PIDFOM purity studies

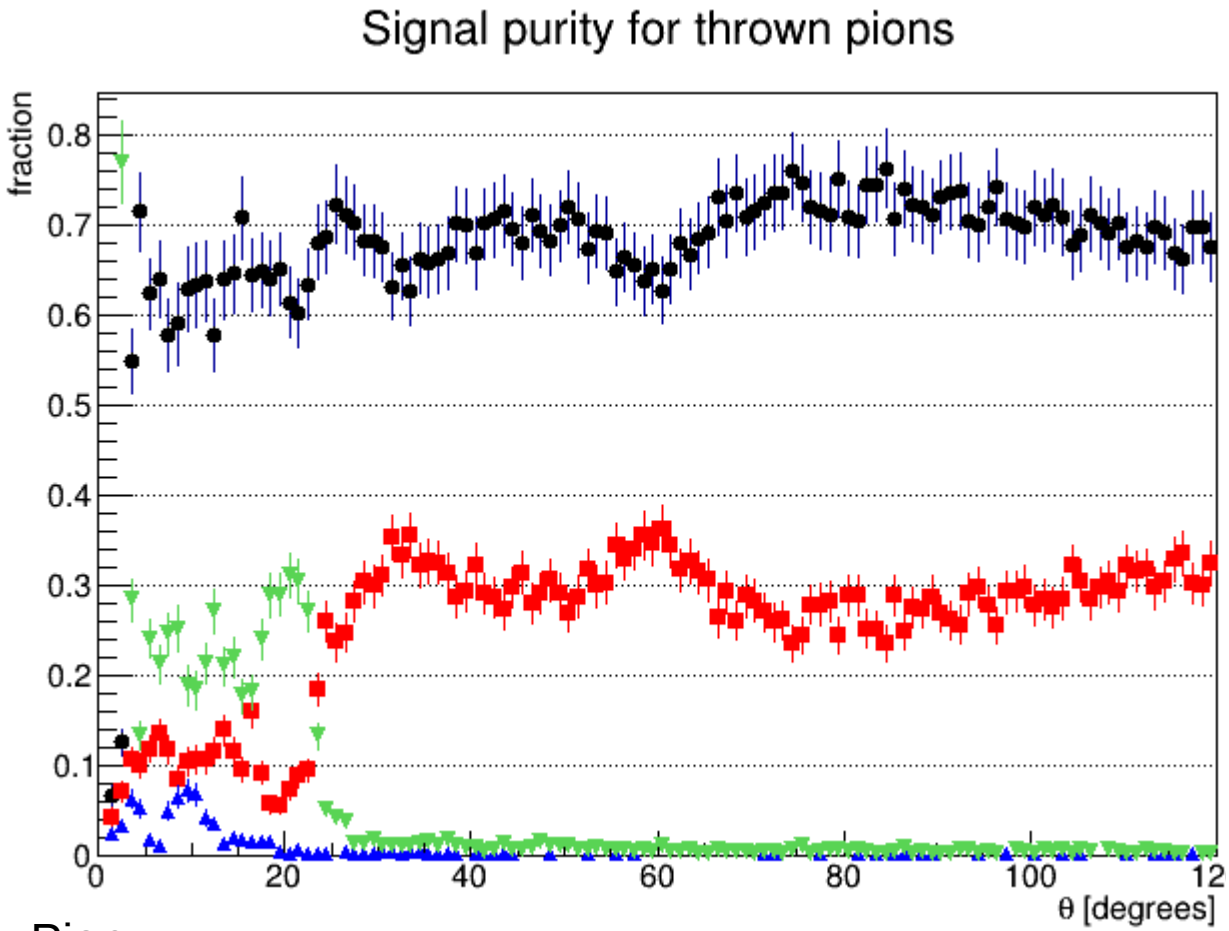
Simon Taylor / JLab

- Particle gun: throw π^-'s at discrete values of momentum (0.5, 1.0, 2.0 GeV/c)
  - θ={1°,121°}, z={50 cm,80 cm}
  - Require reconstructed track within 3σ (p_x, p_y, and p_z) of thrown momentum
    - Select hypothesis with highest PIDFOM
    - No check on PIDFOM value yet – provides denominator for purity fraction
    - Numerator: counts for which highest PIDFOM above cut corresponds to a given particle hypothesis

Directories containing Geant4 results:
/cache/halld/halld-scratch/REQUESTED_MC/ParticleGun/pim_0.5gev_g4_20190225111012am/
/cache/halld/halld-scratch/REQUESTED_MC/ParticleGun/pim_1.0gev_g4_20190225113031am/
/cache/halld/halld-scratch/REQUESTED_MC/ParticleGun/pim_2.0gev_g4_20190225113945am/

