

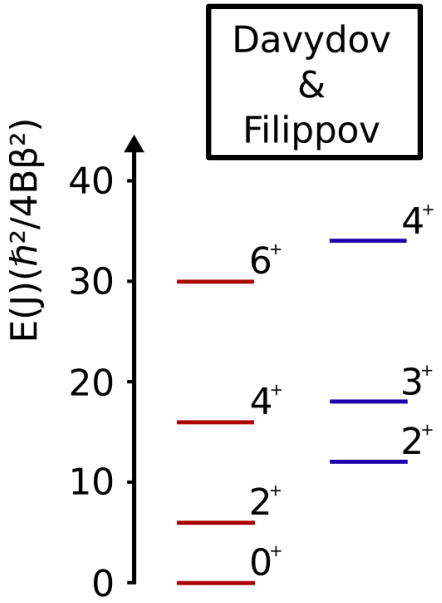
^{76}Ge S(4)=0.091(2)

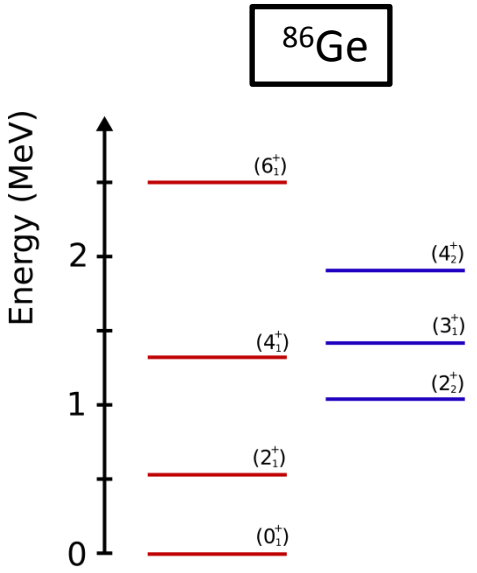
^{86}Ge **S(4)=0.20(9)**

Y. Toh et al., Phys. Rev. C 87, 041304(R) (2013)

Shape of ^{86}Ge

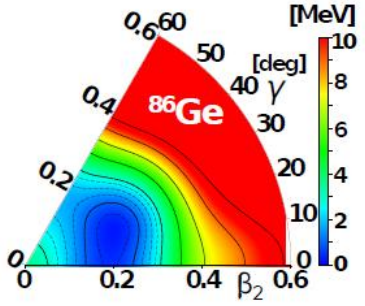






N.V. Zamfir and R.F. Casten, Phys. Lett. B 260, 265-270 (1991)

Position of γ-band head: ⇒ ^{86}Ge ≈30° ⇒ Pronounced triaxiality



Pronounced minimum for ^{86}Ge

Ge isotopes (^{86}Ge especially) are a promising test ground for further studies of triaxial features

Thank you for your attention!

