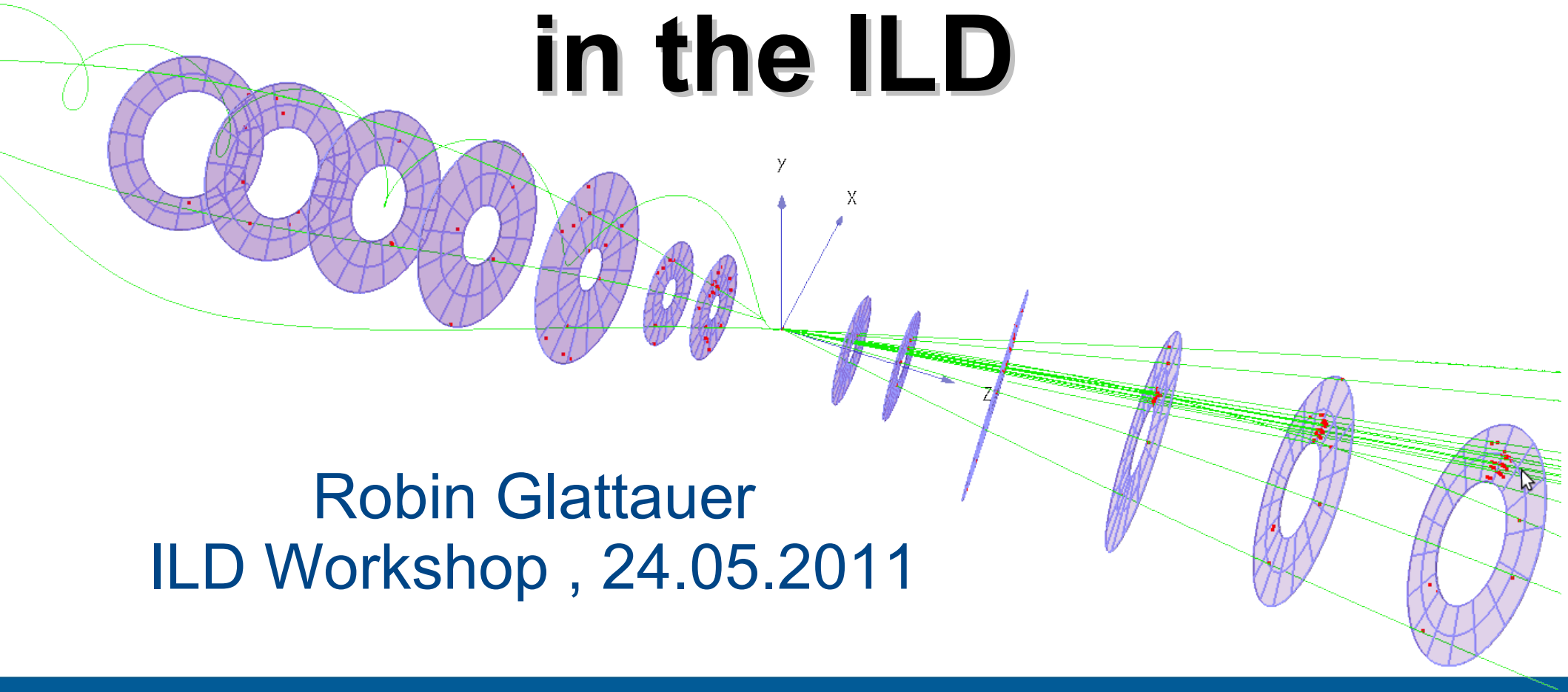
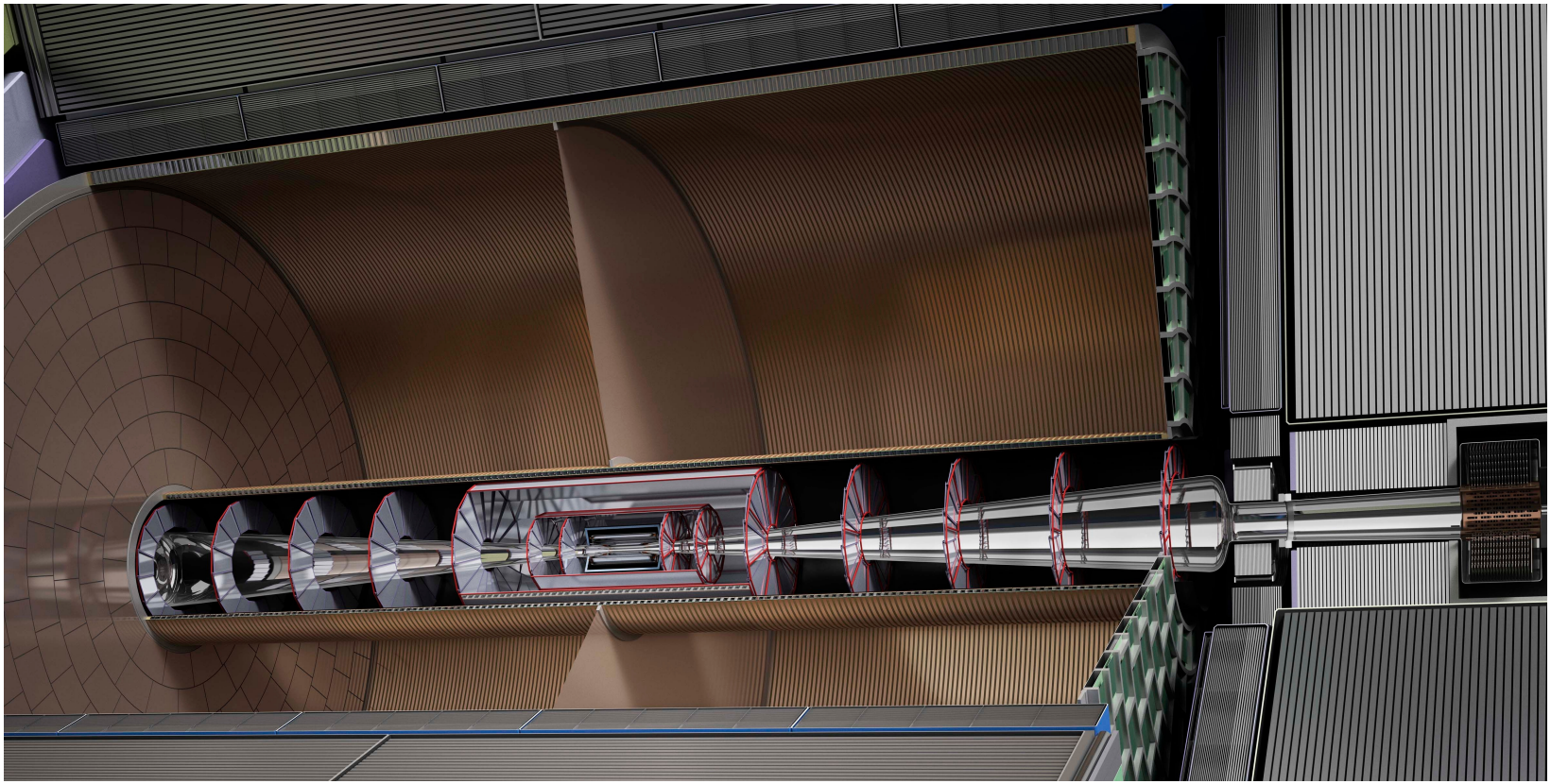
Forward Tracking in the ILD



