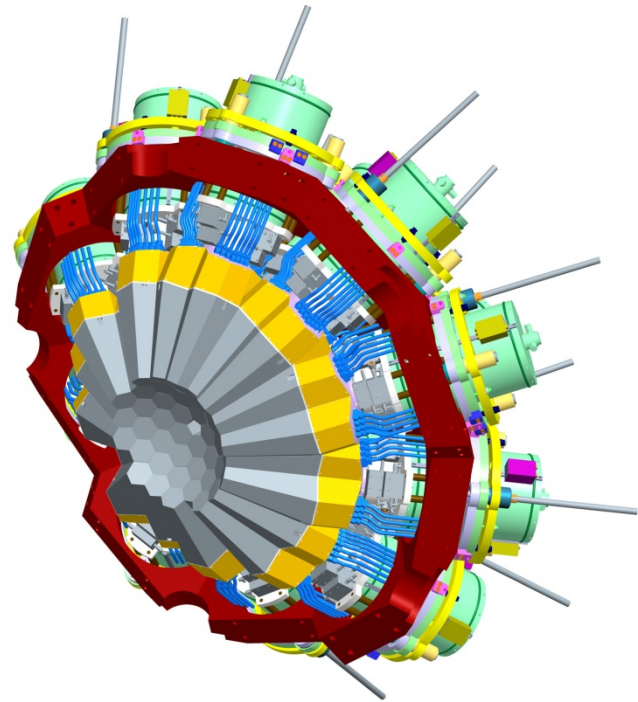


# First results from the Advanced Gamma Tracking Array Demonstrator

- Motivation für AGATA
- Status des Demonstrators
- Testexperimente
- Start der Physikkampagne
- Zusammenfassung & Ausblick



A. Wiens, B. Birkenbach, B. Bruyneel, J. Eberth, H. Hess, D. Lersch,  
 G. Pascovici, P. Reiter — IKP, Köln  
 H. G. Thomas — CTT Montabaur  
 für die AGATA-Kollaboration

# Hochauflösende Spektroskopie an GSI



AGATA @ GSI  
AGATA @ NUSTAR



## Relativistische exotische Strahlen

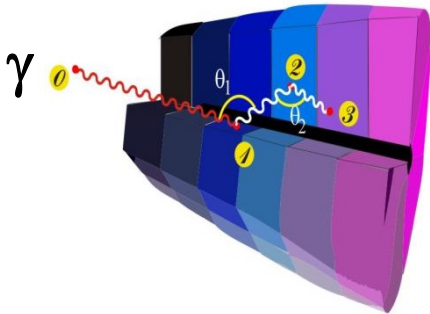
- Geringe Intensität
- Hoher Untergrund
- Starke Doppler-Verbreiterung
- Hohe Zählraten

## Anforderungen:

- Hohe Effizienz
- Hohe Empfindlichkeit
- Hohe Ortsauflösung
- Hohes peak/total-Verhältnis
- Hoher Durchsatz

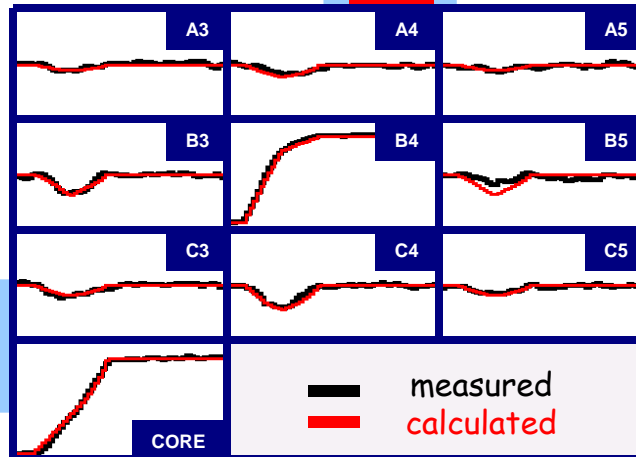
1

Hochsegmentierte HPGe Detektoren



2

Digitale Elektronik zur Aufnahme und Verarbeitung der Segmentsignale

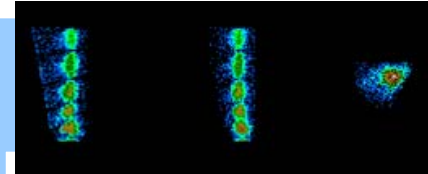


3

Identifizierte Wechselwirkungspunkte

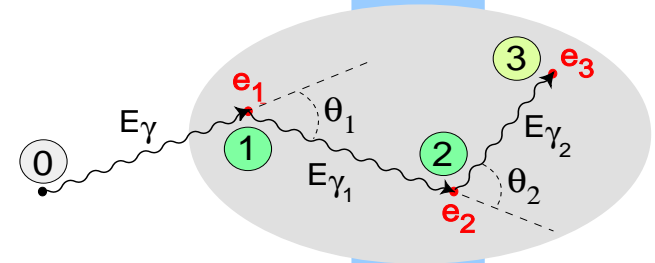
$$(x, y, z, E, t)_i$$

Impulsformanalyse der aufgezeichneten Signale

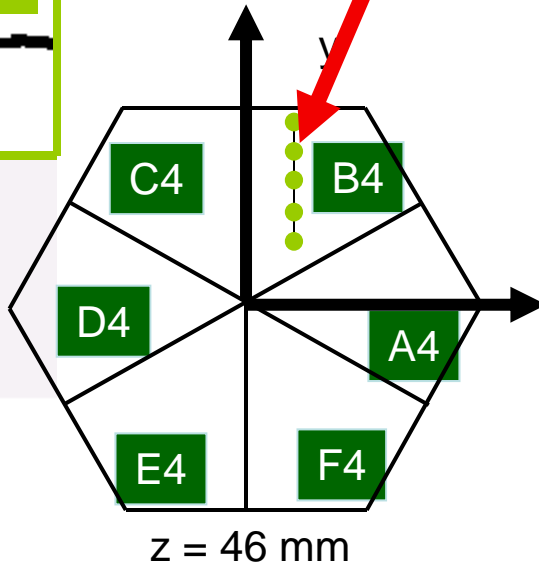
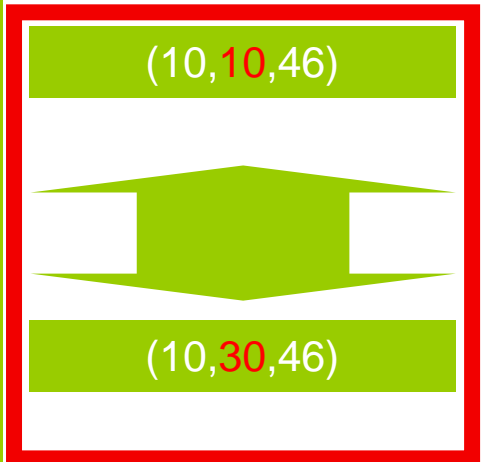
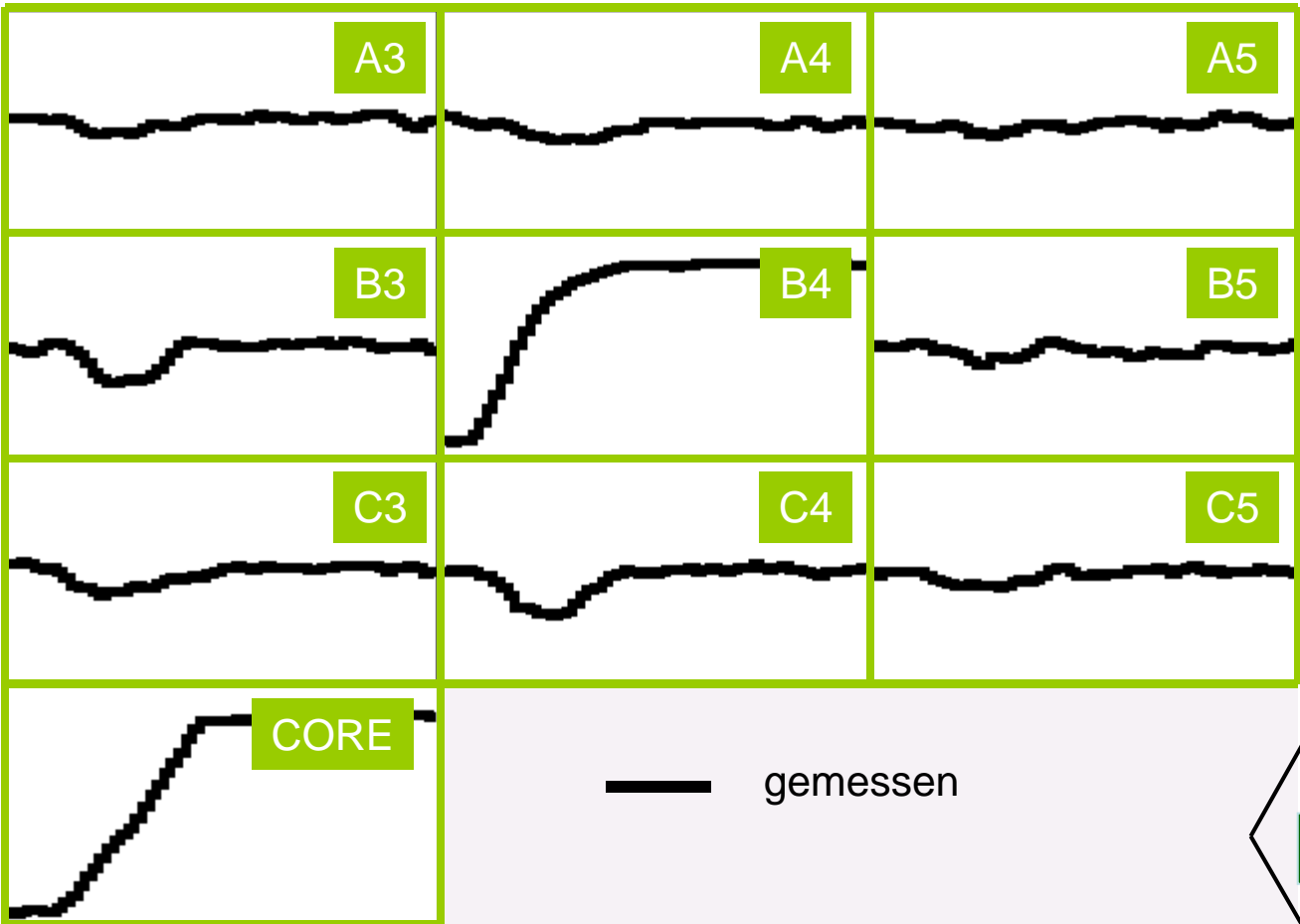


