Offline Electron Seeding Validation - Update

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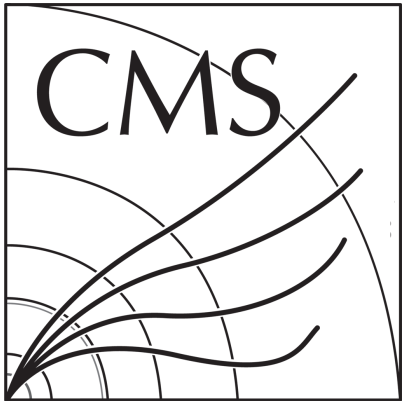


Introduction

- Our goal is to study **seeding** for the **offline** Gsf tracking with the **new pixel detector**.
- Previous talk[1] 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

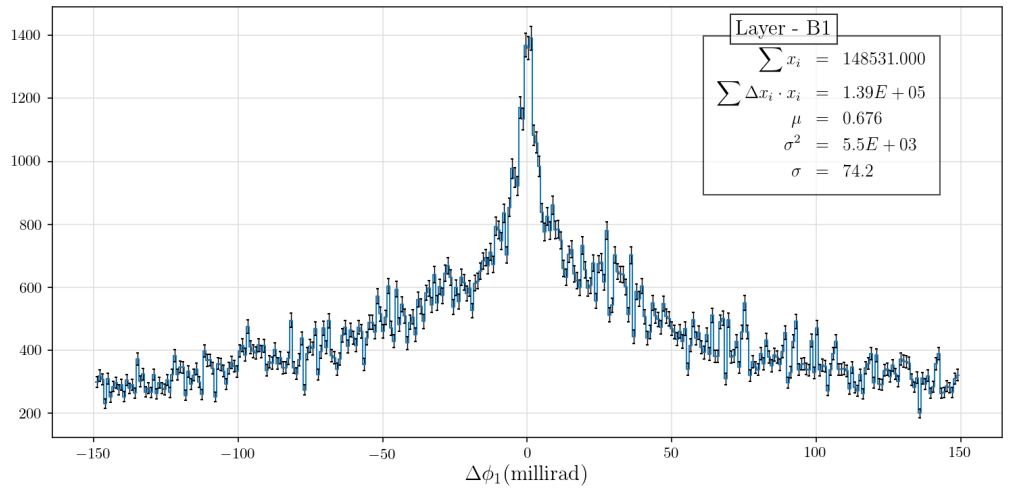
[1] https://indico.cern.ch/event/616443/contributions/2669480/attachments/1496854/2329372/main.pdf

