Gamma-Gamma Angular Correlation Measurements With GRIFFIN

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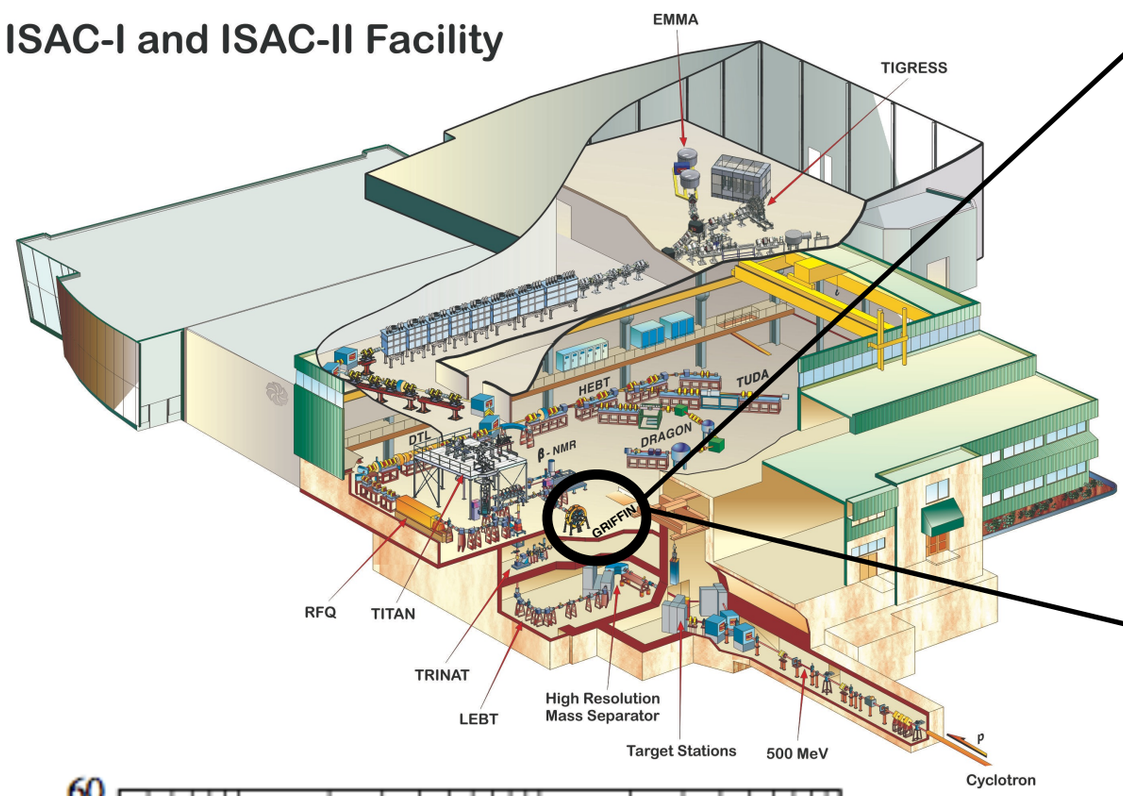
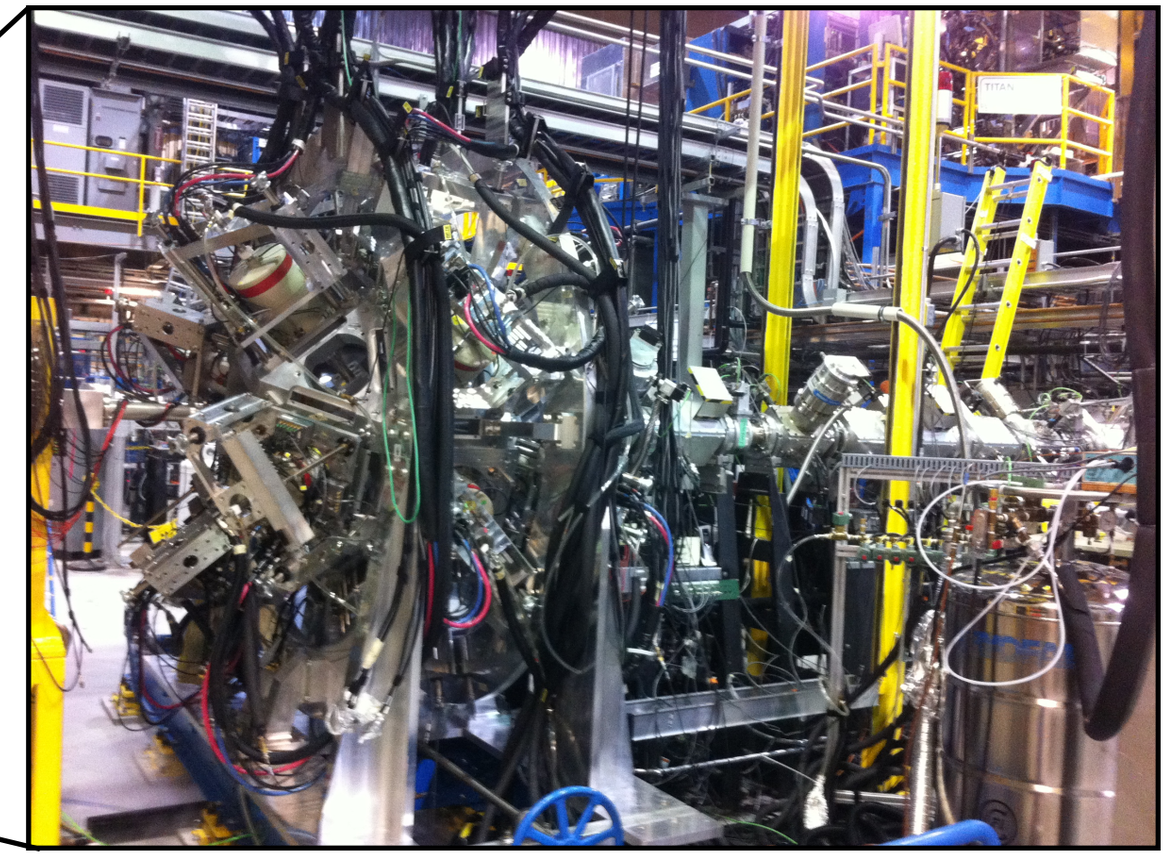
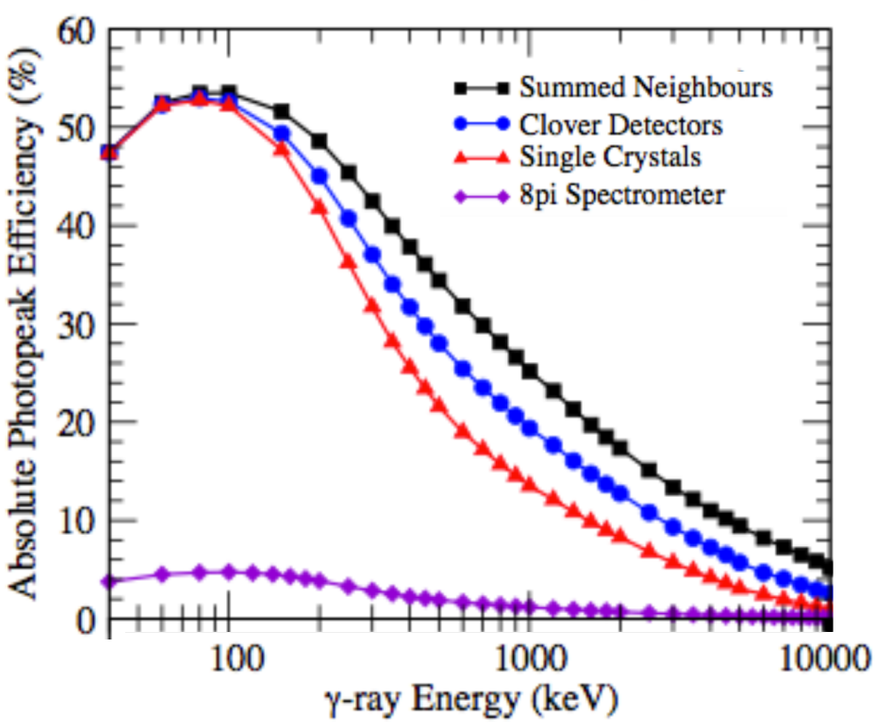
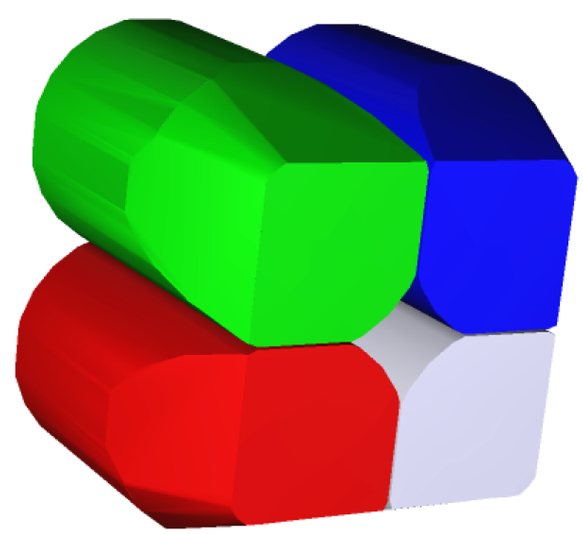
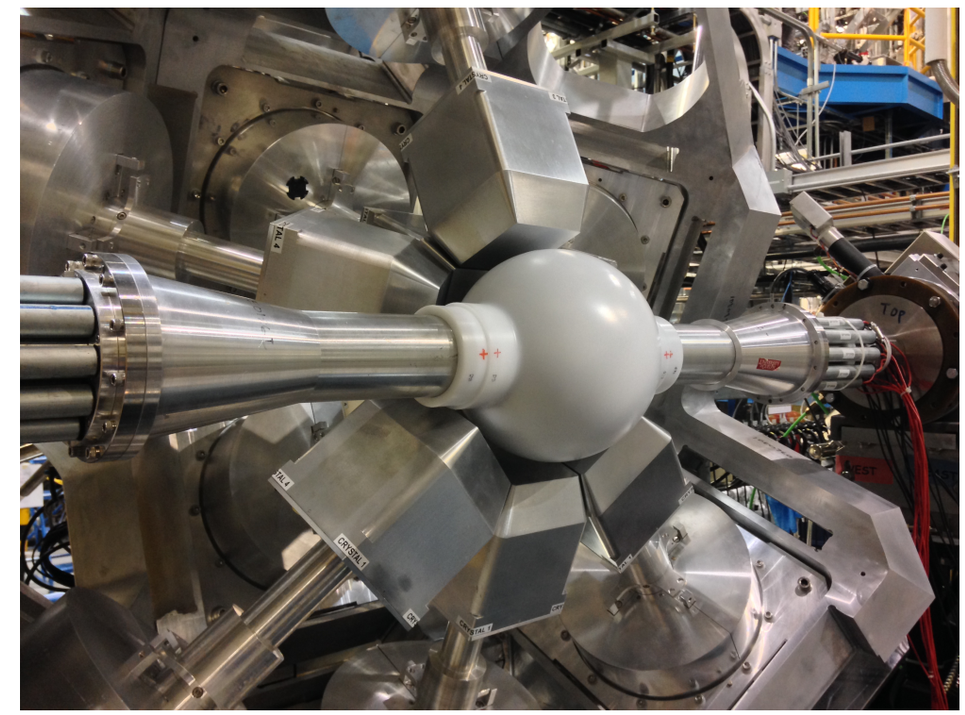










