



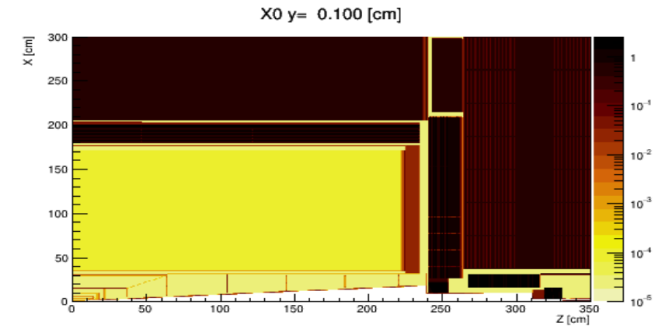
Update on tracking at the full-Si ILD - $t\bar{t}$ events and LLPs

Proposed and implemented in DD4hep by Daniel Jeans (geometry already available in lcggeo)

The idea:

- Replace TPC and SET with CLIC outer tracker
- 1 additional barrel layer w.r.t. CLIC
- Endcap layers slightly more separated w.r.t. CLIC

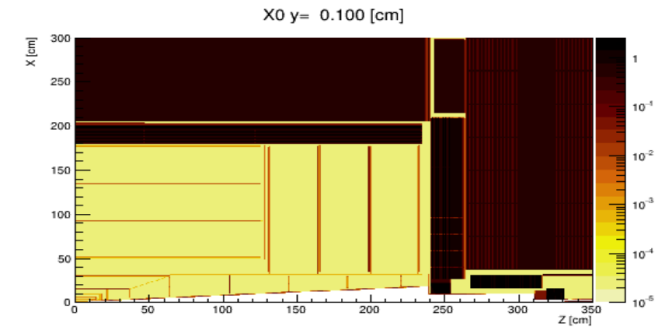
ILD_I5_v02



Goals:

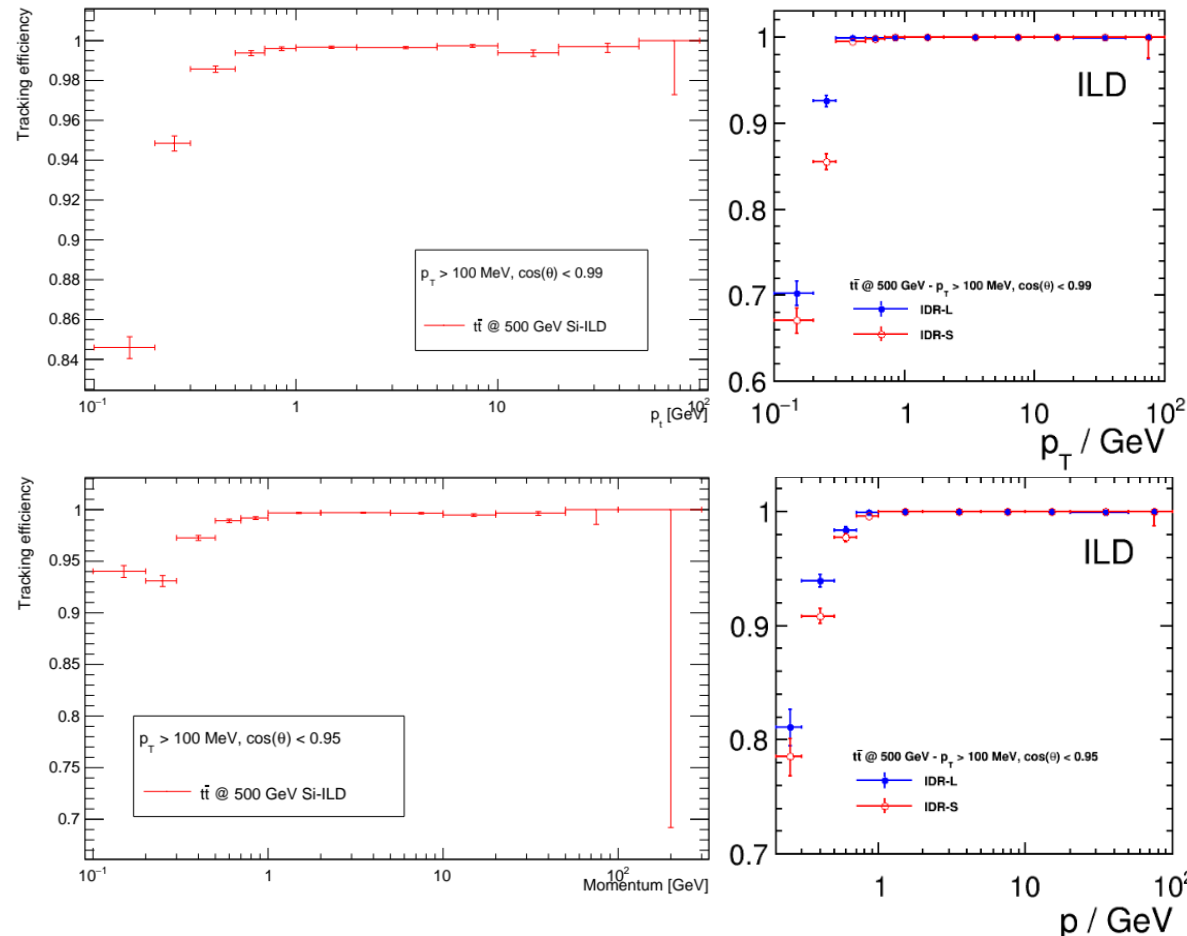
- Compare the performance with the "standard" ILD
→ interesting also for the ongoing LLP search analysis

