PSA Projects

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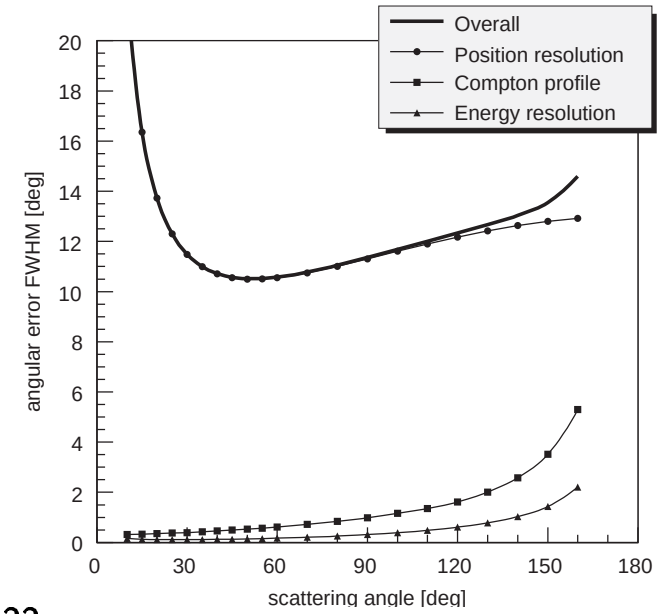
We (I) would like to measure PSA performance with source

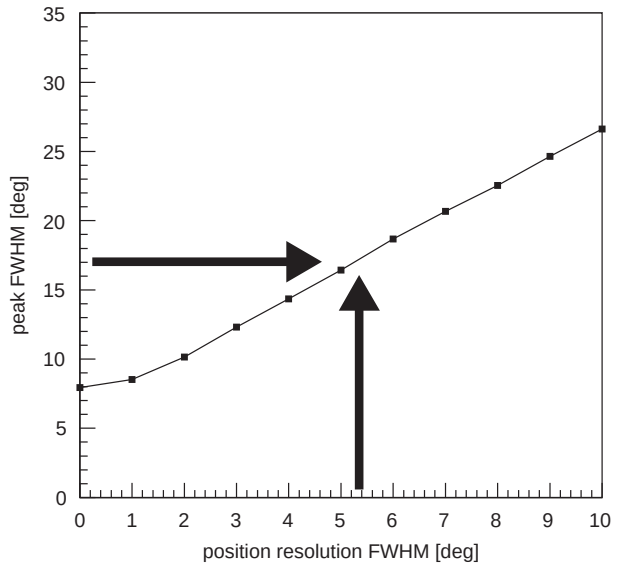
Has been done using imaging techniques[a]

[a] F. Recchia et al. NIM A 604 (1) (2009) 60 – 63

Contributions to image resolution



Extracted resolution



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Reading about γ-ray tracking, I stumbled upon TANGO[a]

[a] S. Tashenov NIM A 622 (3) (2010) 592–601.

The energy of a γ ray that has interacted at least twice in AGATA can be estimated using the equation

$$E_\gamma = \frac{E_1}{2} + \sqrt{\frac{E_1^2}{4} + \frac{E_1 m_e c^2}{(1 - cos\theta_1)}} \quad (1)$$

By selecting good 1332 keV γ rays (tracking or calorimetric) and using above formula I get an energy peak with a width that depends on the position resolution.

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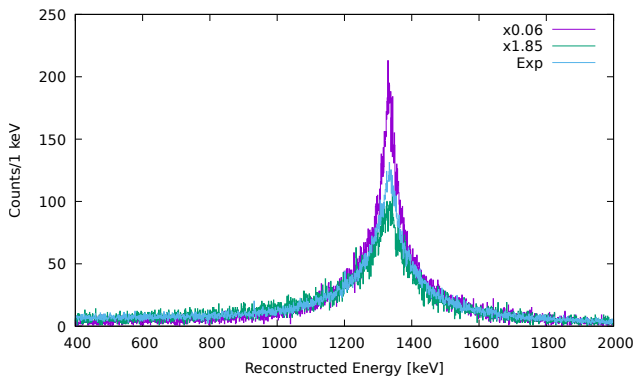
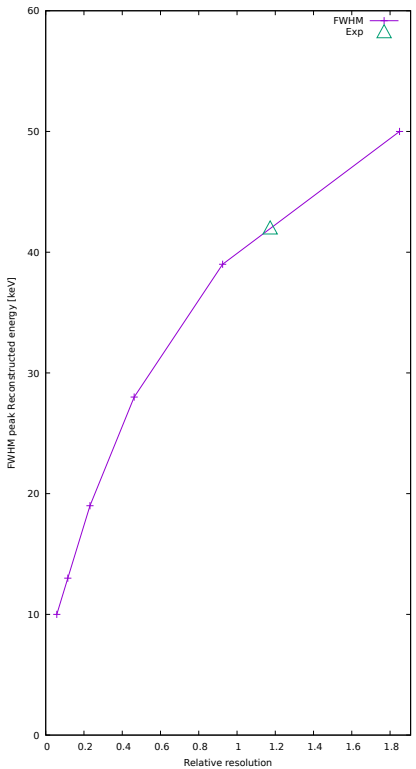
So lets try to use this to estimate PSA performance