GRIFFIN is a new high-efficiency gamma-ray spectrometer for decay spectroscopy with low-energy (30 keV) radioactive ion beams from TRIUMF-ISAC.

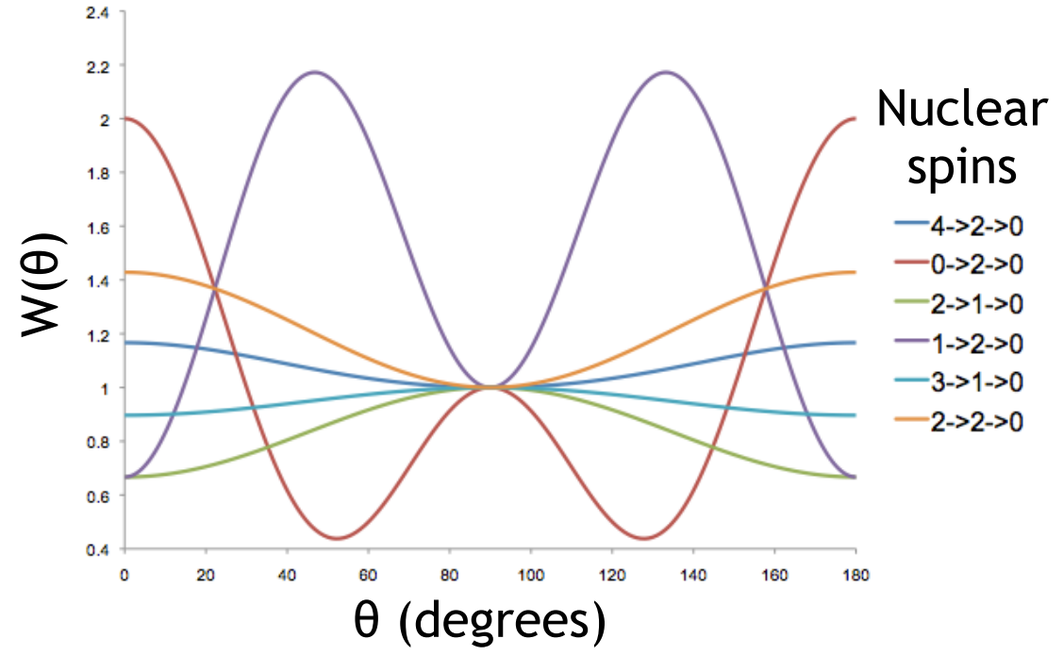
Gamma-Gamma Angular Correlation Measurements With GRIFFIN