ILD_I5_v09



Tracking and digitisation tests already performed for single muons

- Simulated 1k events @ 500 GeV TDR_ws sample (default in ILDPerformance) with ILCSoft v02-02-03
- Overlay events (aa_lowpt, seeablepairs) included
 - exp. number of events per ttbar event corresponding to 1 BX
- We use Conformal Tracking as in CLIC
 - algorithm designed, optimised, and tested for silicon tracker at CLICdet
 - parameters slightly modified w.r.t. previous presentation (will be uploaded to Github)
- DDiagnostics processor used to calculate tracking efficiencies

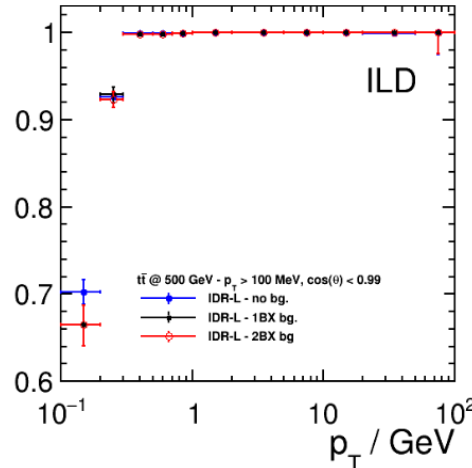
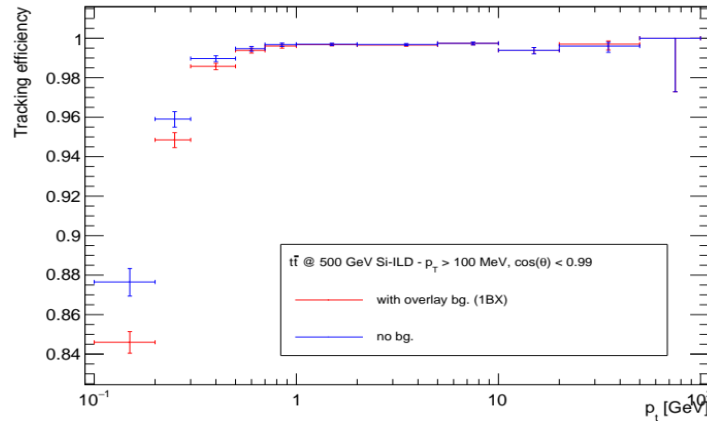
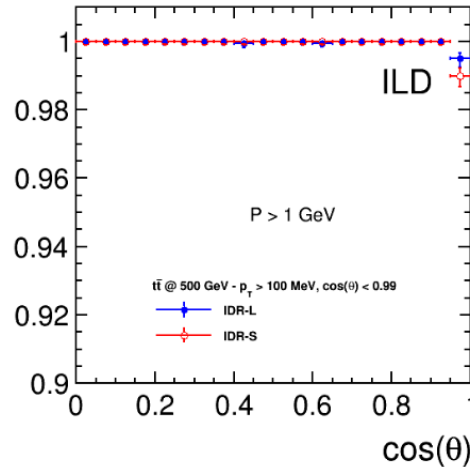
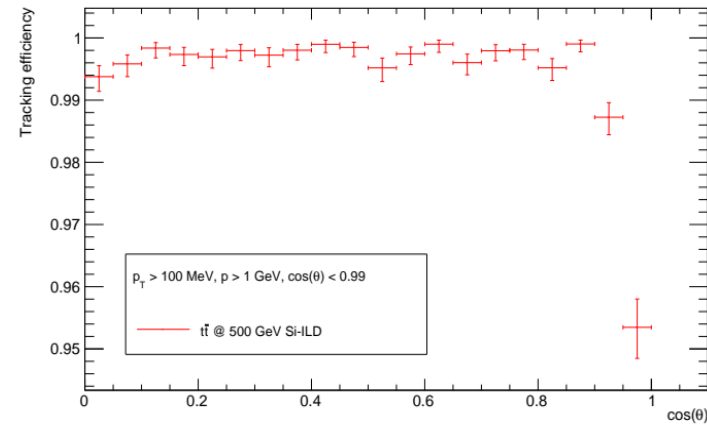


