AGATA Pulse Shape Analysis Intro

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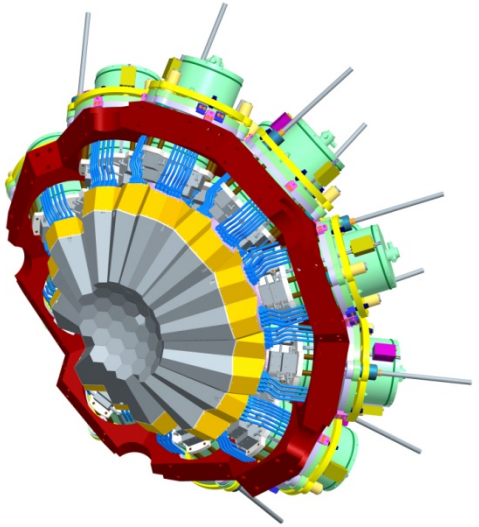
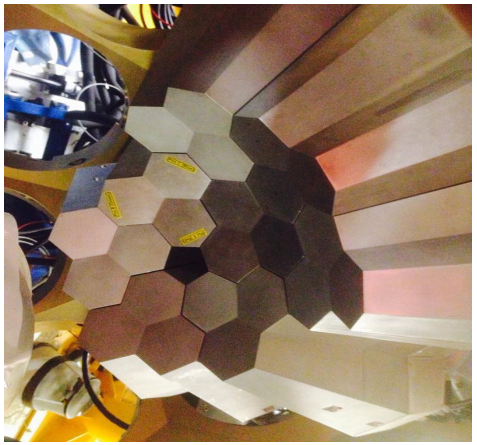
The AGATA PSA team

