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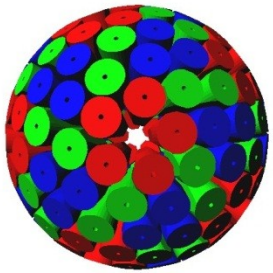
Development of a simulation package for fragmentation reactions at GSI

Daniel Bloor & The AGATA Collaboration

IoP NPPD Conference, University of Glasgow, 05/04/11.

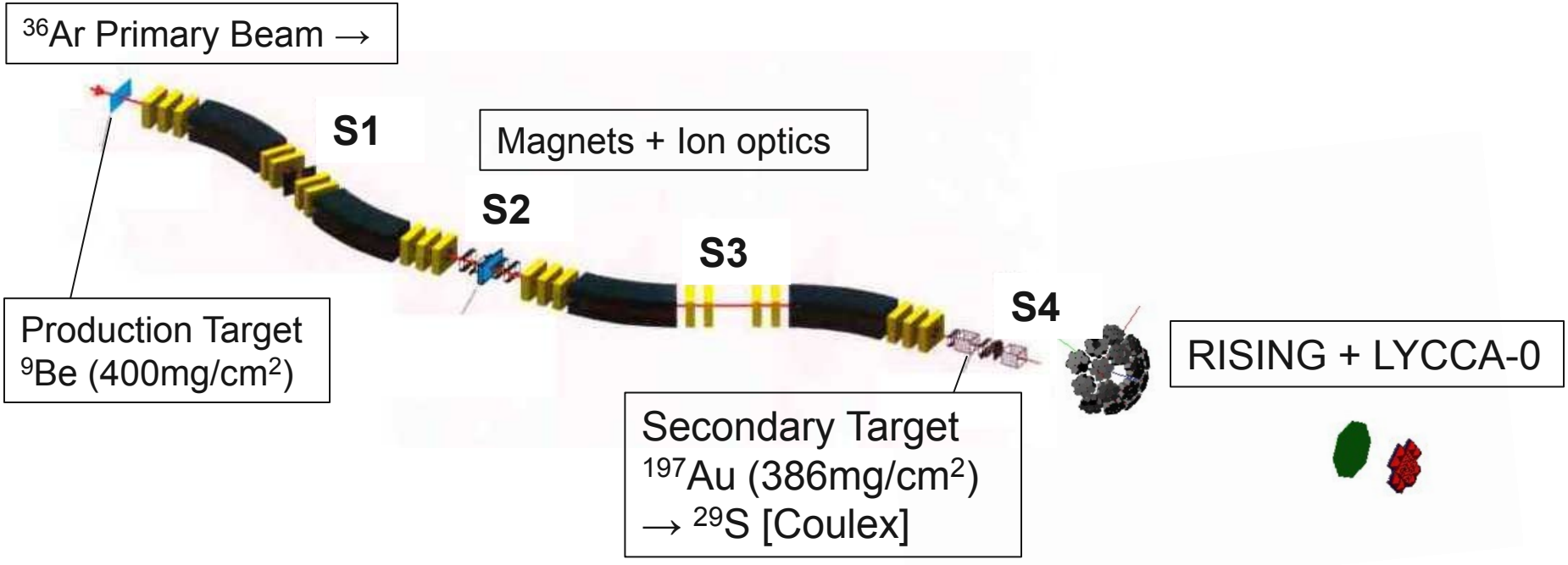
AGATA
ADVANCED GAMMA TRACKING ARRAY

Science & Technology Facilities Council



Motivation

- Simulate secondary fragmentation and relativistic Coulex reactions @ GSI to test response of AGATA in high background, relativistic environment.
  - Spectral reconstruction.
  - Tracking (OFT, MGT).
- Simulate PRESPEC experiment @ GSI (May 2011)