Comparison with [ILD IDR](#); same requirements:

- Track purity $> 75\%$
- Distance from beam axis $< 10 \text{ mm}$
- Same cuts depending on a plot

→ Higher eff. For very low momenta ($< 300 \text{ MeV}$)

→ Plateau ($\gtrsim 99\%$) reached slower (at $\sim 1 \text{ GeV}$)

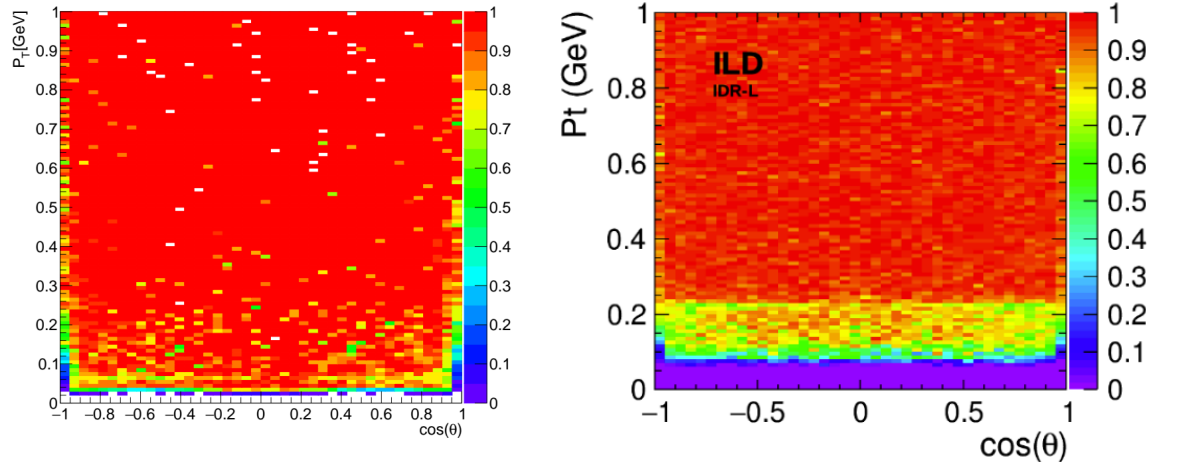


Comparison with [ILD IDR](#); same requirements:

- Track purity > 75%
- Distance from beam axis < 10 mm
- Same cuts depending on a plot

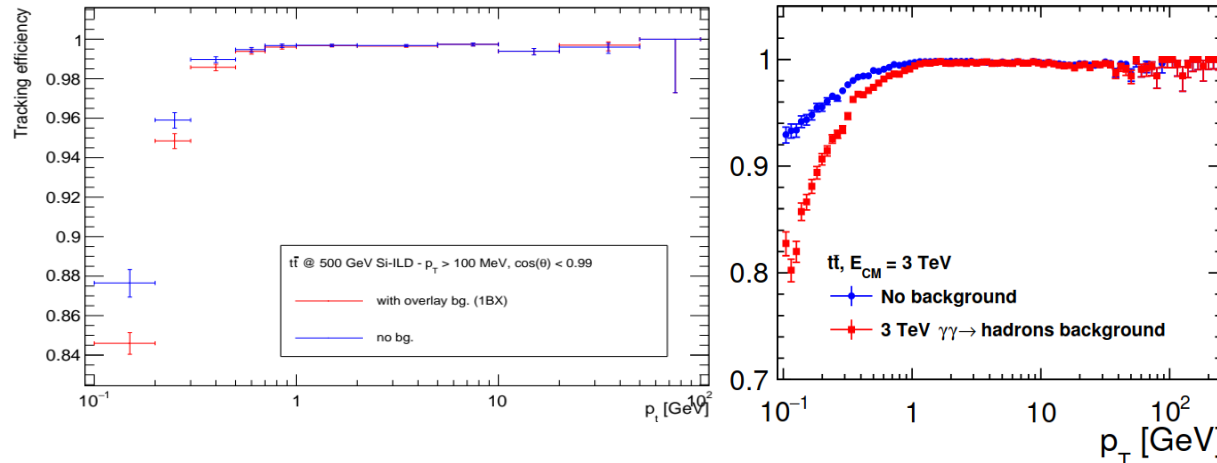
→ Small eff. in the forward direction

→ Slightly higher influence of the overlay for small momenta



Comparison with [ILD IDR](#); same requirements:

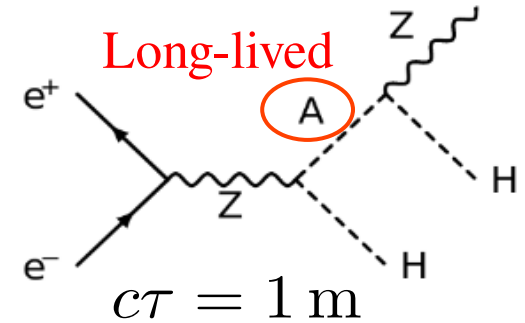
- Track purity > 75%
- Distance from beam axis < 10 mm



Comparison with [CLICdet](#)

- Slightly worse performance for small pT (considering much higher overlay at CLIC)
- Consistent behaviour and dependence on the p_T

- Tuned Inert Doublet Model sample as a test scenario
 - small-boosted, low-pT di-muon final state
 - for details see e.g. [last update on the analysis at TPC-ILD](#)
- Underperformance for settings analogous to standard CLIC setup
 - release some cuts → dedicated settings

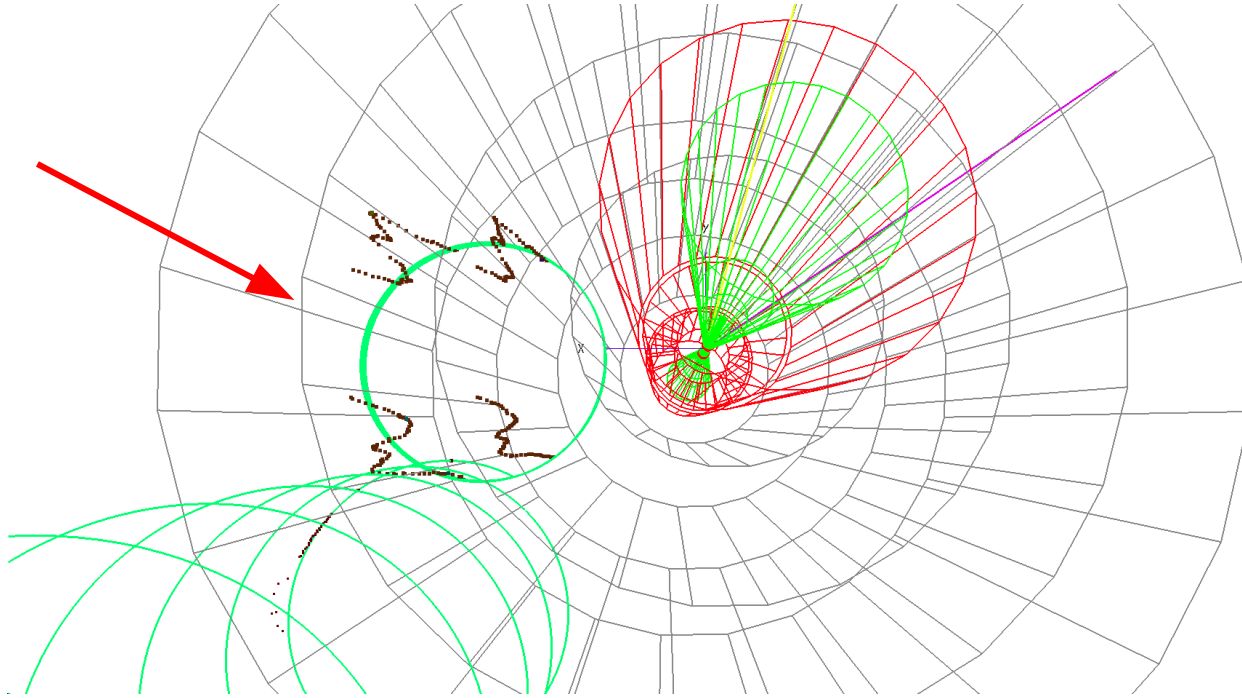


```
[Displaced]
@Collections : VXDTrackerHits, FTDPixelTrackerHits, SITTrackerHits, FTDSripTrackerHits, OTrackerHits, OTrackerEndcapHits
@Parameters : MaxCellAngle : 0.1; MaxCellAngleRZ : 0.1; Chi2Cut : 1000; MinClustersOnTrack : 5; MaxDistance : 0.035; SlopeZRange: 10.0; HighPTCut: 10.0;
@Flags : OnlyZSchi2cut, RadialSearch
@Functions : CombineCollections, BuildNewTracks
```

