Muon measurements with reduced magnetic field

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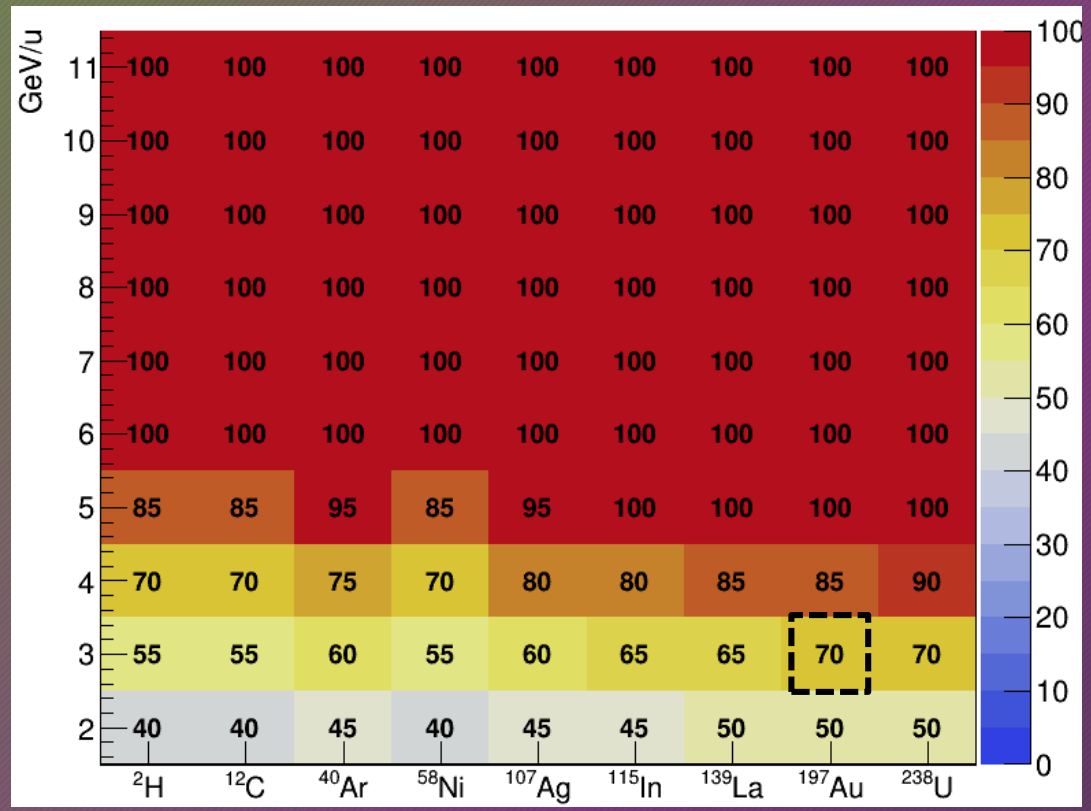
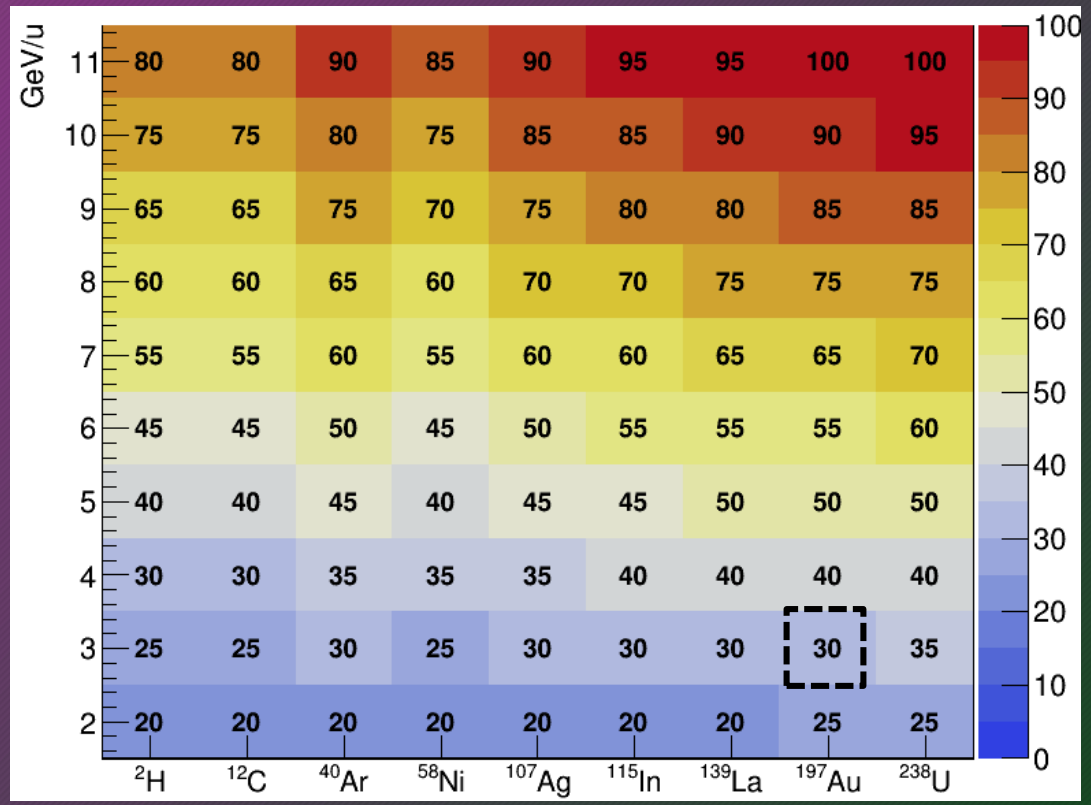
Motivation

Magnetic field scaling:

beam fits beam dump (max. possible field)



