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Deformation in the mid-*fp* shell region: isomer tagging in ^{59}Cr

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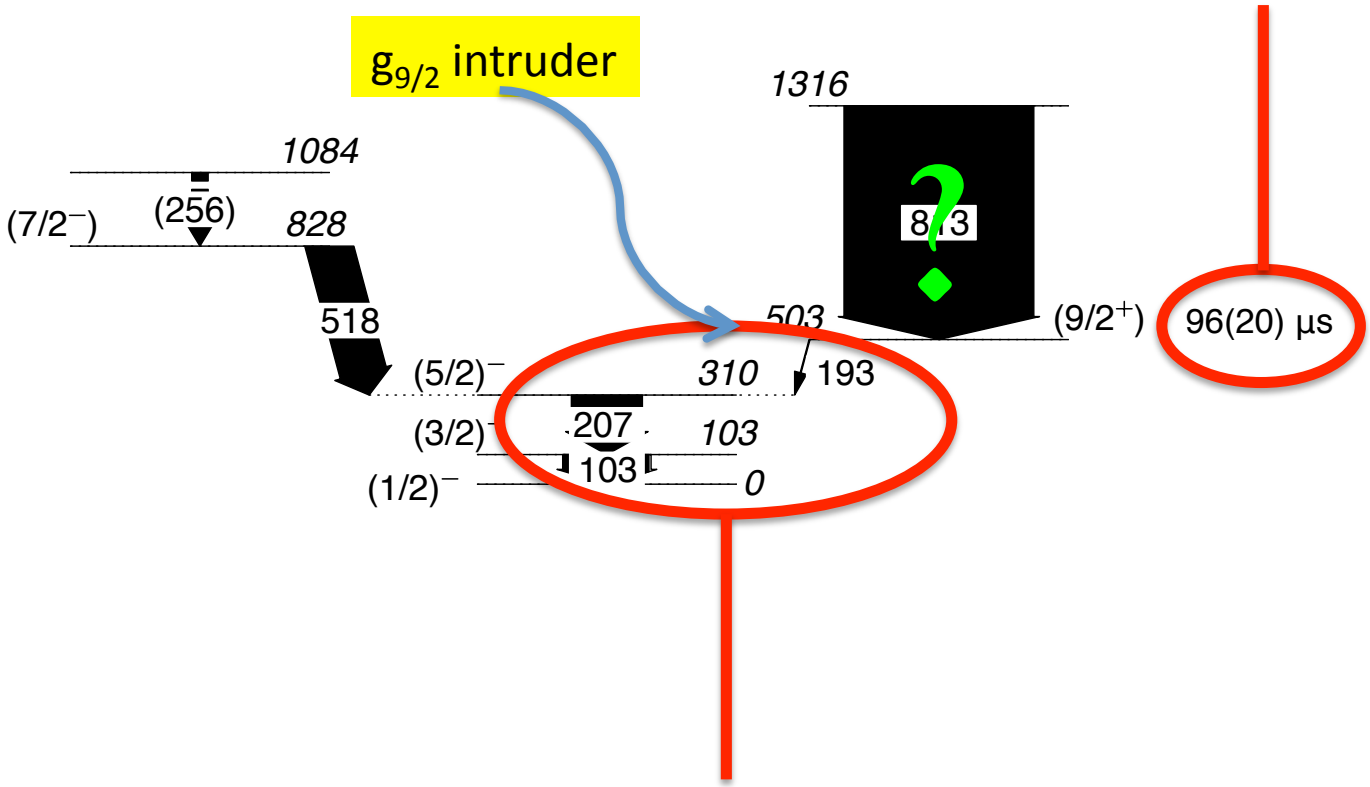
Surrey Isomer Workshop, May 2010

^{59}Cr: the story so far....