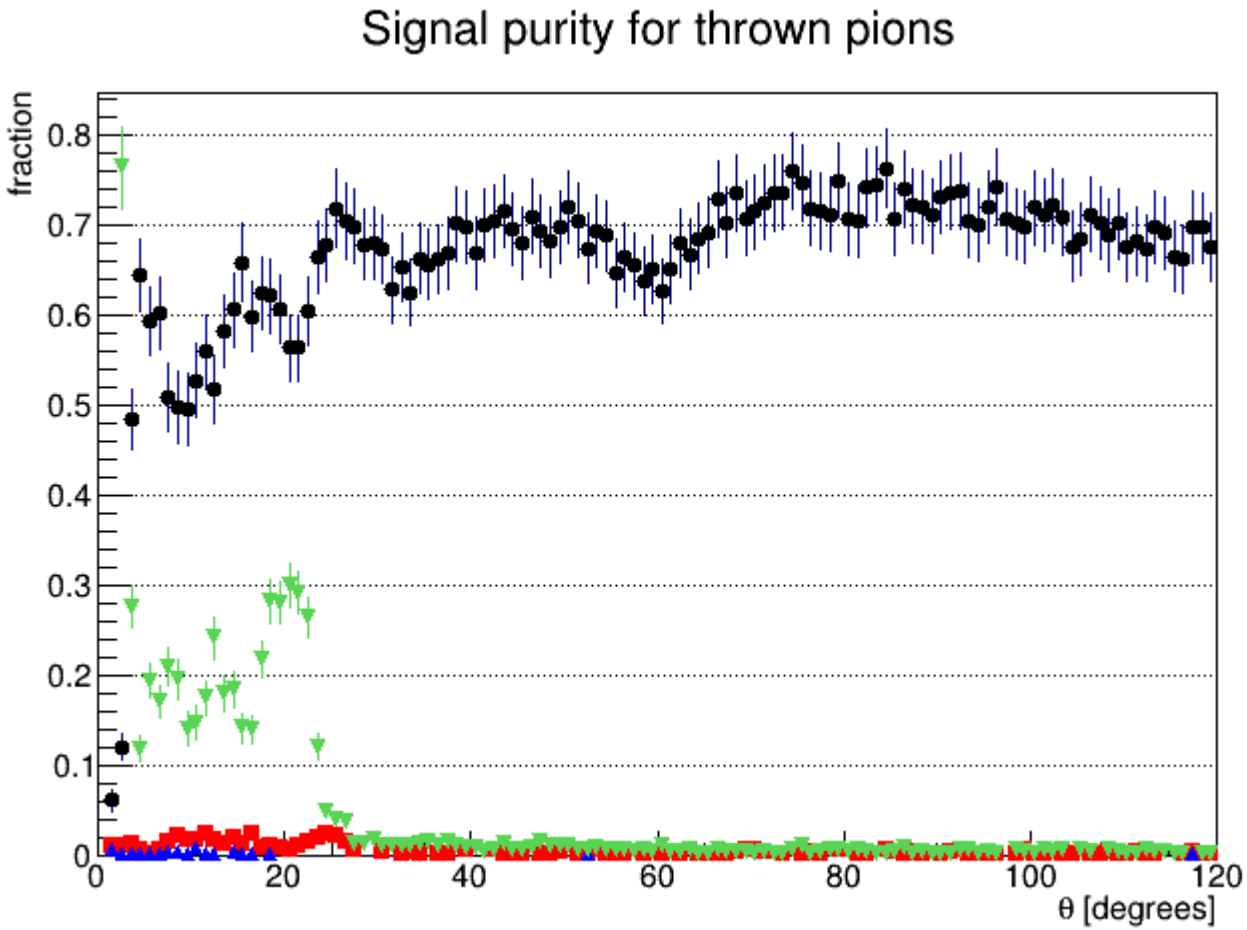
0.5 GeV/c pions

No cut on PIDFOM



Pion
Kaon
Antiproton
Electron

PIDFOM cut = 0.01 for all hypotheses