beam fits beam pipe tuned for Au beam @ 11 AGeV

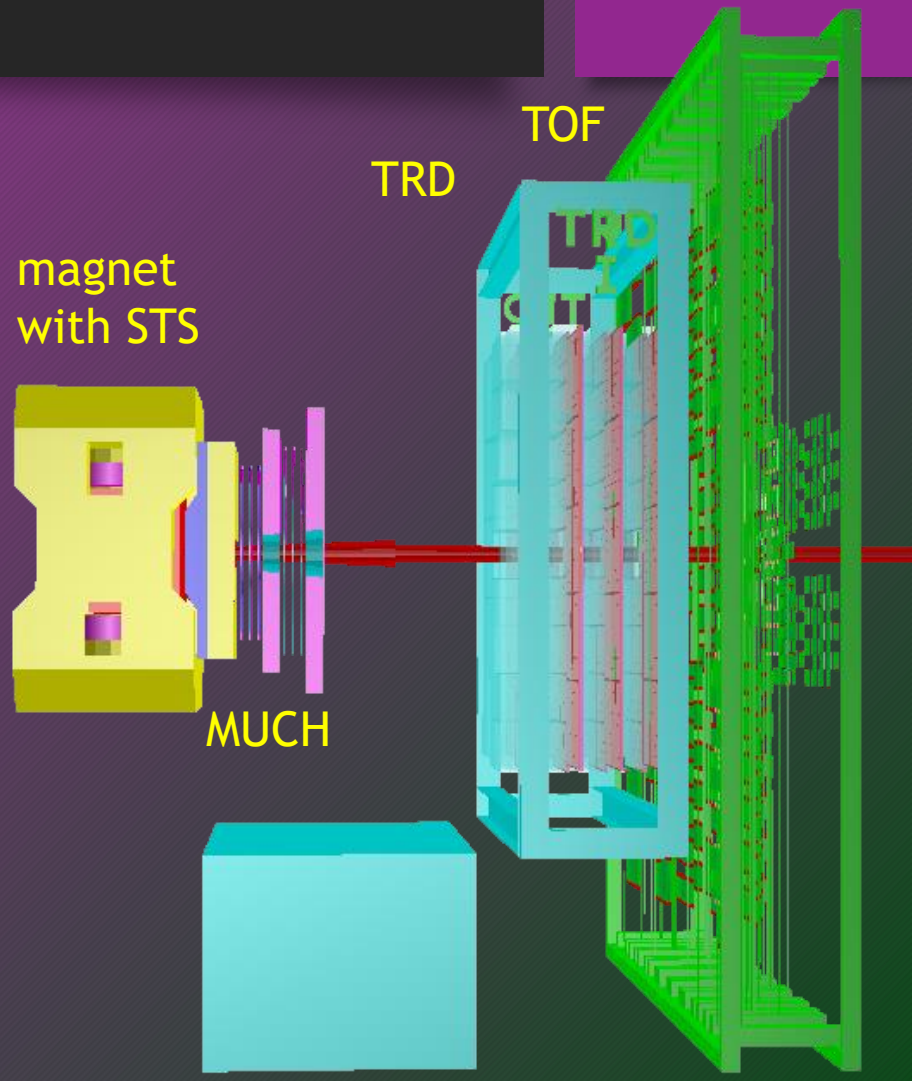


Outline

- Simulation input
- STS track reconstruction
- Muon reconstruction and analysis
- Conclusions

Simulation input and reconstruction

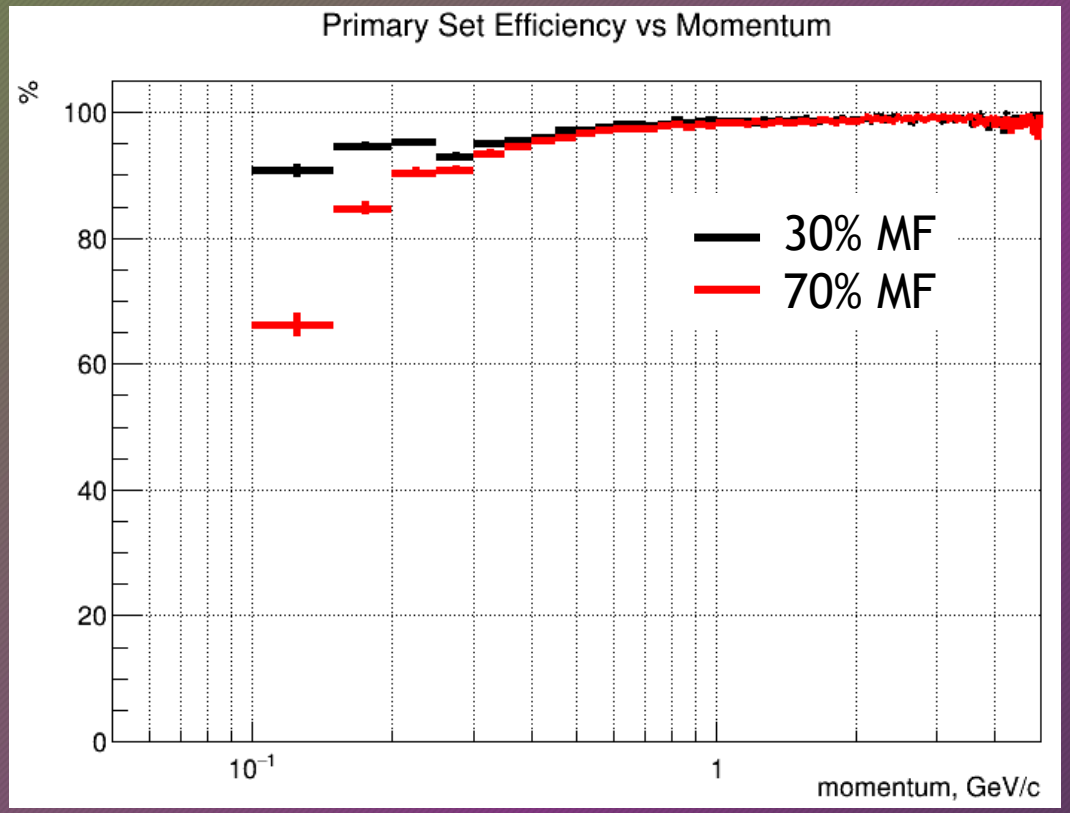
- CBMROOT release APR20
- background – UrQMD central Au+Au @ 4 A GeV/c
- ω→μμ generated by PLUTO (0.3 ω/event)
- magnetic field scaling (MF)
  - 30% (fixed beam pipe)
  - 70% (flexible beam pipe)
- short version of MUCH
  - 2 tracking stations
  - 3 absorbers
- ANN ID for muon track candidate selection



