Muon simulations: $\omega \to \mu\mu$ @ 2A GeV

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Outline

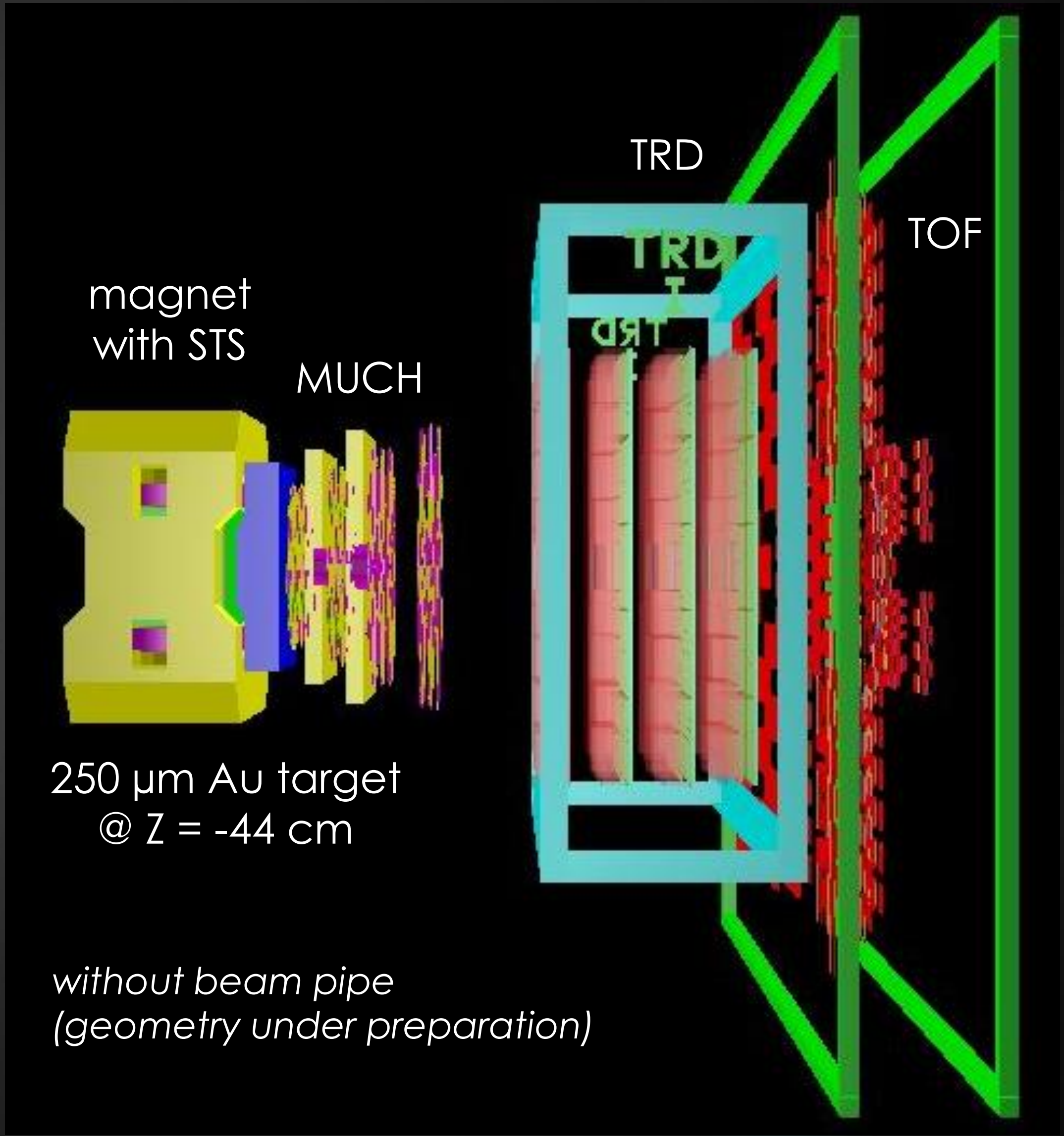
- Acceptance study
- Reconstruction
- Muon particle identification
- Next steps

