

Pulse Shape Analysis in a tracking array with reference pulses obtained from source data

Hongjie LI

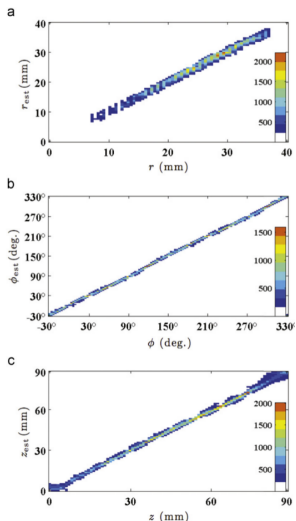
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In-situ Method for Building Basis

Determination of hit coordinates of gamma interactions directly from the experimental signals without requiring the basis from simulation or scanning device.

In-situ Method Using Calculated Signals



P. Désesquelles, NIMA 654 (2011) 324-329

- Signals from simulation.
- Correlations between the coordinates and the estimators.

- Errors of position.

- $R : \frac{\sum_i (i - \langle i \rangle)^3 s_i}{\sum_i s_i}$

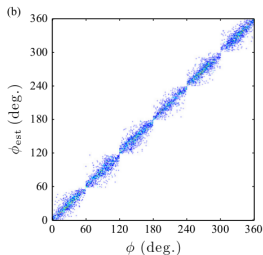
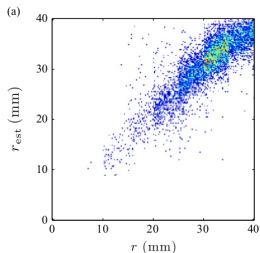
$$\langle i \rangle = \frac{\sum_i i s_i}{\sum_i s_i}$$

$$s_i = (S_{i+1} - S_{i-1})/2$$

- $\Phi : \frac{\sum_i S_{li}^2 - S_{ri}^2}{\sum_i S_{li}^2 + S_{ri}^2}$

- $Z : \frac{\sum_i S_{ti}^2 - S_{bi}^2}{\sum_i S_{ti}^2 + S_{bi}^2}$

In-situ Method Using Scanned Data



- Signals from Liverpool scanning system.
- Correlations between the coordinates and the estimators.
- Errors of position.

Flow Chart

Monte Carlo Geant4 Simulation

Energy, x , y , z positions and hit segment. \Rightarrow The distribution of hit positions (r , ϕ , z).

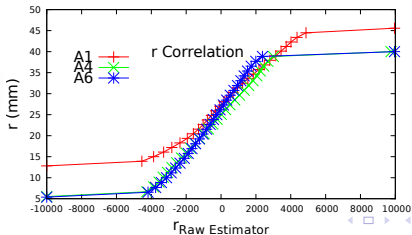
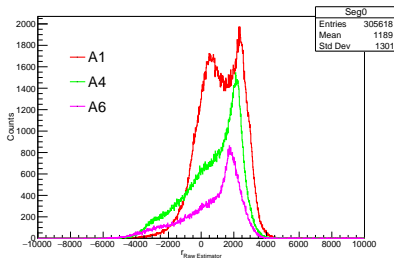
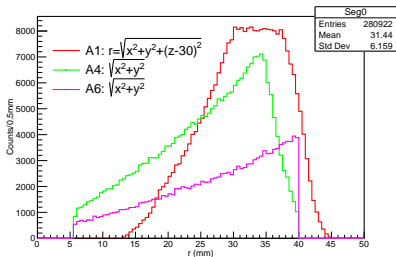
^{60}Co Source Measurement

^{60}Co source pulses. \Rightarrow Distribution of raw estimators (a function of pulses related to hit locations).

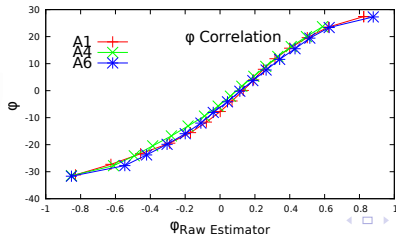
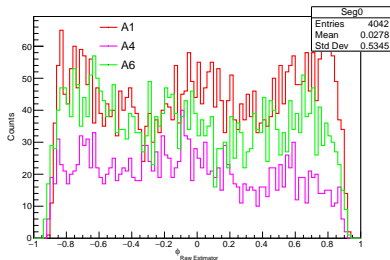
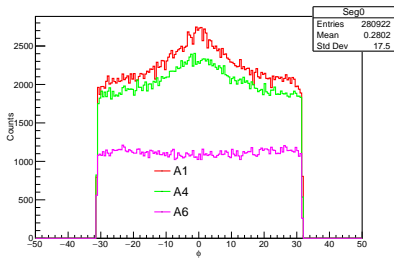
Coordinates Determination

Hit positions determined by the correlation between raw estimators and hit locations.

