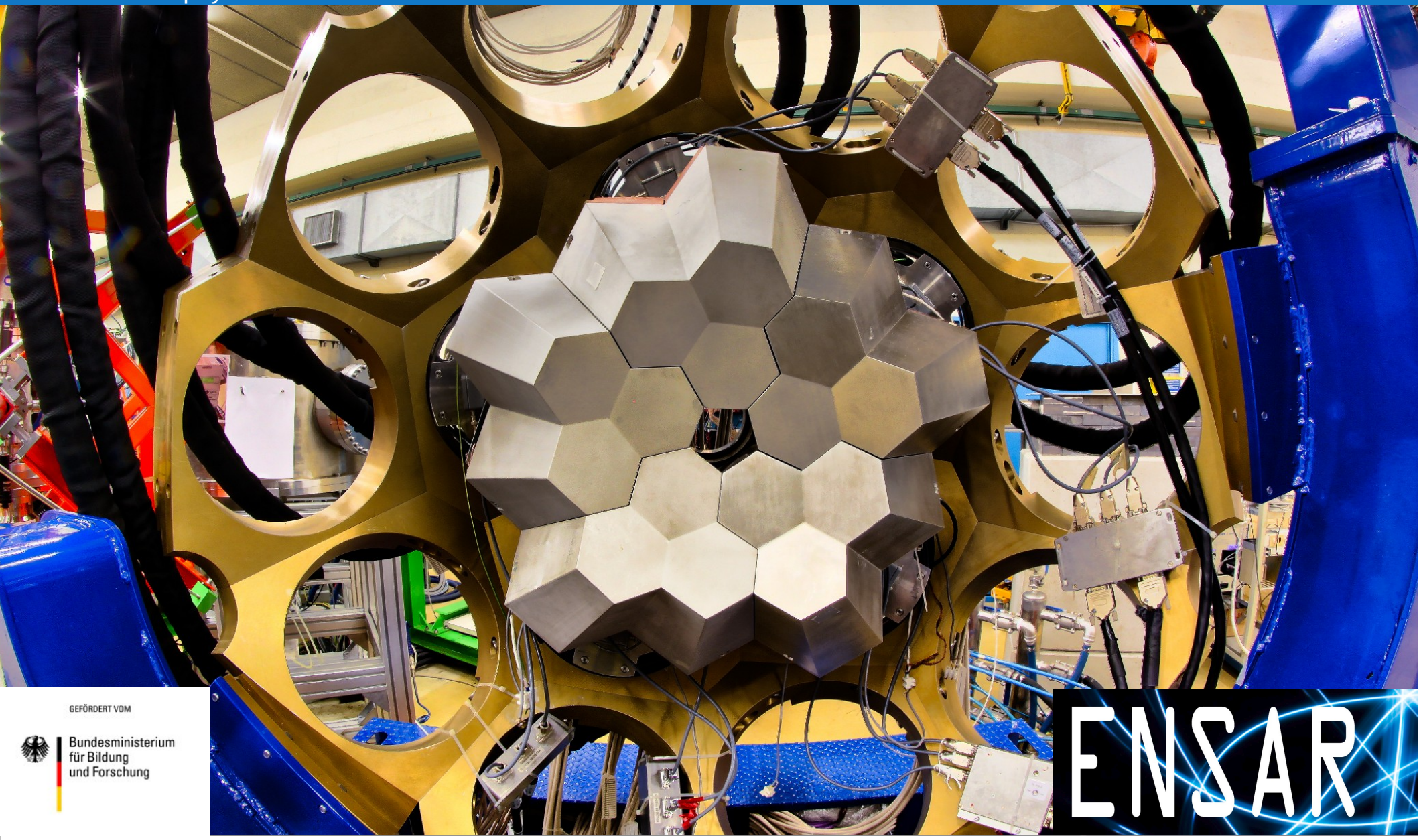

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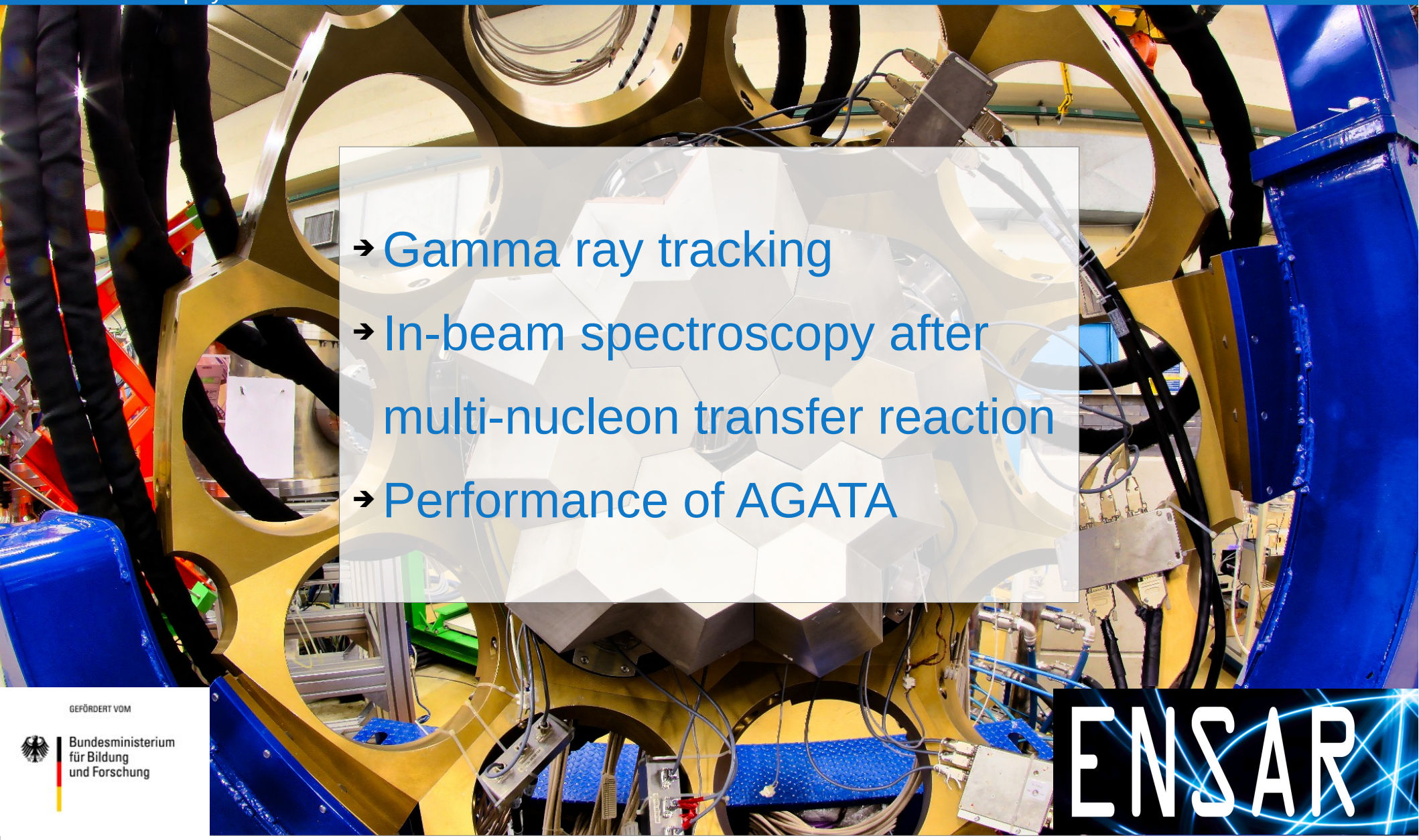
ENSAR

Gamma ray tracking with the AGATA demonstrator

DPG Frankfurt 2014

Benedikt Birkenbach, Herbert Hess, Lewandowski Lars, Peter Reiter, Tim Steinbach, David Schneiders, Andreas Vogt for the AGATA-Collaboration — IKP, Universität zu Köln



- Gamma ray tracking
- In-beam spectroscopy after multi-nucleon transfer reaction
- Performance of AGATA

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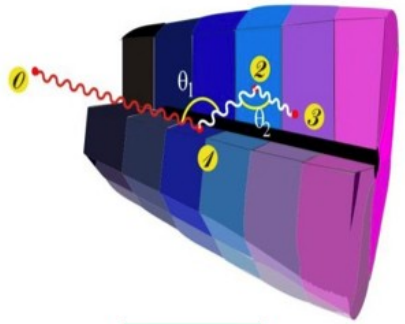
Ingredients of Gamma-Ray Tracking

