Discussion:
tracking in high noise/dense environment

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Workshop of Tracking in Particle Physics Experiments

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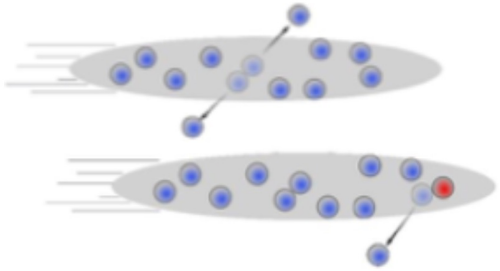
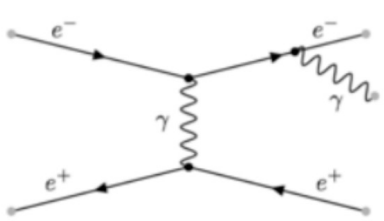
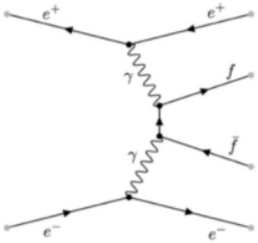
Source of noise in e^+e^- collision experiments

- Electronics noise

- Beam related background:
  - Touschek scattering:
  - Beam-gas scattering
  - Luminosity background
  - Synchrotron radiation
  - Large beam loss accidents
  - Generated particle after interacting with the beam pipe or other machine apparatus