Muon setup for low beam energies

up to 4A GeV for Au beam

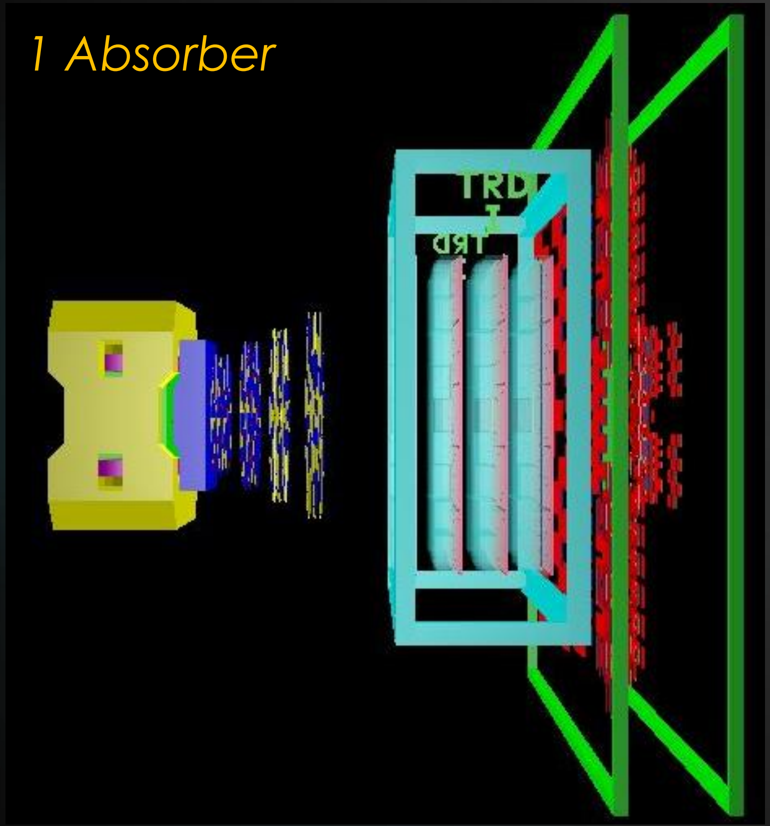
MUCH:
2 GEM stations
2 RPC stations

absorbers:
58 cm C
(20+20) cm Fe

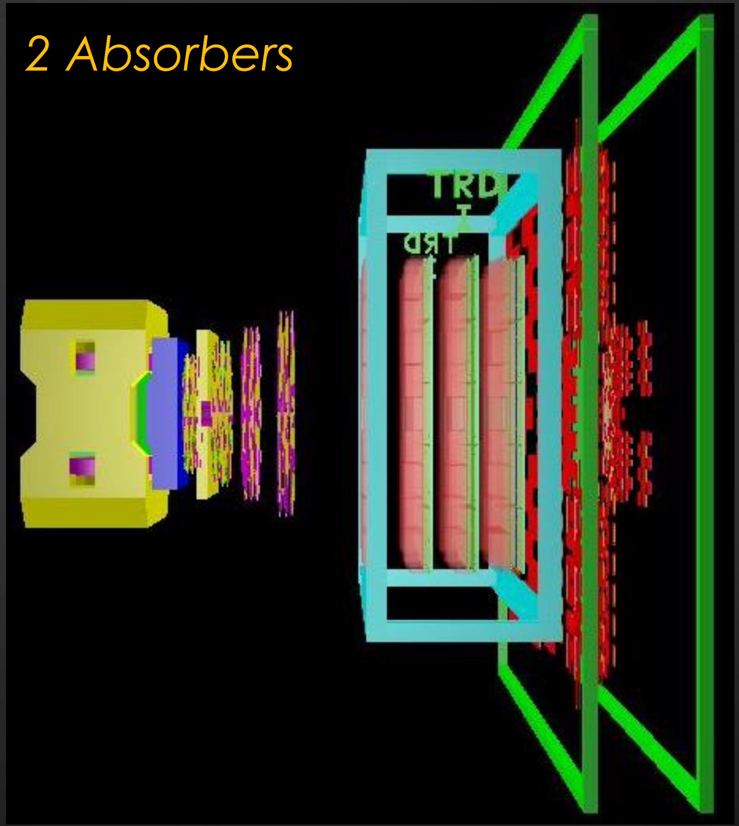


Geometries for acceptance study

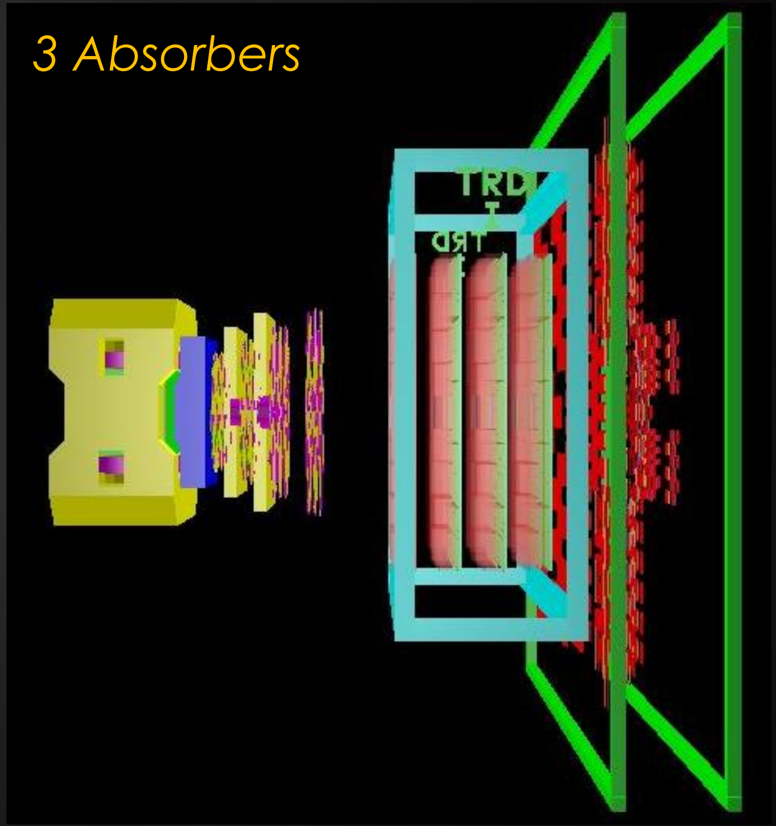
58 cm C



58 cm C + 20 cm Fe



58 cm C + 20+20 cm Fe



Input

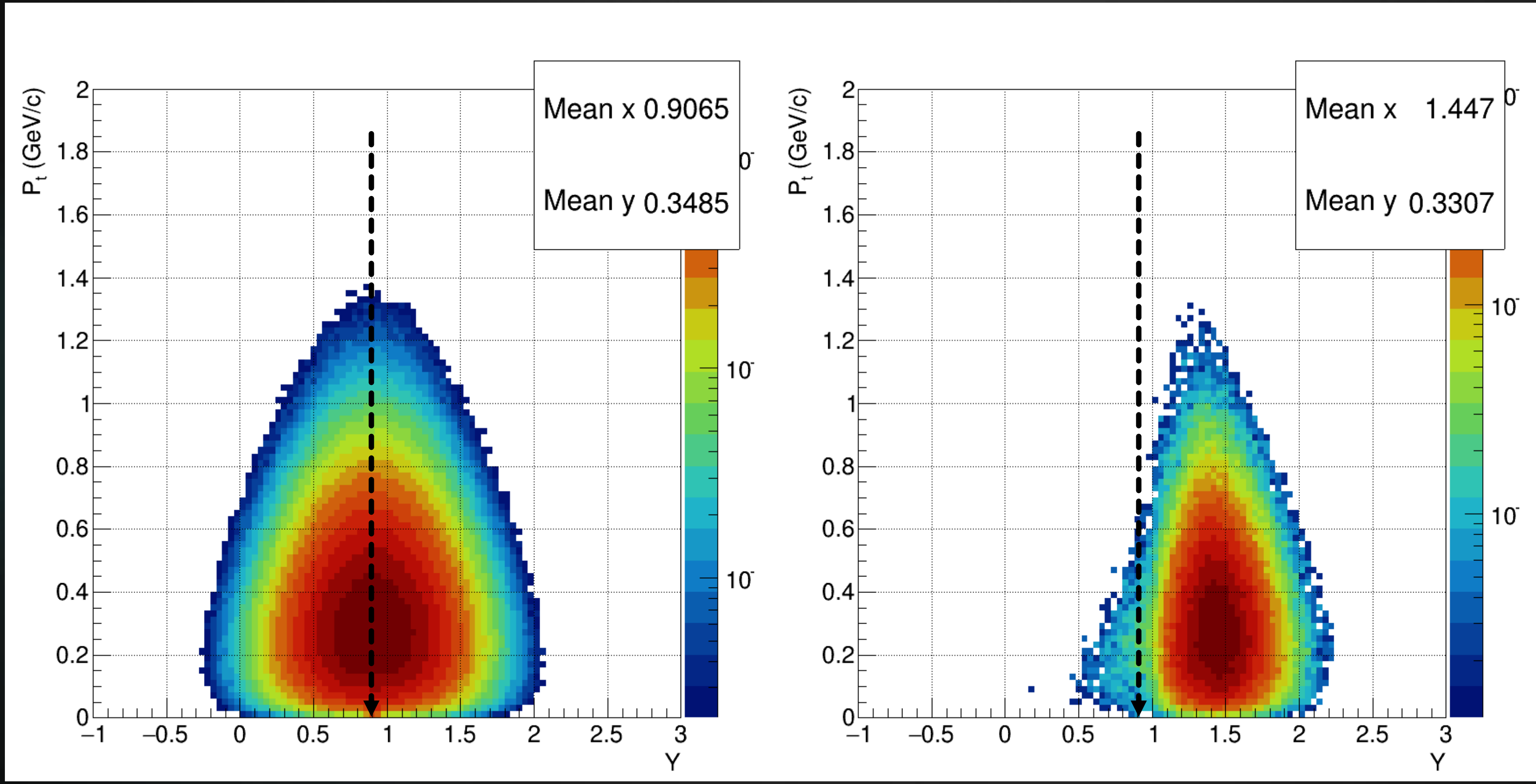
- UrQMD central Au+Au collisions @ 2 A GeV
- PLUTO generated ω (T = 80 MeV) with multiplicity 0.27
- ω→μμ on flight by transport:
  ```
  Int_t daughterPdg[] = {-13, 13};
  Int_t Pdg = 223;
  run.SetDecayMode(Pdg, 2, daughterPdg);
  ```
- 50% magnetic field
- GEANT3 for transport
- sis100_muon_lmvm setup with modified MUCH