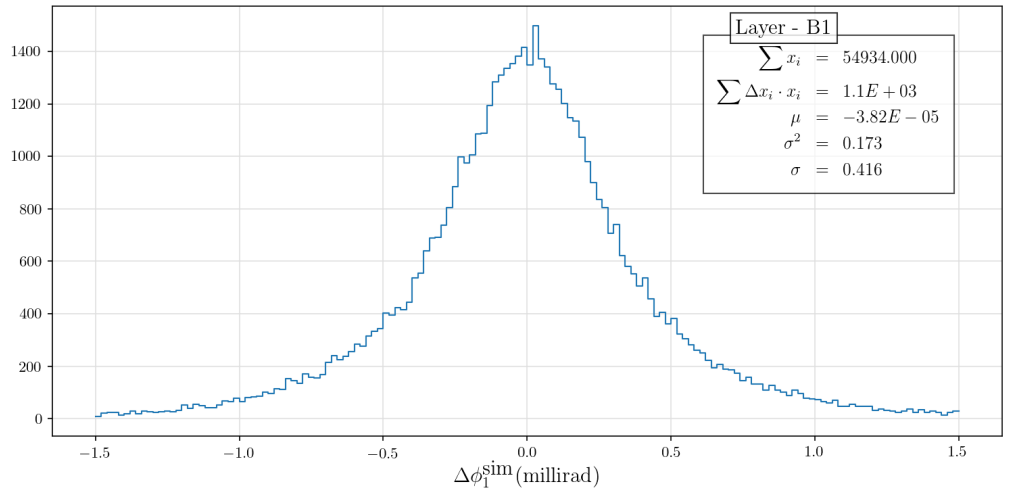
Some Definitions

- $\Delta\phi/z_1$ - 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

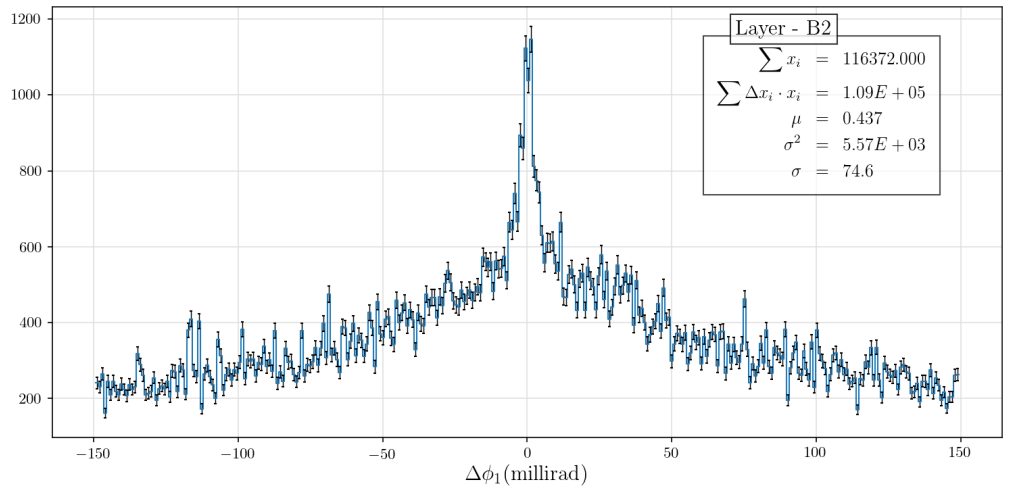
- $\sigma_{\Delta\phi_1}/\sigma_{\Delta\phi_1^{\text{sim}}} \approx 175$
- But these are measuring quite different quantities!
- $\Delta\phi_1^{\text{sim}}$ is effectively just the single-hit pixel resultion
- While $\Delta\phi_1$ is affected by SC position/energy resolution and beam spot.
- So not really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