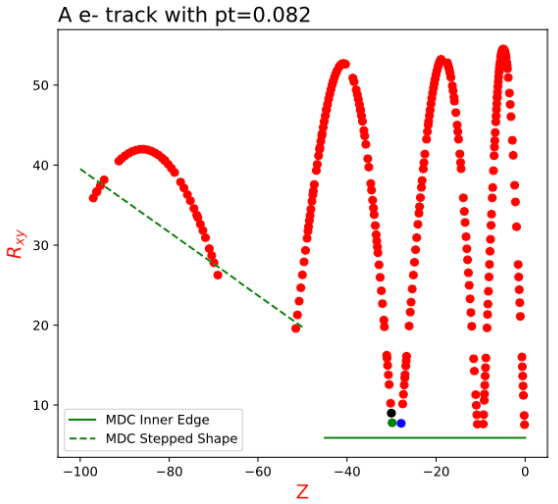




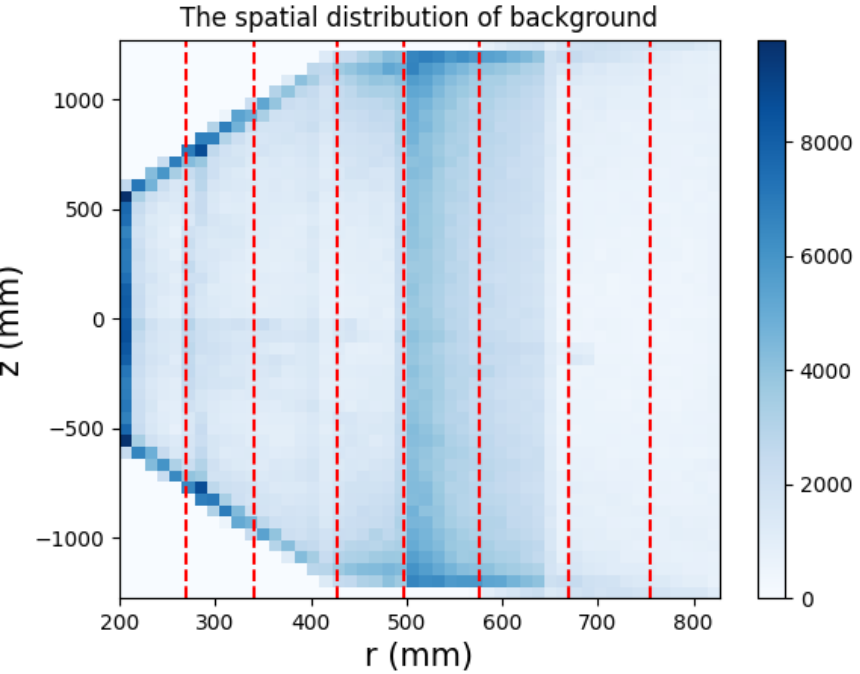


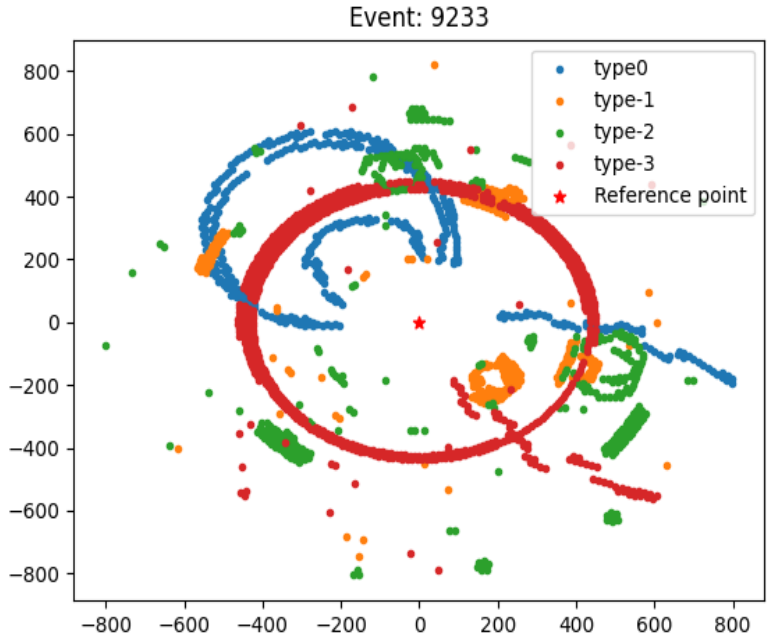
Noise distribution

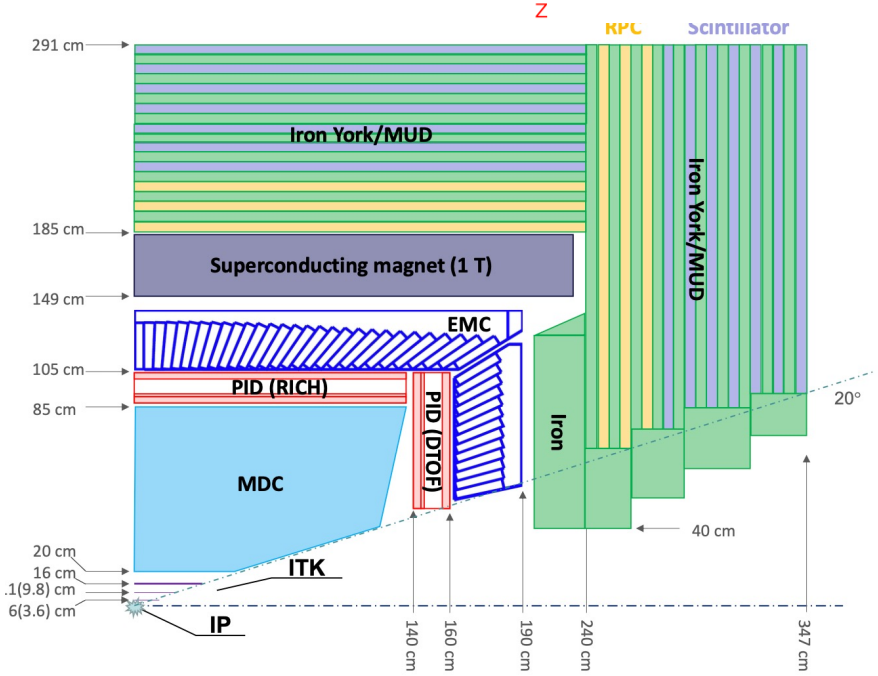
- Noise distribution in STCF
- Particle interaction with materials around detector boundaries