0.3

4

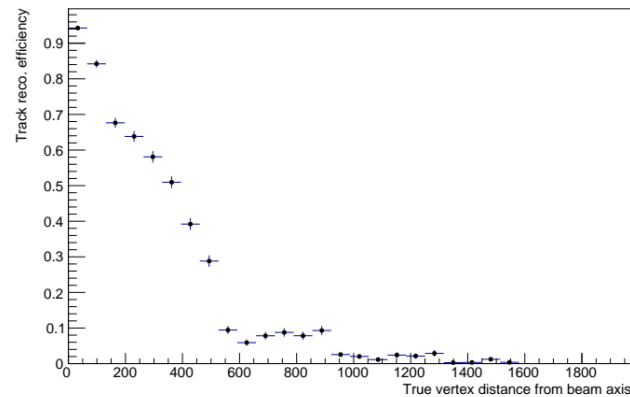
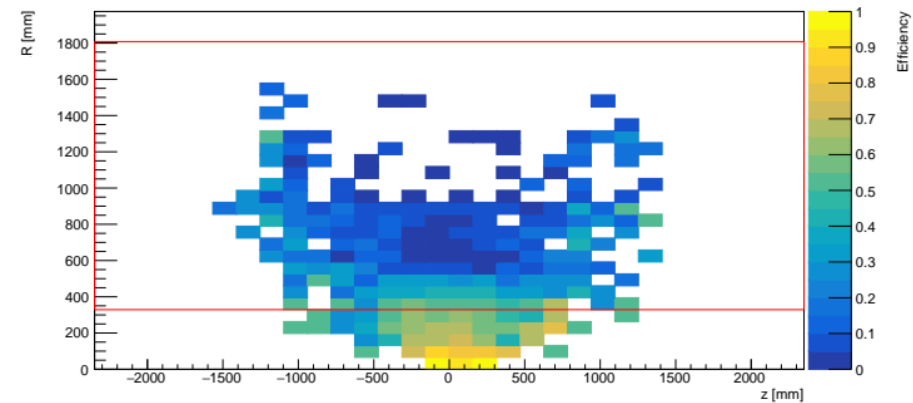
0.04



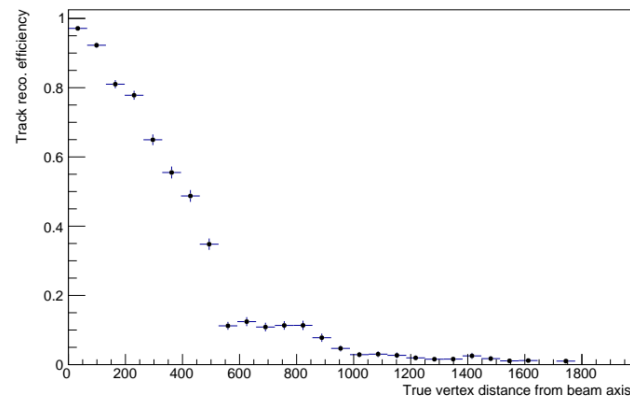
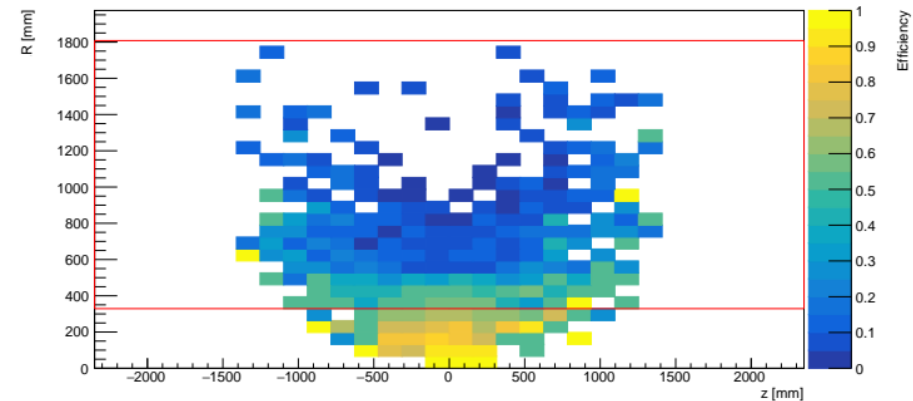
- Displaced curlers perpendicular to the beam axis can travel back and forth while losing energy, further decay or leave many secondary hits
- Reconstruction get stuck on such events if parameters are too loose