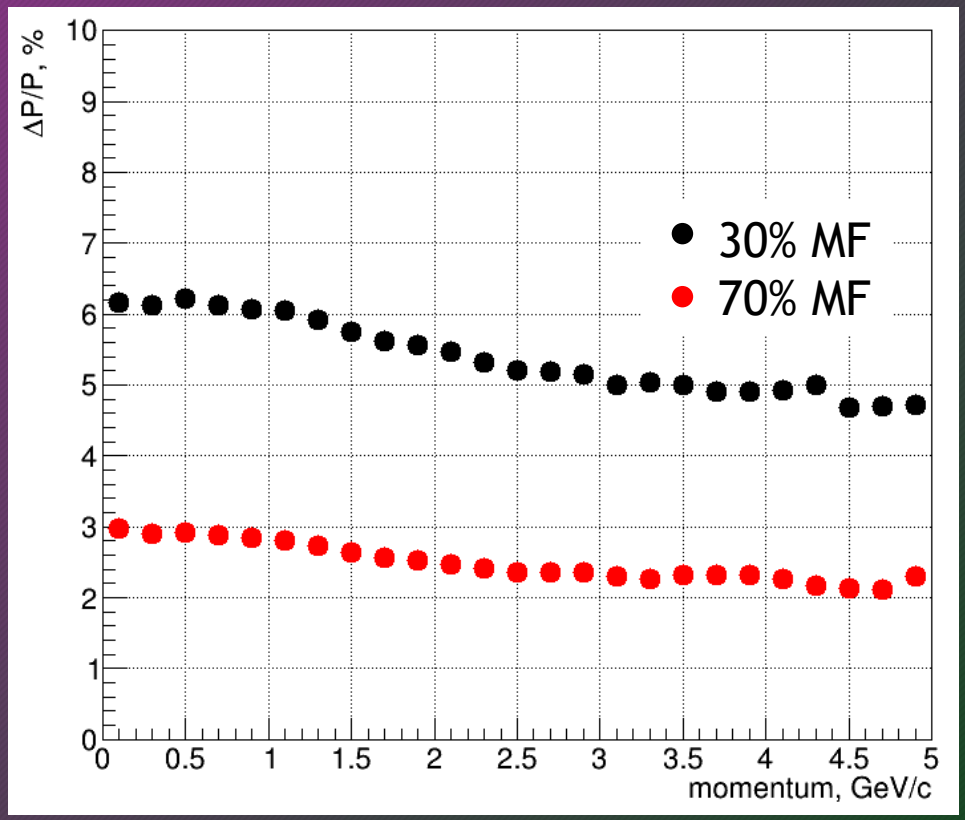
Reconstruction of primary tracks in STS

Au+Au @ 4 A GeV/c

Efficiency



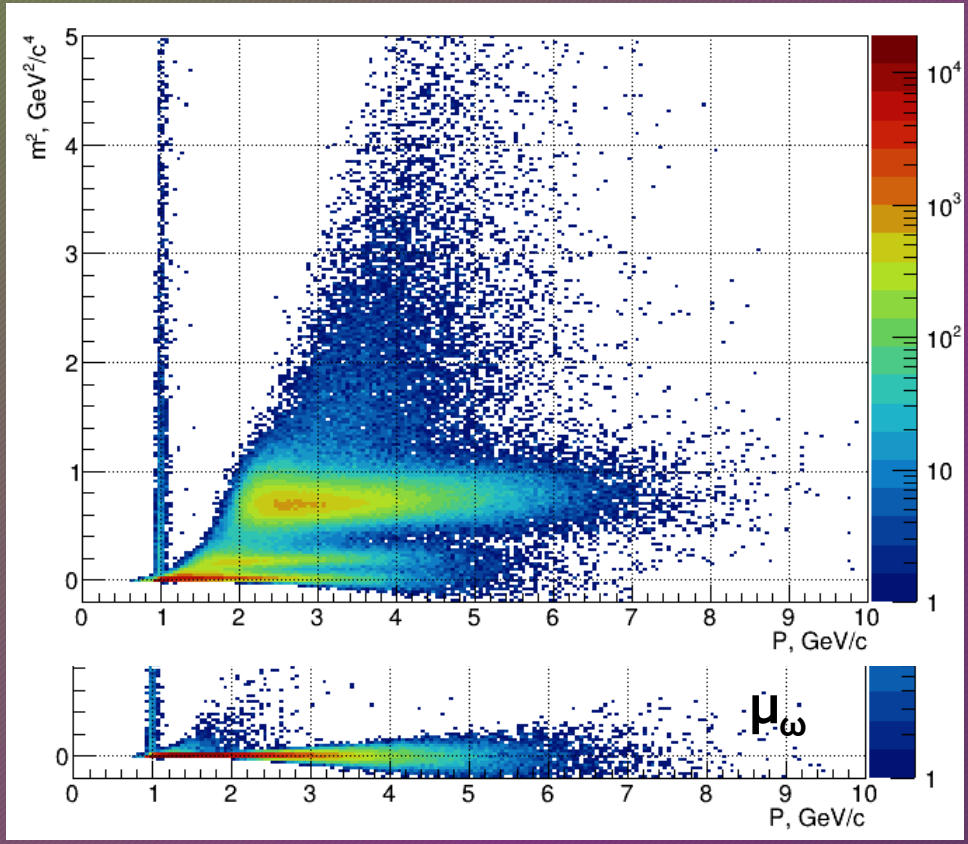
Momentum resolution



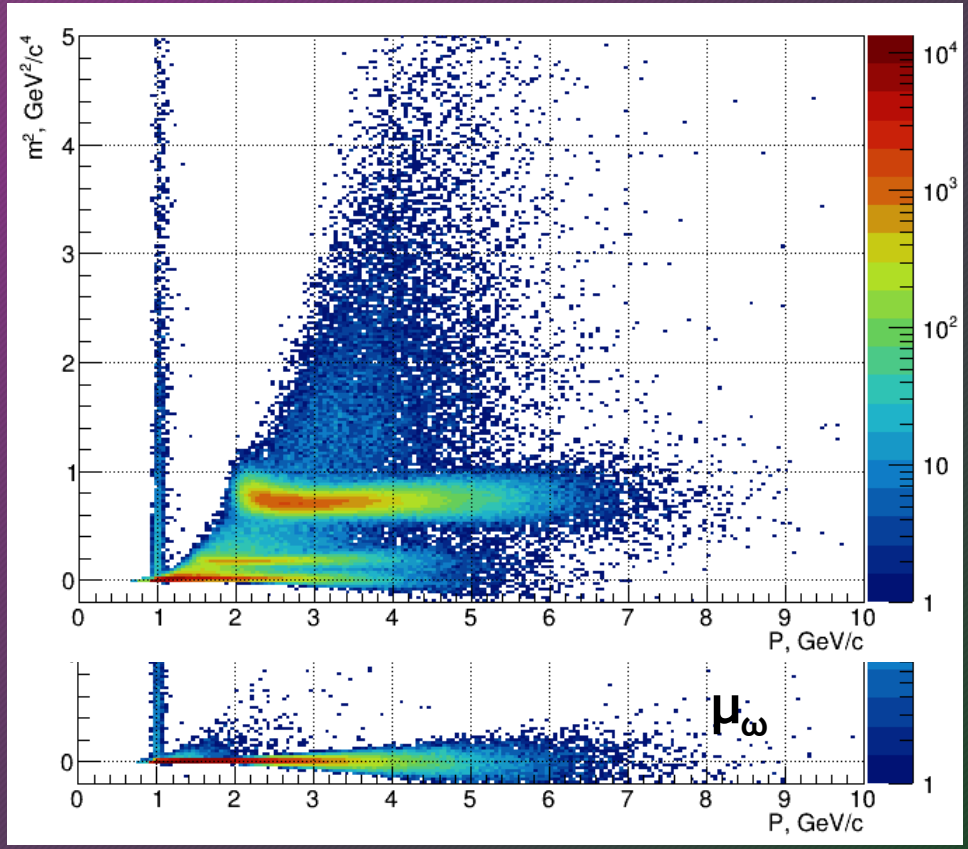
PID in TOF

Au+Au @ 4 A GeV/c

30% MF

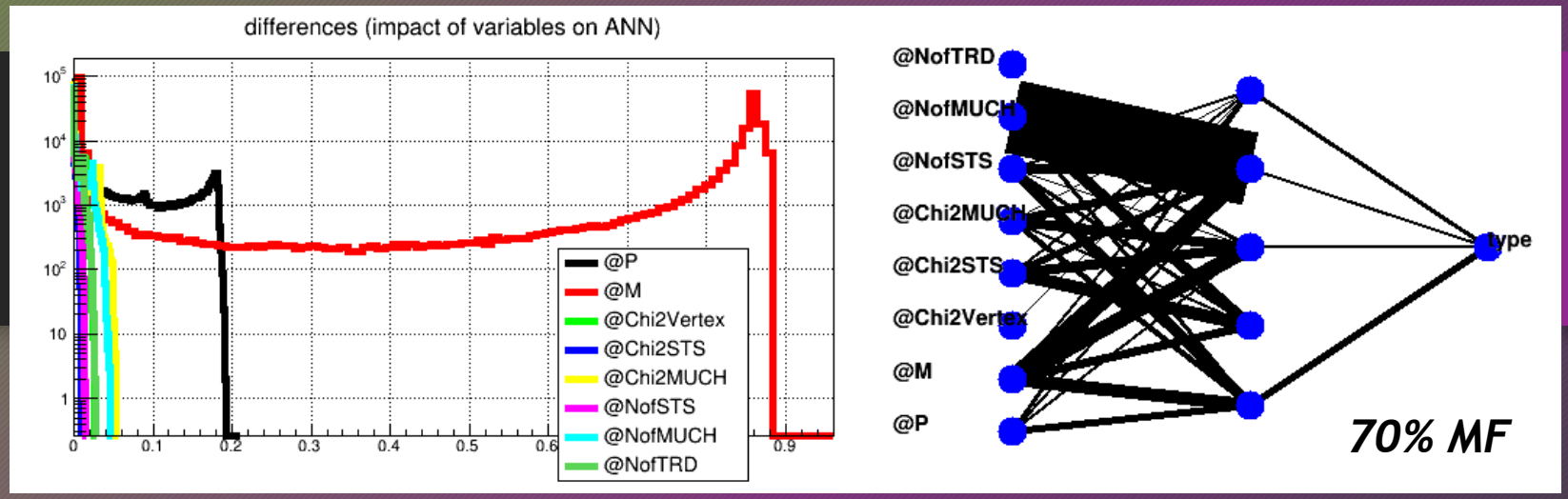


70% MF

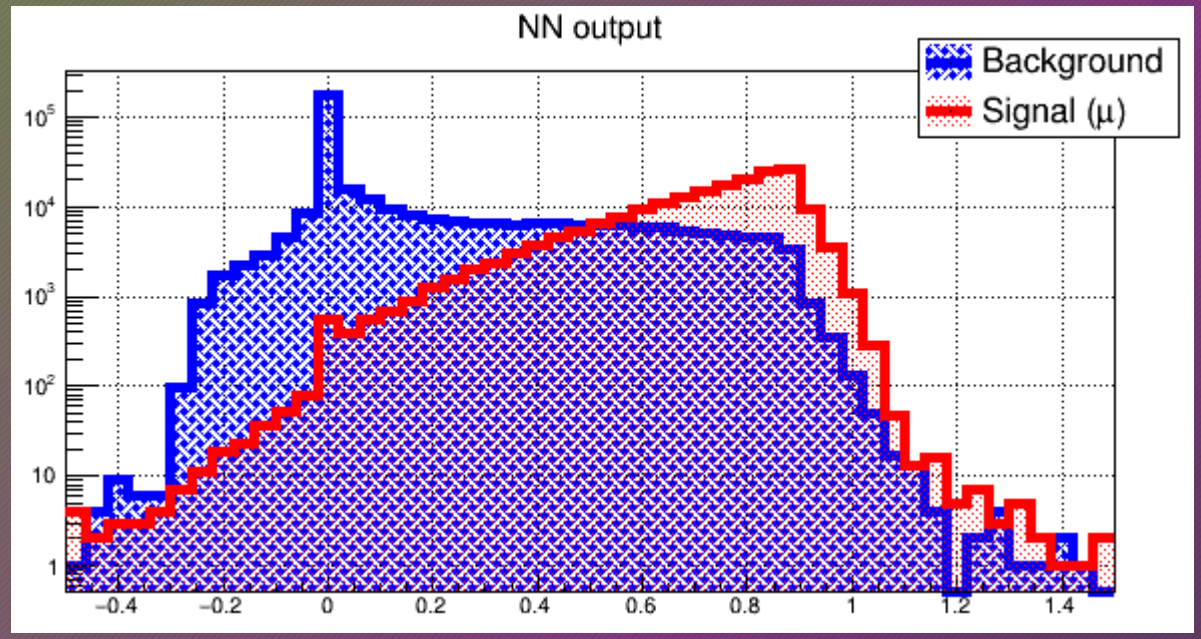


ANN PID

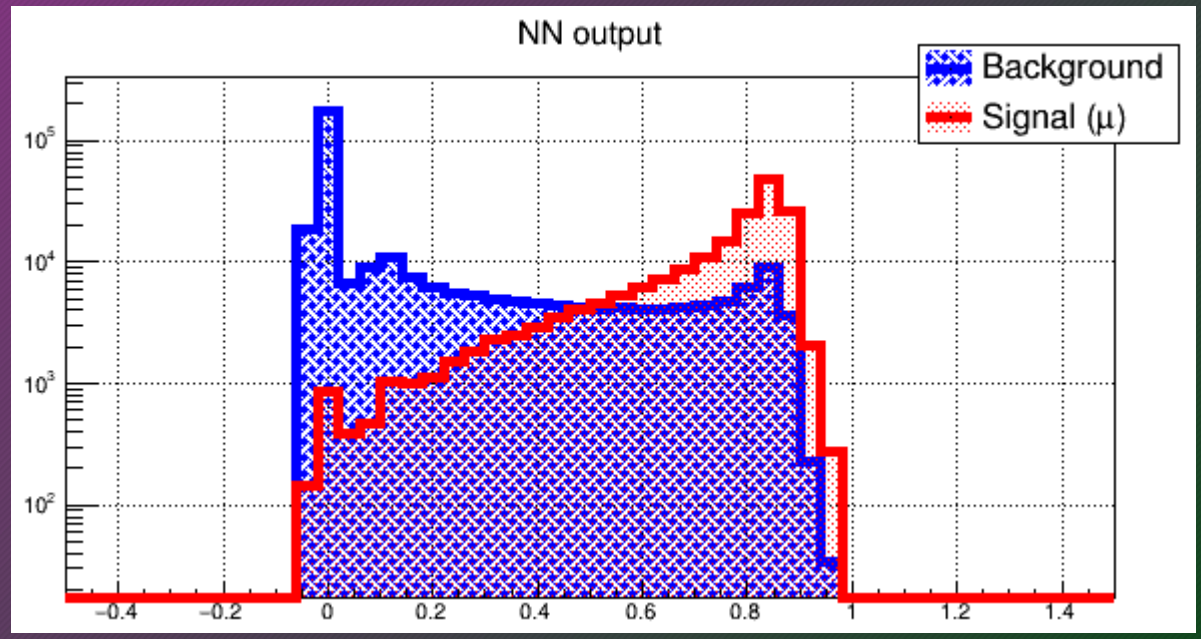