R-z distribution of noise







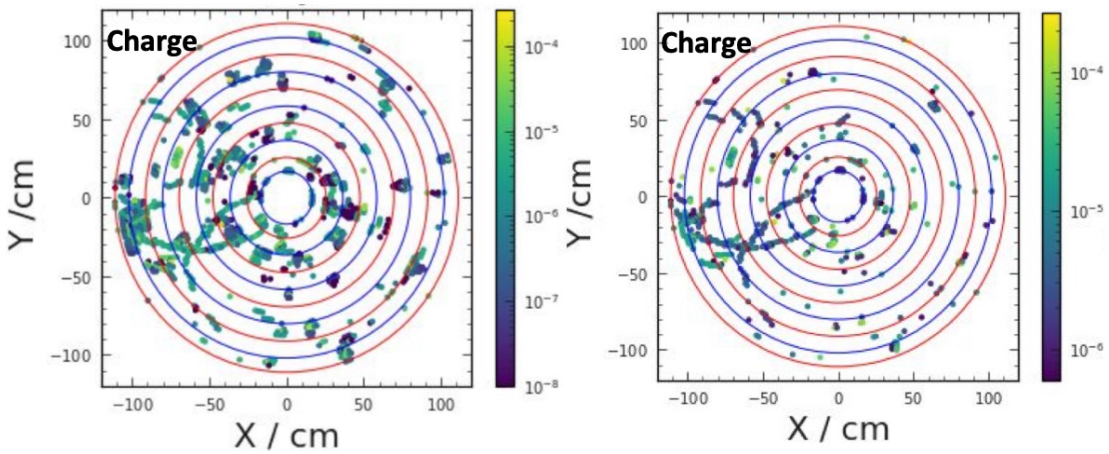
Effect of noise

- Reconstruction performance:
  - Worse efficiency, spatial and vertex resolution
  - Fake tracks, ghost tracks
  - Increase resource consumption
- High noise level in inner tracker
- The situation is even worse for low-momentum tracks

Attempts to handle noise

- Low-level information:
  - ADC, TDC(raw time), space position
- Traditional or machine-learning methods

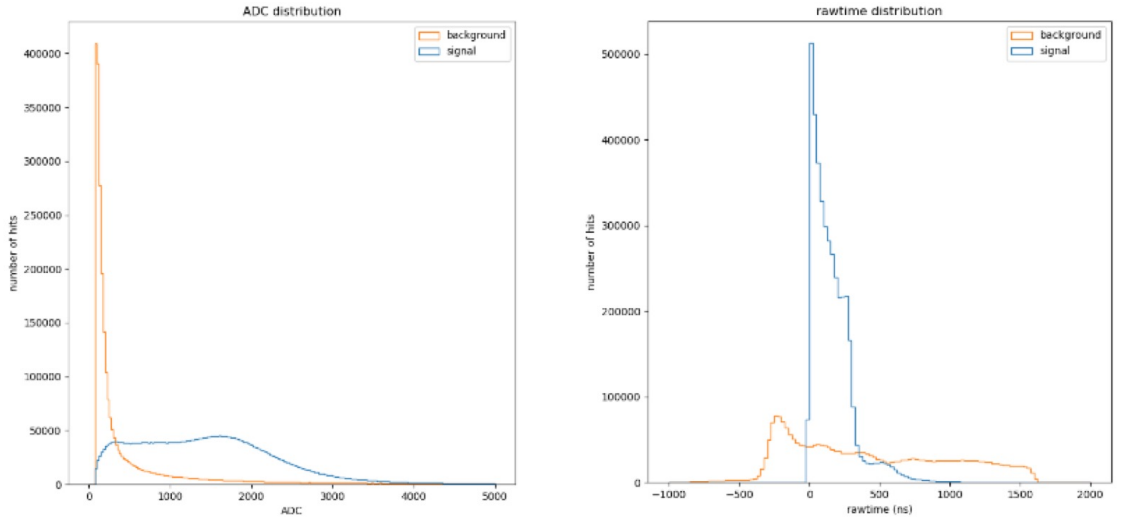
- Local track segment
- Global track finding and fitting



All Hits

Hits after ADC+ASIC cuts

BelleII CDC noise filter
From Yubo Han



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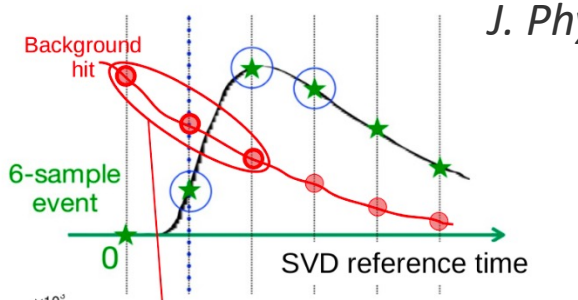