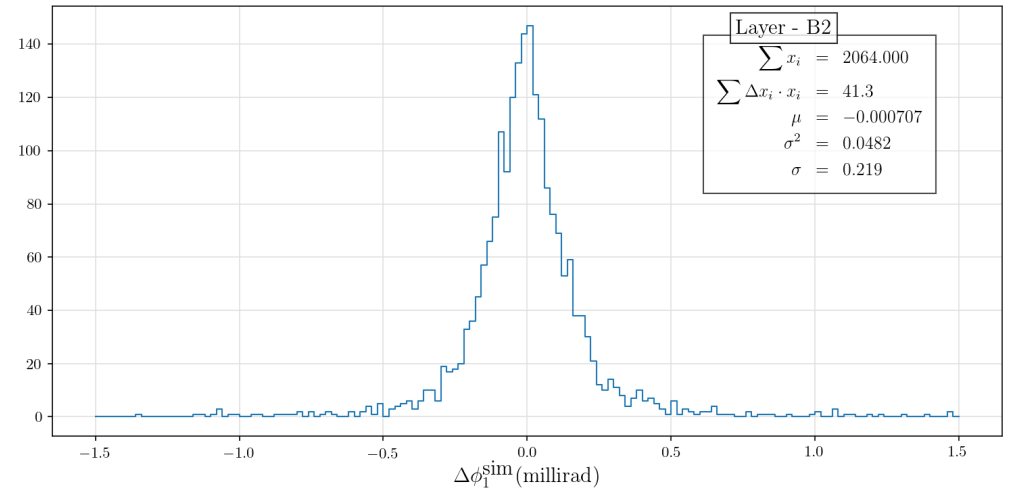




Hits in BPIX Layers 1 and 2

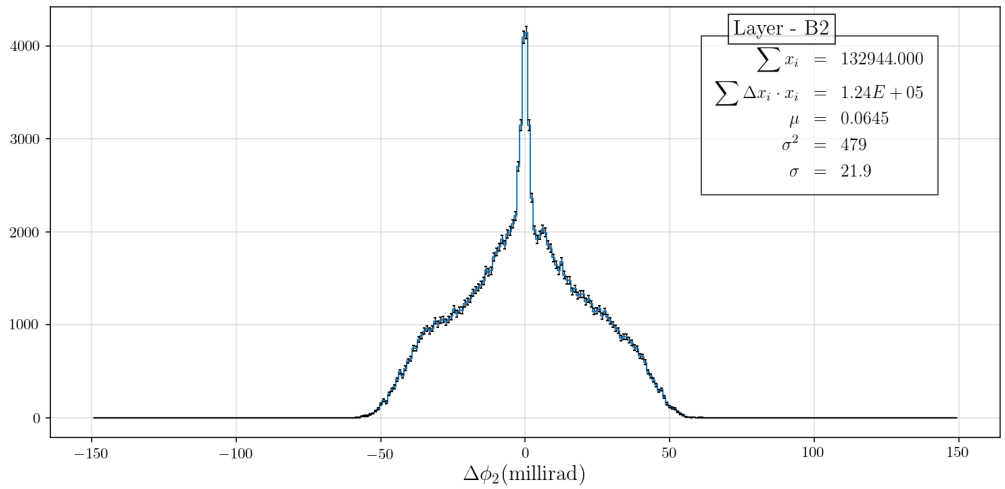
- Same as previous slide, but with Hits in BPIX L2 instead of L1.
- Note that $\sigma_{\Delta\phi_1}$ is almost unchanged from the L1 value (74.2 millirad)
- However, $\sigma_{\Delta\phi_1^{\text{sim}}}$ decreases by $\approx 1/r$
- This is because single-hit resultion is independent of layer.

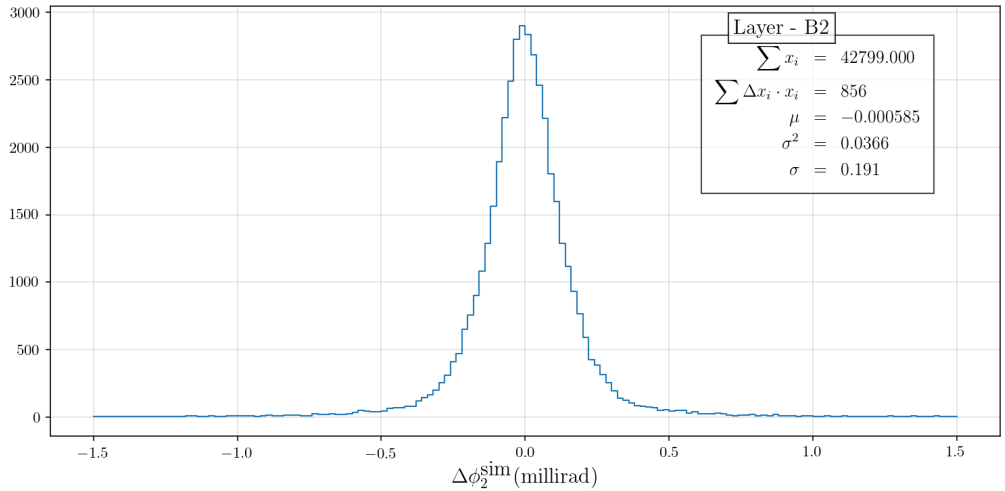




What about 2nd ~~Breakfast~~ Hits?

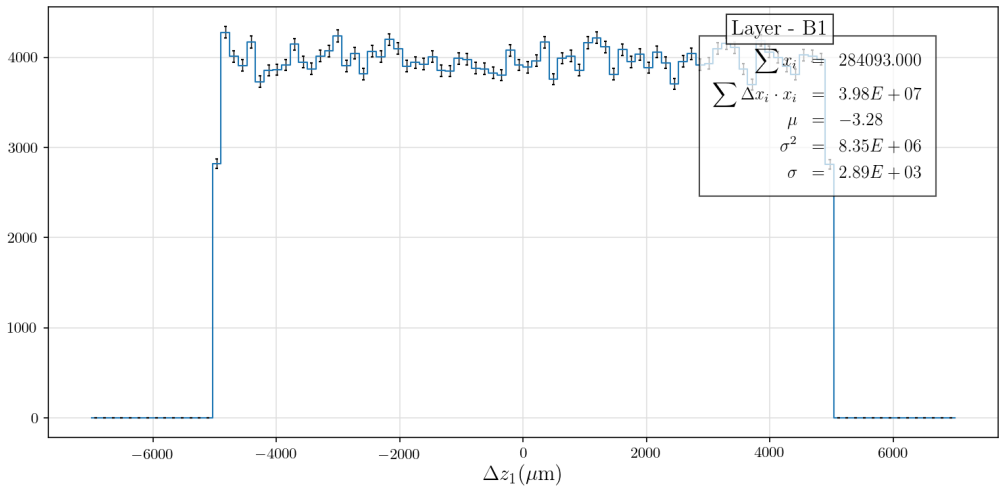
- $\sigma_{\Delta\phi_2^{\text{sim}}}$ is slightly smaller than $\sigma_{\Delta\phi_1^{\text{sim}}}$
- $\sigma_{\Delta\phi_2}$ is about 3.4 times smaller than $\sigma_{\Delta\phi_1}$, but the width of the core is about the same.
- Interesting side-band feature. Do experts recognize this?