ω→μμ: Pt vs. Y

4π

STS acceptance

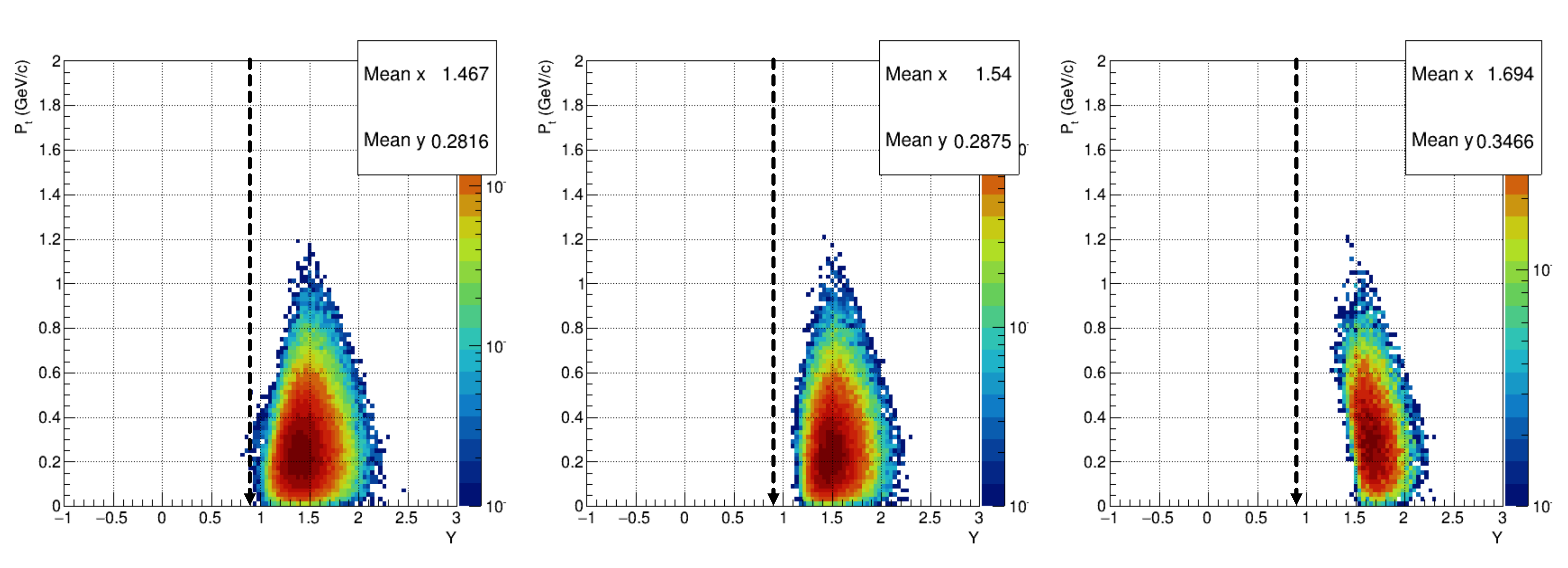
$N_{MC\ points} > 3$



ω acceptance

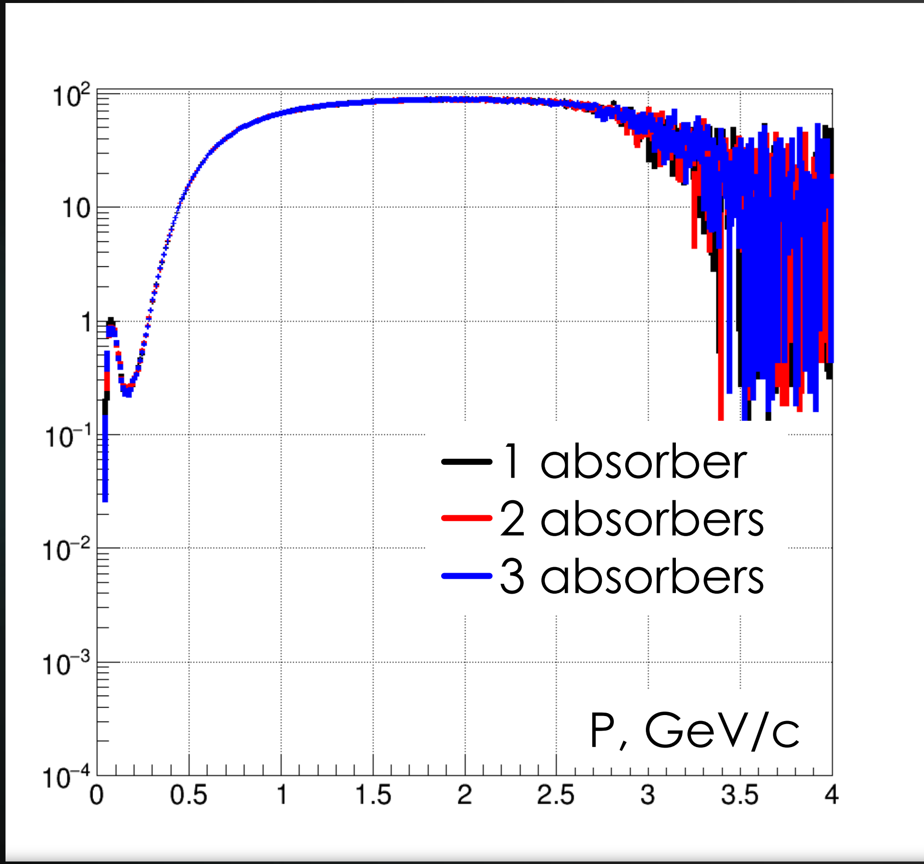
STS > 3
MUCH > 9
TRD
TOF

1 Absorber 2 Absorbers 3 Absorbers

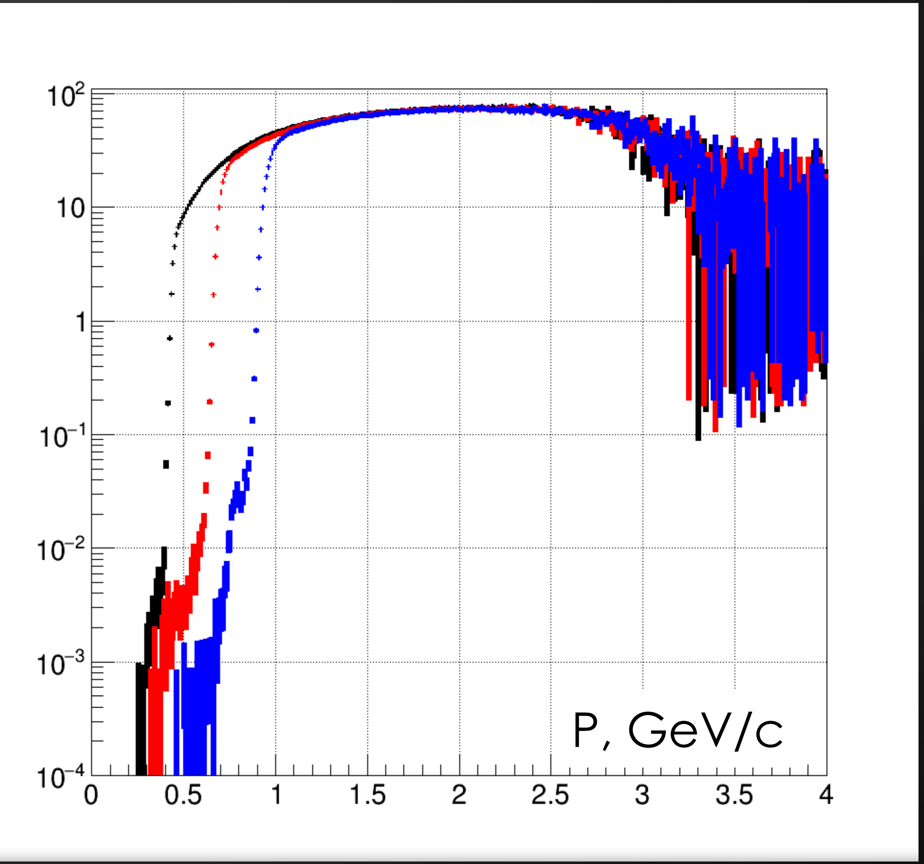


μ acceptance

STS > 3

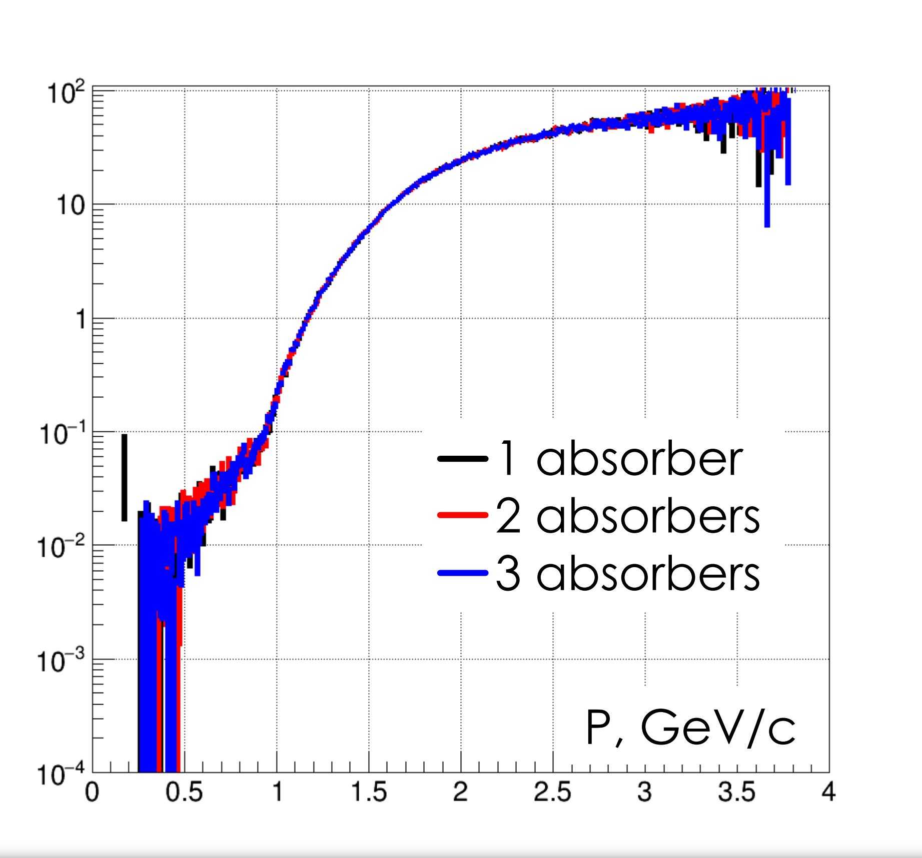


STS > 3, MUCH > 9, TRD, TOF

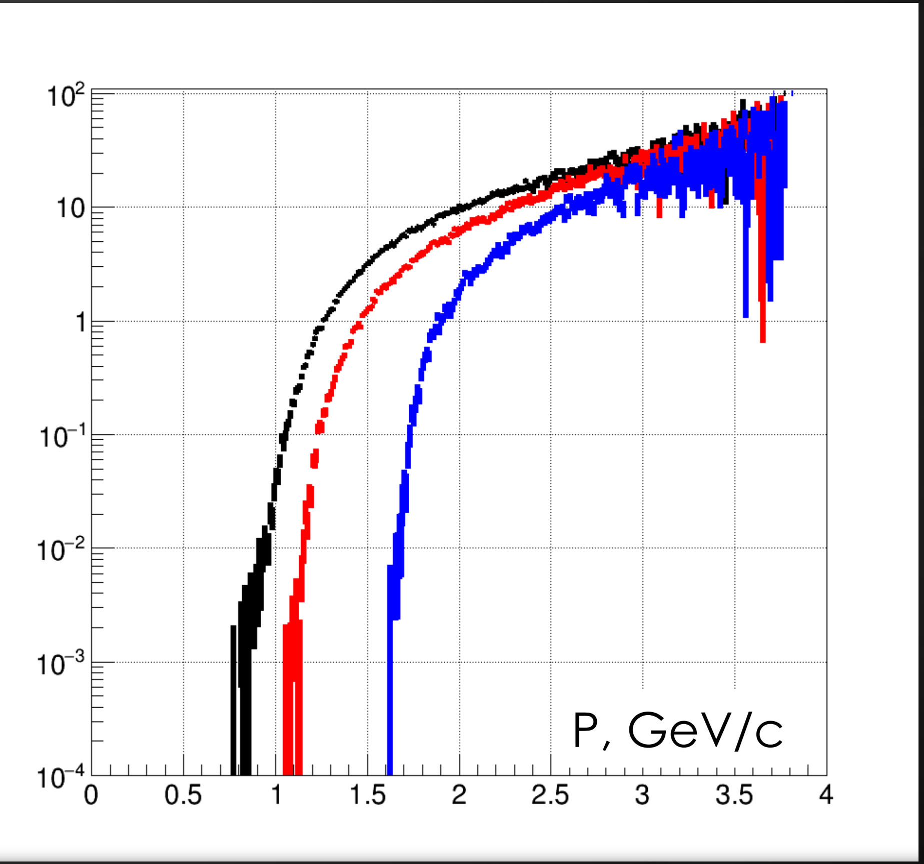


ω acceptance

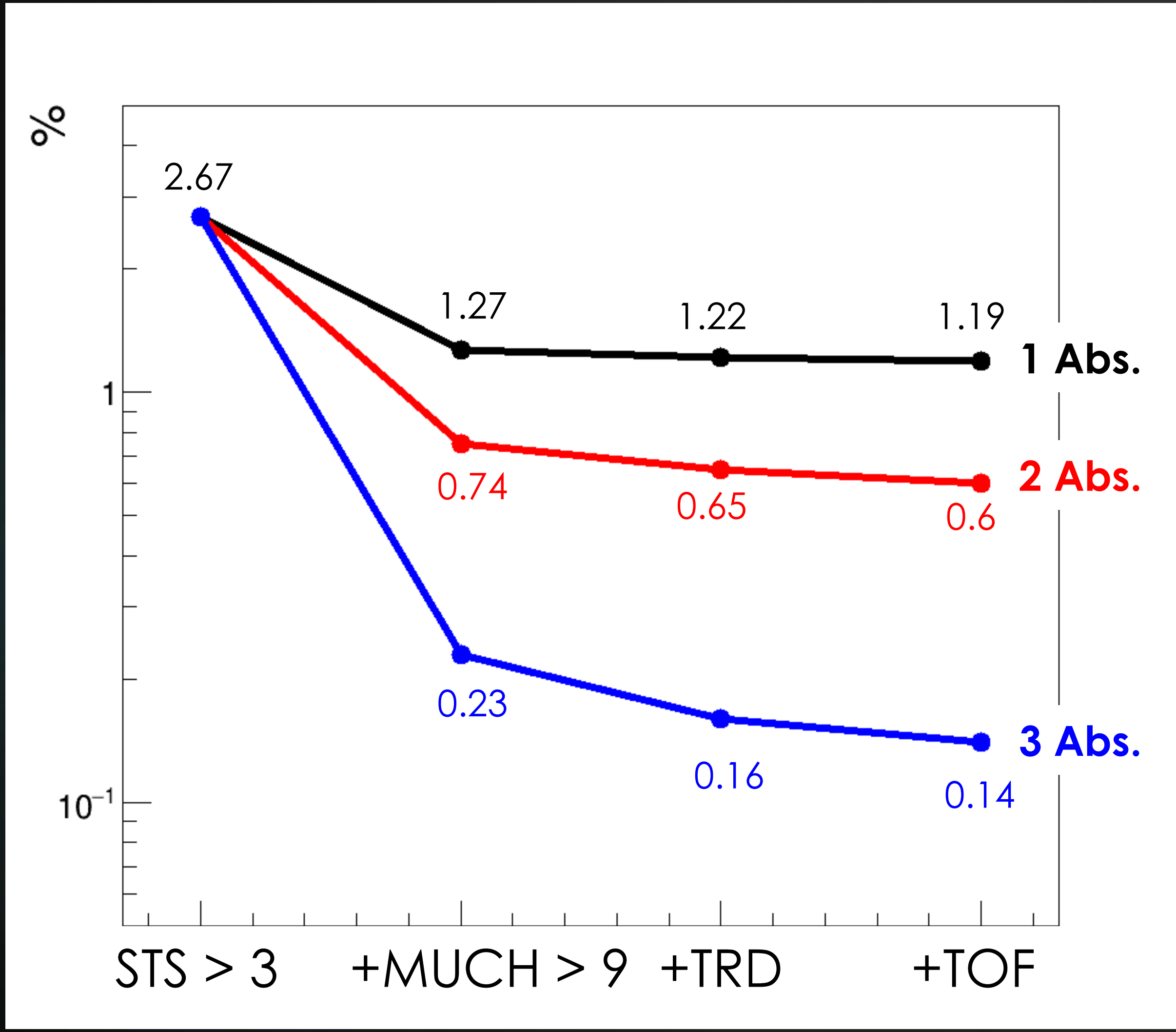
STS > 3