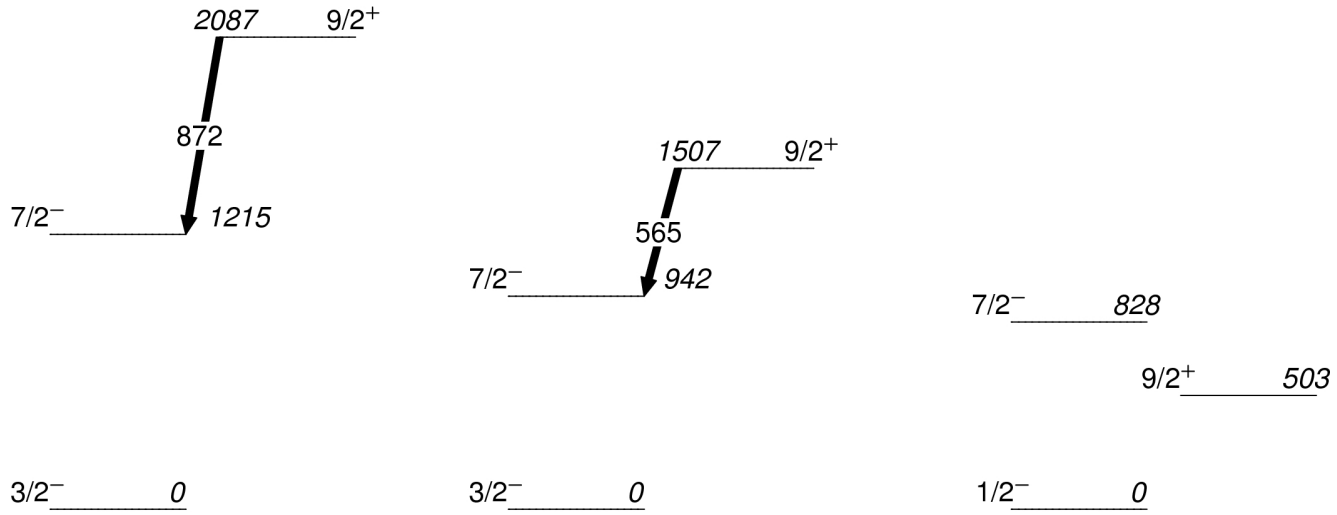
Freeman *et al.*, PRC **69** (2004) 064301.
(fusion-evaporation, Argonne)

Grzywacz *et al.*, PRL **81** (1998) 766.
(projectile fragmentation, GANIL)



Liddick *et al.* PRC **72** (2005) 054321.
(β^- decay, NSCL/MSU)