Displaced tracks – tracking efficiency

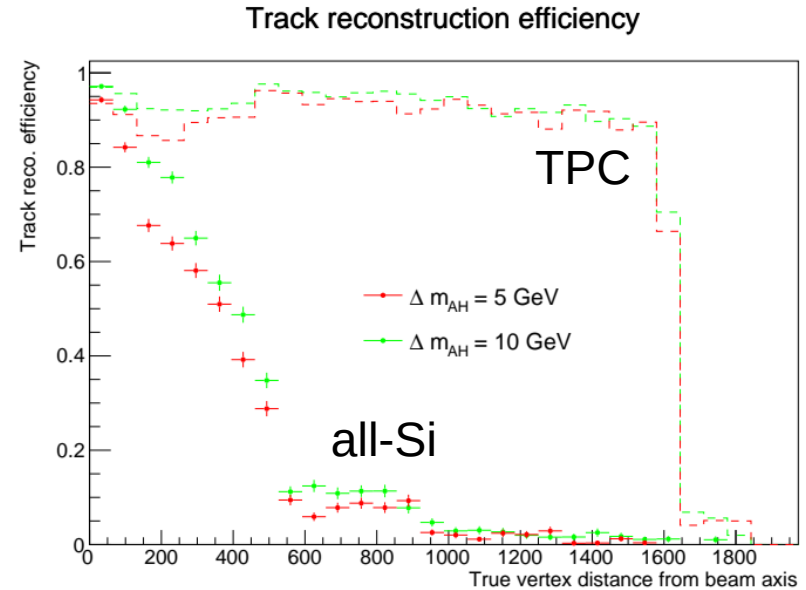
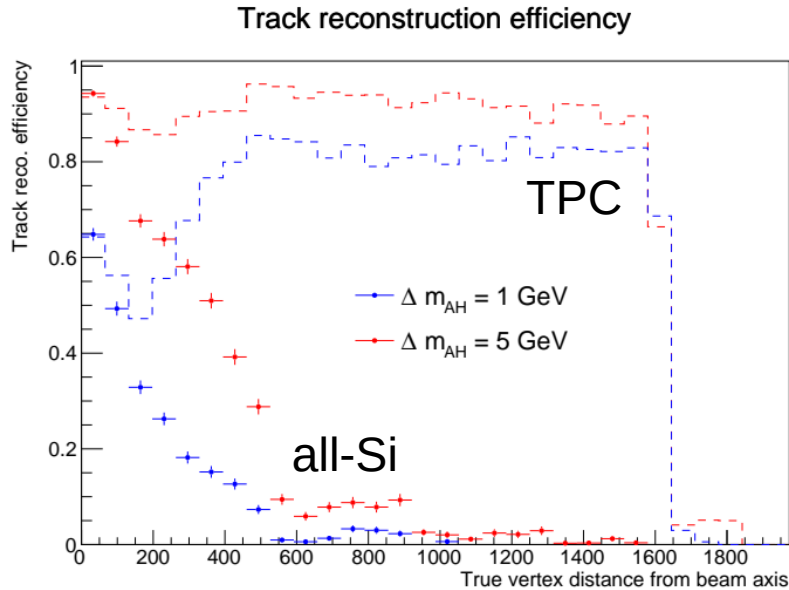