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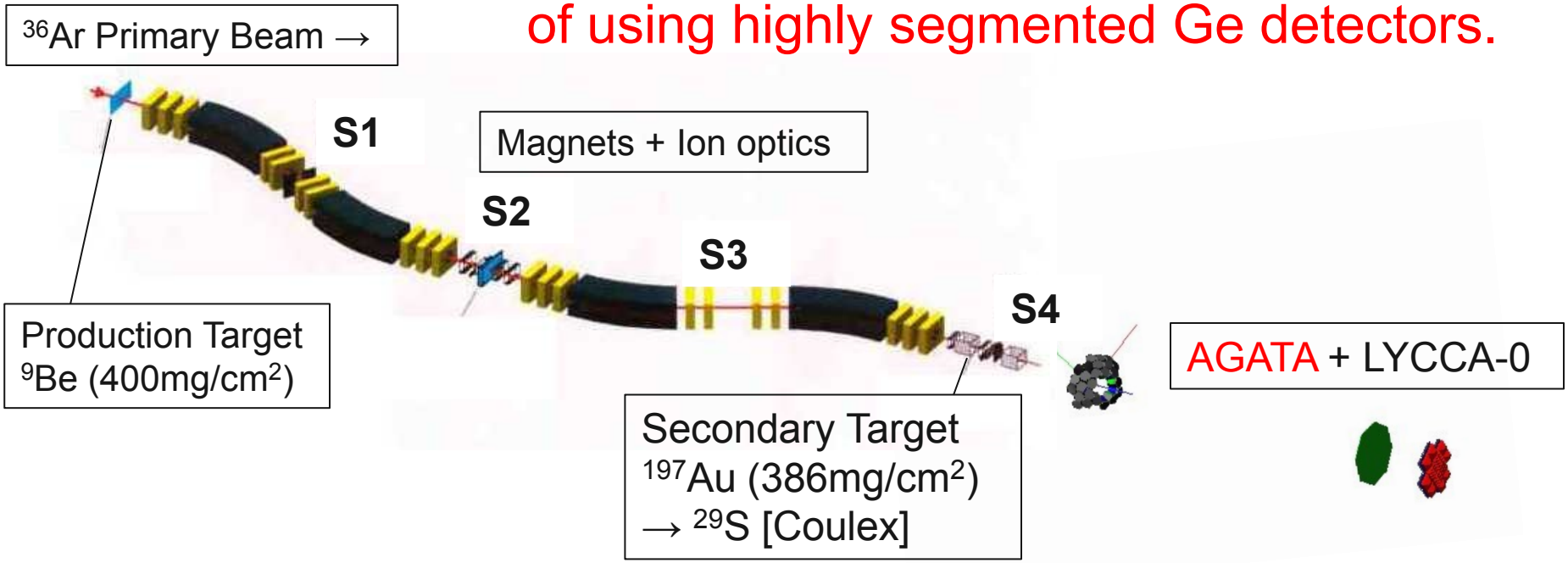
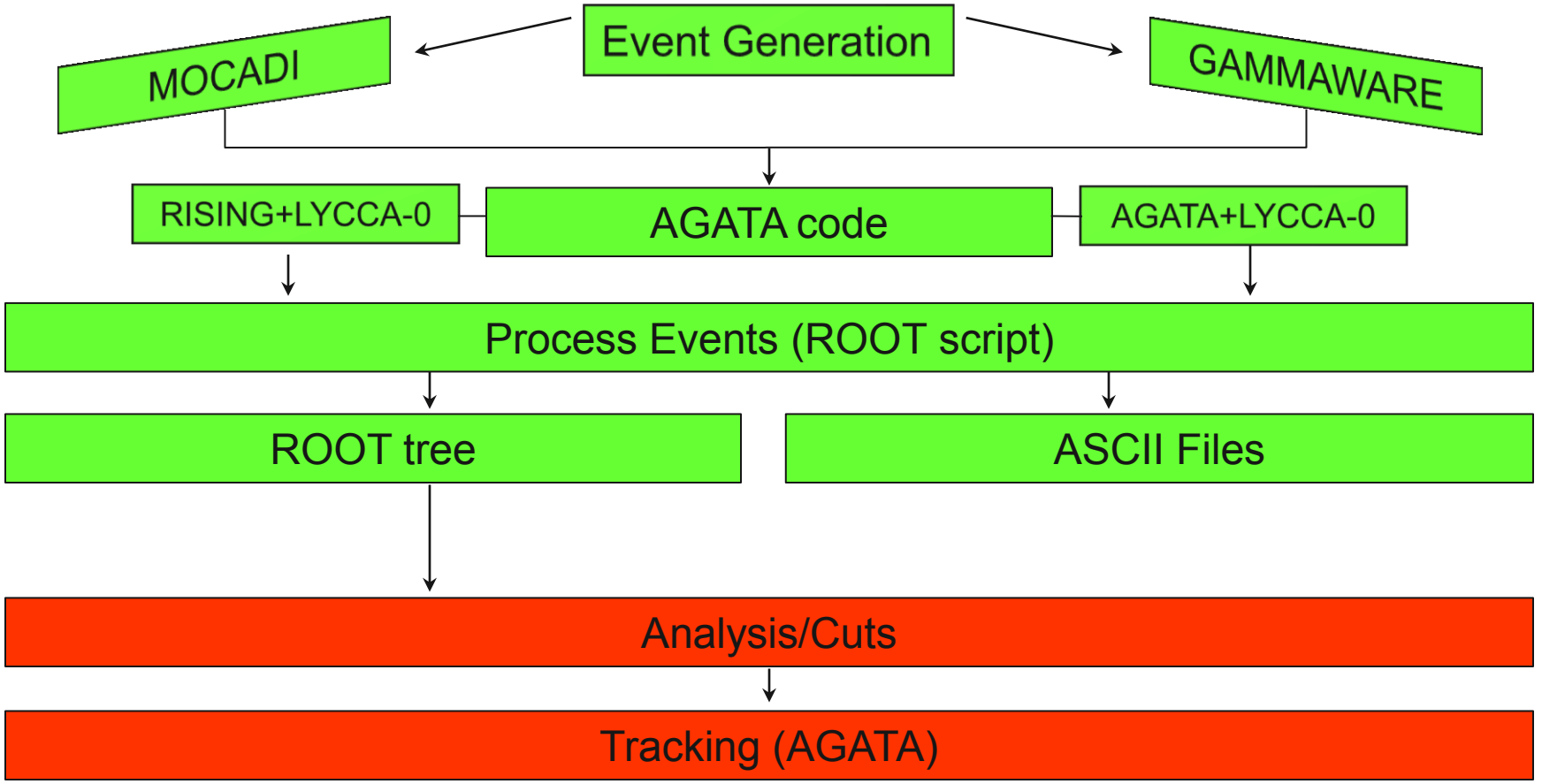
- Simulate PRESPEC experiment @ GSI (May 2011)
  - Replace RISING with AGATA + quantify improvements of using highly segmented Ge detectors.



