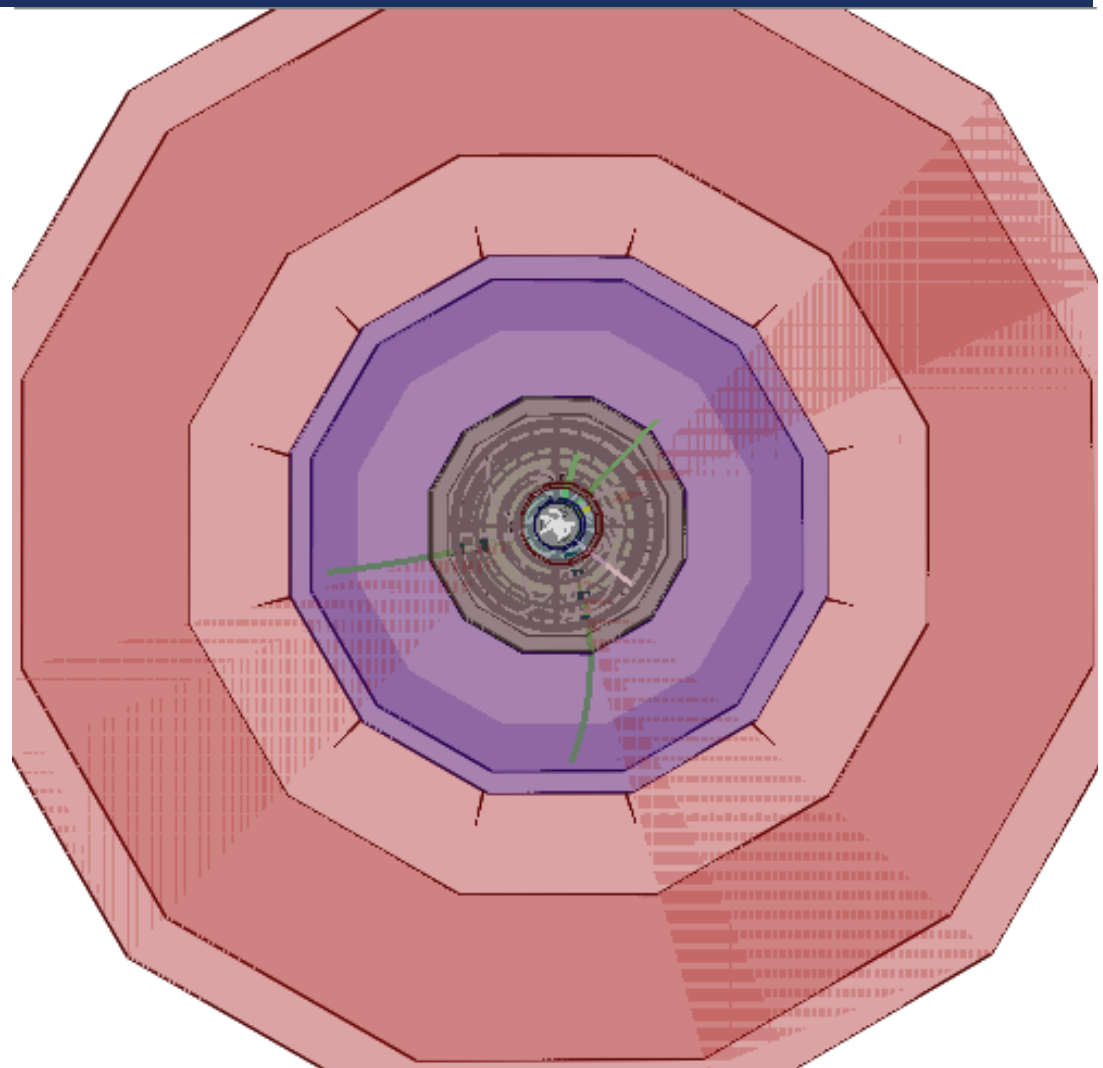
MUON COLLIDER

UNIVERSITÀ DEGLI STUDI DI BARI ALDO MORO

INFN Istituto Nazionale di Fisica Nucleare



Tracking studies

$\mu^+\mu^- \rightarrow \mathrm{H} \rightarrow \mathrm{ZZ} \rightarrow 4\mu$

with BIB

Preliminary results

Angela Zaza, Massimo Casarsa, Anna Colaleo, Filippo Errico, Paola Mastrapasqua, Rosma Venditti

Track reconstruction

- BIB → long time needed to process events
  → ConeFilter (implemented by Massimo Casarsa) used to filter hits in the tracker system in a narrow cone around generated muons
- 2 different configurations of the tracking algorithm tested

7 steps

```
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  @Flags : HighPTFit
  @Functions : CombineCollections, BuildNewTracks
  [VXDInner]
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  @Flags : HighPTFit, RadialSearch
  @Functions : CombineCollections, ExtendTracks, SortTracks
  [Tracker]
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```

2 steps

```
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        [Tracker]
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        @Parameters : MaxCellAngle : 0.025; MaxCellAngleRZ : 0.05; C
        @Flags : HighPTFit, VertexToTracker, RadialSearch
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```
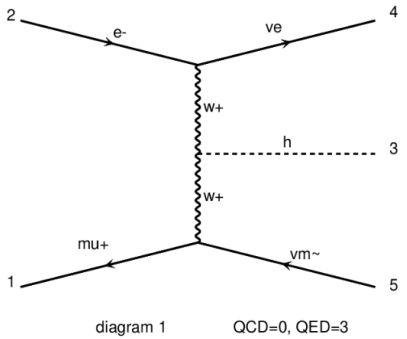

Samples

signal : $\mu^+\mu^- \rightarrow \mathrm{H} \rightarrow \mathrm{ZZ} \rightarrow 4\mu$