Robin Glattauer

ILD Workshop , 24.05.2011

The Forward Region



FTD 0,1 : pixel detector
FTD 2-6 : dual layer strip detector

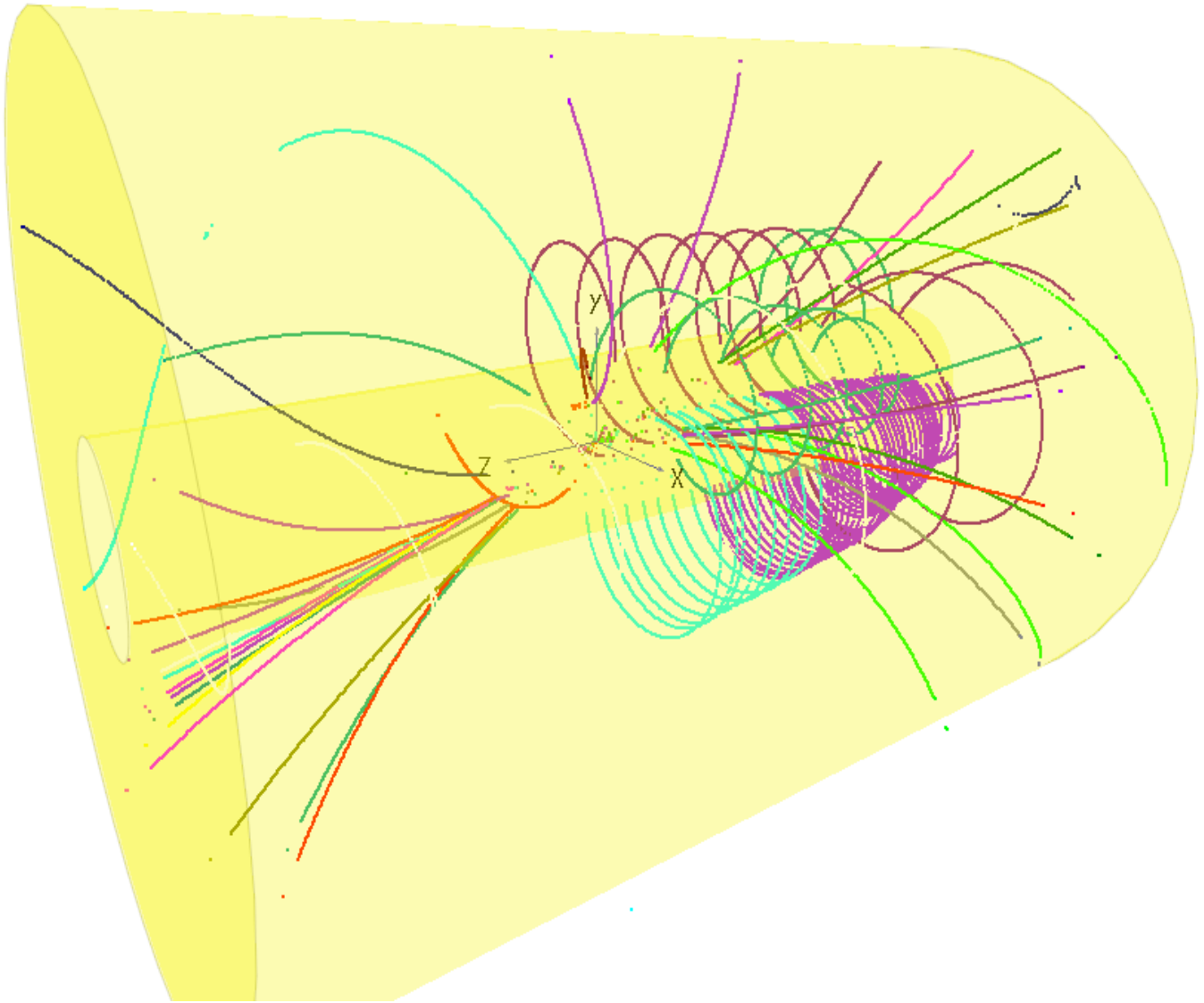
ForwardTracking

- Processor in package with same name
- Standalone track reconstruction for the FTD
- Requirements:
  - Object oriented (flexible, maintainable)
  - Deal with background
  - Better efficiency / ghost rate than SiliconTracking

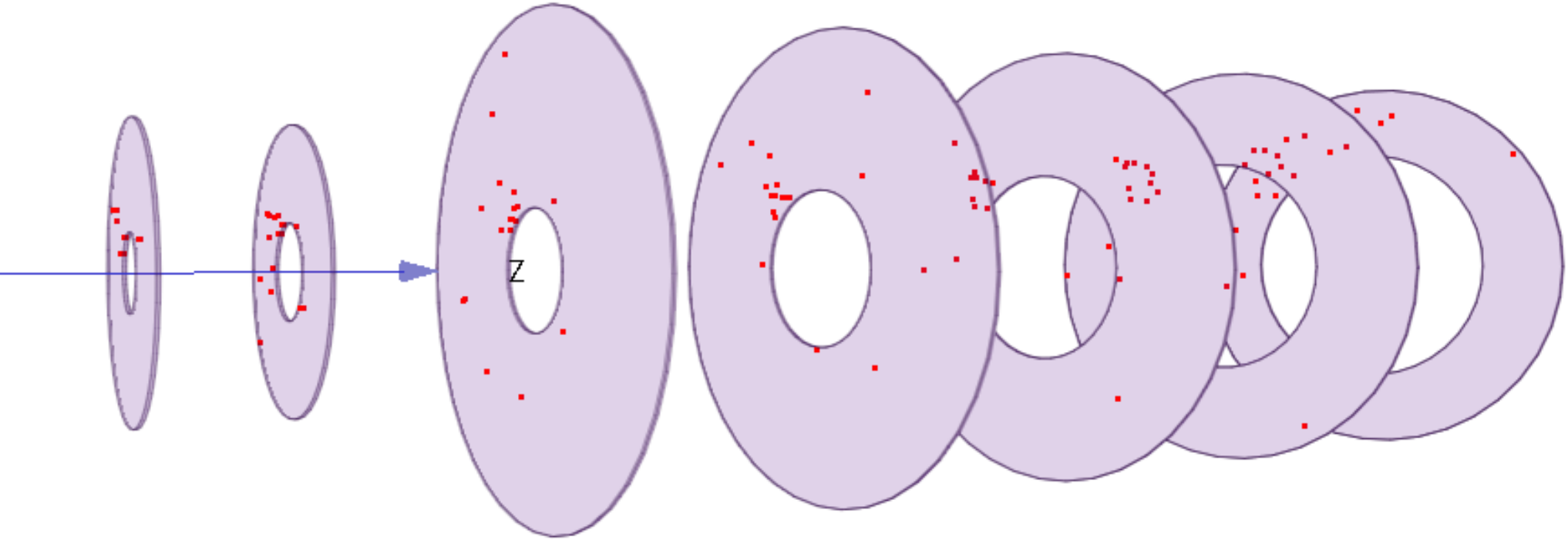
Why is it needed?

- Why a new one?
  - Aim for better results, able to compare
  - Maintainability
- Why not all tracking in one place?
  - Major differences between TPC and FTD
  - Not all hits can be picked up

An event in the TPC

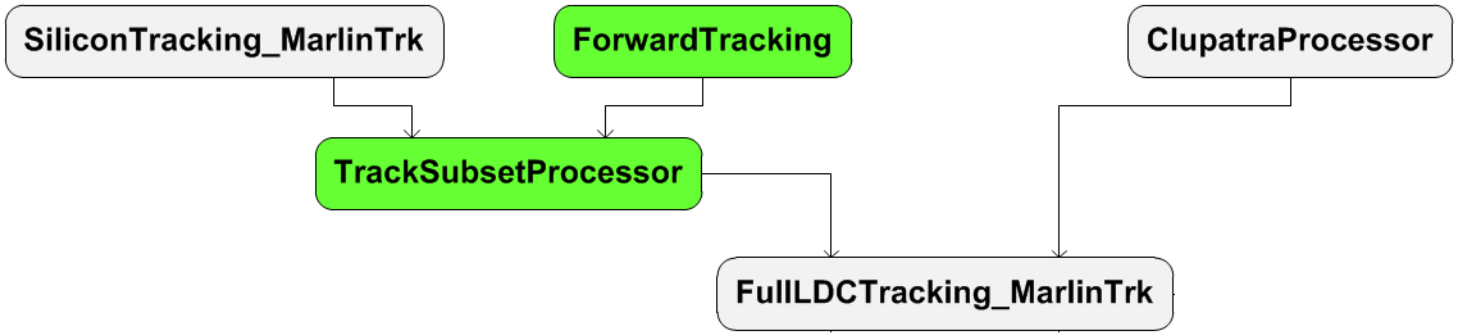


An event in the FTD



ForwardTracking

- In the standard reco chain (in ILDConfig)
- Parallel to SiliconTracking
- Track collections combined in TrackSubsetProcessor



