

Offline Electron Seeding Validation - Update

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INTRODUCTION

- ▶ Our goal is to study **seeding** for the **offline** Gsf tracking with the **new pixel detector**.
- ▶ Previous talk¹ gave introduction/motivation to approach
- ▶ Since Then,
 - ▶ Migrated Code from 8_1_0 to 9_0_2
 - ▶ Regenerated trackingNtuples for dataset

`/DYJetsToLL_M-50_TuneCUETP8M1_13TeV-madgraphMLM-pythia8`
`/PhaseISpring17DR-FlatPU28to62HcalNZS_90X_upgrade2017_realistic_v20-v1/GEN-SIM-RAW`

- ▶ Calculated $\Delta\phi_{1,2}/\Delta z_{1,2}$ for distances between extrapolated SC and reconstructed pixel hit
- ▶ Added additional detector information (Ladder/Blade) for matched hits

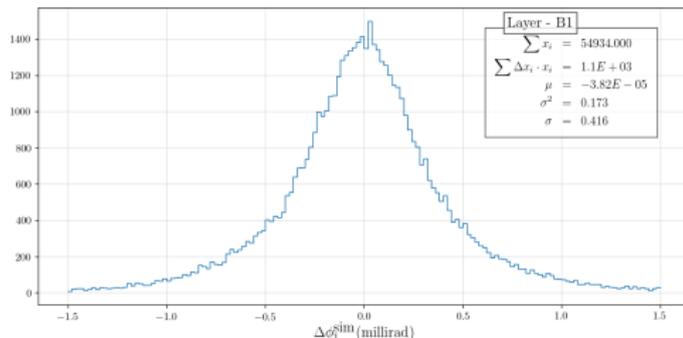
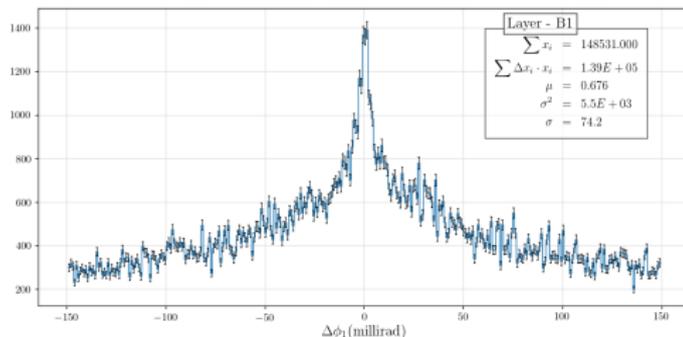
¹<https://indico.cern.ch/event/616443/contributions/2669480/attachments/1496854/2329372/main.pdf>

DEFINITIONS

- ▶ $\Delta\phi/z_1$ - Distance between RecHit and extrapolated impact position for first matched hit
- ▶ $\Delta\phi/z_2$ - Distance between RecHit and extrapolated impact position for second matched hit
- ▶ $\Delta\phi/z_1^{\text{sim}}$ - Distance between RecHit and SimHit for 1st innermost hit in Seed.
- ▶ $\Delta\phi/z_2^{\text{sim}}$ - Distance between RecHit and SimHit for 2nd innermost hit in Seed.