Simulation Process



Test Case

- Events file from Mike Taylor's lyccasim package [1] containing 91 fragments.
  - Two-step fragmentation reaction:

    ^{58}Ni (600MeV/u) + ^{9}Be (4000mg/cm^2) → ^{55}Ni

    ^{55}Ni + ^{9}Be (700mg/cm^2) → ^{53}Ni

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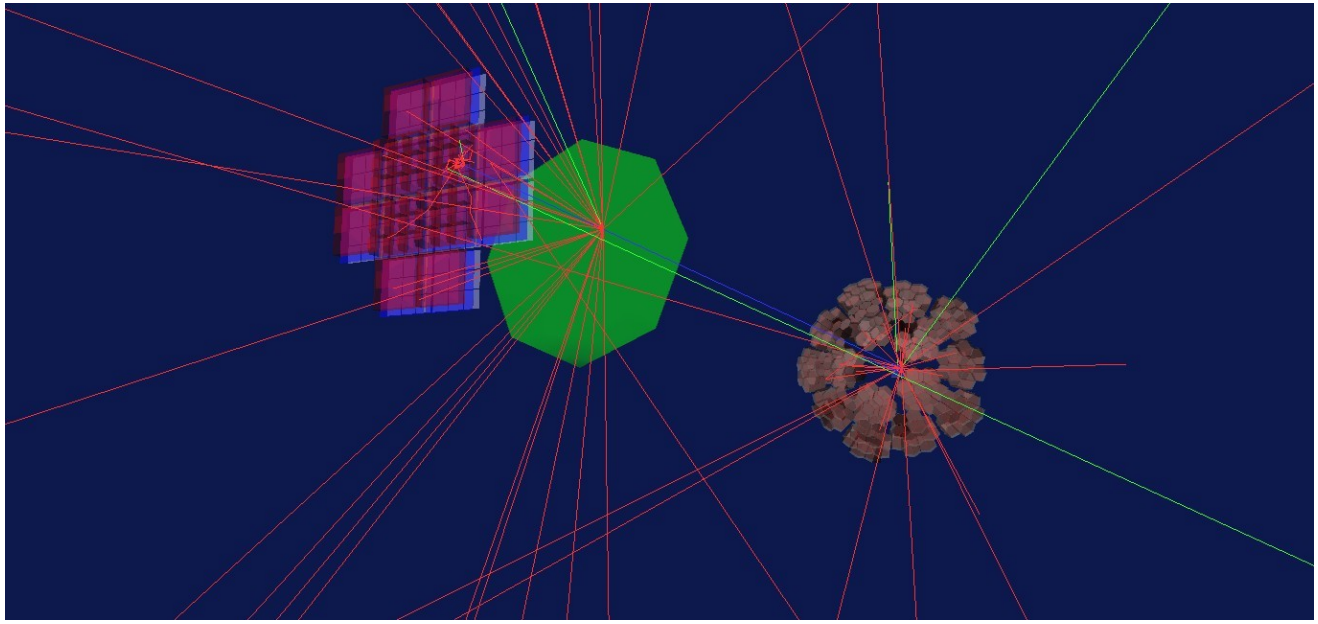

Figure 1. VRML image showing **one** fragmentation event (RISING+LYCCA-0).

[1] M. Taylor *et al.*, Nucl. Instr. Meth. A606, 589 (2009).

