Progress of the ^{85}Br Spin-flip Experiment *S426* at PreSPEC

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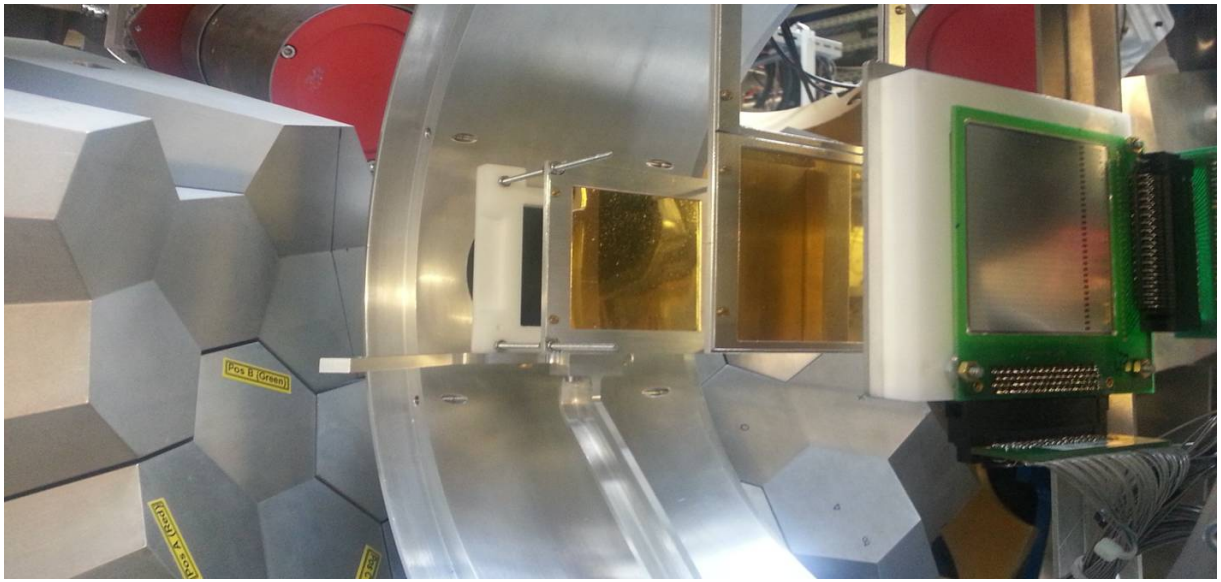

Coulomb Excitation Multipolarimetry Setup @ PreSPEC 2014 (picture by C. Stahl)

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Spin-flip Transitions in $N = 50$ Isotonic Chain

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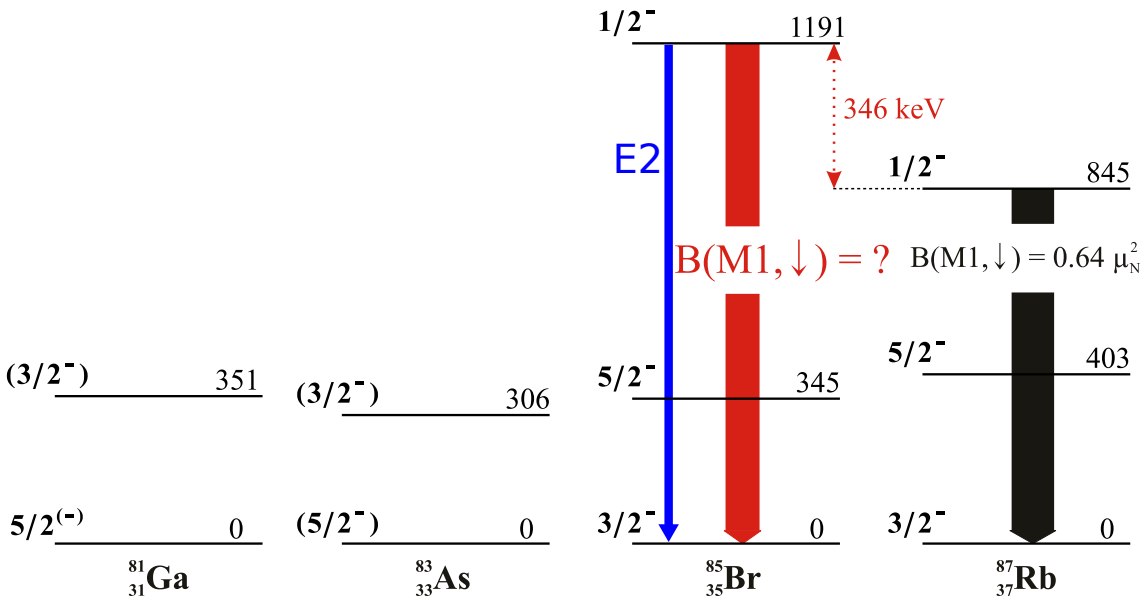
^{83}Rb e- capture	^{84}Rb β+	^{85}Rb Stable	^{86}Rb β-	^{87}Rb Stable	^{88}Rb β-	^{89}Rb β-
^{82}Kr Stable	^{83}Kr Stable	^{84}Kr Stable	^{85}Kr β-	^{86}Kr Stable	^{87}Kr β-	^{88}Kr β-
^{81}Br Stable	^{82}Br β-	^{83}Br β-	^{84}Br β-	^{85}Br β-	^{86}Br β-	^{87}Br β-
^{80}Se Stable	^{81}Se β-	^{82}Se Stable	^{83}Se β-	^{84}Se β-	^{85}Se β-	^{86}Se β-
^{79}As β-	^{80}As β-	^{81}As β-	^{82}As β-	^{83}As β-	^{84}As β-	^{85}As β-
^{78}Ge β-	^{79}Ge β-	^{80}Ge β-	^{81}Ge β-	^{82}Ge β-	^{83}Ge β-	^{84}Ge β-
^{77}Ga β-	^{78}Ga β-	^{79}Ga β-	^{80}Ga β-	^{81}Ga β-	^{82}Ga β-	^{83}Ga β-
^{76}Zn β-	^{77}Zn β-	^{78}Zn β-	^{79}Zn β-	^{80}Zn β-	^{81}Zn β-	^{82}Zn β-
^{75}Cu β-	^{76}Cu β-	^{77}Cu β-	^{78}Cu β-	^{79}Cu β-	^{80}Cu β-	^{81}Cu β-
^{74}Ni β-	^{75}Ni β-	^{76}Ni β-	^{77}Ni β-	^{78}Ni β-	^{79}Ni β-	^{80}Ni β-
^{73}Co β-	^{74}Co β-	^{75}Co β-	^{76}Co β-	^{77}Co β-		



