Electron Spectroscopy at the Limit

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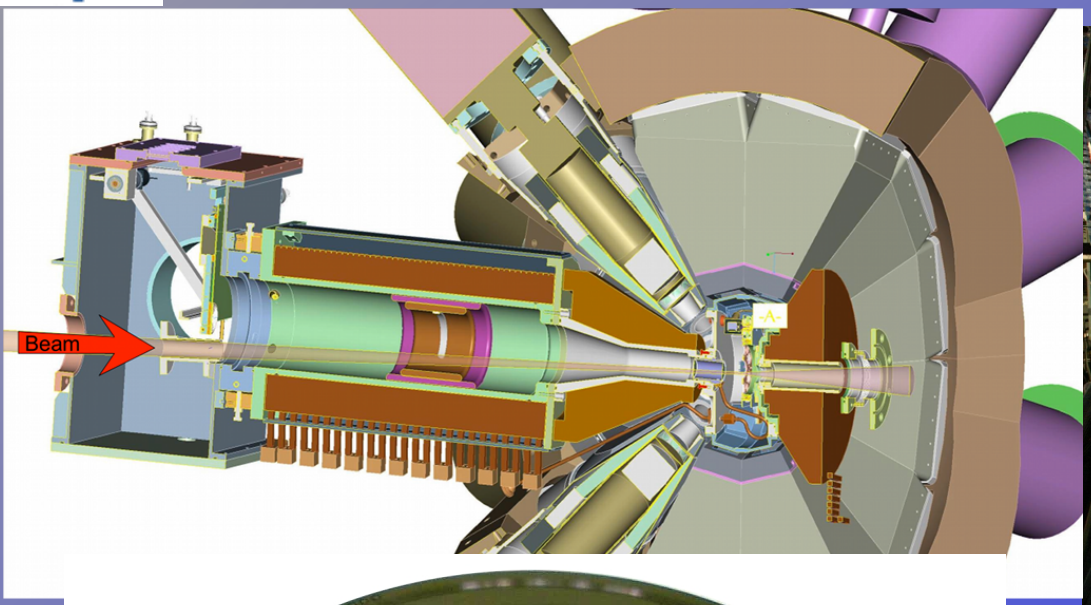
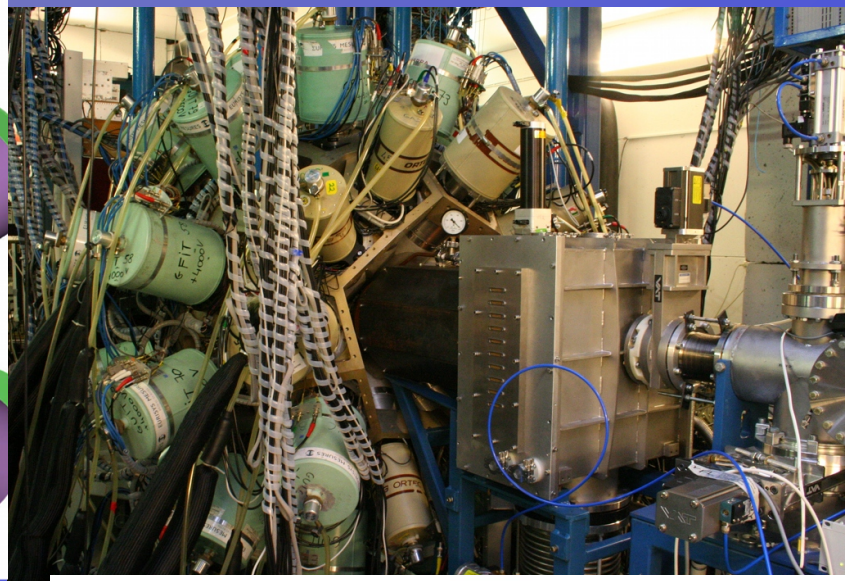
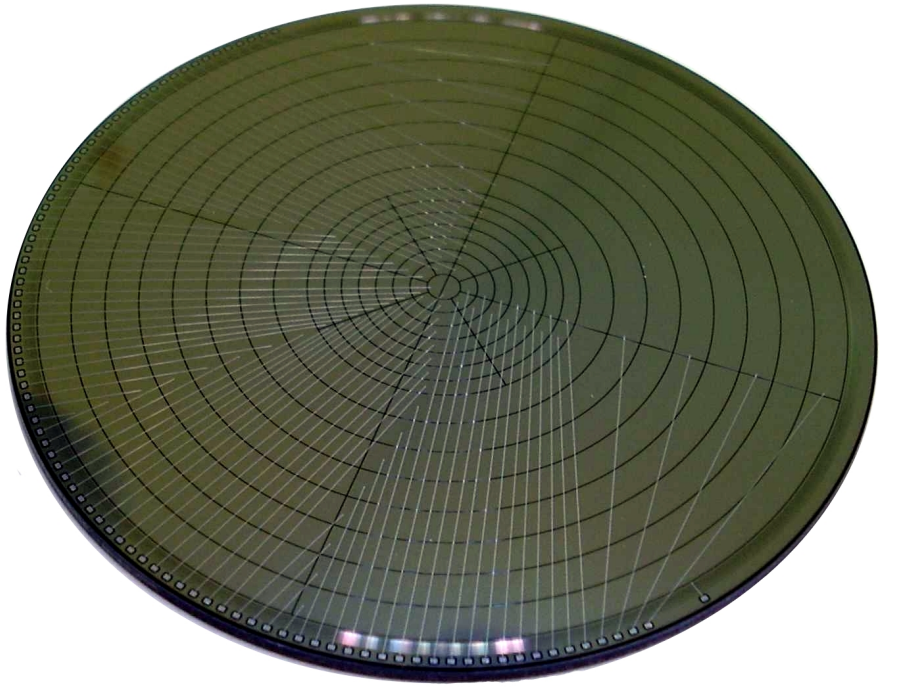
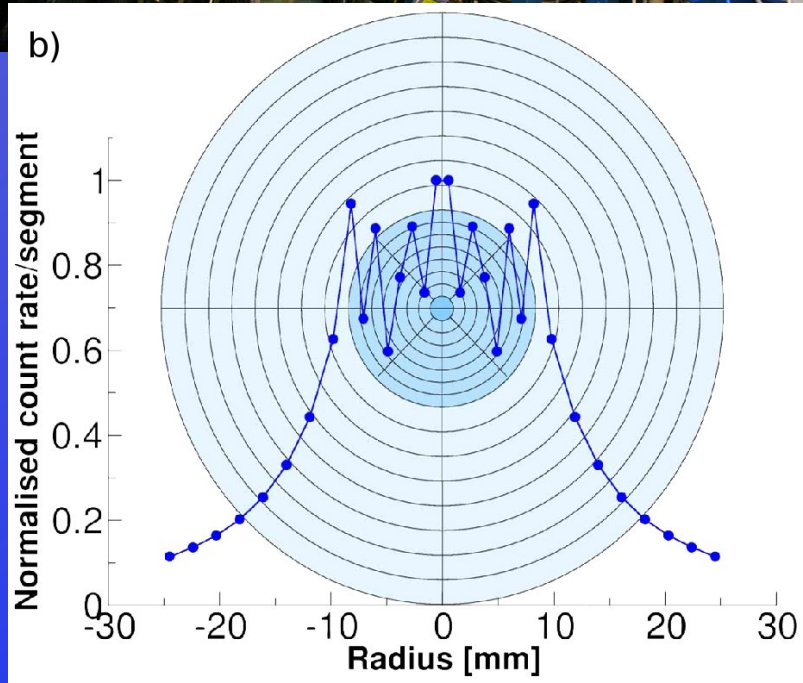
EGAN, Orsay 25-27 June 2012