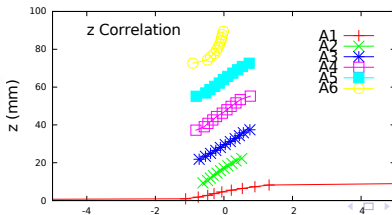
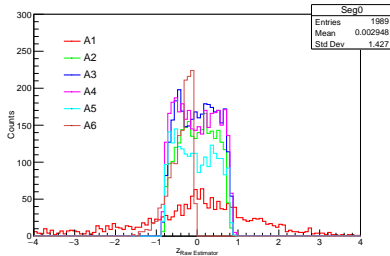
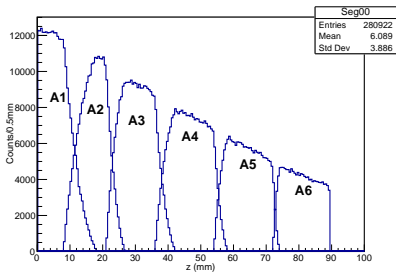
How to Build the Basis? ^{60}Co Centered Source \Rightarrow 1st R Coordinate



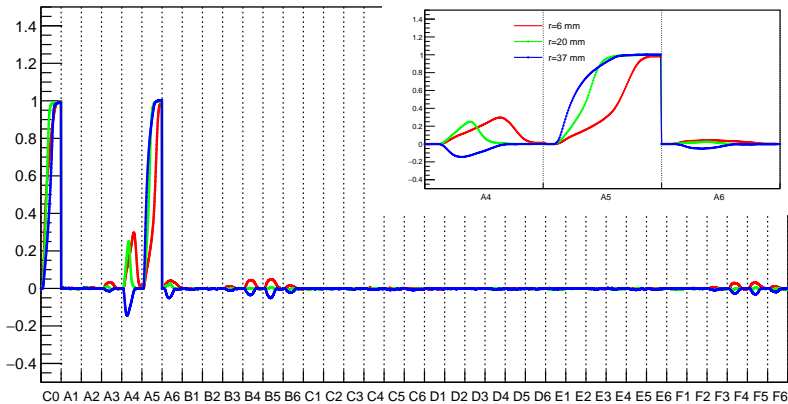
How to Build the Basis? ^{60}Co Centered Source \Rightarrow 2nd φ Coordinate



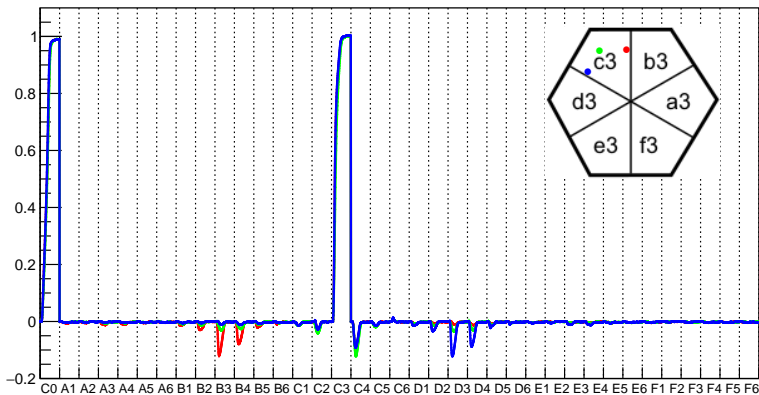
How to Build the Basis? ^{60}Co Centered Source \Rightarrow 3rd Z Coordinate



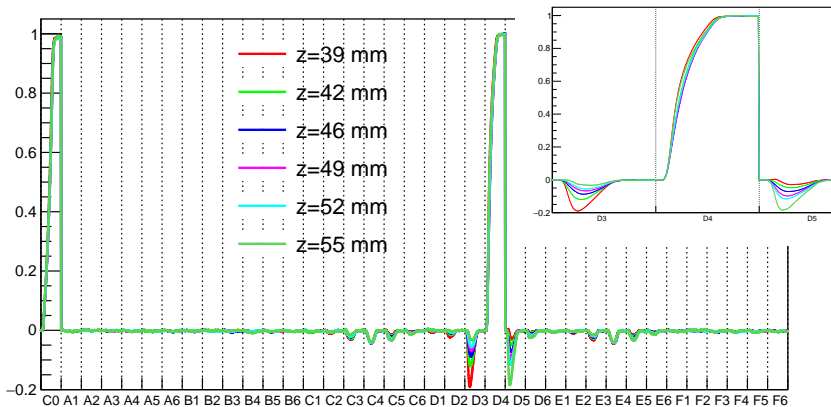
Examples of the Bases



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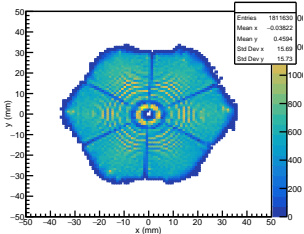