C. Stahl Ph.D. thesis, TU Darmstadt, 2015 (modified)

$E2$ and $M1$ for $\pi p_{3/2} \rightarrow \pi p_{1/2}$ possible

$\Rightarrow$ Measure multipole mixing ratio δ

Taken from:
https://people.physics.anu.edu.au/ ecs103/chart/index.php

Coulex-Multipolarimetry

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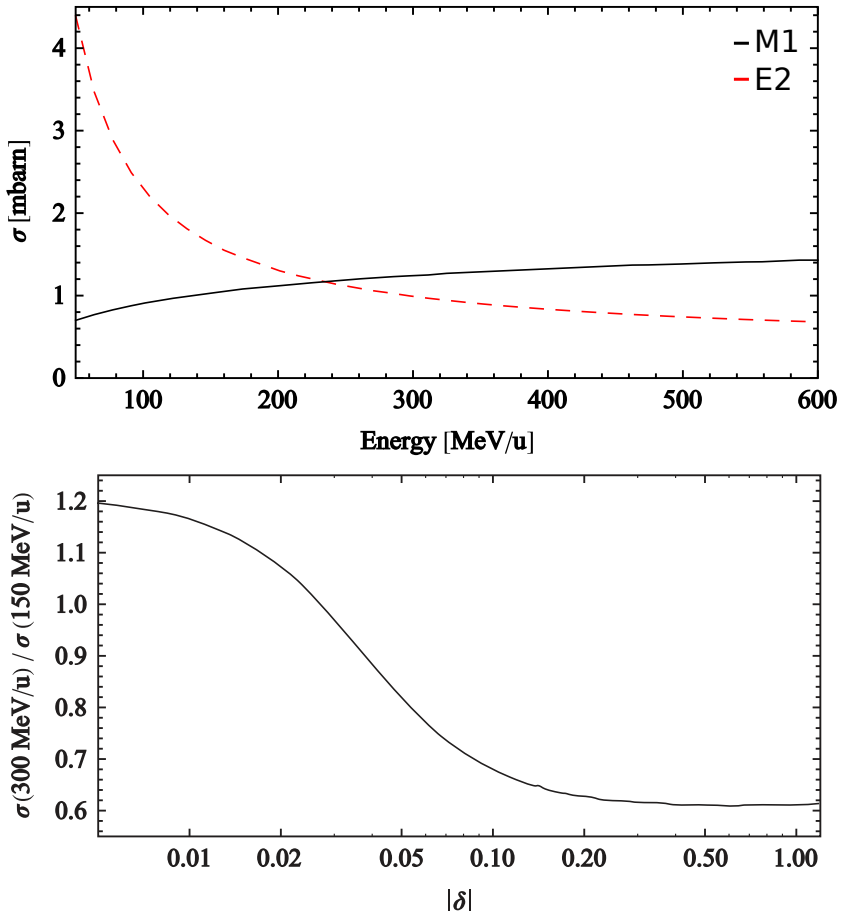
Problem:
$1/2^- \rightarrow 3/2^-$ isotropic γ emission

- $B(M1)$ measurement via angular distributions not possible
- Different method: **Coulex-Multipolarimetry**
- Two beam energies $\rightarrow |\delta|$ from cross sections



C. Stahl *et al.*, NIM A 770 (2015) 123-130 (modified).

Coulex-Multipolarimetry

Two-Target Configuration

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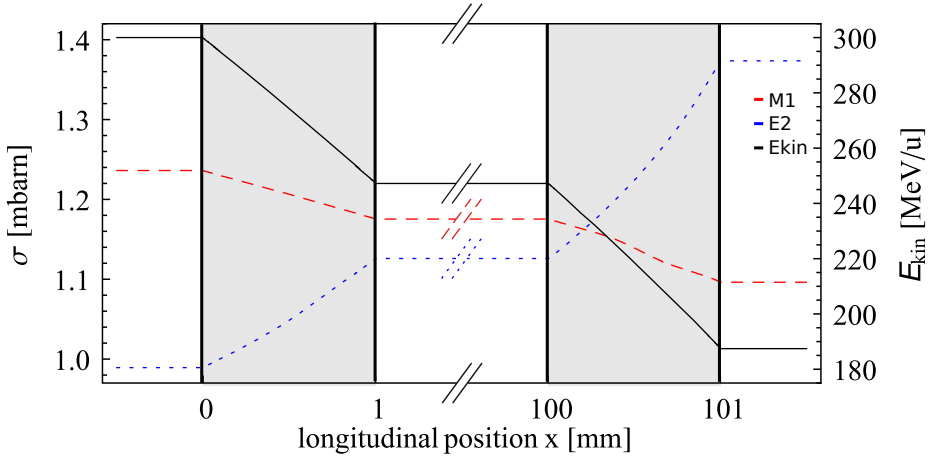
Problem: Beam-time cuts from 24 to 12 shifts

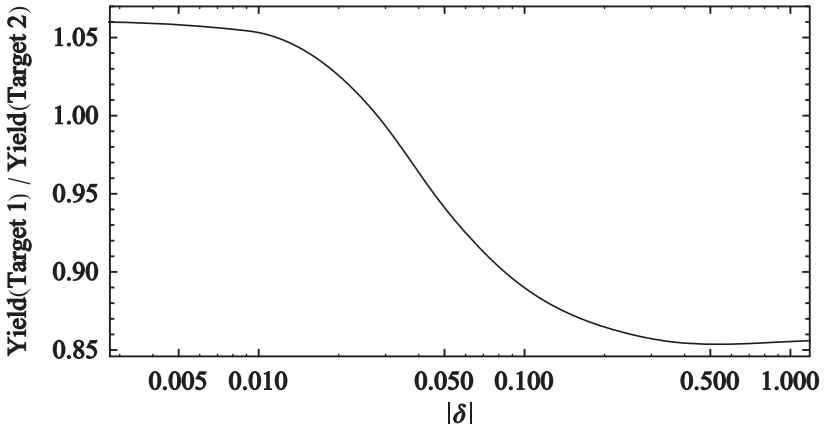
Possible solution: Two targets, one beam energy