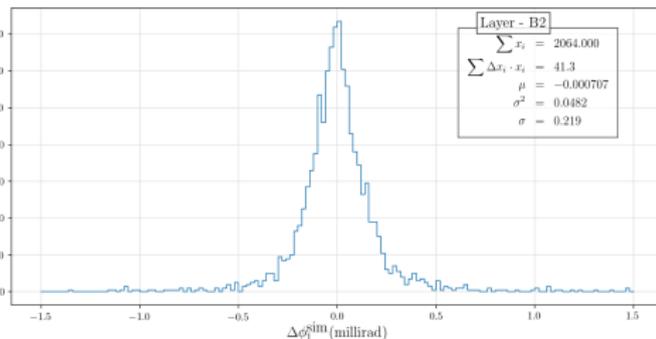
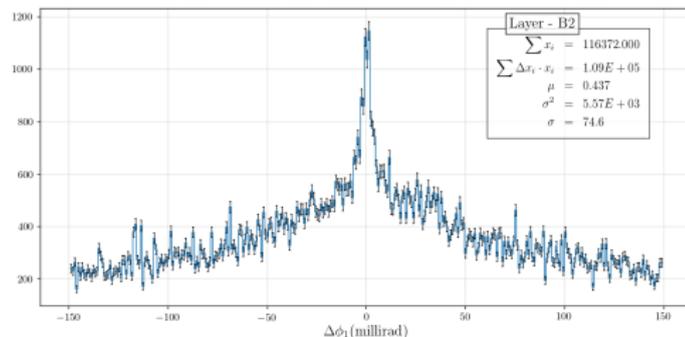
COMPARING $\Delta\phi_1$ AND $\Delta\phi_1^{\text{SIM}}$ RESOLUTION

- ▶ $\sigma_{\Delta\phi_1} / \sigma_{\Delta\phi_1^{\text{sim}}} \approx 175$
- ▶ But these are measuring quite different quantities!
- ▶ $\Delta\phi_1^{\text{sim}}$ is effectively just the single-hit pixel resolution
- ▶ While $\Delta\phi_1$ is affected by SC position/energy resolution and beam spot.
- ▶ So not really an apples-to-apples comparison.



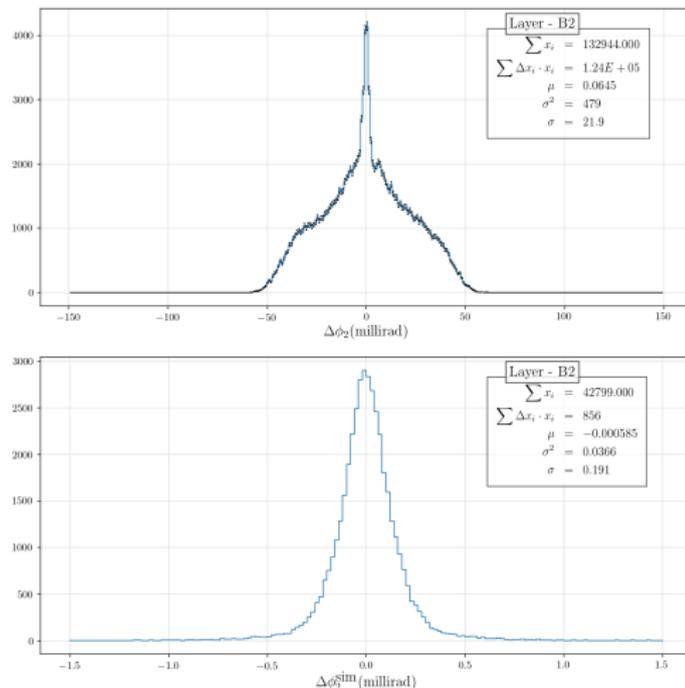
HITS IN BPIX LAYER 2

- ▶ Same as previous slide, but with hits in BPIX L2 instead of L1.
- ▶ Note that $\sigma_{\Delta\phi_1}$ is almost unchanged from the L1 value (74.2 millirad)
- ▶ However, $\sigma_{\Delta\phi_1^{\text{sim}}}$ decreases by $\approx 1/r$
- ▶ This is because single-hit resolution is independent of layer.