AGATA
ADVANCED GAMMA TRACKING ARRAY

AGATA PSA Implementation

- Architecture
- Implementation
- Opportunities





AGATA
ADVANCED GAMMA TRACKING ARRAY

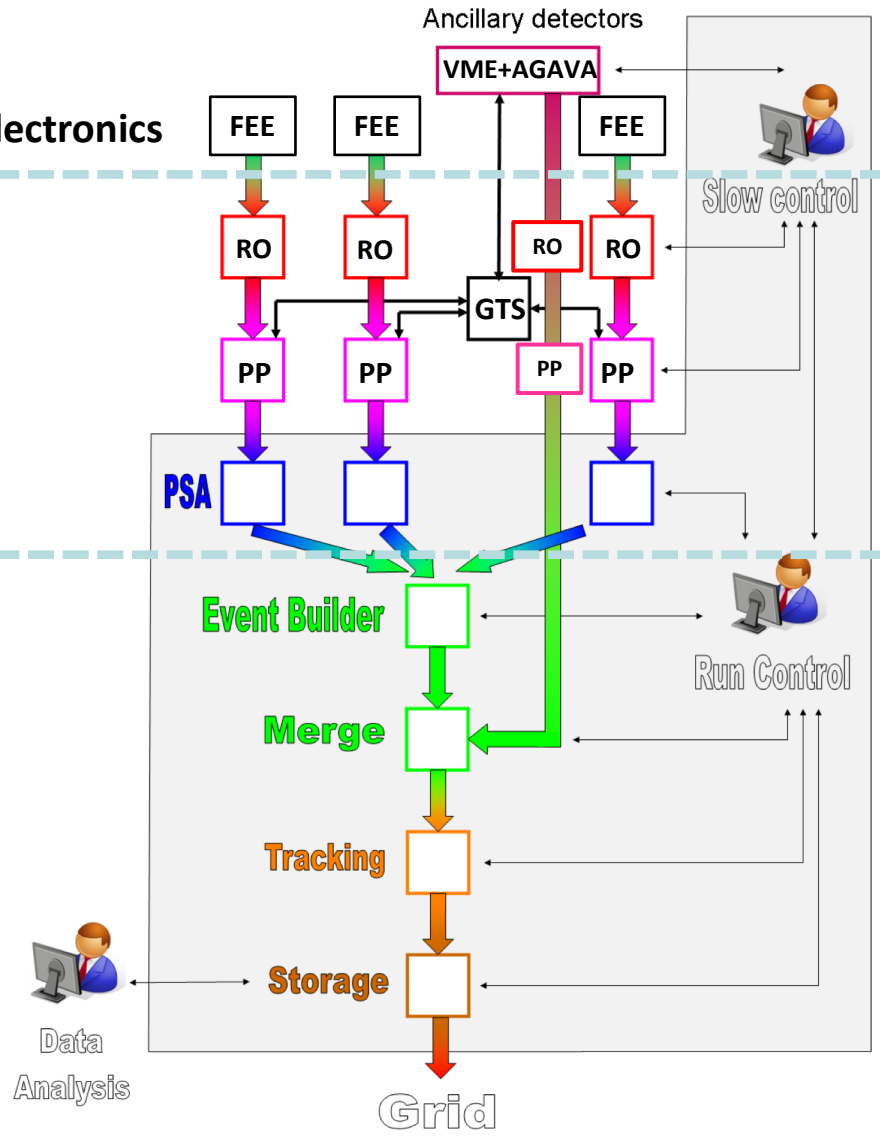
PSA ARCHITECTURE