Conversion Electron Detection

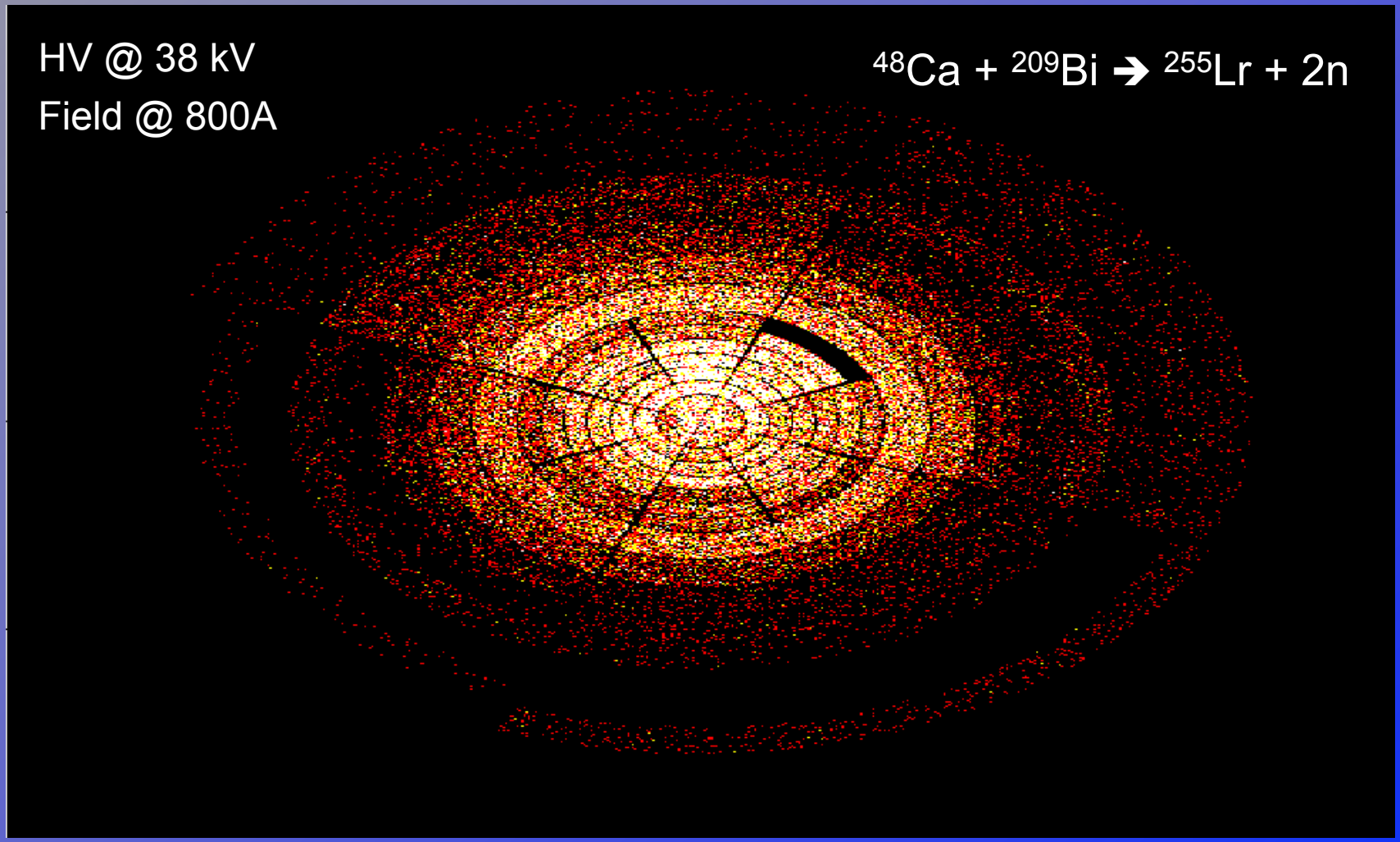






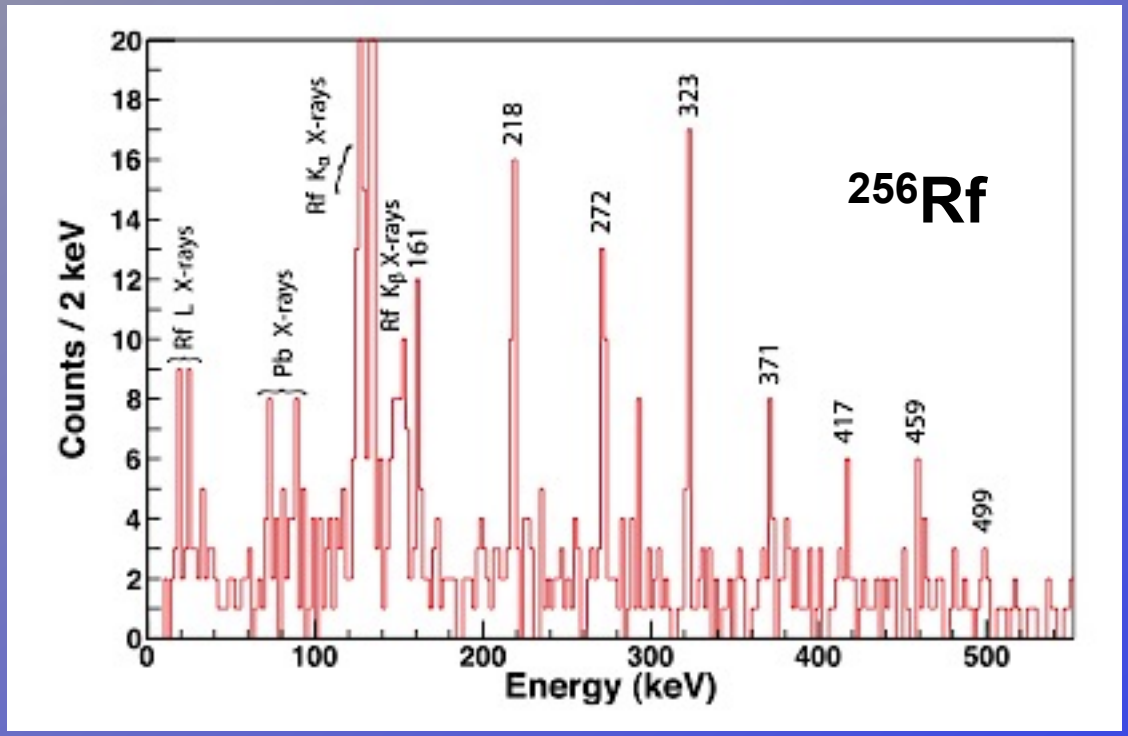


Conversion Electron Distribution

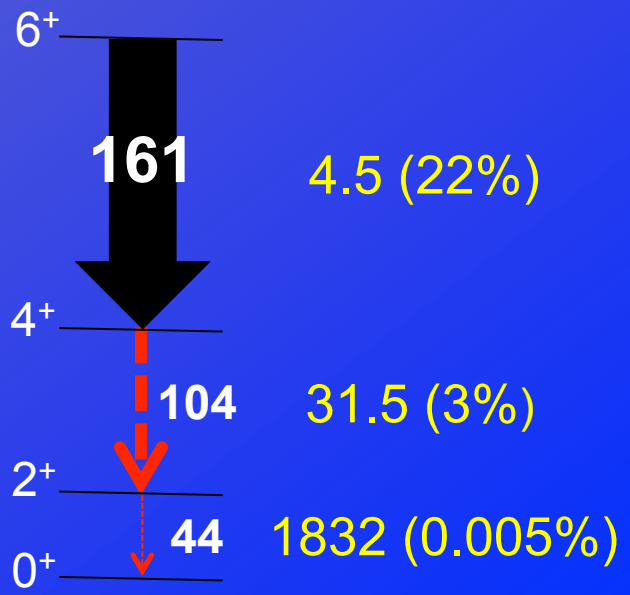


Central pixels are more exposed than outer ones, typical count rates are 25-35 kHz per pixel/ch

Why do we need it?

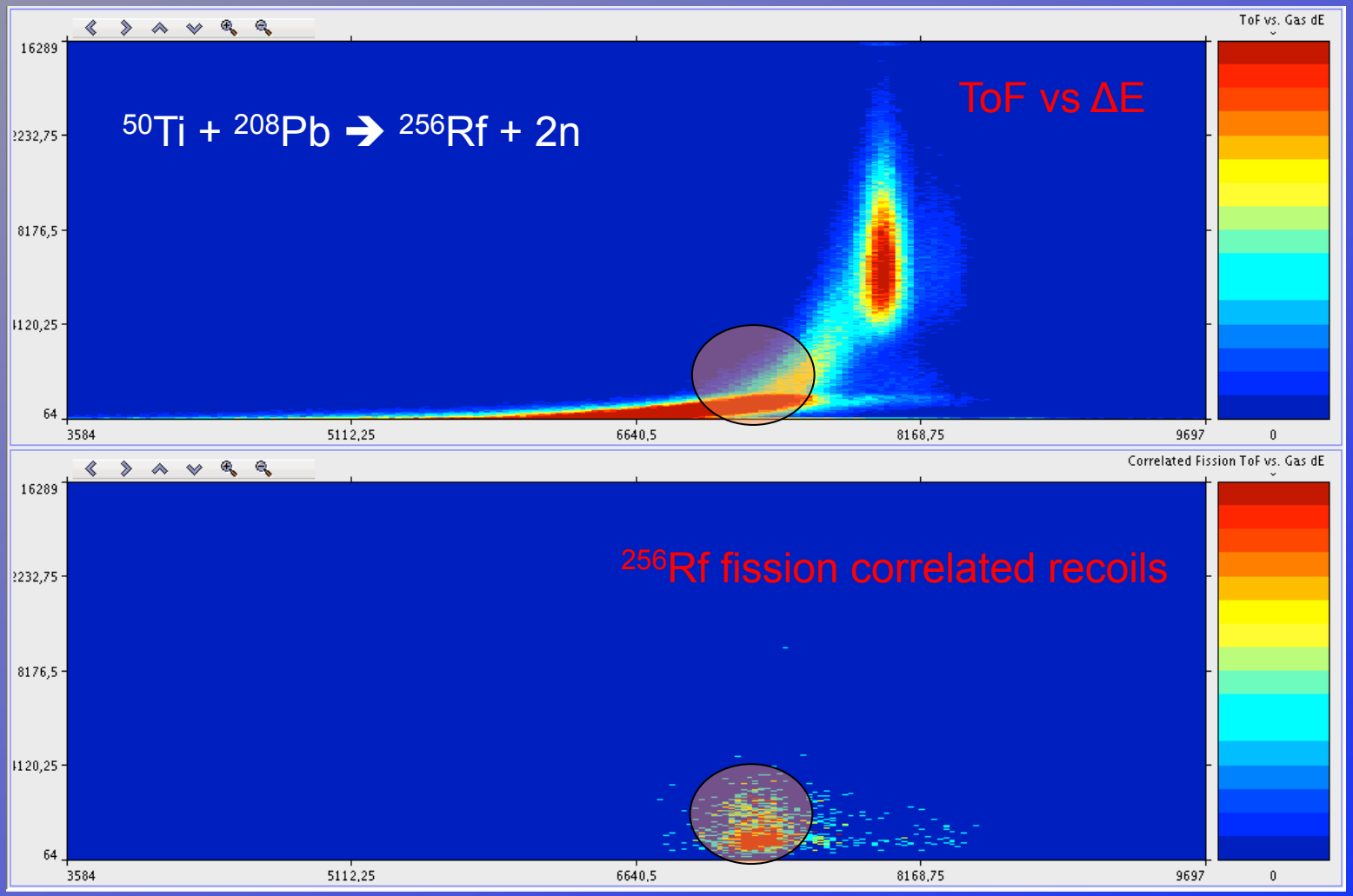


Eγ (keV)	Transition assignment	Relative intensity (%)
44±1	$(2^+ \rightarrow 0^+)$	
104±1	$(4^+ \rightarrow 2^+)$	
161±1	$(6^+ \rightarrow 4^+)$	100 ± 30
218±1	$(8^+ \rightarrow 6^+)$	80 ± 20
272±1	$(10^+ \rightarrow 8^+)$	53 ± 12
323±1	$(12^+ \rightarrow 10^+)$	49 ± 11
371±1	$(14^+ \rightarrow 12^+)$	22 ± 8
417±2	$(16^+ \rightarrow 14^+)$	20 ± 7
459±2	$(18^+ \rightarrow 16^+)$	18 ± 7
499±2	$(20^+ \rightarrow 18^+)$	16 ± 7