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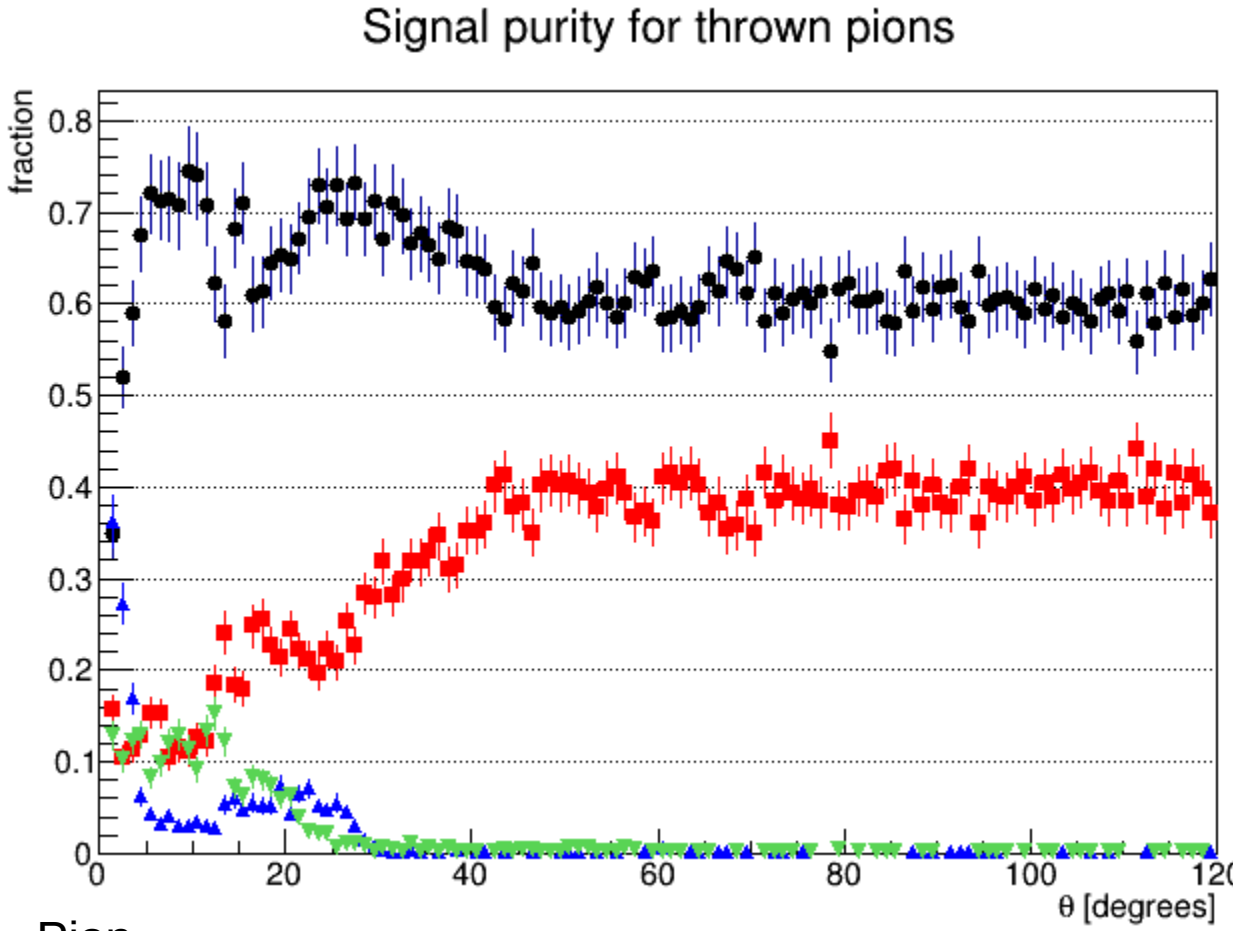
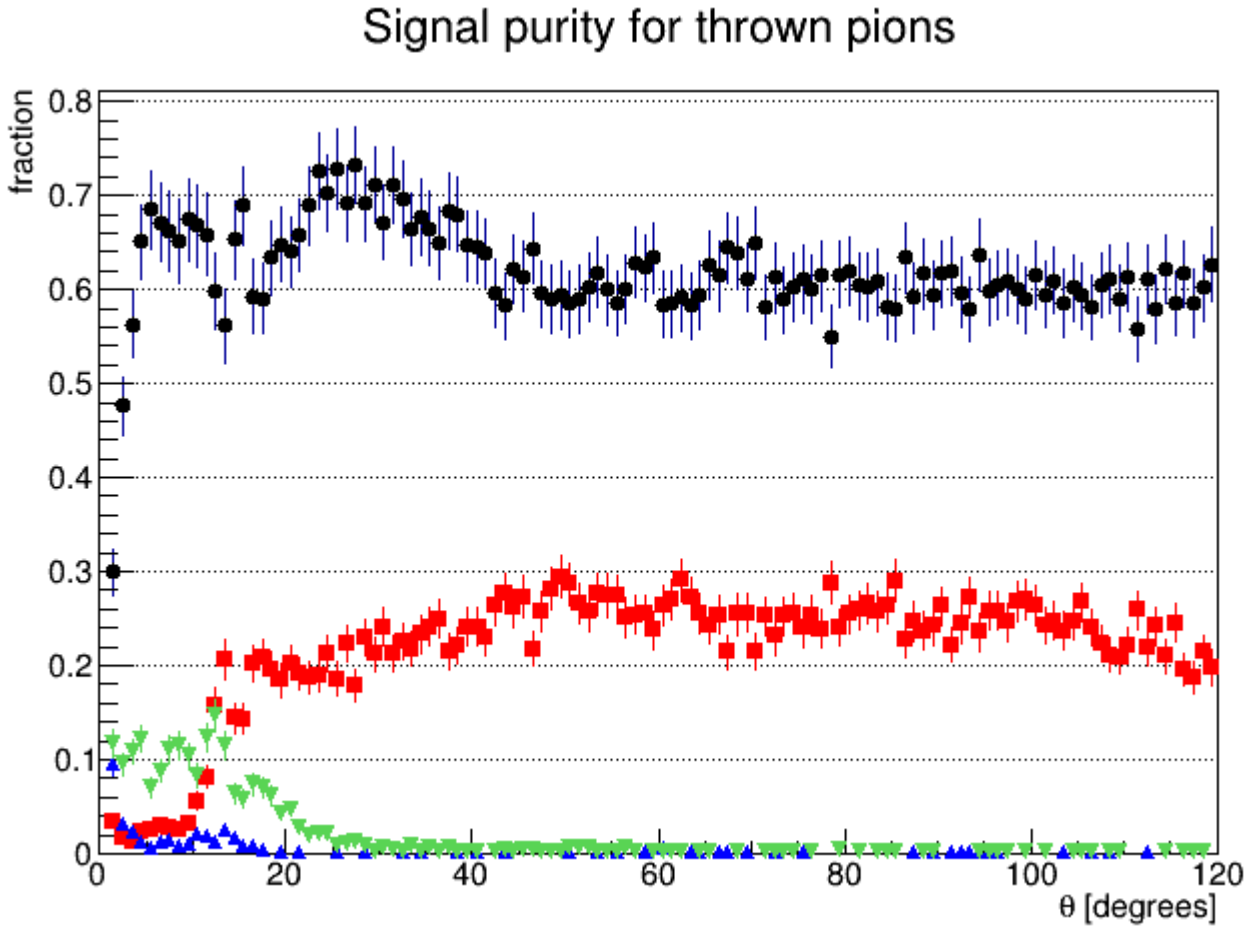
1.0 GeV/c pions