1

Highly segmented HPGe detectors



2

Digital electronics to record and process segment signals

3

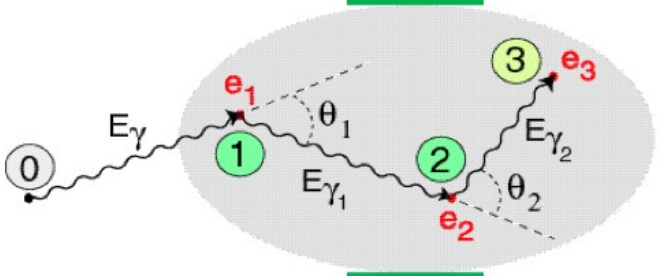
Identified interaction points

$(x,y,z,E,t)_i$

Pulse Shape Analysis to decompose recorded waves

4

Reconstruction of tracks evaluating permutations of interaction points

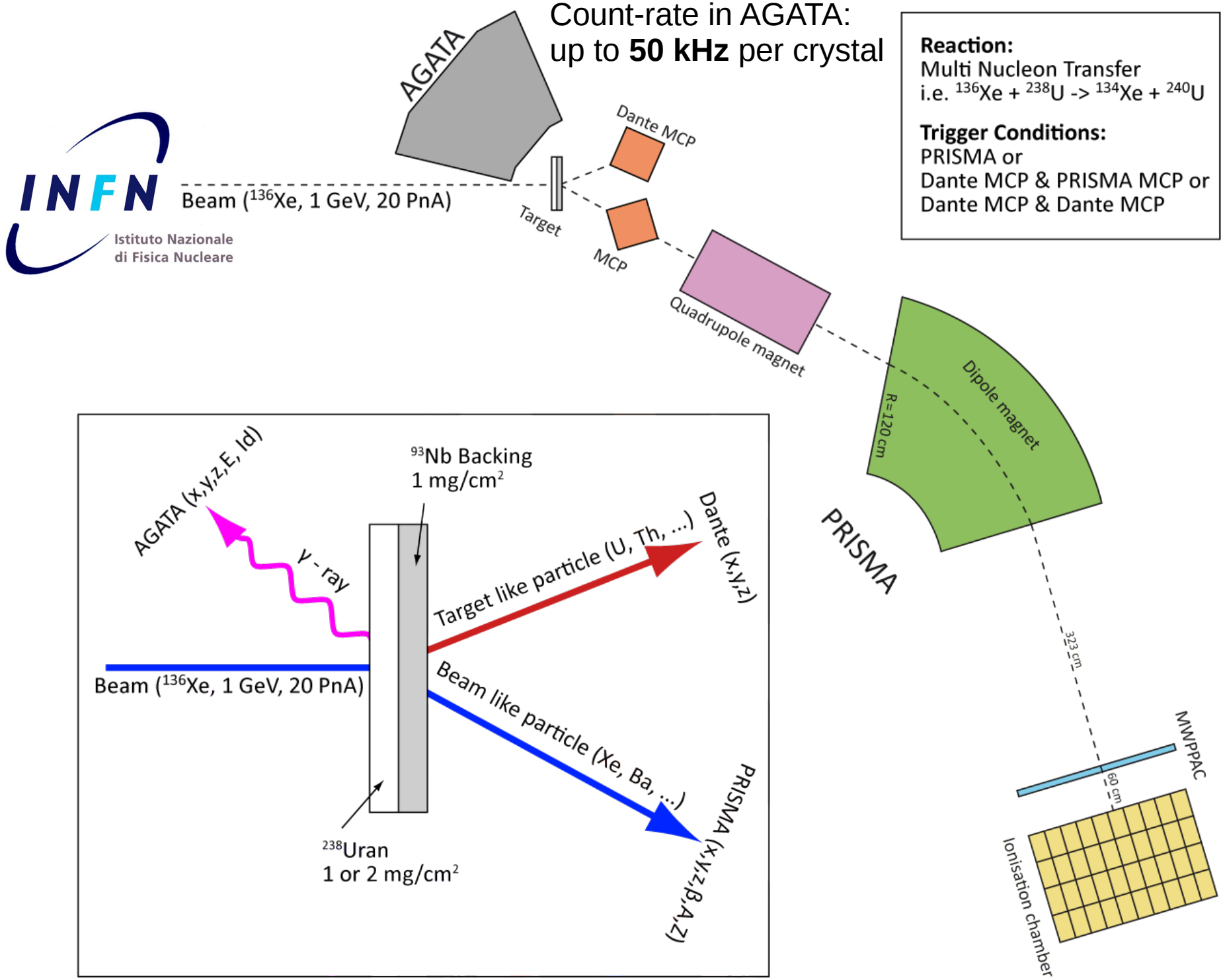


Reconstructed gamma-rays

Count-rate in AGATA:
up to **50 kHz** per crystal

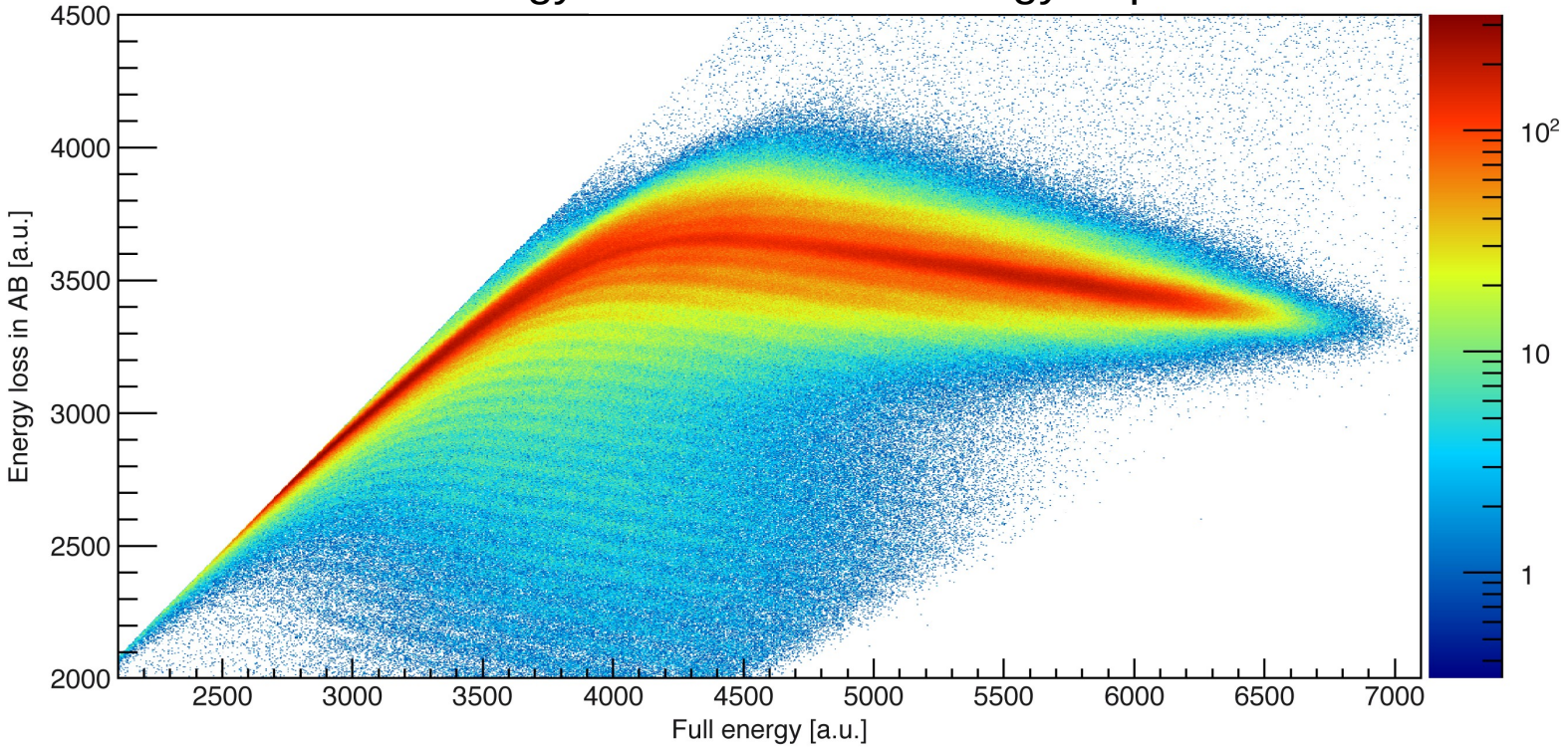
Reaction:
Multi Nucleon Transfer
i.e. $^{136}Xe + ^{238}U \rightarrow ^{134}Xe + ^{240}U$