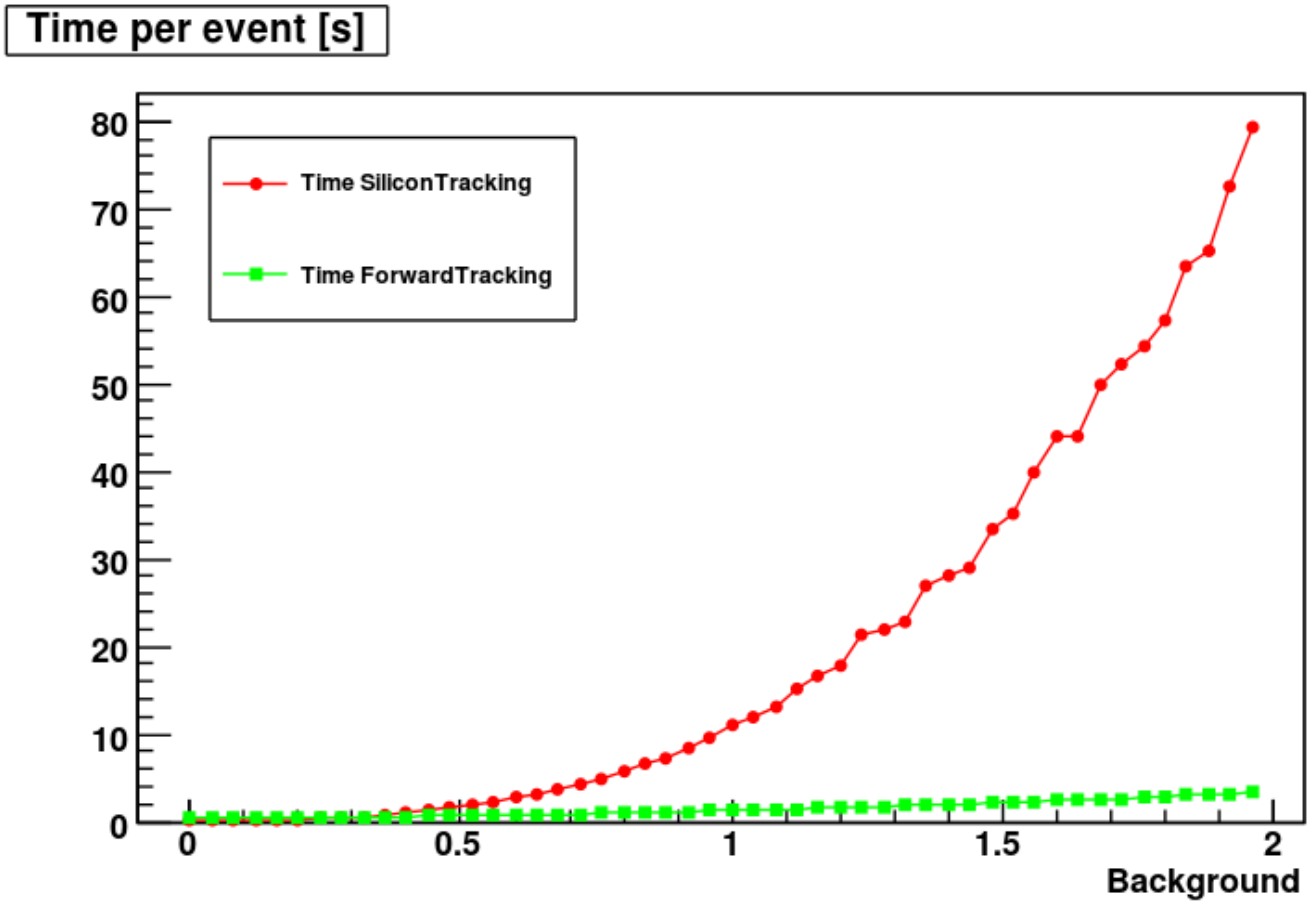
Main Methods

- Cellular Automaton: find tracks
- Kalman Filter: fit tracks and gain quality indicator
- Hopfield Neural Network: find a compatible subset
- Alternative methods possible for every step

Results: What was tested

- Realistic events (not particle gun)
- Hits only in FTD
- Cuts:
  - X^2 probability > 0.005
  - number of hits >= 4
  - P_T > 100 MeV

Results: time



Event: 500 GeV bbudsc

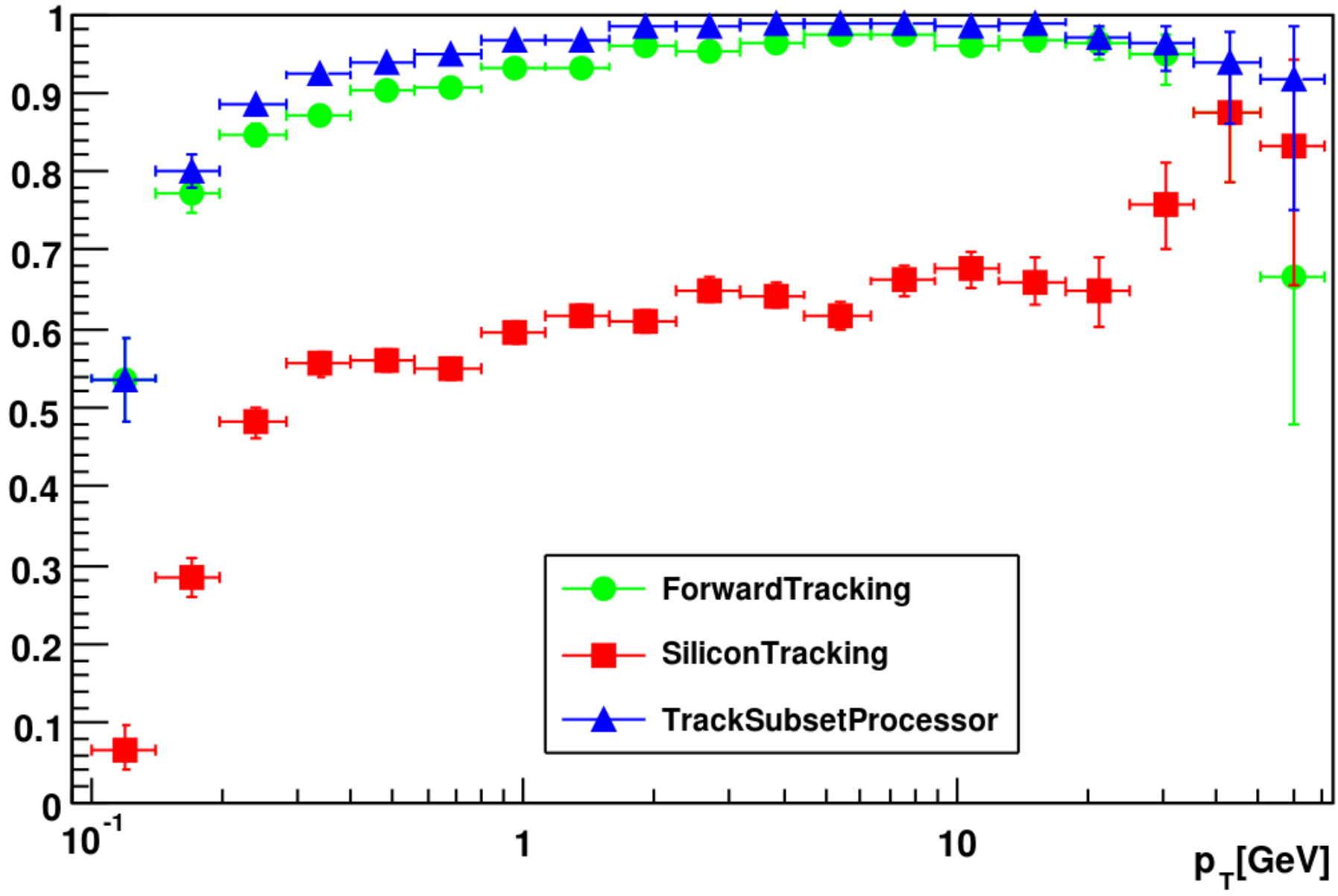
X-axis: scaled LoI background

100 BX for pixel disks (disk 0 and 1)

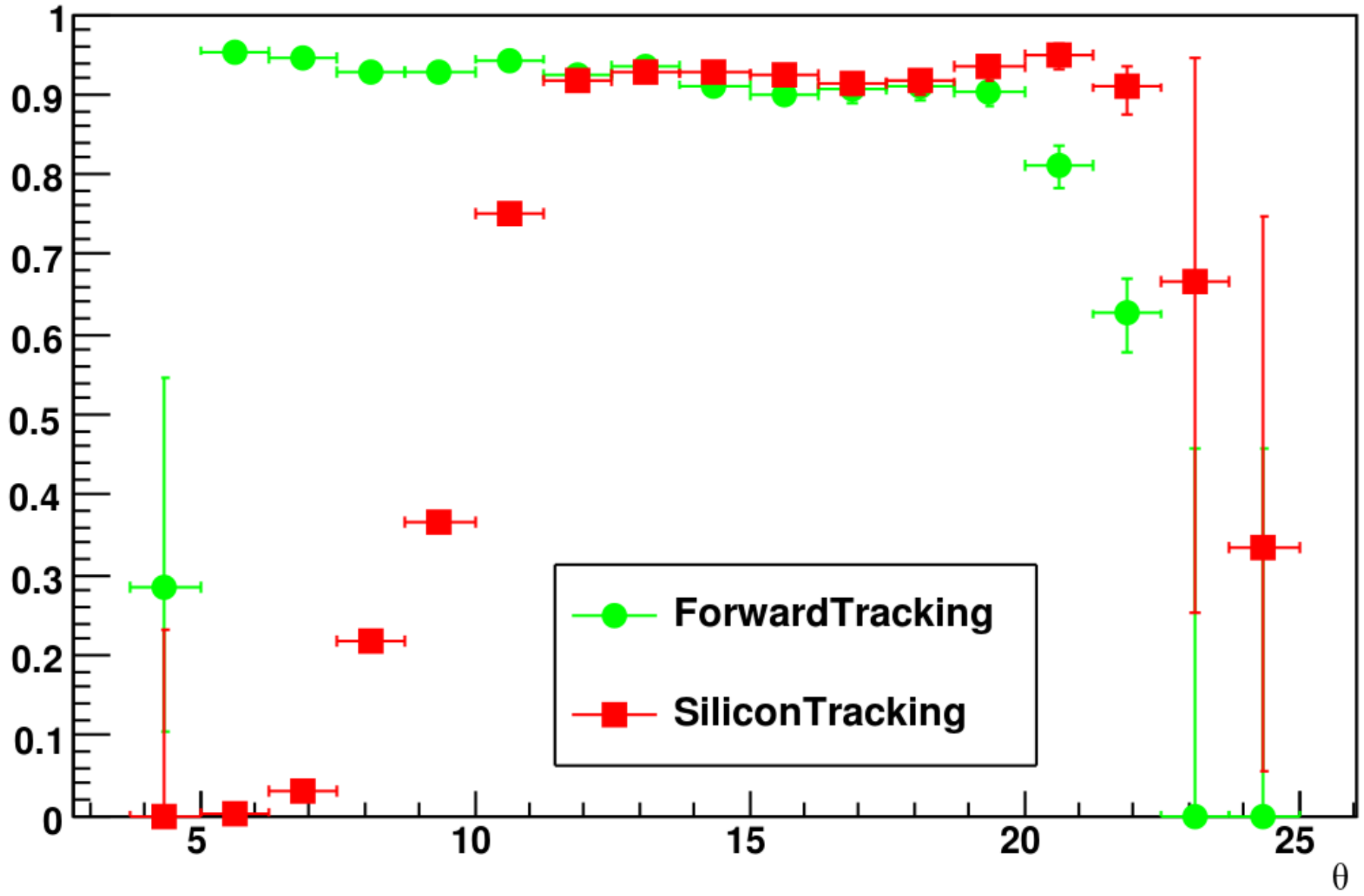
Efficiency and Ghost Rate

- Used event: 1TeV WW
- Track is “found”, if:
  - found hits of true track / all hits of true track > 50%
  - true hits in reco track / all hits in reco track > 50%
- $$Efficiency = \frac{true\ tracks\ found}{true\ tracks\ findable}$$
- $$Ghost\ Rate = \frac{reconstructed\ tracks\ that\ don't\ match\ any\ true\ track}{all\ reconstructed\ tracks}$$