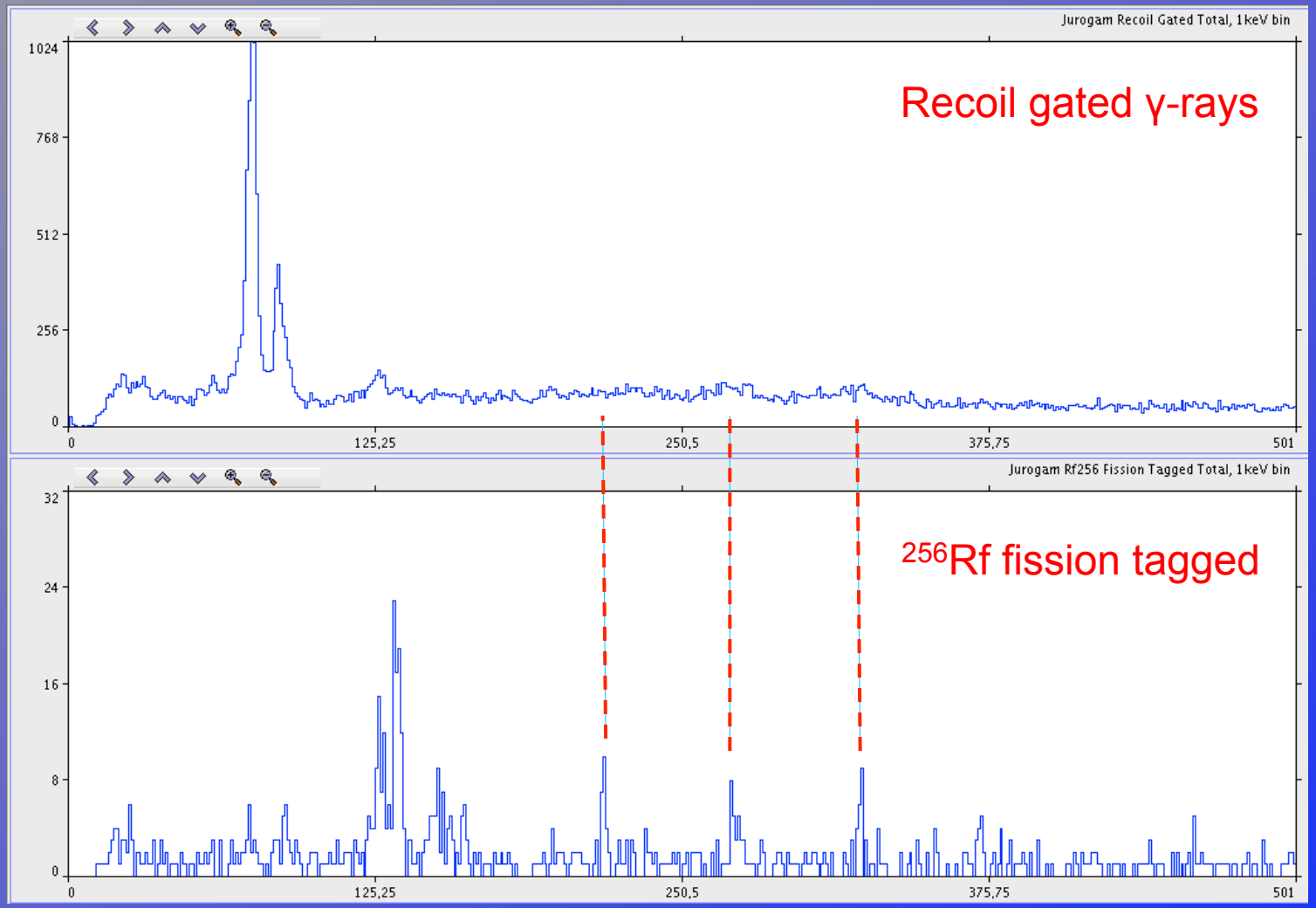
$$\alpha \propto \frac{Z^3}{E^*} \qquad \alpha = \frac{N_e}{N_\gamma}$$

Identification of Recoils



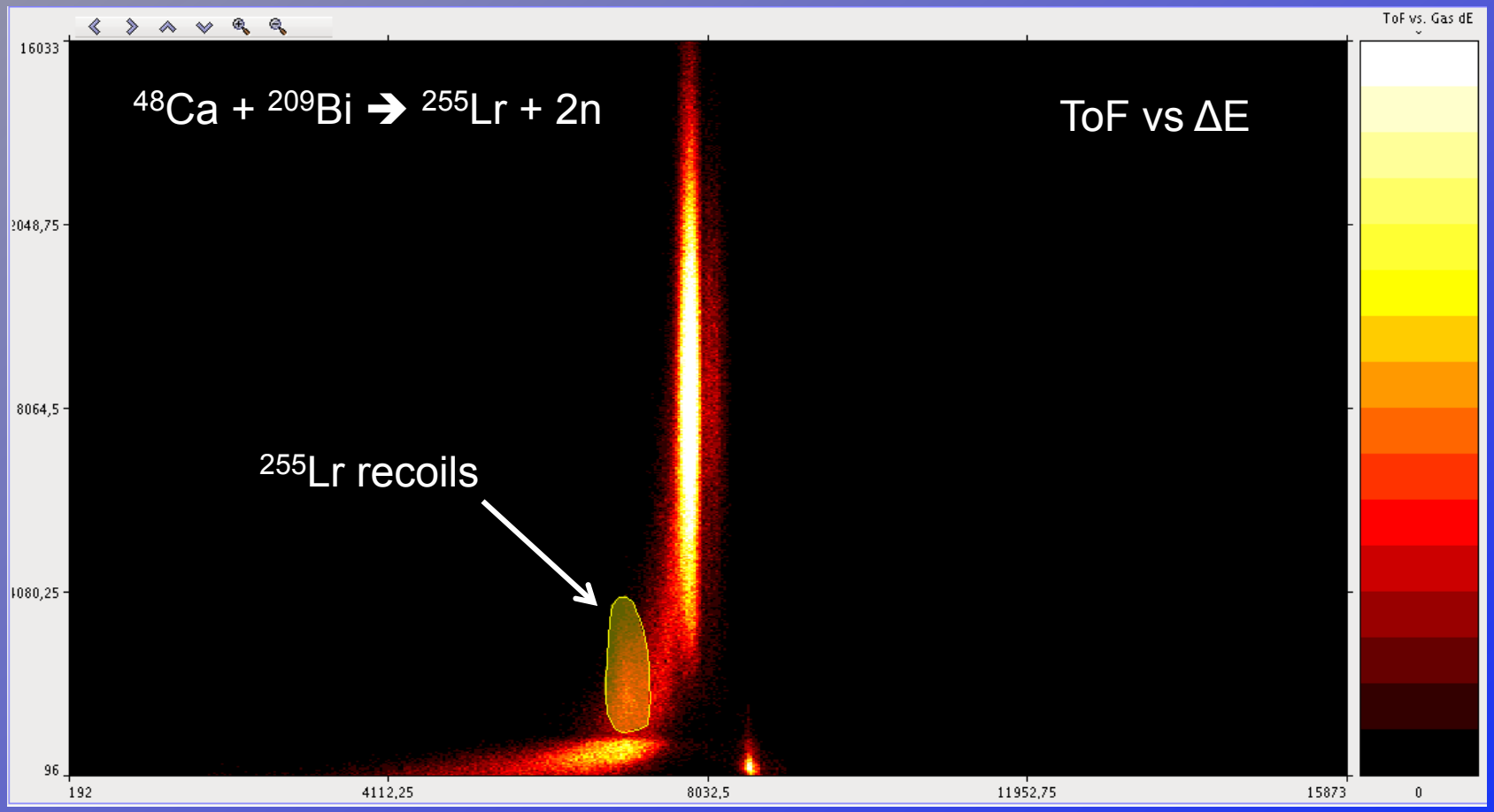
A ToF-ΔE 2D gate would not be clean enough