STS > 3, MUCH > 9, TRD, TOF



ω acceptance

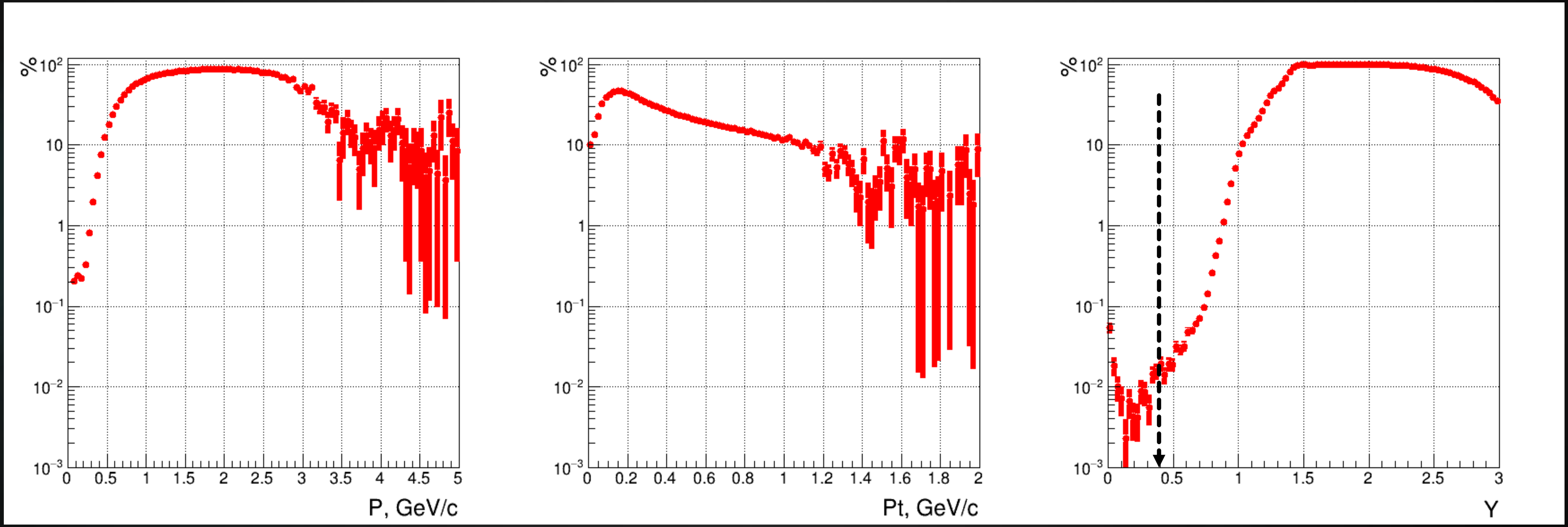


STS reconstruction efficiency for μ_ω 4π normalization

vs. momentum

vs. transverse momentum

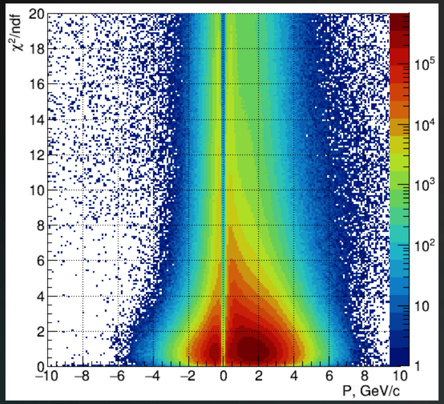
vs. rapidity

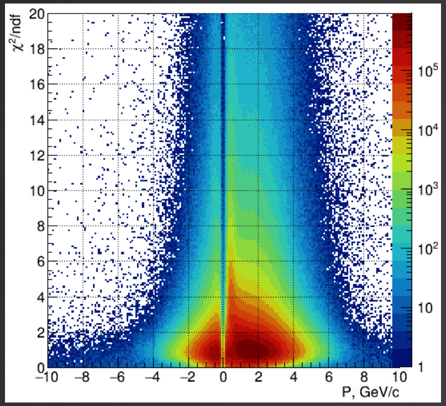


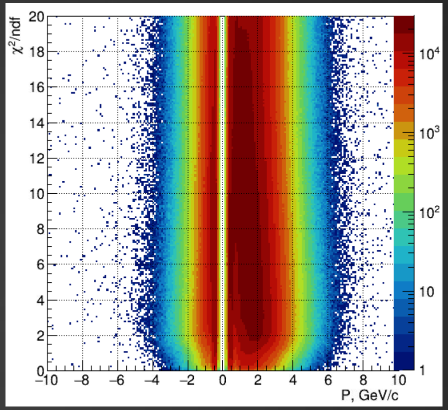
μ particle identification

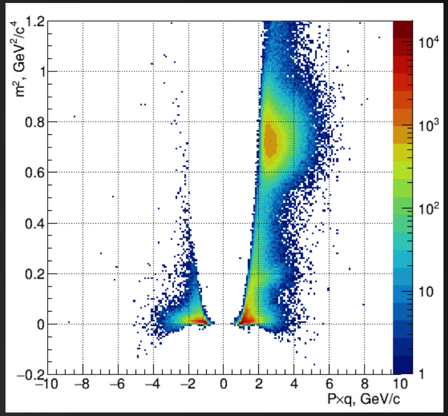
χ^2/ndf in vertex | χ^2/ndf in STS | χ^2/ndf in MUCH | m^2 in TOF