4

Rekonstruktion des Pfades des  $\gamma$ -Strahls aus den Wechselwirkungspunkten

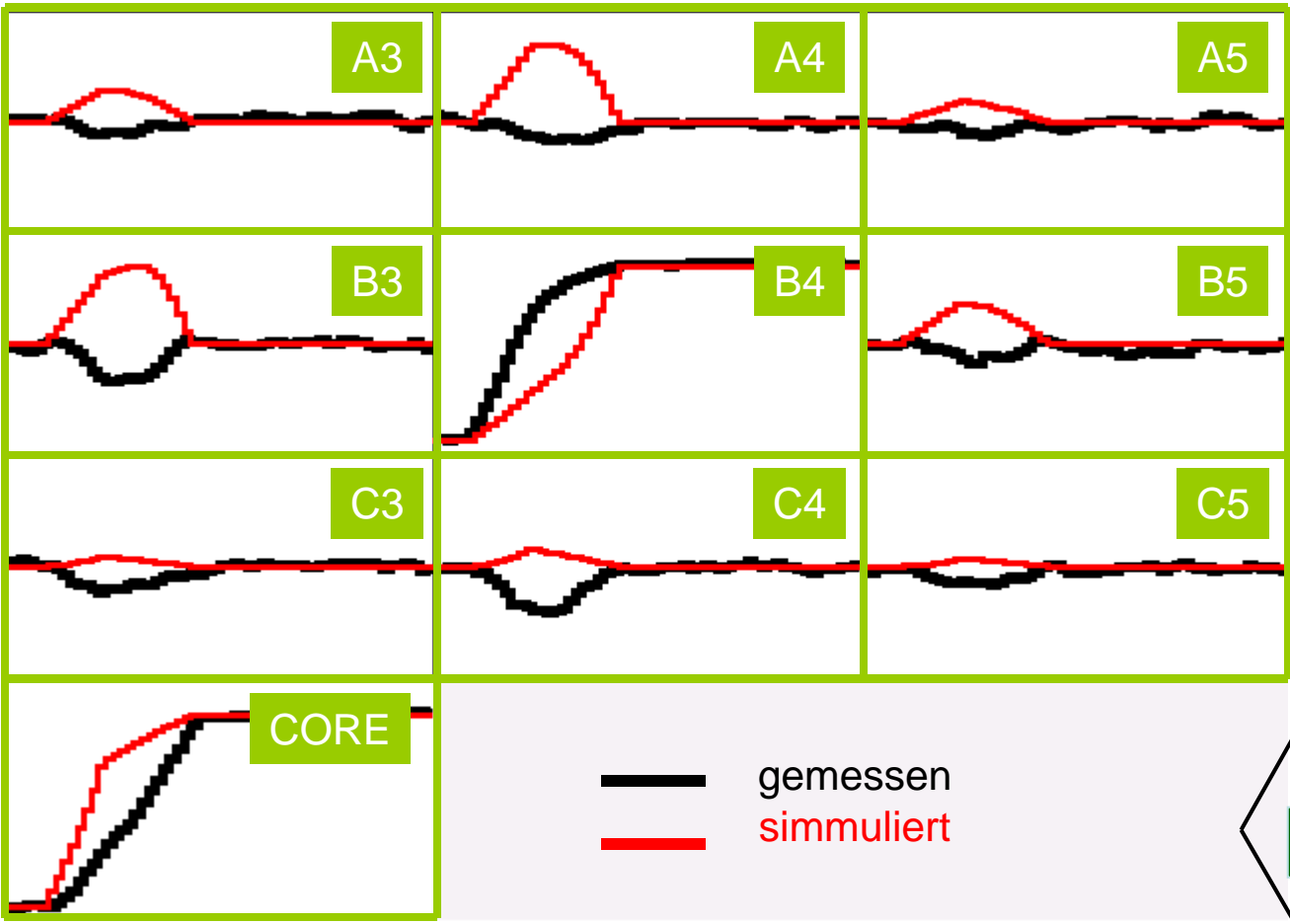


„getracktes“  $\gamma$ -Quant

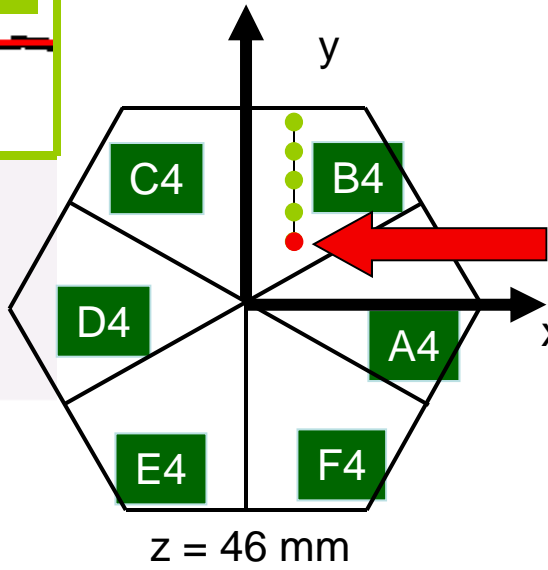


791 keV nachgewiesen in Segment B4

# ikp Pulse Shape Analysis Prinzip

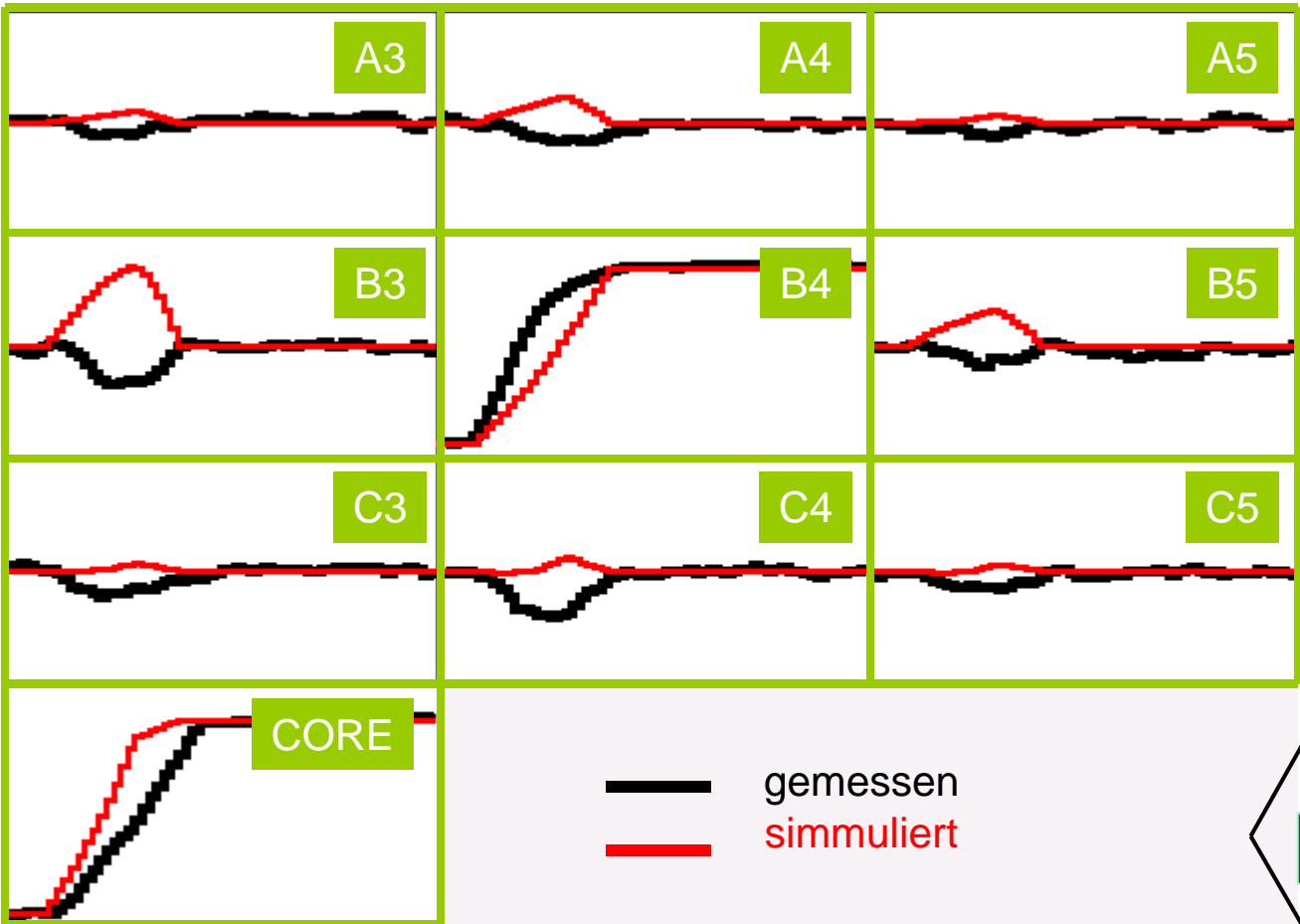


(10, 10, 46)

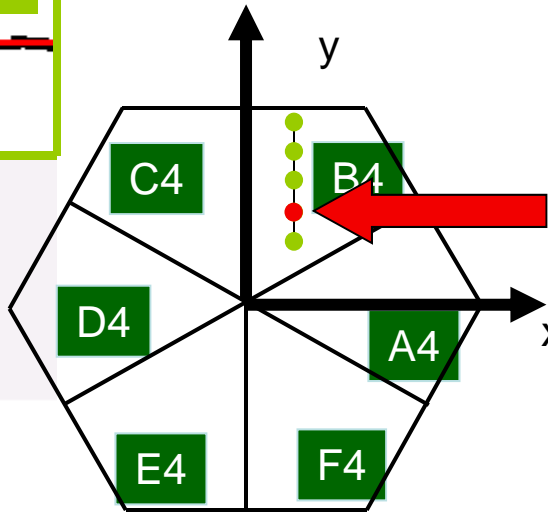


791 keV nachgewiesen in Segment B4

# ikp Pulse Shape Analysis Prinzip



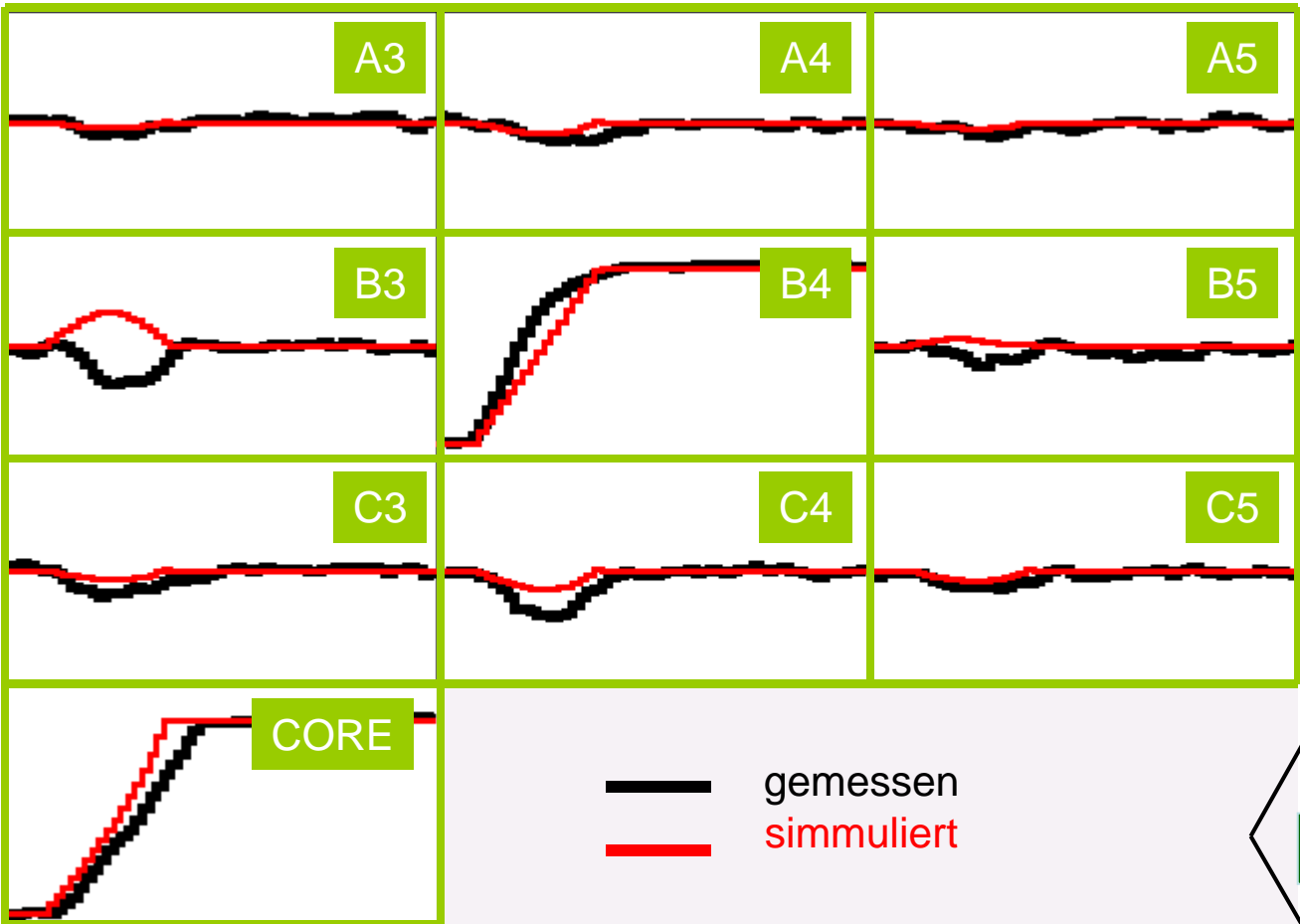
(10, 15, 46)



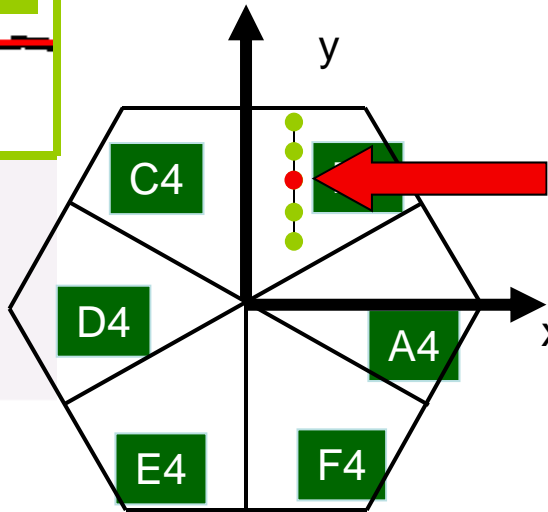
z = 46 mm

791 keV nachgewiesen in Segment B4

# ikp Pulse Shape Analysis Prinzip

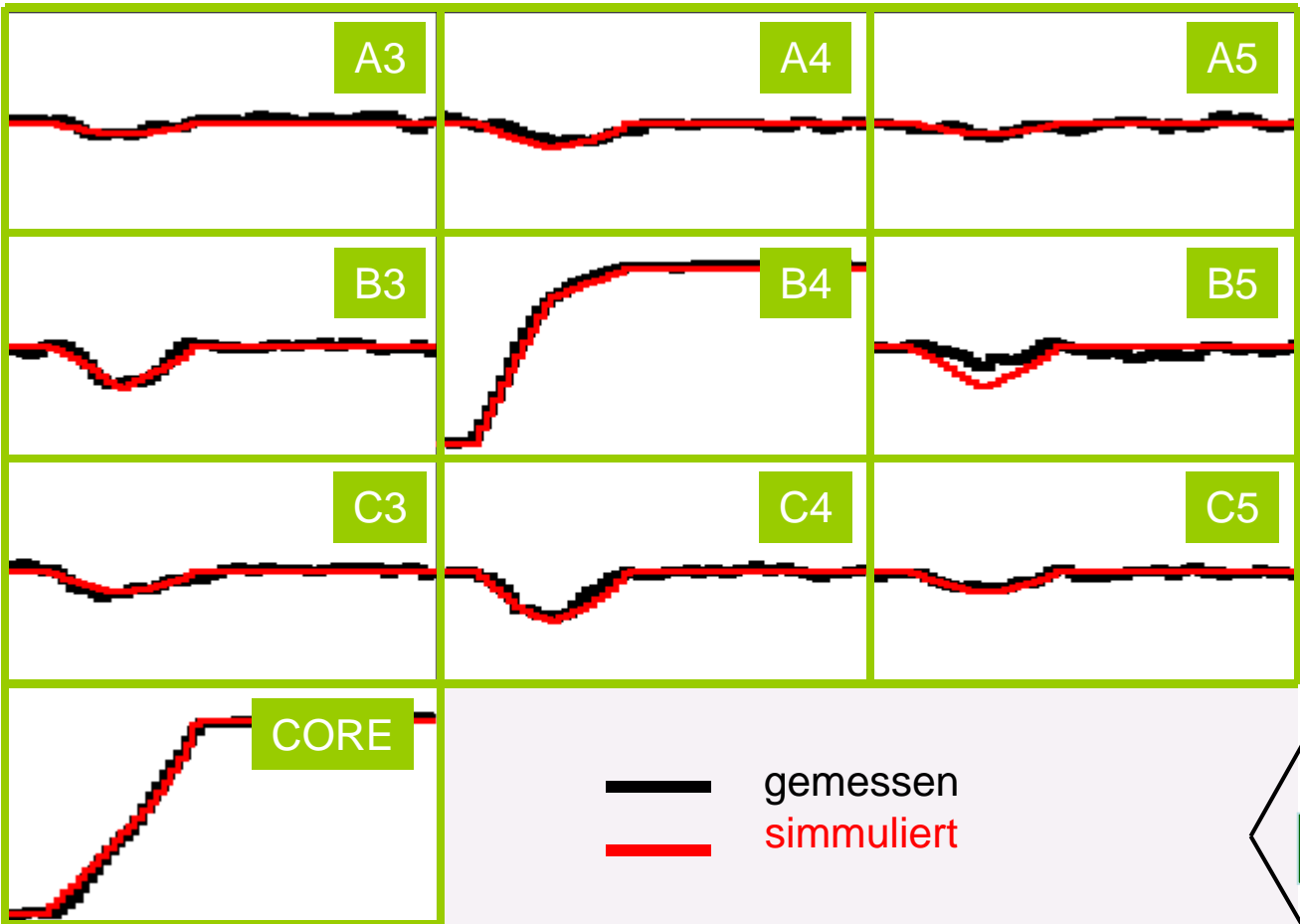


(10,20,46)