Structure of Data Processing

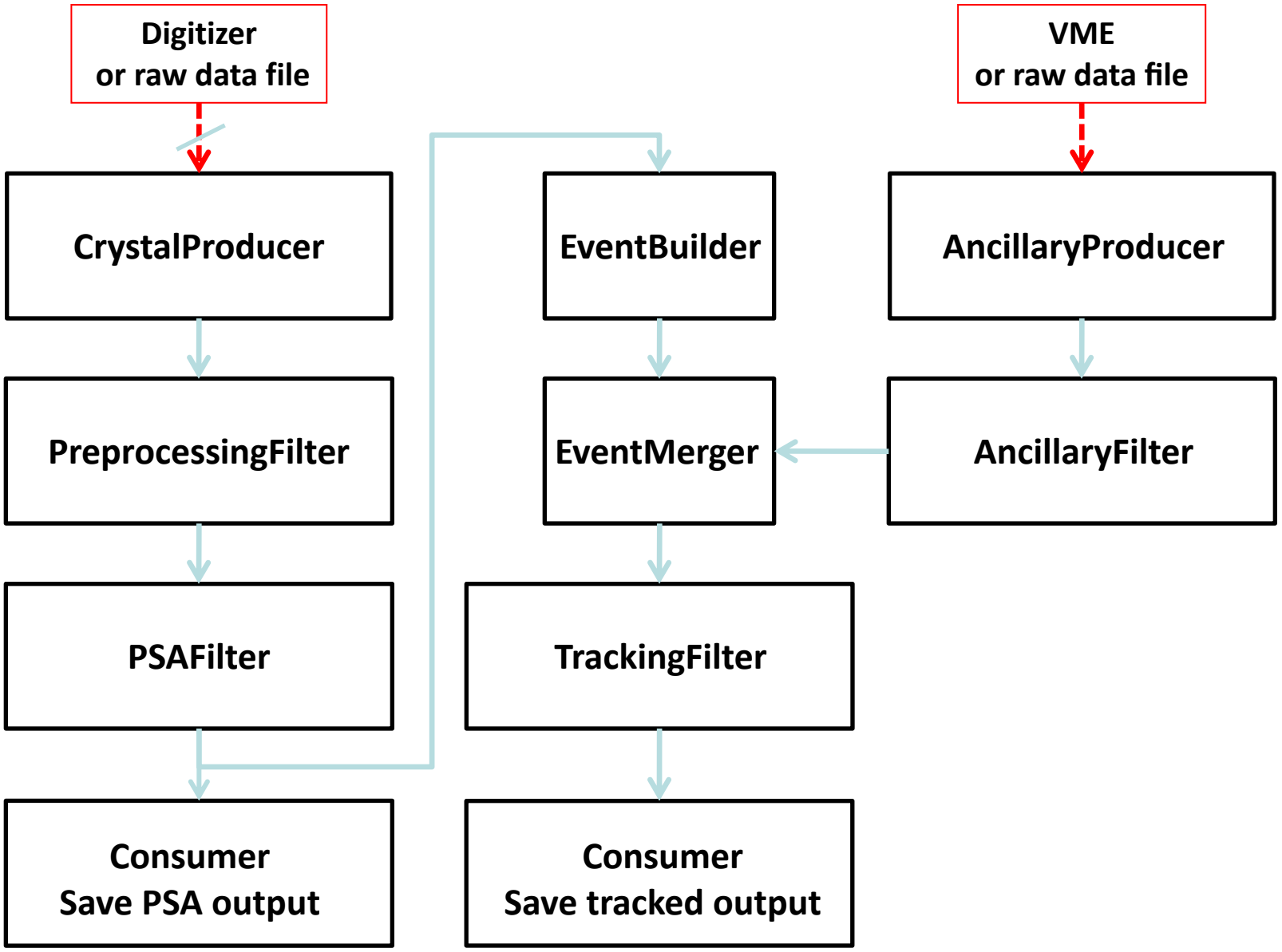
- **Local level processing**
  - AGATA
    - Readout
    - Pre-processing
    - PSA
  - Ancillaries
    - Readout
    - Pre-processing