Trigger Conditions:
PRISMA or
Dante MCP & PRISMA MCP or
Dante MCP & Dante MCP

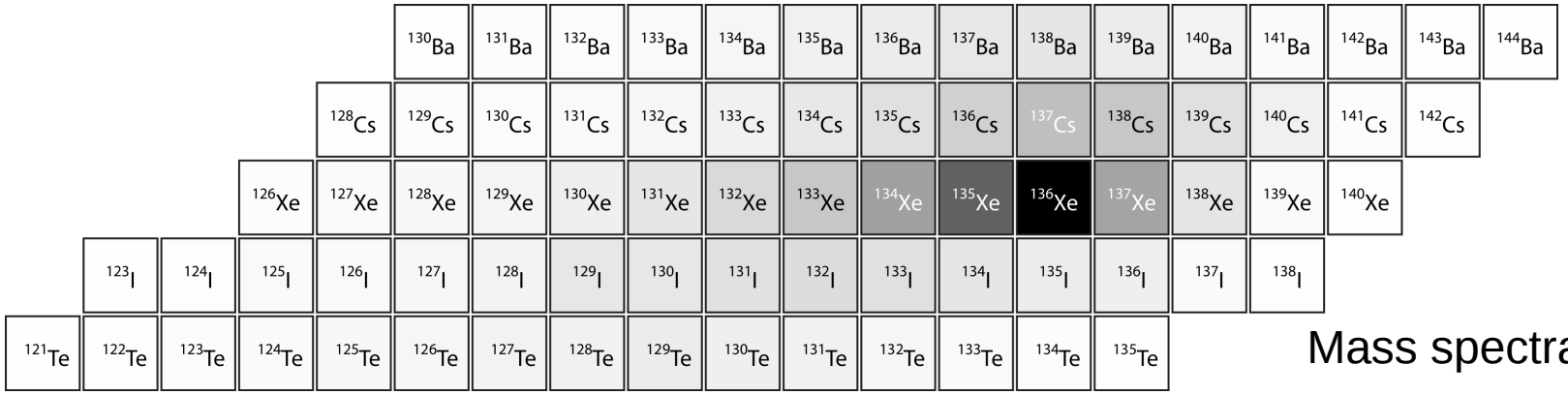


Particle identification with PRISMA

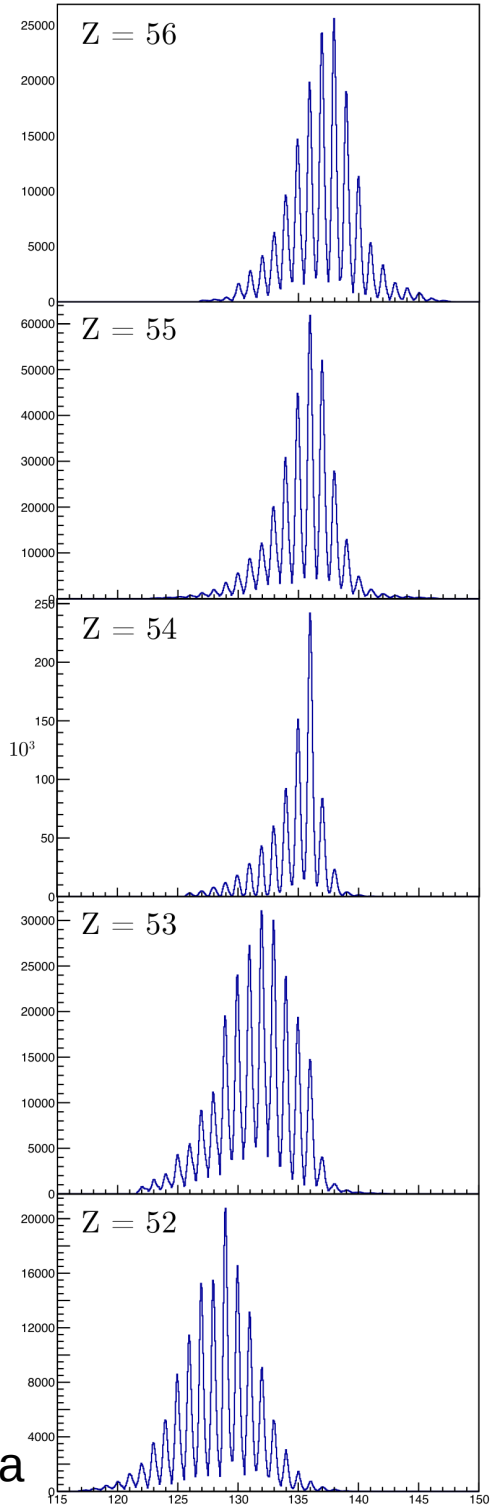
Energy loss versus full energy deposition



HK 11.2 A. Vogt:
Gamma ray spectroscopy of neutron-rich actinides after multi-nucleon transfer reactions