$WWfusion$

BIB: 2993 events (1 bunch crossing) overlapped to each signal event



	7 steps + DLF	2 steps
Only signal	2500	2500
Signal + BIB	2500	2500

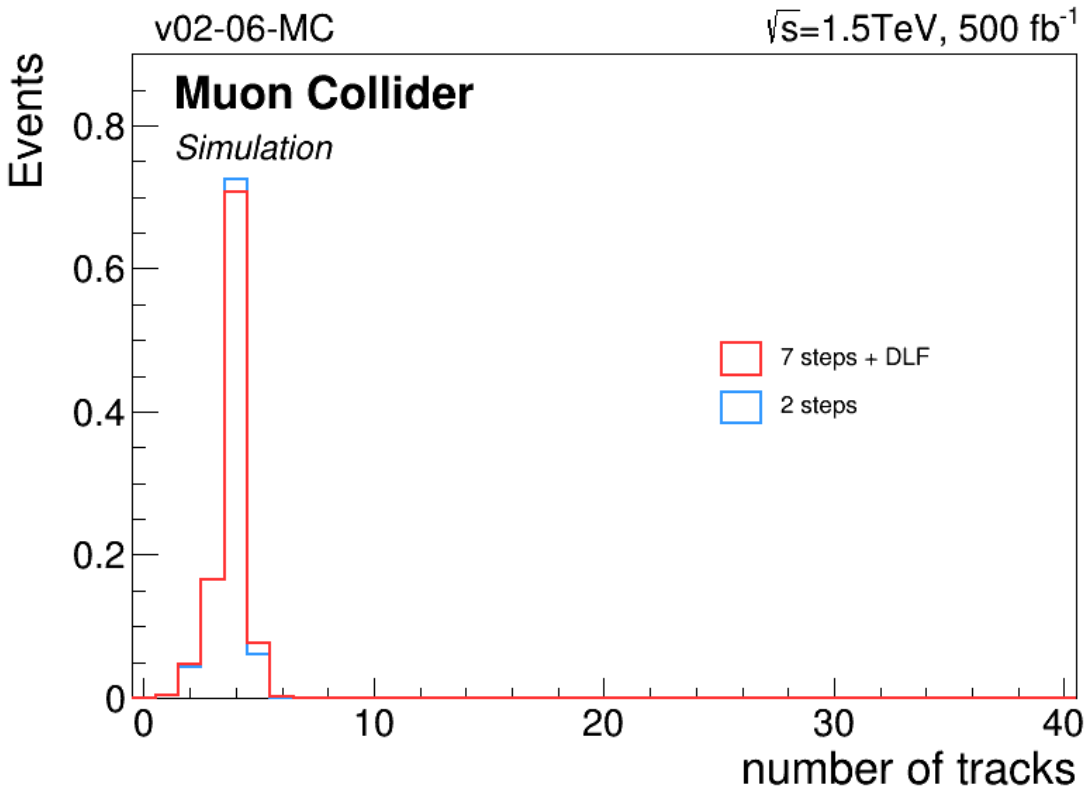
DLF: Double Layer Filter

$\sqrt{s}$ = 1.5 TeV

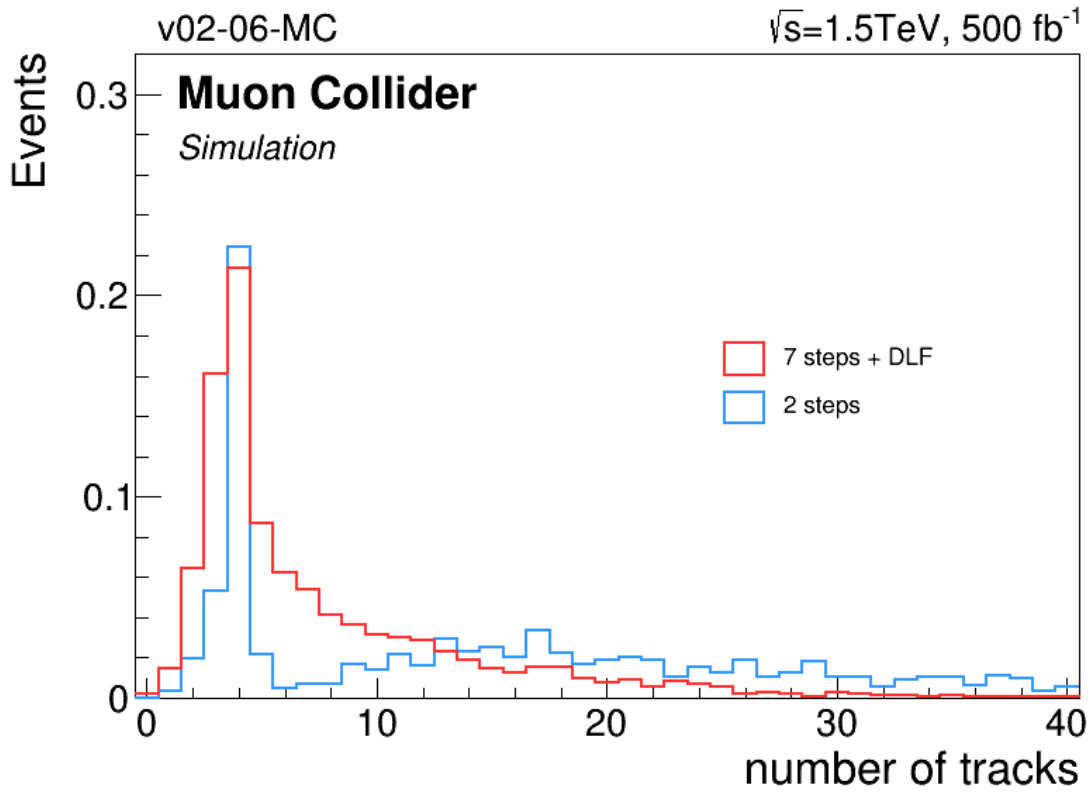
Software release: v02-06-MC

Number of reconstructed tracks per event

Only SIGNAL

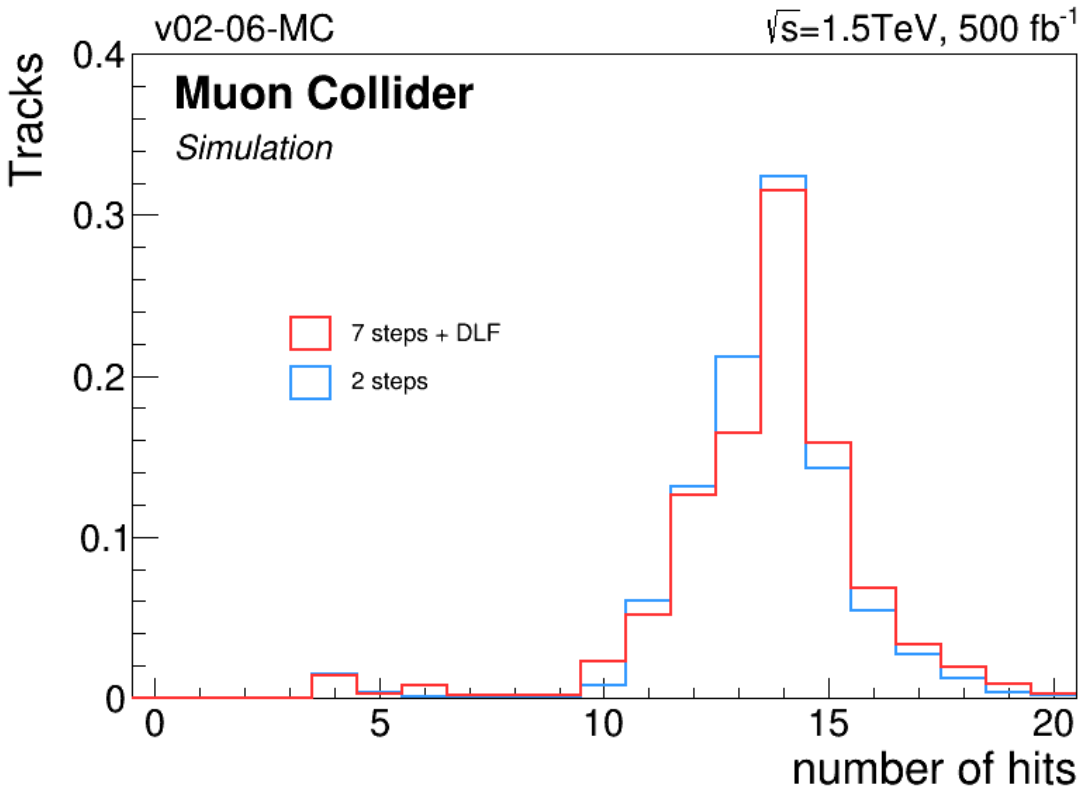


SIGNAL + BIB

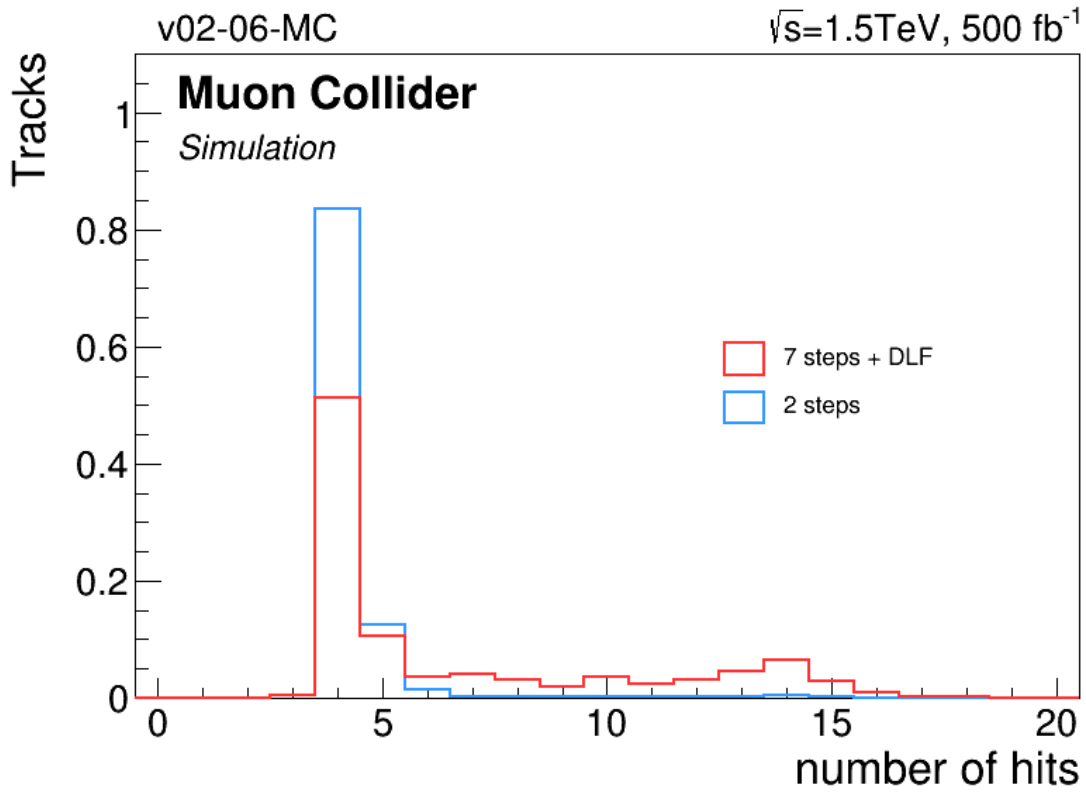


Number of hits per track

Only SIGNAL



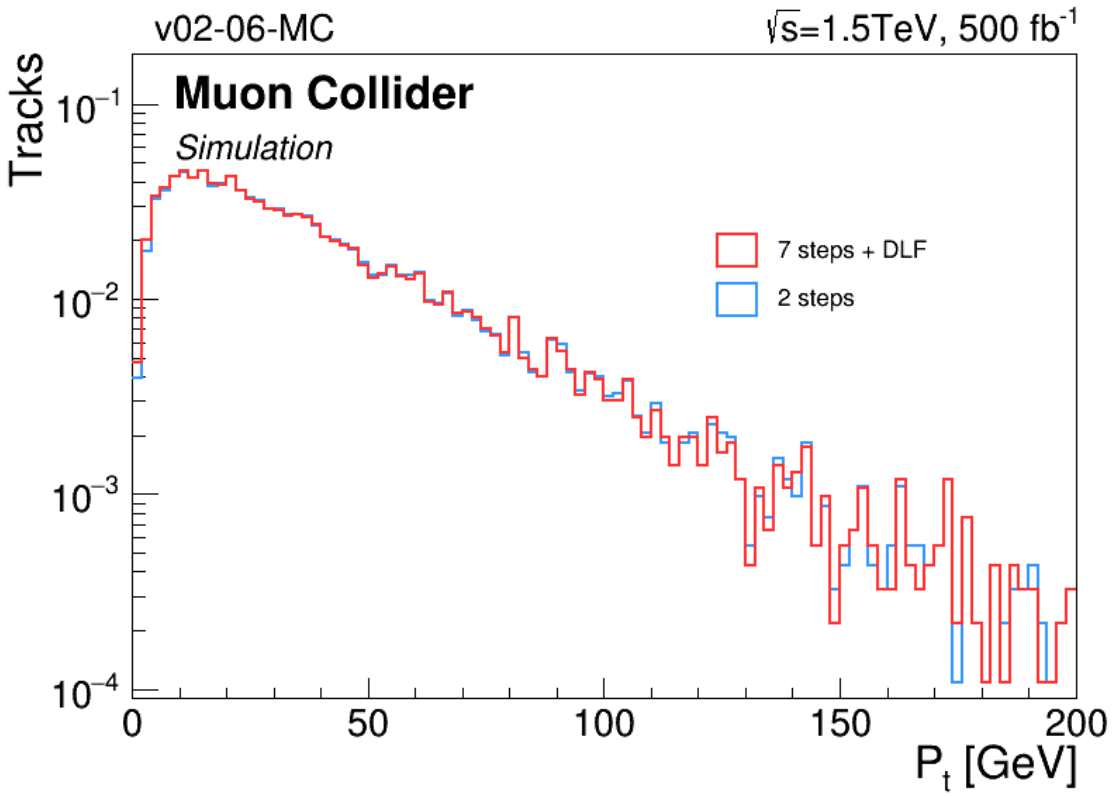
SIGNAL + BIB



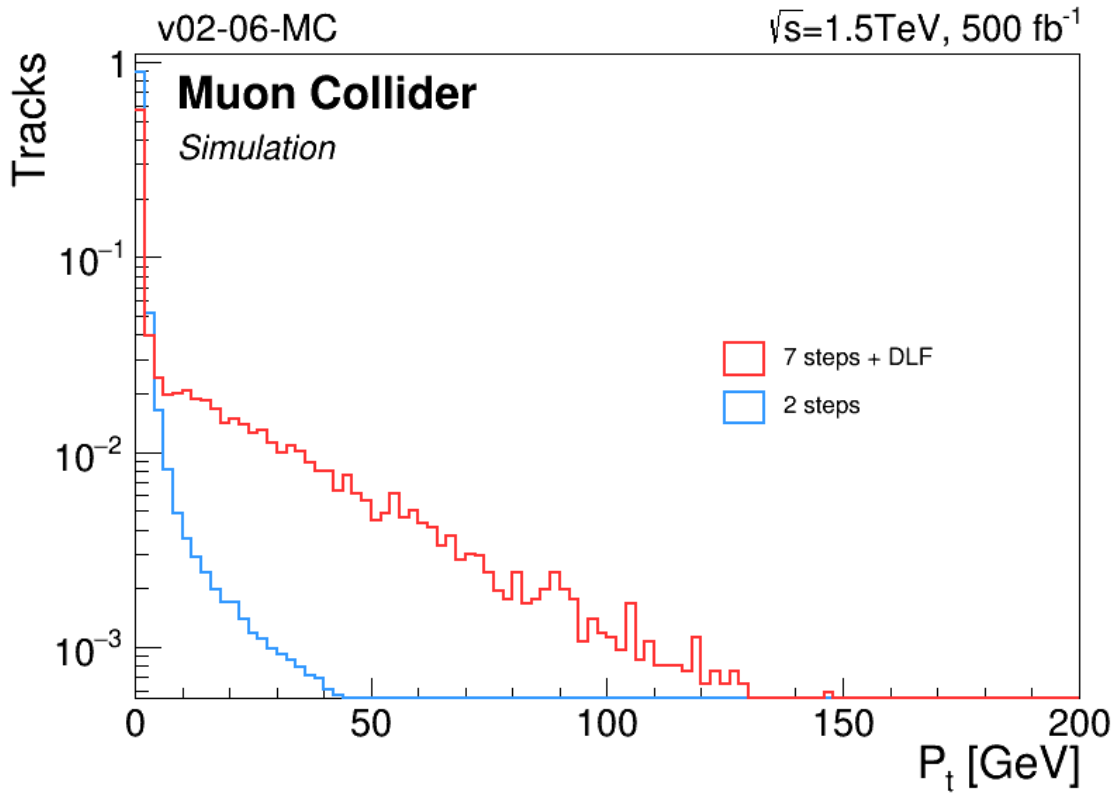
Cut: #hits > 4

Track transverse momentum

Only SIGNAL



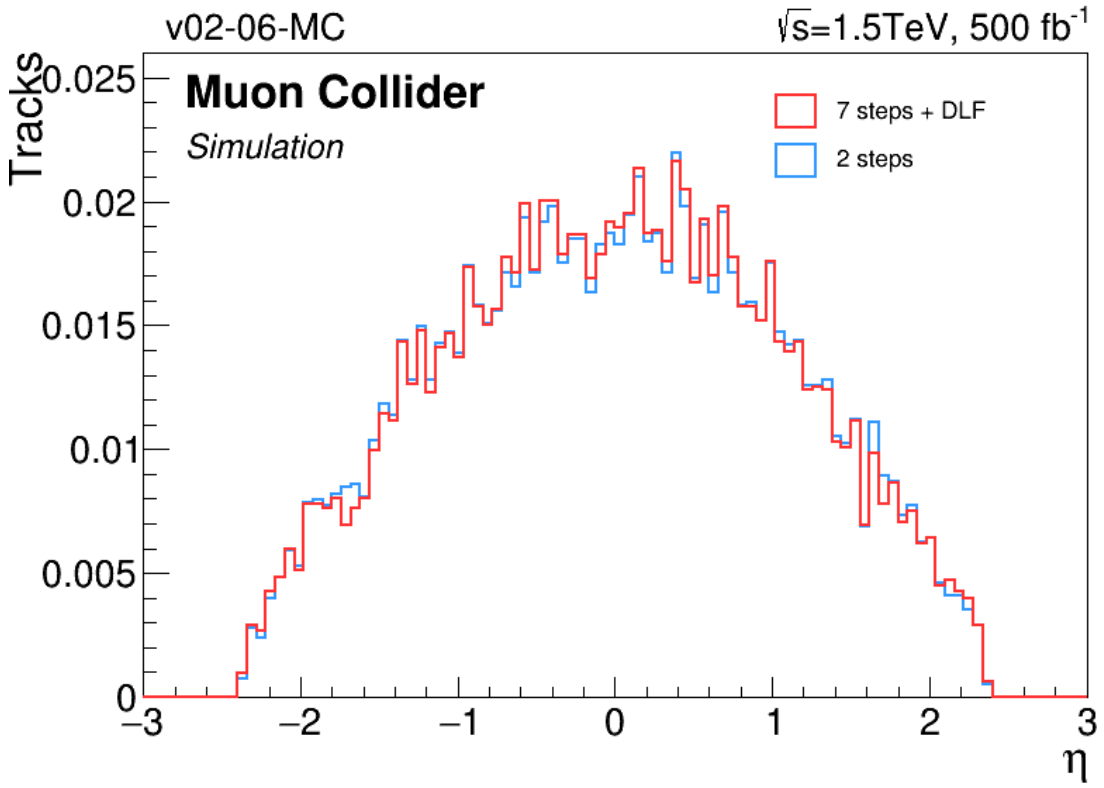
SIGNAL + BIB