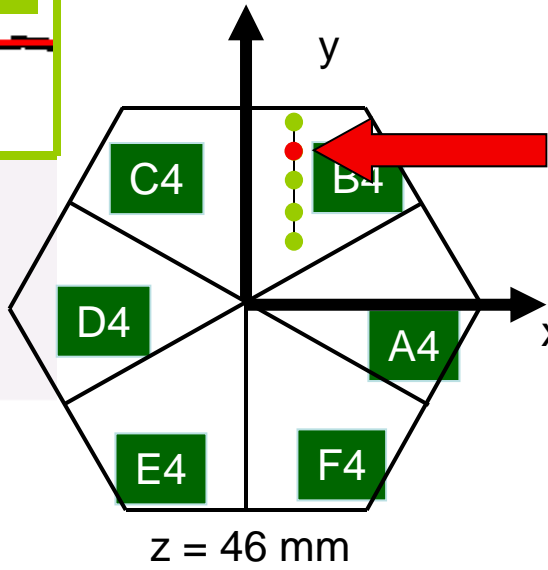


z = 46 mm

791 keV nachgewiesen in Segment B4



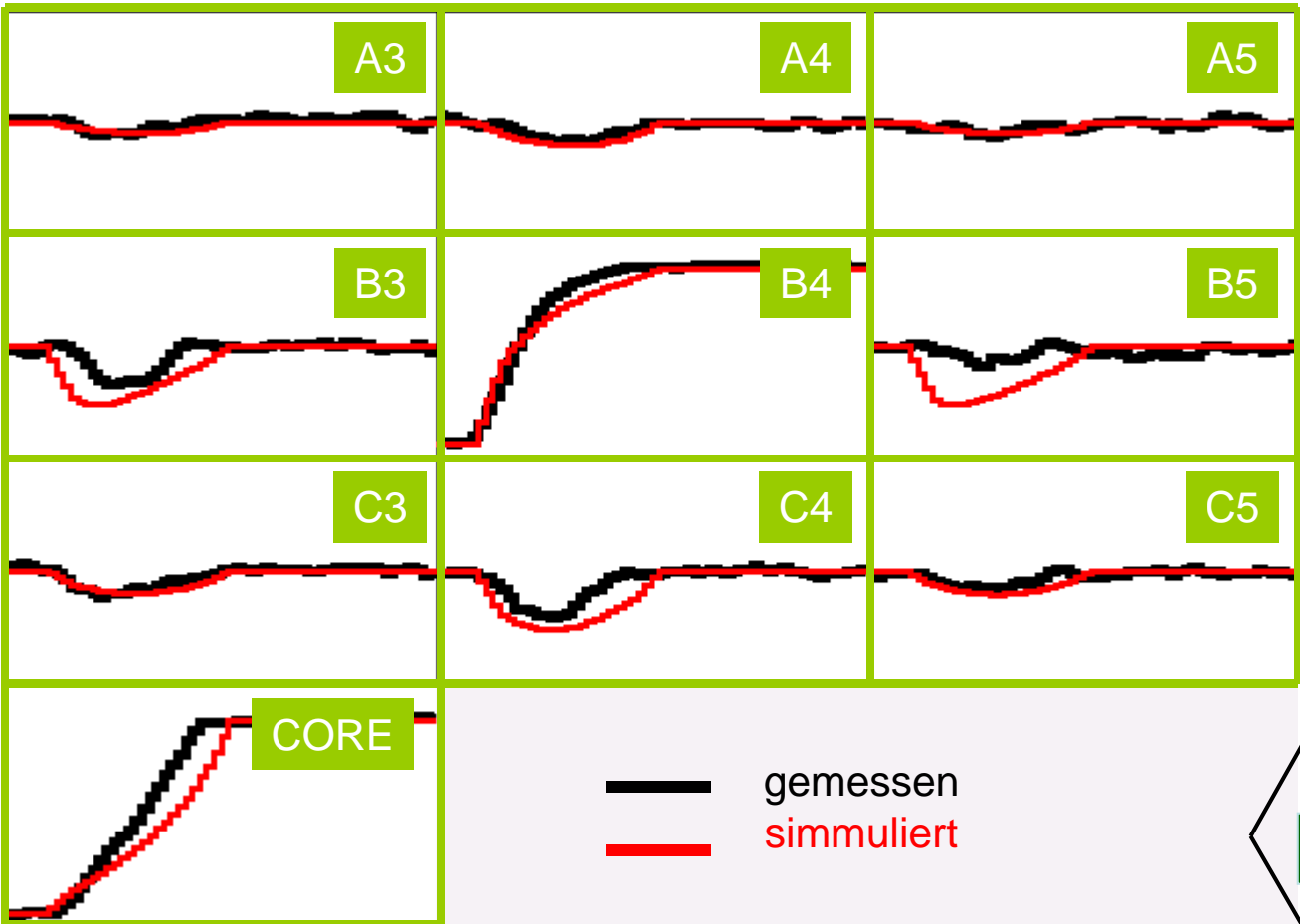
(10, 25, 46)



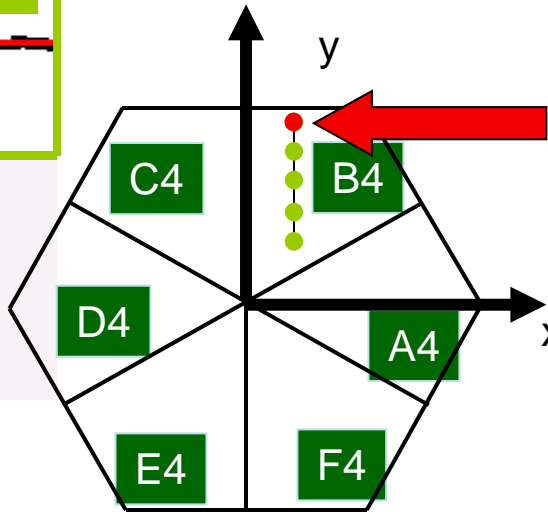
791 keV nachgewiesen in Segment B4



# ikp Pulse Shape Analysis Prinzip



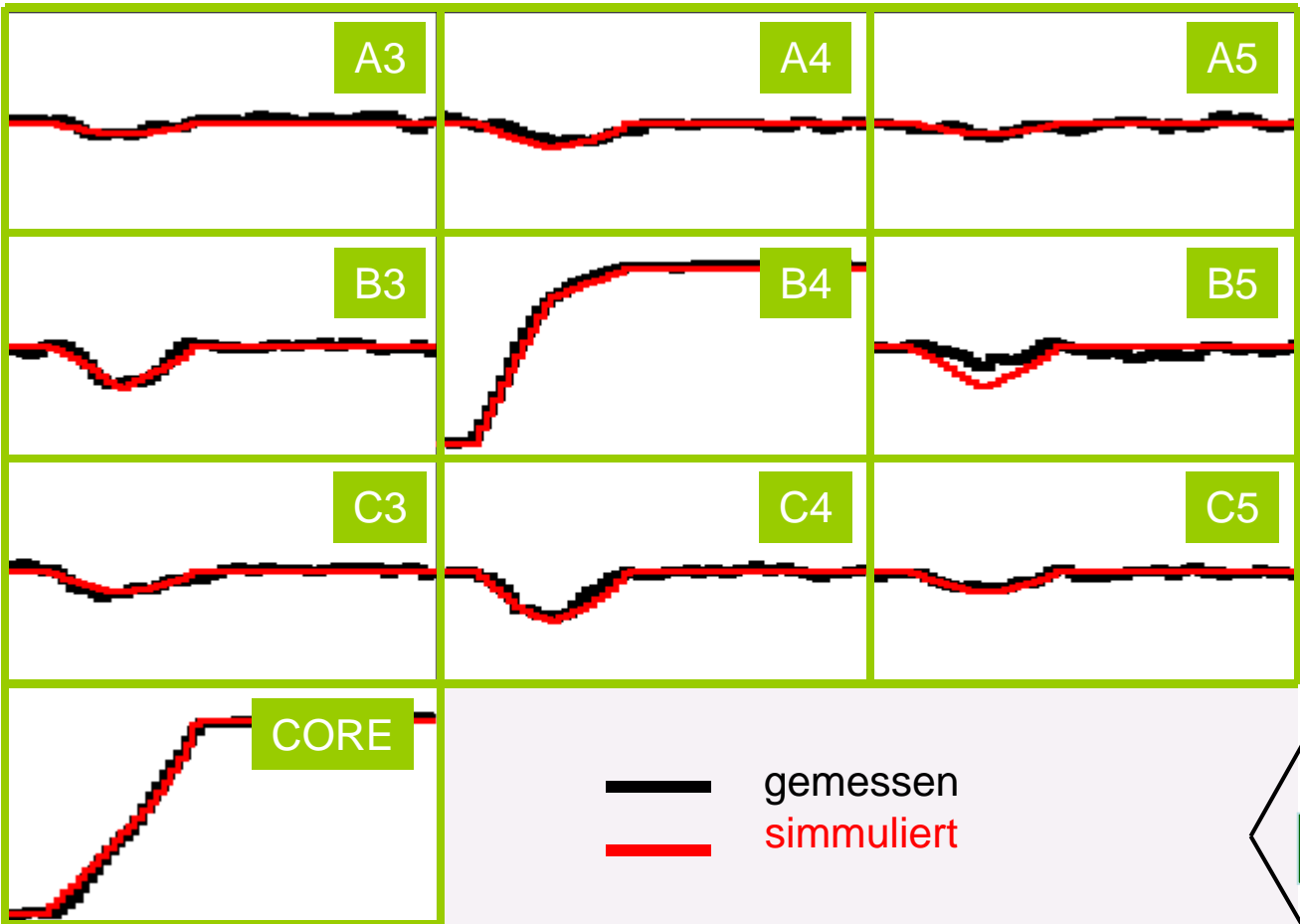
(10,30,46)



z = 46 mm

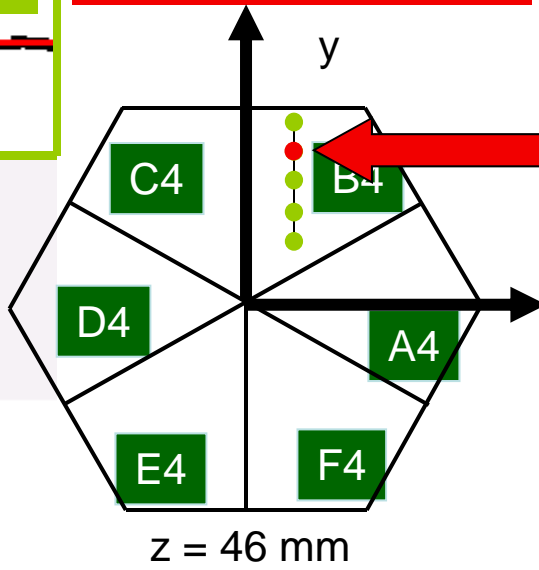
791 keV nachgewiesen in Segment B4

# ikp Pulse Shape Analysis Prinzip

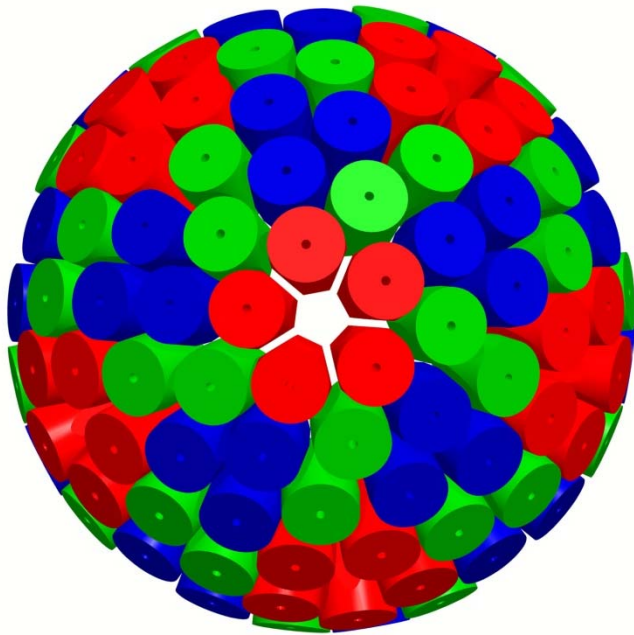


Ergebnisse des Grid Search Algorithmus

(10,25,46)