Mass spectra



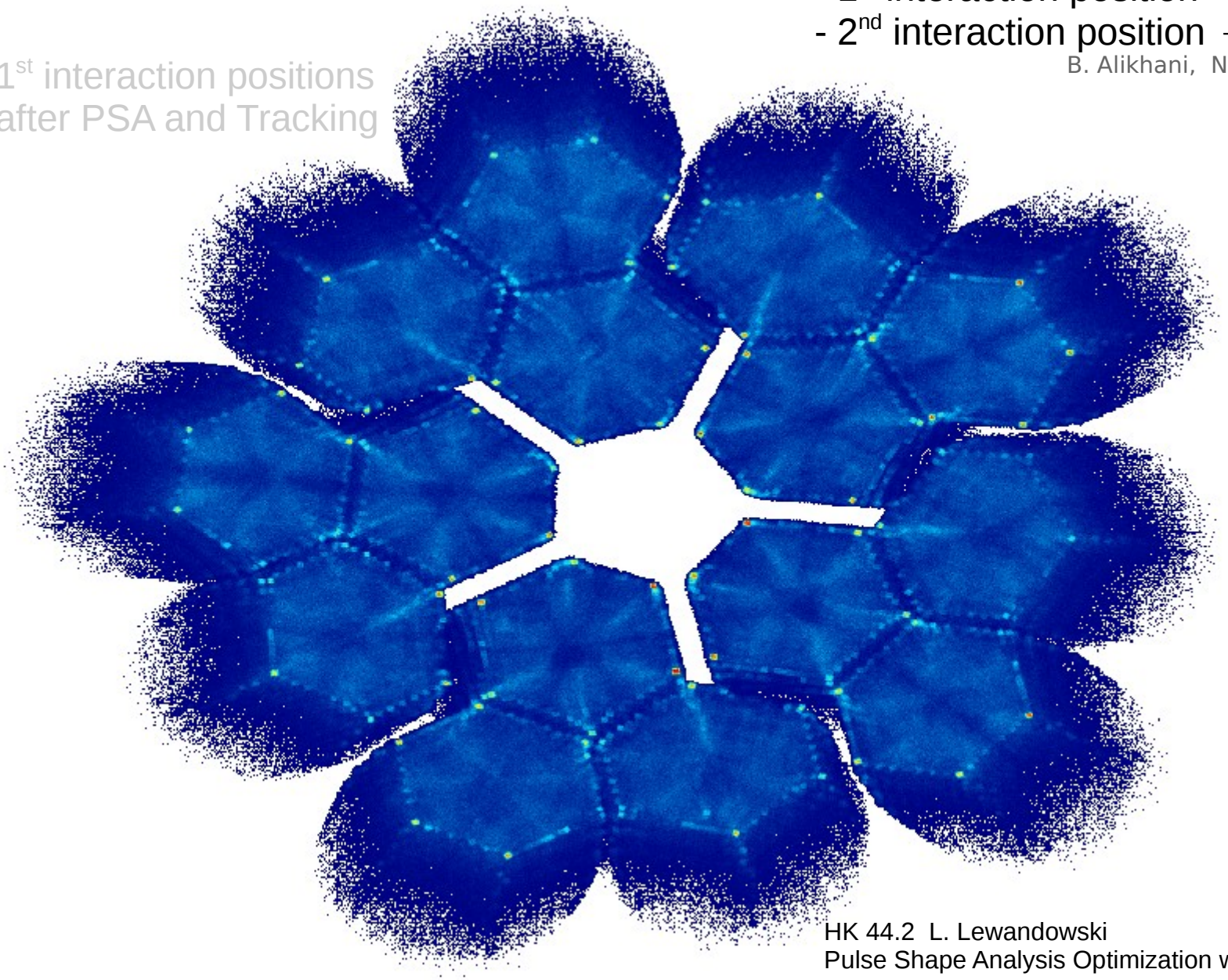
Result of AGATA tracking

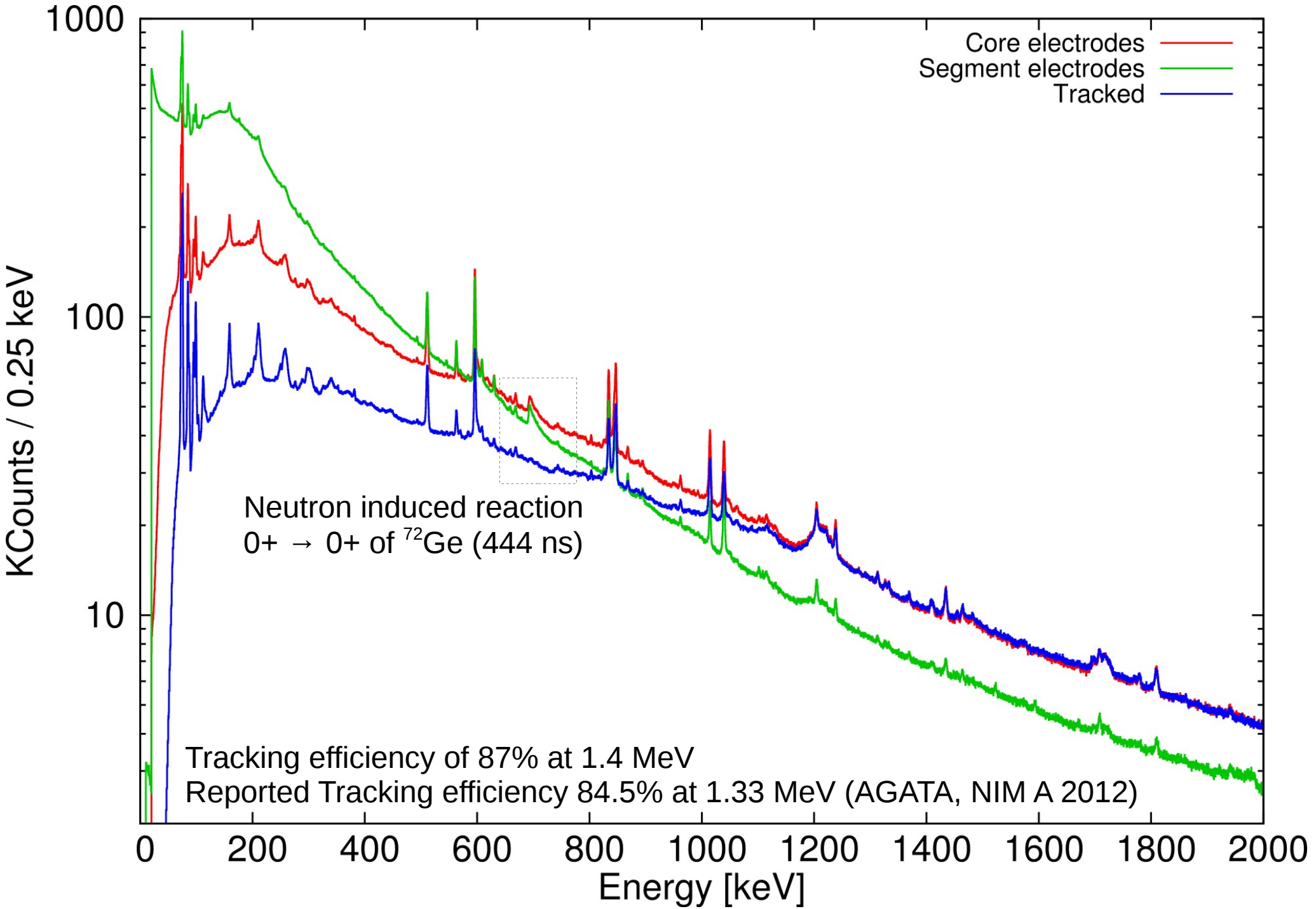
Reconstructed initial gamma rays with:

- gamma ray energy
- 1st interaction position → Doppler correction
- 2nd interaction position → Polarization

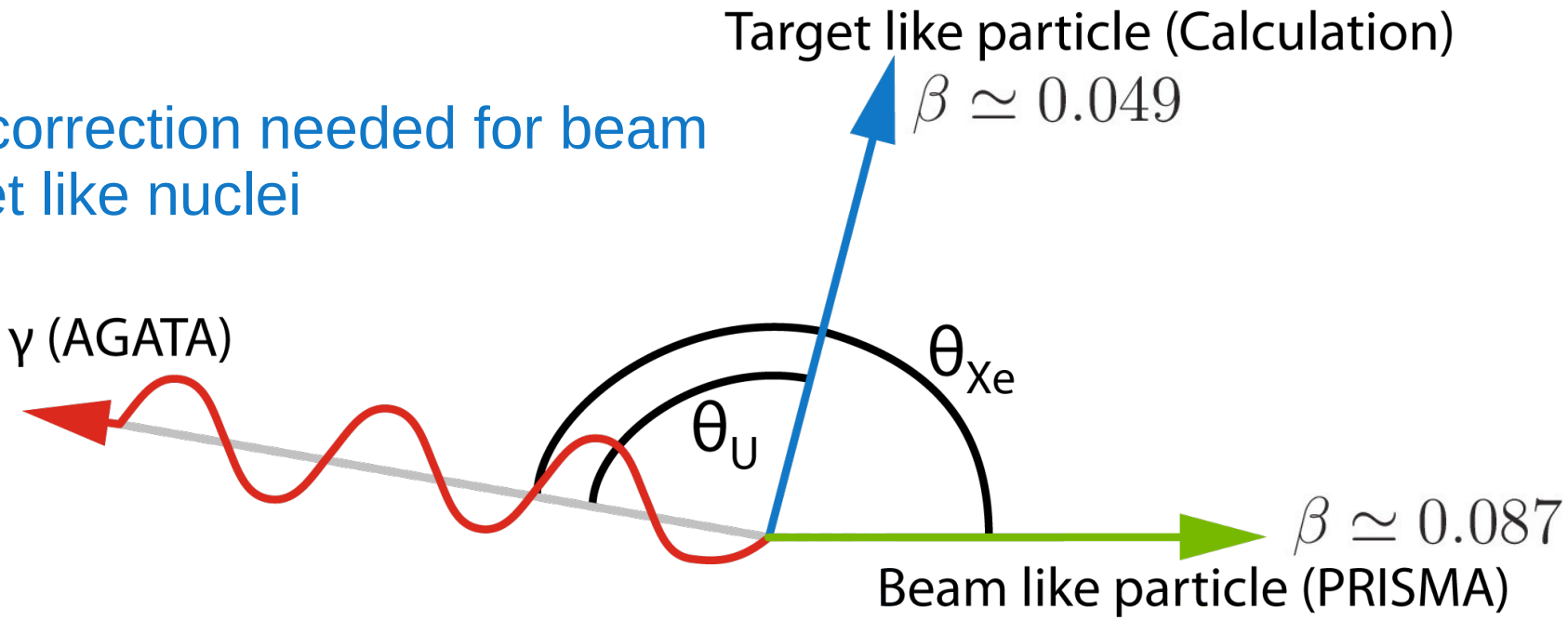
B. Alikhani, NIM A, 675(0):144 - 154, 2012.

1st interaction positions
after PSA and Tracking



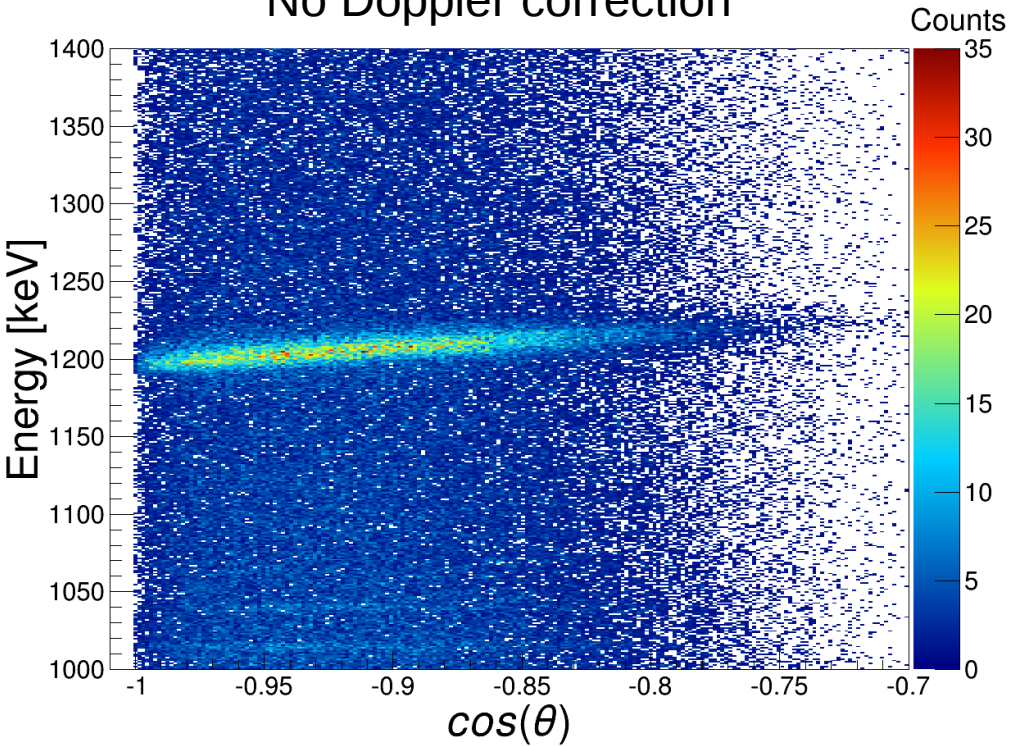

Core electrodes
Segment electrodes
Tracked
Neutron induced reaction
0+ → 0+ of ^{72}Ge (444 ns)
Tracking efficiency of 87% at 1.4 MeV
Reported Tracking efficiency 84.5% at 1.33 MeV (AGATA, NIM A 2012)
KCounts / 0.25 keV
Energy [keV]
1000
100
10
0
200
400
600
800
1000
1200
1400
1600
1800
2000