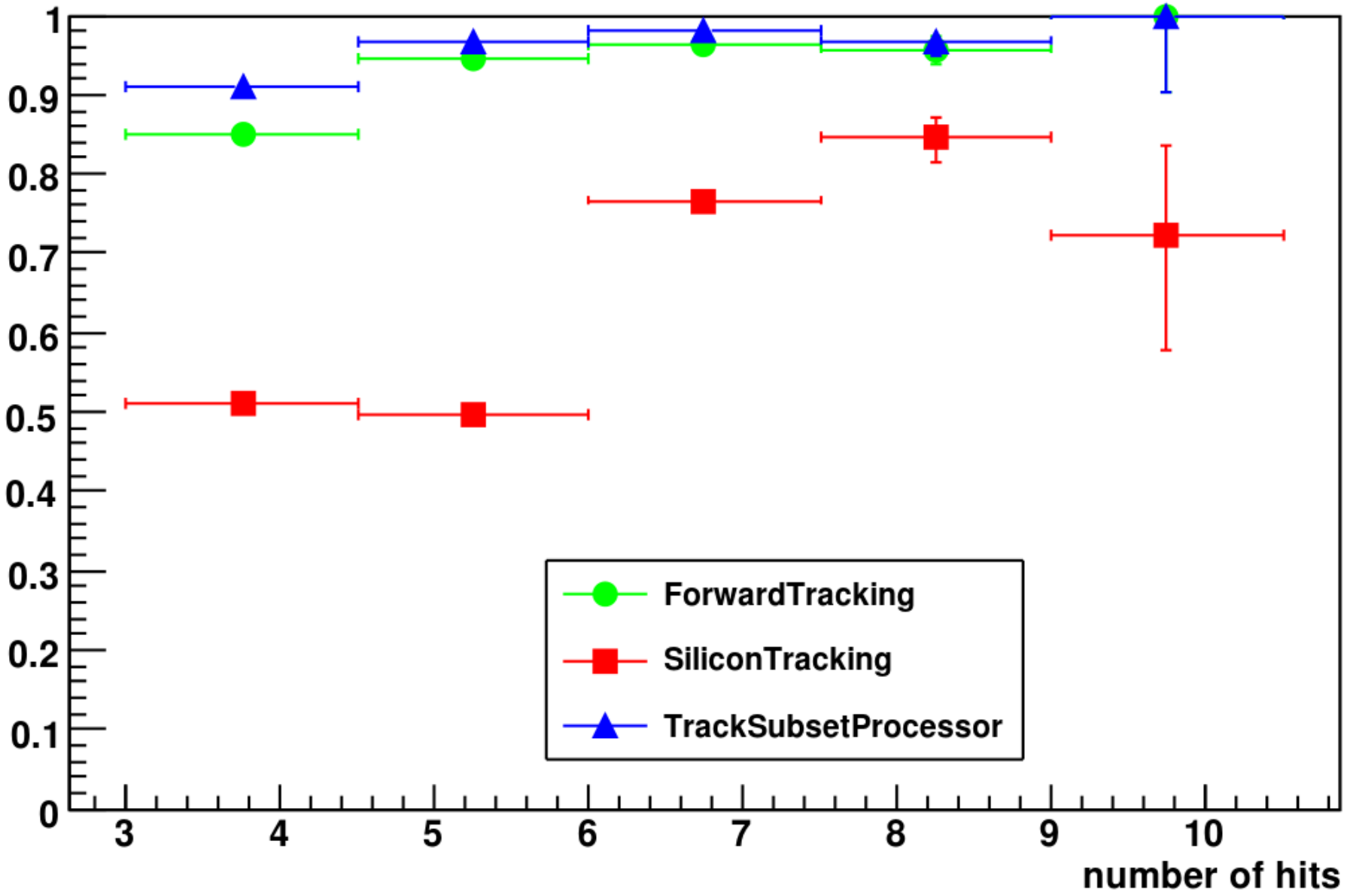
Efficiency

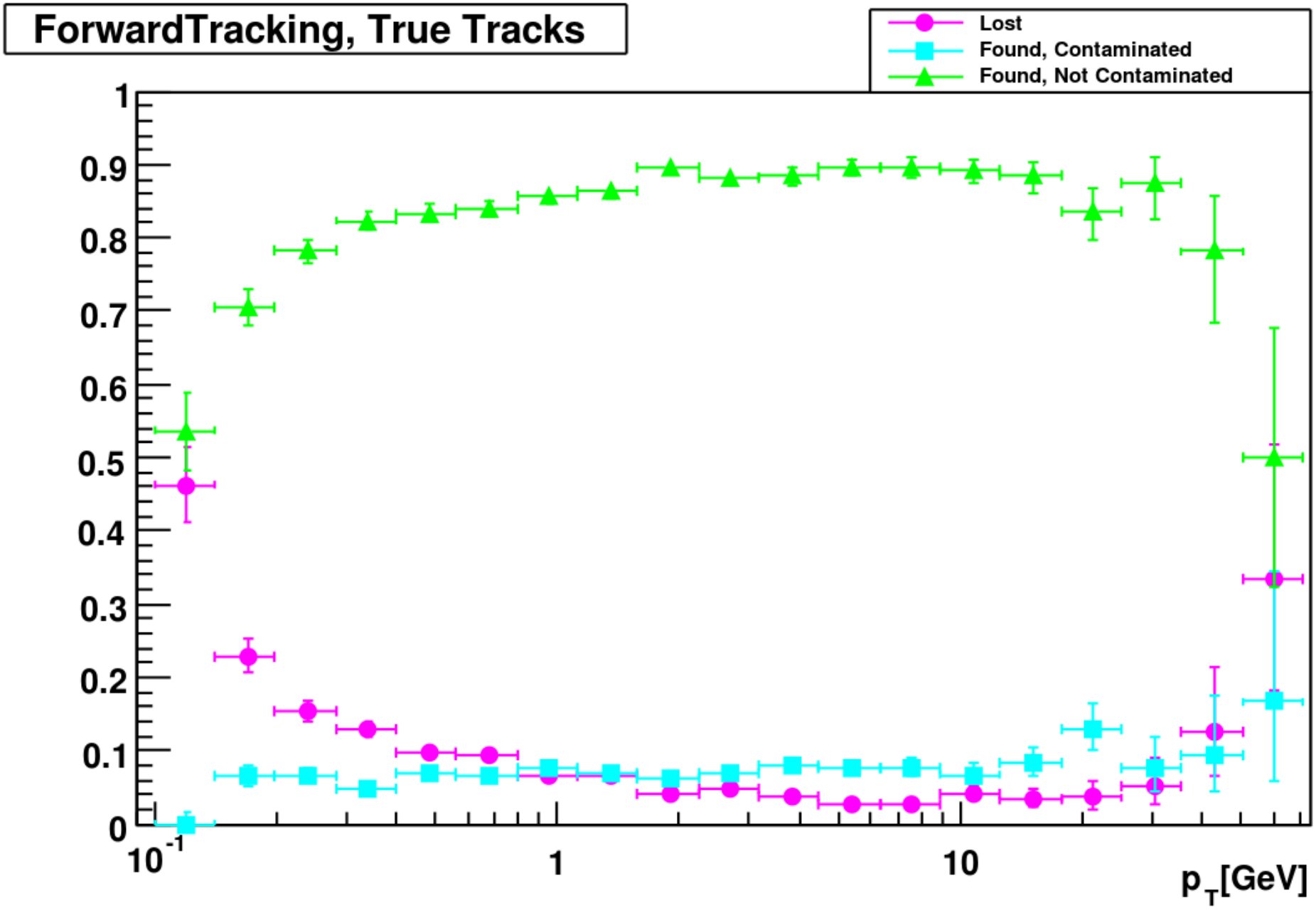

1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
10^{-1}
1
10
p_T[GeV]
ForwardTracking
SiliconTracking
TrackSubsetProcessor

