In-situ experimental basis

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In-situ experimental basis - what is this?

This is an idea of P. Désesquelles [1, 2, 3]

To make a long story short: Put a ^{60}Co source inside the array Friday, get brand new set of reference pulse shapes for PSA Monday morning including:

- Cross talk
- Time (mis-)alignment
- Electronics responses
- ...

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It is a simple concept to understand (once understood ;-)

1. A measured quantity that is a good "estimator" of this quantity.
2. Given a theoretical distribution of some quantity (x, spin, E. . .).
3. We can match "probabilities" between the two to use the first to get the second. . .

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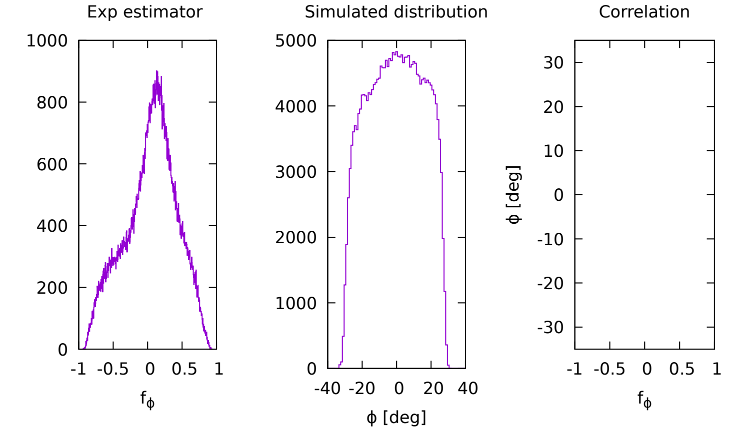
As example, lets look at φ for one segment in an AGATA crystal



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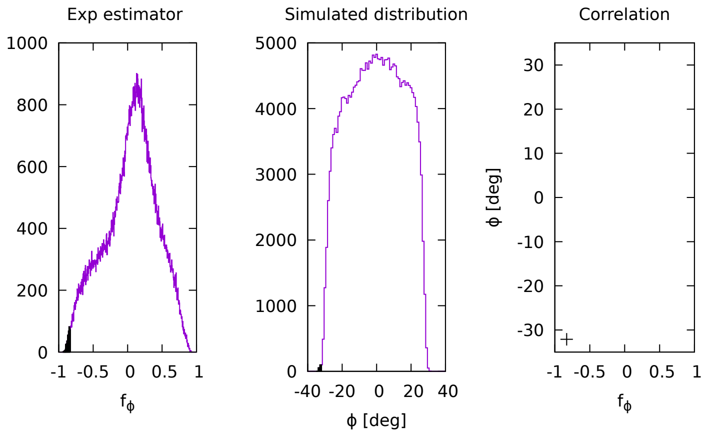

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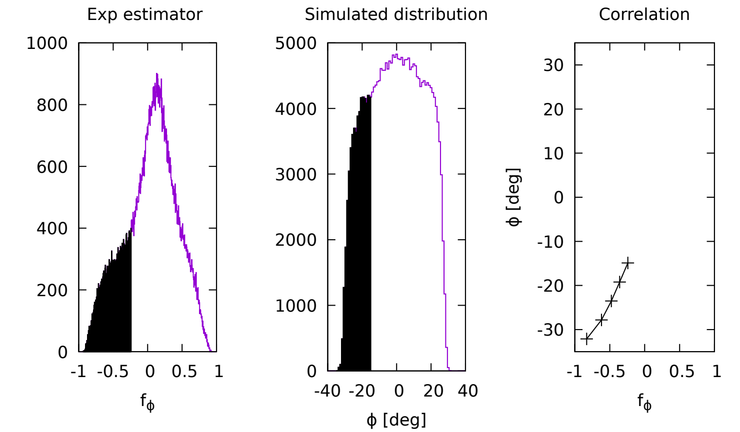