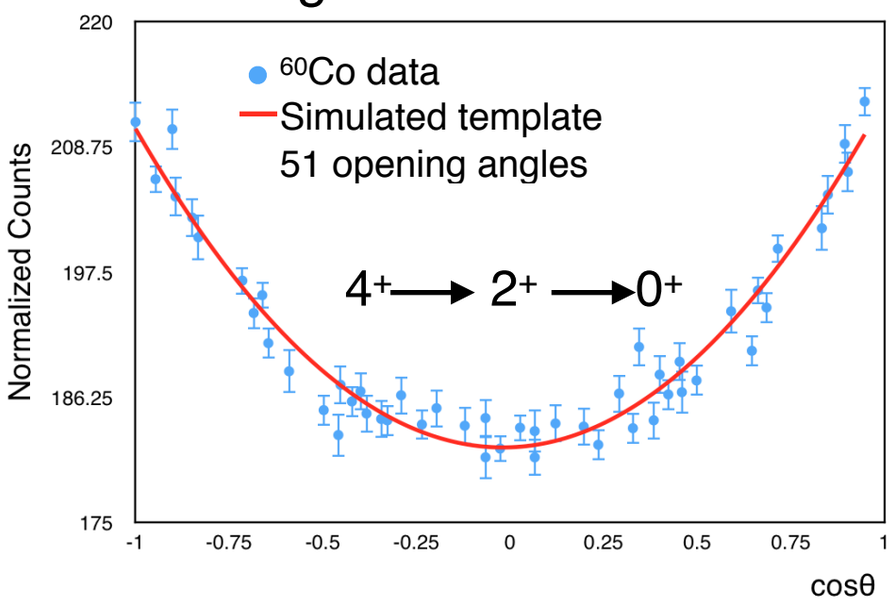
γ–γ angular correlations can be expressed as:

$$W(\theta) = 1 + \sum_{k=even}^{2L} a_k P_k(cos\theta)$$

The a_k are coefficients are dependent on the nuclear spins, mixing ratios and multipolarities and $P_k(\cos\theta)$ are the Legendre polynomials.

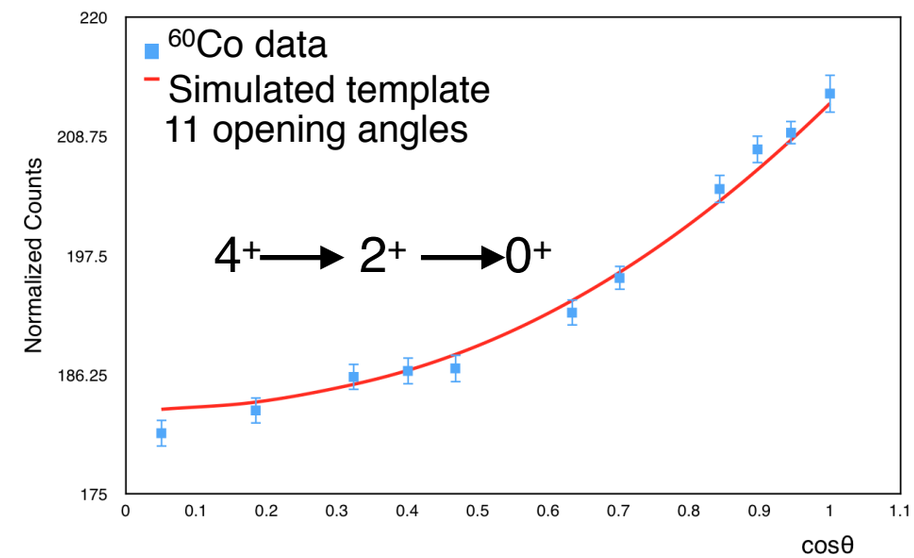
In the GRIFFIN geometry there are 51 distinct opening angles between HPGe crystals. Solid angle effects are treated through Geant4 simulated templates



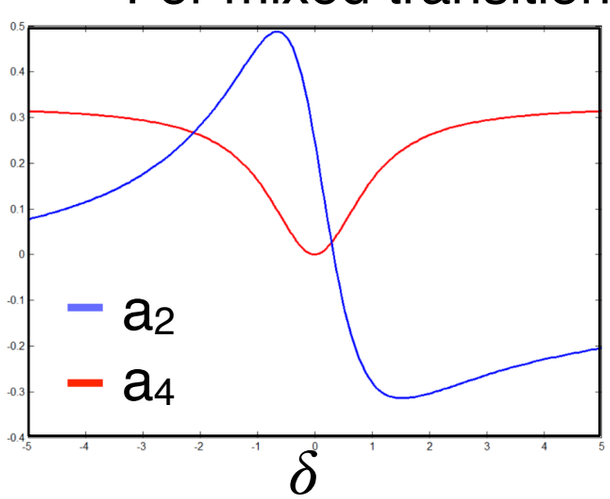


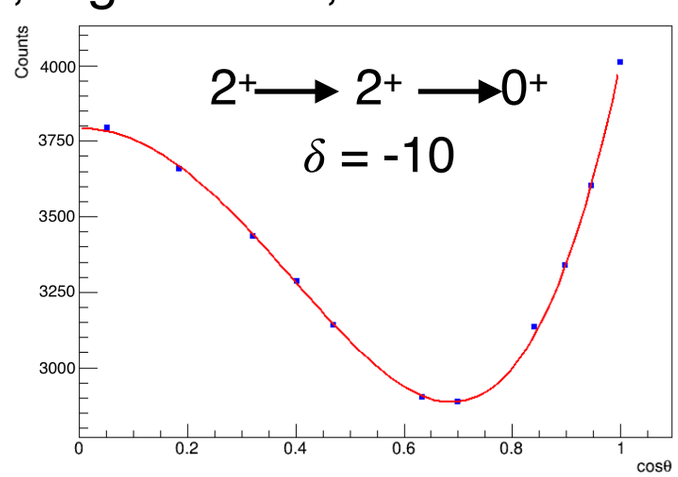
Grouped similar angles and folded about 90°.

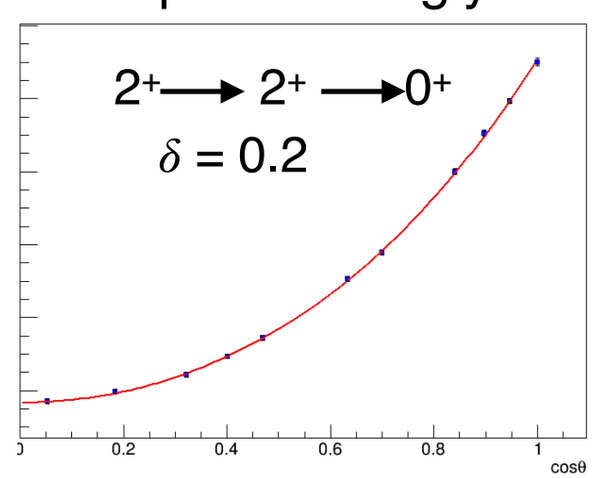
Reduces angular bins from 51 to 11.

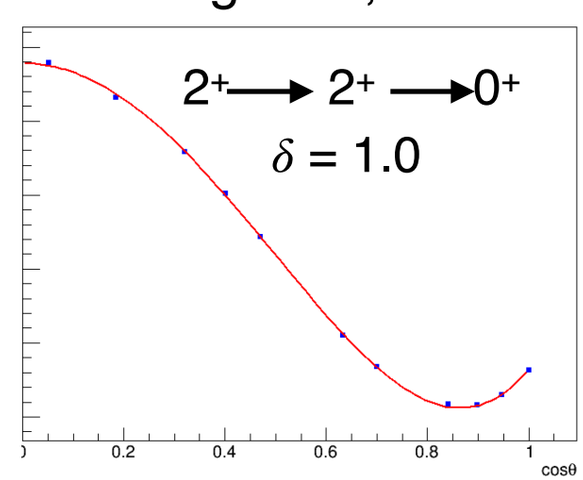


For mixed transitions, e.g.. M1/E2, these correlation depend strongly on the mixing ratio, δ.

