

Offline Electron Seeding Validation - Update

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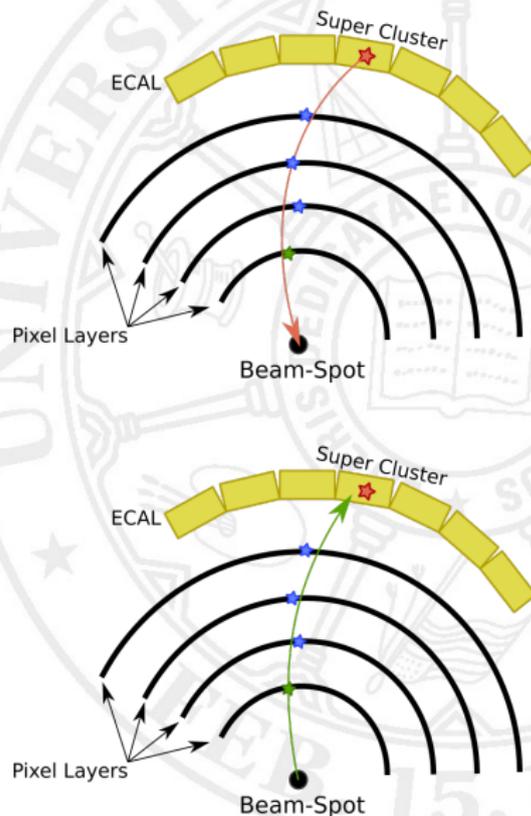


INTRODUCTION

- ▶ Our goal is to study **seeding** for the **offline** GSF tracking with the **new pixel detector**.
- ▶ Specifically, we want to optimize the new pixel-matching scheme from HLT for use in off-line reconstruction.
- ▶ This Talk:
 - ▶ Show corrected performance comparisons between old and new seeding
 - ▶ Show reduction in number of seeds not resulting in GSF tracks
- ▶ Additional plots are available here
https://eg.fangmeier.tech/seeding_studies_2018_03_08_17/output/

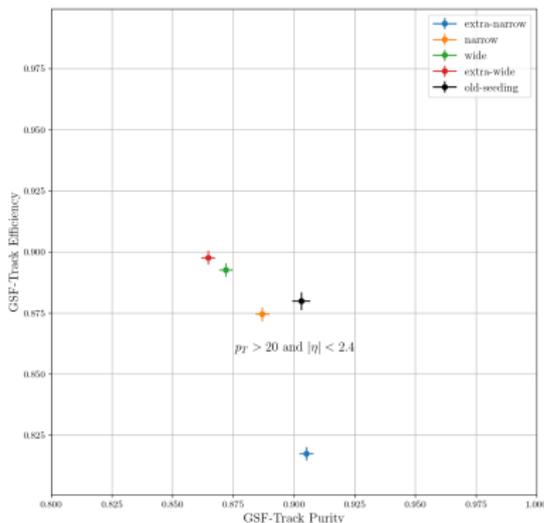
N-HIT ELECTRON SEEDING

1. Using the beam spot, the SC position, and SC energy, propagate a path through the pixels.
2. Require the first hit to be within a $\delta\phi$ and δz window. ($\delta\phi$ and δR for FPIX)
3. δz window for first hit is huge as SC and beam spot positions give very little information about z .
4. Forget the SC position, and propagate a new track based on the vertex and first hit positions, and the SC energy.
5. Progress one-by-one through the remaining hits in the seed and require each one fit within a specified window around the track.
6. Quit when all hits are matched, or a hit falls outside the window. No skipping is allowed.