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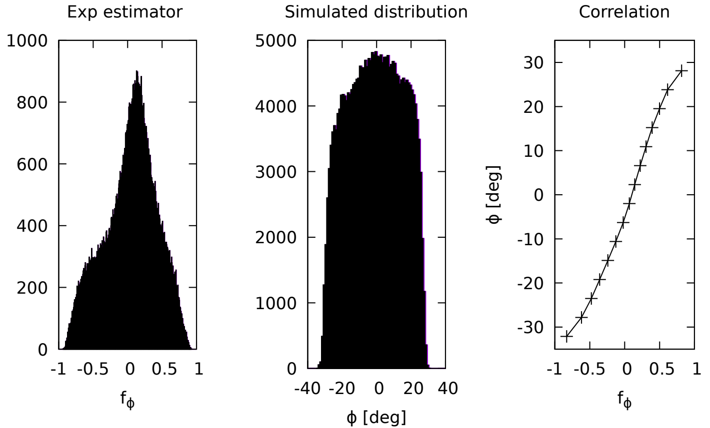

Some 3D complications

Experimental estimator for z depends φ that depends on r...

We have to make experimental estimators for each coordinate that depends on each other, our choice is:

- First estimate r
- Then estimate φ
- And finally estimate z

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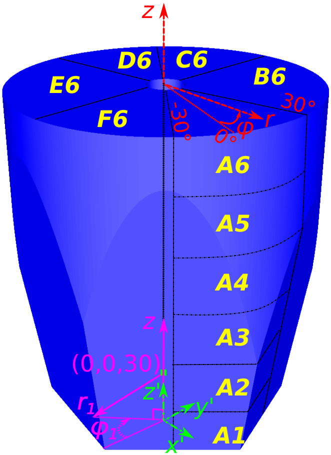
With the following coordinate system definitions



Choices of estimators and corresponding simulated quantities

The experimental r estimator f_r and corresponding simulated distributions

- f_r combines risetime information with information on the sign of the transient signals on neighbour segments.
- The simulated distribution for slice 1 is $r = \sqrt{x^2 + y^2 + (z - 30)^2}$
- For the other slices $r = \sqrt{x^2 + y^2}$

I.e. r the distance "projected" on the electric field direction

Choices of estimators and corresponding simulated quantities

The experimental φ estimator f_φ and corresponding simulated distributions

- f_φ is a variant on mirror asymmetry
- For all segments φ is measured with respect to the closest "60° branch" with a range $\approx \pm 30^\circ$

Choices of estimators and corresponding simulated quantities

The experimental z estimator f_z and corresponding simulated distributions

- f_z is a variant on mirror asymmetry for slice 2-5
- For the last slice it is the max amplitude of the transient signal in slice 5 scaled by energy.
- For slice 1 f_z is a measure of risetime.
- For all segments z just z.

Choice of grid for basis

This is how we partition r,φ and z distributions

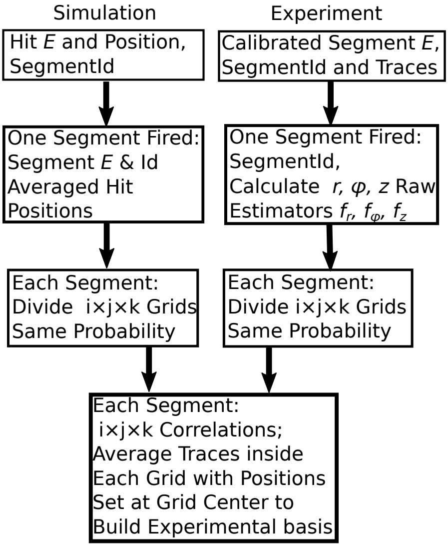
- We aimed at having same volume voxels.
- This by increasing the number of φ divisions with r
- And by having different number of z divisions for some r,φ combinations

Our rationale for this was to have approximately the same solid angle precision and comparable resolution in z.