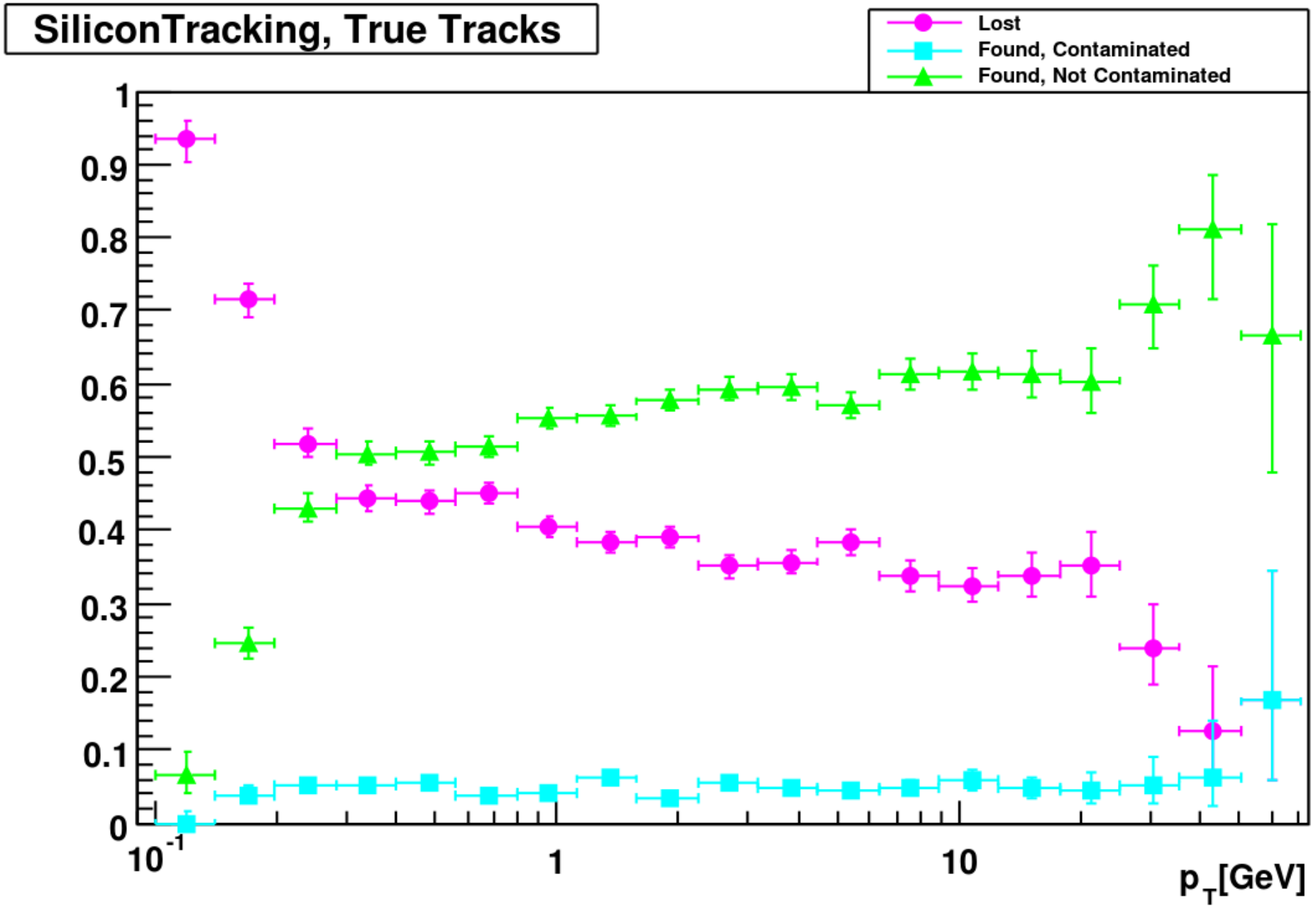
Efficiency

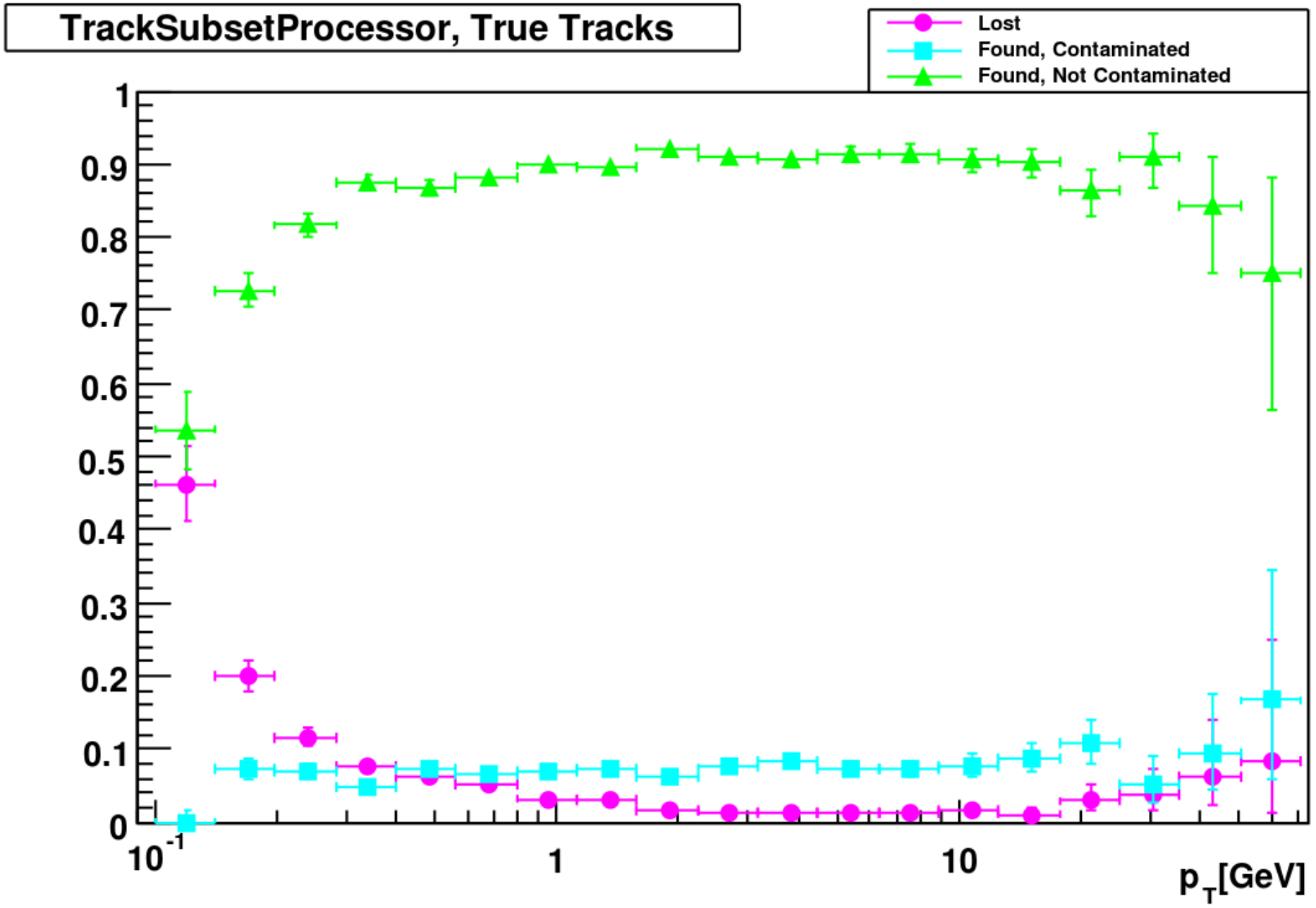

1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
5
10
15
20
25
θ
ForwardTracking
SiliconTracking