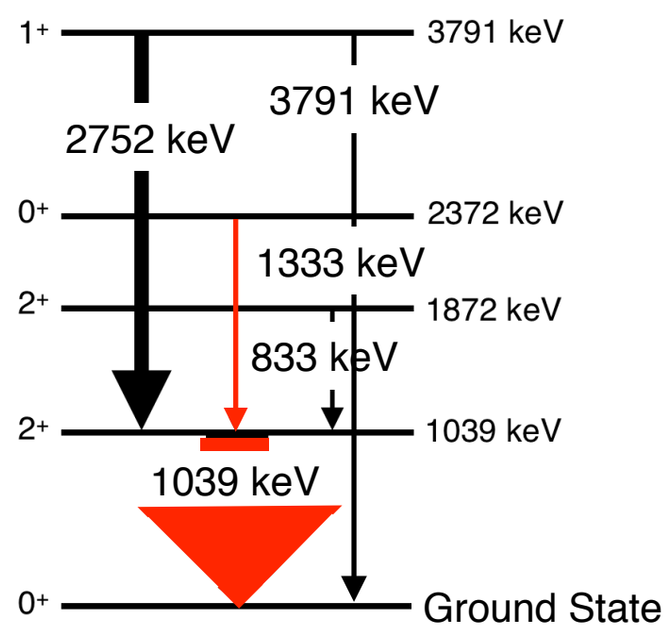




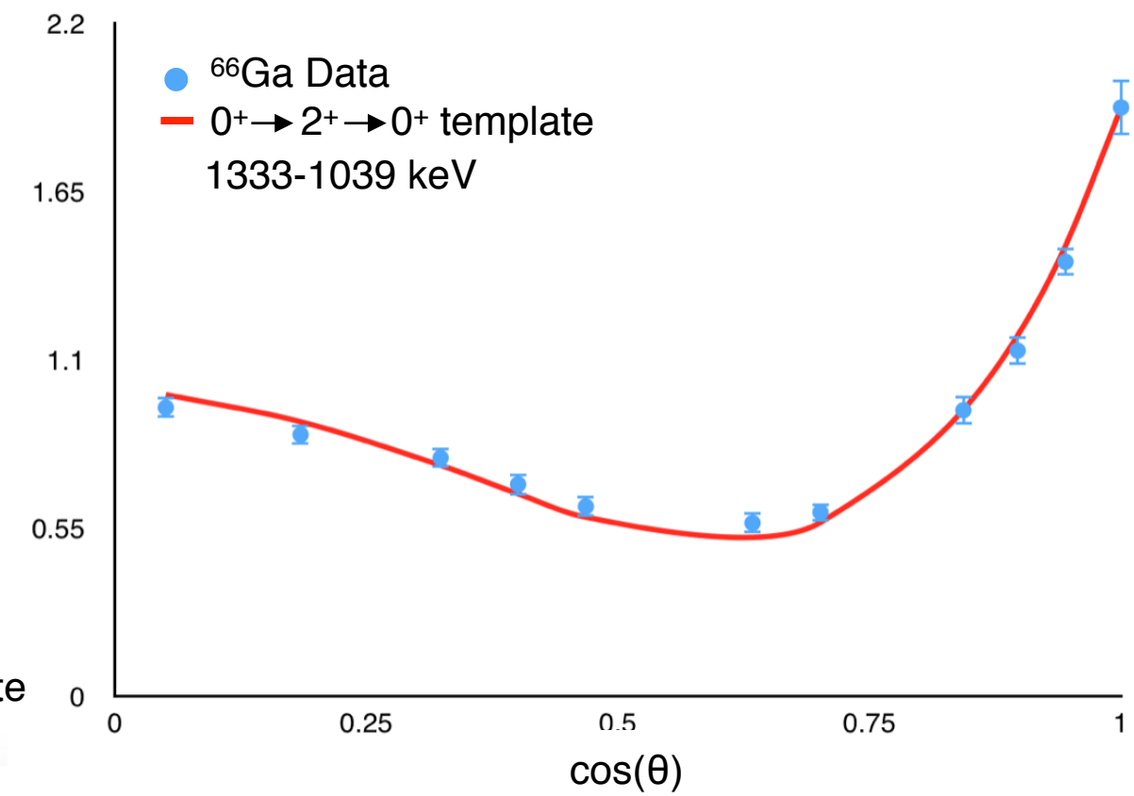




^{66}Ga Radioactive Beam Experimental Data



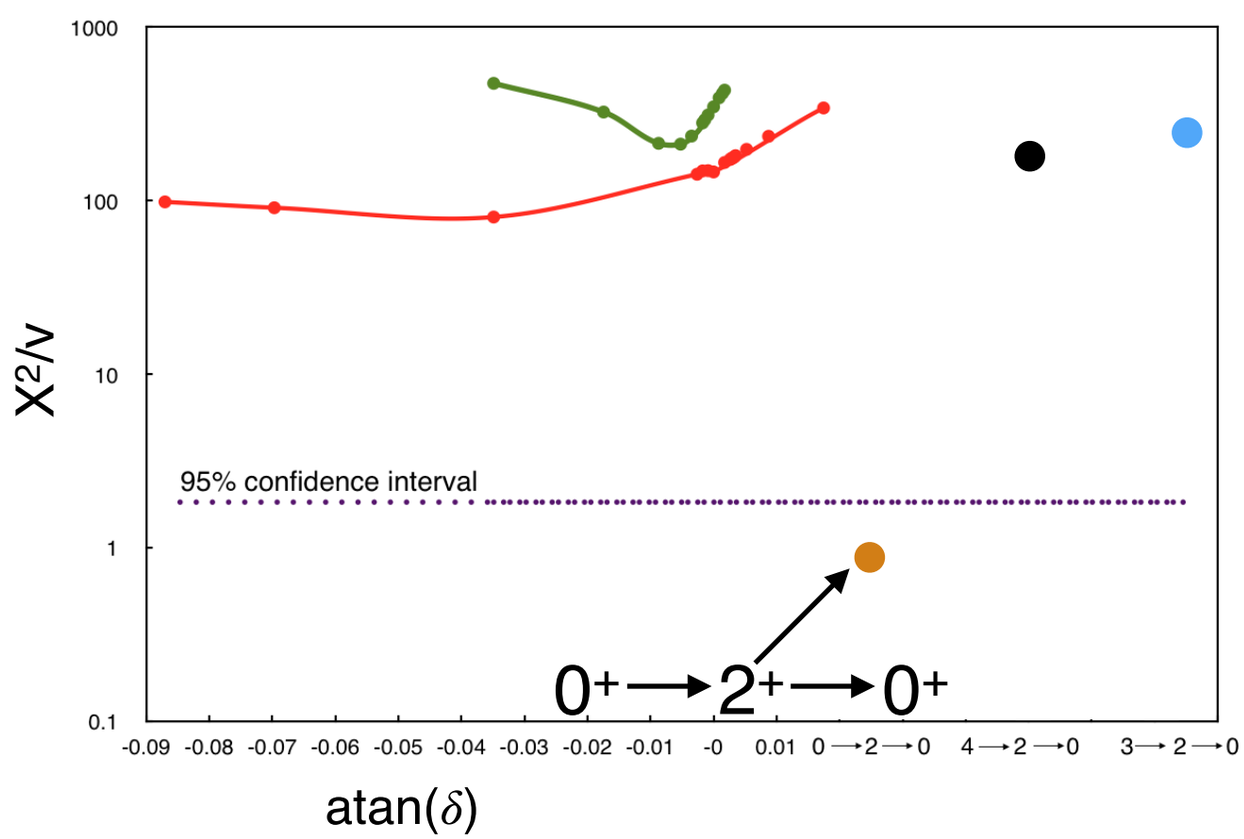
^{66}Zn



The first in-beam measurement was to investigate a $0^+ \longrightarrow 2^+ \longrightarrow 0^+$ cascade between the 1333-1039 keV gamma-rays following ^{66}Ga beta decay.