Au+Au @ 4 A GeV/c



30% MF



70% MF



Analysis results

Au+Au @ 4 A GeV/c

ANN ID > 0.76
σ_ω = 27.7 MeV/c^2

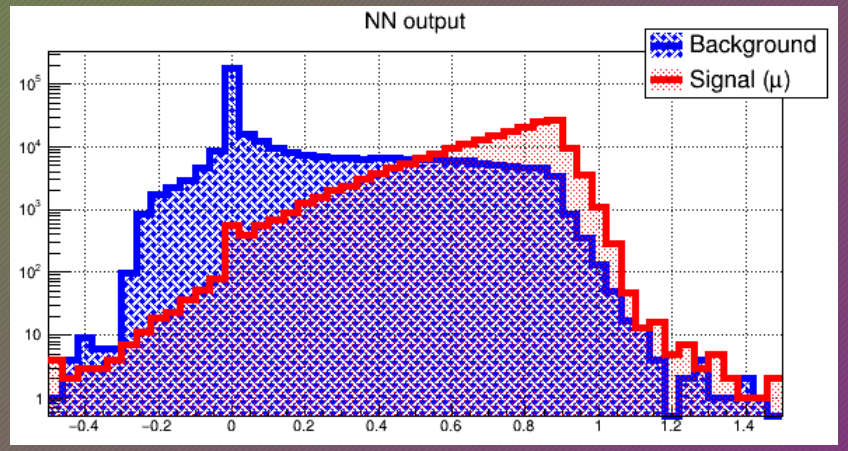
ANN ID > 0.8
σ_ω = 16.1 MeV/c^2

30% MF				70% MF			
ω/B ratio		ε_ω, %		ω/B ratio		ε_ω, %	
MC PID	Background subtraction	MC PID	Background subtraction	MC PID	Background subtraction	MC PID	Background subtraction
0.011	0.007	1.0	0.5	0.018	0.019	1.0	1.0