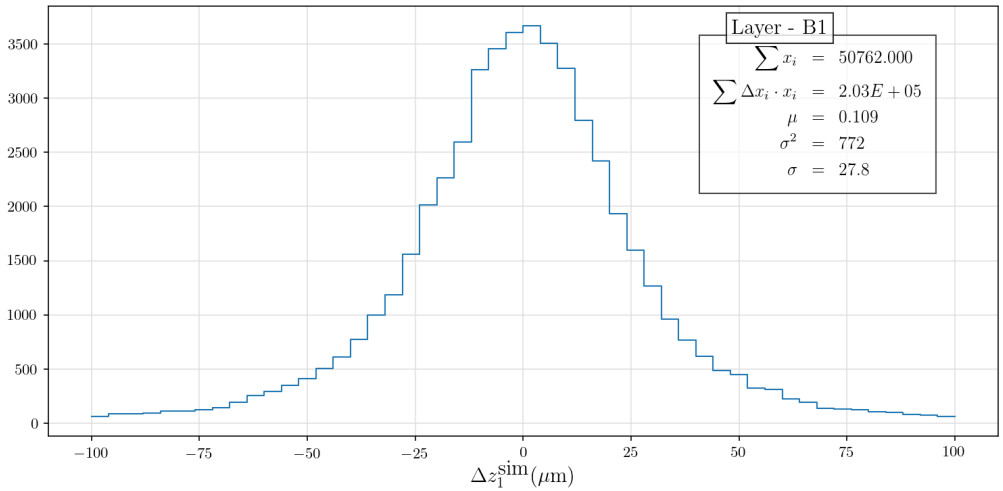




What about Δz?

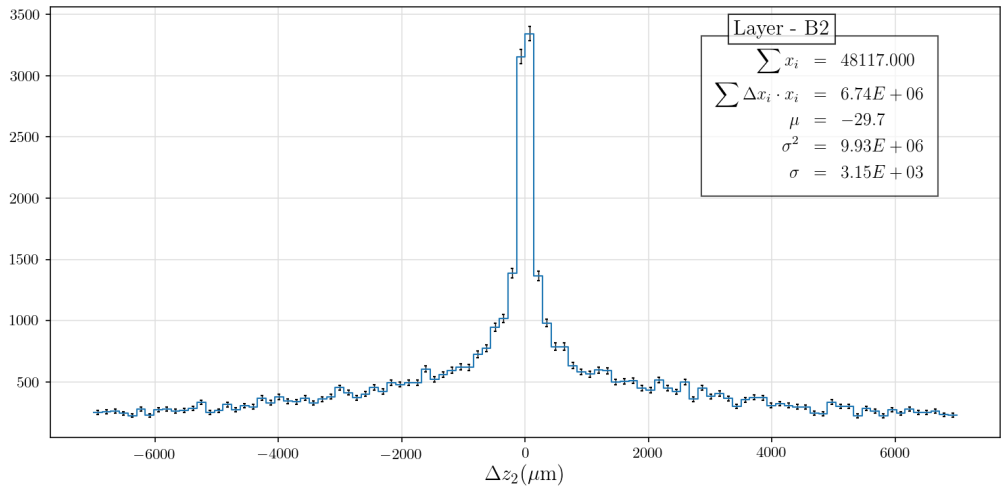
- The distribution of Δz_1 is essentially flat within the window (± 0.5 cm).
- Not surprising due to the rough extrapolation and high likelihood of unrelated hits in area of extrapolated point.