- Energy loss in target "causes" two beam energies
- Compare target yields

$$y_i \propto \int_{x_{i,1}}^{x_{i,2}} \mathrm{d}x\, \sigma(E_{\mathrm{kin}}(x))$$

- $|\delta|$ from yields





C. Stahl *et al.*, NIM A 770 (2015) 123-130 (modified).

PreSPEC Experiment *S426*

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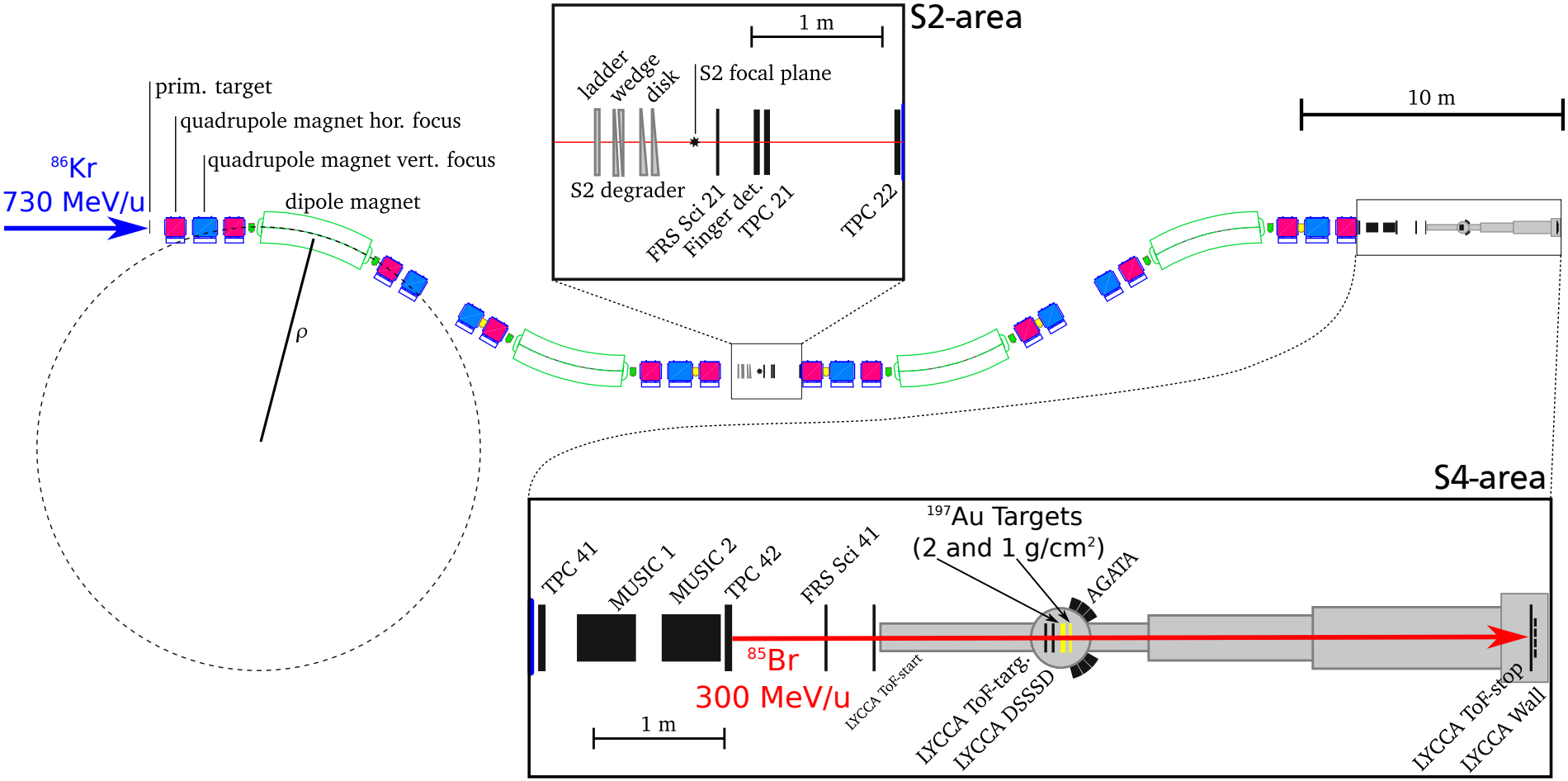
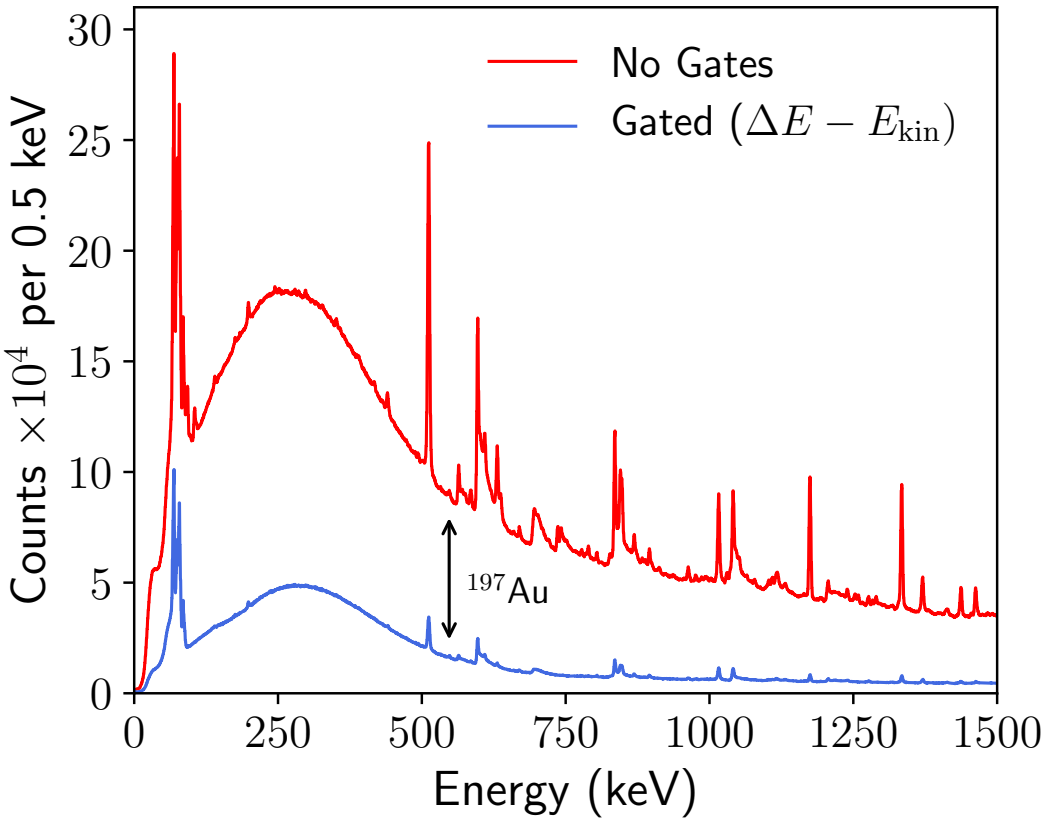
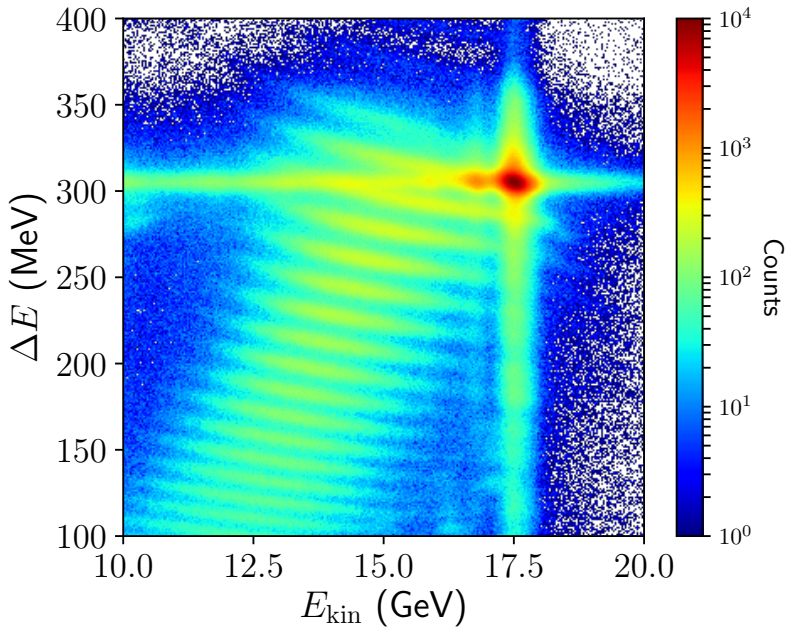