Data selection and treatment

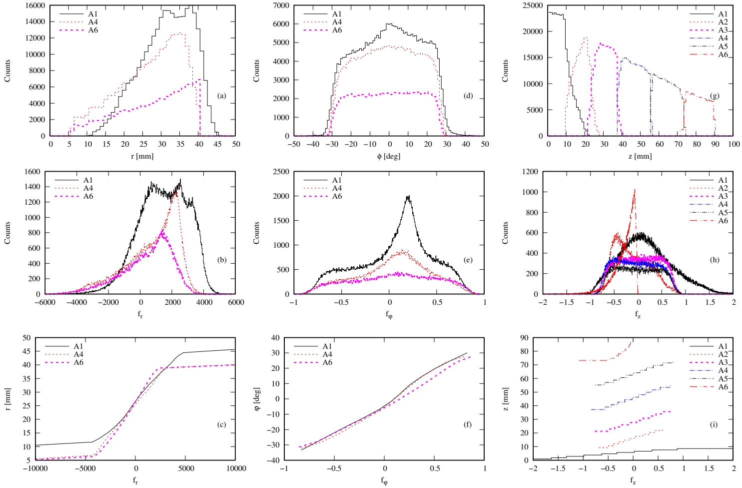
- We used events with only one net-charge segment. This was also the condition for geant4 simulations used for simulated distributions.
- Gain matching, time-alignment etc. done using the pre-processing codes of AGATA.
- All events within a voxel had traces averaged with out selection

Before some results, recapitulate what we do



Some results. . .

Estimators



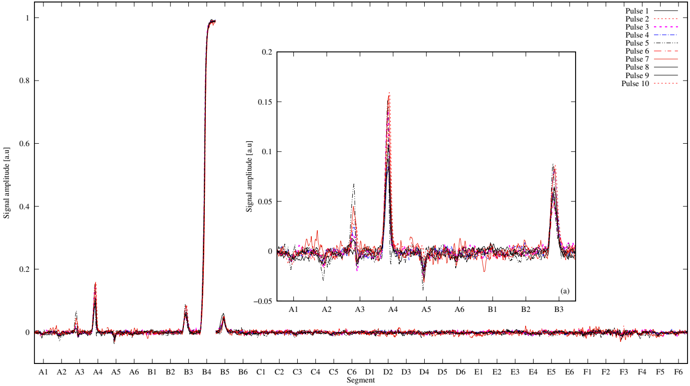
Some results. . .

Intermezzo

For events with only one net-charge segment the correlations can be used to directly get the position (under the assumption that 1 seg $=$ 1 interaction. . .)

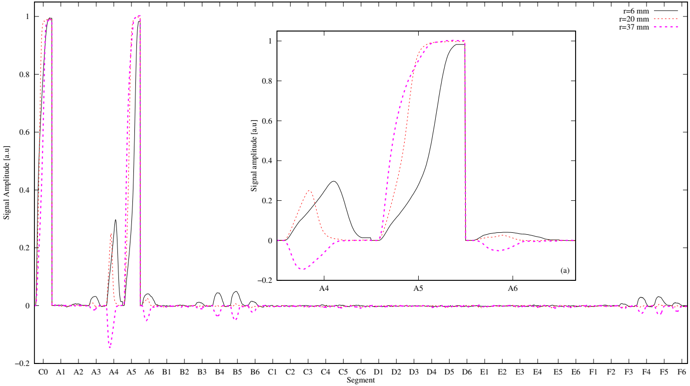
Some results. . .

Examples of averaged pulses for one position



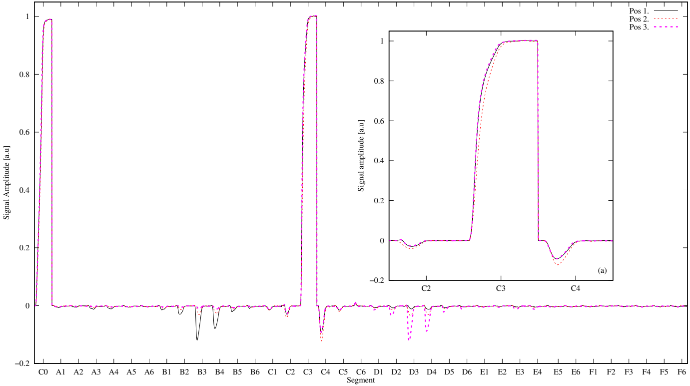
Some results. . .