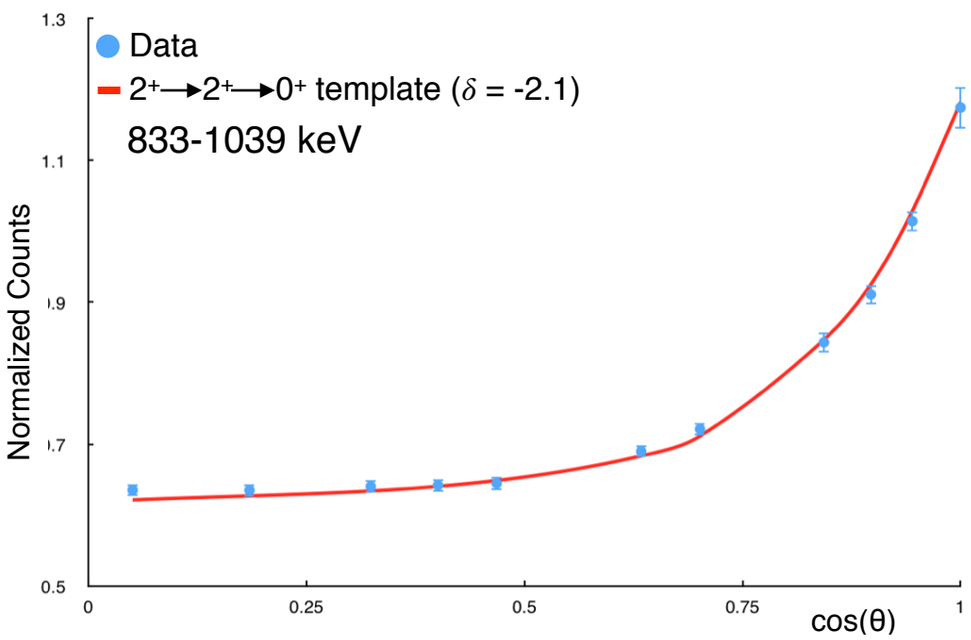
Nuclear Spins Legend

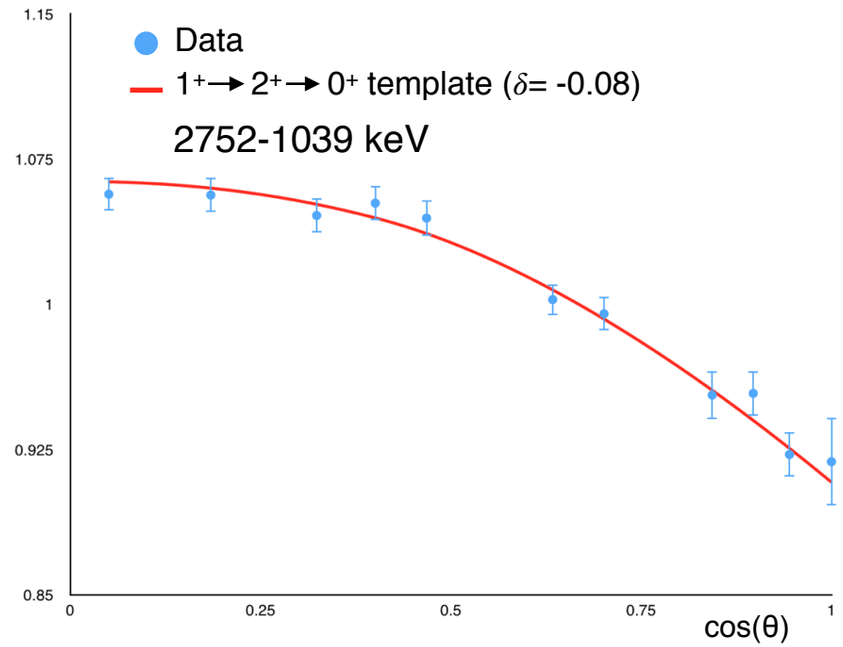
- $0^+ \longrightarrow 2^+ \longrightarrow 0^+$
- $1^+ \longrightarrow 2^+ \longrightarrow 0^+$
- $2^+ \longrightarrow 2^+ \longrightarrow 0^+$
- $3^+ \longrightarrow 2^+ \longrightarrow 0^+$
- $4^+ \longrightarrow 2^+ \longrightarrow 0^+$