No cut on PIDFOM



PIDFOM cut = 0.01 for all hypotheses

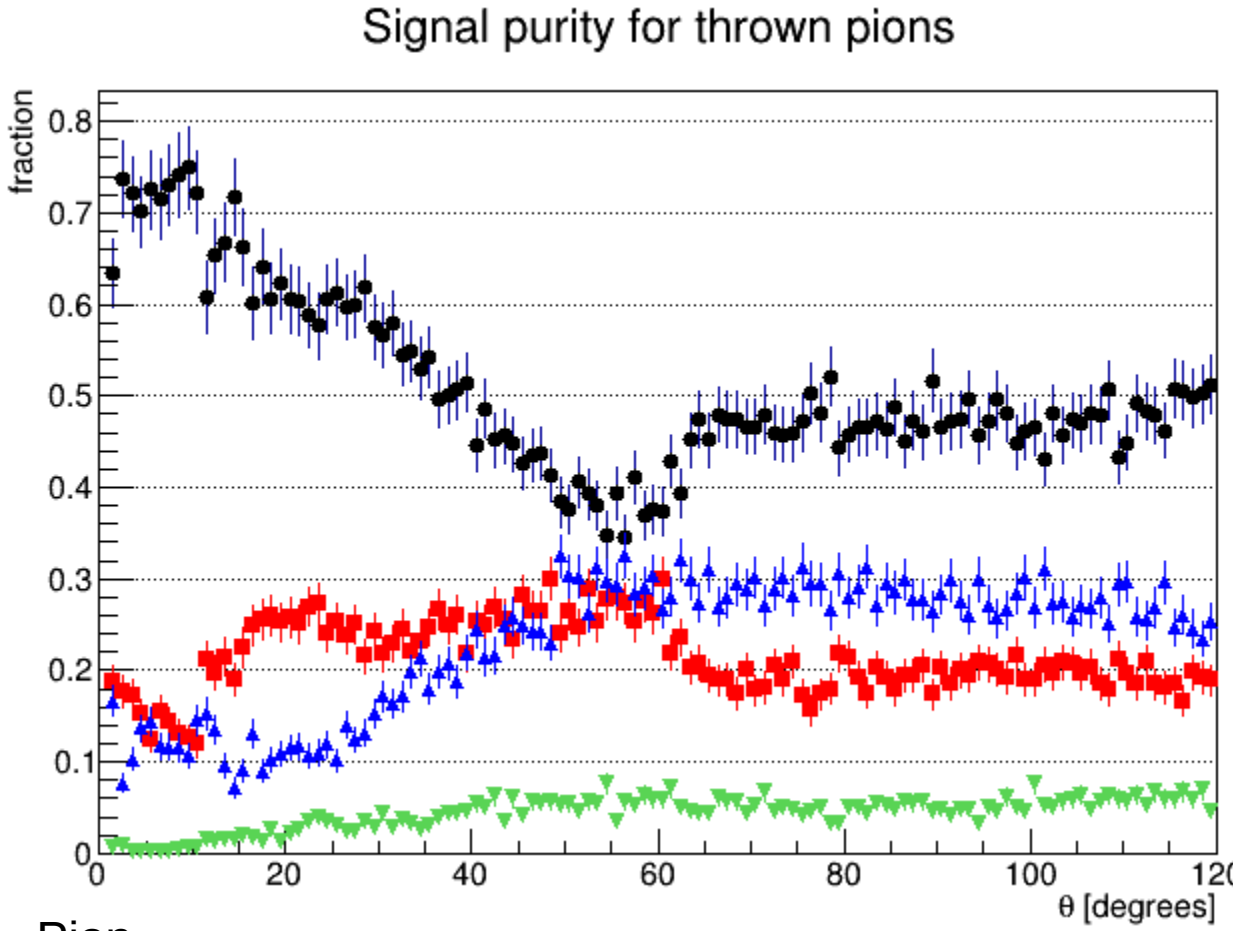


Pion
Kaon
Antiproton
Electron

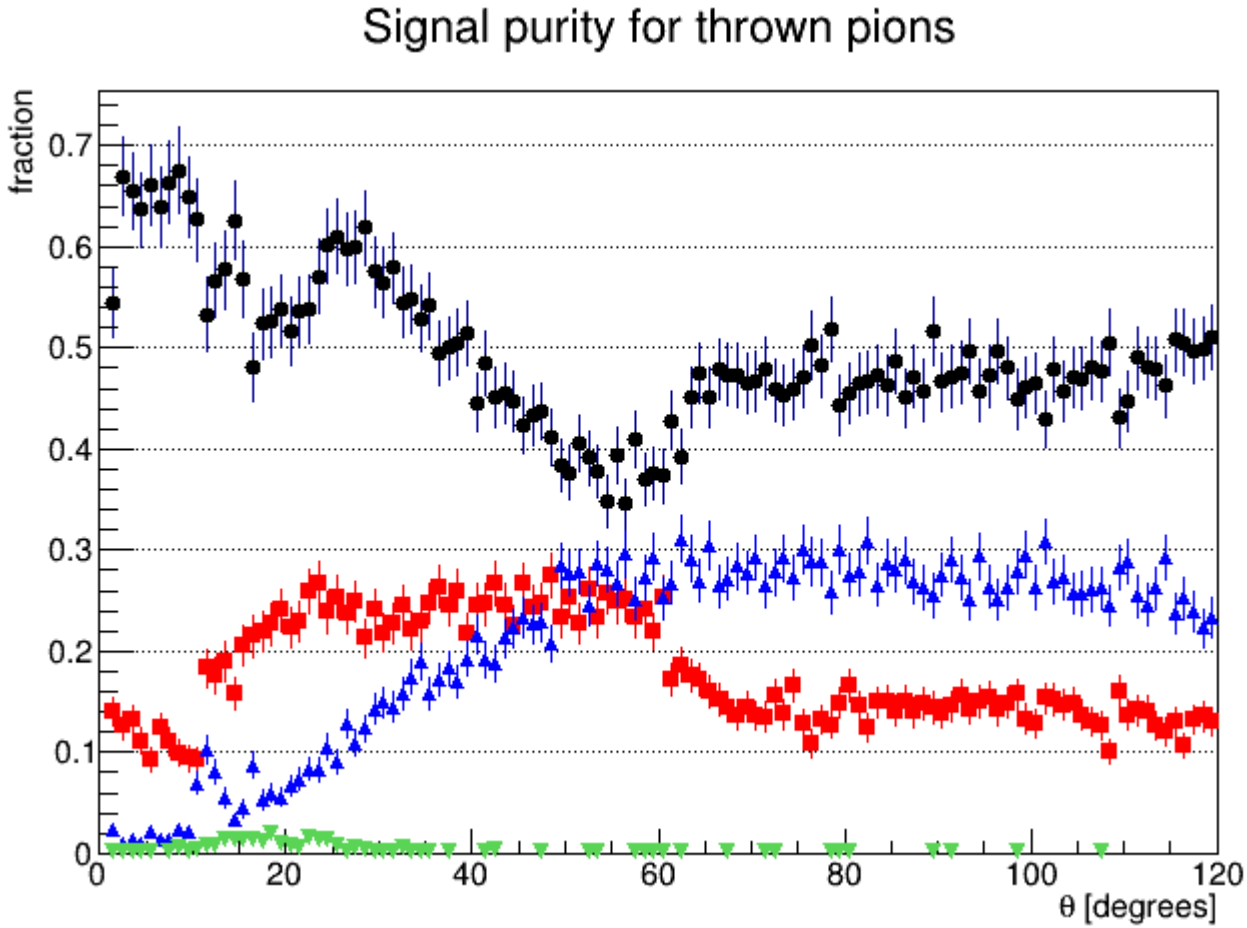
Jefferson Lab

2.0 GeV/c pions

No cut on PIDFOM



PIDFOM cut = 0.01 for all hypotheses



Pion
Kaon
Antiproton
Electron

Jefferson Lab

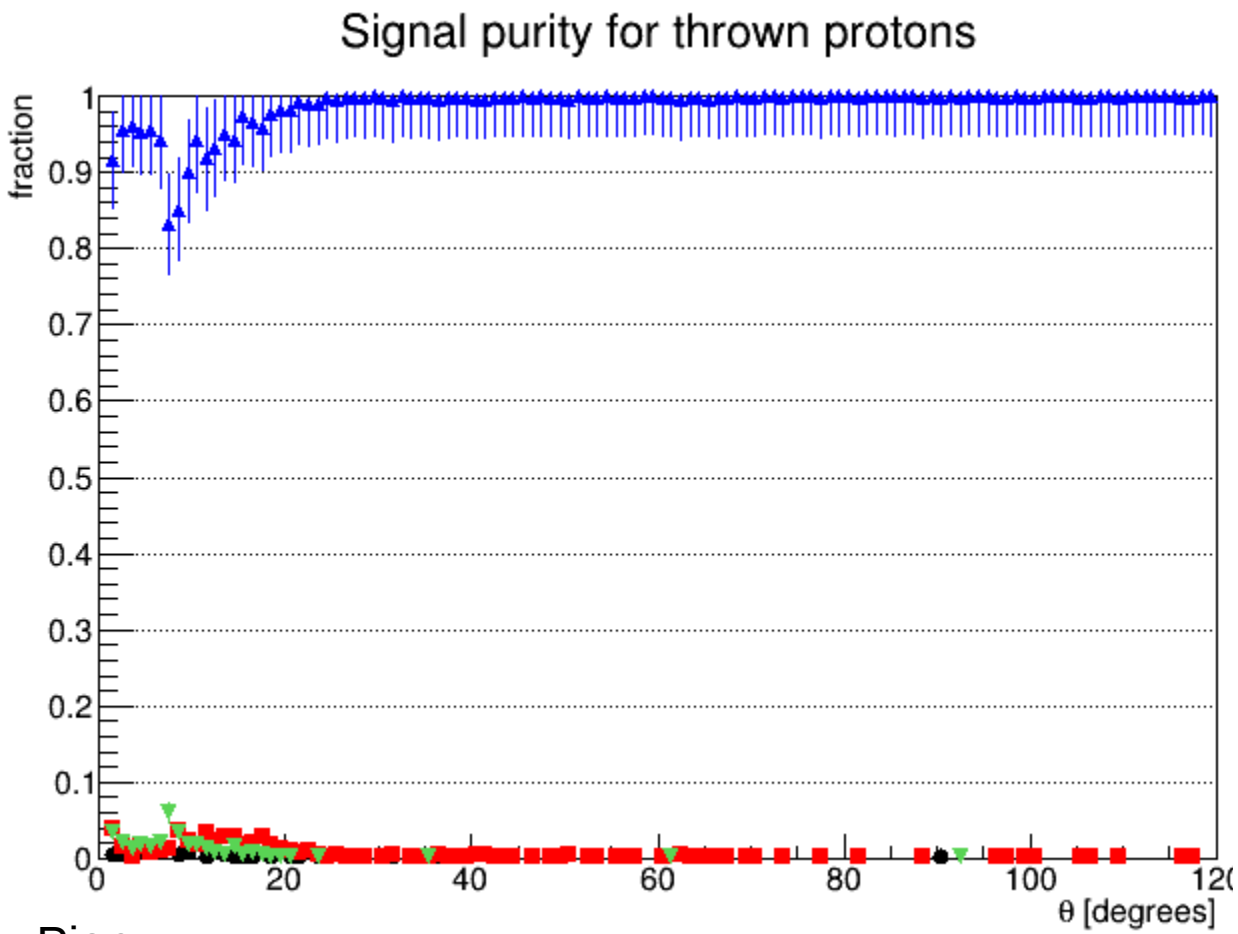