based on `https://www-win.gsi.de/frs-setup/Downloads//T-Autocad-FRS_CAVE-FRS_04_17_Model.pdf`, modified by M. Reese (modified again)

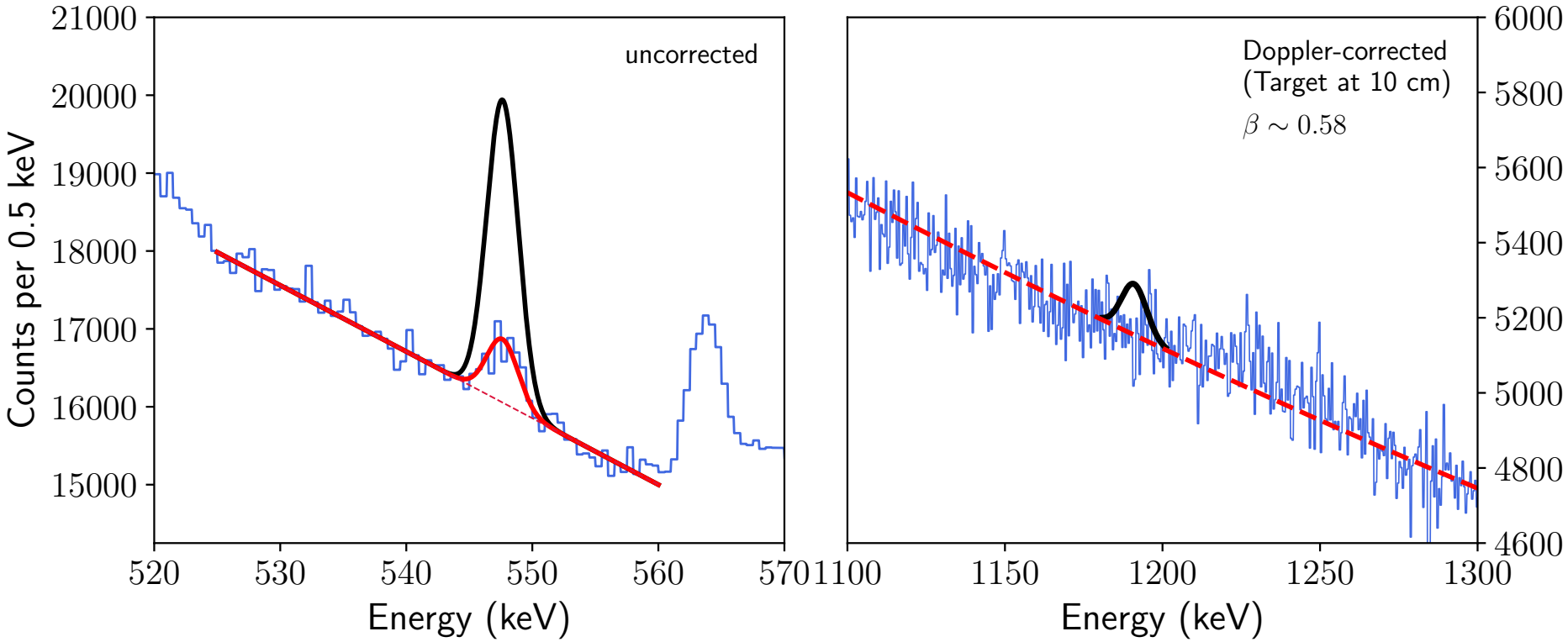
Particle Identification





^{85}Br Coulomb-Excitation Detection Limits

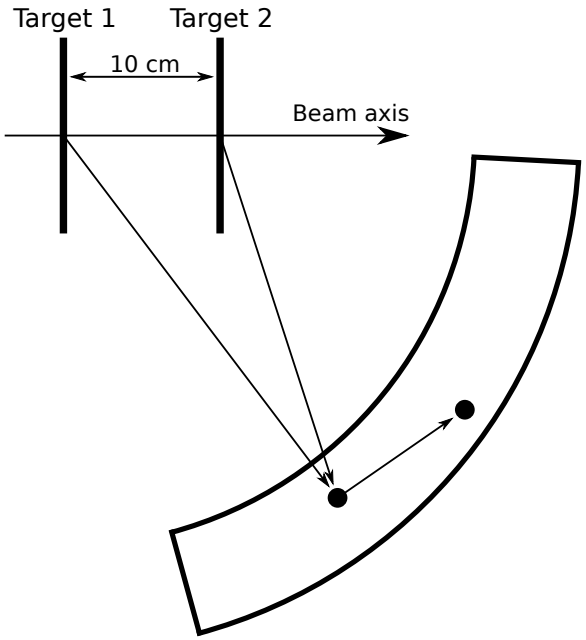
Core Spectra



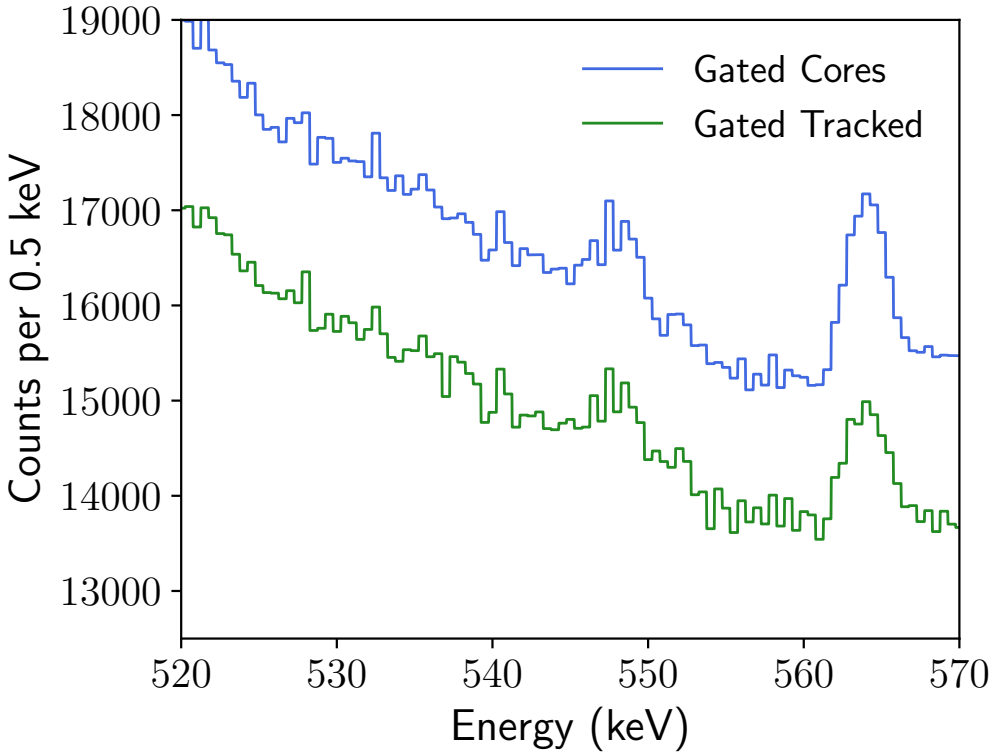
Counts	^{197}Au (548 keV)	^{85}Br (1191 keV)	Missing
Measured	5079 (891)	177*	$\times$ **8**
Required	40000	1400	(for 3σ)

* Expected counts in ^{85}Br peak