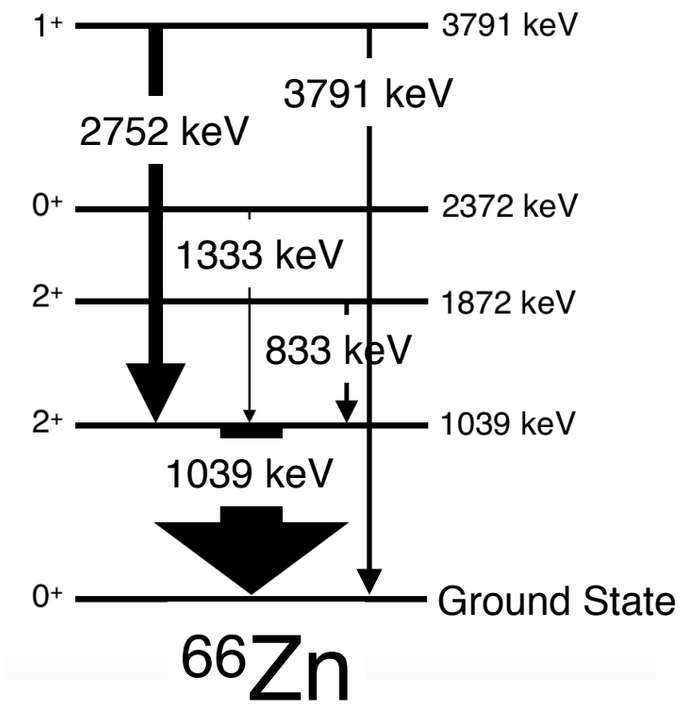


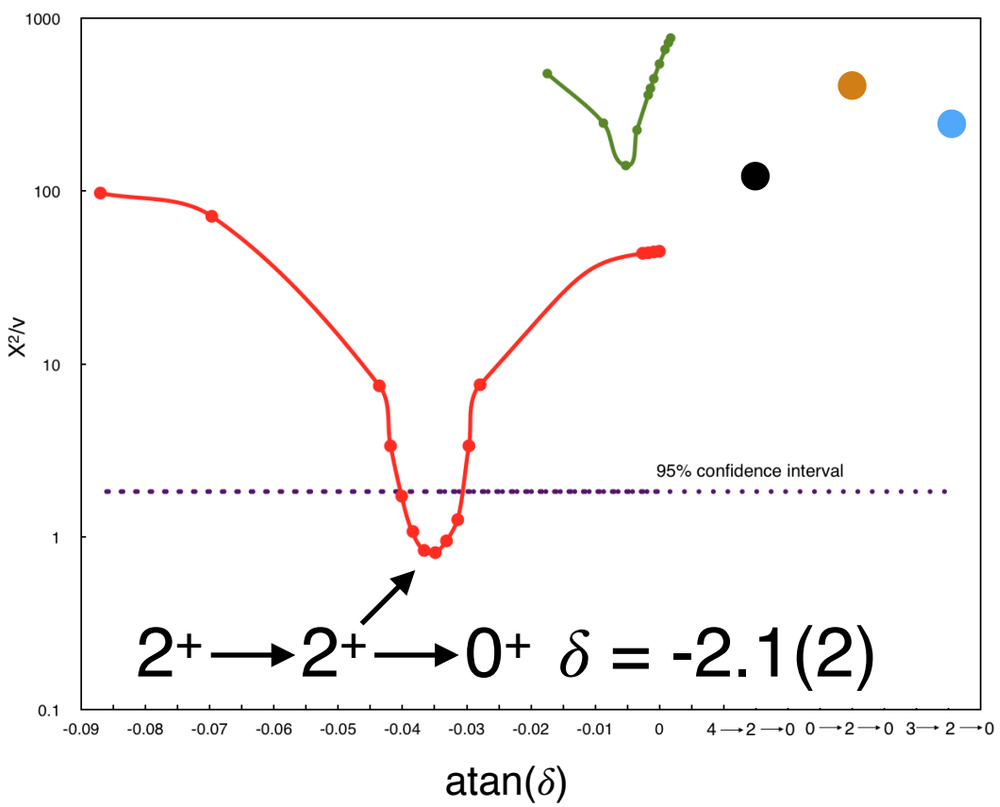
The distinct $0^+ \longrightarrow 2^+ \longrightarrow 0^+$ template yields a $X^2/v = 0.96$ when compared to experimental data, while all other spin sequences yield $X^2/v > 100$.

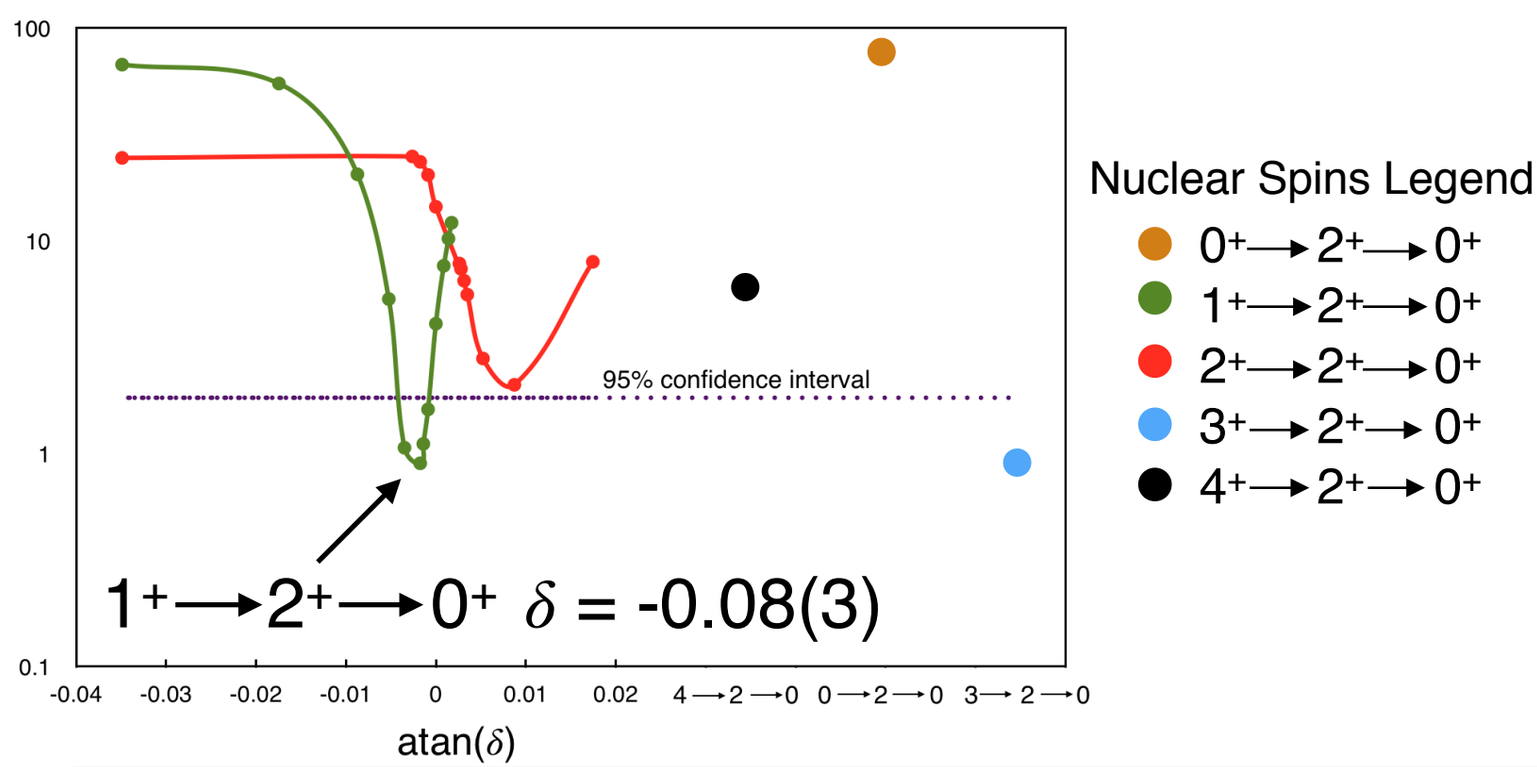
^{66}Ga Radioactive Beam Experimental Data