Proton simulations

- Particle gun: throw protons at discrete values of momentum (0.5, 1.0 GeV/c)
  - θ={1°,121°}, z={50 cm,80 cm}
  - Require reconstructed track within 3σ (p_x, p_y, and p_z) of thrown momentum
    - Select hypothesis with highest PIDFOM
    - No check on PIDFOM value yet – provides denominator for purity fraction
    - Numerator: counts for which highest PIDFOM above cut corresponds to a given particle hypothesis

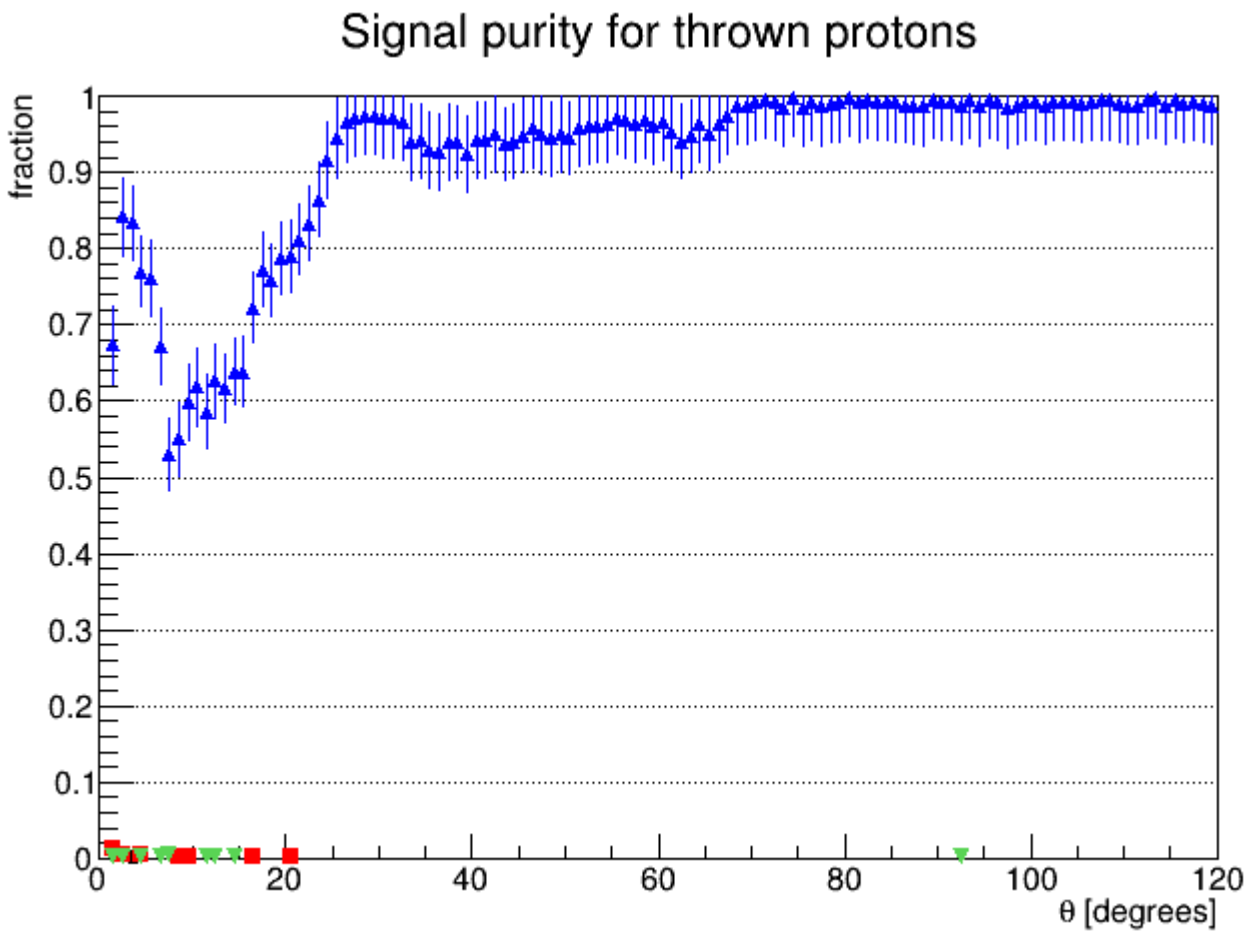
Directories containing Geant4 results:
/cache/halld/halld-scratch/REQUESTED_MC/ParticleGun/proton_0.5gev_g4_2019030103244 2pm/
/cache/halld/halld-scratch/REQUESTED_MC/ParticleGun/proton_1.0gev_g4_2019030411435 4am/