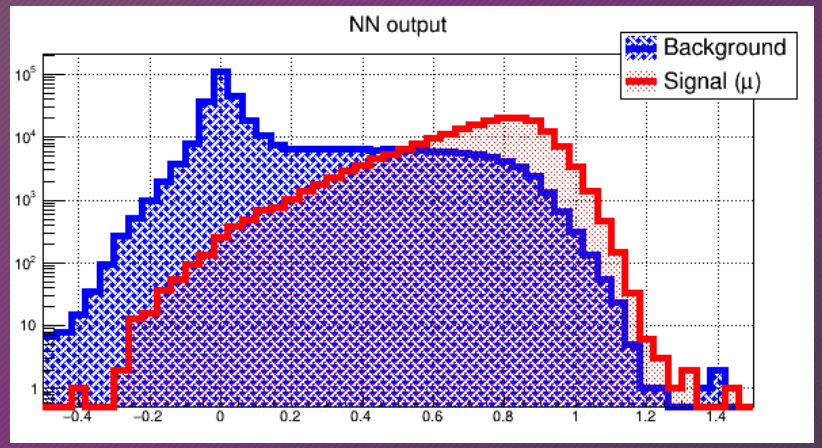
ANN PID for 30% MF scaling

Au+Au @ 4 A GeV/c

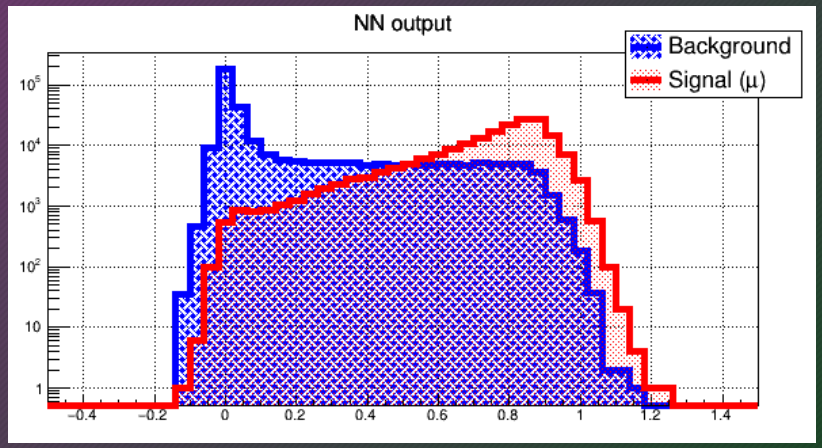
1 hidden layer (5 neurons)



1 hidden layer (16 neurons)



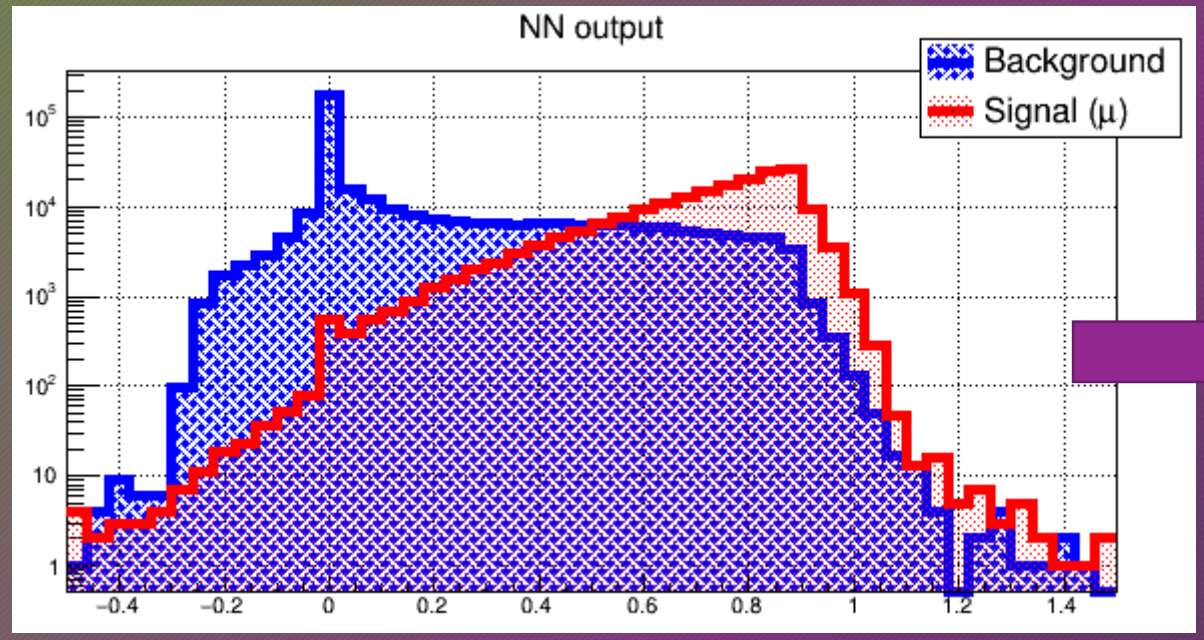
3 hidden layers (16, 8 and 4 neurons)



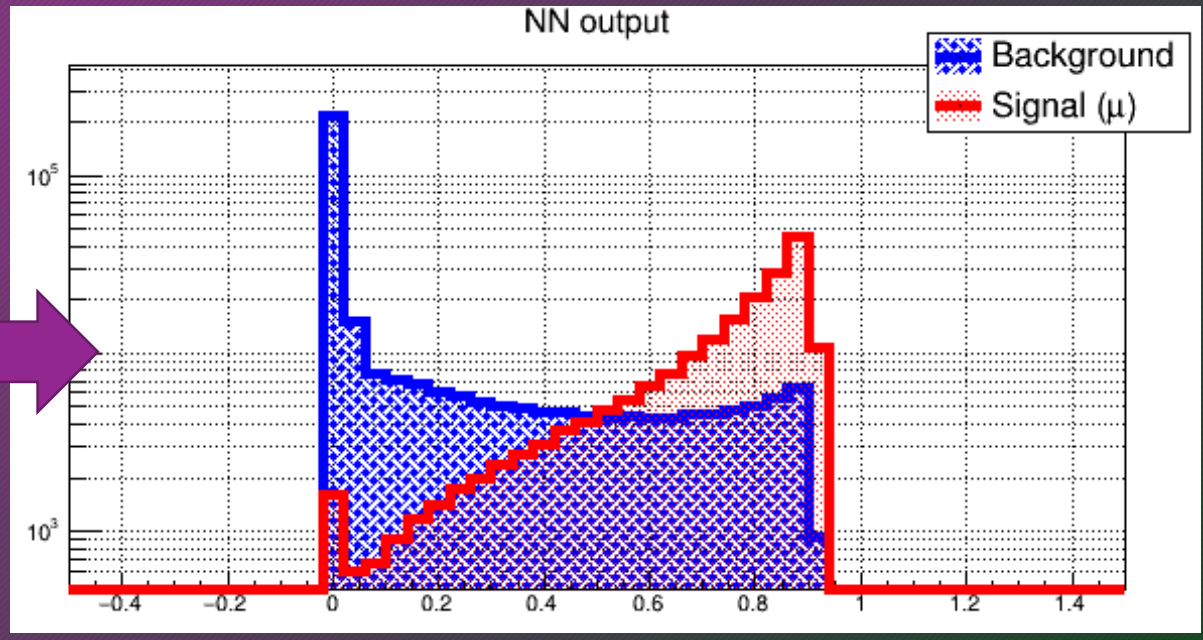
ANN PID for 30% MF scaling

Au+Au @ 4 A GeV/c

1 hidden layer (5 neurons)

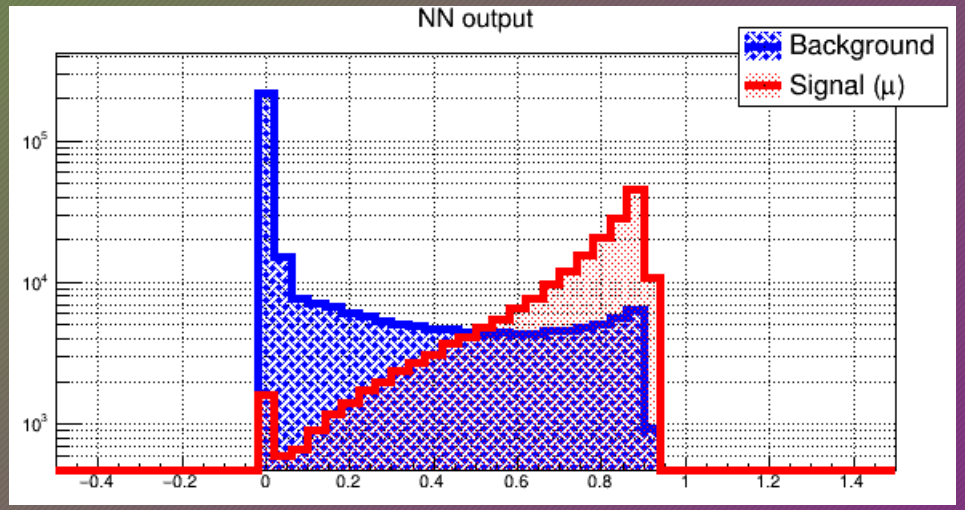


4 hidden layers (16, 12, 8 and 4 neurons)