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LYCCA-0 Spectra

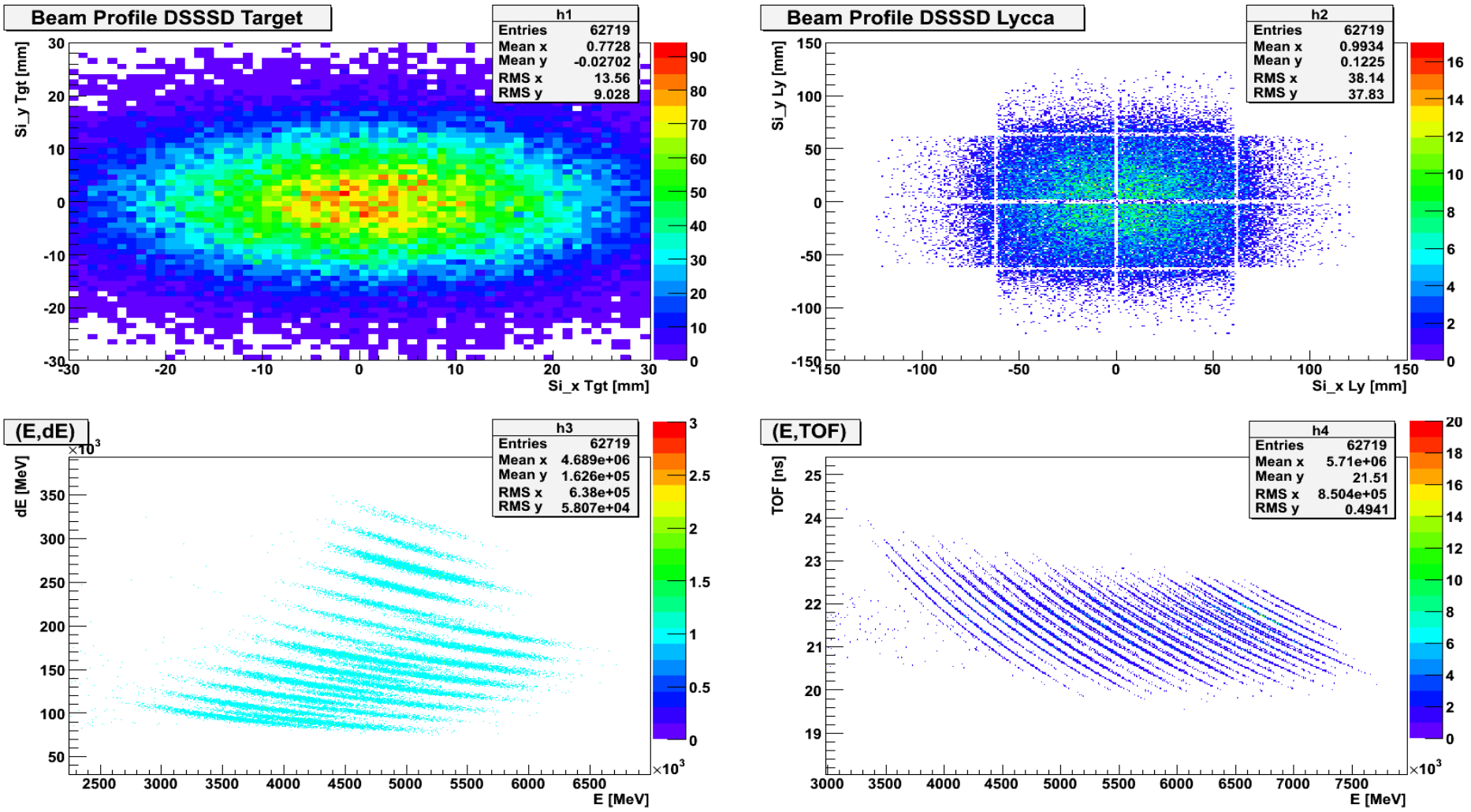

Figure 2. [Top left + right] Beam profile in both the Si detectors. [Bottom left] (E,dE) plot. [Bottom right] (E,TOF) plot (TOF start signal taken from S2 focal plane).