background

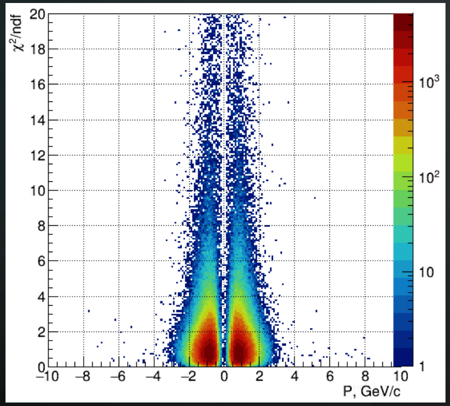


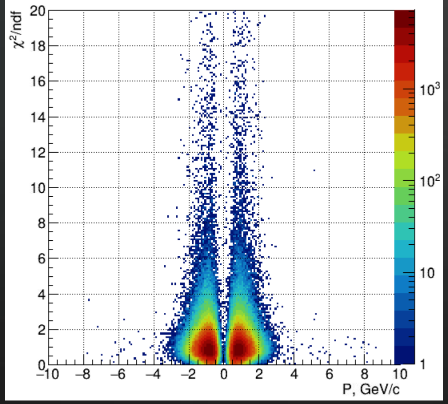


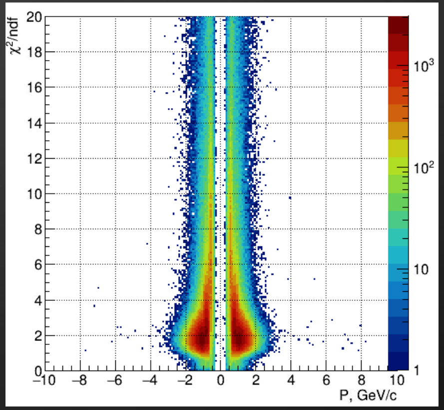


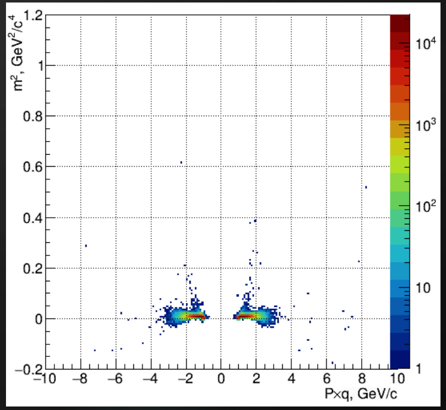


μ from ω



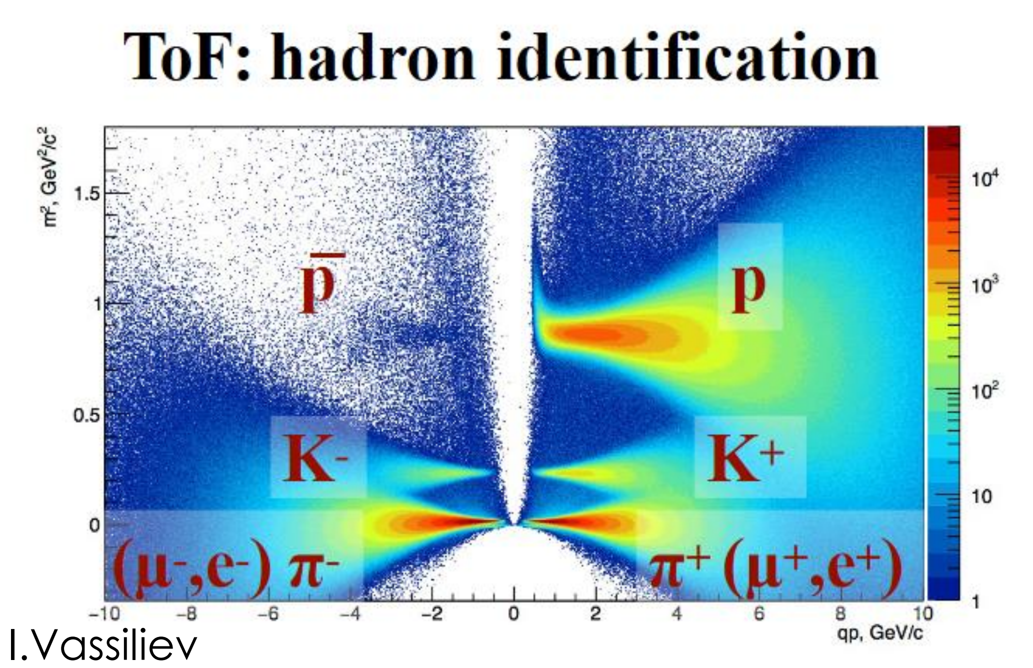




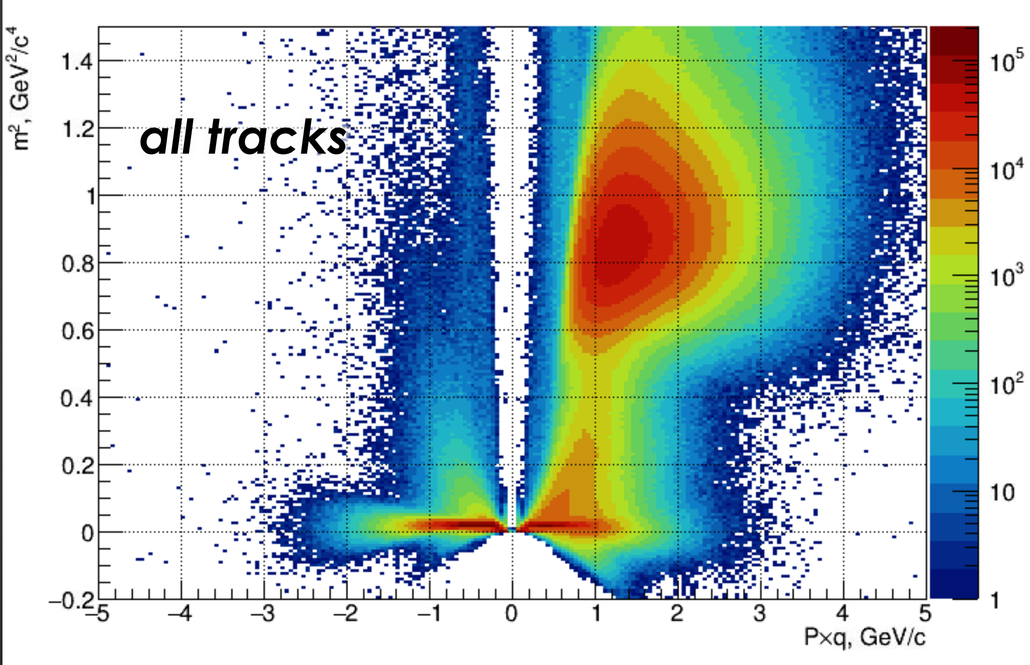


PID in TOF (hadron setup)