Diminishing *N*=40 gap

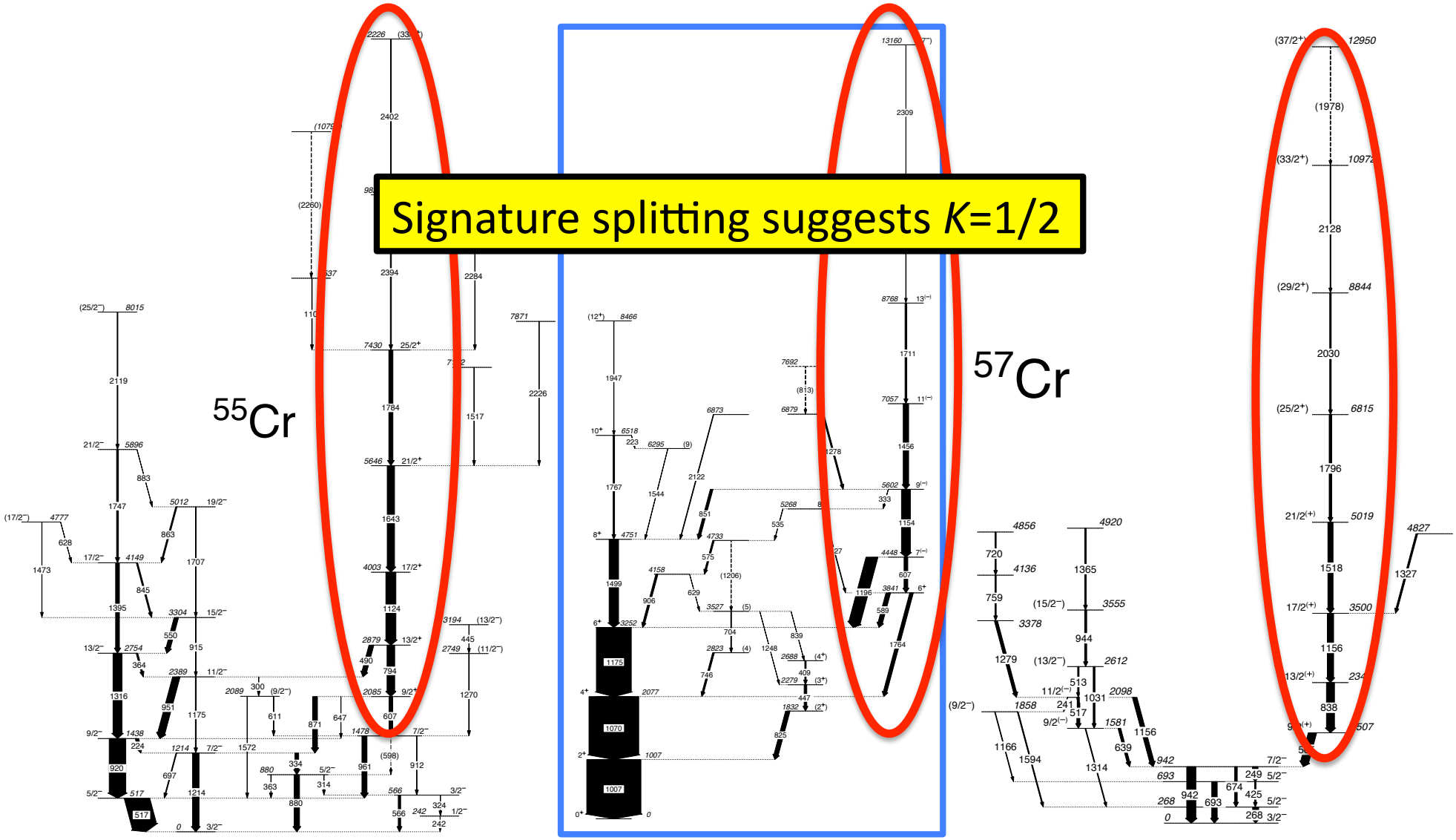


^{55}Cr ^{57}Cr ^{59}Cr

- $g_{9/2}$ falls with increasing *N*
- Falls below $7/2^-$ ➔ no E1 decay route available.

Prolate deformation?