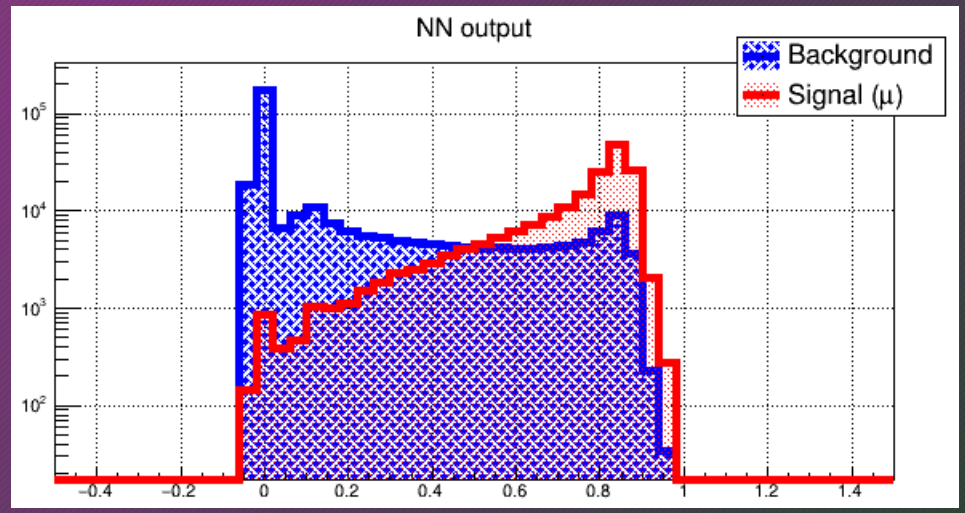


ANN ID

Au+Au @ 4 A GeV/c



30% MF:
4 hidden layers
(16, 12, 8 and 4 neurons)
ANN ID > 0.8



70% MF:
1 hidden layer
(5 neurons)
ANN ID > 0.8

Analysis results

Au+Au @ 4 A GeV/c

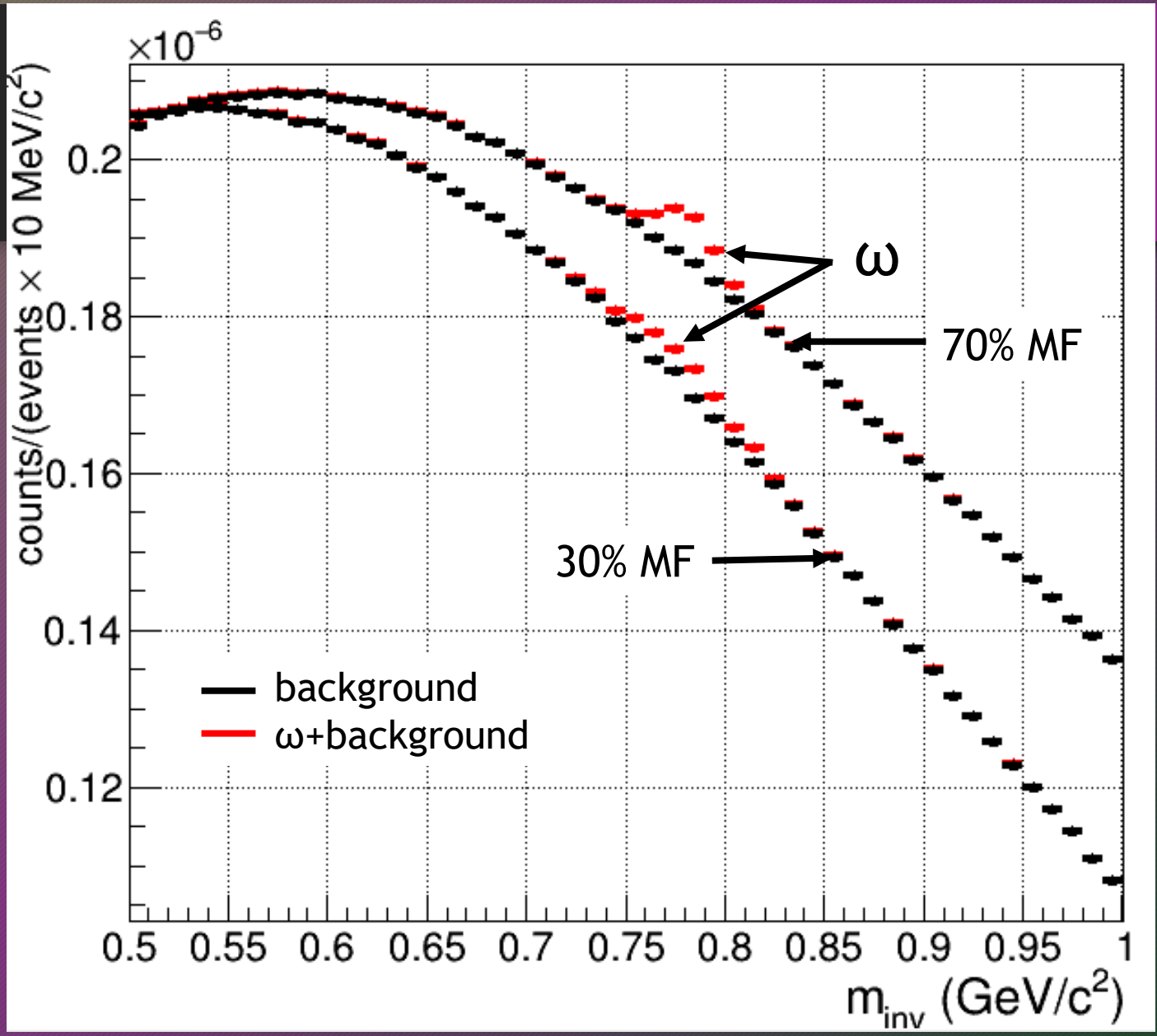
ANN ID > 0.8
σ_ω = 27.5 MeV/c^2

ANN ID > 0.8
σ_ω = 16.1 MeV/c^2

30% MF				70% MF			
ω/B ratio		ε_ω, %		ω/B ratio		ε_ω, %	
MC PID	Background subtraction	MC PID	Background subtraction	MC PID	Background subtraction	MC PID	Background subtraction
0.011	0.007 0.009	1.0	0.5 0.6	0.018	0.019	1.0	1.0