791 keV nachgewiesen in Segment B4



## Eigenschaften von AGATA

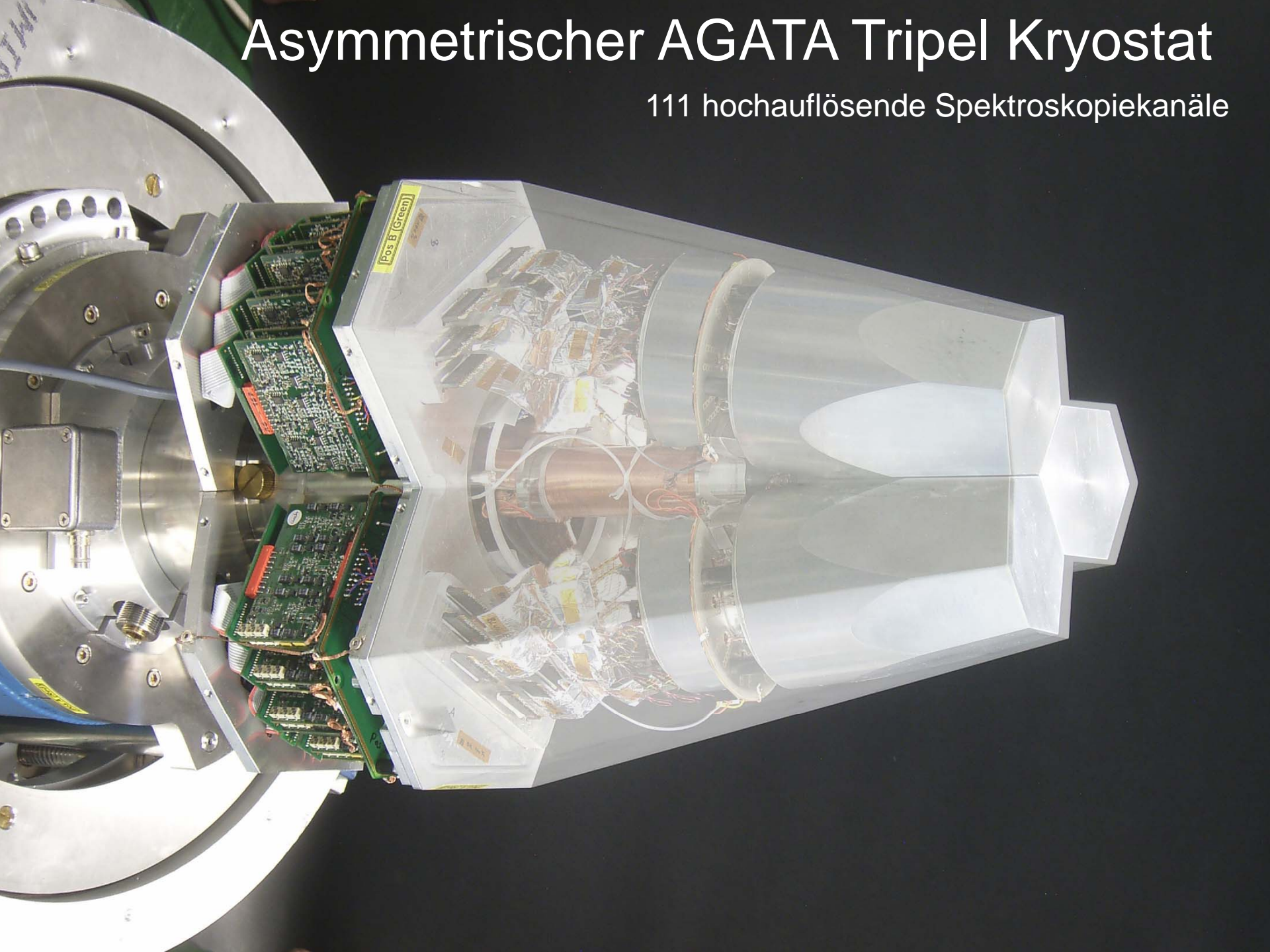
<b>Effizienz</b> (bei 1 MeV):	43% ( $M_\gamma=1$ )	28% ( $M_\gamma=30$ )
bisher	~10% (Faktor ~4)	5% (Faktor ~1000)
<b>Peak/Total:</b>	58% ( $M_\gamma=1$ )	49% ( $M_\gamma=30$ )
bisher	~55%	40%
<b>FWHM:</b>	1.0keV @ 60keV / 2.3keV @ 1.3MeV	
<b>Winkelauflösung:</b>	~1° →	
<b>FWHM (1 MeV, <math>v/c=50\%</math>)</b>	~ 6 keV !!!	
bisher	~ 40 keV	
<b>Rates:</b>	3 MHz ( $M_\gamma=1$ )	300 kHz ( $M_\gamma=30$ )
bisher	1 MHz	20 kHz



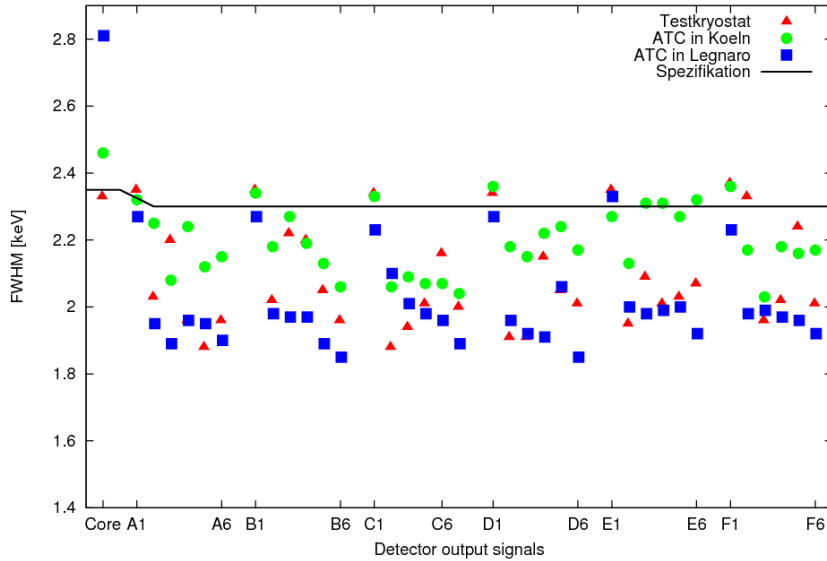
- 180 großvolumige 36-fach segmentierte Ge kristalle in 60 Tripelclustern

# Asymmetrischer AGATA Tripel Kryostat

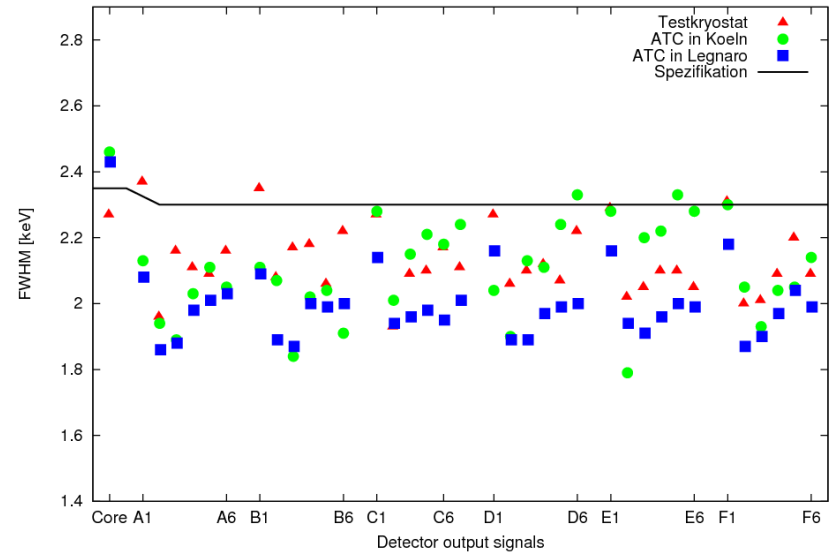
111 hochauflösende Spektroskopiekanäle



ATC1 A001



ATC1 B002



Gemessen in Köln und Legnaro

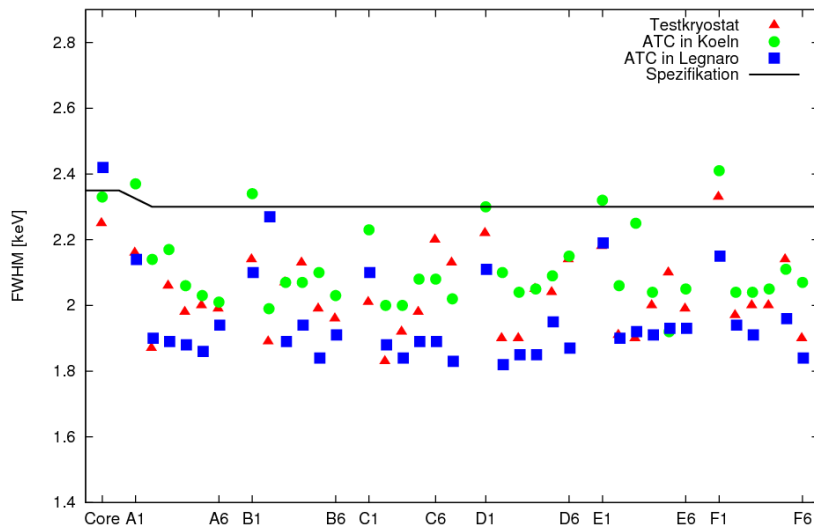
Mittelwerte der Energieauflösung der Segmente bei 1,3 MeV:

IKP / Legnaro

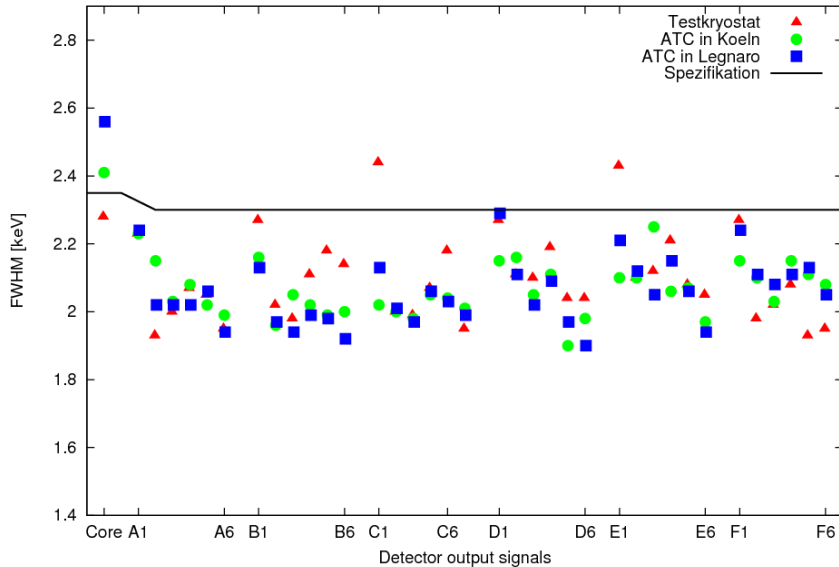
A001: 2,19 keV / 2,00 keV

B002: 2,09 keV / 1,98 keV

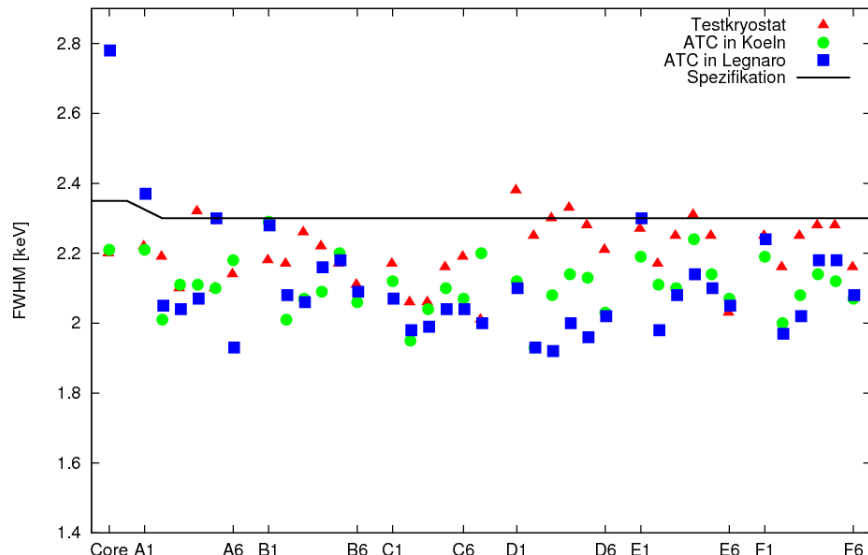
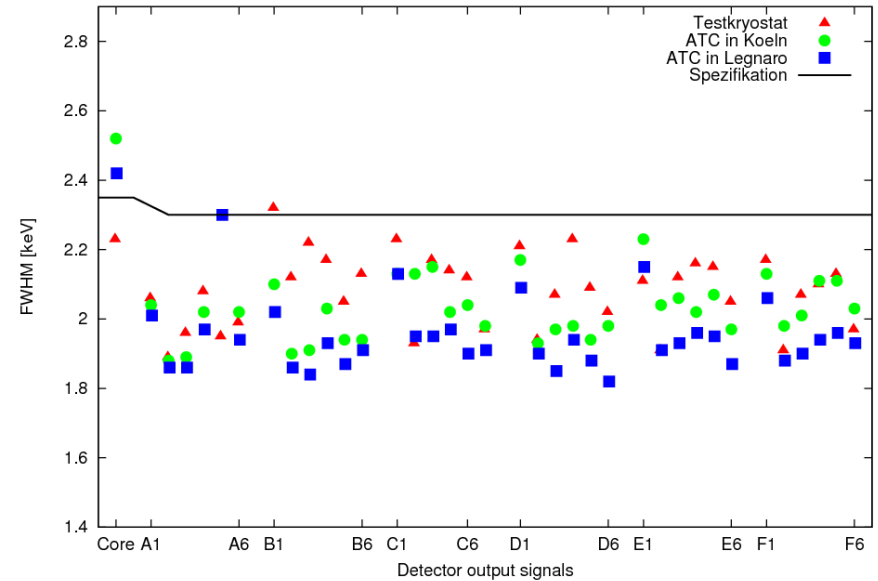
C002: 2,1 keV / 1,94 keV