Efficiency

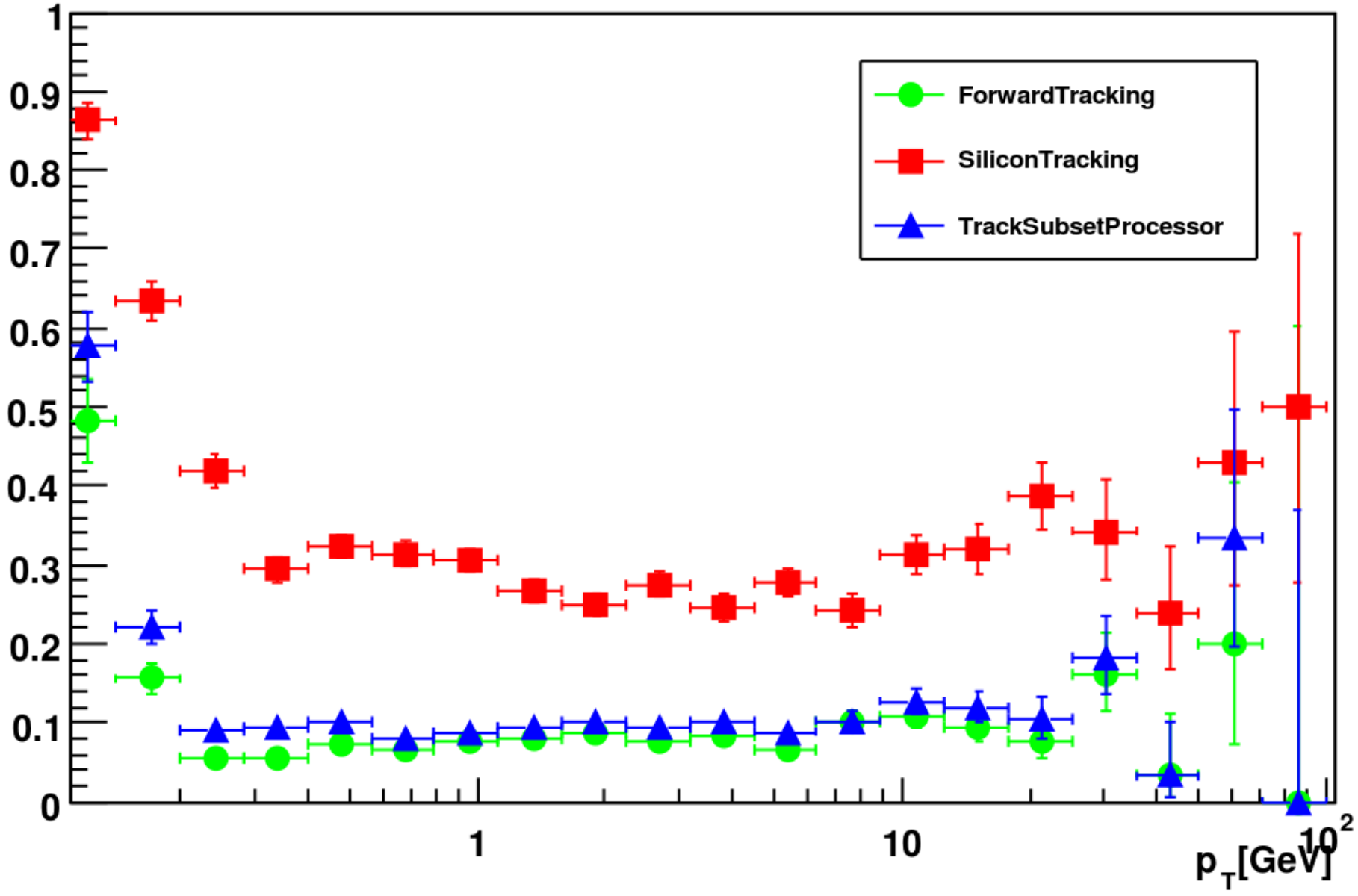

1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
3
4
5
6
7
8
9
10
number of hits
ForwardTracking
SiliconTracking
TrackSubsetProcessor


ForwardTracking, True Tracks
Lost
Found, Contaminated
Found, Not Contaminated
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
10^-1
1
10
p_T[GeV]


SiliconTracking, True Tracks
Lost
Found, Contaminated
Found, Not Contaminated
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
10^-1
1
10
p_T[GeV]


TrackSubsetProcessor, True Tracks
Lost
Found, Contaminated
Found, Not Contaminated
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
10^-1
1
10
p_T[GeV]

Ghost Rate


ForwardTracking
SiliconTracking
TrackSubsetProcessor
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1
10
10^2
p_T [GeV]

At the moment

- No more major changes (most probably)
- Testing
- Tuning
- Documentation
- Intermediate Region

The Future

- Soon: Getting ready for mass production
- Afterwards: keeping up support and minor changes

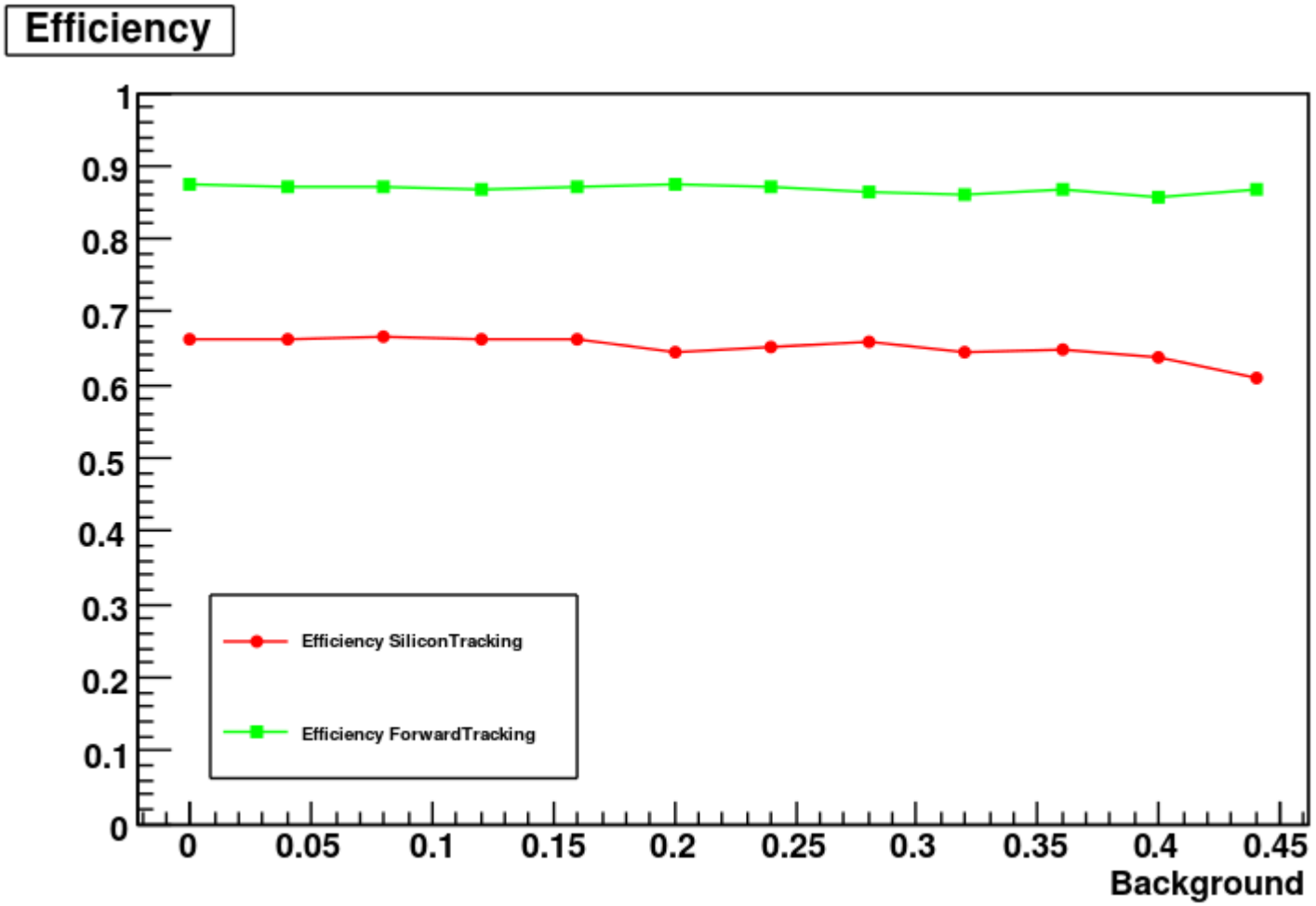
Summary

- ForwardTracking part of reco chain
- Gives satisfactory results
- Improve as much as possible through tuning and small changes until mass production

Thank you!