Gamma-ray Selectivity



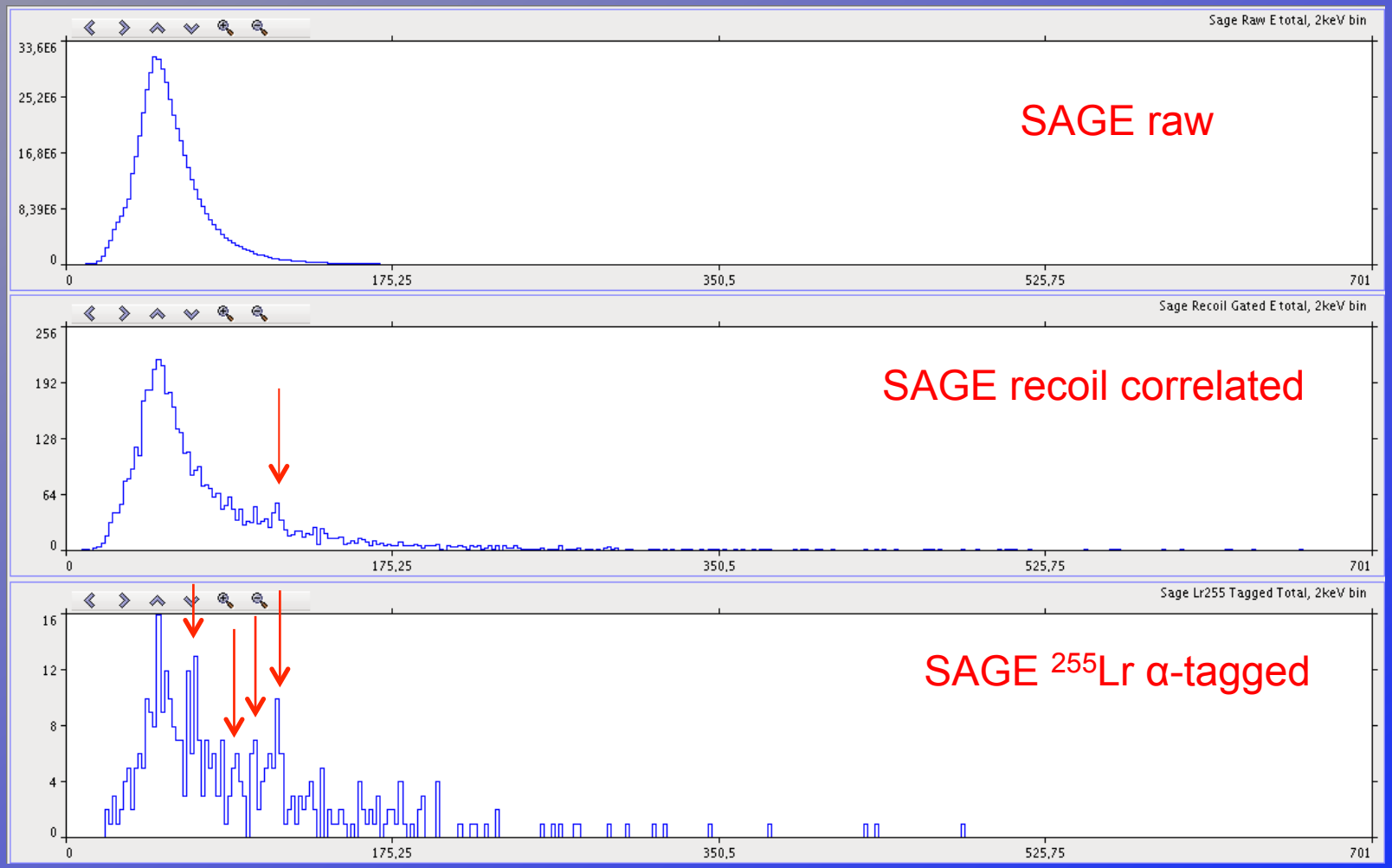
- A clean tag is vital for γ-ray identification
- The selectivity allows γ-ray spectroscopy to be performed at a ~17 nb level !

Identification of Recoils II



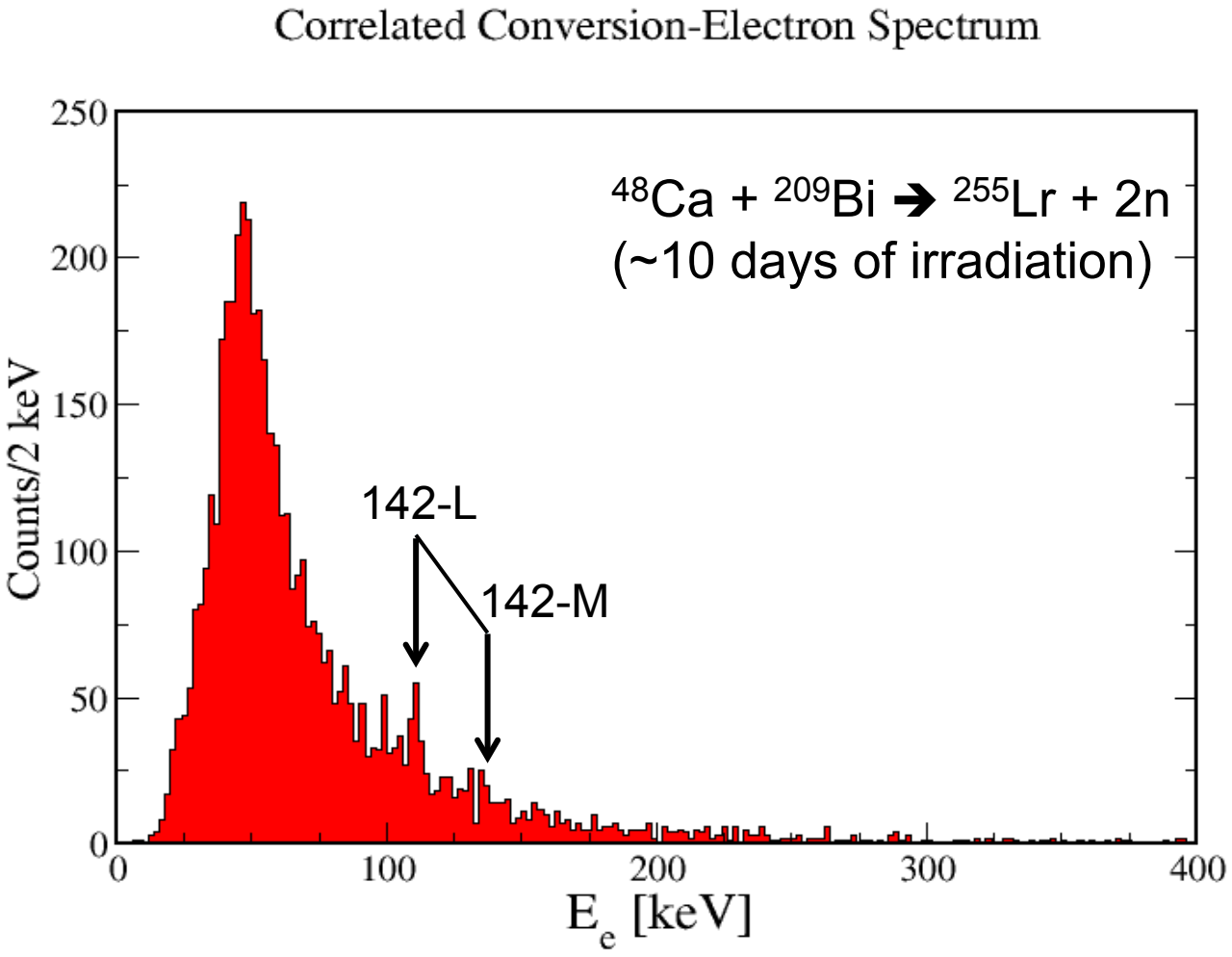
Recoils sufficiently separated for a clean ToF-ΔE 2D gate