Au+Au @ 10 A GeV/c



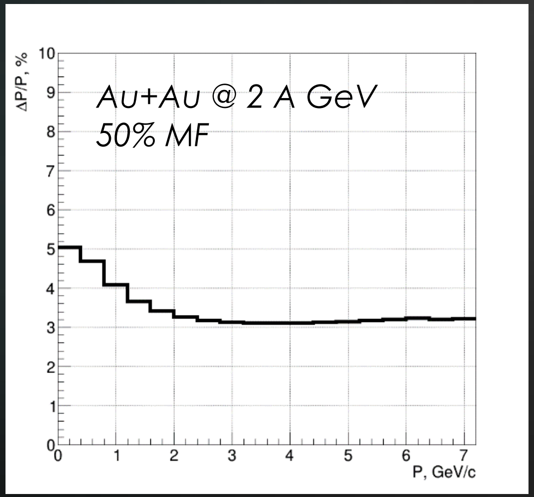
Au+Au @ 1.23 A GeV

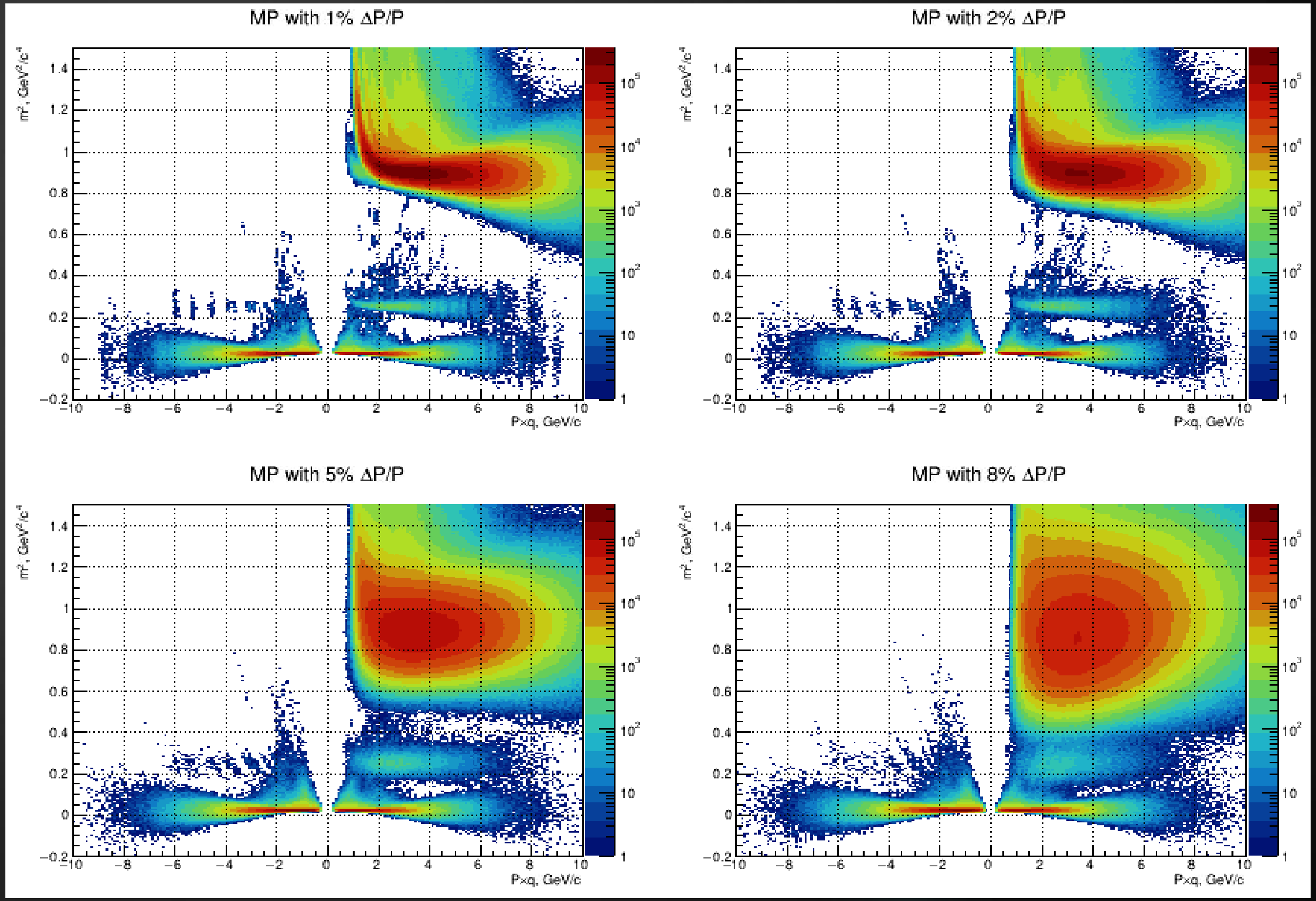


Mass distribution vs. momentum resolution

MC
primary tracks
Gauss smearing:
80 π time resolution
1, 2, 5, 8 % $\Delta P/P$

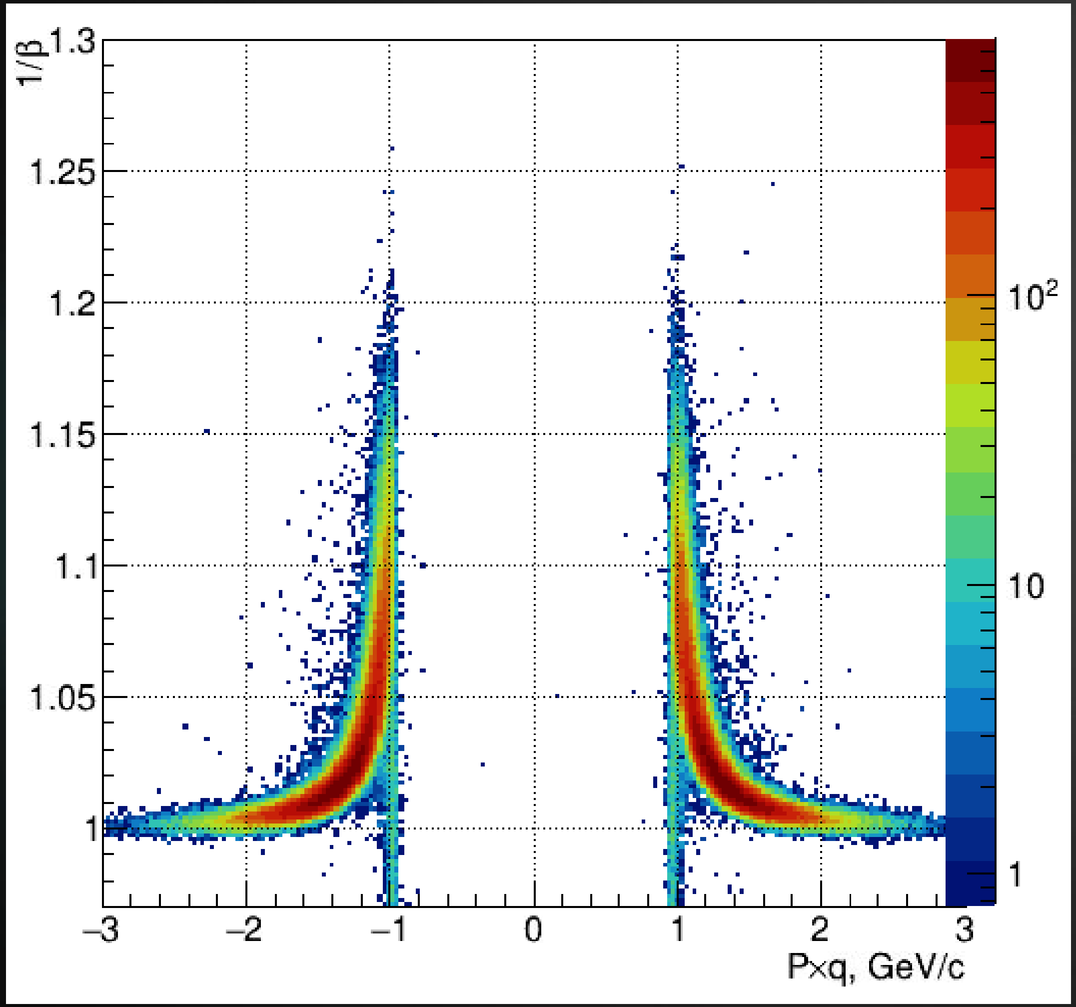
momentum resolution



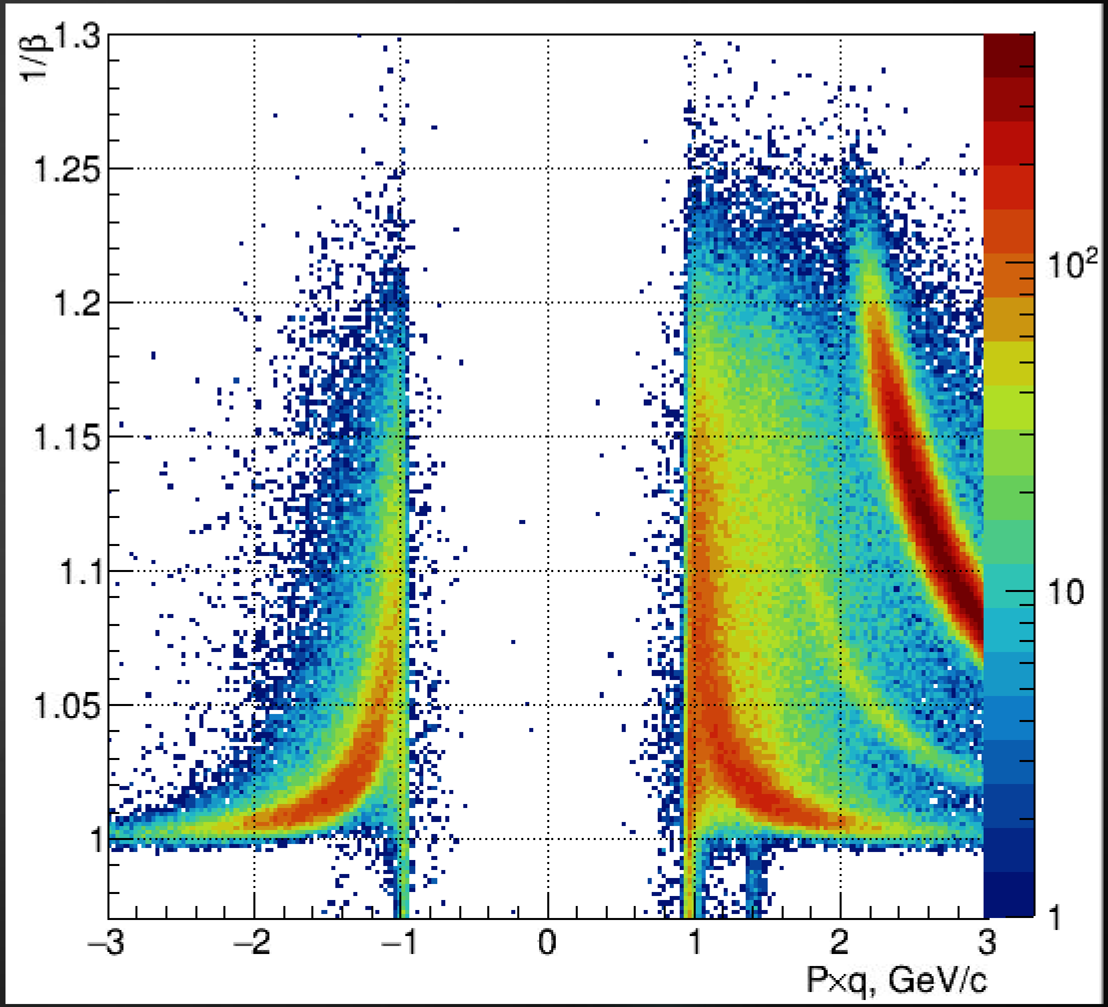


Particle identification using β

μ from ω



background



Preselection for machine learning procedure

7 STS hits

10 MUCH hits

1 TRD hit

χ^2/ndf in vertex

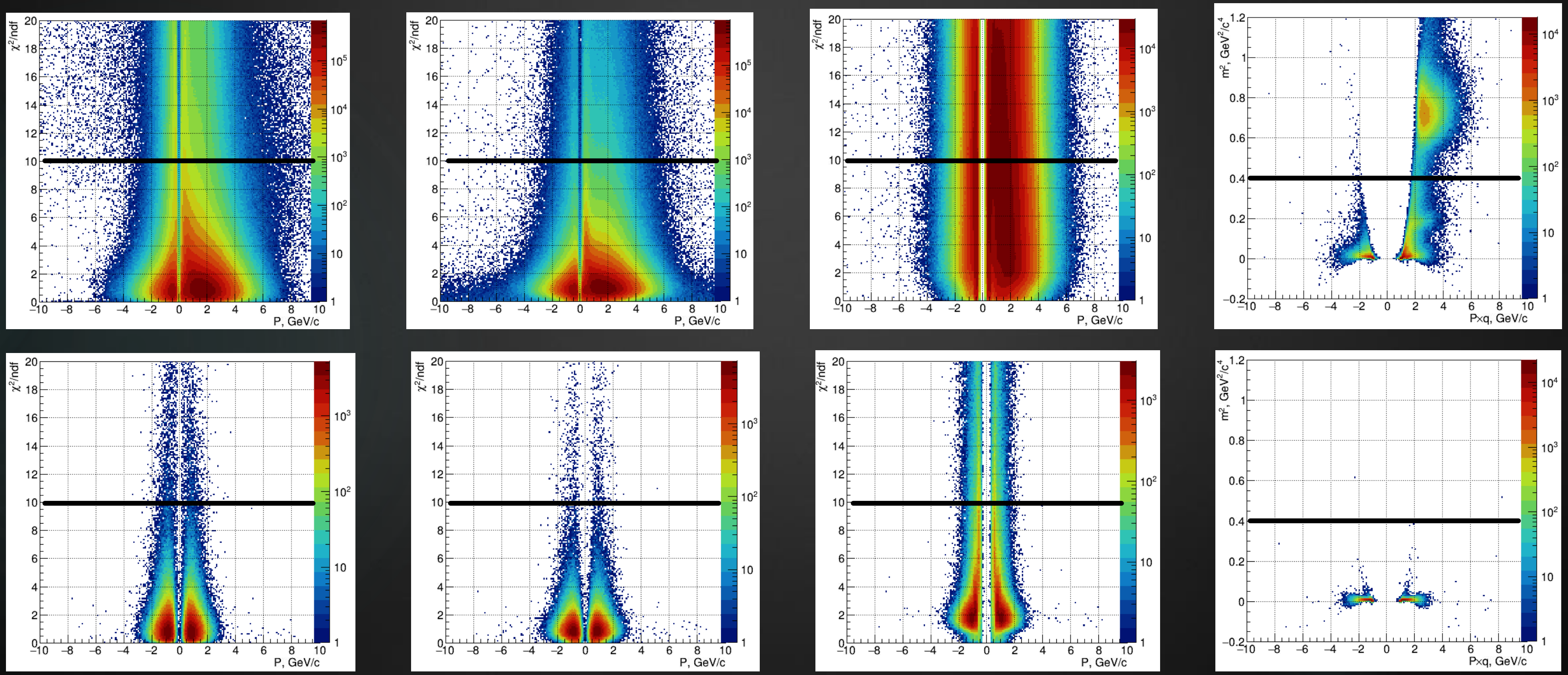