Doppler correction needed for beam and target like nuclei

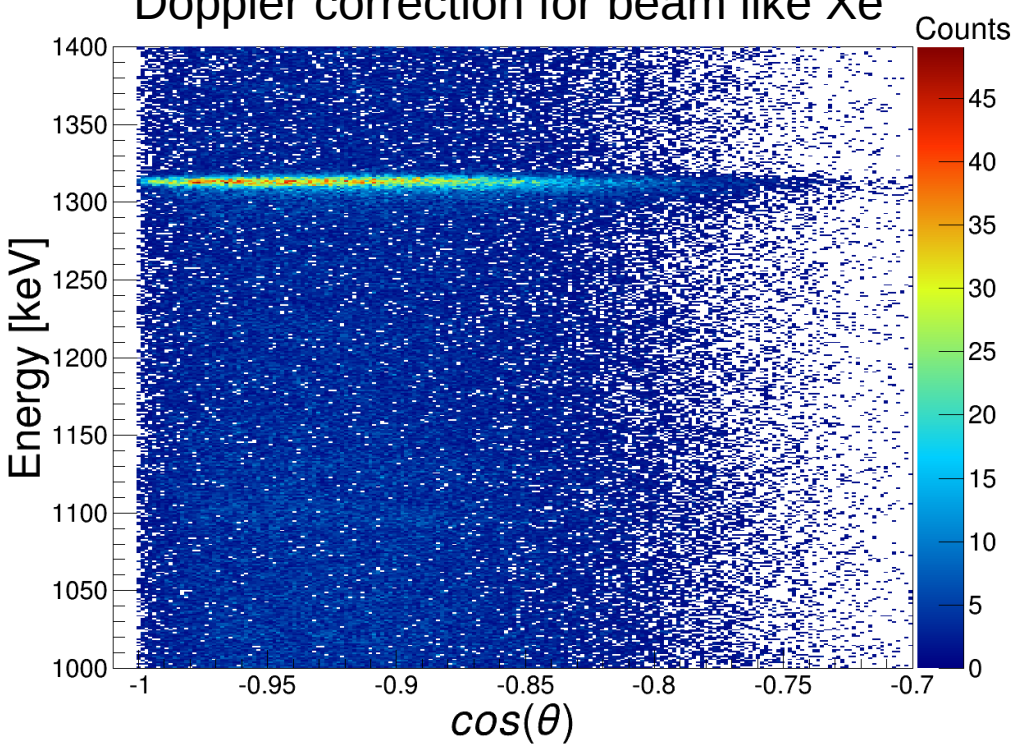


Example: ^{136}Xe: 2+ → 0+ 1313 keV

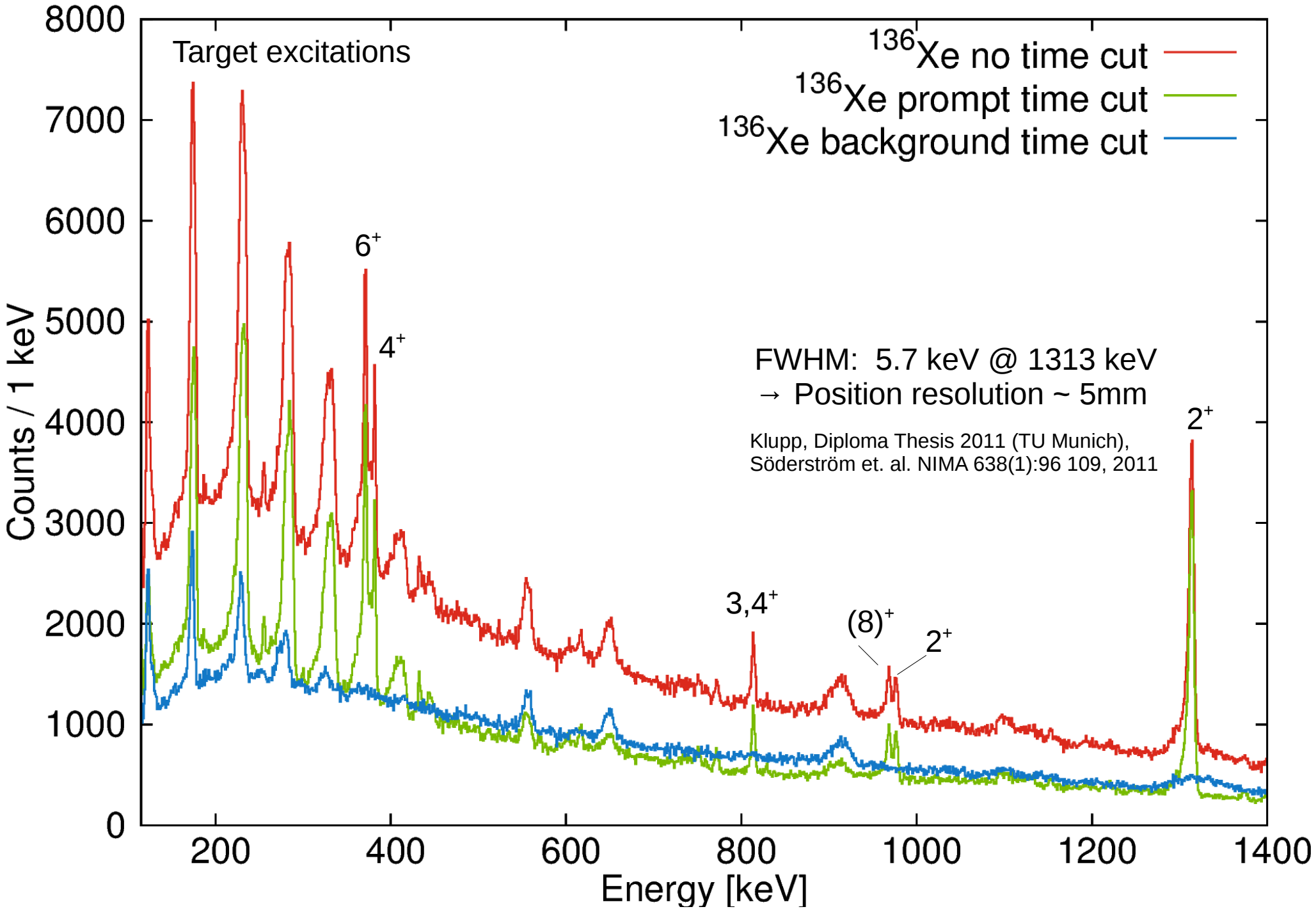
No Doppler correction



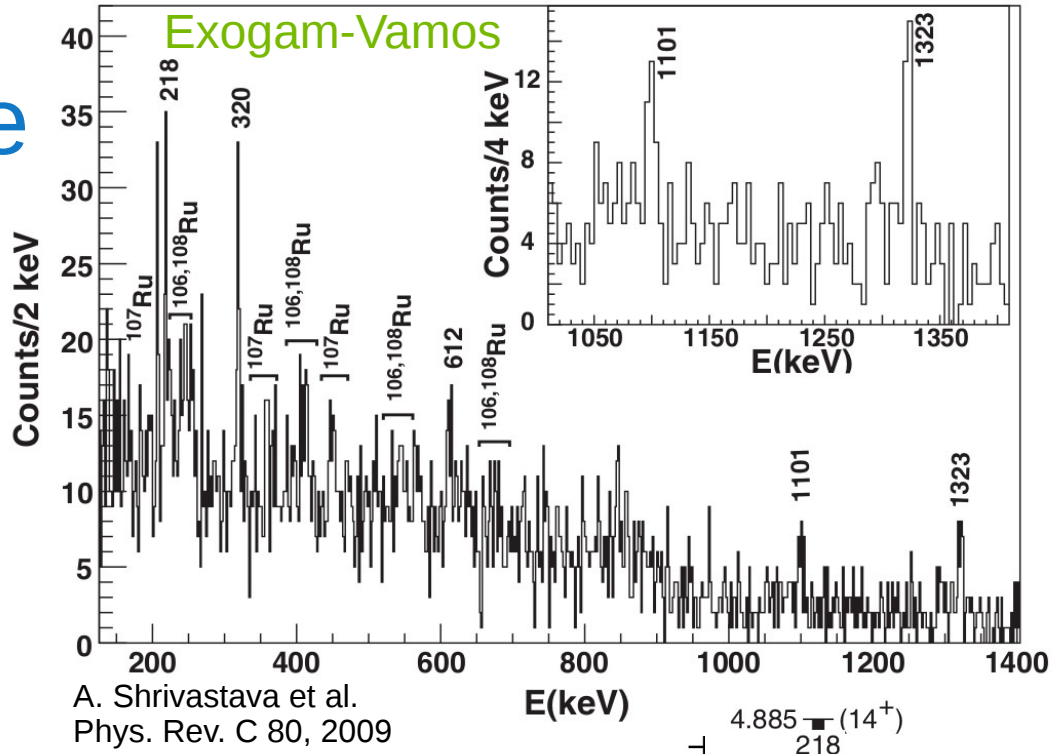
Doppler correction for beam like Xe



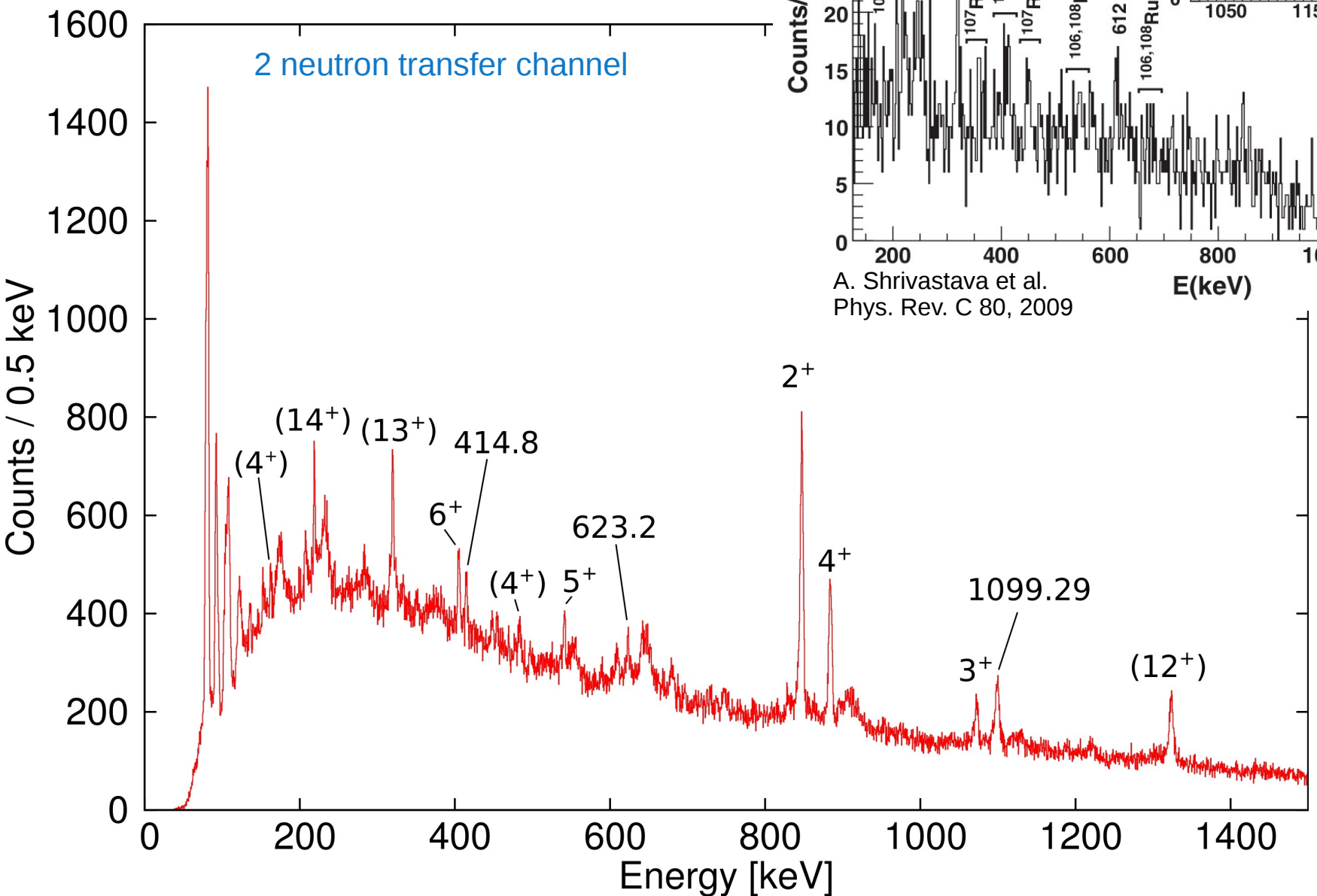
Doppler corrected 136Xe spectrum with different gates on the prompt time peak