Signature splitting suggests K=1/2

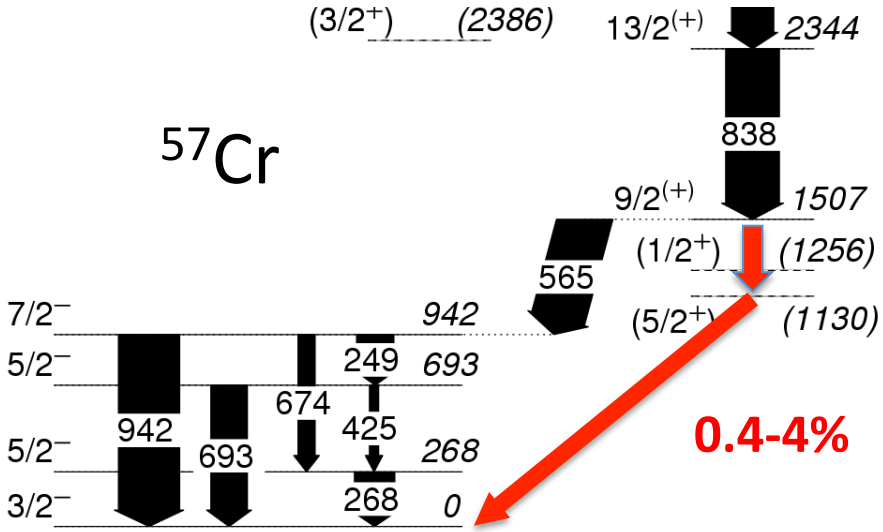


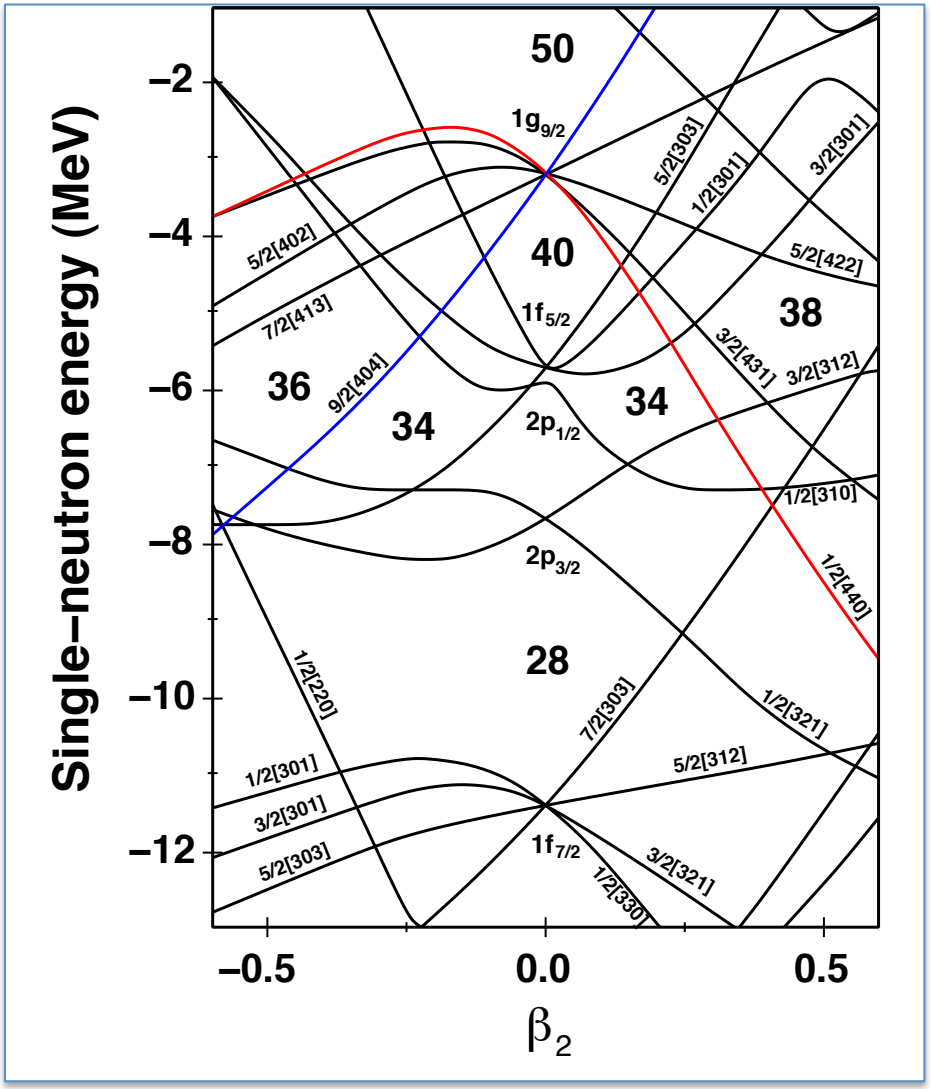
Deacon, *et al.*, in preparation

Zhu, *et al.*,
PRC **74** (2006) 064315

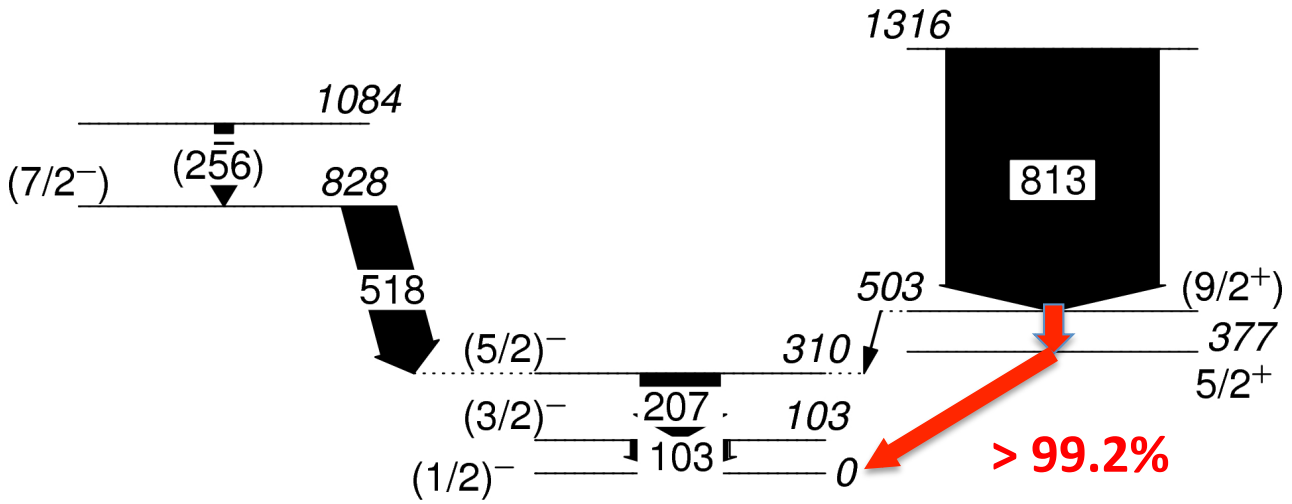
Deacon, *et al.*,
PLB **622** (2005) 151