$$m_A - m_H = 5 \text{ GeV}$$

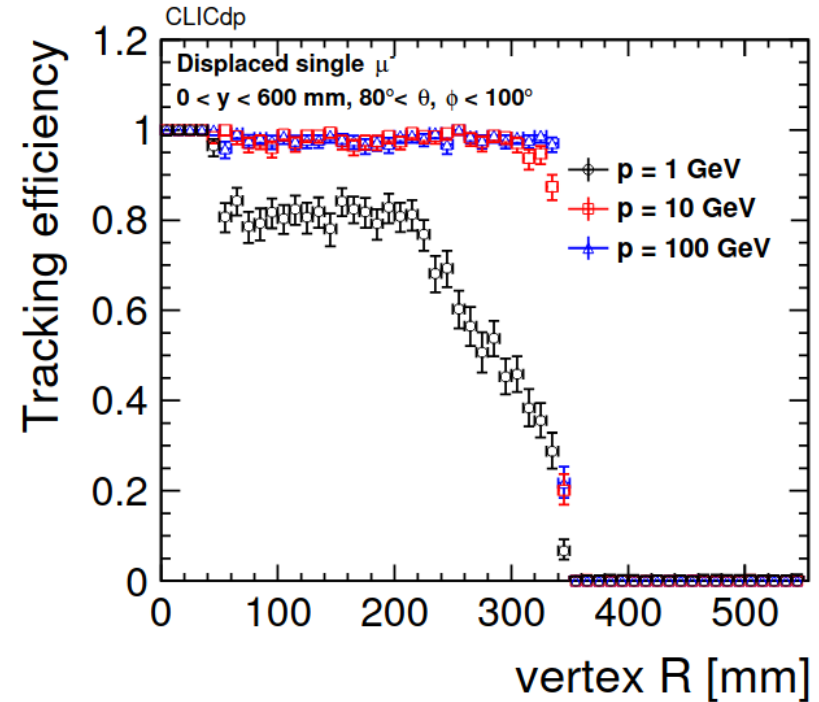
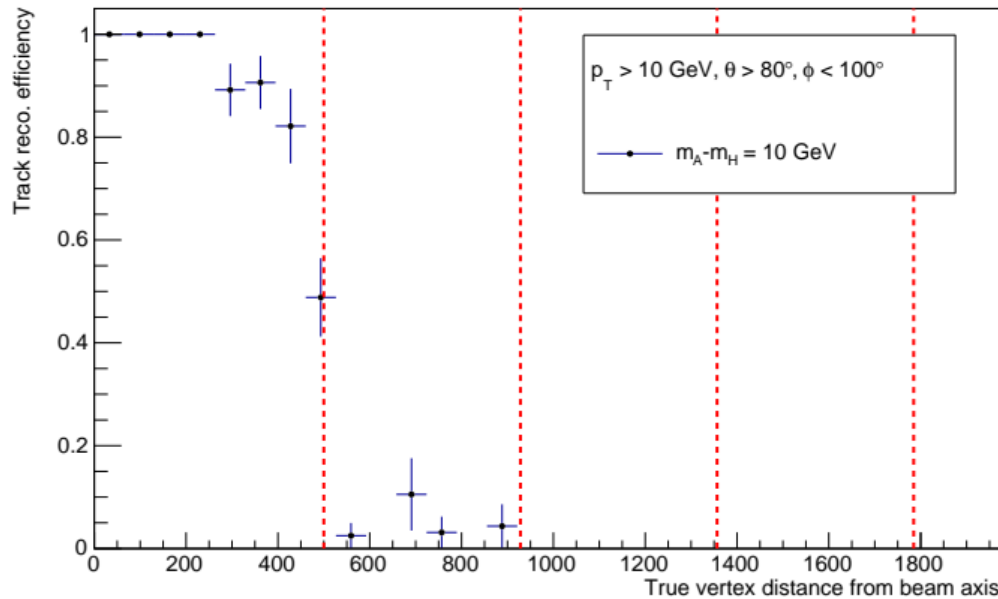


$$m_A - m_H = 10 \text{ GeV}$$

- Good performance near the beam axis

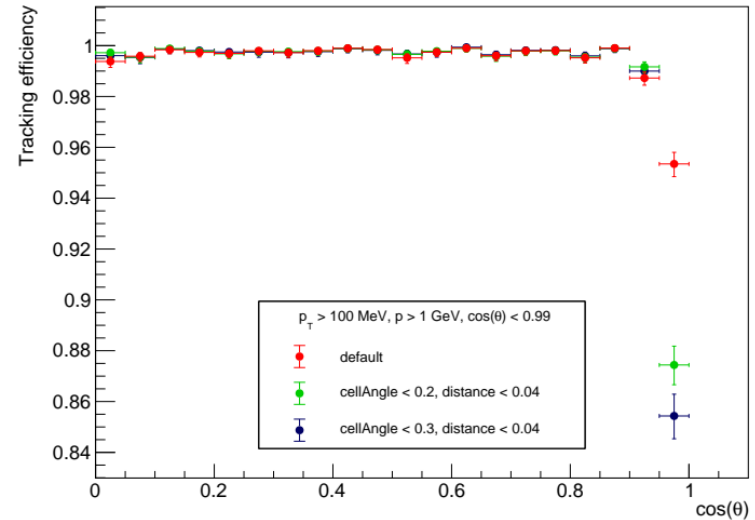
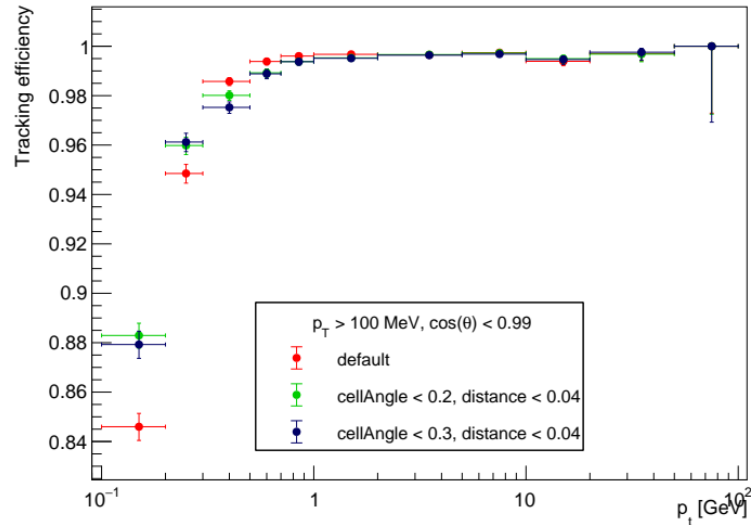