Conversion Electron Spectra



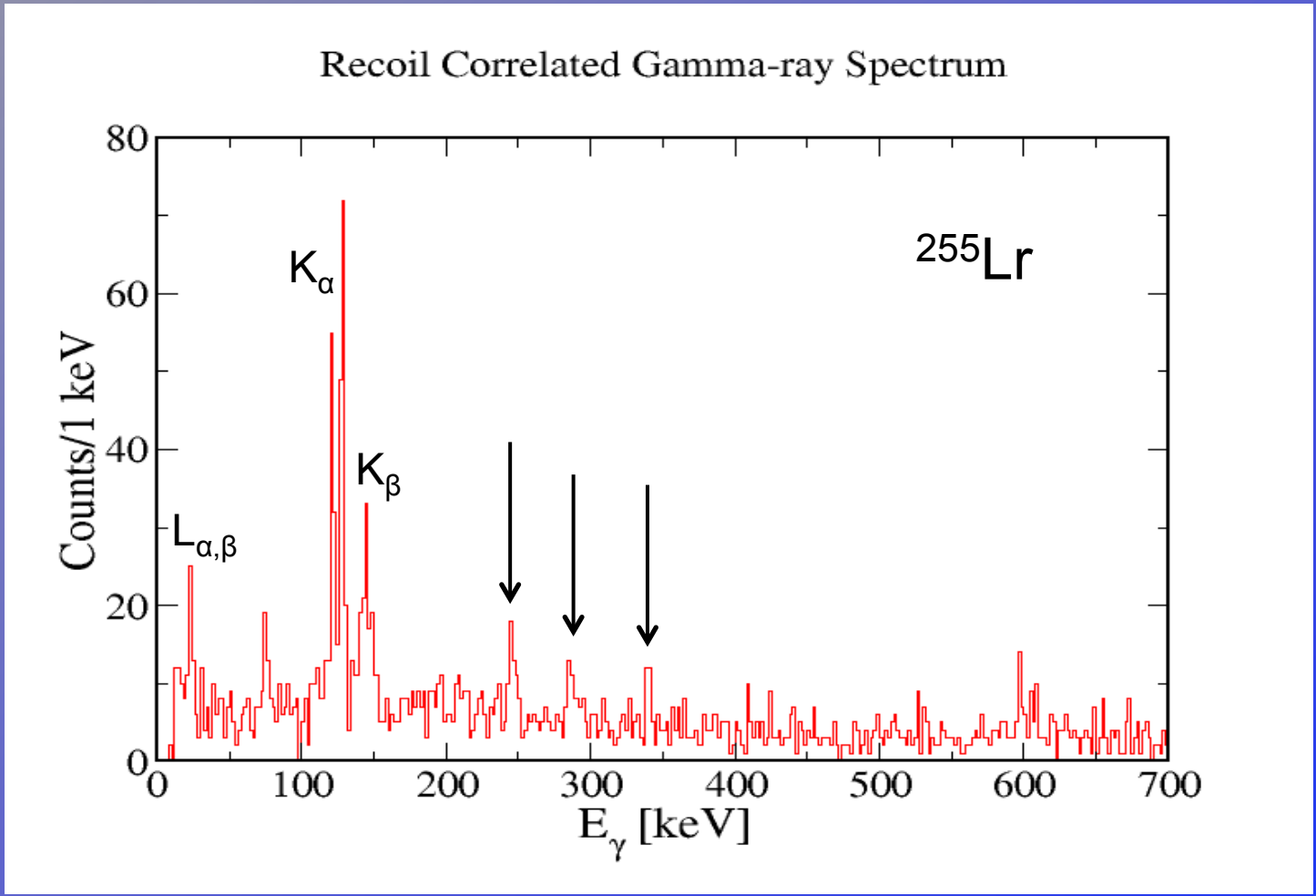
A tag necessary for distinguishing any features in the spectrum