0.5 GeV/c protons

No cut on PIDFOM



PIDFOM cut = 0.01 for all hypotheses

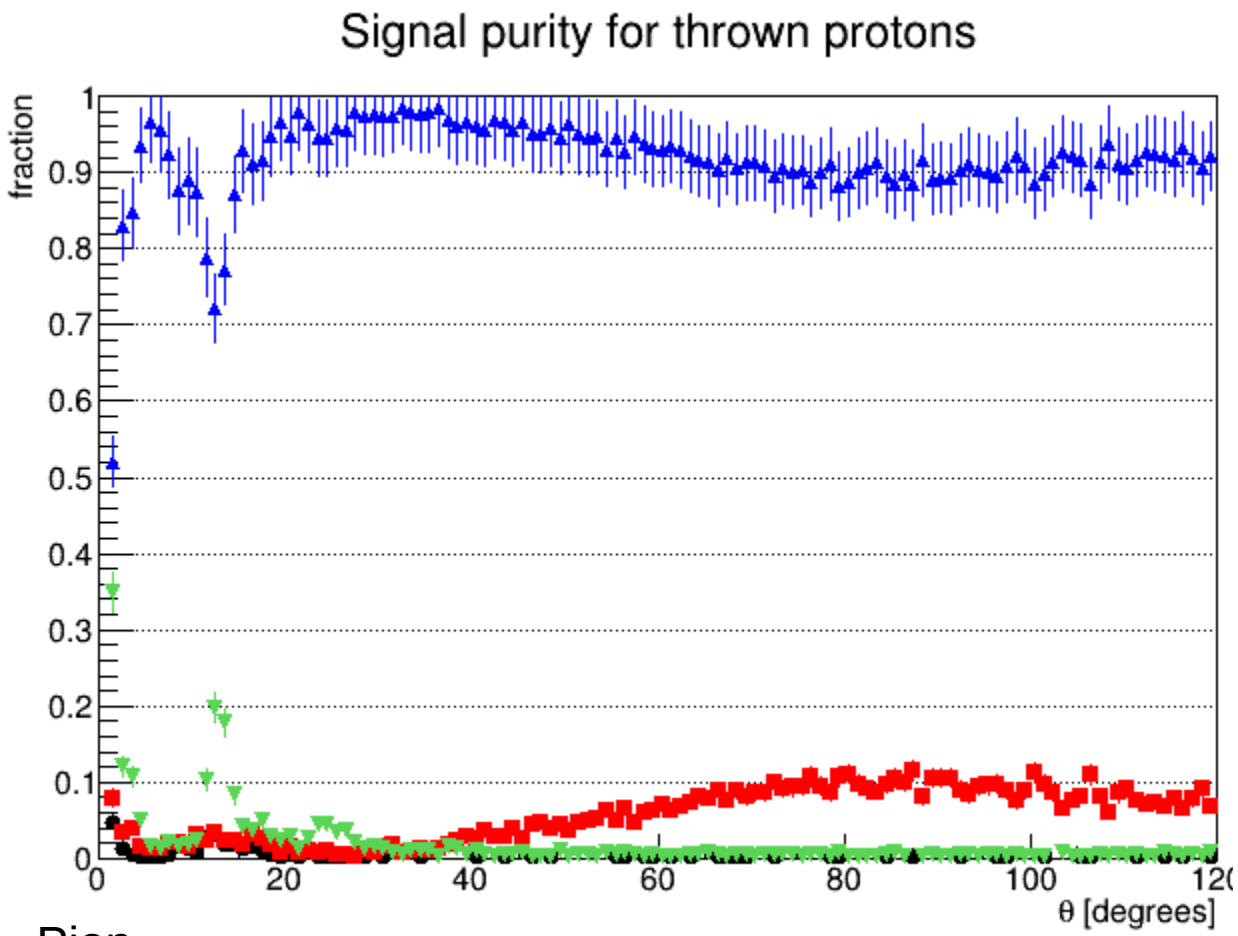


Pion
Kaon
Proton
Positron

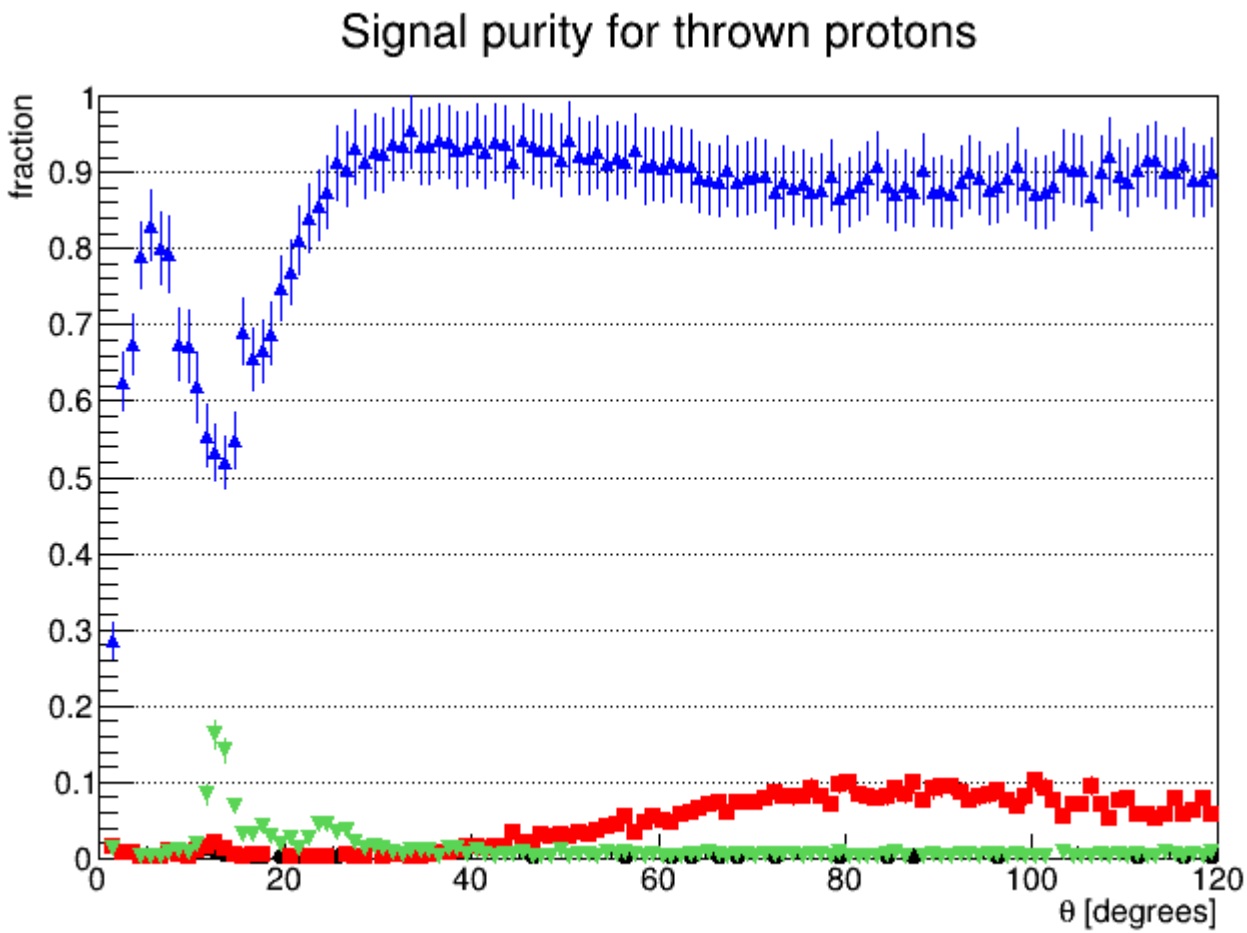
Jefferson Lab

1.0 GeV/c protons

No cut on PIDFOM



PIDFOM cut = 0.01 for all hypotheses



Pion
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Jefferson Lab

Summary

- Likelihood of correctly identifying pions depends on momentum and angle
  - Decreases from about 70%
- Likelihood of false kaon and anti-proton IDs increases with momentum, especially at back angles
- False electron ID more common at low angles and momenta
  - Electron identification needs more work...

- Likelihood of correct proton ID drops dramatically in the CDC→FDC transition region near 20°