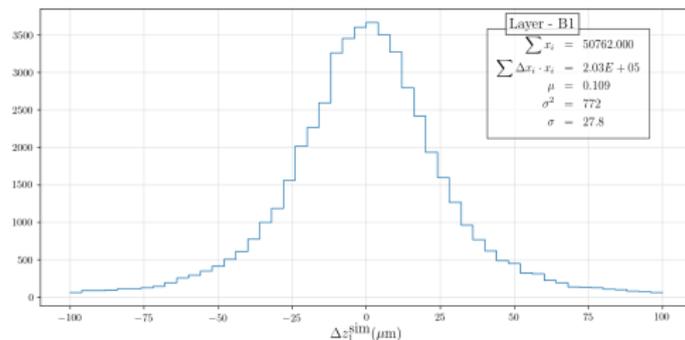
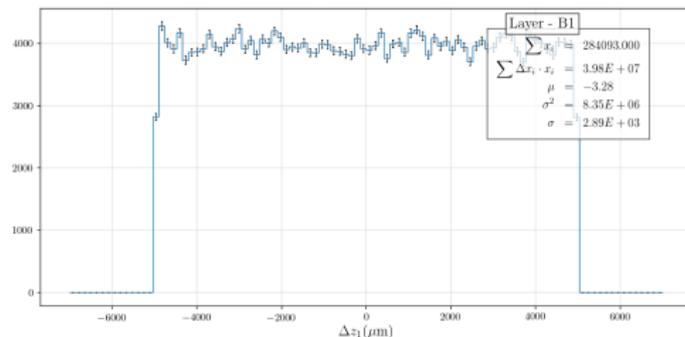
WHAT ABOUT 2ND BREAKFAST HITS?

- ▶ $\sigma_{\Delta\phi_2^{\text{sim}}}$ is slightly smaller than $\sigma_{\Delta\phi_1^{\text{sim}}}$
- ▶ $\sigma_{\Delta\phi_2}$ is about 3.4 times smaller than $\sigma_{\Delta\phi_1}$, but the width of the core is about the same.
- ▶ Interesting side-band feature. Do experts recognize this?



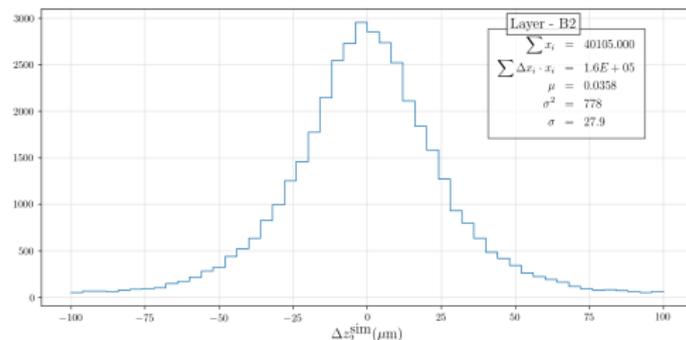
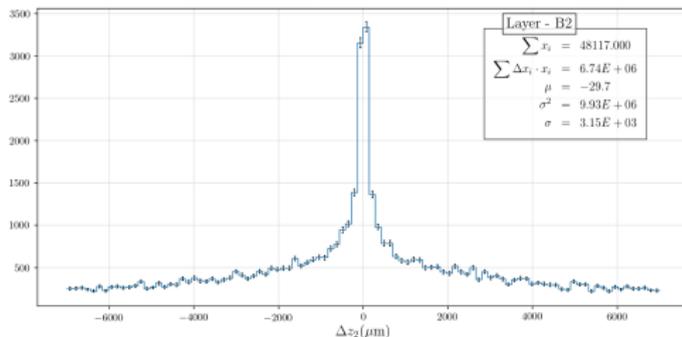
WHAT ABOUT Δz ?

- ▶ The distribution of Δz_1 is essentially flat within the window (± 0.5 cm).
- ▶ Not surprising due to the rough extrapolation and high likelihood of unrelated hits in area of extrapolated point.



AND FINALLY, WHAT ABOUT Δz FOR SECOND HITS?