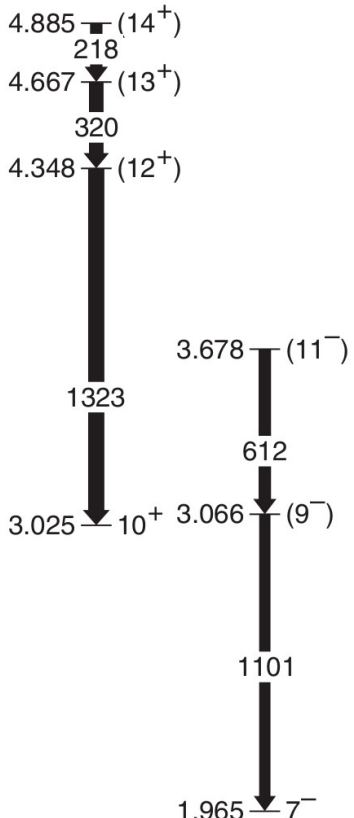


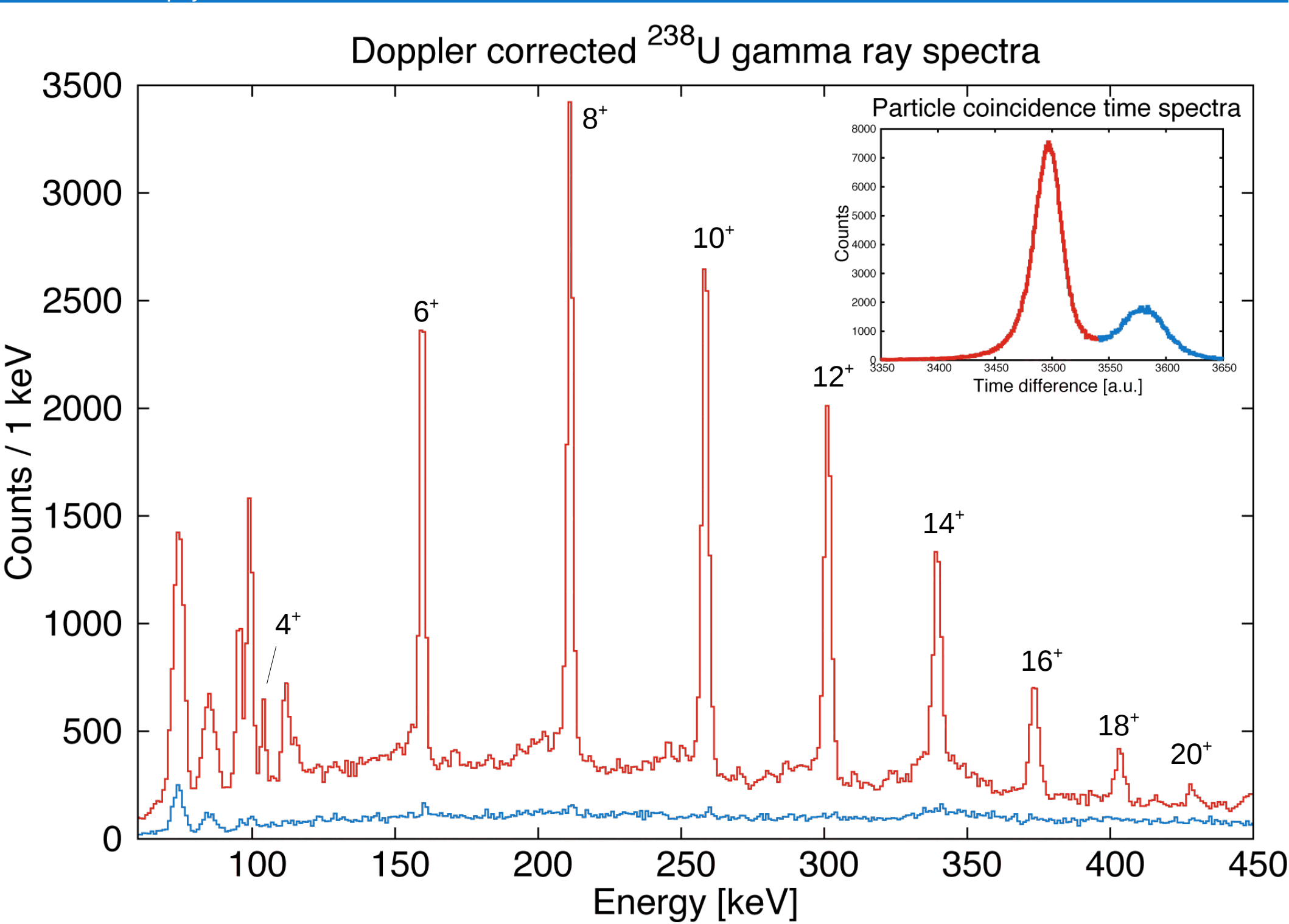
High spin states in ^{134}Xe

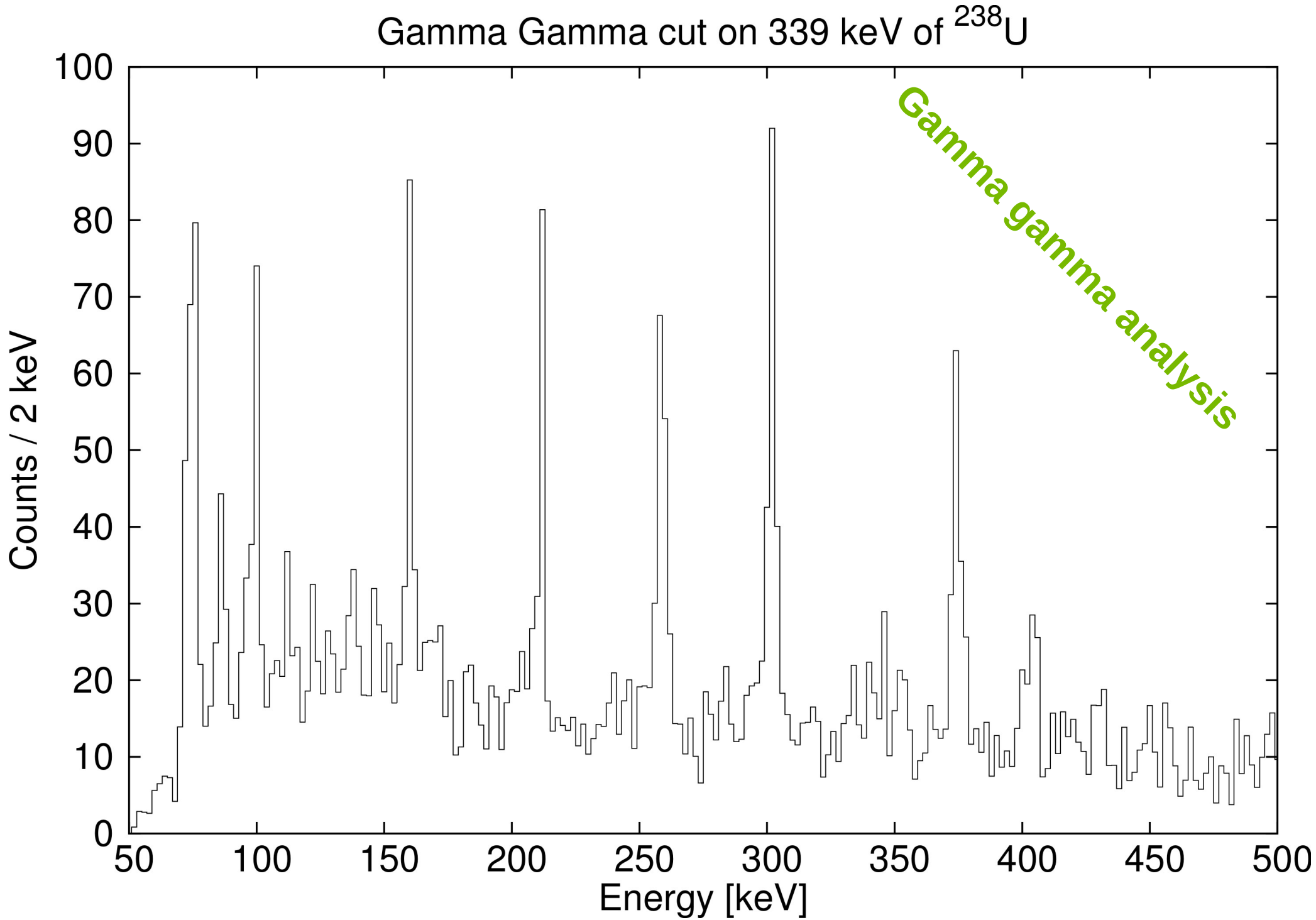


A. Shrivastava et al.
Phys. Rev. C 80, 2009






Doppler corrected ^{238}U gamma ray spectra
Counts / 1 keV
Energy [keV]
0
500
1000
1500
2000
2500
3000
3500
100
150
200
250
300
350
400
450
4+
6+
8+
10+
12+
14+
16+
18+
20+
Particle coincidence time spectra
Counts
Time difference [a.u.]
0
1000
2000
3000
4000
5000
6000
7000
8000
3350
3400
3450
3500
3550
3600
3650


Gamma Gamma cut on 339 keV of ^{238}U
Gamma gamma analysis