Analysis results

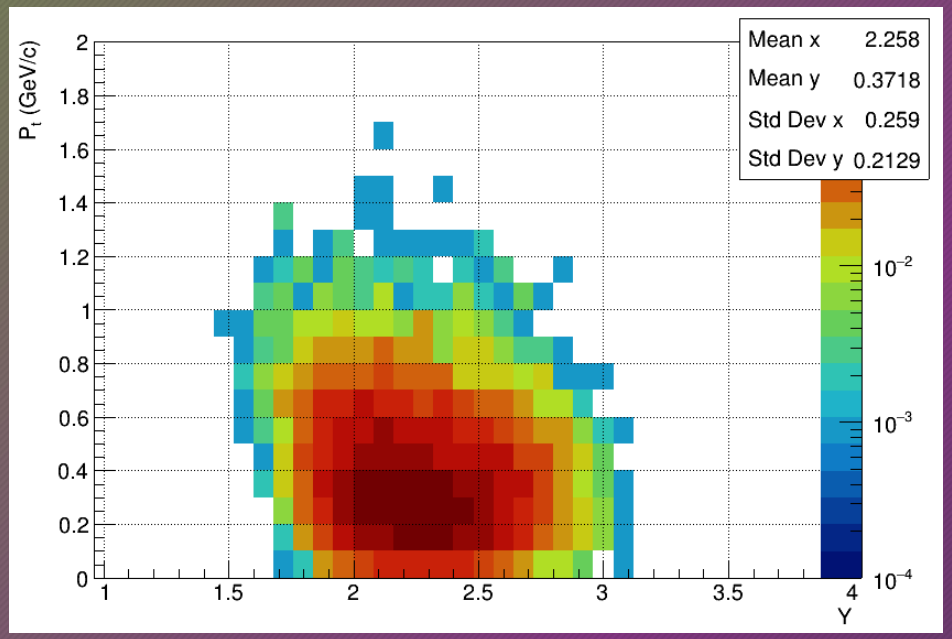
Au+Au @ 4 A GeV/c



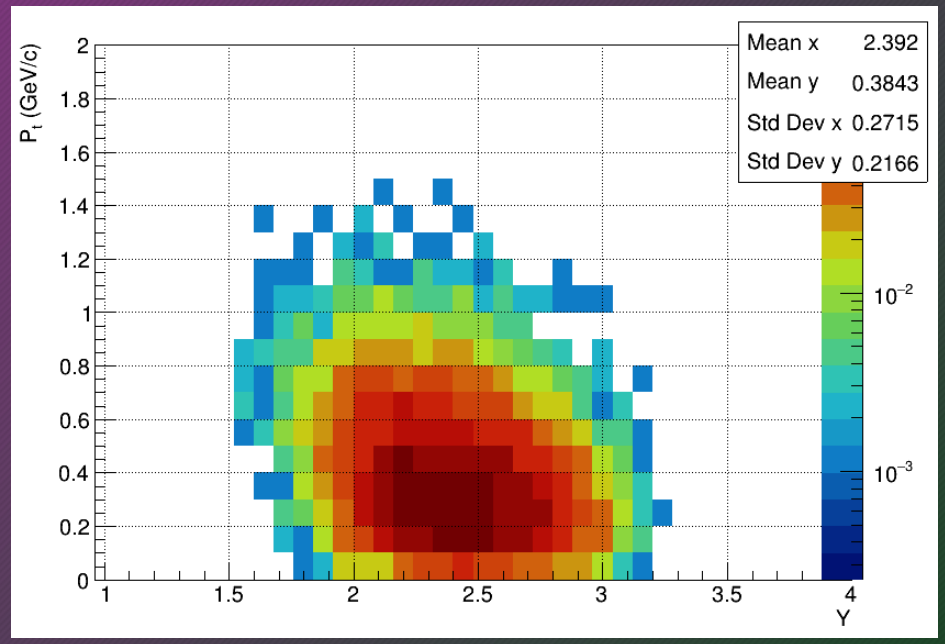
Analysis results

Au+Au @ 4 A GeV/c

30% MF



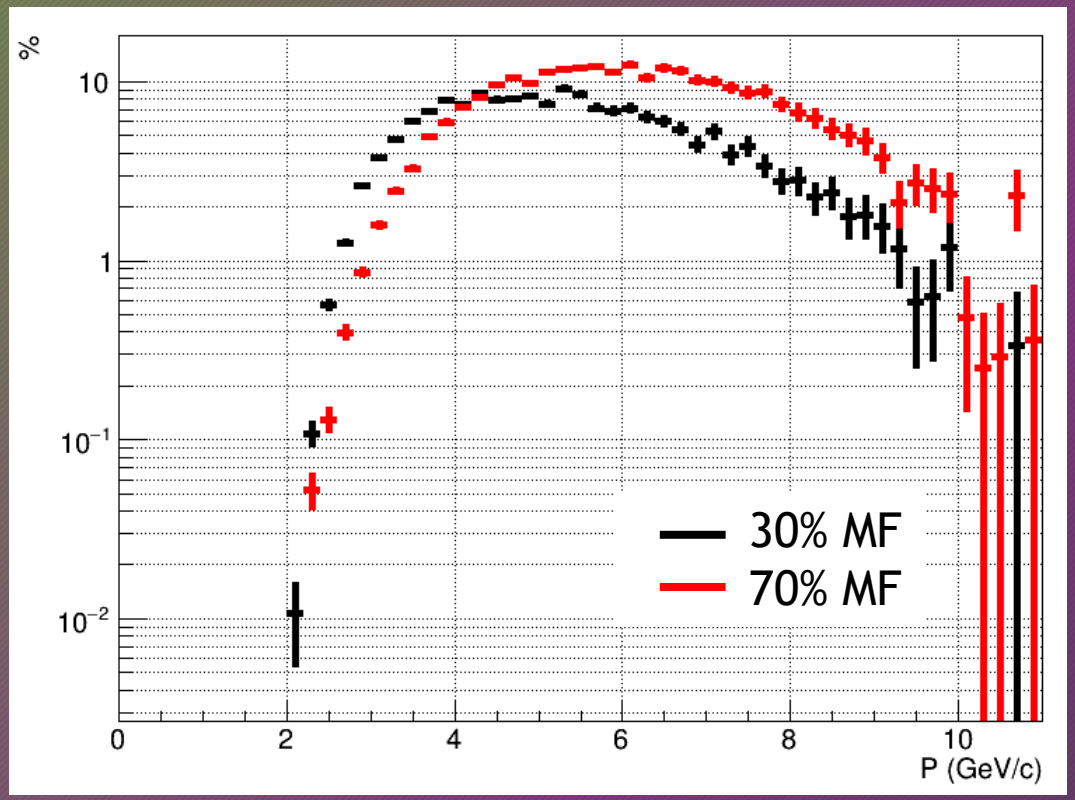
70% MF



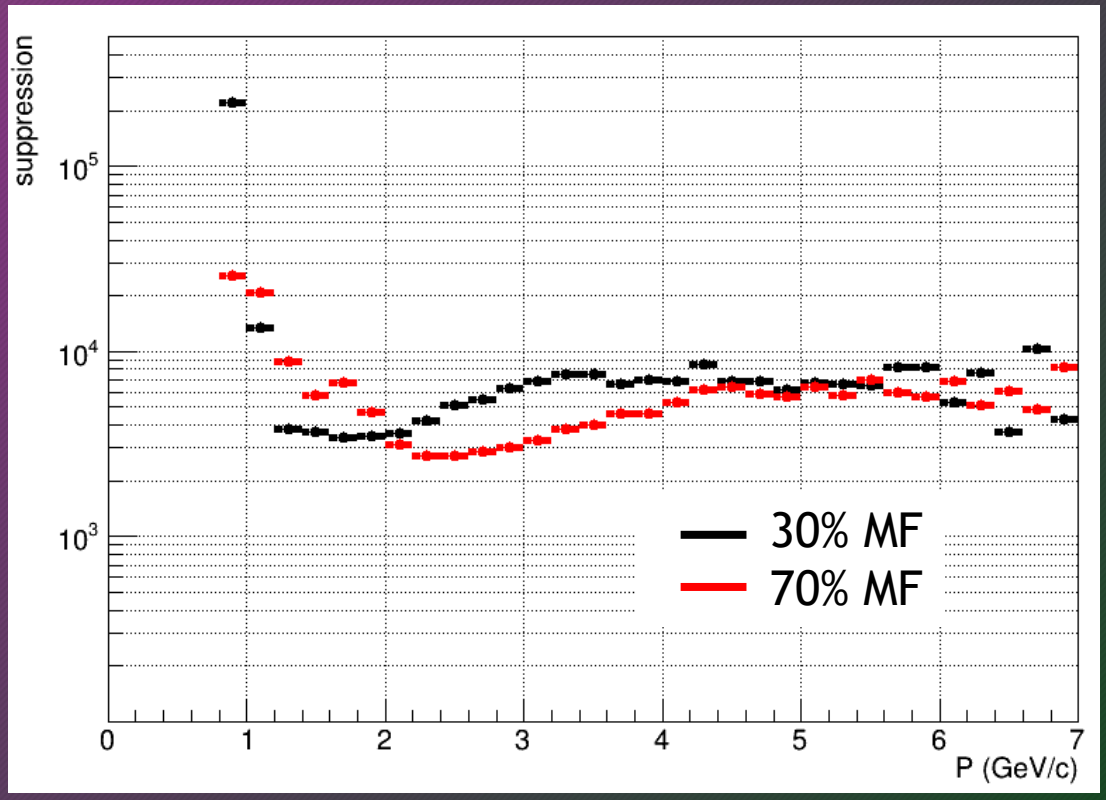
Analysis results

Au+Au @ 4 A GeV/c

ω efficiency



background suppression



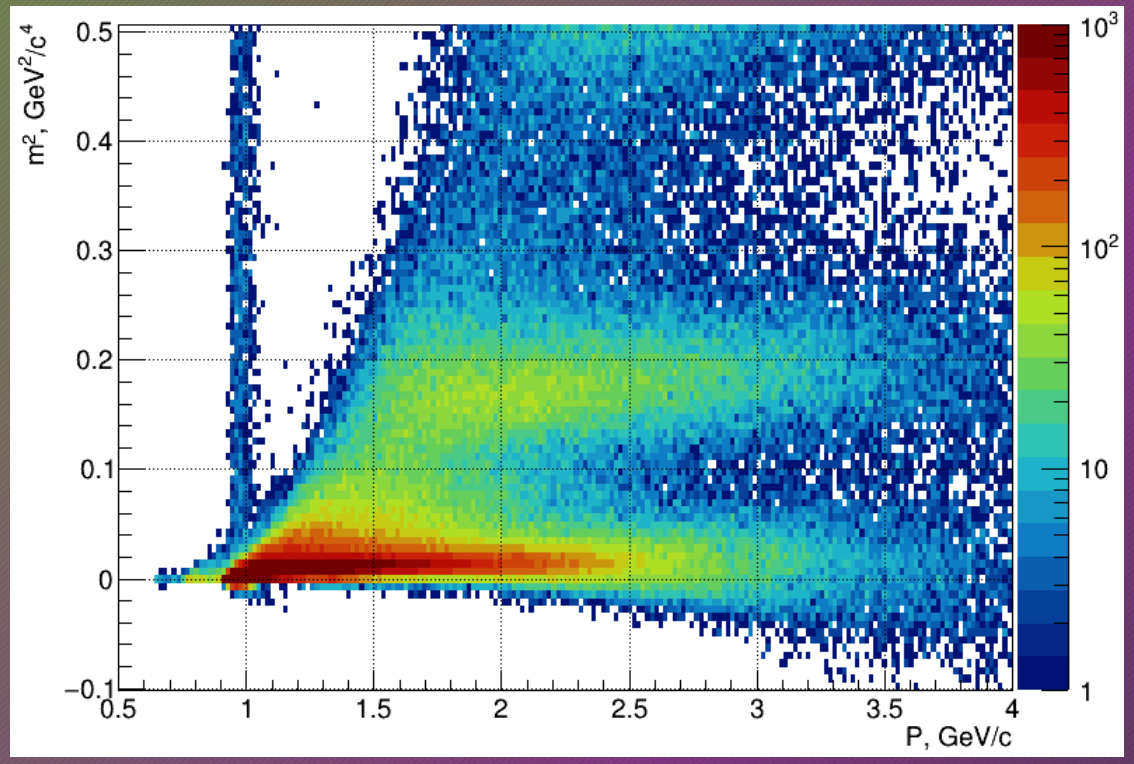
Conclusions

- A strong reduction of the magnetic field (e.g. down to 30%) results in a