Back Up

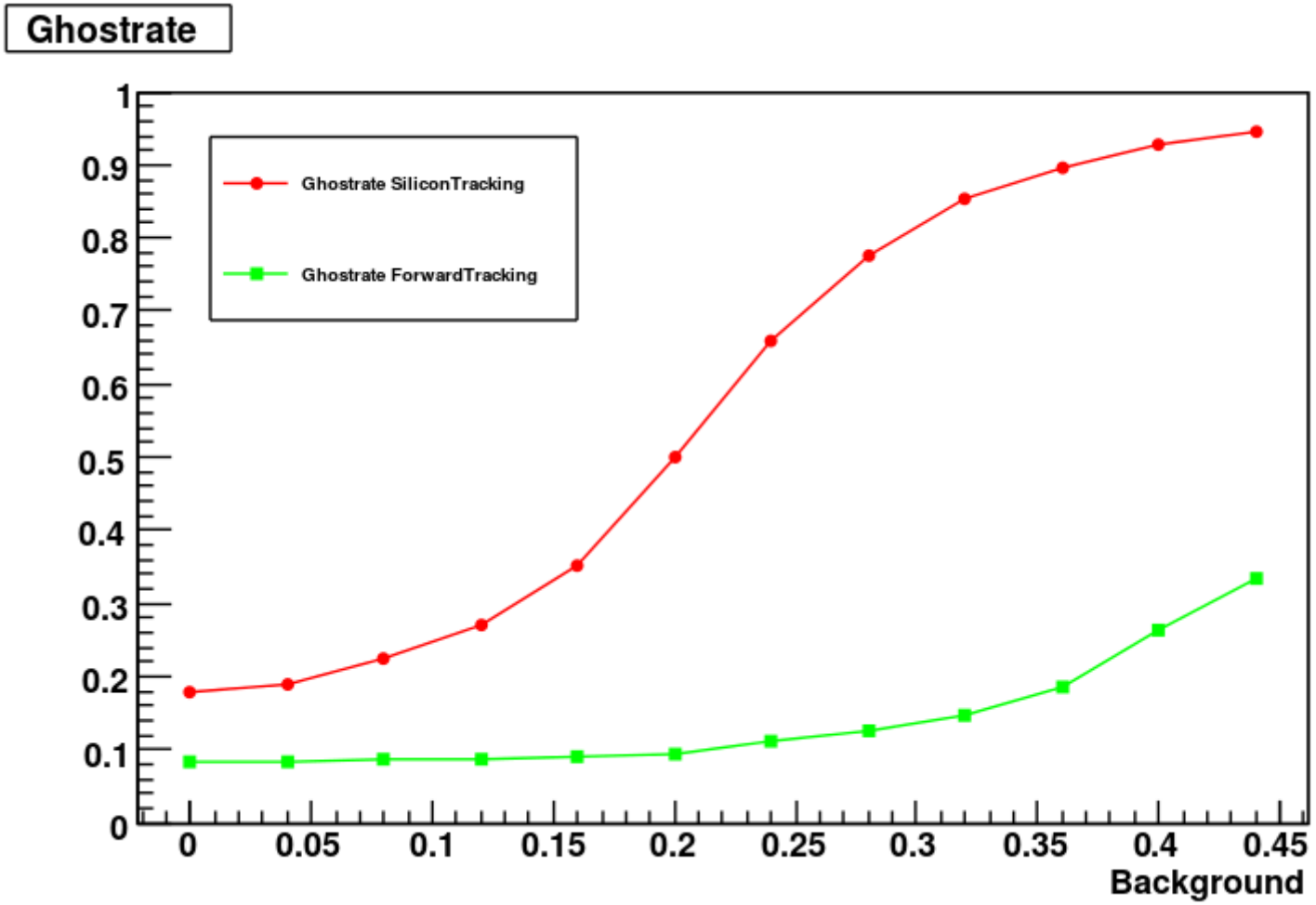
Just for interest



500 GeV event
x-axis: LoI background
BUT: integrate over 100 BX on ALL layers

→ extremely high bg on strip detectors as well (not realistic, just to see the limits)

Just for interest



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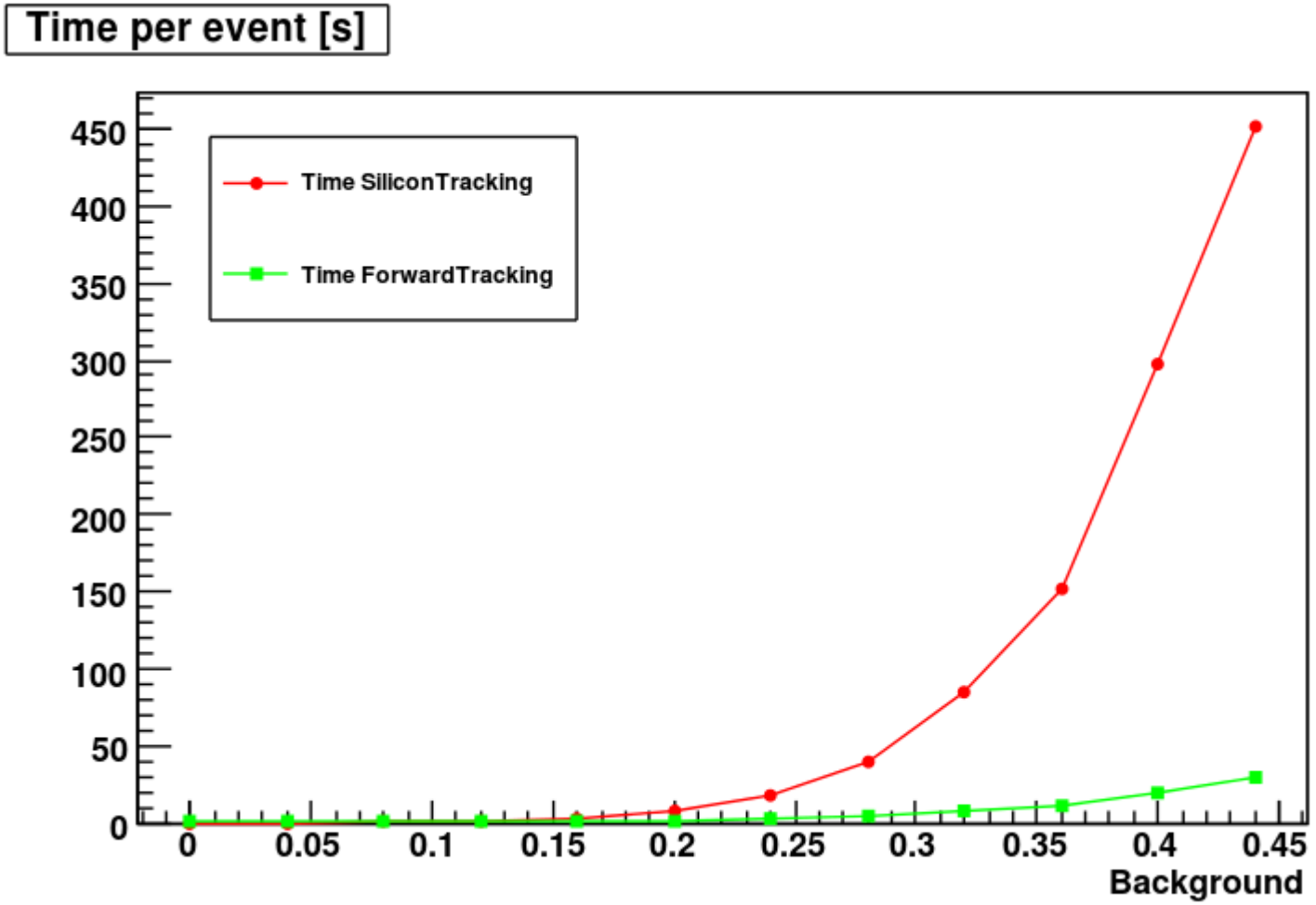