Example of varying r of the created references pulses



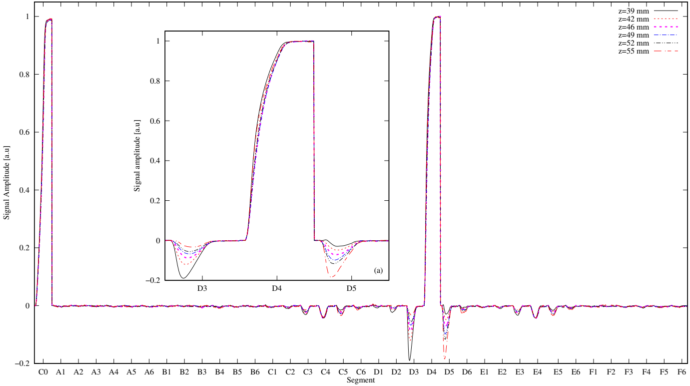
Some results. . .

Example of varying φ of the created references pulses



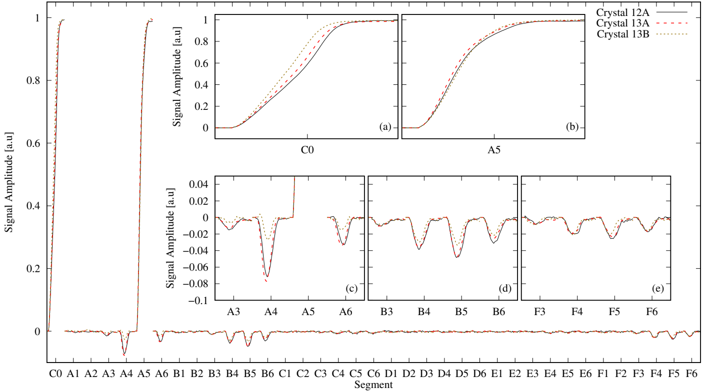
Some results. . .

Example of varying z of the created references pulses



Some results. . .

Example of same x,y,z for different detector shapes



Are we worse, as good as, or better than the ADL basis?

I will not discuss this in detail. Based on Doppler Correction capabilities the conclusion, to find in a submitted paper, is that we do not as good as ADL but not so bad either. . . so instead on dwelling on the details on how we concluded this I will try to discuss how we could maybe do better. . .

What are the weaknesses of this work as I see them

1. We make an identification between number of net-charge segments and number of γ-ray interactions.
2. No post-selection on traces used for the average trace.
3. How to know the geometry? How to go from (x,y,z) given by geant4 simulations to distributions gated on hit segment? What are the real measurements of the active HPGe Volume?

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How to deal with problem 1?

Gate on Compton edge of a ^{60}Co line while demanding full energy peak of the other line in another detector. We did not have the statistics for this (requires a lot). Have yet to simulate that this solves the problem.

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How to deal with problem 2?

Simple, do χ^2 test for the average. We did not, mainly because our reference data base seemed sensitive to small position changes (see figures above)

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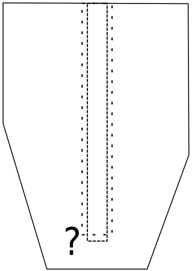
What about problem 3?

How exactly do we know the crystal geometry



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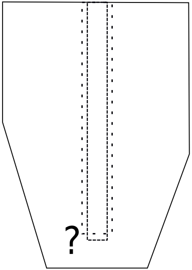
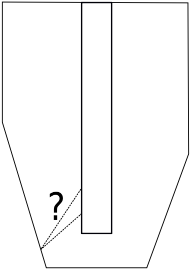


How can we get the real segmentation without calculations?



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What we did this time

- Assumed that the active volume of the crystal is according to drawings.
- We used segmentation boundaries as given by the approximation used in the geant4 AGATA simulation (taken from ?)

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What I would do next time

- Hmm. . . I do not have a very good idea for this yet.

Contributors

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References

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