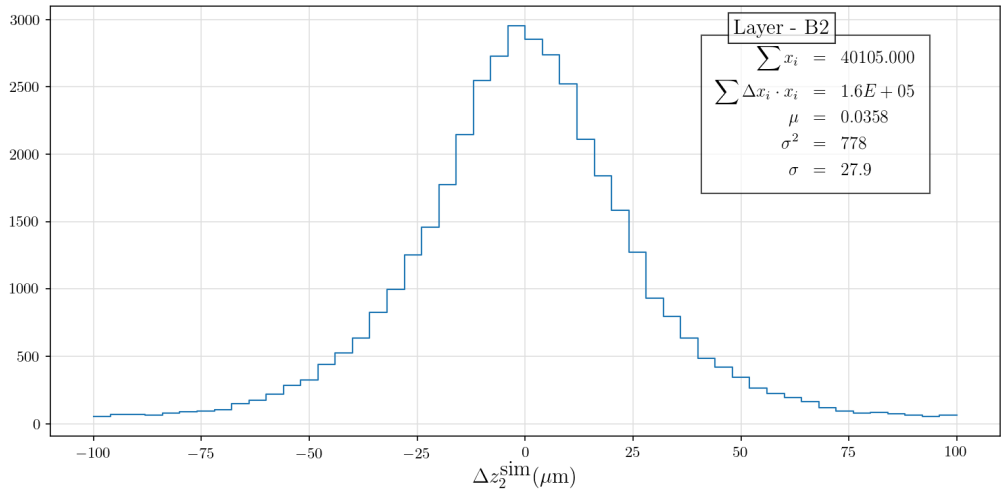




And finally, what about Δz for second hits?

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



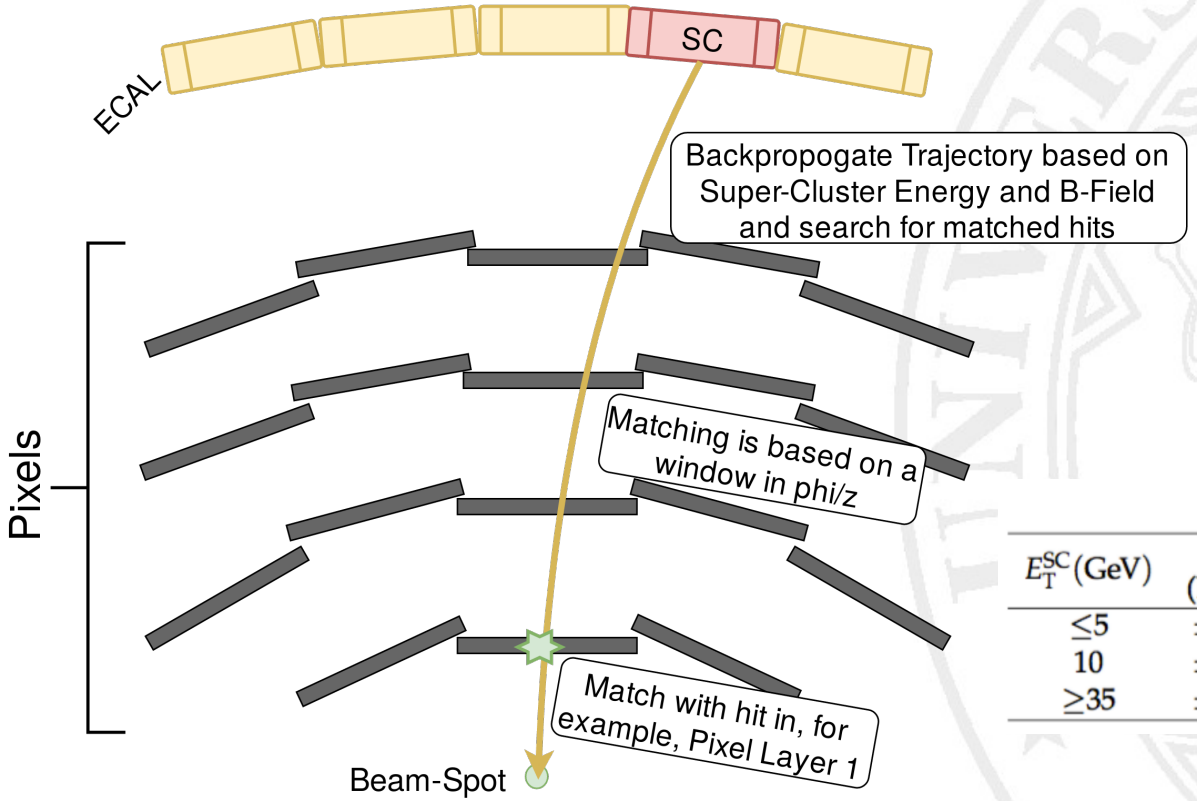


Outlook

- Equivalent studies for FPIX
- Define and measure efficiencies
- Optimize window sizes
- Test triplet (instead of pair) matching
- Suggestions from experts?