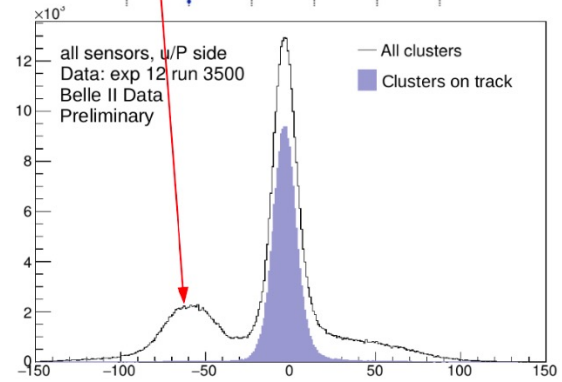

BelleII SVD noise filter
From Thomas' talk

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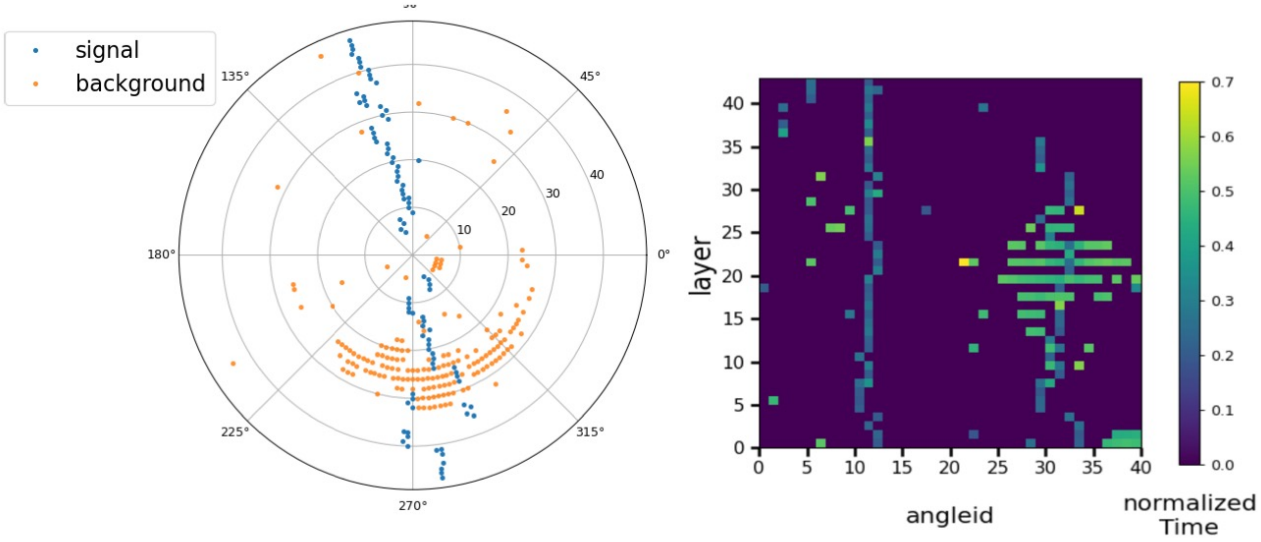
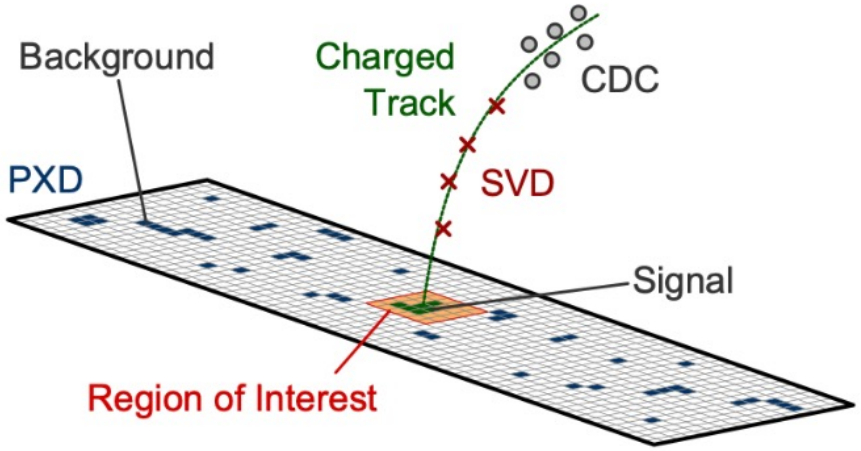
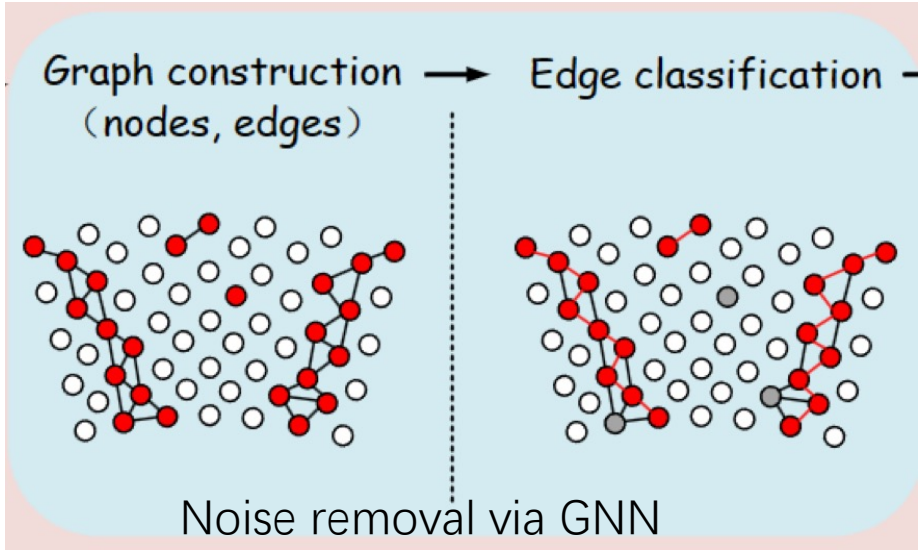