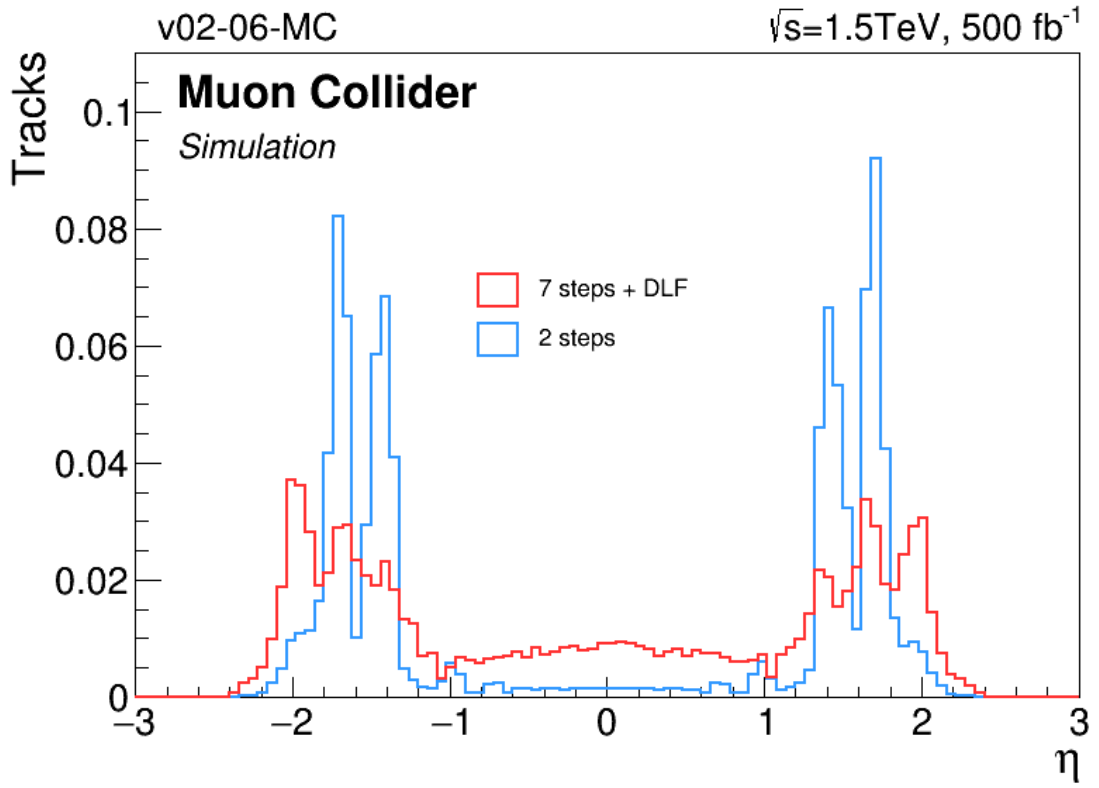
Cut: Pt > 5 GeV

Track pseudorapidity

Only SIGNAL



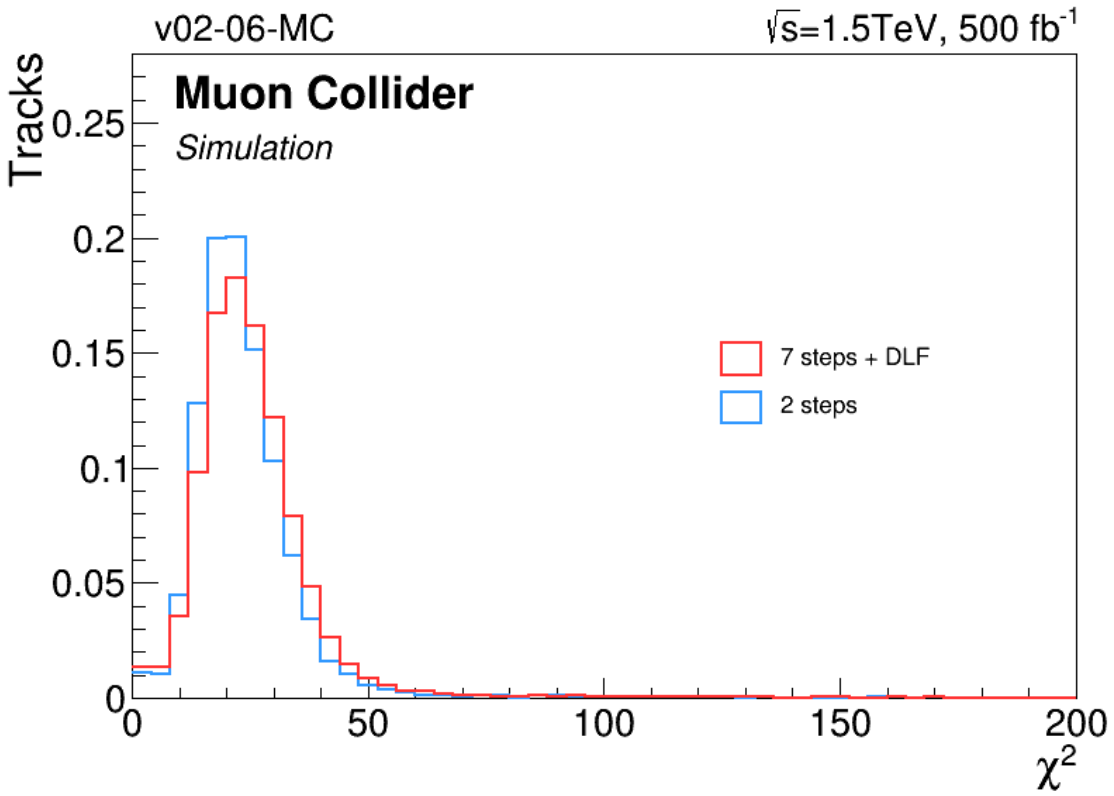
SIGNAL + BIB



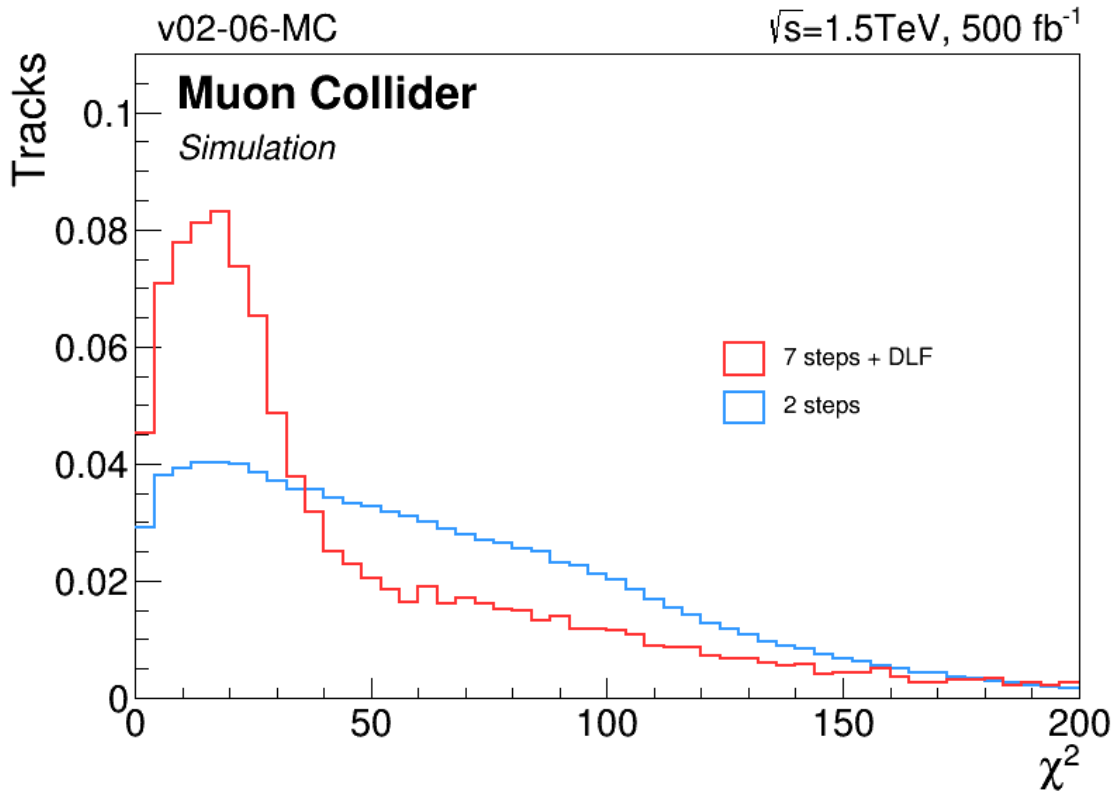
Cut: $\eta < 2.5$

Track Chi Square

Only SIGNAL



SIGNAL + BIB



Cut: $\chi^2 < 60$

Track selection

7 steps + DLF

	#tracks	err	Absolute efficiency	err	Relative efficiency	err
			ONLY SIGNAL			
reco	9334					
$\eta < 2.5$	9334	96.61	1	0	1	0
$Pt > 5GeV$	8960	94.66	0.9599	0.0021	0.9599	0.0020
$\chi^2 < 60$	8774	93.67	0.9400	0.0025	0.9792	0.0015
$hits > 4$	8687	93.20	0.9307	0.0026	0.9900	0.0011
			SIG + BIB			
reco	18748					
$\eta < 2.5$	18743	136.91	0.9997	0.0001	0.9997	0.0001
$Pt > 5GeV$	7250	85.15	0.3867	0.0036	0.3868	0.0036
$\chi^2 < 60$	6135	78.33	0.3272	0.0034	0.8462	0.0042
$hits > 4$	5889	76.74	0.3141	0.0034	0.9599	0.0025

	Evts with at least 4 selected tracks	percentage
SIG	1520	62%
SIG + BIB	328	13%

2 steps

	#tracks	err	Absolute efficiency	err	Relative efficiency	err
			ONLY SIGNAL			
reco	9293					
$\eta < 2.5$	9293	96.40	1	0	1	0
$Pt > 5GeV$	8957	94.64	0.9638	0.0019	0.9638	0.0019
$\chi^2 < 60$	8811	93.87	0.9481	0.0023	0.9837	0.0013
$hits > 4$	8680	93.17	0.9340	0.0026	0.9851	0.0013
			SIG + BIB			
reco	418868					
$\eta < 2.5$	418800	647.15	0.9998	0.0001	0.9998	0.0001
$Pt > 5GeV$	22487	149.96	0.0537	0.0003	0.0537	0.0003
$\chi^2 < 60$	12672	112.57	0.0303	0.0002	0.5635	0.0033
$hits > 4$	8124	90.13	0.01940	0.0002	0.6411	0.0043