- Signature splitting indicates ½⁺[440] orbital
- Can calculate energies of $1/2^+$, $5/2^+$ states, and E1/E2 branching ratio



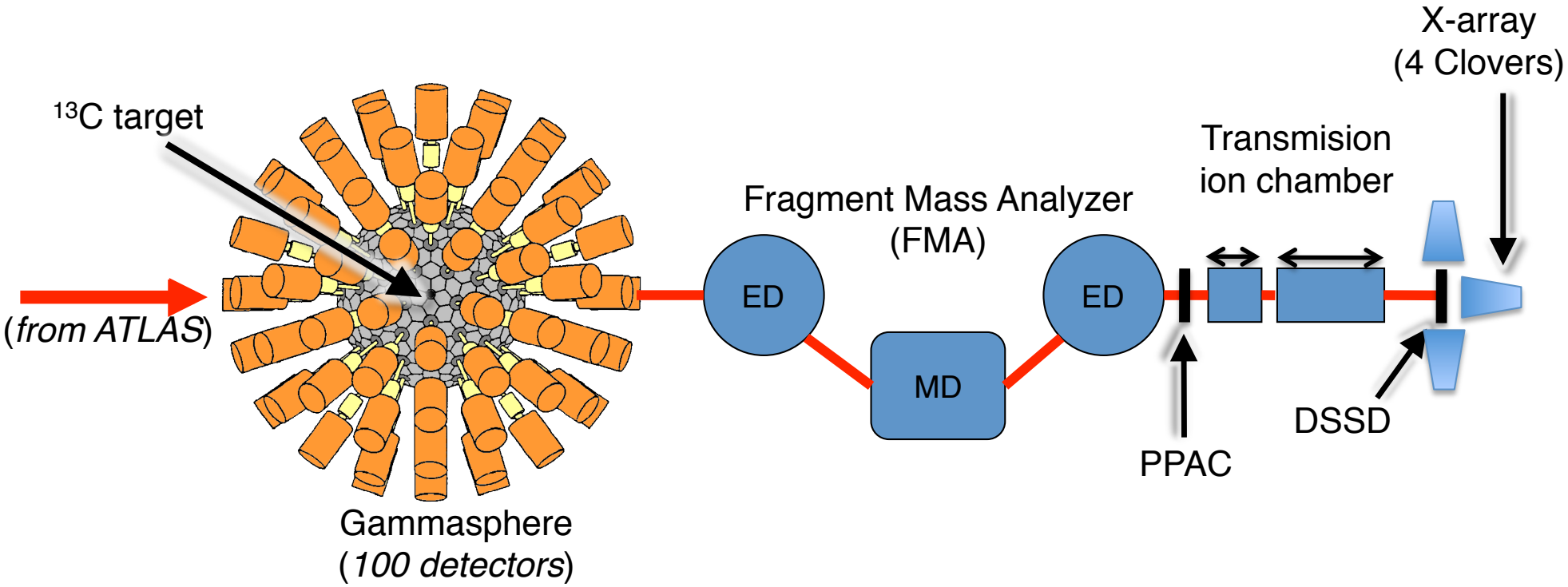


- Same calculation for ^{59}Cr: should see in-band E2 transition



- UNLESS: not 1/2[440] configuration.
- 9/2$^+$ band head implies 9/2[404] with oblate deformation.
- (consistent with low-lying structure)