BACKUP

Gsf Electron Seeding I

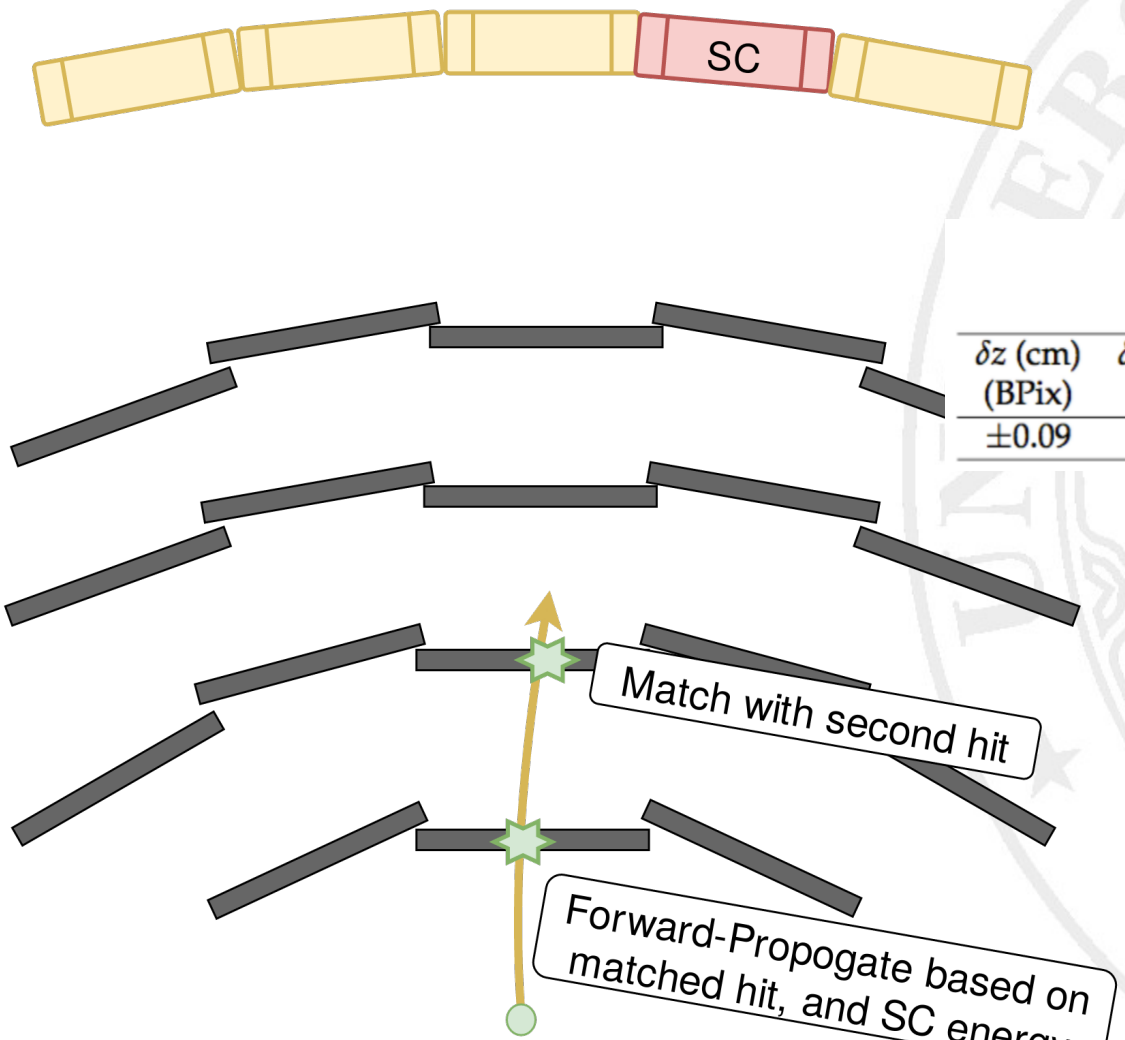


First window

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

Gsf Electron Seeding III