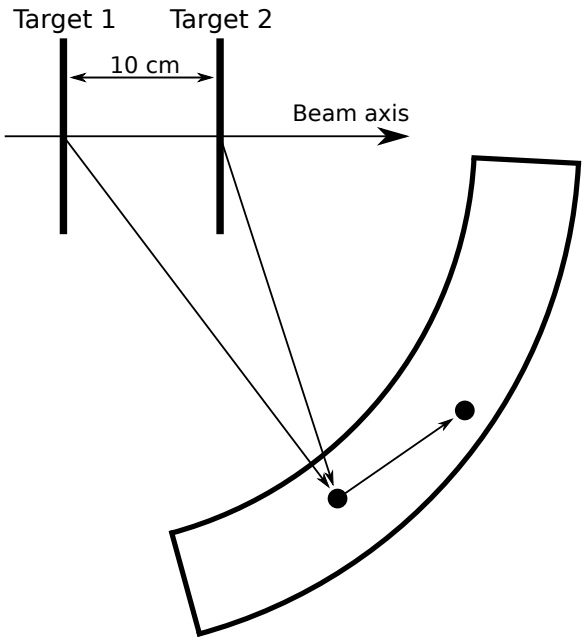
Target Identification



Schematic drawing of γ-ray tracking scenario for target identification



Target Identification



Schematic drawing of γ-ray tracking scenario for target identification

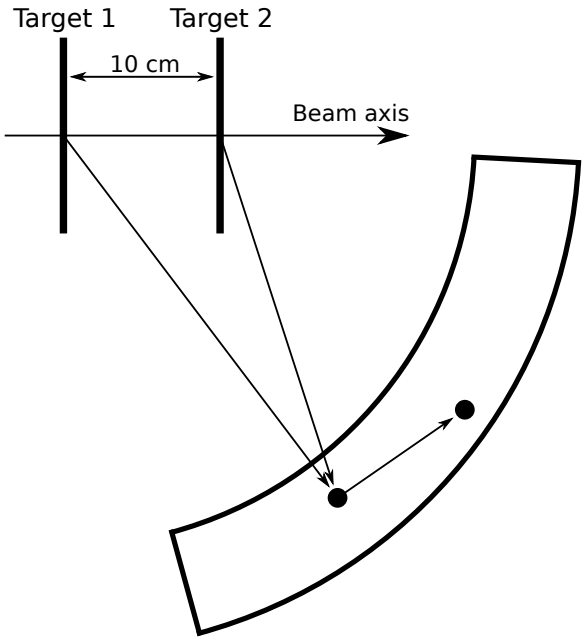
Target identification via γ-ray tracking
$\rightarrow$ Define Asymmetry

$$P_{1,2} = \frac{P_1 - P_2}{P_1 + P_2}$$

- $P_i \propto \exp\left(-\frac{|\theta_E - \vartheta_X|^2}{2\sigma^2_{\theta\vartheta}}\right)$
- $P_{1,2} \in [-1, 1]$