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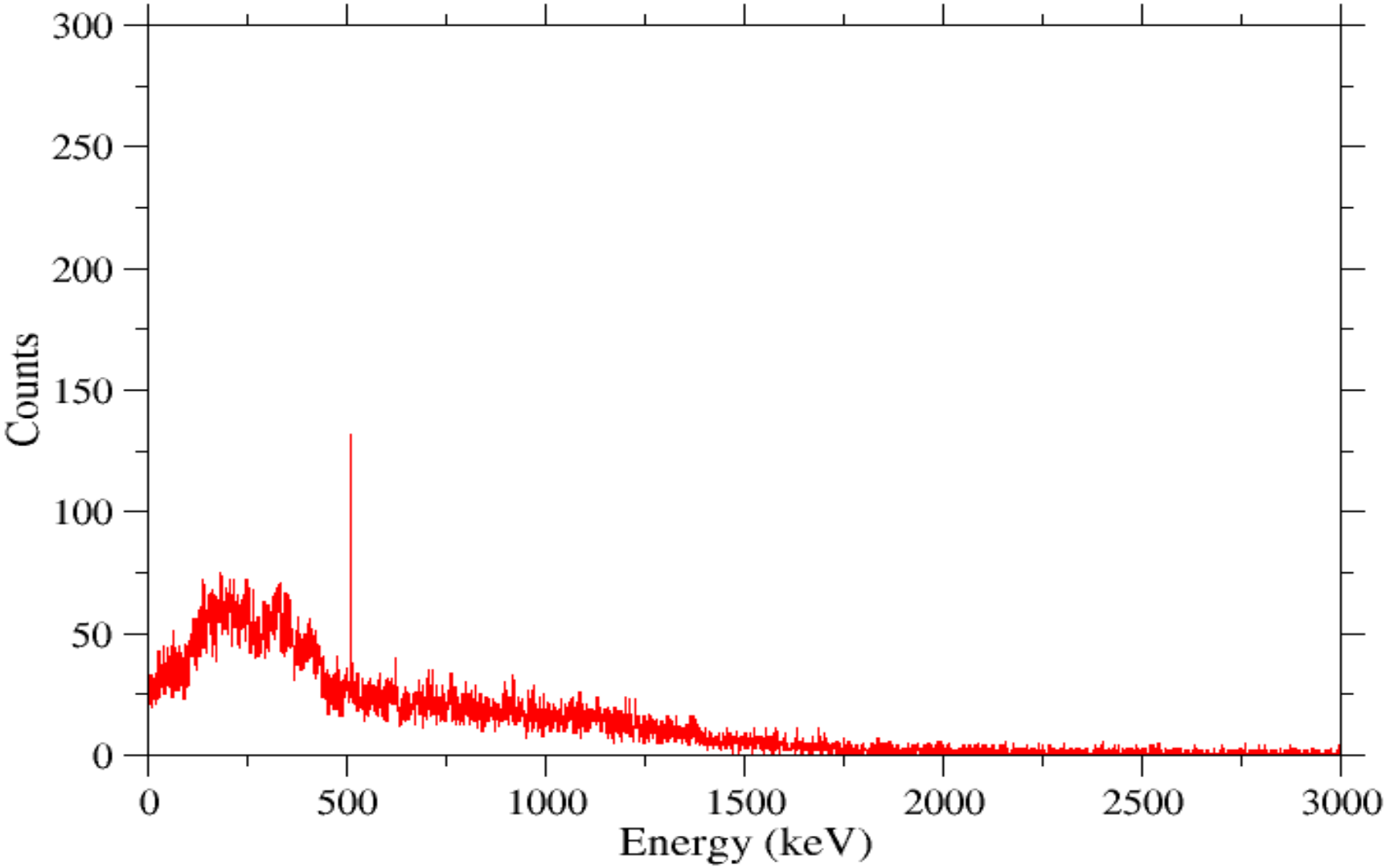
RISING γ-spectrum

Figure 3. Uncorrected γ-spectrum showing 'sum of all crystals' for ^{54}Co.



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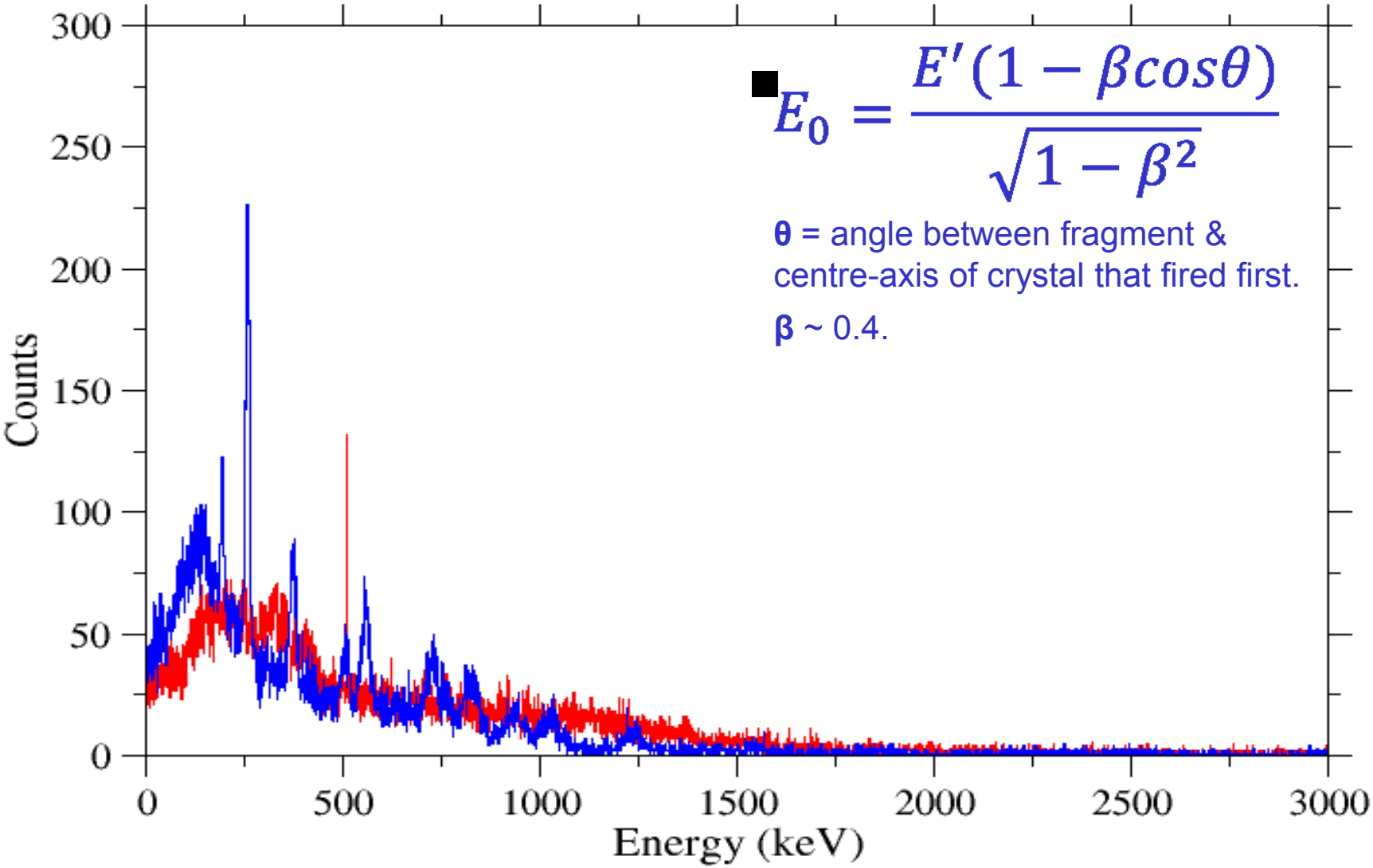
RISING γ-spectra