- ▶ Current window size ($\pm 900\mu\text{m}$) still seems appropriate, but maybe could be optimized?
- ▶ Δz_2^{sim} resolution almost identical to Δz_1^{sim}
- ▶ Implies single-hit resolution is independent of whether the hit is the 1st or 2nd innermost in seed



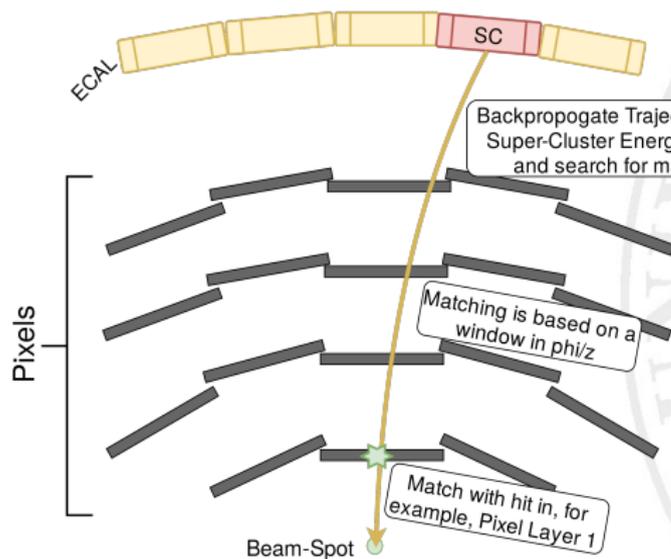
OUTLOOK

- ▶ Equivalent studies for FPIX
- ▶ Define and measure hit inefficiencies
- ▶ Test independently effects of supercluster position and energy mis-measurement
- ▶ Optimize window sizes
- ▶ Test triplet (instead of pair) matching
- ▶ Suggestions (and priorities!) from experts?

BACKUP



GSF ELECTRON SEEDING I



First window

E_T^{SC} (GeV)	δz (BPix)	δr (FPix or TEC)	$\delta\phi$ (rad) (positive charge)
≤ 5	$\pm 5\sigma_z$	$\pm 5\sigma_z$	$[-0.075; 0.155]$
10	$\pm 5\sigma_z$	$\pm 5\sigma_z$	$[-0.046; 0.096]$
≥ 35	$\pm 5\sigma_z$	$\pm 5\sigma_z$	$[-0.026; 0.054]$

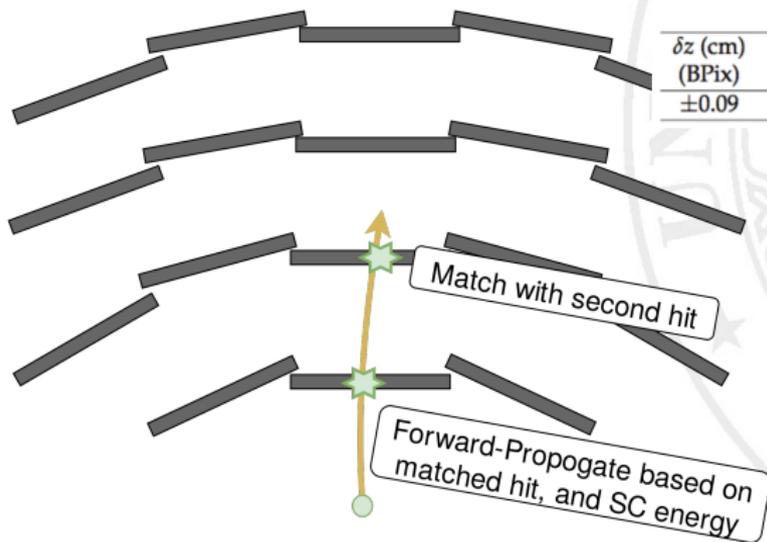
Windows from <https://indico.cern.ch/event/611042/contributions/2464057/attachments/1406271/2148742/ElectronTracking30112016.pdf>

Gsf Electron Seeding II



Second window

δz (cm)	δr (cm)	δr (cm)	$\delta\phi$ (rad)	$\delta\phi$ (rad)
(BPix)	(FPix)	(TEC)	(BPix)	(FPix or TEC)
± 0.09	± 0.15	± 0.2	± 0.004	± 0.006



Gsf ELECTRON SEEDING III