Quality of identification $\Rightarrow P_i \geq 10^{-3}$

Target Identification



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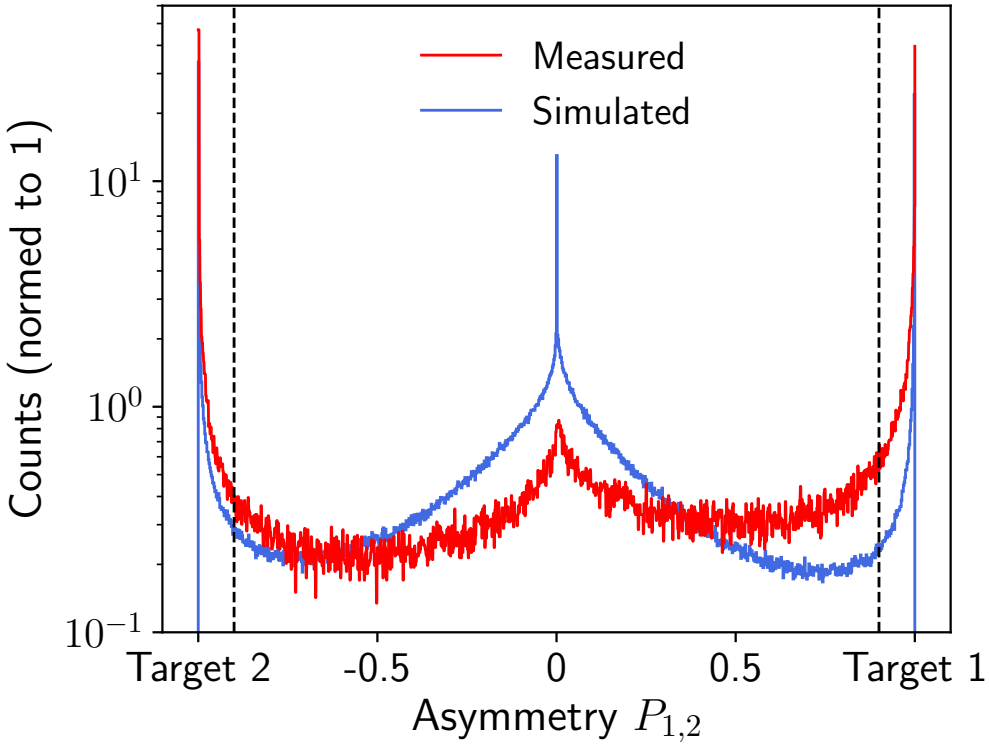
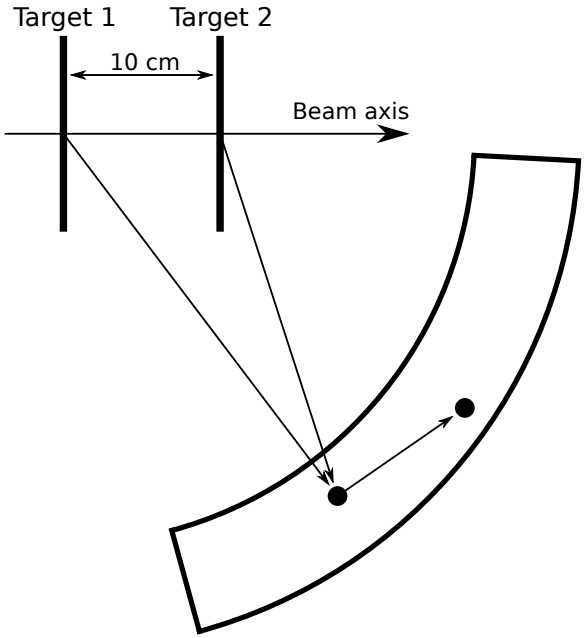


Measured and simulated asymmetries $P_{1,2}$ for E_γ = 547.5 keV

Target Identification



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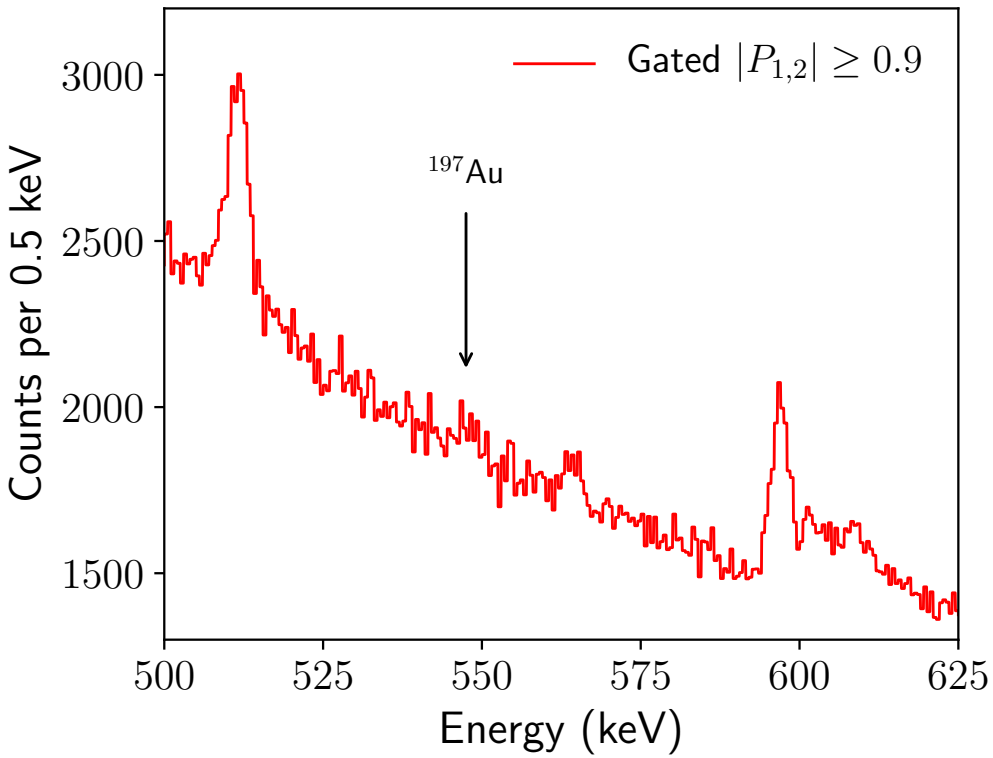