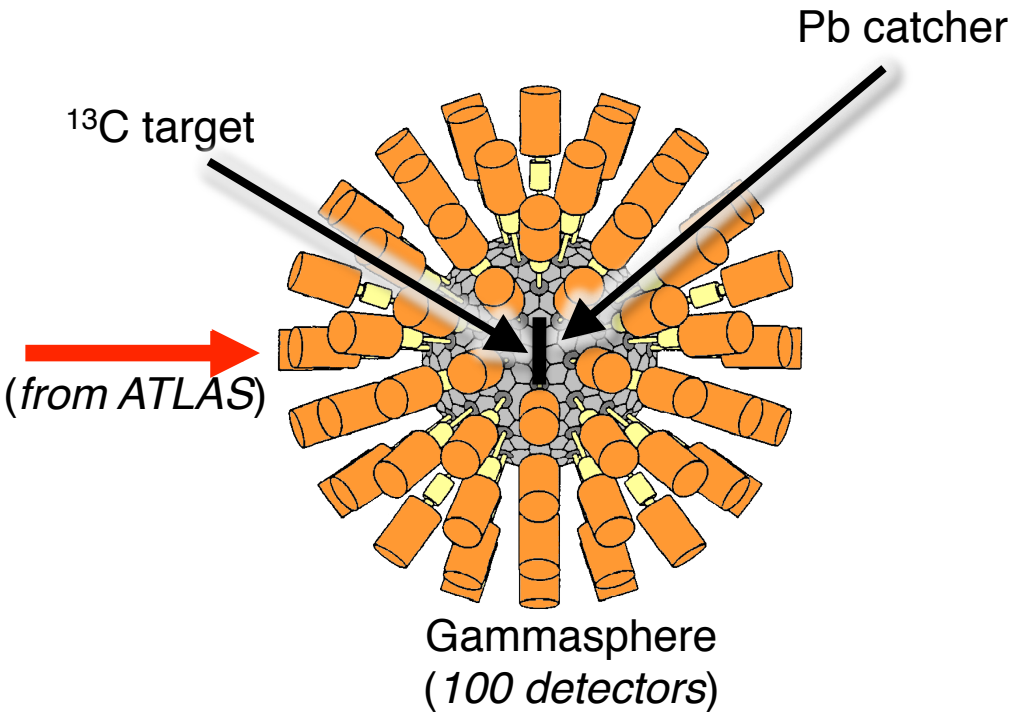
2 methods of isomer tagging:



✓ Very clean gating → A/q, Z, ToF, delayed E_γs

✗ Very low statistics → max. 1 isomer / s

2 methods of isomer tagging:



Beam sweeping:

100 µs ON $(1 \times T_{½})$

200 µs OFF $(2 \times T_{½})$

✓ High statistics (gain factor ≈20 from FMA opening angle)

✗ Contamination from *x*n channels

Progress so far…

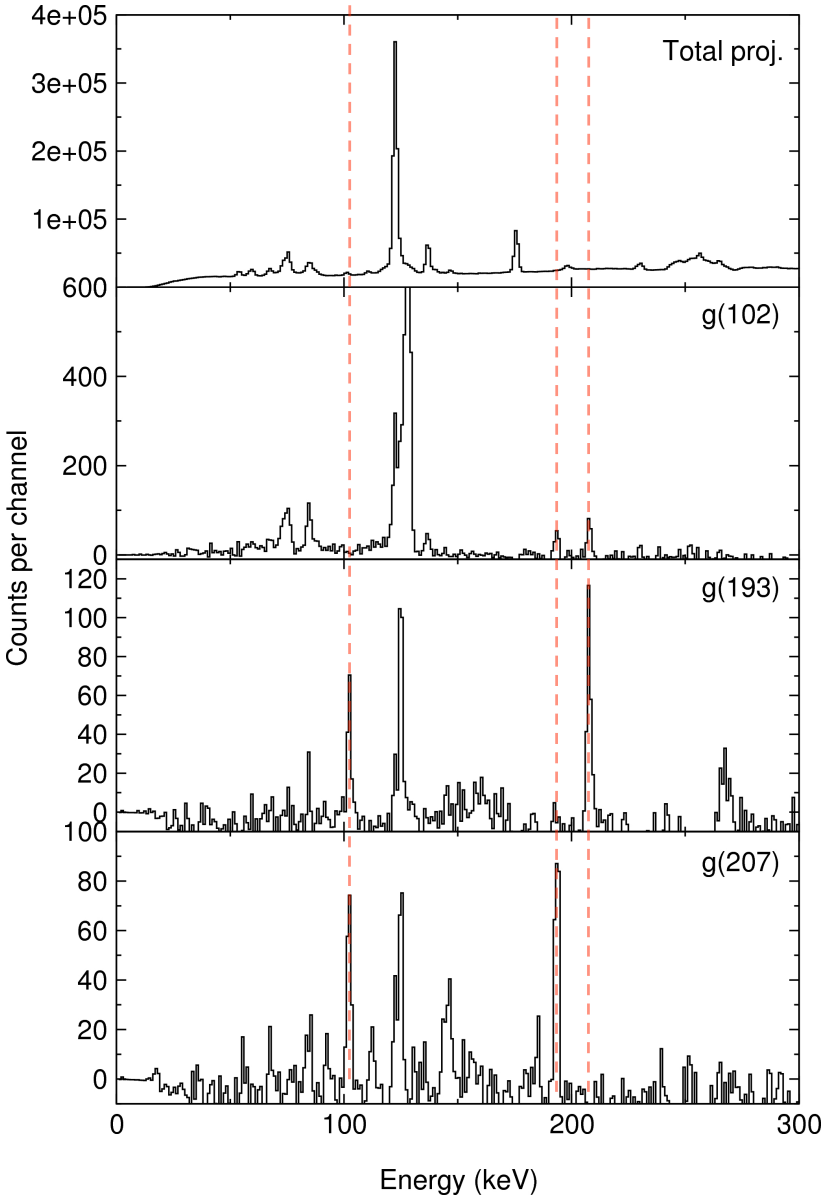
Out-of-beam γγ matrix:

1. Each of 3 delayed transitions "sees" other two

   We made the right stuff!

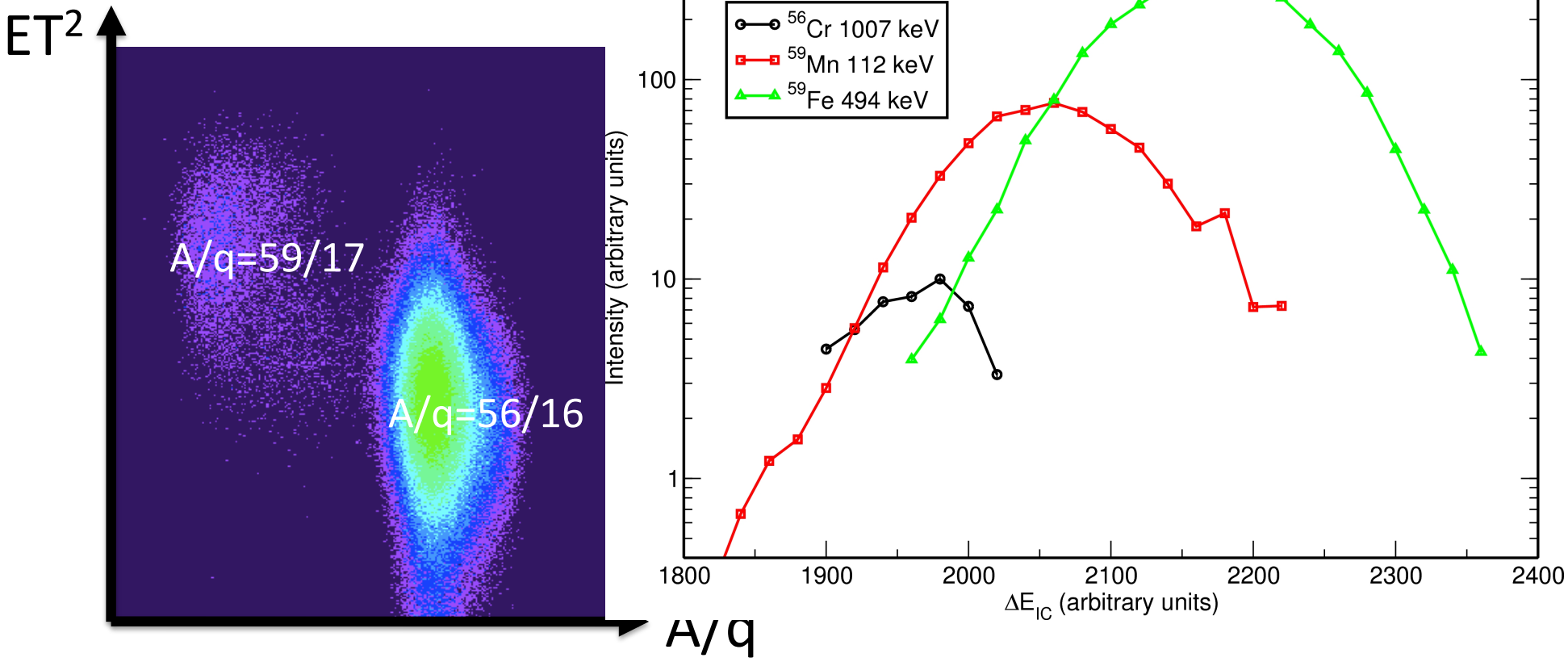
2. Relative intensities can be extracted

Ordering of 102/207-keV transitions should be reversed (consistent with β-decay paper Liddick *et al.* PRC **72** (2005) 054321.)