Examples of the Bases

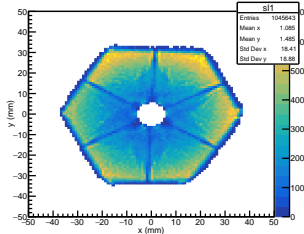


Estimated Distribution from Experimental Traces

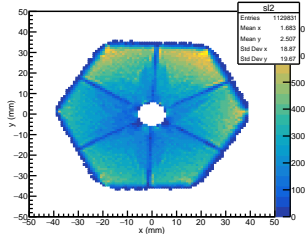
First Ring



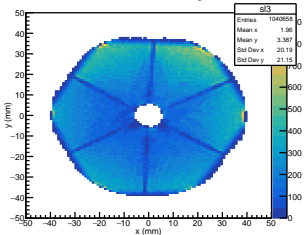
Second Ring



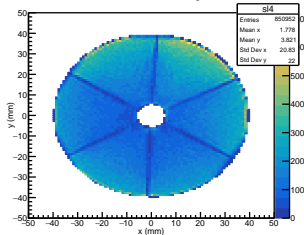
Third Ring



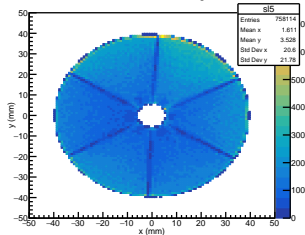
Forth Ring



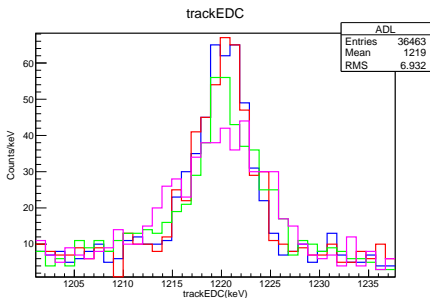
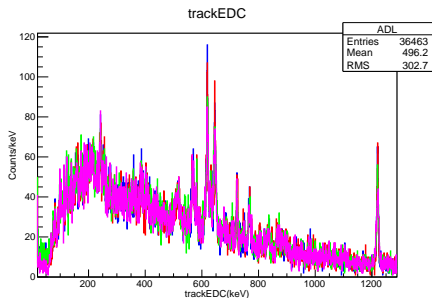
Fifth Ring



Sixth Ring



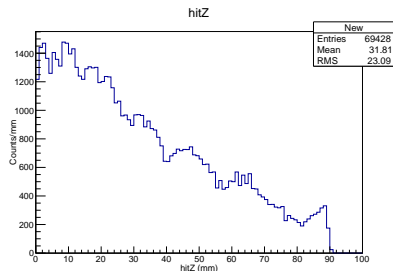
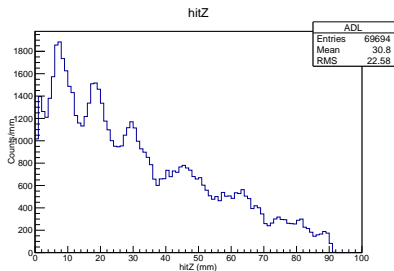
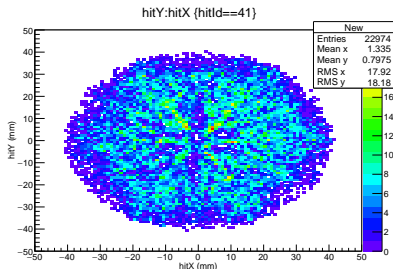
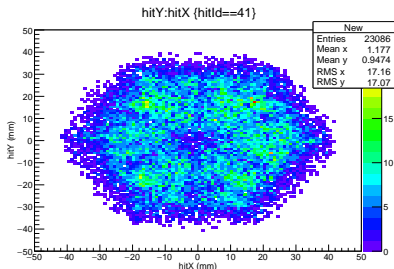
$^{98}\text{Zr } 2^+ @ 1223 \text{ keV}$ from e680 data