^{85}Br Spin-flip @ FAIR

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At the moment:

- For successful measurement, $\sim$**8** times more statistics needed

Possible improvements:

- AGATA 1π: **twice** as much statistics expected
- FAIR: designed to have lower background

Assuming background reduction of 5 + using AGATA 1π

Required beam time: $\sim 50 - 60$ h for 3σ ^{85}Br peak

Conclusion & Outlook

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Conclusion

- For significant ^{85}Br peak: 8 times more statistics needed
- Impact of γ-ray tracking not known yet
- Background suppression crucial for successful experiment

Outlook

- Experiment @ FAIR probably possible (depending on background)
- Questionable: One or two targets

Collaboration

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and especially to:
M. Lettmann, N. Pietralla, G. Rainovski, R. Kern, M. Reese, C. Stahl

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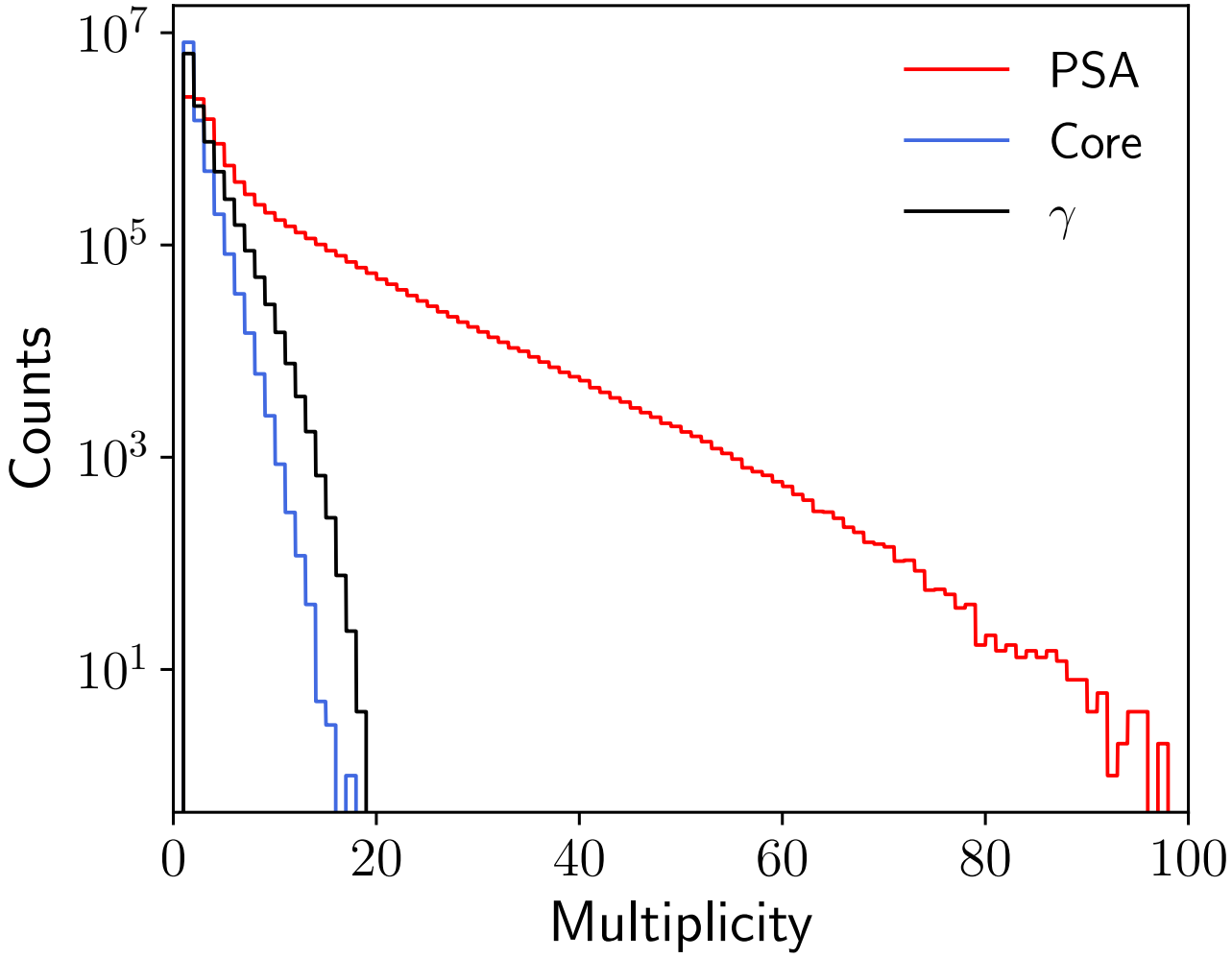
AGATA
ADVANCED GAMMA TRACKING ARRAY