Counts / 2 keV
Energy [keV]
0
10
20
30
40
50
60
70
80
90
100
50
100
150
200
250
300
350
400
450
500

Conclusion

- **AGATA demonstrator for in-beam gamma ray spectroscopy**
  - High count-rates ✓
  - Tracking efficiency ✓
  - Doppler correction ✓
  - Energy resolution ✓
  - Position resolution ✓
  - Peak to total / Peak to background ✓
  - Gamma Gamma Analysis ✓

Outlook

- Physics analysis of the experimental results

Thank you !

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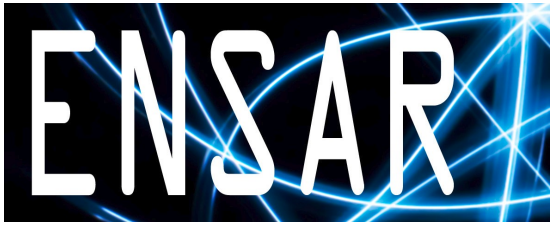
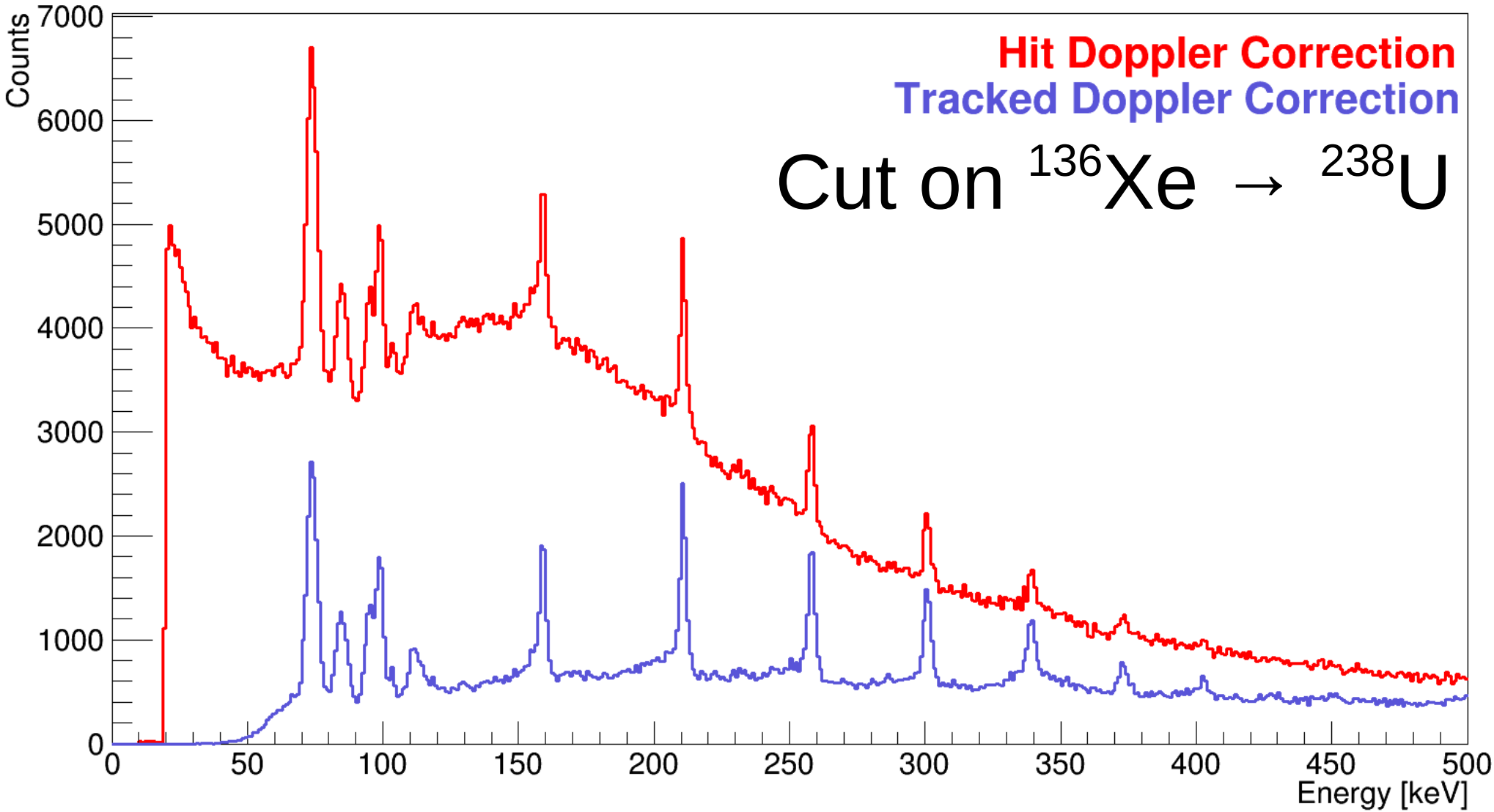