ATC2 A003



ATC2 B003



Mittelwerte der Energieauflösung der Segmente bei 1,3 MeV:

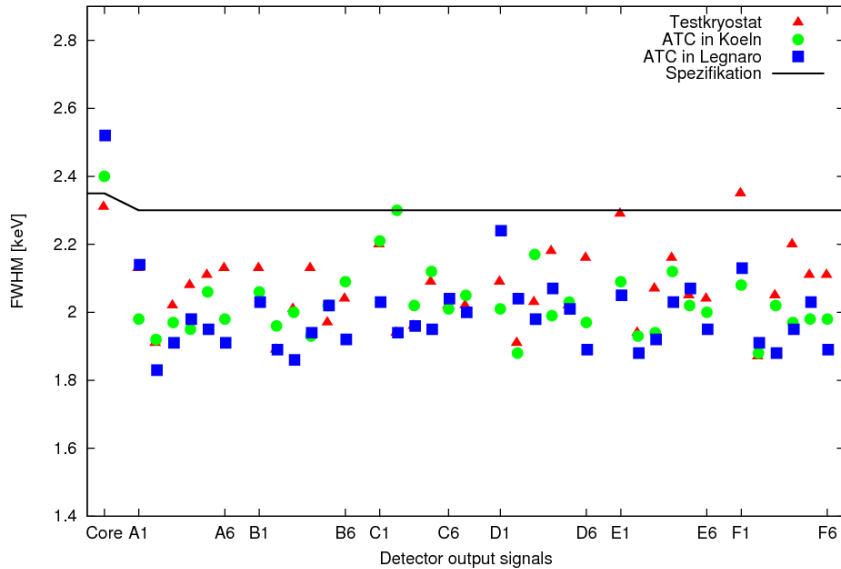
IKP / Legnaro

A003: 2,06 keV / 2,06 keV

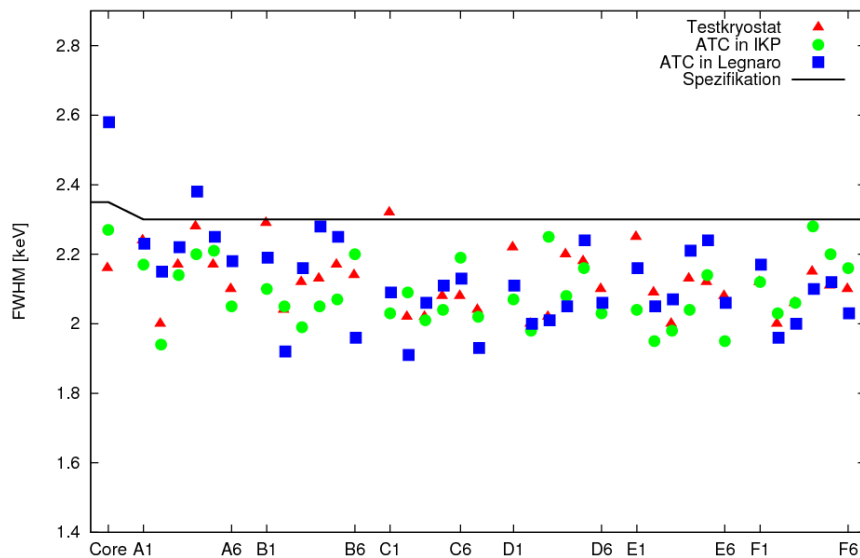
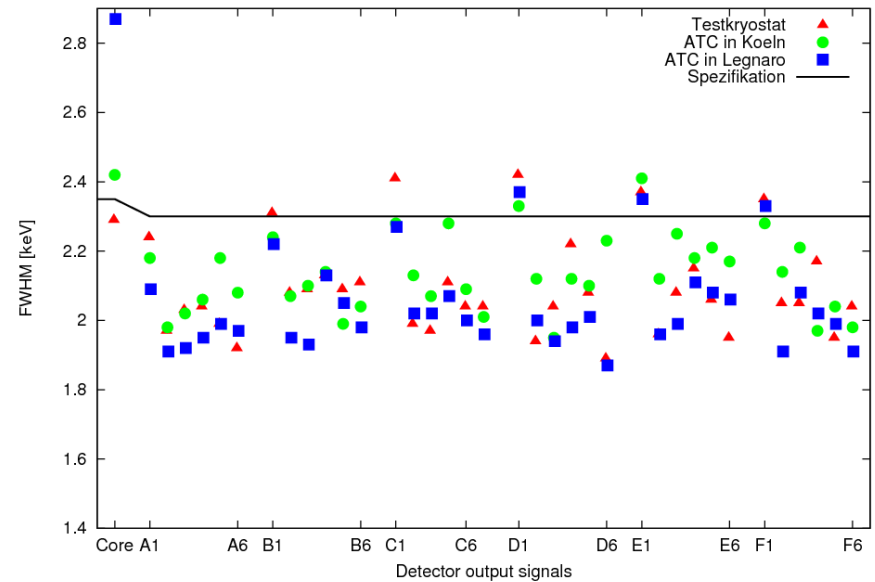
B003: 2,03 keV / 1,94 keV

C005: 2,11 keV / 2,08 keV

ATC3 A002



ATC3 B005



Mittelwerte der Energieauflösung der Segmente bei 1,3 MeV:

IKP / Legnaro

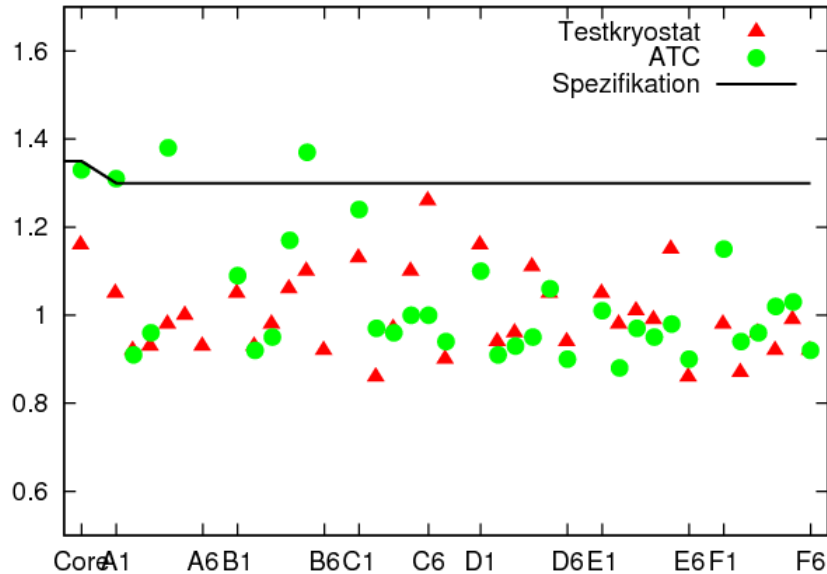
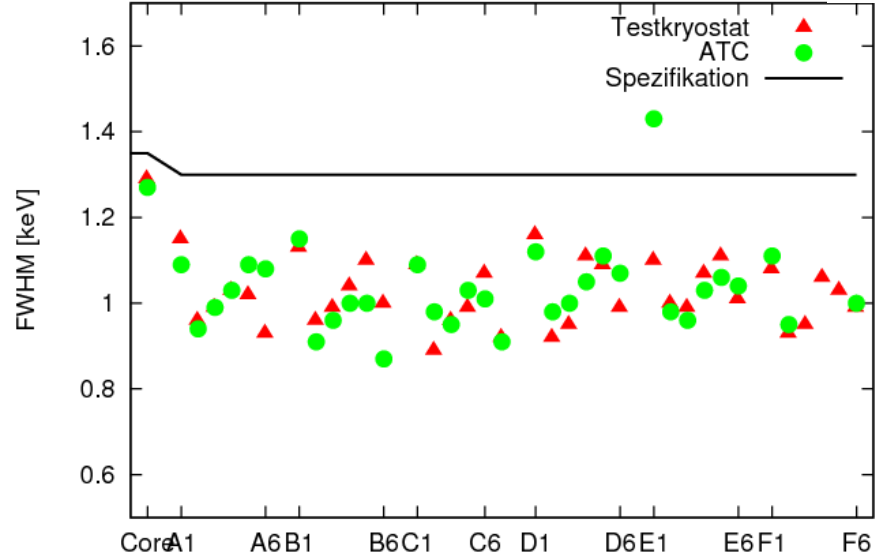
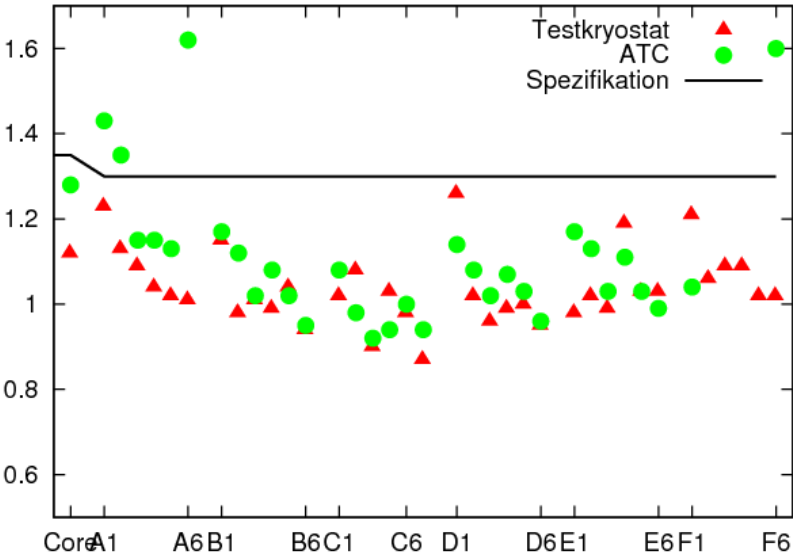
A002: 2,03 keV / 2,00 keV

B005: 2,13 keV / 2,06 keV

C006: 2,09 keV / 2,11 keV

ATC4 A005

ATC4 B001



Mittelwerte der Energieauflösung der Segmente bei 60 keV:  
 (Spezifikation: 1,3 keV)  
 Testkryostat / ATC4:

A005: 1,03 / 1,09 keV

B001: 1,02 / 1,03 keV

C003: 1,00 / 1,13 keV



# ATC5



Kryostat



Vorverstärker

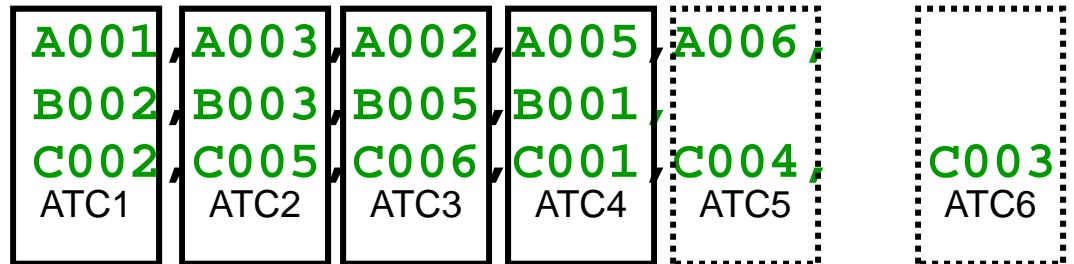


Verkabelung

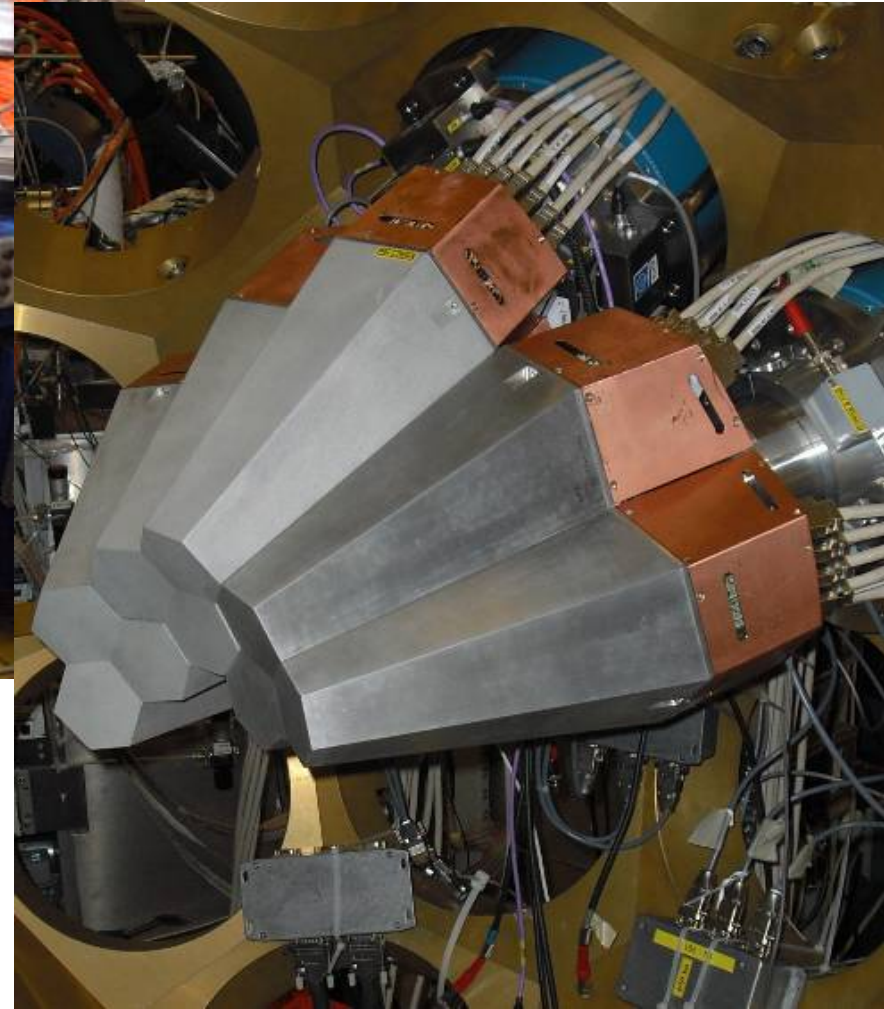


Fehlender B-typ-Kristall

Verfügbare Detektoren:

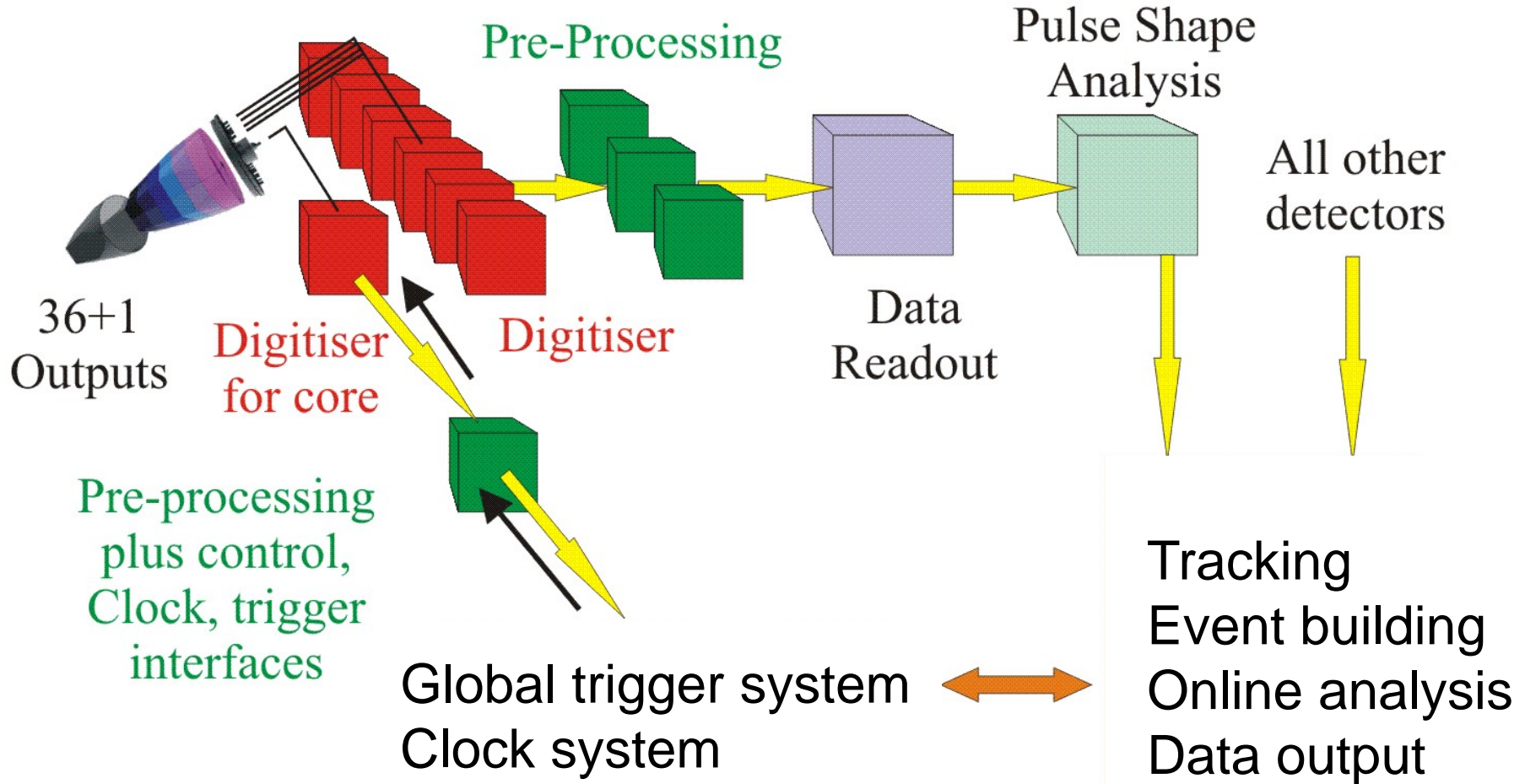


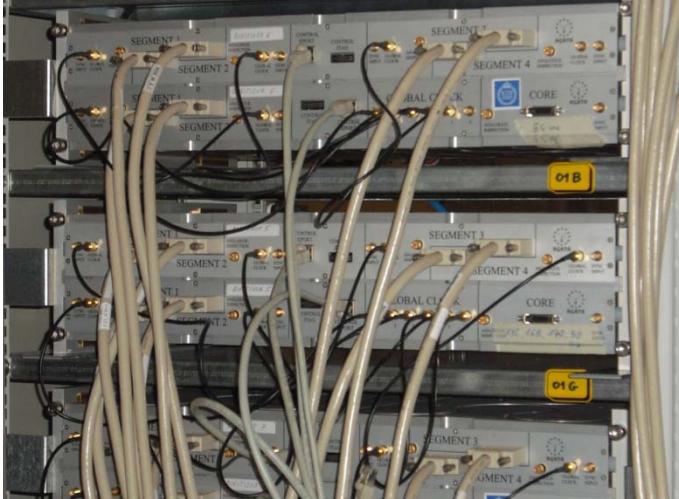
Demonstrator



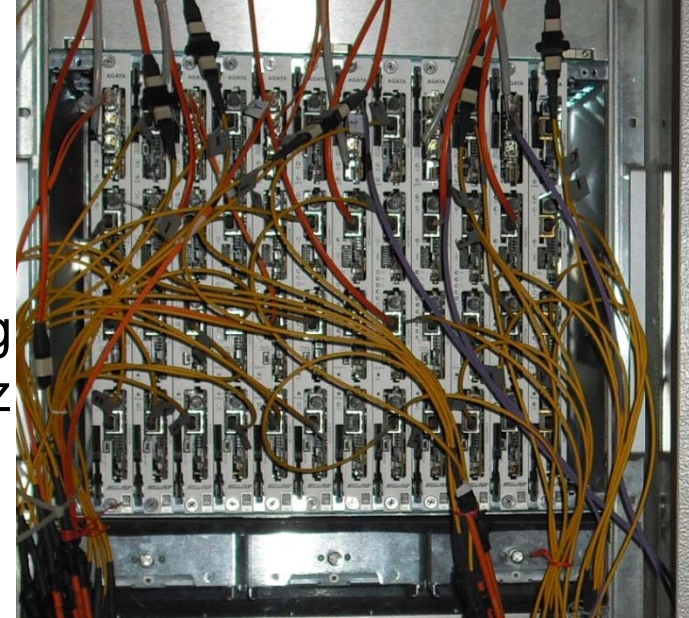
3 ATCs an Targetposition des PRISMA-Spektrometers am LNL

## *Schematic of the Digital Electronics and Data Acquisition System for AGATA*





Digitizer  
100 MHz  
14 bit



Preprocessing  
100 MHz



Computerfarm  
26 x 2 Quadcore  
108 TB  
Plattenvolumen  
On- und Offline  
Analyse



Global Trigger System

# Commissioning Experimente

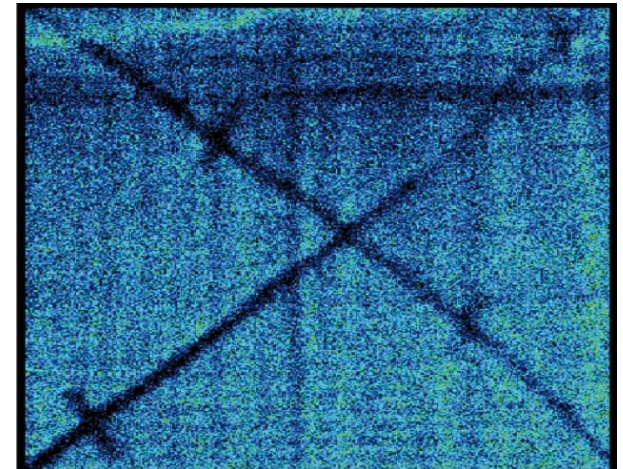
- $^{30}\text{Si}@70\text{MeV}+^{12}\text{C}$  Fusionsverdampfung, nur AGATA
- $^{56}\text{Fe}@220\text{MeV}+^{197}\text{Au}$  Coulombanregung,  
AGATA+Zusatzdetektor DANTE

DANTE ortsempfindlicher MCP-Detektor

$\gamma$  in Koinzidenz mit Projektil- oder Targetkern

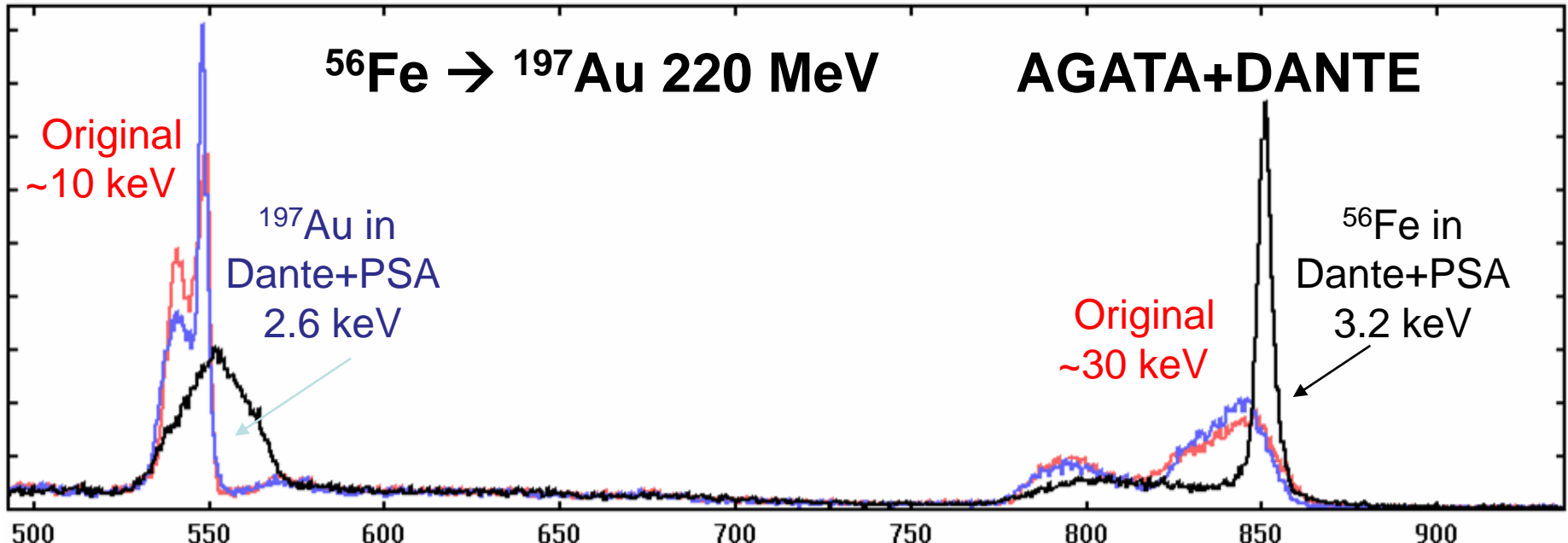
Qualität der Dopplerkorrektur:

- DANTE-Ortsauflösung
- PSA+tracking

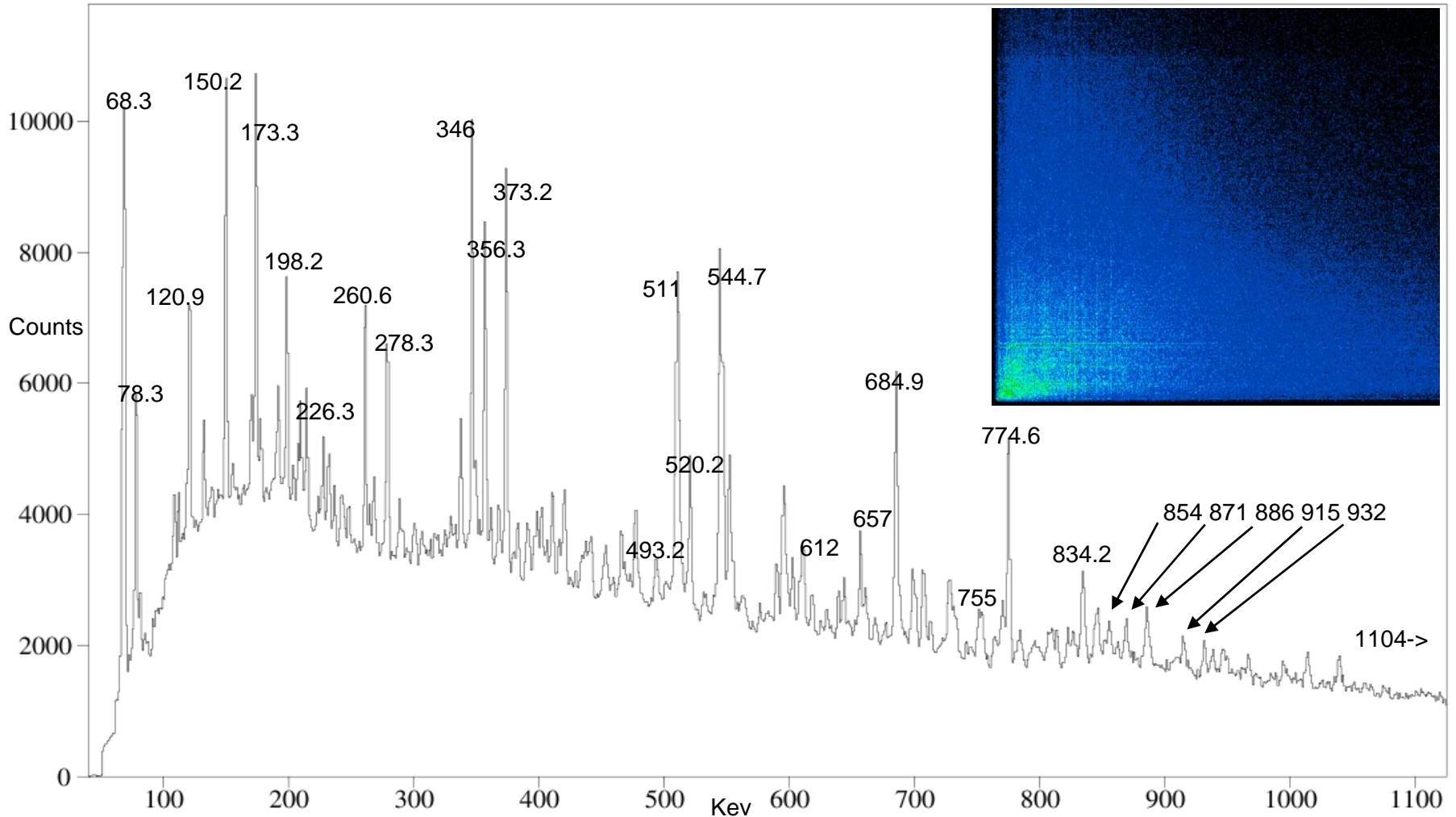


547 keV(<sup>197</sup>Au)

847 keV(<sup>56</sup>Fe)



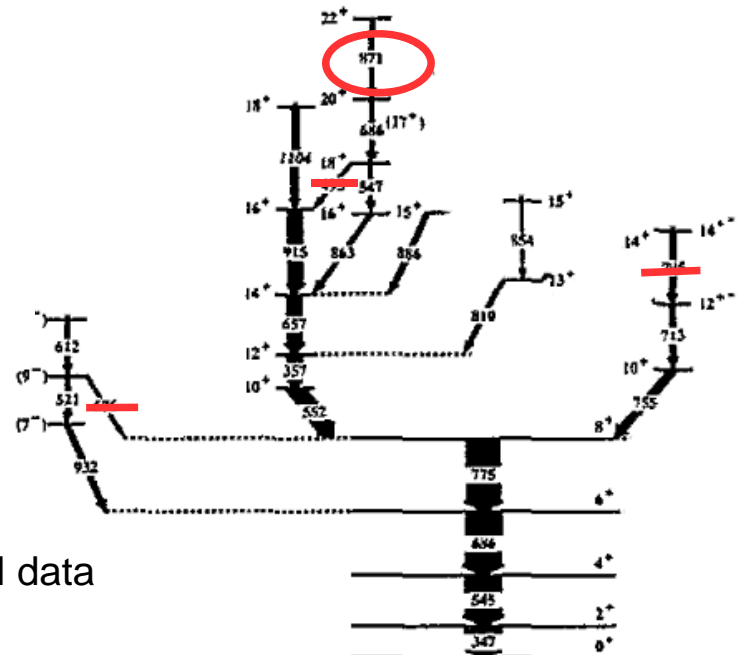
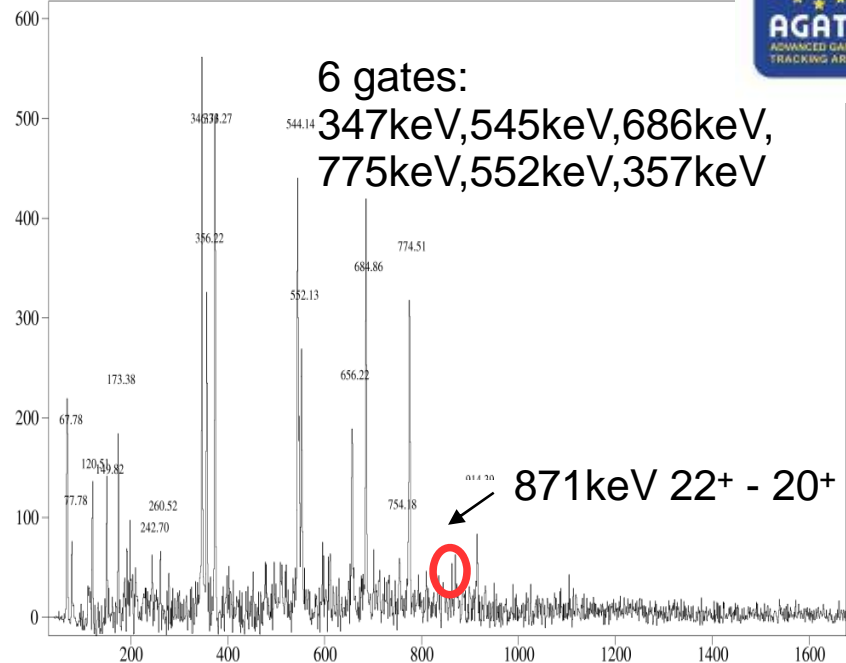
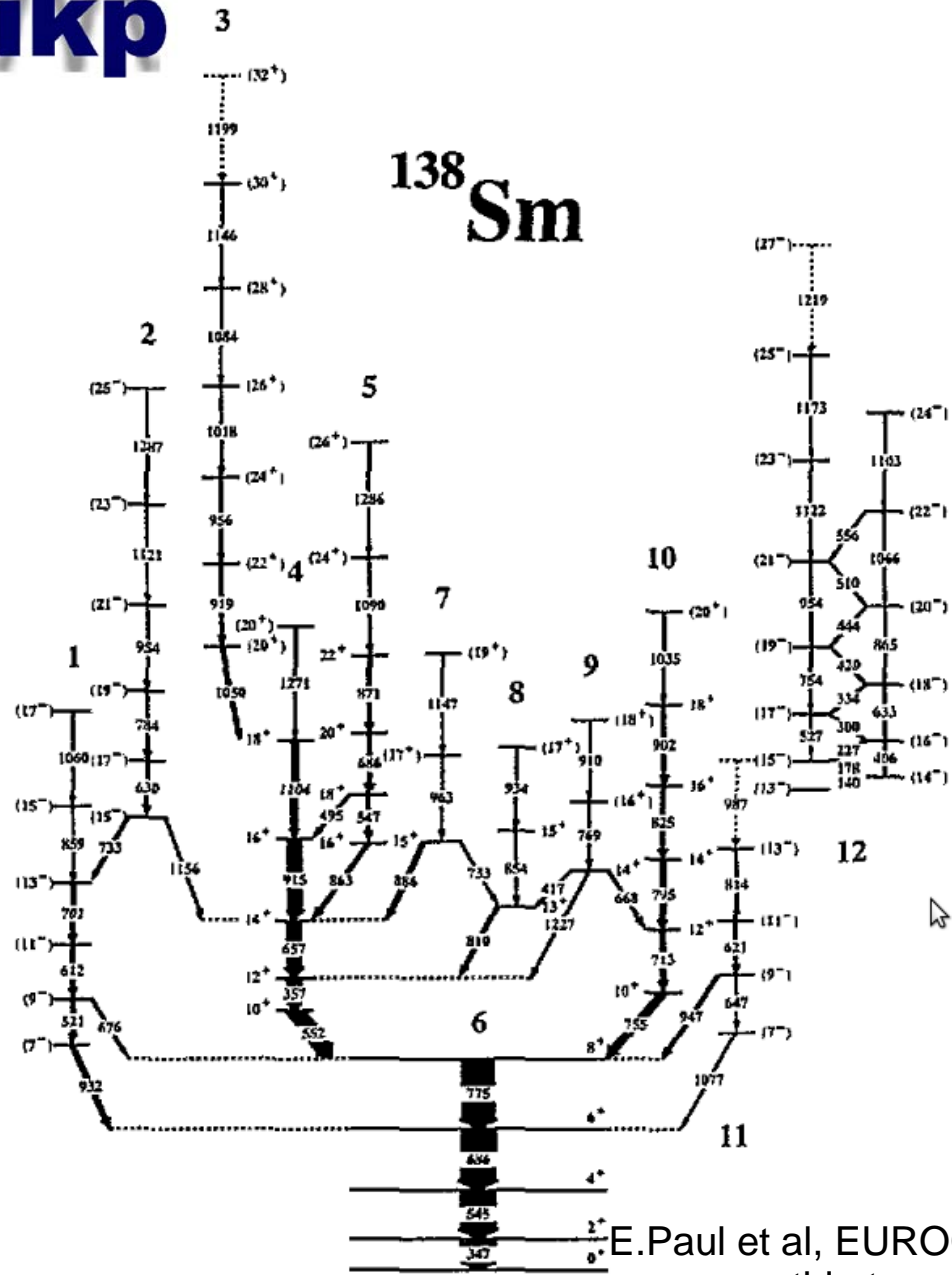
- $^{30}\text{Si}@70\text{MeV}+^{12}\text{C}$  Fusionsverdampfung, nur AGATA
- $^{56}\text{Fe}@220\text{MeV}+^{197}\text{Au}$  Coulombanregung, AGATA+DANTE
- $^{32}\text{S}@130\text{MeV}+^{110}\text{Pd}$  Fusionsverdampfung
  - Ereignisse mit hoher Multiplizität
  - Koinzidenzen zwischen zwei AGATA Tripelclustern, fünf  $\text{LaBr}_3$  Detektoren und einem Si-Streifendetektor
  - $\gamma\gamma$ -Koinzidenzen zwischen getrackten  $\gamma$ s gemessen



Ungegatetes Spektrum, markierte Peaks von  $^{138}\text{Sm}$  und andere bekannte Linien