Singles Electron Spectrum



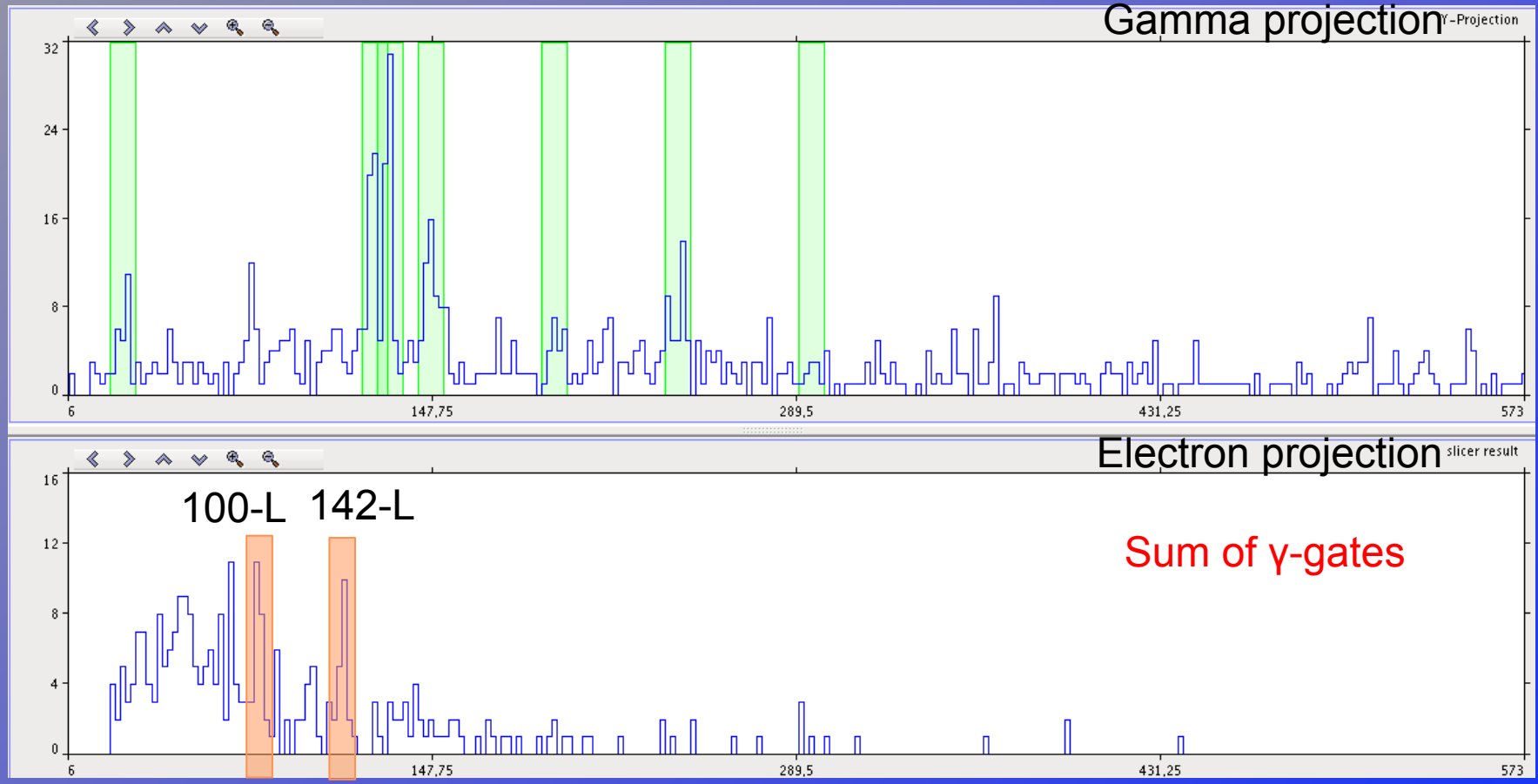
The recoil gated electron spectrum is sufficiently clean

Singles Gamma-ray Spectrum



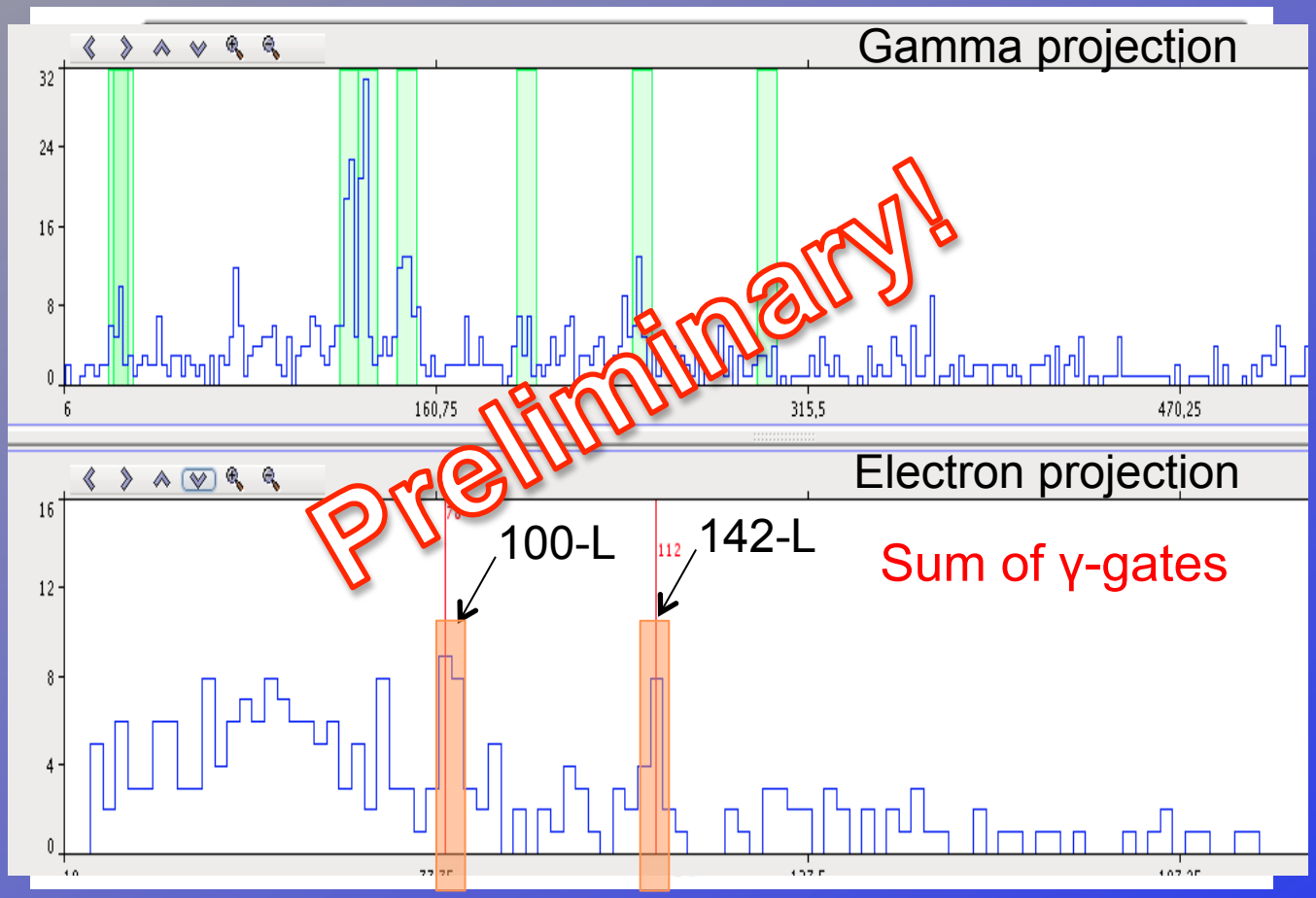
Transitions are visible from the favoured signature band build on the 1/2⁻ ground state