Grant Numbers:
05P19RDFN1 and
05P18RDFN9

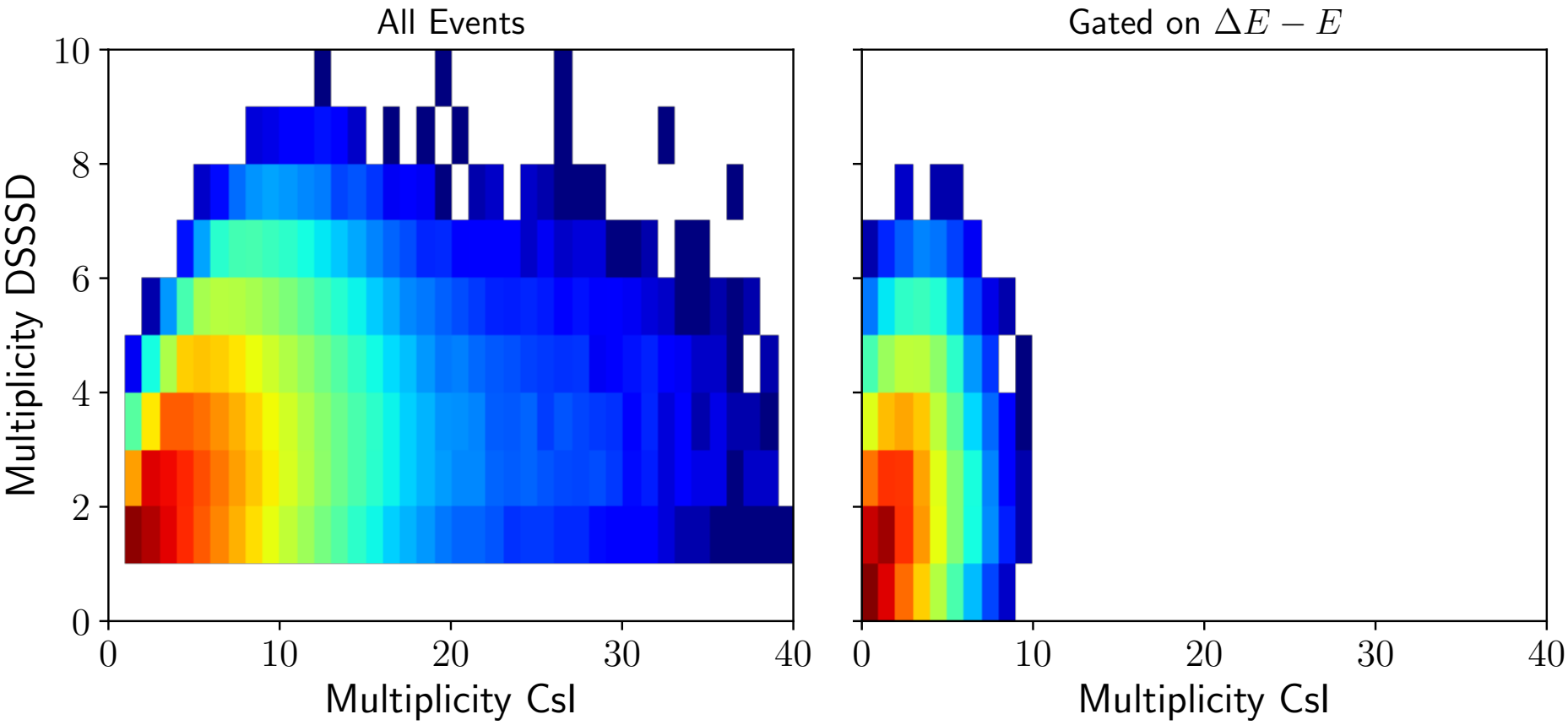
Additional Plots

AGATA Multiplicities



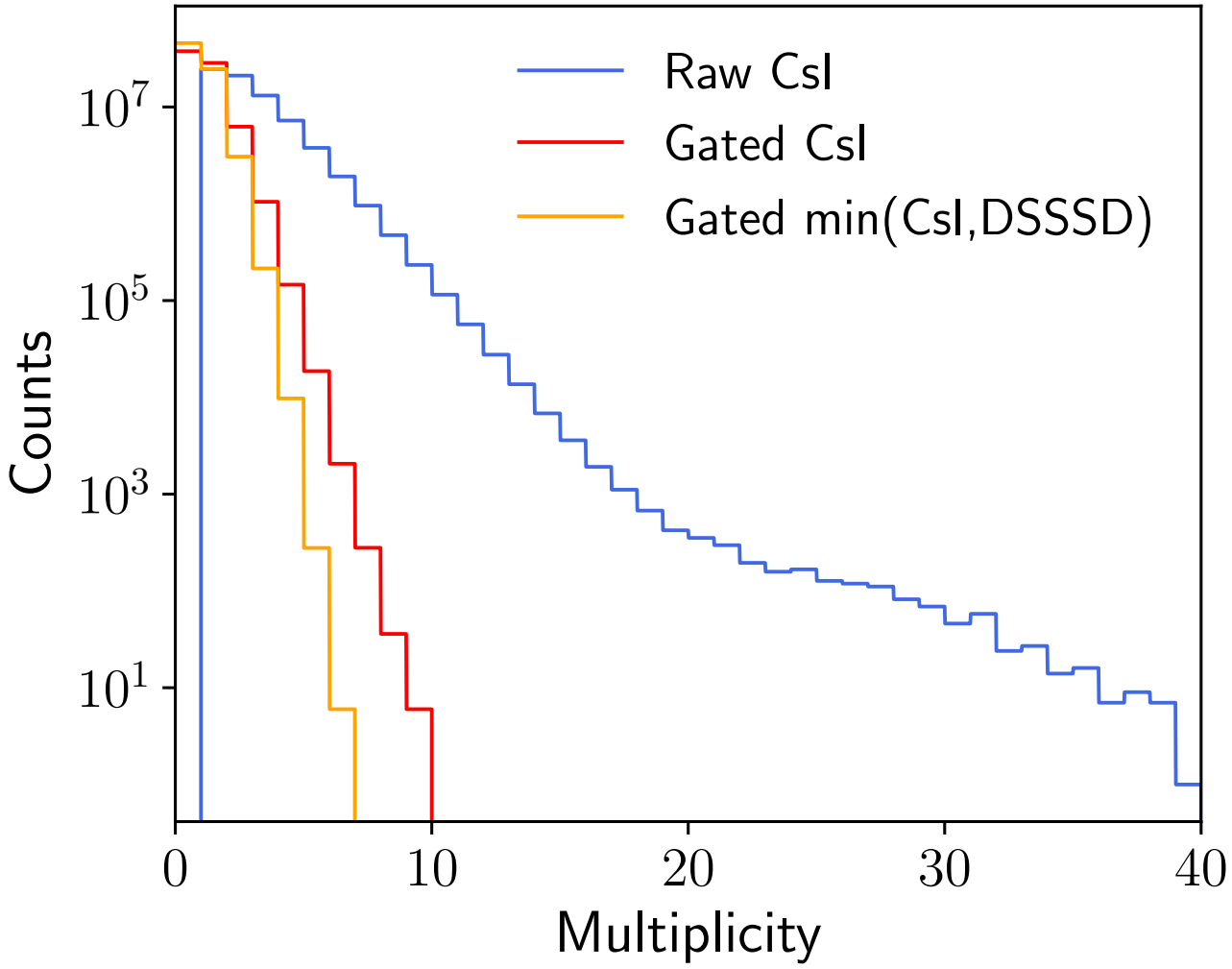
Additional Plots

Lycca Multiplicities



Additional Plots

Lycca Multiplicities



Additional Plots

Particle–Core Time