	Evts with at least 4 selected tracks	percentage
SIG	1544	63%
SIG + BIB	1190	49%

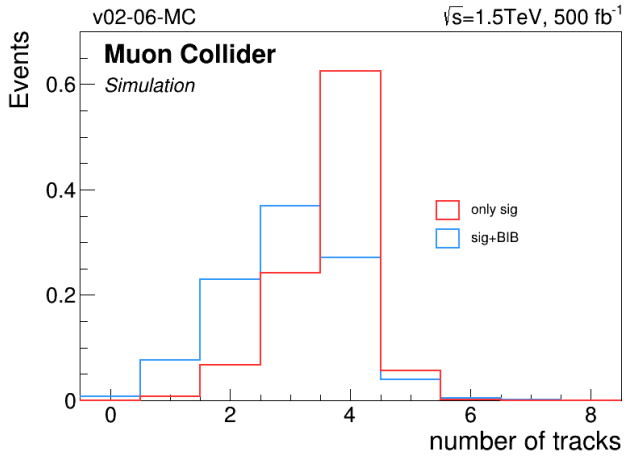
Number of tracks per event after applying cuts

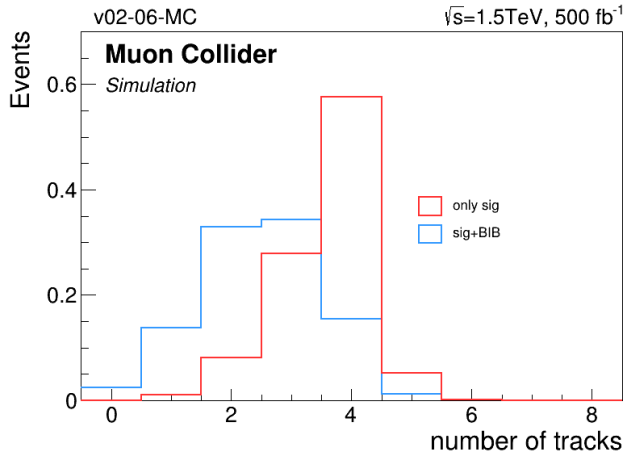
$\eta < 2.5 \; + \; Pt > 5GeV$

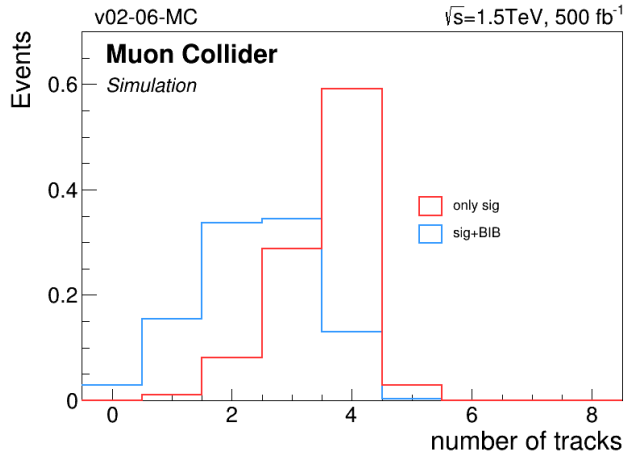
$+ \; \chi^2 < 60$

$+ \; number \; of \; hits > 4$

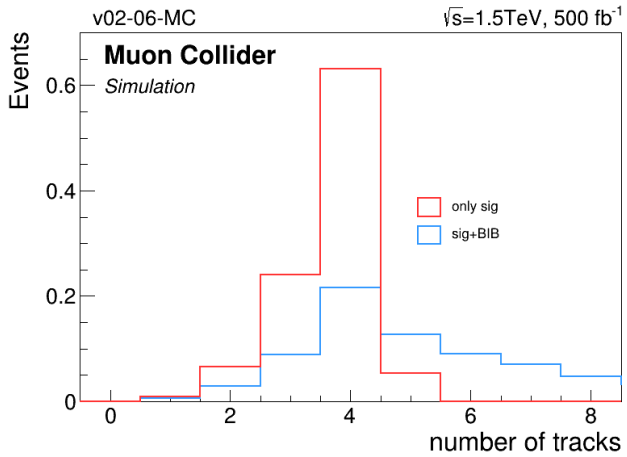
7 steps + DLF

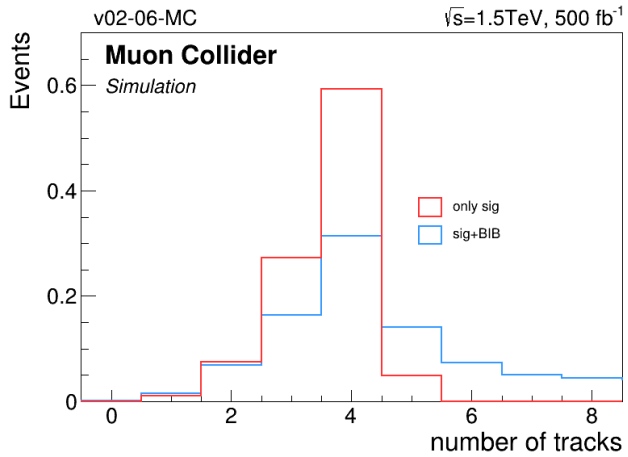


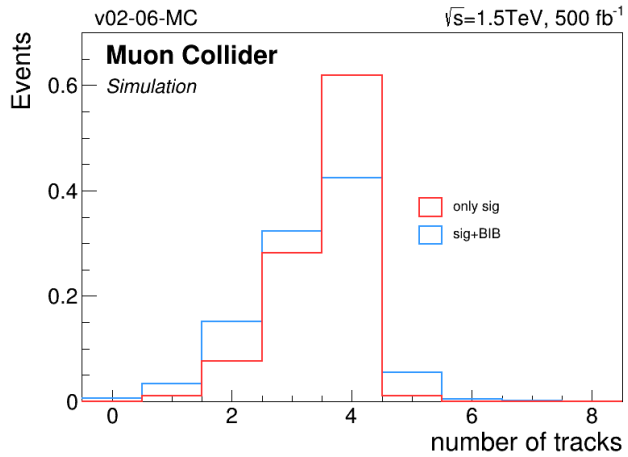




2 steps

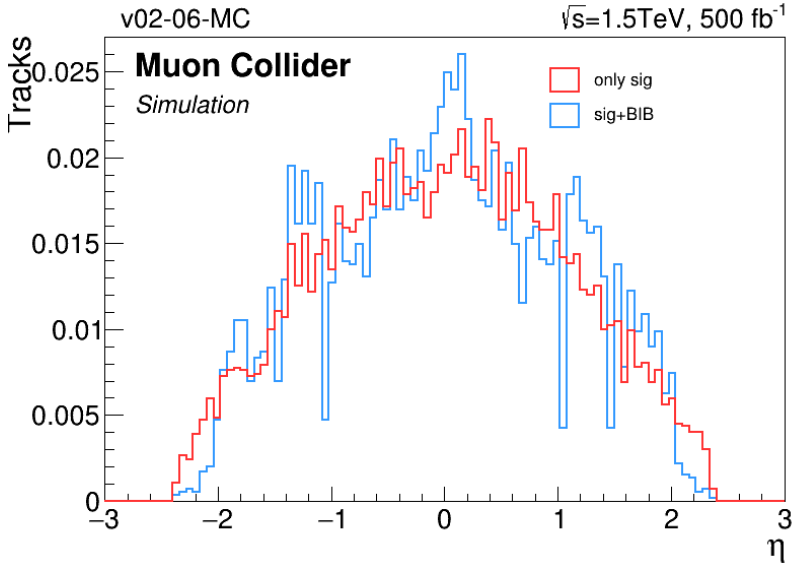


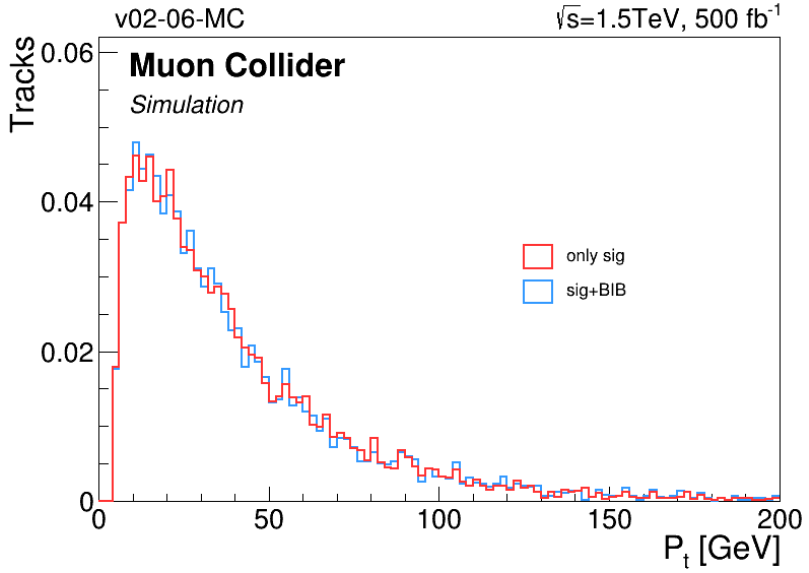




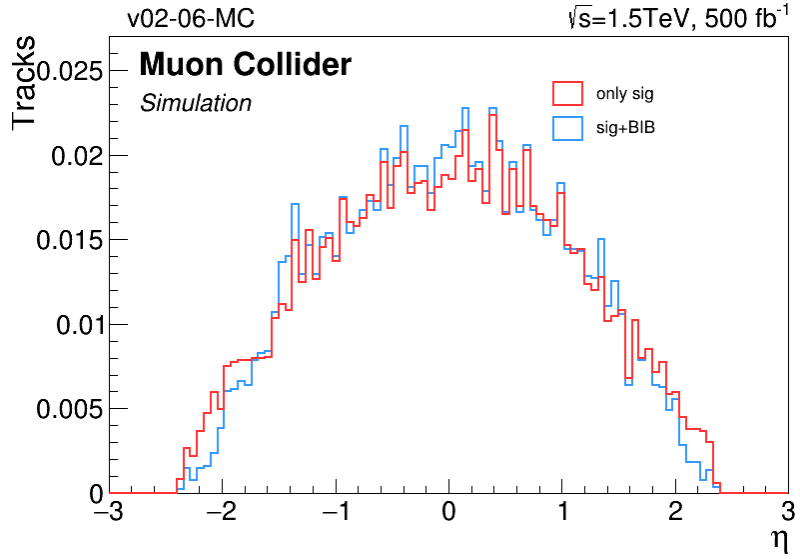
Transverse momentum and pseudorapidity distributions after applying cuts