Energy distributions

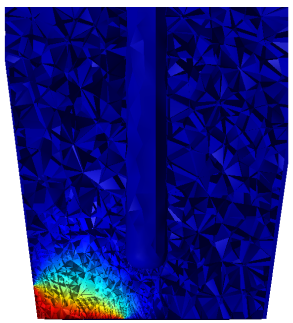


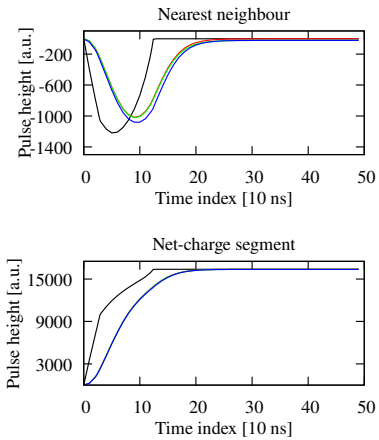
Extracted resolution



AGATAGeFEM produces a good database but...

AGATAGeFEM





FEM based code with strong coupling to ROOT, geant4, and ADF.

Need to verify this using neutron damage corrections

- This is a bit tedious work...
- Calibrations...
- Tests...
- Calibrations...

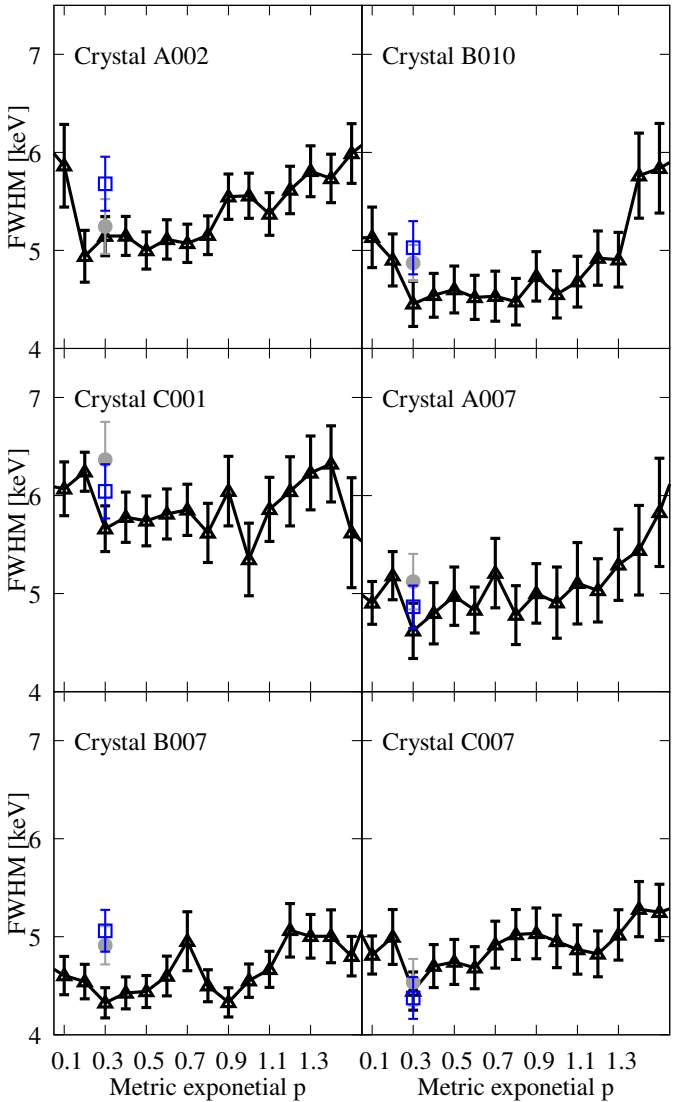
But will be done at some point not to far in the future

What metric do we use for the moment?

A sum like

$$\sum_i \left(|y_i^{exp} - y_i^{base}|\right)^{0.3}$$

This has been verified using both ADL and AGATAGeFEM (fig to the right) basis signals



What is (might be) missing?

- As the noise has the same magnitude for all points, no Δy in square sum
- But, what about Δt (e.g. t_0)?

Normal solution

$$\chi^2 = \sum_i \left(\frac{y_i^{exp} - y_i^{base}}{\sqrt{(\Delta y_i)^2 + (\frac{dy}{dt}^{base}(t_i)\Delta t)^2}} \right)^2$$

Note, that noise level suddenly matters as it has a magnitude compared to error induced by t_0 determination. Idea is to implement this metric in PSA and test. [1]

[1] Old news,see P Désesquelles et al 2009 J. Phys. G: Nucl. Part. Phys. 36 037001

Continuation of a project that started 2021

- Try to use ML to count number of interactions in segments
- Idea was to use some kind of simple tracking that could correlate segment energies with number of interaction... fail
- Using energies together with pulse shapes was never done. Will be done now by D. Kovalenko (remote France-Ukraine grant).
  1. AGATA geant4 simulation gives γ-ray interactions AND energy deposition positions.
  2. AGATAGeFEM calculates pulse shapes from energy deposition positions.
  3. Gamma-ray interactions used to train NN to get #interactions/segment.