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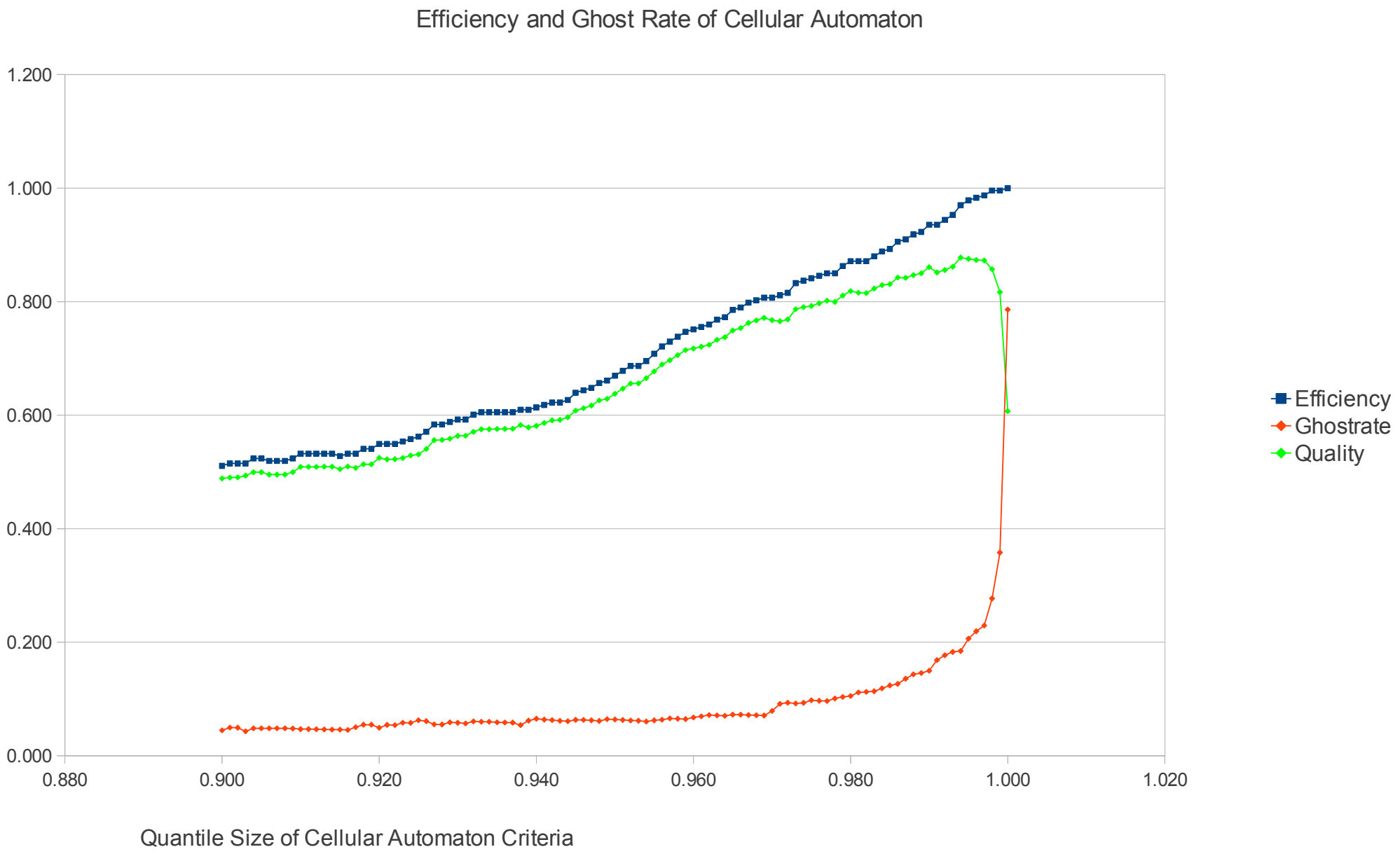
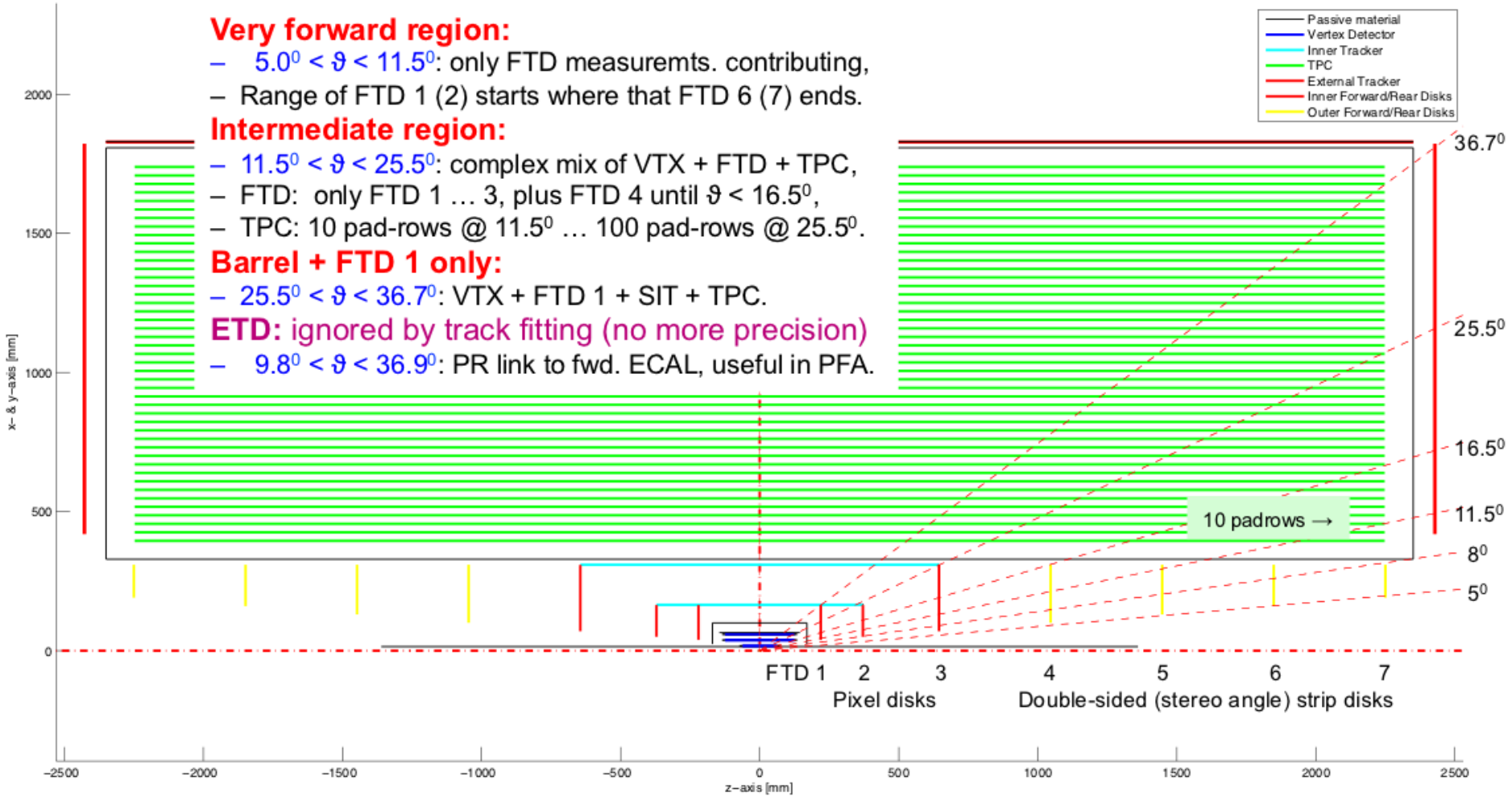

Efficiency and Ghost Rate of Cellular Automaton
1.200
1.000
0.800
0.600
0.400
0.200
0.000
0.880
0.900
0.920
0.940
0.960
0.980
1.000
1.020
Efficiency
Ghostrate
Quality
Quantile Size of Cellular Automaton Criteria

Very forward region:
- $5.0^0 < \vartheta < 11.5^0$: only FTD measuremts. contributing,
- Range of FTD 1 (2) starts where that FTD 6 (7) ends.

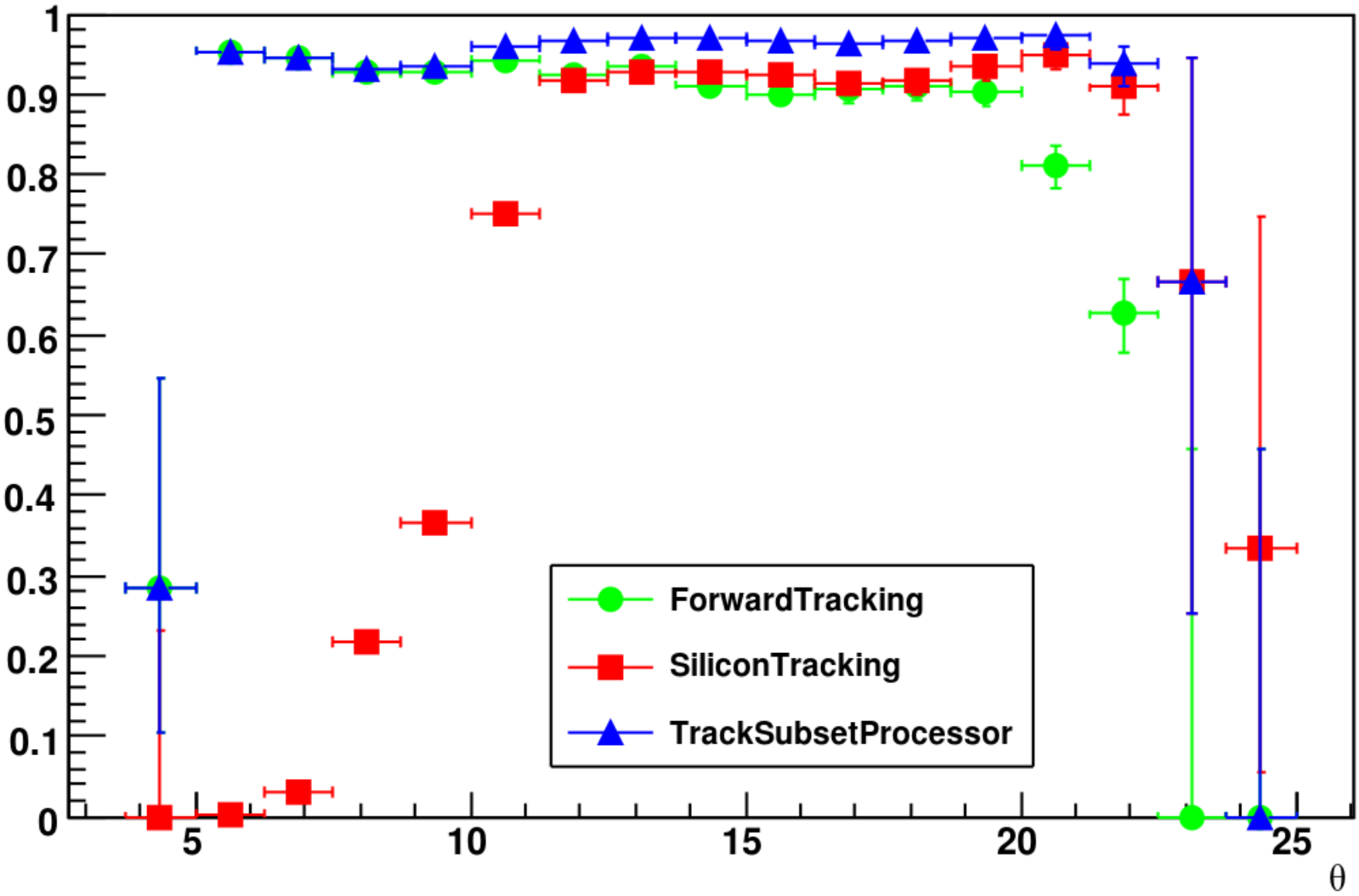
Intermediate region:
- $11.5^0 < \vartheta < 25.5^0$: complex mix of VTX + FTD + TPC,
- FTD: only FTD 1 … 3, plus FTD 4 until $\vartheta < 16.5^0$,
- TPC: 10 pad-rows @ 11.5^0 … 100 pad-rows @ 25.5^0.

Barrel + FTD 1 only:
- $25.5^0 < \vartheta < 36.7^0$: VTX + FTD 1 + SIT + TPC.

ETD: ignored by track fitting (no more precision)
- $9.8^0 < \vartheta < 36.9^0$: PR link to fwd. ECAL, useful in PFA.



Efficiency


1
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0.4
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0.2
0.1
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20
25
θ
ForwardTracking
SiliconTracking
TrackSubsetProcessor