χ^2/ndf in STS

χ^2/ndf in MUCH

m^2 in TOF

background

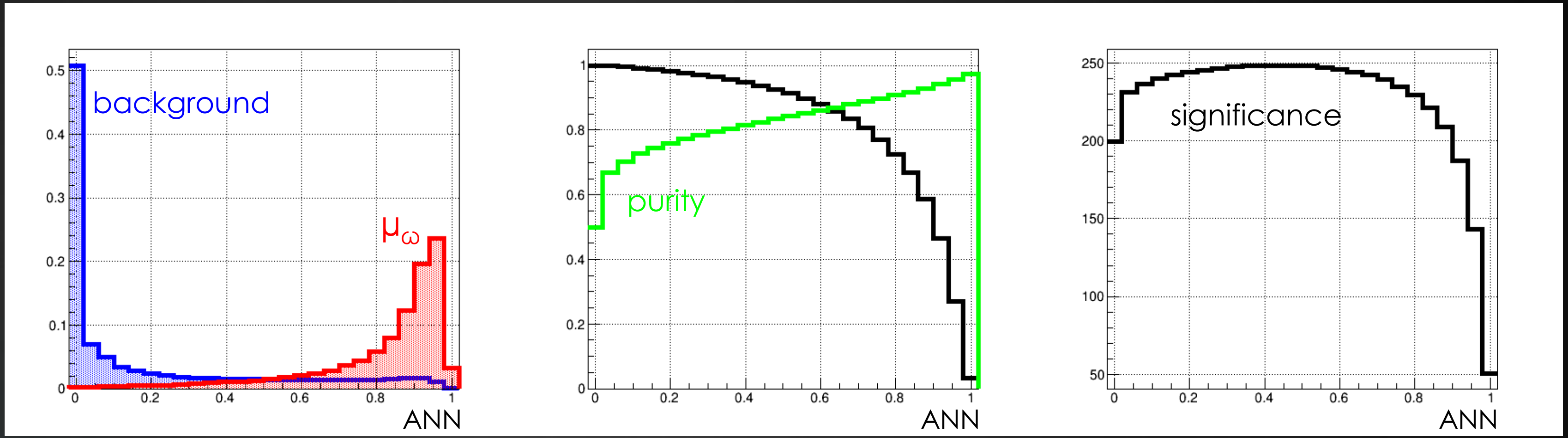
μ from ω



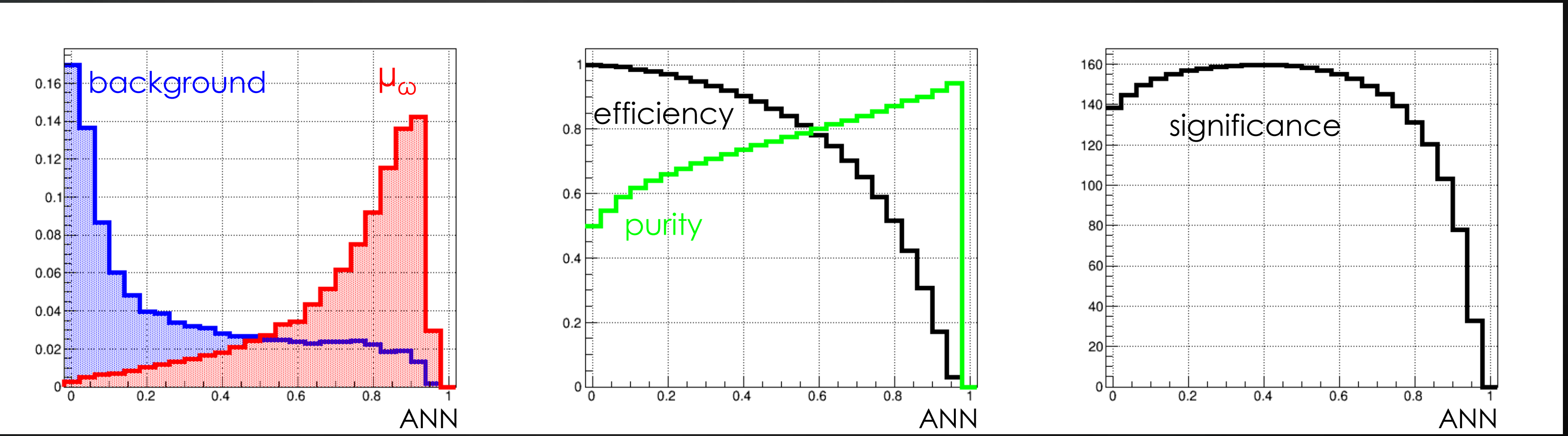
Training *TMultiLayerPerceptron*

- χ^2/ndf in vertex
- χ^2/ndf in STS
- χ^2/ndf in MUCH
- $1/\beta$ in TOF
- momentum

positive charged tracks



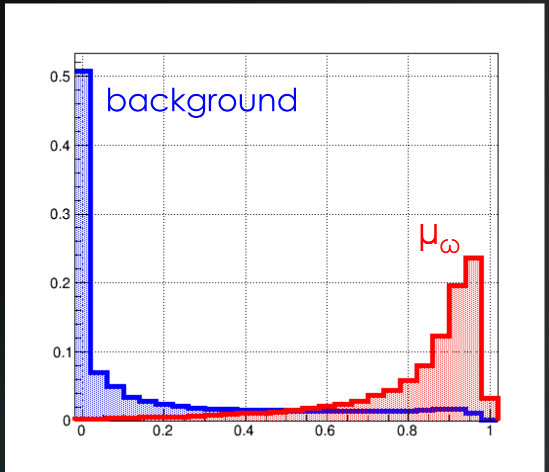
negative charged tracks



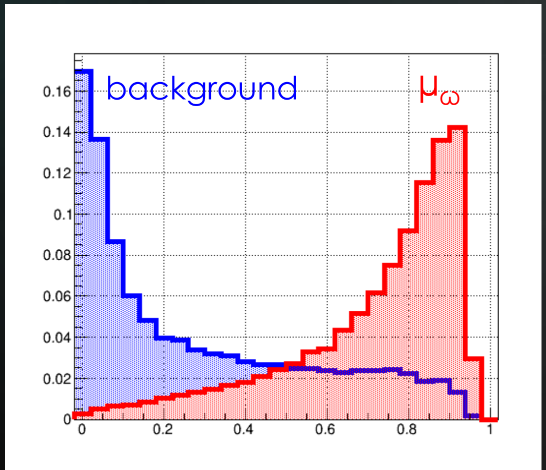
efficiency = signal passing ANN cut / total signal
purity = signal passing ANN cut / (signal+background passing ANN cut)