PREVIOUS STATUS-QUO

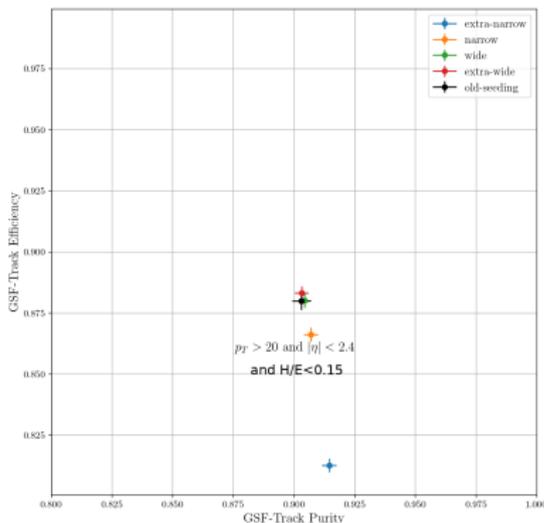
- ▶ In a previous presentation¹, I showed efficiency vs. purity for
 - ▶ Old pair-match seeding (`ElectronSeedProducer`)
 - ▶ New triplet+ seeding (`ElectronNHitSeedProducer`) for several choices of matching windows.
- ▶ Old seeding produced far fewer fake (non-truth matched) seeds at similar efficiency.
- ▶ Unclear why. Perhaps not optimal matching windows?



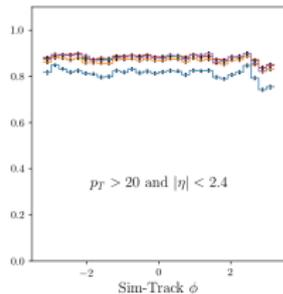
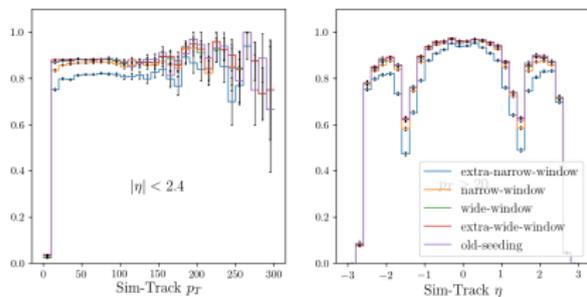
¹<https://indico.cern.ch/event/697074/contributions/2898322/attachments/1602057/2540261/main.pdf>

H/E REQUIREMENT ON SUPER-CLUSTERS

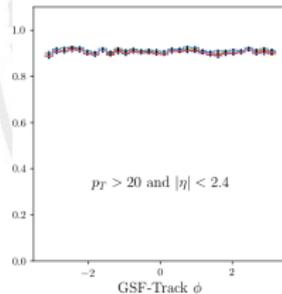
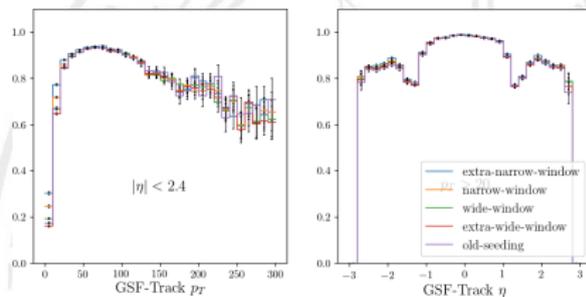
- ▶ Investigating the cause of this revealed that the old seeding had applied a $H/E < 0.15$ cut on super-clusters.
- ▶ After applying this same cut on the new seeds, the performance gap becomes negligible.
- ▶ The **narrow** working point of the new seeding uses HLT window sizes (see backup).
- ▶ Performance of the old seeding can be closely matched with the **wide** matching windows.