Noise removal via CNN at BESIII. arXiv:2303.12202



Extrapolate from the outer tracker at BelleII



Noise removal via GNN
From Xiaoqian's talk

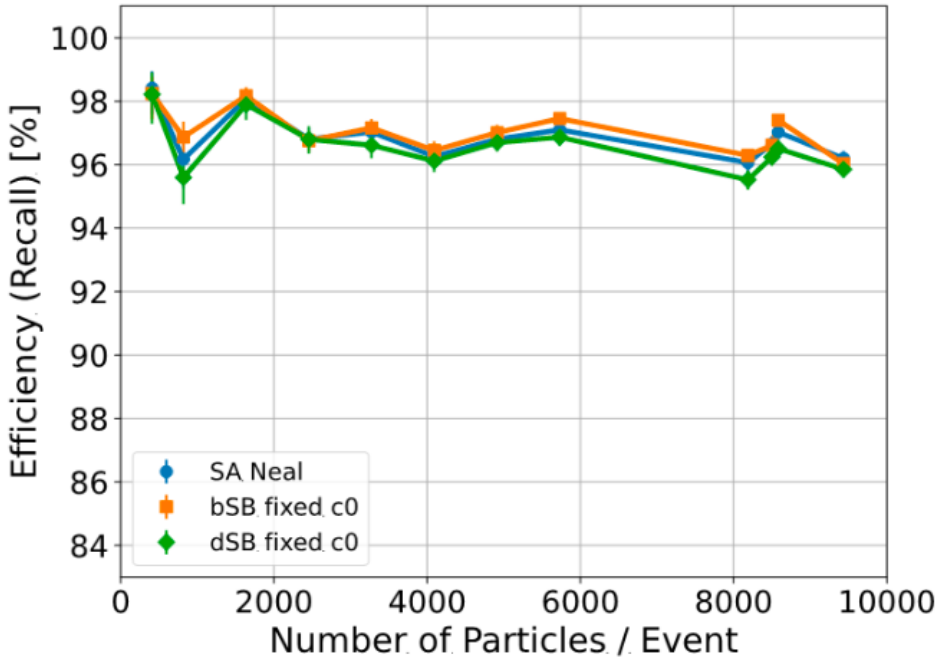
Tracking in high dense environment

- Fake rates, ghost tracks
- Large multiplicity:
  - contamination from other tracks
  - hits sharing / merging

- For HL-LHC: can have ~10k tracks/event

Ideas to cope with high noise/high dense environment?

- Hardware optimization
- Ensure signal hits efficiency after noise filtering.
- Event level or end to end reconstruction?
- Large multiplicity: quantum algorithm?



Talk from Hideki