Gamma-Electron Coincidences



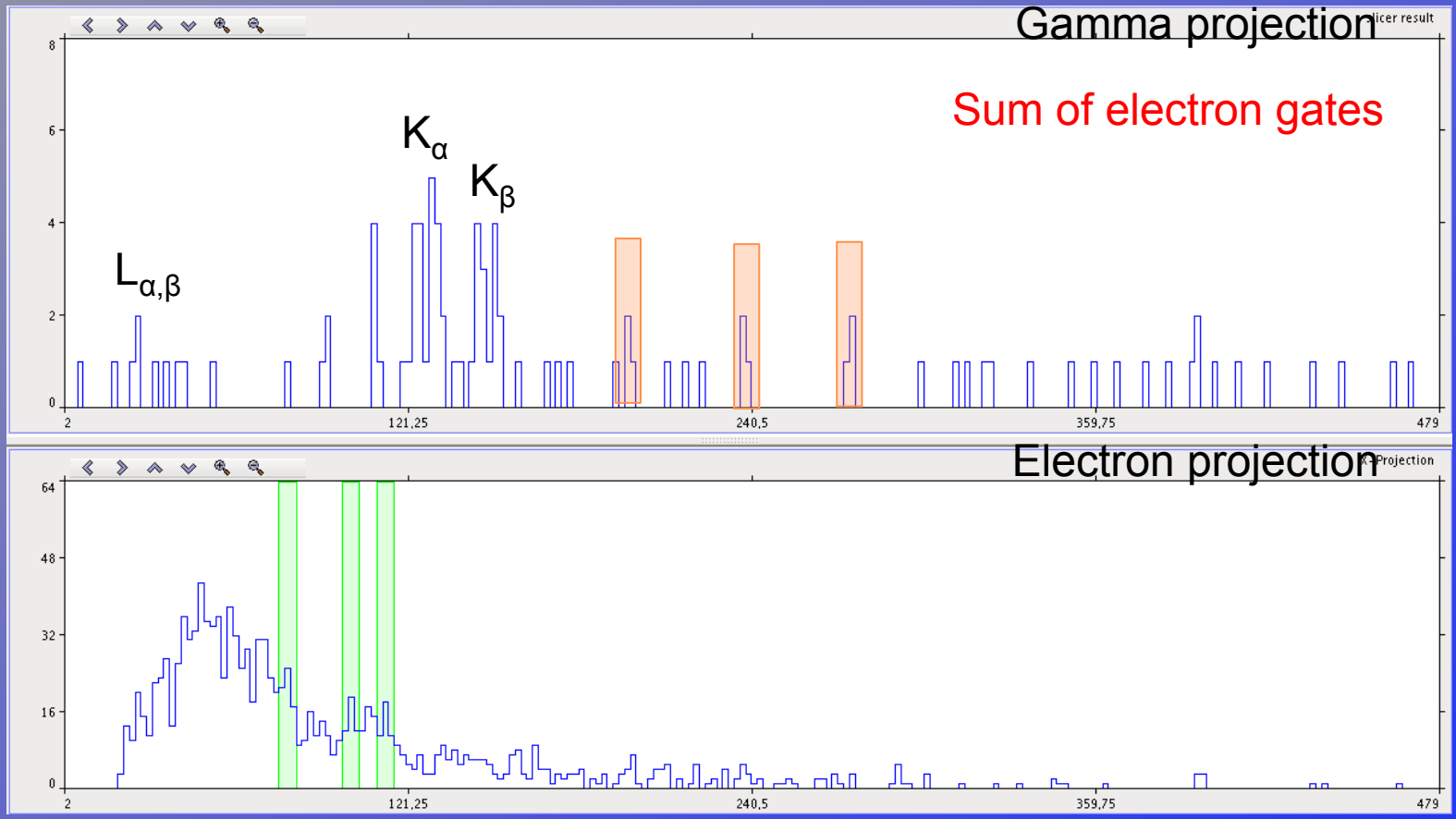
With the gamma-electron coincidences the low-lying members of the gs band can be elucidated

Gamma-Electron Coincidences



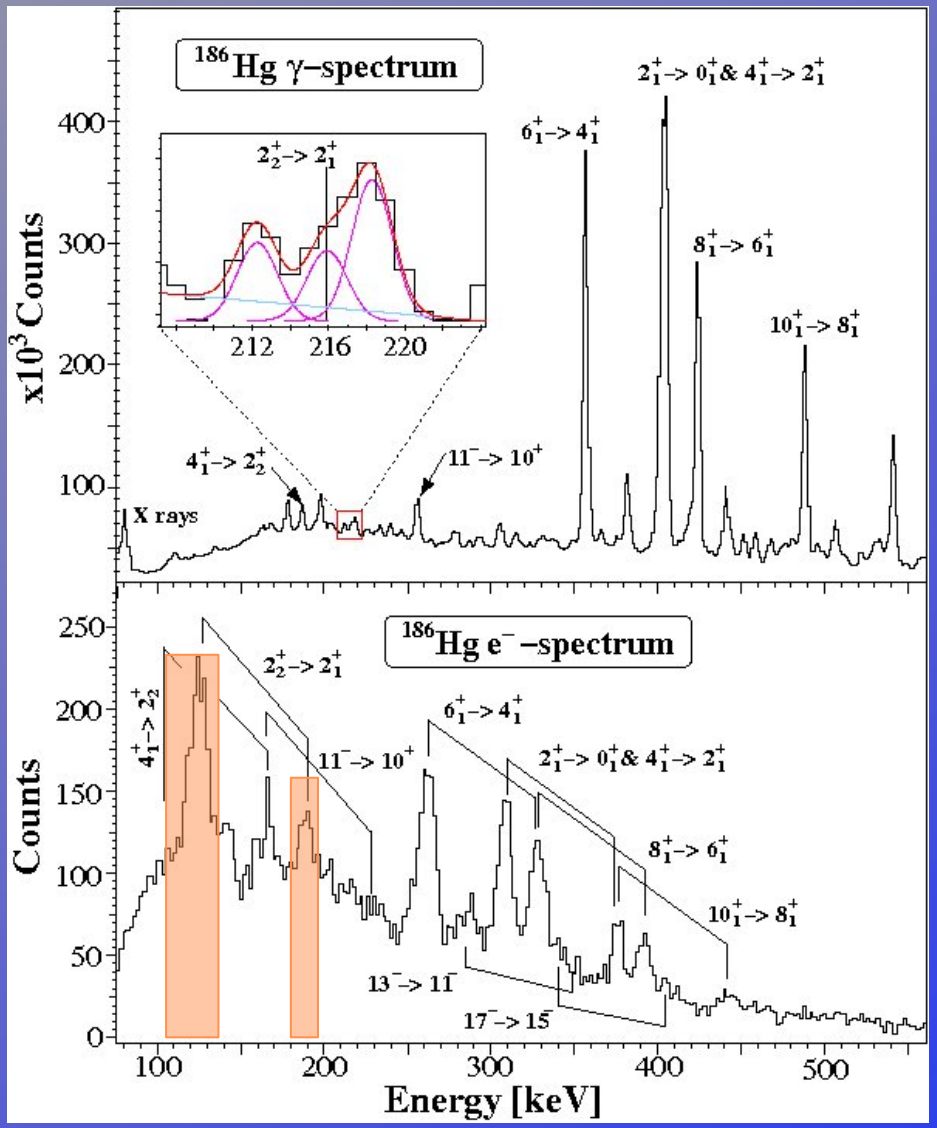
Are essential!

Electron-Gamma Coincidences



Prompt conversion-electron and gamma-ray spectroscopy is possible down to ~250 nb level!

When there's more Statistics



- **Possible to extract highly converted E0 transitions**

M. Scheck *et al.* Phys. Rev. C 83, 037303 (2011)

Summary

- Prompt conversion-electron and gamma-ray coincidences are essential in order to unveil low-lying transitions in heavy nuclei
- A cross section of several hundreds of nb needed for establishing coincidences
- With a clean tag prompt gamma-ray spectroscopy is feasible down to a few tenth of nb with currents state-of-the-art techniques