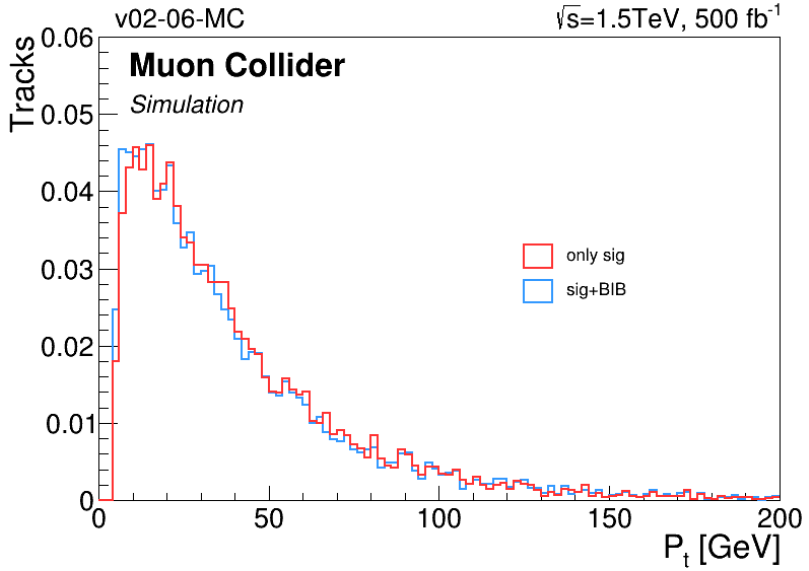
7 steps + DLF





2 steps



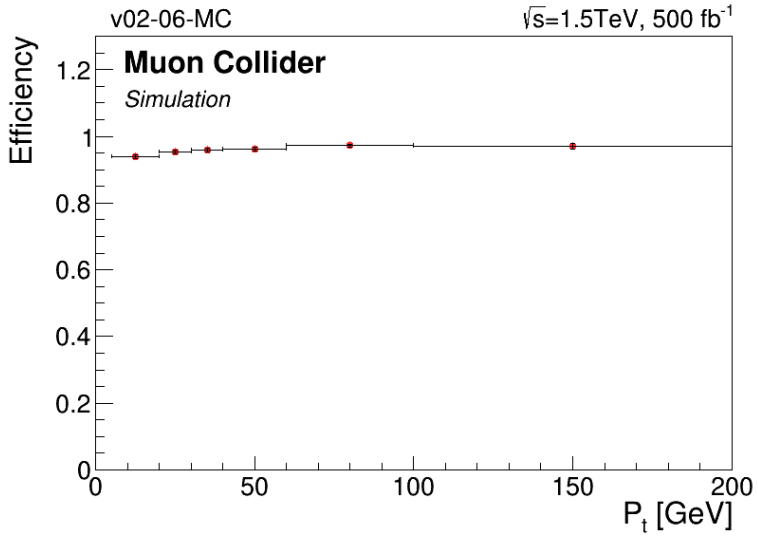


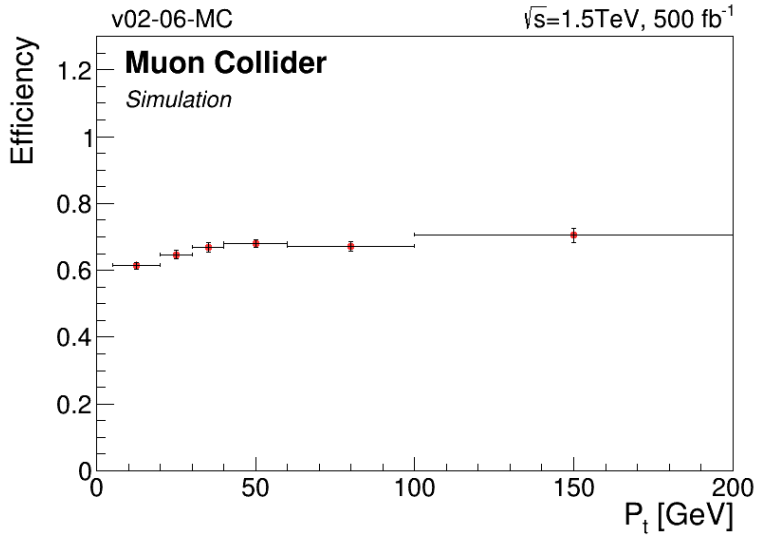
Reconstruction efficiency vs Pt

Only SIGNAL

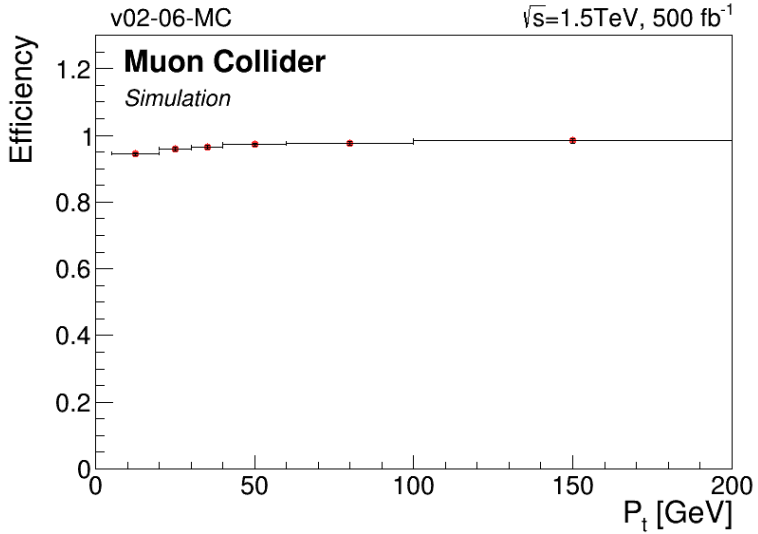
SIGNAL + BIB

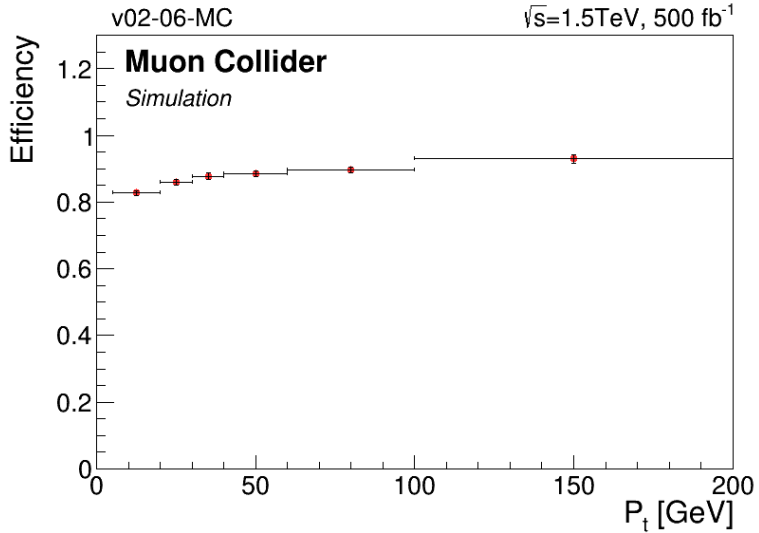
7 steps + DLF





2 steps



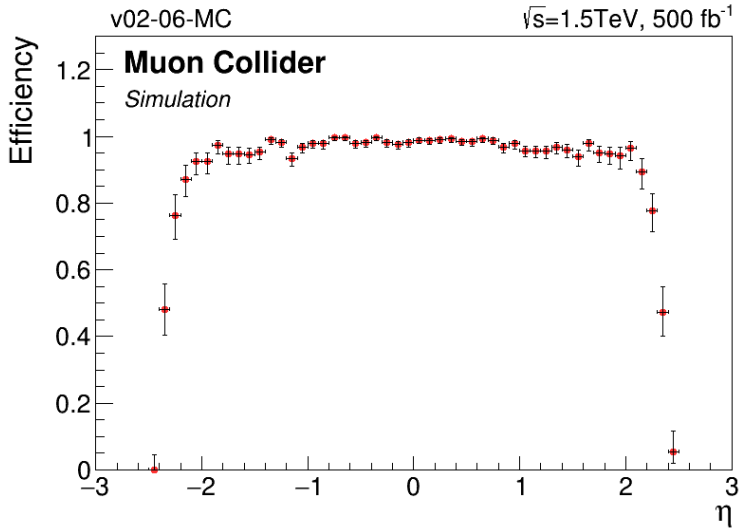


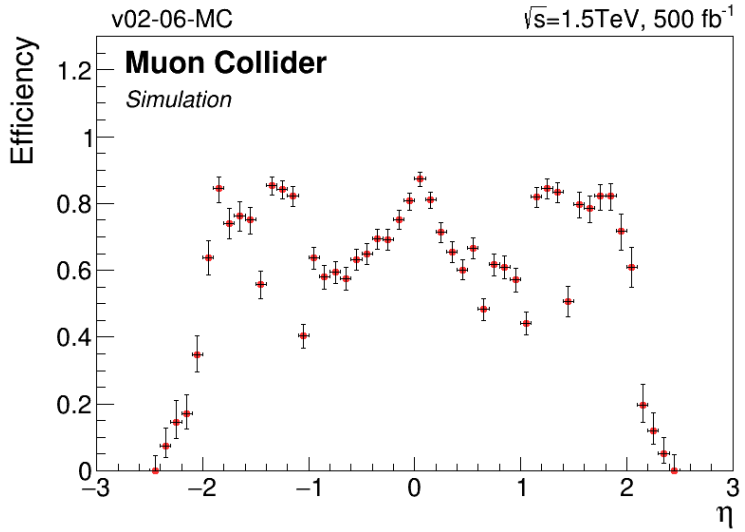
Reconstruction efficiency vs η

Only SIGNAL

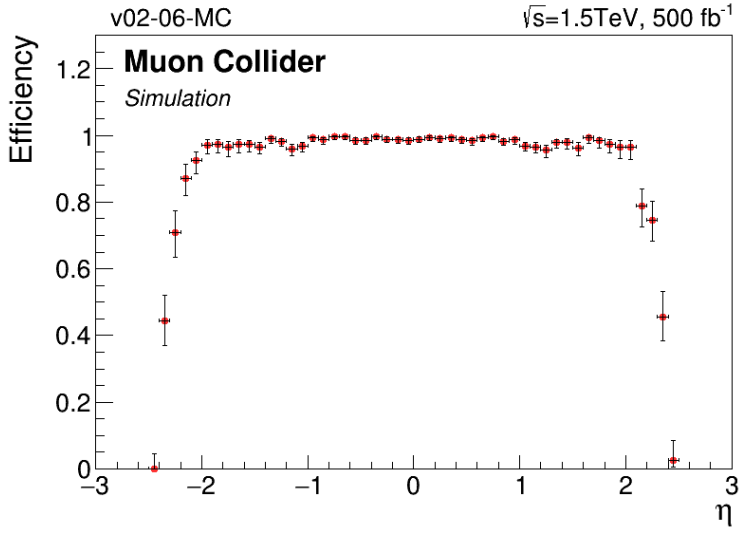
SIGNAL + BIB

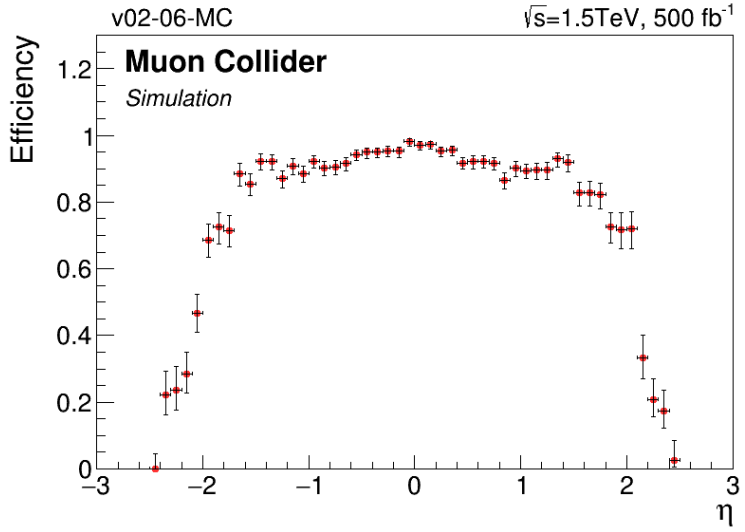
7 steps + DLF