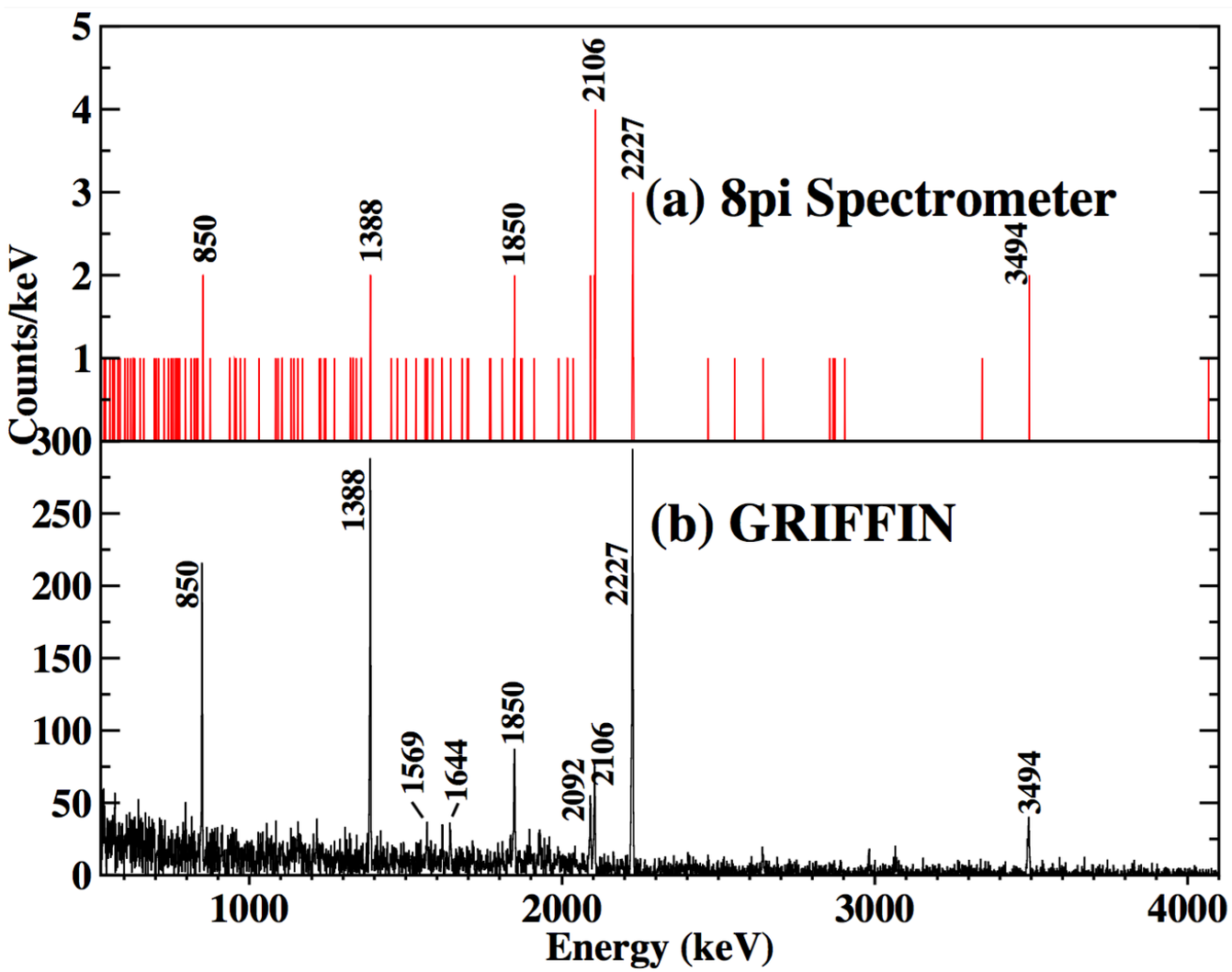


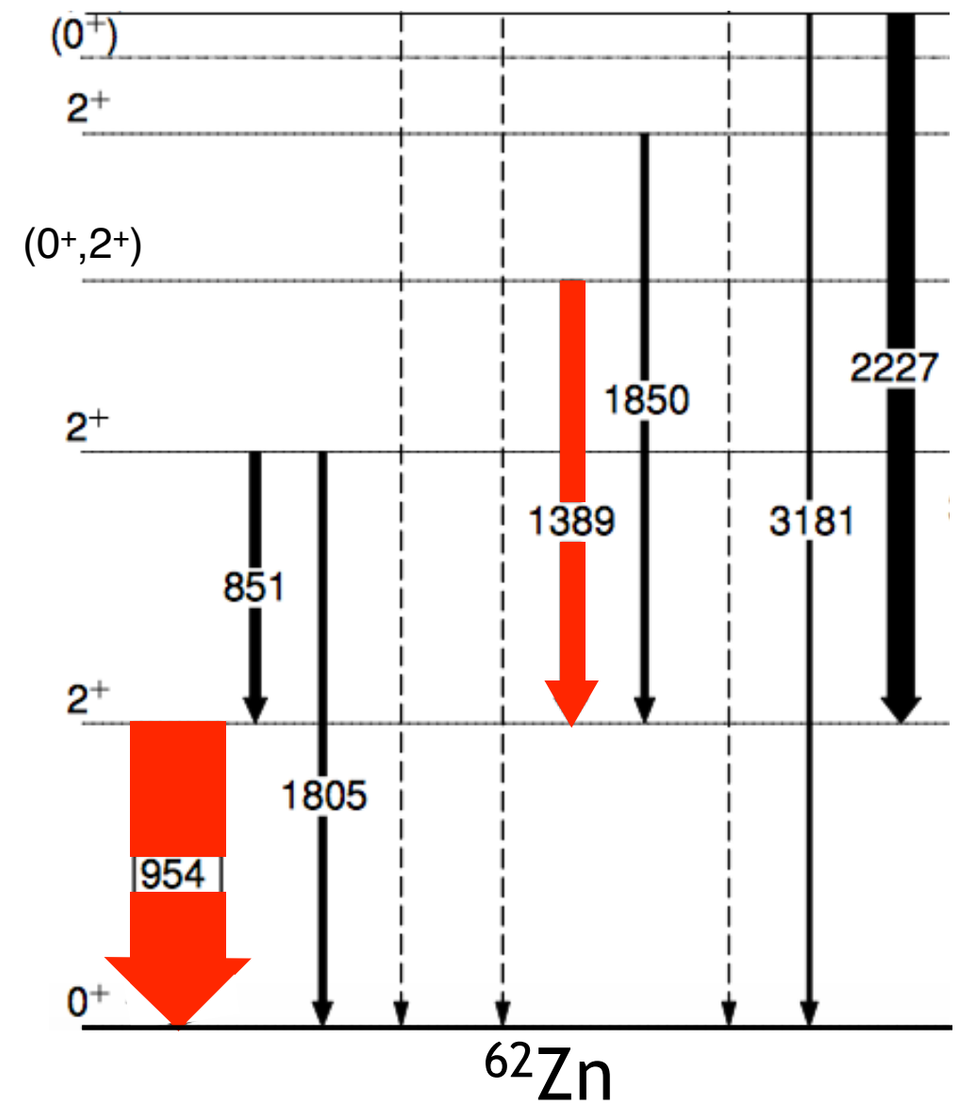
Cascade	[1]	[2]	δ (This work)
833-1039 keV	-1.9(3)	-1.6(2)	-2.1(2)
2752-1039 keV	-0.09(3)	-0.12(2)	-0.08(3)

[1] M. R. Bhat, Nucl. Data Sheets **83**, 83.
[2] A. Gade, Phys. Rev. C **65**, 054311.

^{62}Ga Superallowed Beta Decay Data (Preliminary)

With techniques demonstrated a preliminary experiment was preformed with a radioactive ^{62}Ga beam to resolve a recently disputed spin assignment to the 2.34 MeV excited state in ^{62}Zn.