Koll 2: AGATA-Kollaboration

Benedikt Birkenbach[1], Jürgen Eberth[1], Herbert Hess[1], Rouven Hirsch[1], Jan Jolie[1], Peter Reiter[1], David Schneiders[1], Tim Steinbach[1], Andreas Vogt[1], Nigel Warr[1], Andreas Zilges[1], Lars Lewandowski[1], Reiner Krücken[2], Roman Gernhäuser[2], Micheal Schlarb[2], Jürgen Gerl[3], Tobias Engert[3], Tobias Habermann[3], Gilles de France[3], Ivan Kojouharov[3], Nikolaus Kurz[3], Stephane Pietri[3], Henning Schaffner[3], Liliana Cortes[4], Plamen Boutachkov[4], Giulia Guastalla[4], Angel Givechev[4], Corinne Louchart-Henning[4], Edana Merchan[4], Oliver Möller[4], Norbert Pietralla[4], Damian Ralet[4], Michael Reese[4], Pushpendra Singh[4], Christian Stahl[4], Andi Boston[5], Helen Boston[5], Samantha Colosimo[5], Fay Filmer[5], Dan Judson[5], Steven Moon[5], Mike Slee[5], Paul Nolan[5], Johan Nyberg[6], Alia Gengelbach[6], Bo Cederwall[7], Carlos Rossi[8], Dino Bazzaco[8], Marco Bellato[8], Damiano Bortolato[8], Enrico Farnea[8], Andres Gadea[8], Roberto Isocrate[8], Raluca Marginean[8], Roberto Menegazzo[8], Gabriele Rampazzo[8], Francesco Recchia[8], Calin Ur[8], Roberto Venturelli[8], Alberto Pullia[9], Francesca Zocca[9], Sylvain Broussard[10], Bart Bruyneel[10], Andreas Goergen[10], Wolfram Korten[10], Alexandre Obertelli[10], Julien Pancin[10], Christophe Theisen[10], Christian Veyssiere[9], Andre Bouty[10], Ange Lotode[10], Yannick Mariette[10], Dominique Curien[11], Olivier Dorvaux[11], Gilbert Duchene[11], Benoit Gall[11], Patrice Medina[11], Cayetano Santos[11], Elmhdi Chambit[11], Laurent Charles[11], Remy Baumann[11], Francois Didierjean[11], Marie-Helene Sigward[11], Alexander Buerger[12], Marc Labiche[13], Ian Lazarus[13], Roy Lemon[13], Belen Gomez[13], John Simpson[13], Pierre Desequelles[14], Pierre Edelbruck[14], Xavier Grave[14], Karl Hauschild[14], Amel Korichi[14], Joa Ljungvall[14], Araceli Lopez-Martens[14], Hoa Ha Mai[14], Christophe Oziol[14], Lounis Benallegue[15], Sebastien Lhenortet[15], Stephane Leboutellier[15], Denis Linget[15], Bruno Travers[15], Daniel Guinet[16], Nadin Redon[16], Olivier Stezowski[16], Tuyen Doan Quang[16], Serkan Akkoyum[17], Ayse Atac[17], Ayse Kaskas[17], Jean Ropert[18] und Michel Tripon[18] — [1]IKP , Universität zu Köln, Germany — [2]TU München, Germany — [3]G.S.I. Darmstadt, Germany — [4]IKP, TU Darmstadt, Germany — [5]University of Liverpool, England — [6]R.I.T. University Uppsala, Sweden — [7]University of Stockholm, Sweden — [8]INFN Padua, Italy — [9]University of Milano, Italy — [10]Irfu Saclay, France — [11]IPHC Strasbourg, France — [12]ISKP Universität Bonn, Germany — [13]CCLRC Daresbury, England — [14]IPN Orsay, France — [15]CSNSM Orsay, France — [16]IPN Lyon, France — [17]Ankara University, Turkey — [18]JYFL

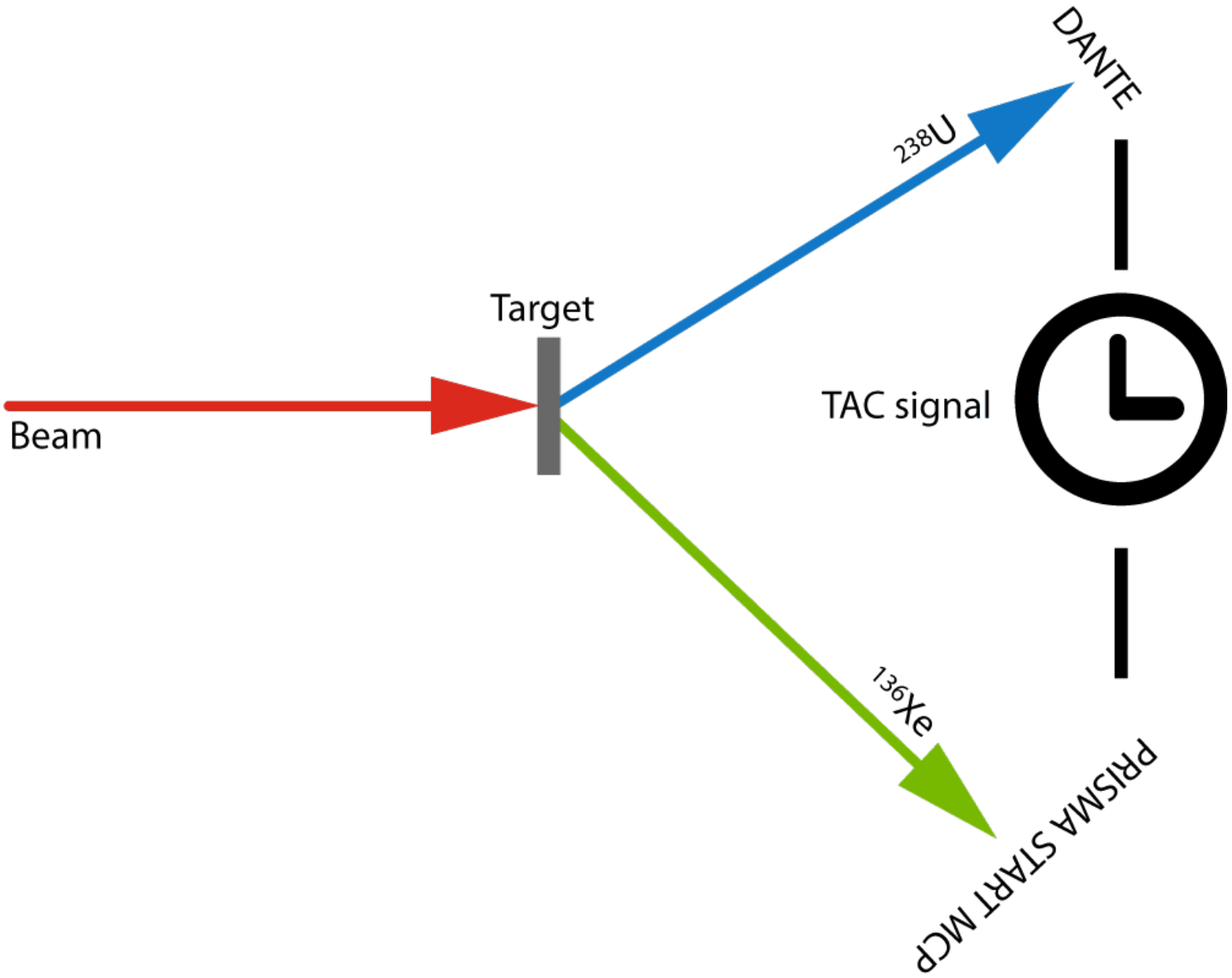
Tracking and Doppler Correction for the target like actinide nuclei



Hit Doppler correction: Doppler correction for every hit identified in the PSA

Tracked Doppler correction: Doppler correction after tracking (including 1st Interaction)

Particle coincidence



Particle identification with PRISMA