- Overall efficiency higher for the TPC-ILD
- Similar behaviour near the beam axis



- Cone of 10 deg. around the y axis
- Better performance at the ILD (but with looser CT settings and a different sample)

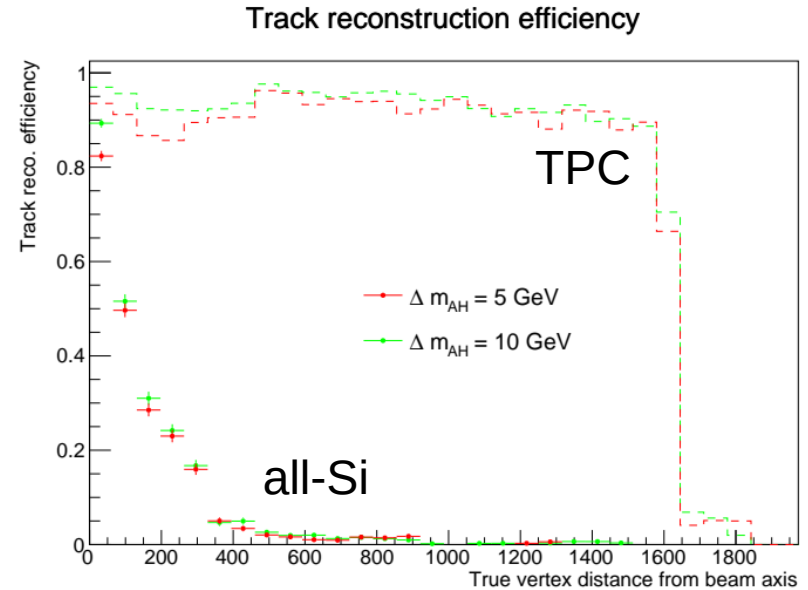
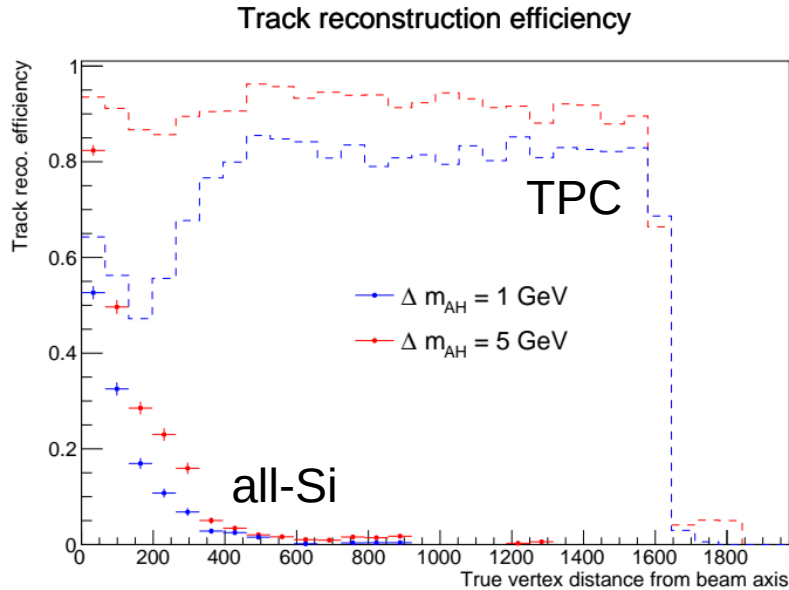
Change of "Displaced" step parameters in CT influences also prompt decays:



- Default – corresponds to results on slides 4-6
 - CellAngle < 0.3 – to results on slides 9-11
- a trade-off has to be found

- Track reco. analysed in the ILD with full-silicon, CLIC-like tracker
 - prompt tracks in complex events ($t\bar{t}$) and displaced tracks (IDM) considered
- Implementation inspired by the CLIC setup – rather straightforward, but some parameters had to be tuned
- $t\bar{t}$ events:
 - efficiency higher for momenta $\lesssim 300$ MeV, much lower in the forward region
 - performance seem consistent with CLICdet
- displaced tracks:
 - consistency with CLICdp results, but much worse performance than TPC-ILD
- Steering files will be available on Github, at this [pull request](#) (with which setup?)

BACKUP



- With the settings optimal for $t\bar{t}$, results for displaced tracks get much worse