Figure 4. Corrected & uncorrected γ-spectra showing 'sum of all crystals' for ^{54}Co.



$$E_0 = \frac{E'(1-\beta cos\theta)}{\sqrt{1-\beta^2}}$$

θ = angle between fragment & centre-axis of crystal that fired first.

β ~ 0.4.

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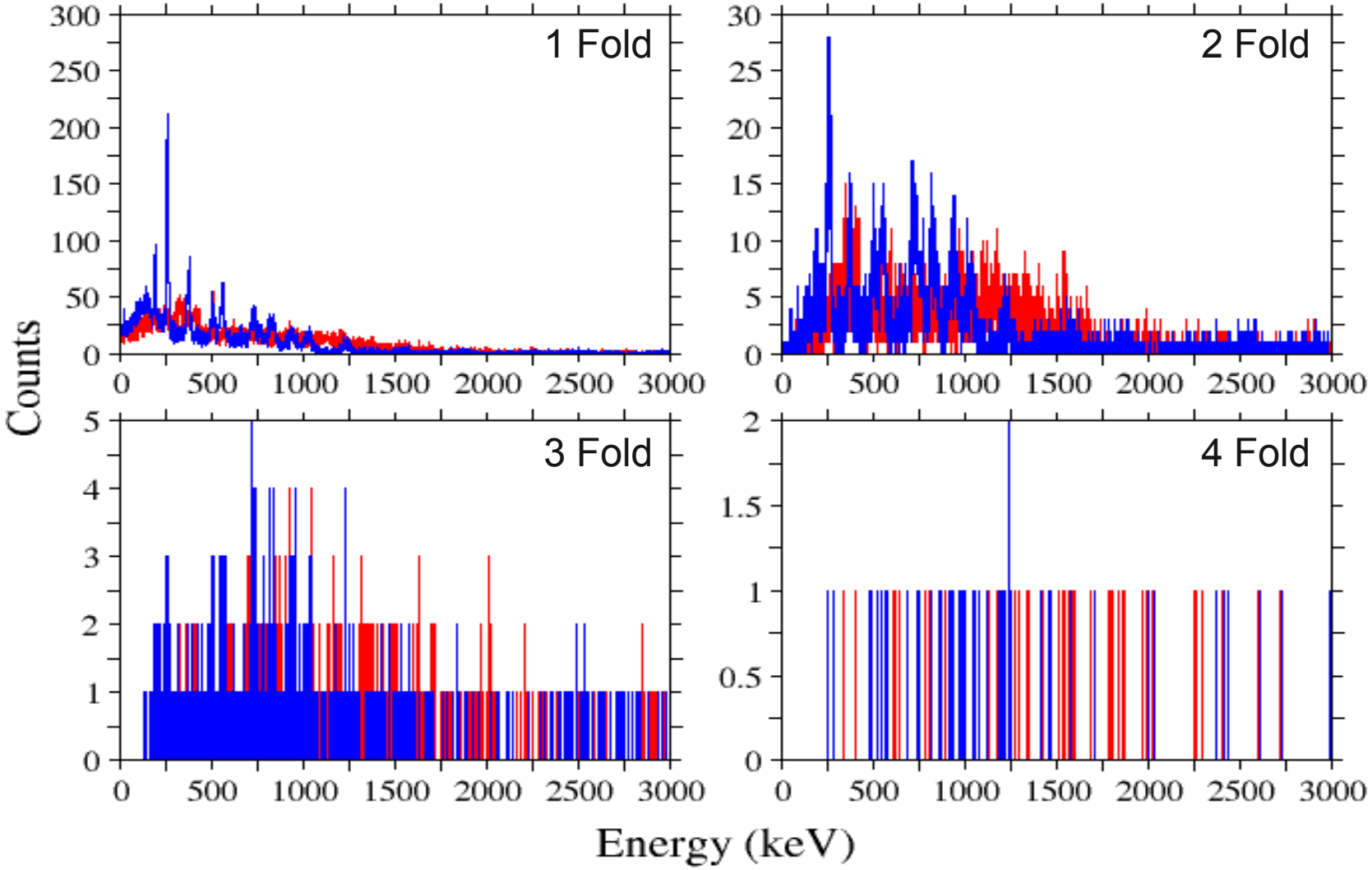
RISING γ-spectra