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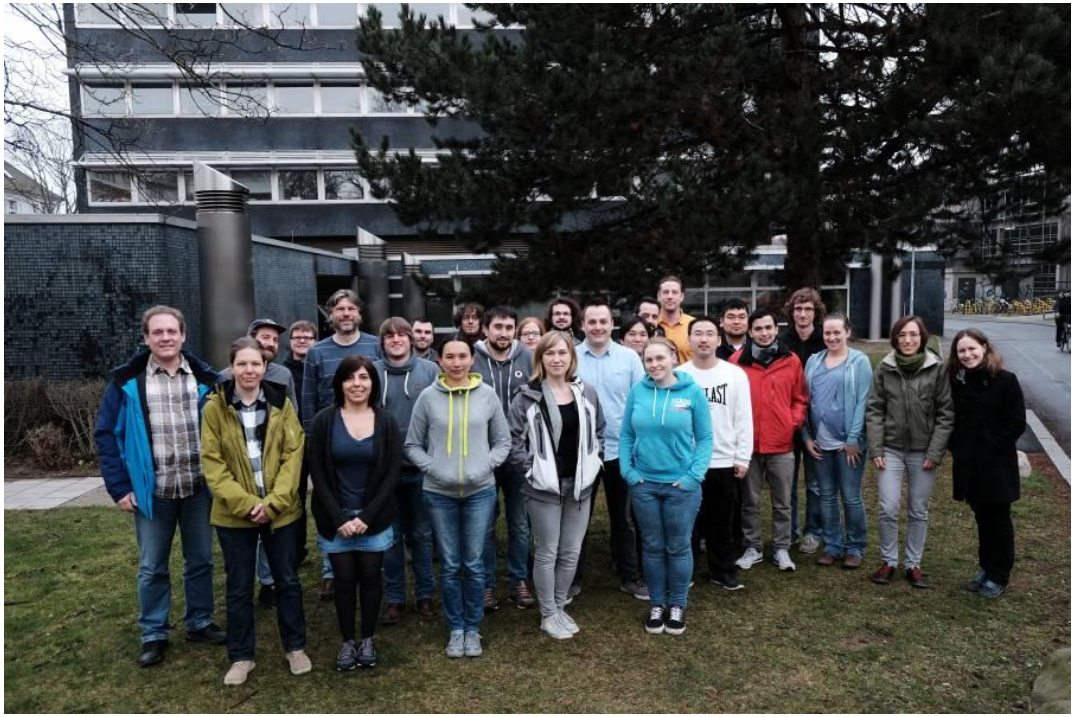

Appendix

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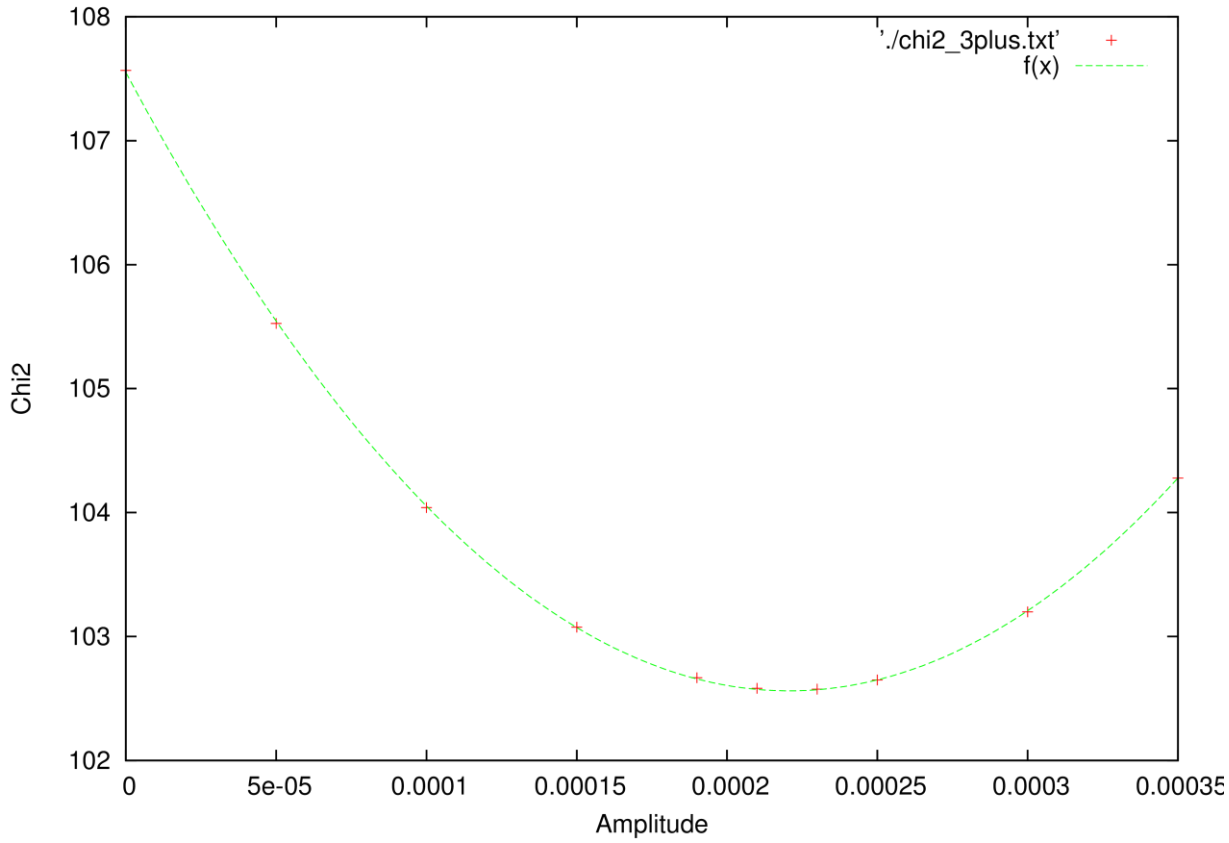
χ2 test:



Appendix

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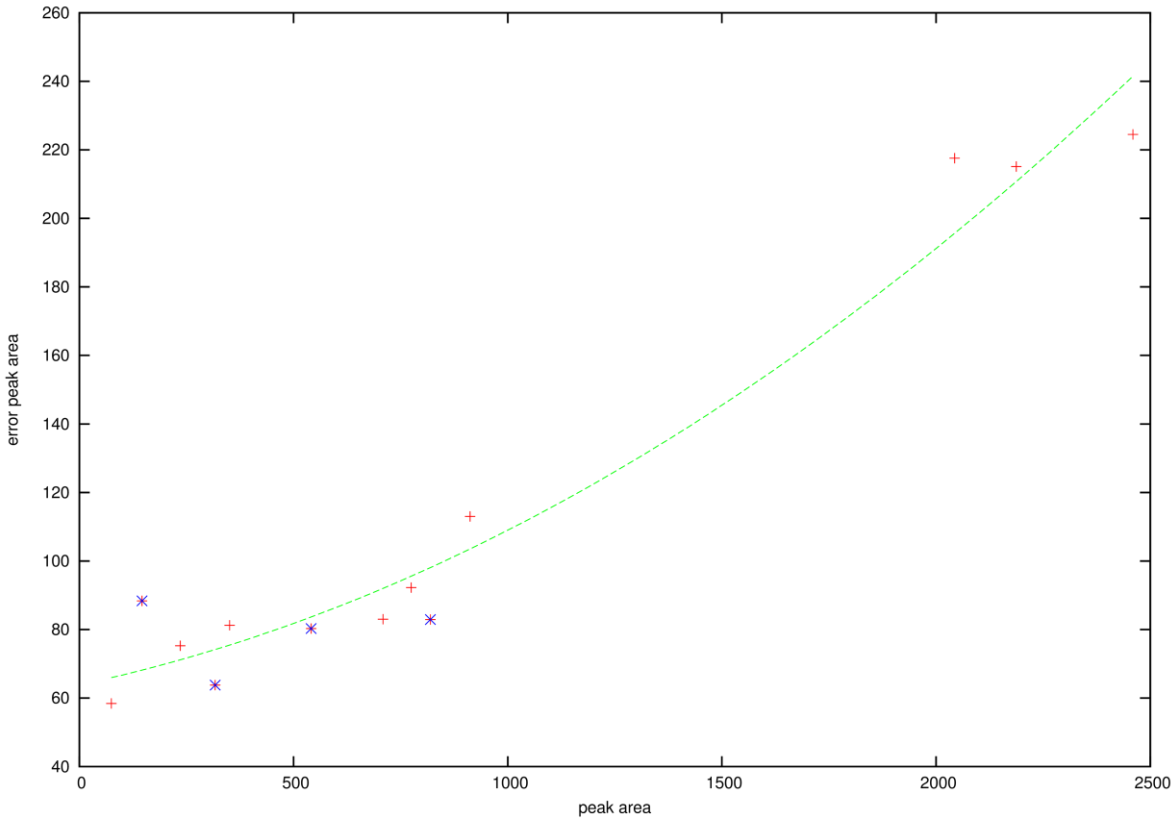
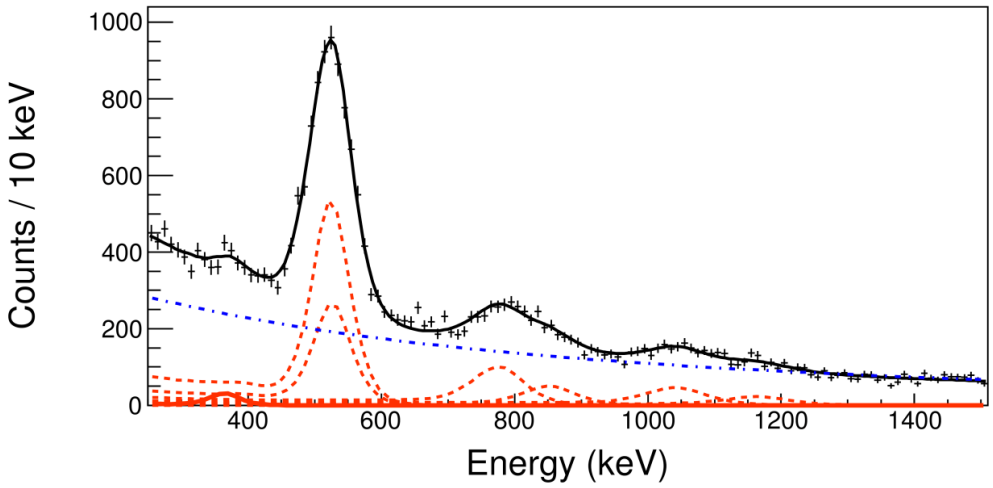
Standard ISO significance test:

Procedure: ΔA vs. A, extrapolate to “0” to obtain the “error of the background (σ)”



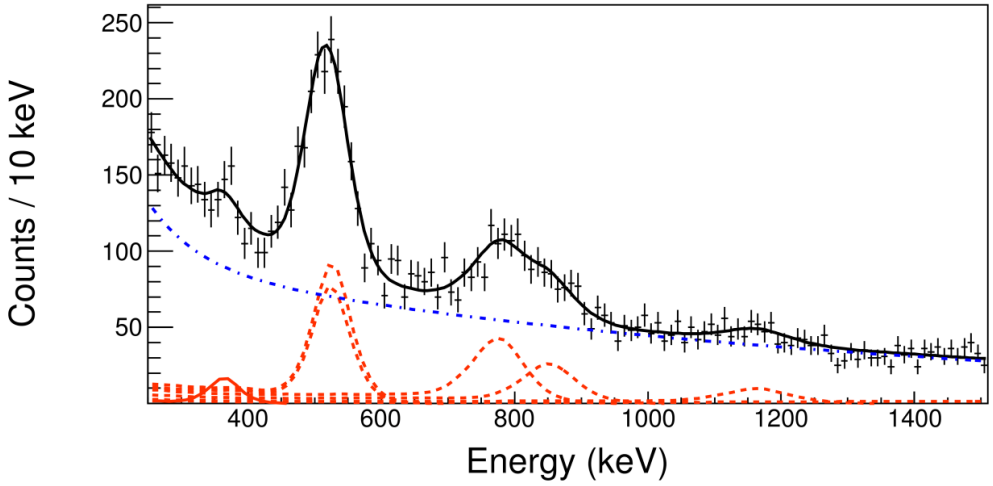
F(0)=64(8)=σ obtained by a conervative fit using a parabola

Appendix



288 Counts

4 σ



158 Counts

2,2 σ