# $^{138}\text{Sm}$ Niveauschema



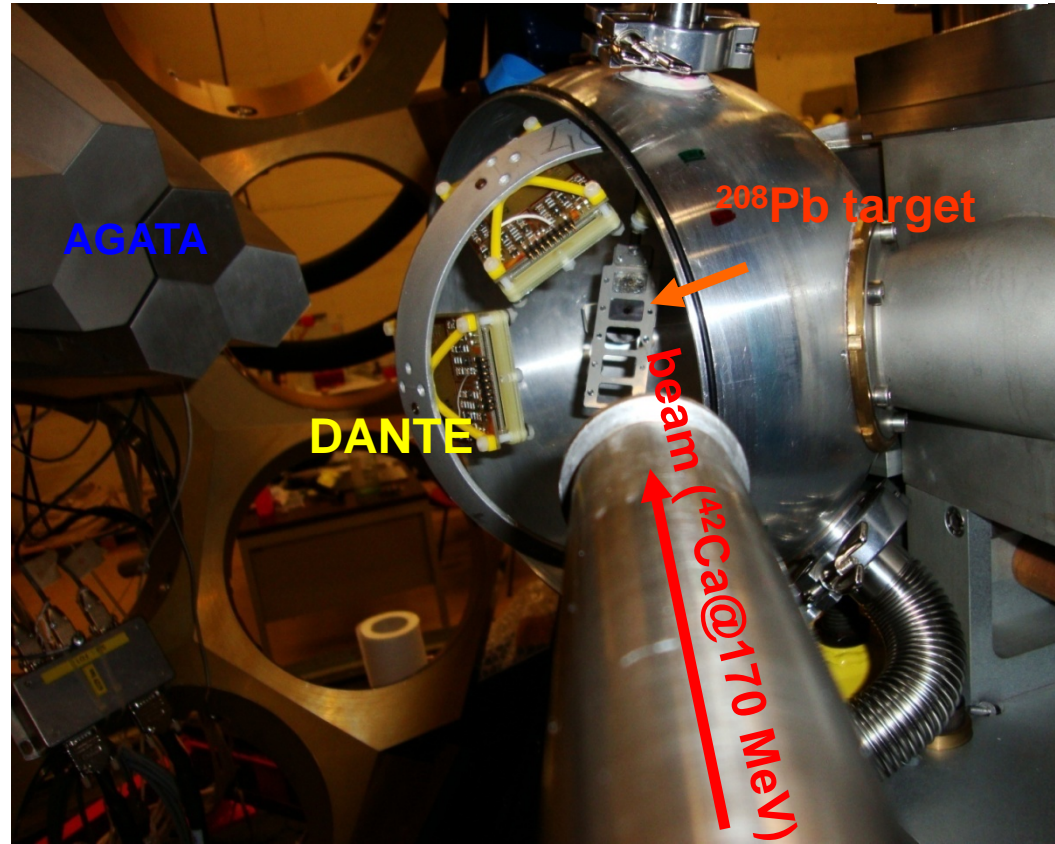
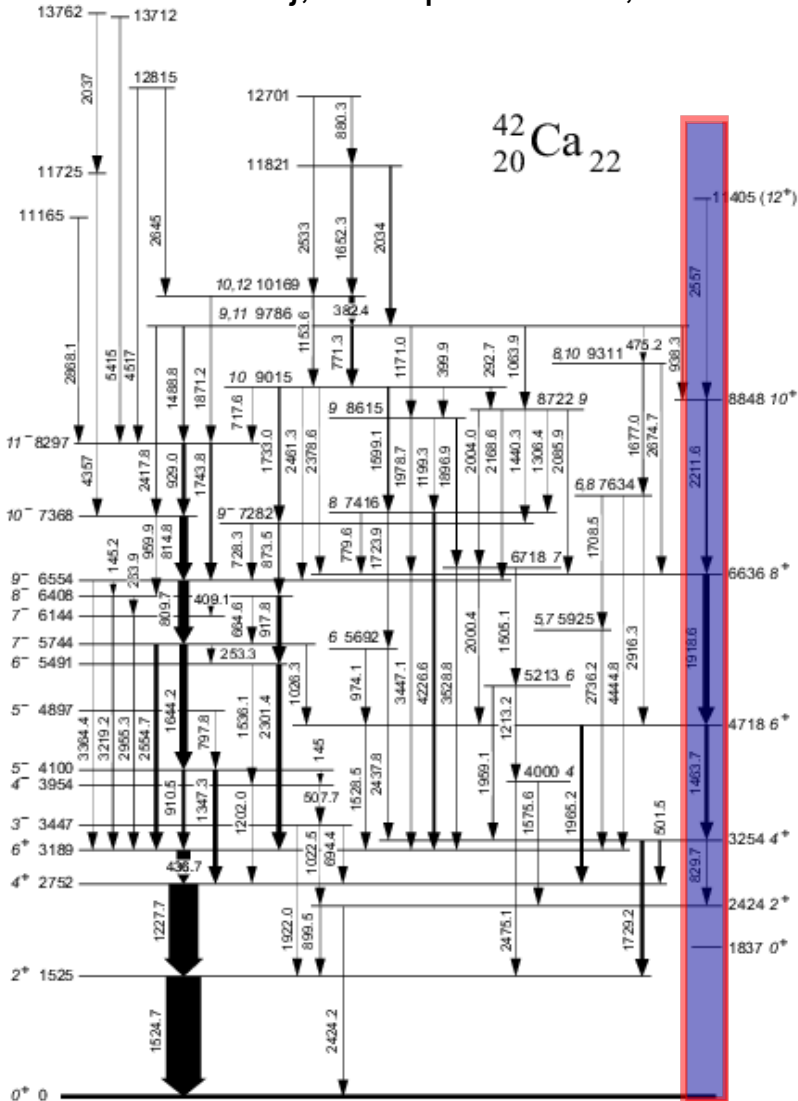
E. Paul et al, EUROGAM I data  
thin target

- $^{30}\text{Si}@70\text{MeV}+^{12}\text{C}$  Fusionsverdampfung, nur AGATA
- $^{56}\text{Fe}@220\text{MeV}+^{197}\text{Au}$  Coulombanregung, AGATA+DANTE
  - Optimierung der Signaldatenbank
- $^{32}\text{S}@130\text{MeV}+^{110}\text{Pd}$  Fusionsverdampfung
  - Erstes in-beam Experiment mit AGATA
  - Ereignisse mit hoher Multiplizität
- $^{58}\text{Ni}@^{96}\text{Zr}$  multinucleon transfer, AGATA+PRISMA
  - Optimierung der Software und des DAQ-Setup

**Start der Physik Kampagne**  
**Februar 2010**

# Superdeformed band in $^{42}\text{Ca}$ ?

A. Maj, P. Napiorkowski, F. Azaiez



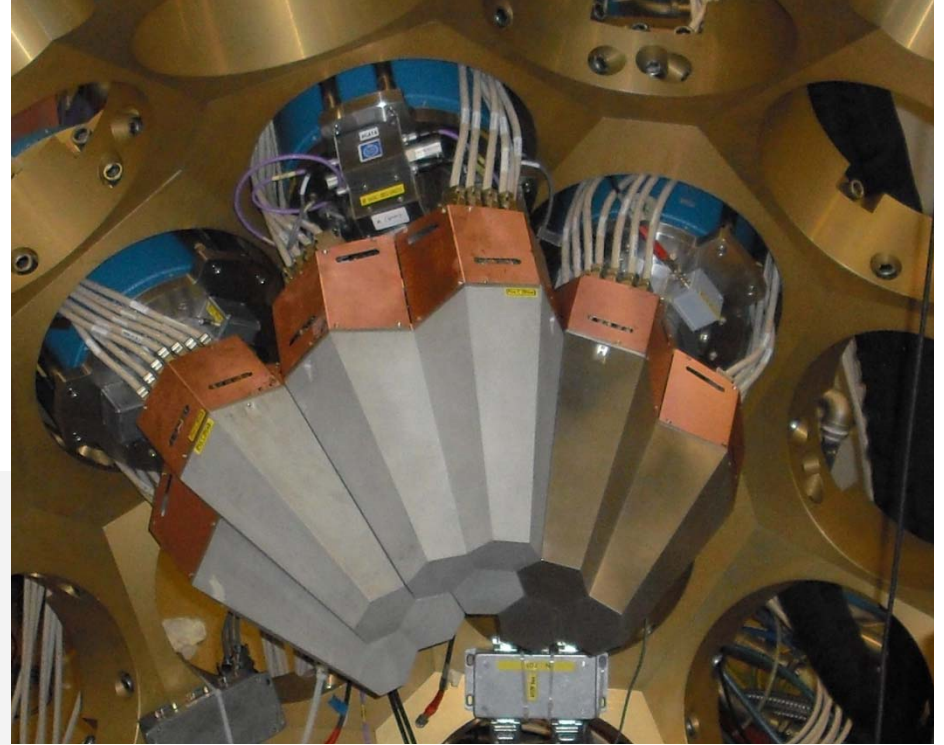
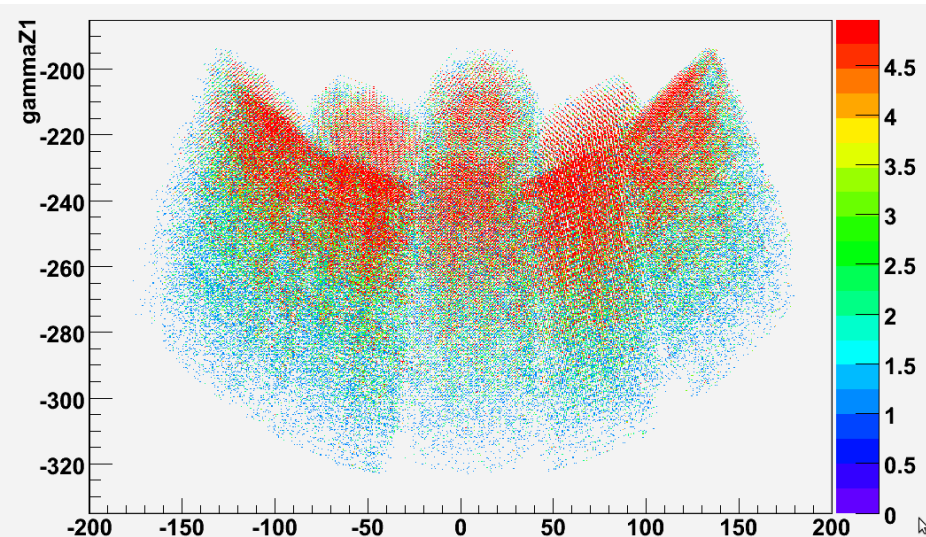
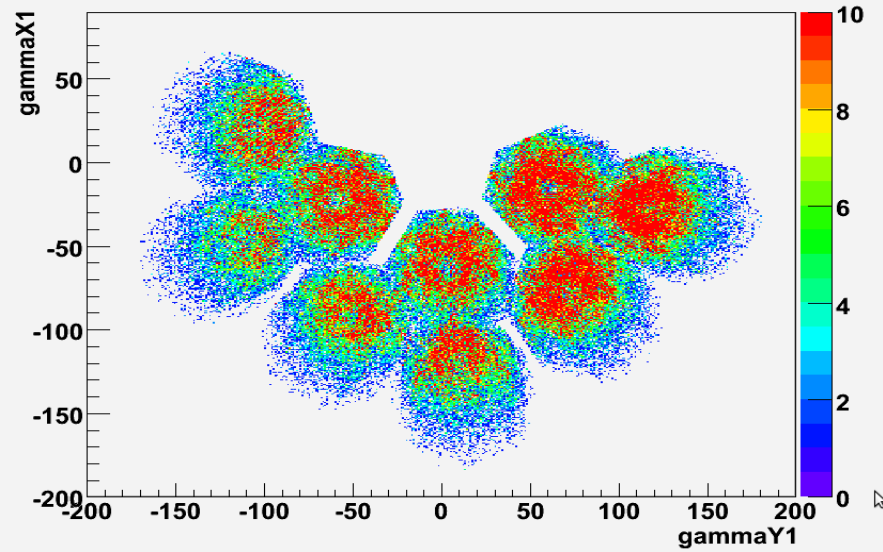
Population der Bande über mehrfache Coulombanregung

$^{42}\text{Ca}@170\text{ MeV}+^{208}\text{Pb}$

rückwärtsgestreute Ionen: DANTE

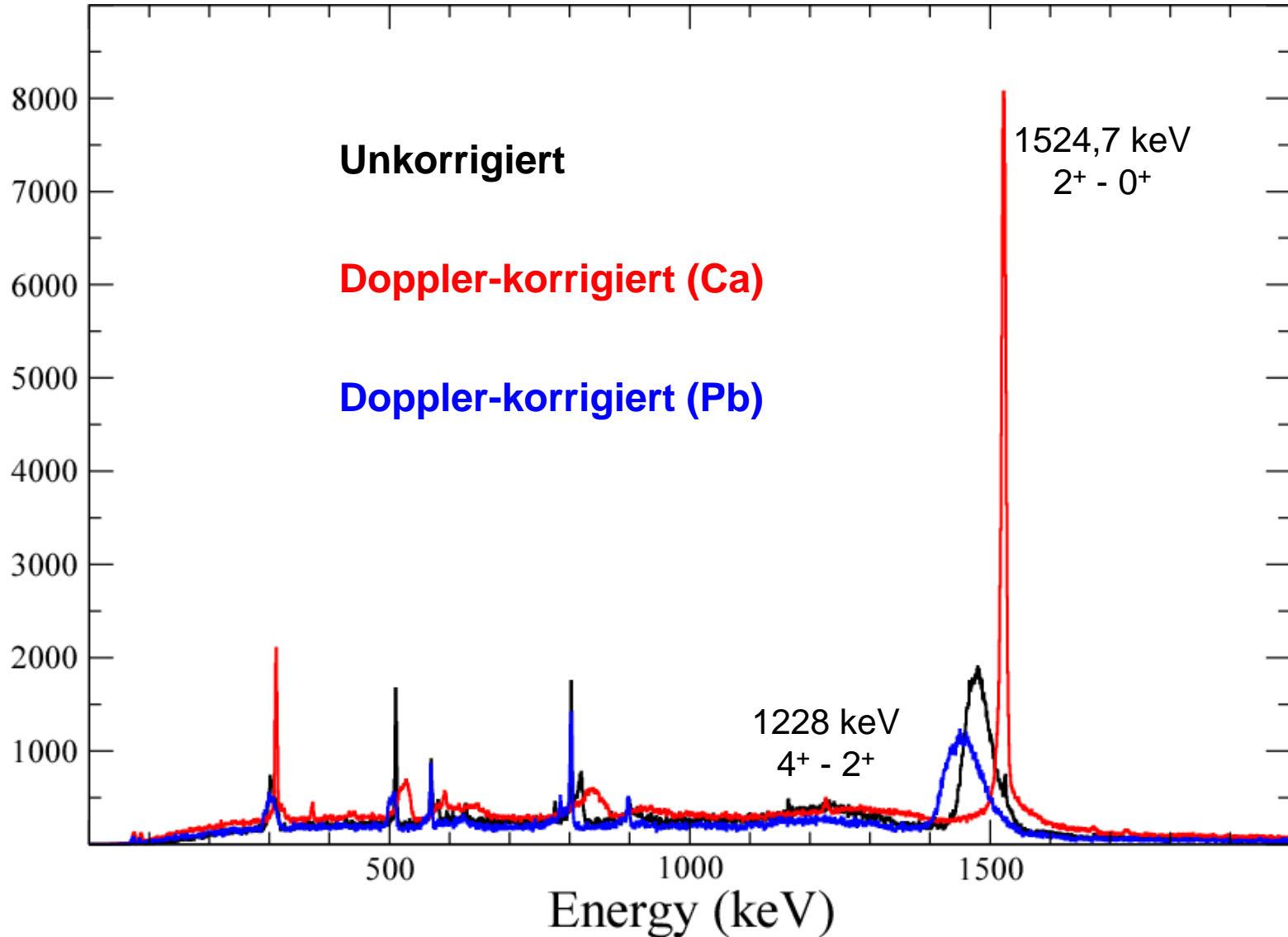
M. Lach et al., *Eur Phys J. A12*, 381 (2001)

EB IV+RFD exp.



# Online-Ergebnis

$^{42}\text{Ca}@170\text{MeV}+^{208}\text{Pb}$



- AGATA Demonstrator in Legnaro mit 3 ATCs
- AGATA Elektronik und DAQ in Betrieb
- Test-Experimente abgeschlossen
- Erstes Physikexperiment durchgeführt

## Ausblick