Front end electronics

- **Global Level processing**
  - Event builder
  - Event merger
  - Pre-processing
  - Tracking
  - Post-Processing



Structure of Data Processing



Preprocesssing Filter

- **Performs**
  - Energy calibrations and xTalk (proportional) correction
  - Analysis of traces
    - Calculation of T0 from core (Digital CFD or linear fit of the first samples)
    - Time calibrations and shifts
    - Vertical normalization of traces
    - Define the net-charge segments
  - Reformats the data

- **The calibration files are produced by external programs as part of the calibration procedures**

PSA Filter

- Signal decomposition & diff xtalk
- Implemented algorithm is the Grid Search
  - As a full grid search
  - As a coarse/fine search (AGS)
- Reduces size of data by factor 20
- Provides the parameters for the correction of neutron damage (can also perform it)
- Must be expanded to improve timing
- Takes ~95 % of total CPU time
- Is the critical point for the processing speed of online and offline analyses

PSA IMPLEMENTATION

PSA Implementation

- **The signal decomposition algorithm (AGS)**
- **The quality of the signal basis**
  - Physics of the detector
  - Impurity profile
  - Application of the detector response function to the calculated signals
- **The preparation of the data**
  - Energy calibration
  - Cross-talk correction (applied to the signals or to the basis!)
  - Time aligment of traces
- **A well working decomposition has additional benefits, e.g.**
  - Correction of energy losses due to neutron damage

Signal basis generation

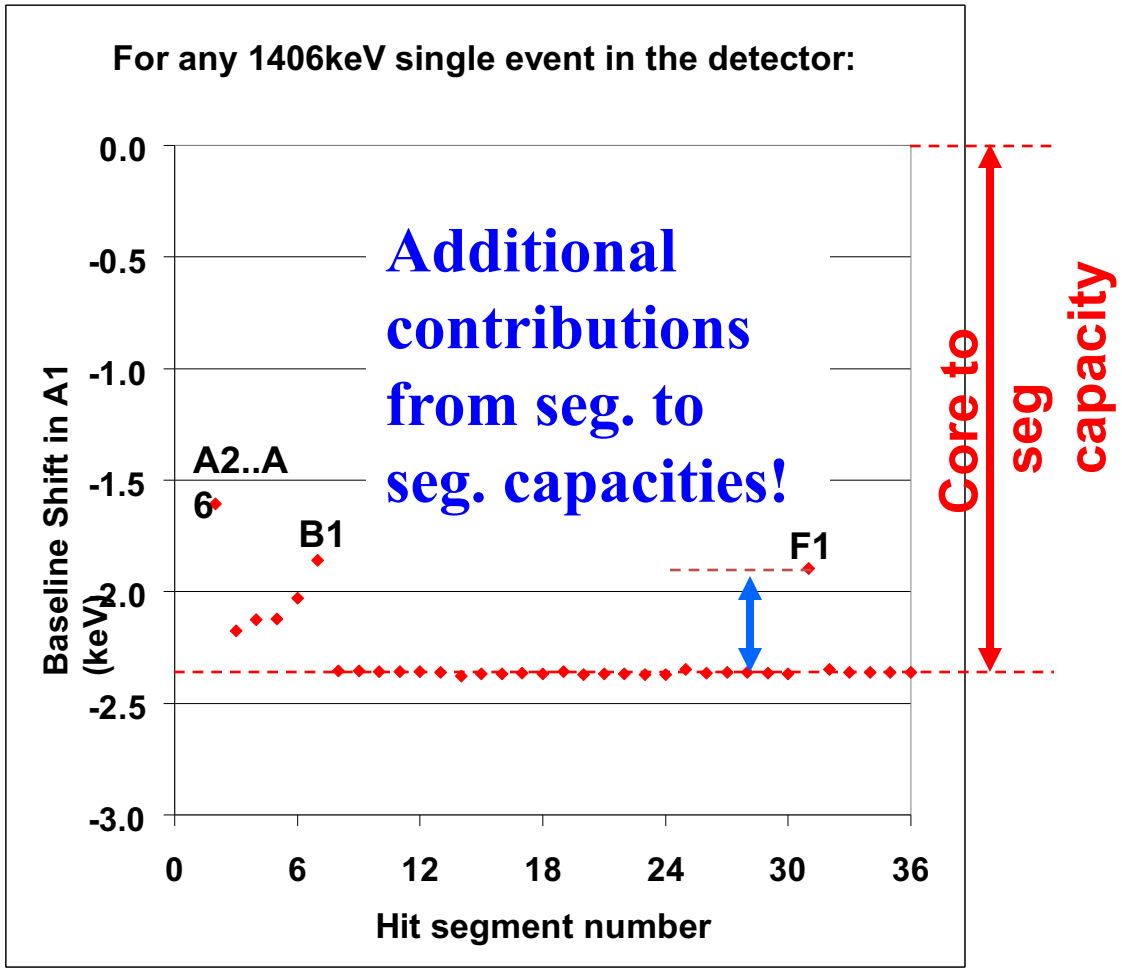
- Simulation: MGS, JASS, **ADL**
- Experimental: Coincidence, PSCS