degradation of the momentum resolution, and as a consequence, in a degradation of the mass resolution.
- While the reconstruction efficiency for ω-mesons is similar for a 70% and a 30% magnetic field, the ω-to-background ratio will be almost a factor of 2 lower for the 30% magnetic field.
- At low magnetic field, background subtraction does not result in correct efficiency

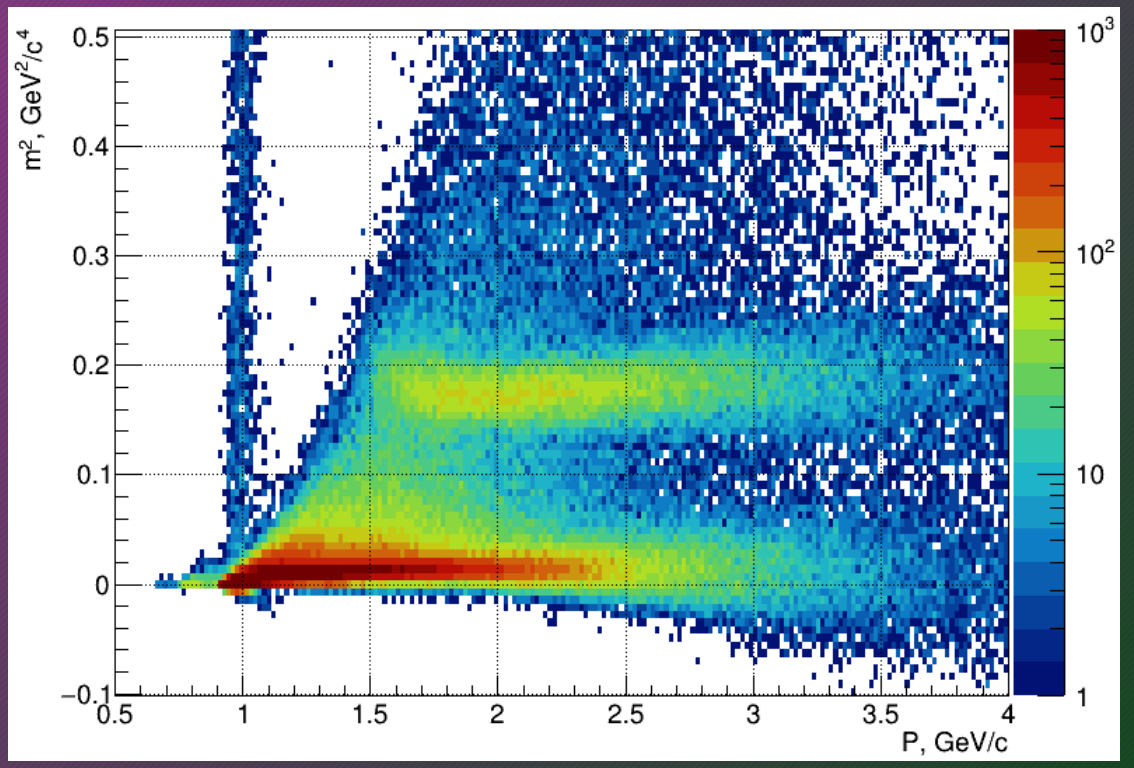
Backup

PID in TOF

40% MF



70% MF



Invariant mass spectra