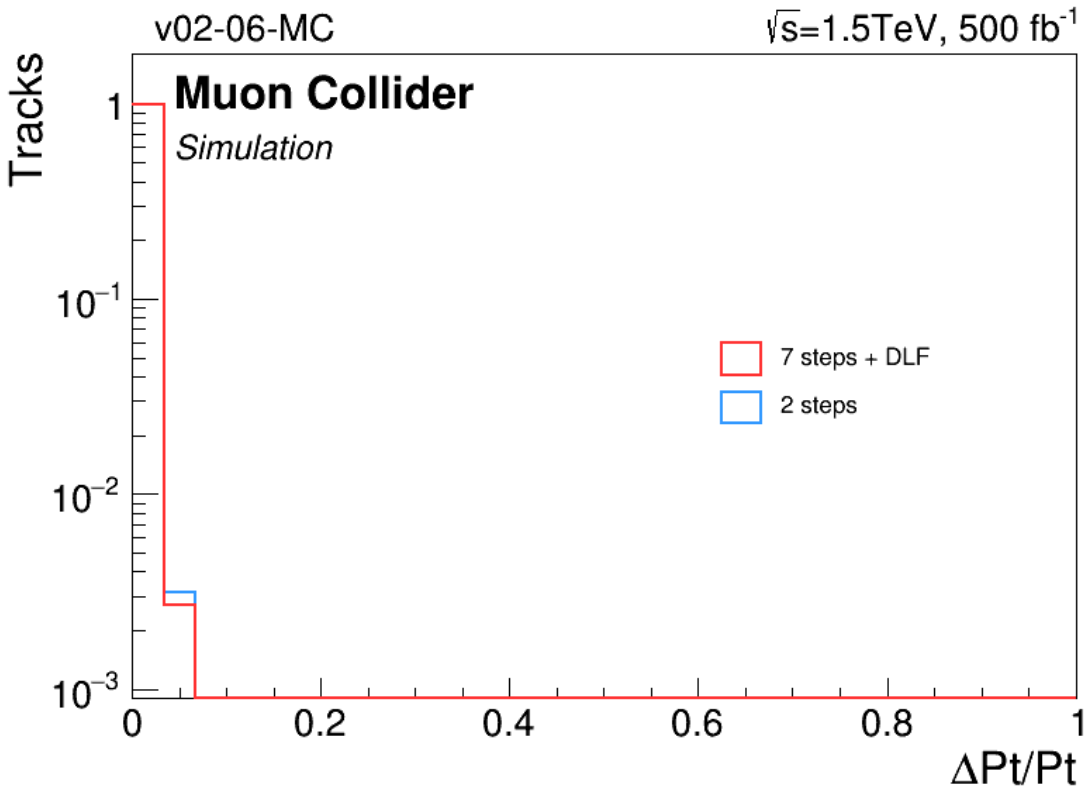
2 steps



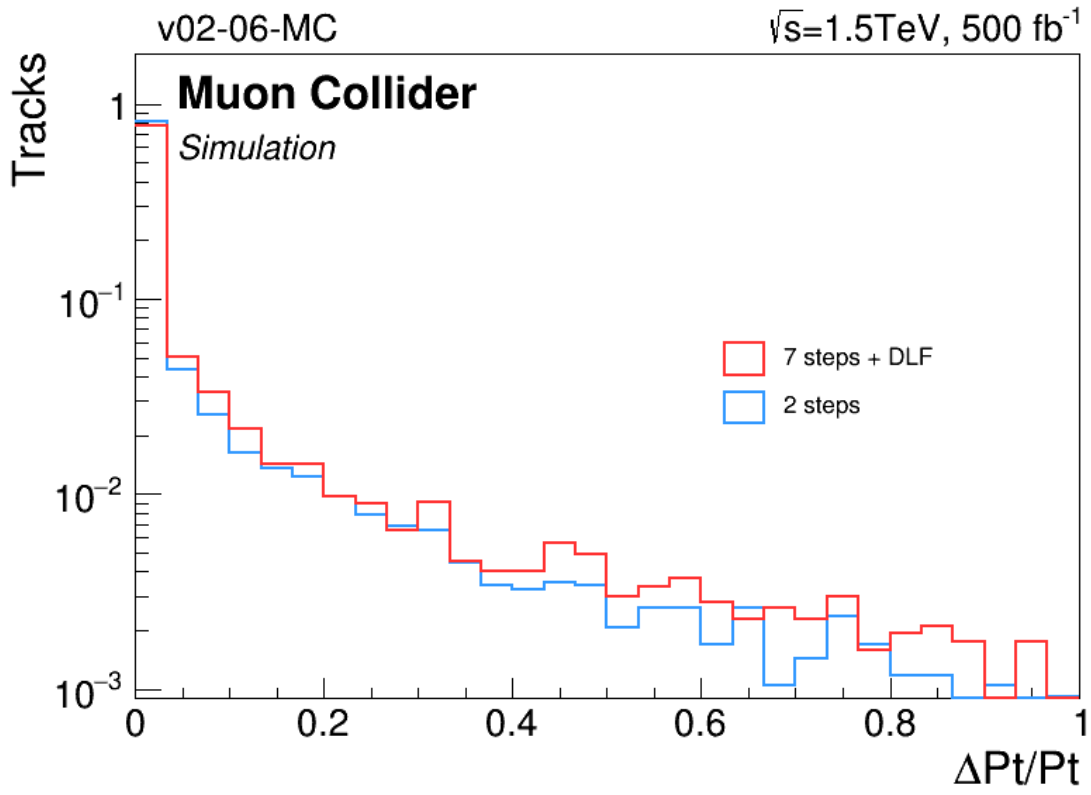


Generated muon– Reco Track Transverse Momentum

Only SIGNAL



SIGNAL + BIB



Comparison between tracks reconstructed with and without the cone filter for hits

cone filter

7 steps + DLF

No cone filter

	#tracks	err	Absolute efficiency	err	Relative efficiency	err
			ONLY SIGNAL			
reco	9334					
$\eta < 2.5$	9334	96.61	1	0	1	0
$Pt > 5GeV$	8960	94.66	0.9599	0.0021	0.9599	0.0020
$\chi^2 < 60$	8774	93.67	0.9400	0.0025	0.9792	0.0015
$hits > 4$	8687	93.20	0.9307	0.0026	0.9900	0.0011