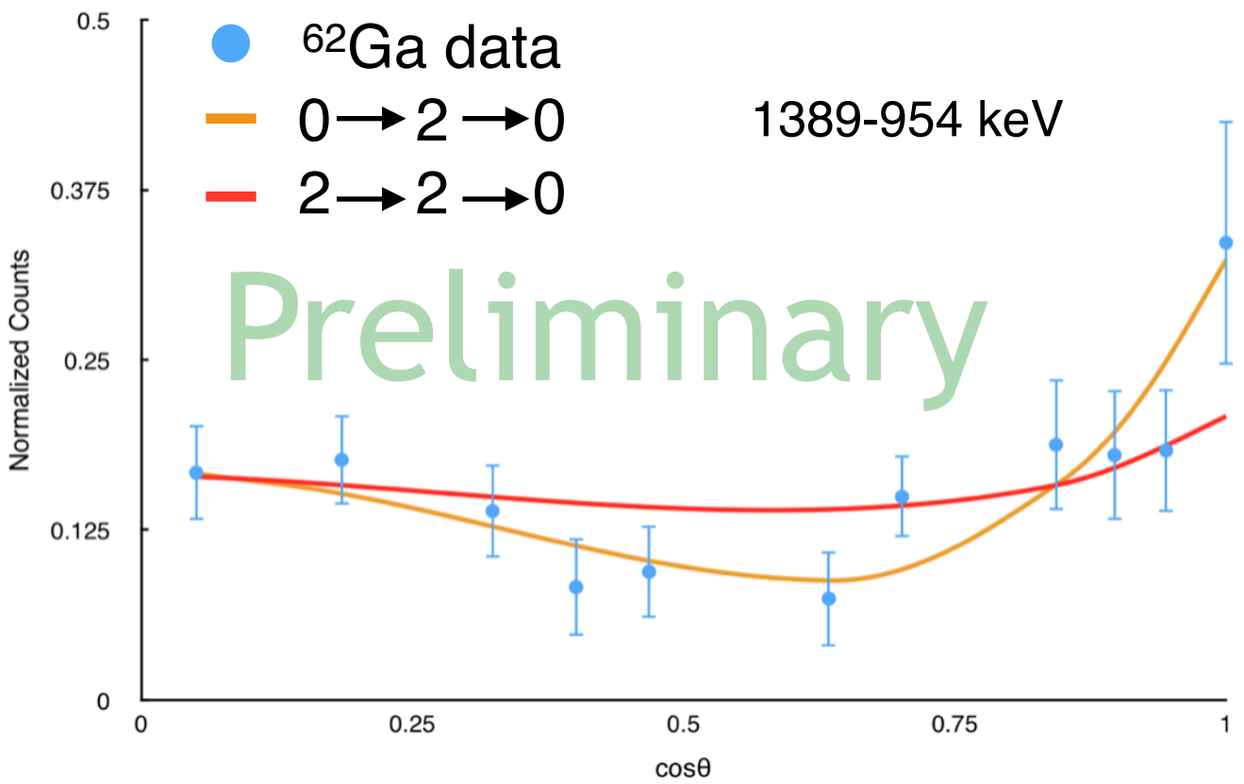


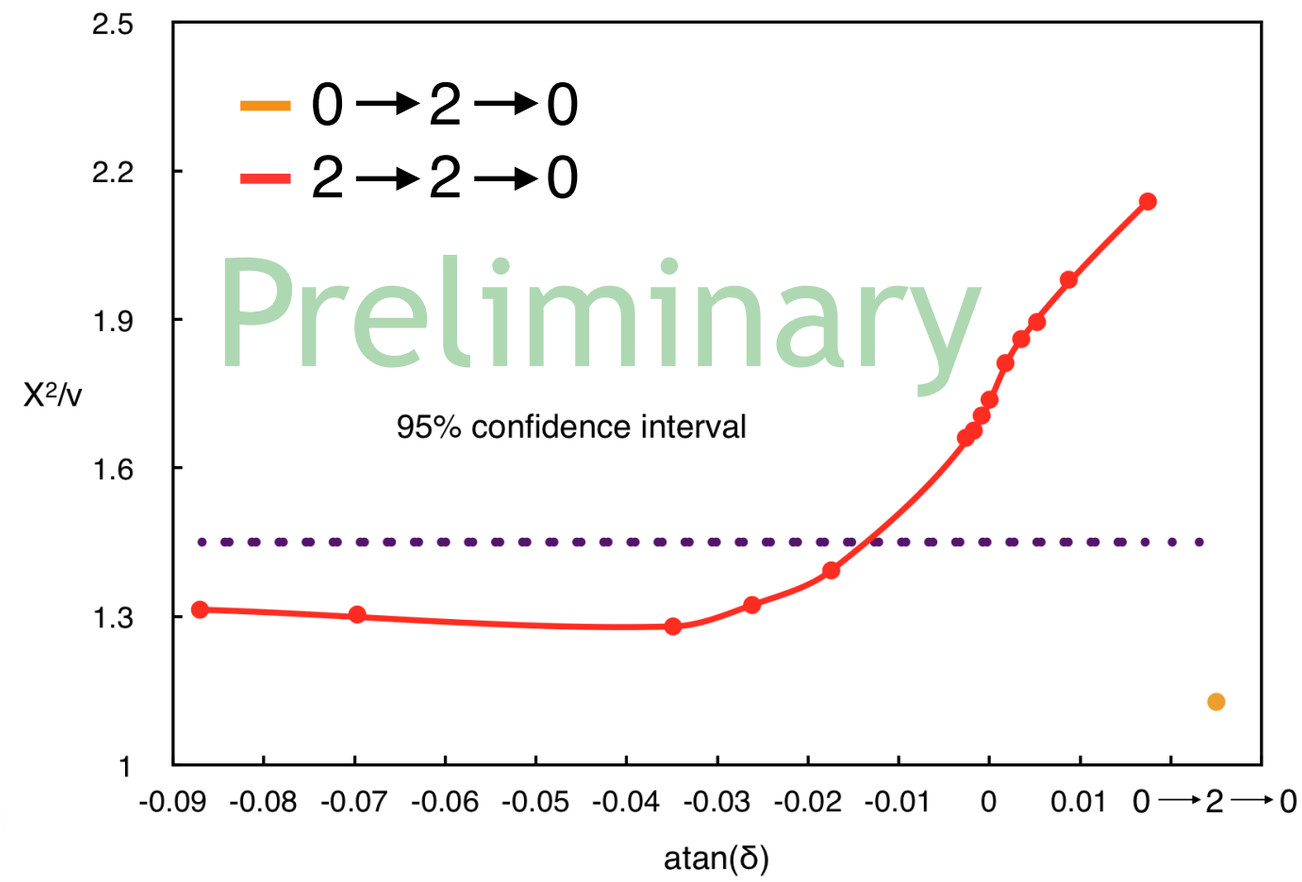


In comparison to a previous experiment at TRIUMF, the high efficiency of GRIFFIN provided two orders of magnitude more statistics with half the number of decays using the 8π array.

^{62}Ga Superallowed Beta Decay Data (Preliminary)

With a beam rate of 1250 ions per second and a beta branch of 191ppm to the 2.34 MeV state, the measurement favoured the assignment of this state as a 0^+. A higher statistic experiment will be run with GRIFFIN to make a definitive spin assignment for this state.





GRIFFIN at ISAC-I is a powerful new facility for gamma-gamma angular correlation measurements to establish nuclear spins and transition mixing ratios in decay spectroscopy with radioactive ion beams.