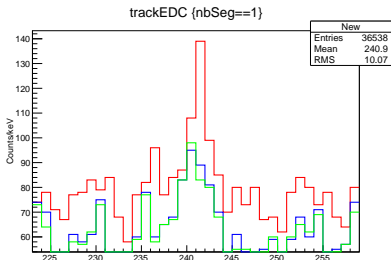
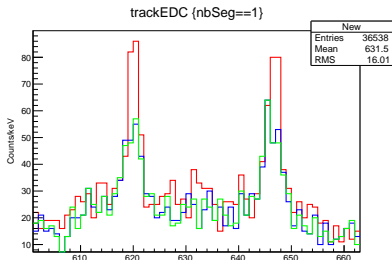
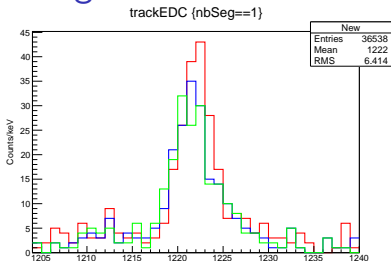
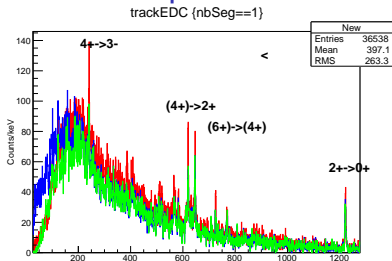
Replay with the Same Procedure but Different Basis between ADL and Exp Base

Case	Width	Area	Counts in Whole Spectra
ADL	5.1(6)	392(28)	36463
Exp Base with XTalk	5.7(5)	390(30)	36241
Exp Base without XTalk	6.7(7)	389(37)	36382
SegCenter	8.7(18)	411(35)	34207

hit Distribution with ADL and Exp Basis



PSA Comparison with One Segment Fired Events



Summary

- Why does it work better with CrossTalk for Experimental Basis?
- Direct Method gets more statistics than Grid Search after PSA actor for one segment fired events
- Combine Grid Search and Direct Method

Thank You!

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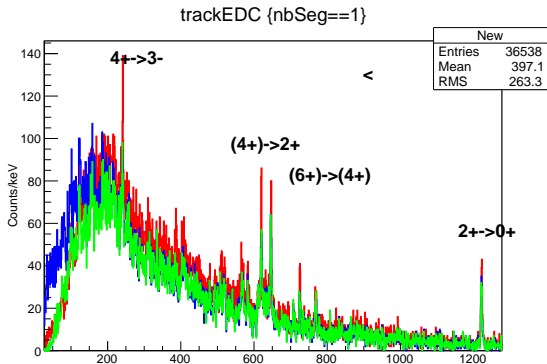
[1] GANIL, Caen, France.

[2] CSNSM, Orsay, France.

[3] ILL, Grenoble, France.

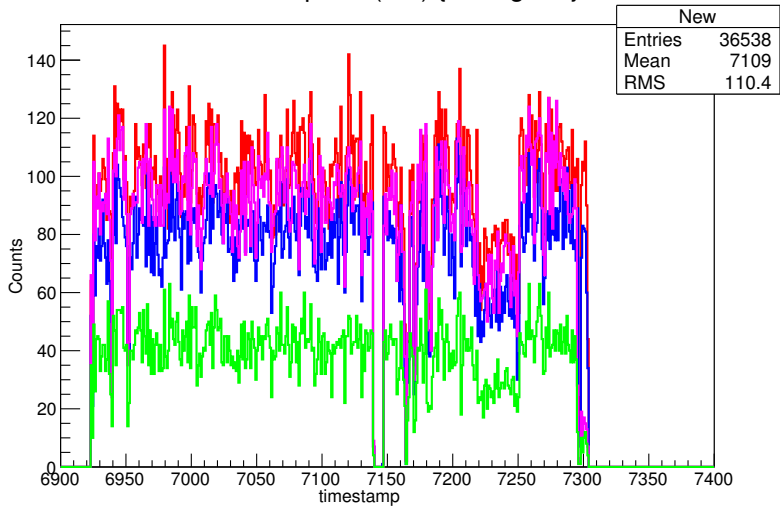
[4] IPNL, Lyon, France.