Figure 5. Corrected & uncorrected nFold γ-spectra. Add-back method used and Doppler correction applied to crystal containing highest *E*.



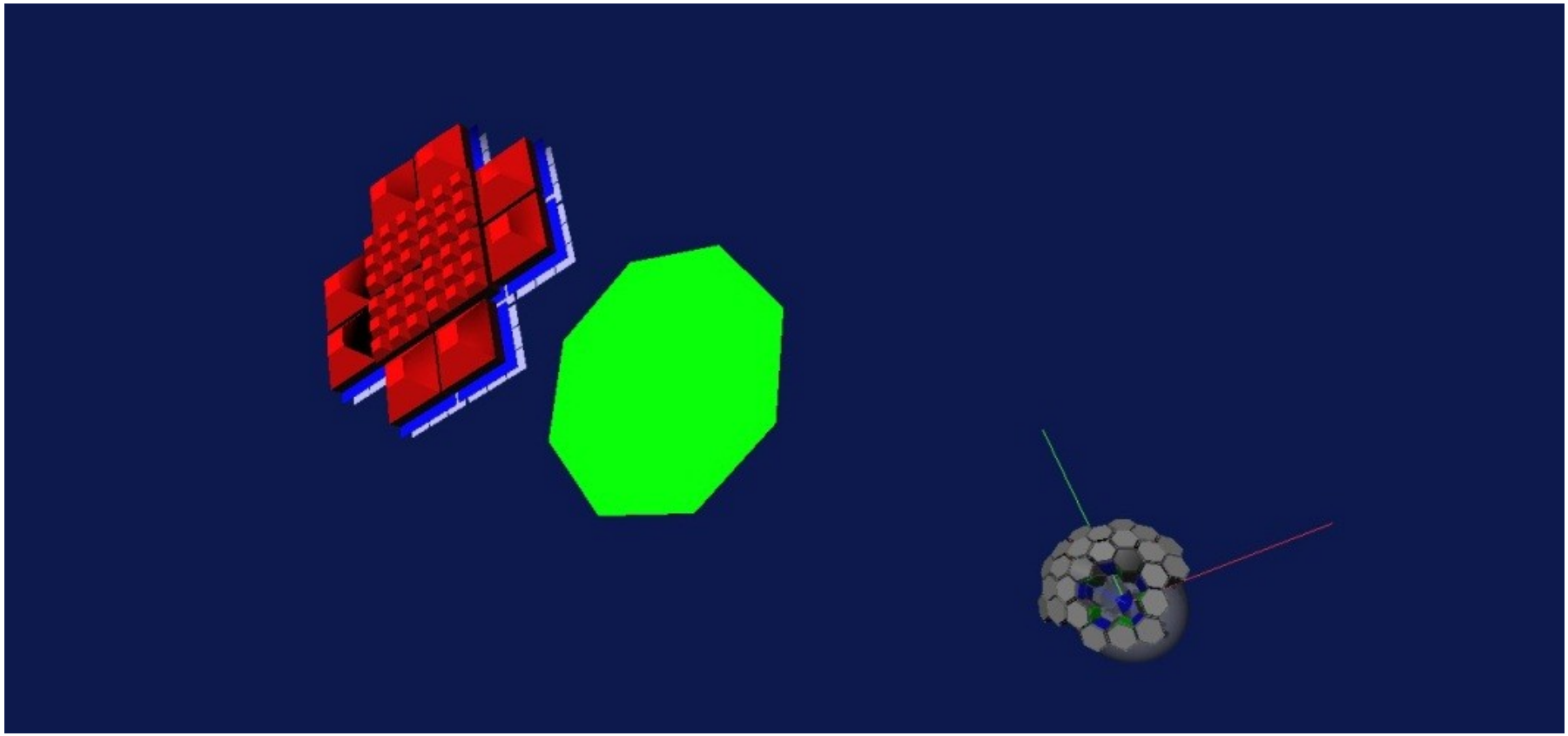


Figure 6. AGATA S2 configuration (5 triples + 5 doubles) + LYCCA-0.