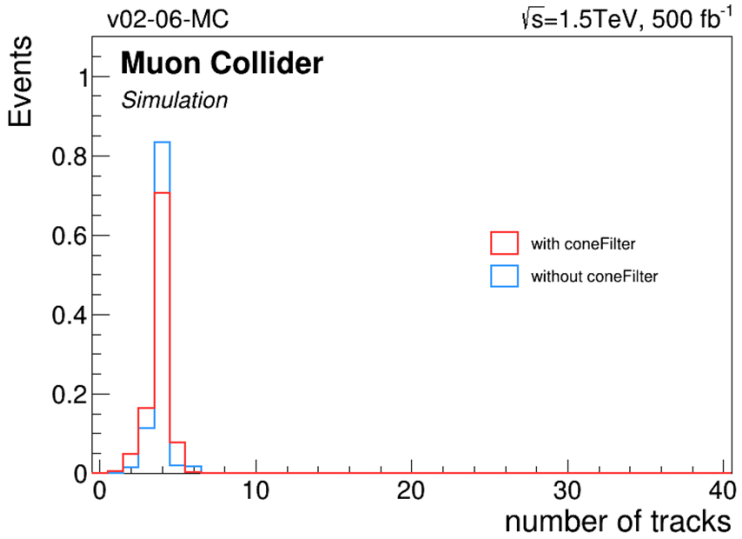
	Evts with at least 4 selected tracks	percentage
SIG	1520	62%

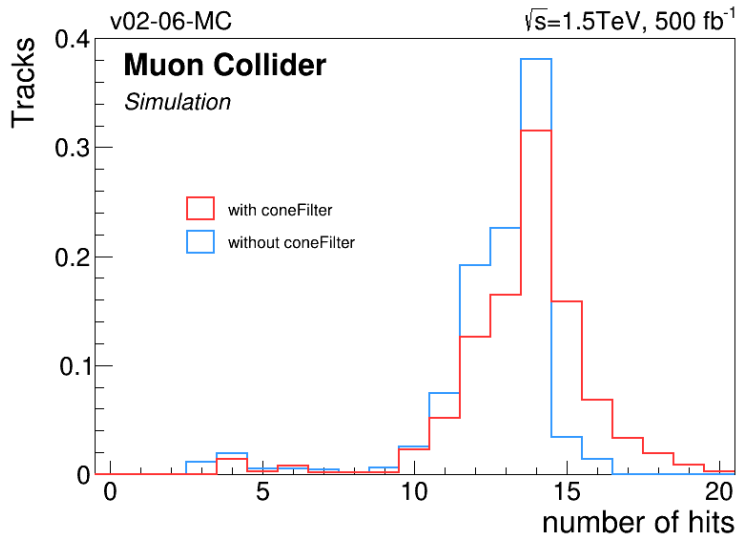
	#tracks	err	Absolute efficiency	err	Relative efficiency	err
			ONLY SIGNAL			
reco	9596					
$\eta < 2.5$	9477	97.35	0.9876	0.0011	0.9876	0.0011
$Pt > 5GeV$	8944	94.57	0.9321	0.0026	0.9438	0.0024
$\chi^2 < 60$	8889	94.28	0.9263	0.0027	0.9939	0.0008
$hits > 4$	8843	94.04	0.9215	0.0027	0.9948	0.0008

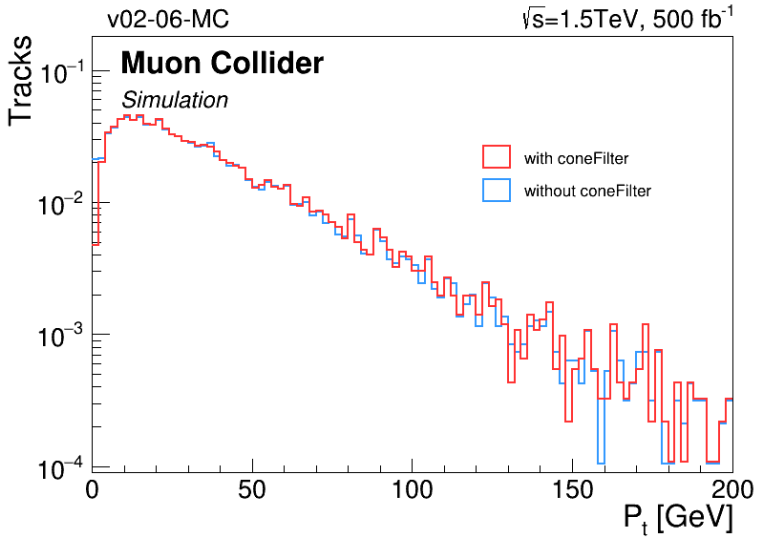
	Evts with at least 4 selected tracks	percentage
SIG	1646	67%

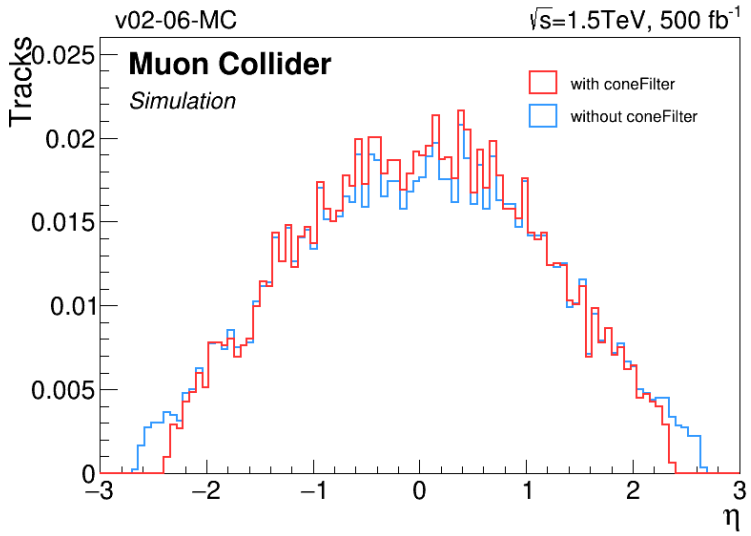
Only SIGNAL - 7 steps + DLF

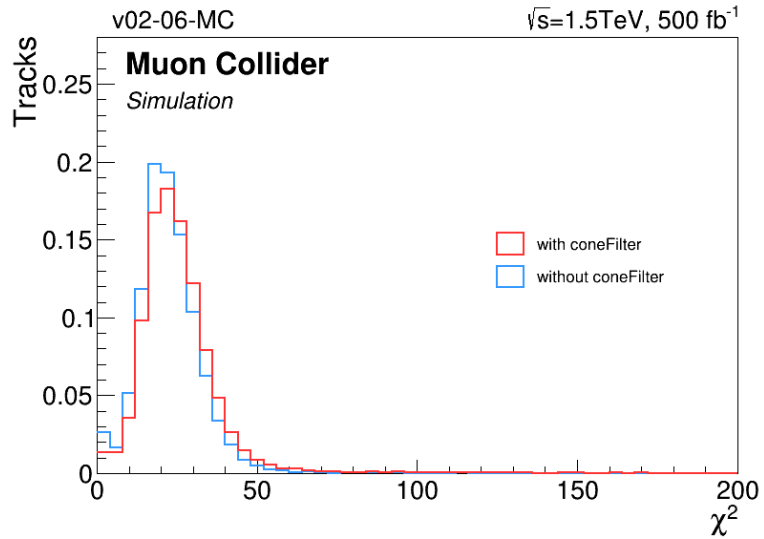
Comparison between tracks reconstructed with and without the cone filter for hits











Conclusions

Preliminary study:

- When reconstructing only signal events, the two algorithm configurations seem to have similar performances
- When reconstructing signal with BIB, the 2-steps algorithm configuration performs better than that of 7-steps + DLF
- The effect of the cone filter is minimal

Next steps:

- Increase statistics
- Evaluate the performance of muon reconstruction when BIB is considered
  A filter for calorimeter hits is needed

THANK YOU!!