Direct Comparison with One Segment Fired Events



Case	Width	Area	Total	241	620	646
Prep Data for PSA	4.6(3)	162(16)	36538	2.0(4)	2.11(22)	2.8(3)
ADL No Tracking	5.5(5)	143(16)	32817	Fail Fit	4.0(6)	3.9(5)
ADL AfterTrack	5.4(4)	164(41)	28610	Fail Fit	4.1(6)	4.1(5)

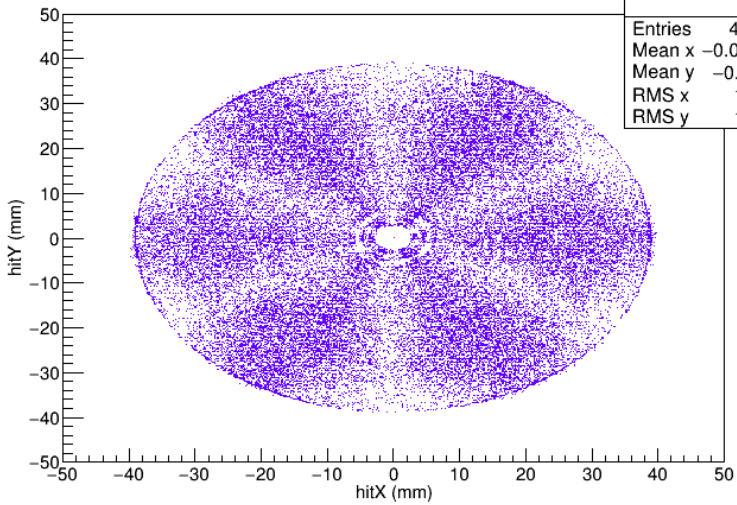
timestamp*10⁽⁻¹⁰⁾ {nbSeg==1}



red:

direct method; blue: ADL DC by hand; green: ADL track
 nbHits==1; pink: ADL all tracked events
 32817 No tracking; 28610 tracking In the replay

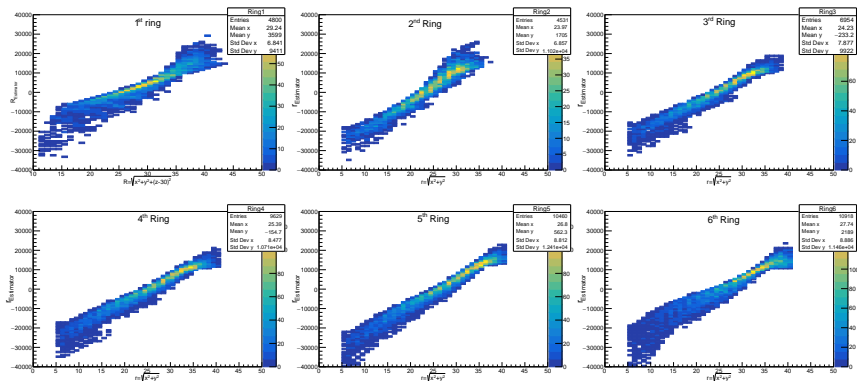
hitY:hitX



Entries	47016
Mean x	-0.03103
Mean y	-0.3283
RMS x	18.88
RMS y	18.93

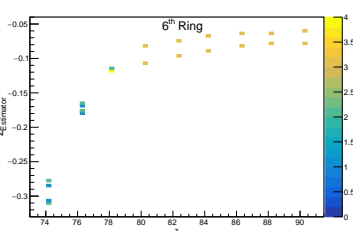
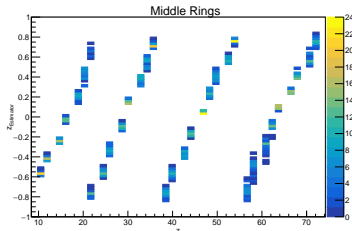
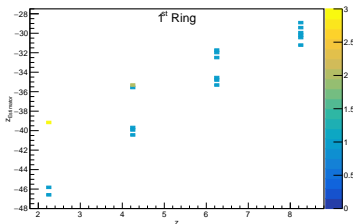
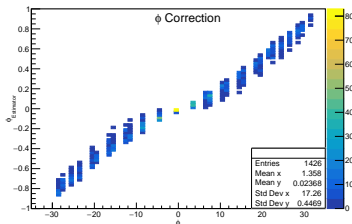
Validate the Method with ADL Signals: 2mm×2mm×2mm grid size

Correlation between the Coordinates and its Raw Estimators



Validate the Method with ADL Signals: 2mm×2mm×2mm grid size

Correlation between the Coordinates and its Raw Estimators



Coordinates Determination from ADL Simulation Data