- AGATA Data Library
  - Geometries for a wide variety of detectors
  - E-field solver, SIMION potential arrays
  - Creates the calculated basis for each detector

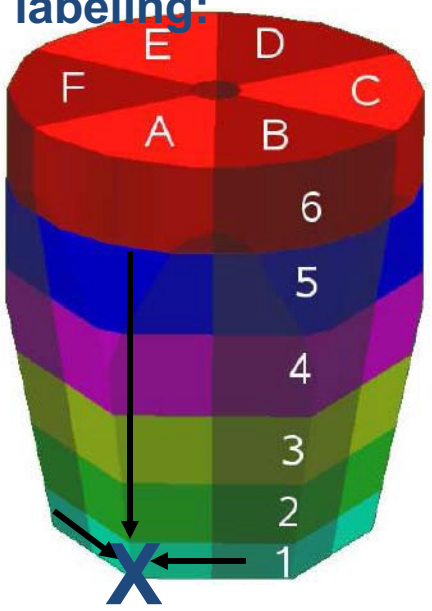
-> Rouven's talk

Bart Bruyneel and Benedikt Birkenbach IKP (Eur. Phys. J. A (2016) 52: 70)

Proportional Xtalk measurement



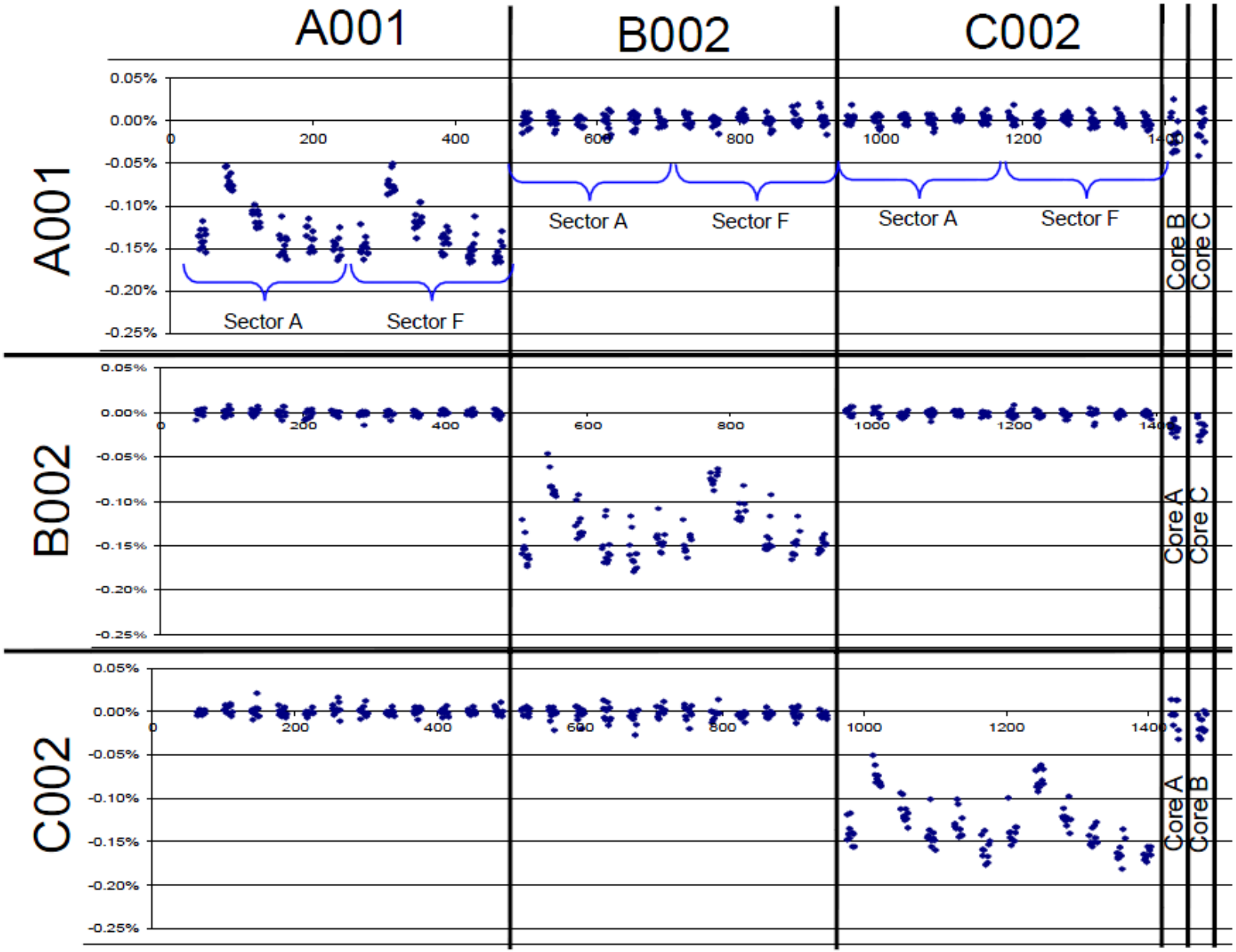
Segment labeling:



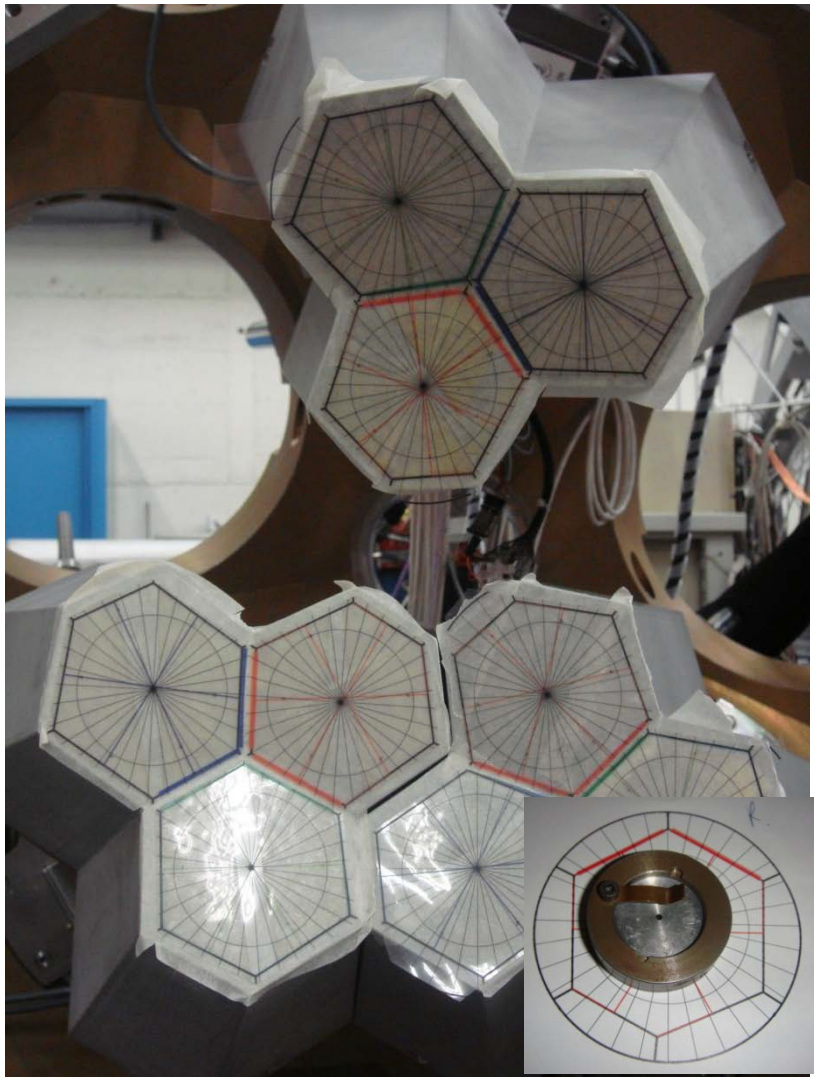
Sectors: A...F

Rings: 1...6

Cross talk in AGATA Triple Cluster

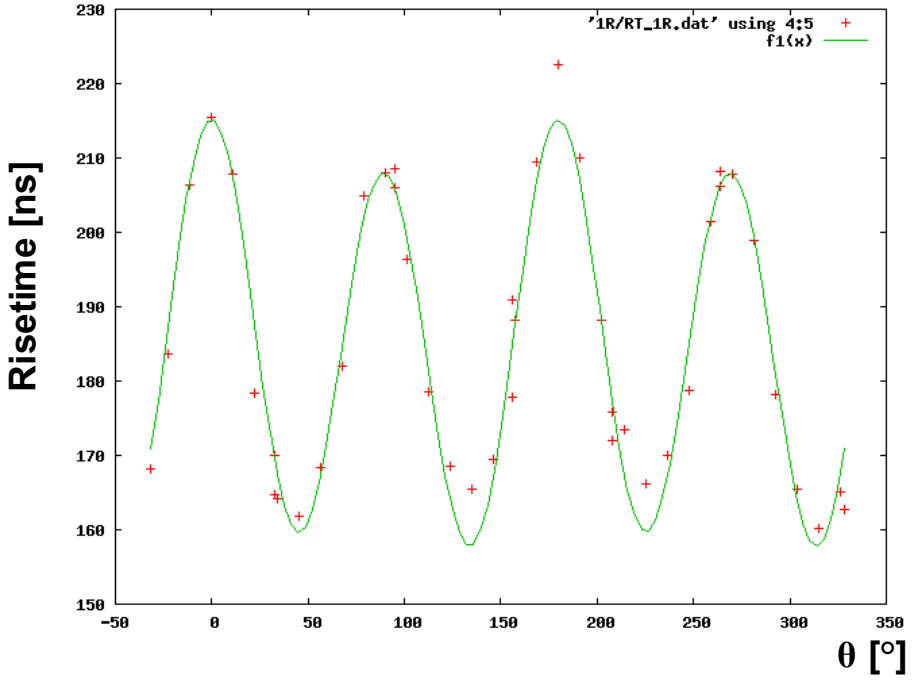


Optimisation: Crystal orientation



- 400kBq Am source +
- Lead Collimator: ∅1.5mm X 1cm
- Front Scan at ∅4.7cm: 300 cts/s

- Fitfunction Risetime(θ) = $A.[1+R_4\cos(\theta-\theta_4)].[1+R_2\cos(\theta-\theta_2)]$



Status as of December 2016

- **AGATA AGS algorithm with one interaction per segment achieves similar performance to GRETINA signal decomp.**
- **What are the limiting factors?**
- **Performance of AGATA detectors coupled to digital electronics chain**

Lots of opportunities

- Continuous improvement of signal basis -> PSA team - Fraser
- Push towards experimental basis generation -> Joa's talk
- Implementation of multiple segment interaction algorithm -> AGATA/GRETINA collaboration
- Offline decomp using GRETINA basis

- **Challenges:**
  - Availability of AGATA capsules for characterization.
  - Clustering of points distributed inside detectors
  - Continuity of available personnel to implement PSA algorithms
  - Documentation + Howto guide (so so…) ☺