Test

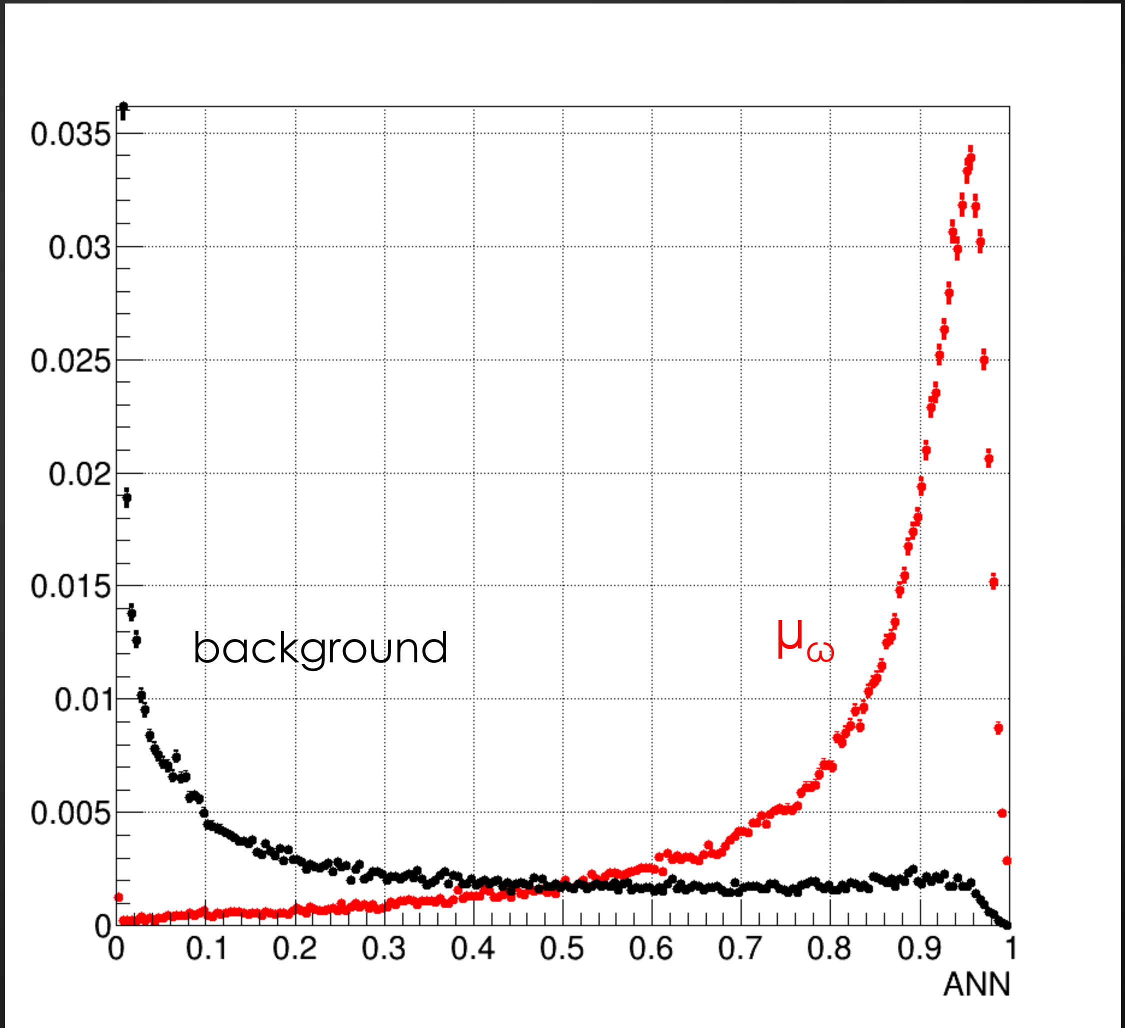
positive charged tracks



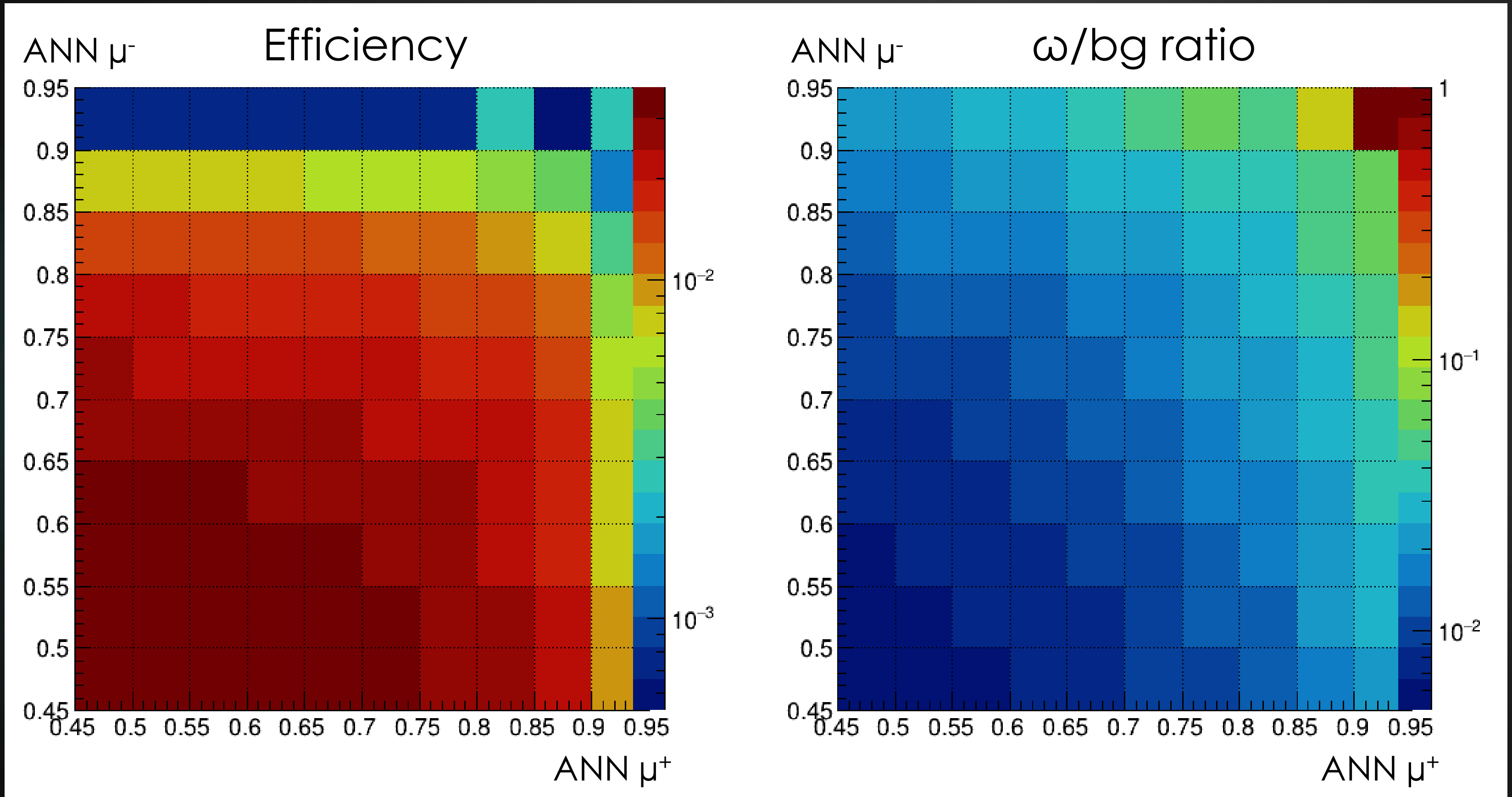
negative charged tracks



Reconstructed tracks



Efficiency and ω-to-background ratio *preliminary*



Next steps

- Simulations with different target position - possible increase of the acceptance
- Study possibility to reject secondary muons produced in STS (separate track reconstruction of mother and daughter particles)