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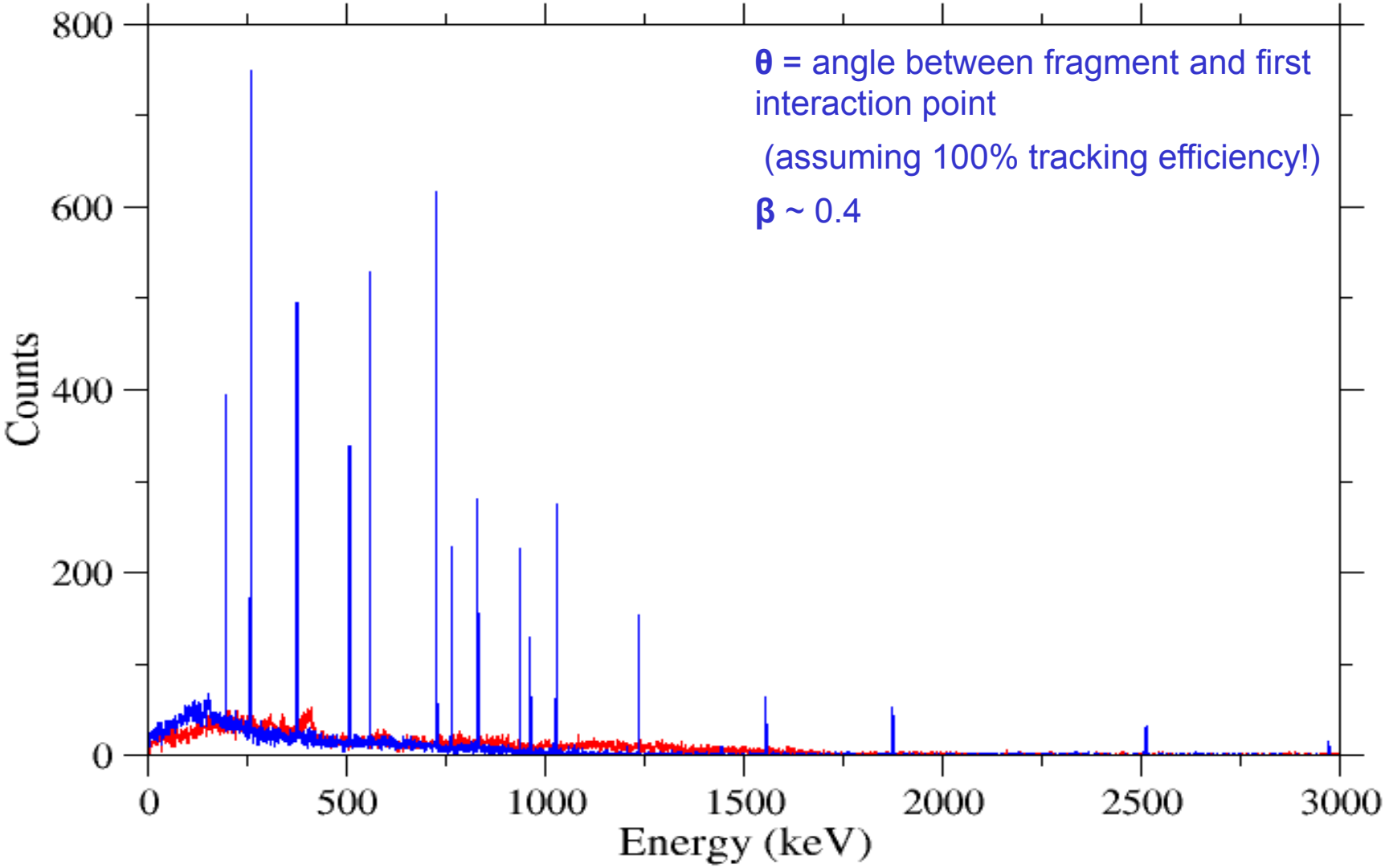
AGATA γ-spectra

Figure 7. Uncorrected & corrected 'sum of all crystals' γ-spectra for ^{54}Co.



Summary

- Simulation package to simulate secondary fragmentation and relativistic Coulex reactions from an AGATA perspective
  - Calculate recoil velocity and direction from LYCCA-0 interactions.
  - Test performance of Doppler correction/spectral reconstruction + tracking.

To do:

- Fine tune package & simulate up and coming PRESPEC experiment (Coulex of ^{29}S).

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Univ. Cracow, Poland
STFC Daresbury, UK
GSI Darmstadt, Germany
TU Darmstadt, Germany
INFN Firenze, Italy
INFN Genova, Italy
Univ. Göteborg, Sweden
FZ Jülich, Germany
Univ. Jyväskylä, Finland
Univ. Keele, UK
Univ. Köln, Germany
IFJ PAN Krakow, Poland
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