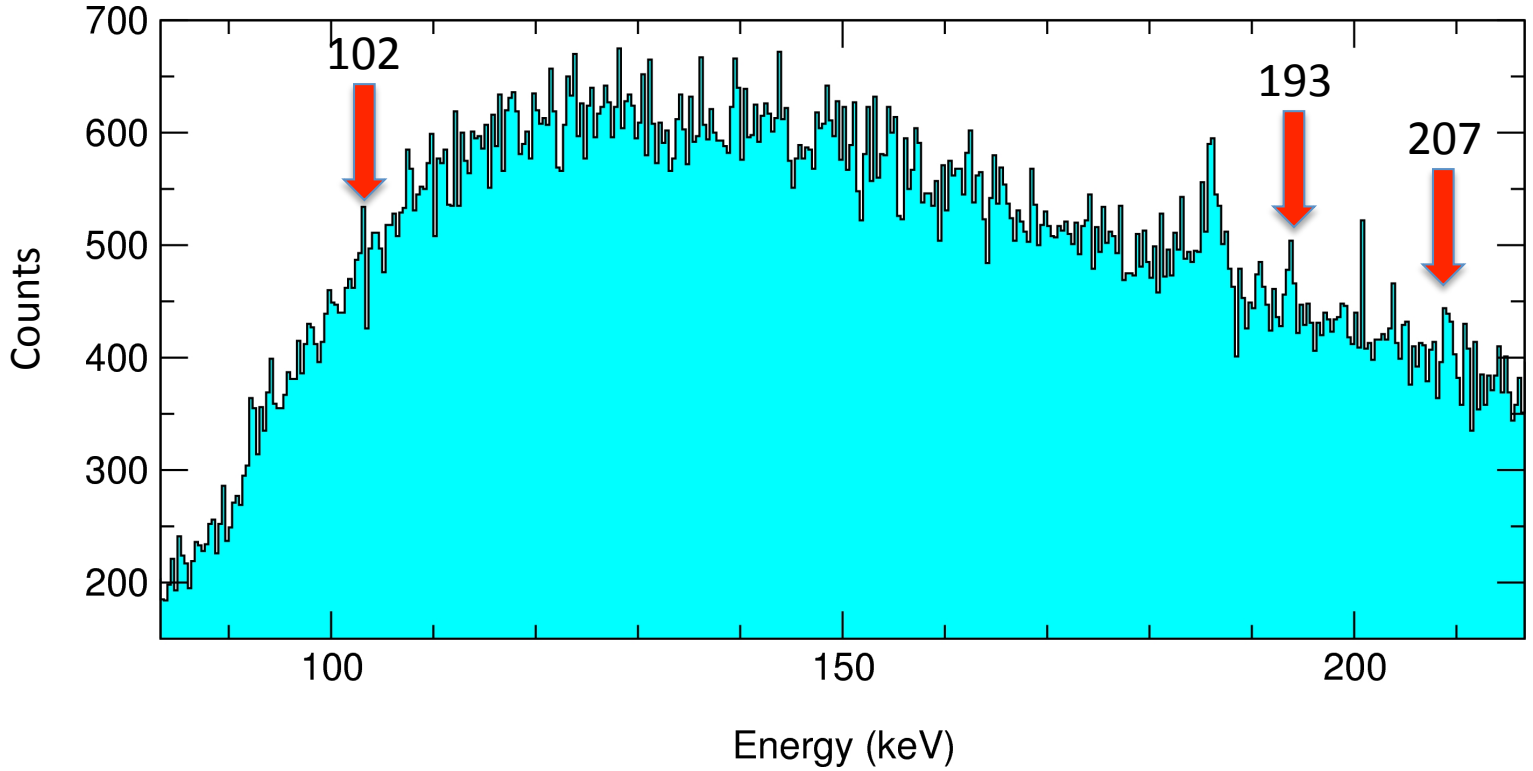


GS+FMA+IC+DSSD+Clovers

- Have mass resolution (ET^2 vs A/q)
- Have some Z dispersion (ΔE)



- Using A=59, Z=24 gates…
- Possible signs of delayed transitions in Clovers



- Have issues with background (β-delayed γ rays)
- Time gates?
- Low stats

Much more still to do….

- FMA/Clovers data:
  - Optimise time/recoil gates
  - Balance between statistics and cleanliness
- Swept-beam data:
  - Coincidence cubes

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