KINEMATIC DISTRIBUTIONS



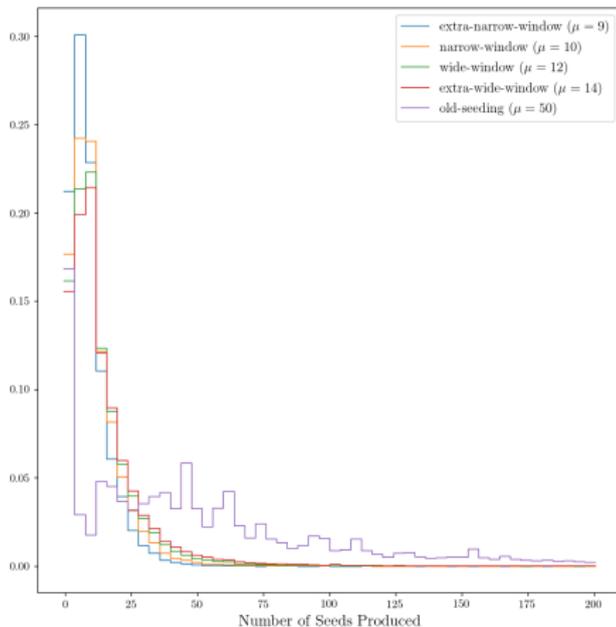
Tracking Efficiency



Tracking Purity

SEED COUNTS

- ▶ The amount of electron seeds is dramatically reduced by the new matching scheme.
- ▶ Part of the motivation for use in HLT.
- ▶ Factor of ≈ 4 reduction comparing to the wide working point



OUTLOOK

- ▶ NHit seeding can match (and perhaps even slightly improve upon) the old pair-match seeding.
 - ▶ It can do this while producing far fewer candidate seeds.
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- ▶ Next Steps:
 - ▶ Verify performance is still acceptable in high fake environments ($t\bar{t}$ for example)
 - ▶ Settle on an “optimal enough” set of windows
 - ▶ Decide on which CMSSW release to target and begin preparing (private branch/merge request/etc.)
 - ▶ Other Thoughts
 - ▶ What are expert’s opinions on continued window optimization? (Likely some small gains still to be had)
 - ▶ Are there other ideas for cross-checks to be done before proceeding further?

BACKUP



DEFINITIONS

- ▶ **Sim-Track** - A track from a simulated electron originating from the luminous region of CMS (beam-spot $\pm 5\sigma$)
- ▶ **ECAL-Driven Seed** - A seed created via a matching procedure between Super-Clusters and General Tracking Seeds (Either from `ElectronSeedProducer` or `ElectronNHitSeedProducer`)
- ▶ **GSF Track** - A track from GSF-Tracking resulting from an **ECAL-Driven Seed**
- ▶ **Seeding Efficiency** - The fraction of **Sim-Tracks** that have a matching **ECAL-Driven Seed** (based on `simhit-rechit` linkage)
- ▶ **GSF Tracking Efficiency** - The fraction of **Sim-Tracks** that have a matching **GSF Track** (again, based on `simhit-rechit` linkage)
- ▶ **ECAL-Driven Seed Purity** - The fraction of **ECAL-Driven Seeds** that have a matching **Sim-Track**
- ▶ **GSF Tracking Purity** - The fraction of **GSF Tracks** that have a matching **Sim-Track**

MATCHING WINDOW PARAMETERS

		extra-narrow	narrow(HLT)	wide	extra-wide
Hit 1	dPhiMaxHighEt	0.025	0.05	0.1	0.15
	dPhiMaxHighEtThres	20.0	20.0	20.0	20.0
	dPhiMaxLowEtGrad	-0.002	-0.002	-0.002	-0.002
	dRzMaxHighEt	9999.0	9999.0	9999.0	9999.0
	dRzMaxHighEtThres	0.0	0.0	0.0	0.0
	dRzMaxLowEtGrad	0.0	0.0	0.0	0.0
Hit 2	dPhiMaxHighEt	0.0015	0.003	0.006	0.009
	dPhiMaxHighEtThres	0.0	0.0	0.0	0.0
	dPhiMaxLowEtGrad	0.0	0.0	0.0	0.0
	dRzMaxHighEt	0.025	0.05	0.1	0.15
	dRzMaxHighEtThres	30.0	30.0	30.0	30.0
	dRzMaxLowEtGrad	-0.002	-0.002	-0.002	-0.002
Hit 3+	dPhiMaxHighEt	0.0015	0.003	0.006	0.009
	dPhiMaxHighEtThres	0.0	0.0	0.0	0.0
	dPhiMaxLowEtGrad	0.0	0.0	0.0	0.0
	dRzMaxHighEt	0.025	0.05	0.1	0.15
	dRzMaxHighEtThres	30.0	30.0	30.0	30.0
	dRzMaxLowEtGrad	-0.002	-0.002	-0.002	-0.002

NHit Seeding window parameters. Bold designates modified values.