ANALYSIS OF THE EMPTY CELL RUNS INCLUDING COMPARISON WITH SIMULATION

$$\gamma p \rightarrow \rho p \rightarrow \pi^{+}\pi^{-}p$$

NATHALY SANTIESTEBAN
APRIL 2021

DATA SELECTION

Empty Cell Runs
030333 030334 030335 030336 030337
030728 030949 030564 041155 040903
041615 051556 041386 051011 051013 050766)

- $E_\gamma > 7$ GeV
- 3 Charged Tracks (-,+,+) = (π^-, π^+, p) (Hypothesis)
  - Probability of being (π^-, π^+, p) > 1E-4 based on the timing information.
  - Vertex fit (Coming from the same vertex)
  - CL>0.002 (Confidence Level of the vertex fit

- 79.8 cm < Z_{vertex} < 85 cm: Kapton and Al endcaps selection
- $|dE| < 1$ GeV, where $dE = E_\gamma + m_p - E_p - E_{\pi^+} - E_{\pi^-}$
- In-time Photons $\Delta t = t - \left(t_{RF} + \frac{Z_{vtx} - Z_{Center}}{29.9792458} \right) < 2ns$

  t : Time from the vertex fit

  t_{RF} : Time from the beam to the center of the target

  Z_{vtx} : Z position from the vertex fit

  Z_{center} : Z position from the center of the target (65 cm)

$\gamma p \to \rho p \to \pi^+\pi^- p$
CANDIDATES

- Mass of the reconstructed rho: $0.6 < m_\rho < 1.$ [GeV]
- Coplanarity between ρ and p: $150 < \Delta\phi(\rho - p) < 200$ deg
- The remaining improperly reconstructed π^+ and p can be removed by using: $m^2_{\pi^- p} > 4\ \mathrm{GeV}^2$ and keep most of the $t > -1 GeV^2$GeV, $u > -2 GeV^2$GeV

$t = -(P_\gamma - P_\rho)^2$ where $P_\rho = P_{\pi^+} + P_{\pi^-}$
$s = (P_\rho - P_p)^2$
$u = -(P_\gamma - P_p)^2$

$\gamma p \rightarrow \rho p \rightarrow \pi^+\pi^- p$
SIMULATION

- Generated for ^4He
- Two components Mean Field (MF) and Short Range Correlation (SRC)
- Uses hdgeant4
- All events in the simulation was from the center of the target.
- The simulation events have been selected using the same logic than the data. (Requirements for the event selection)

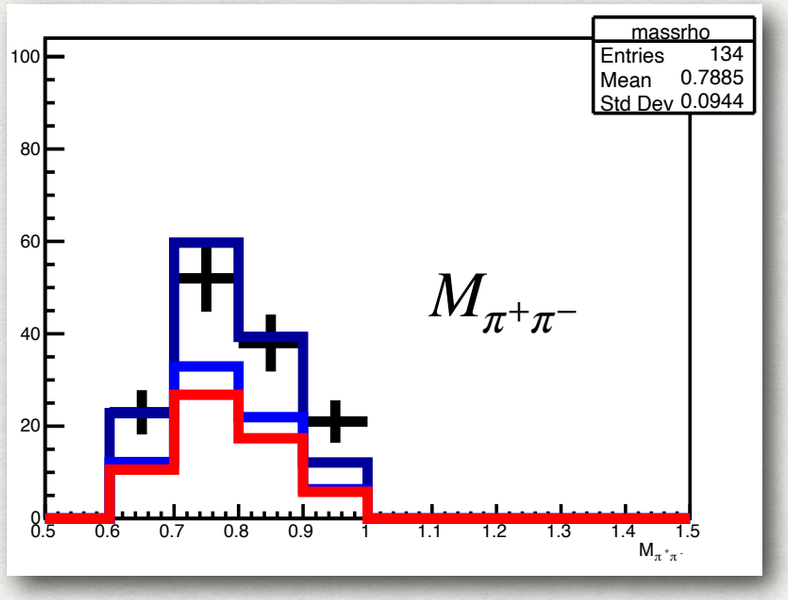
RECONSTRUCTED EVENTS

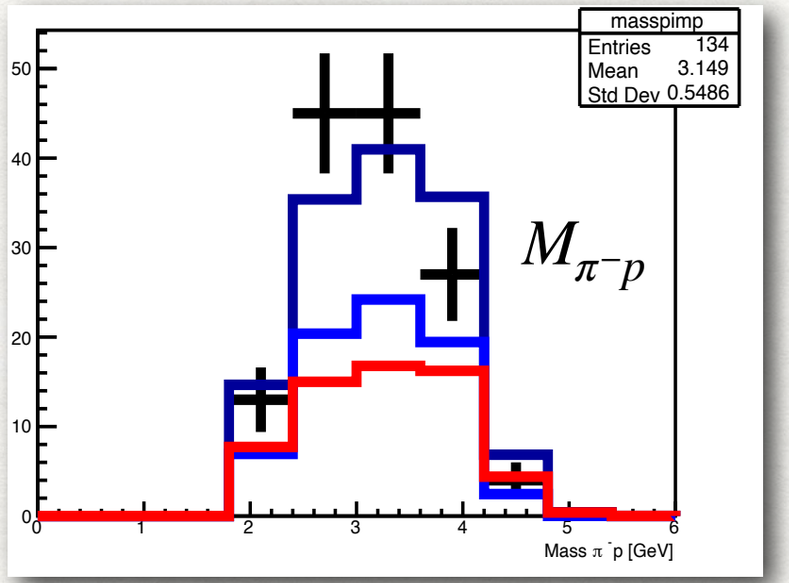
+ Data

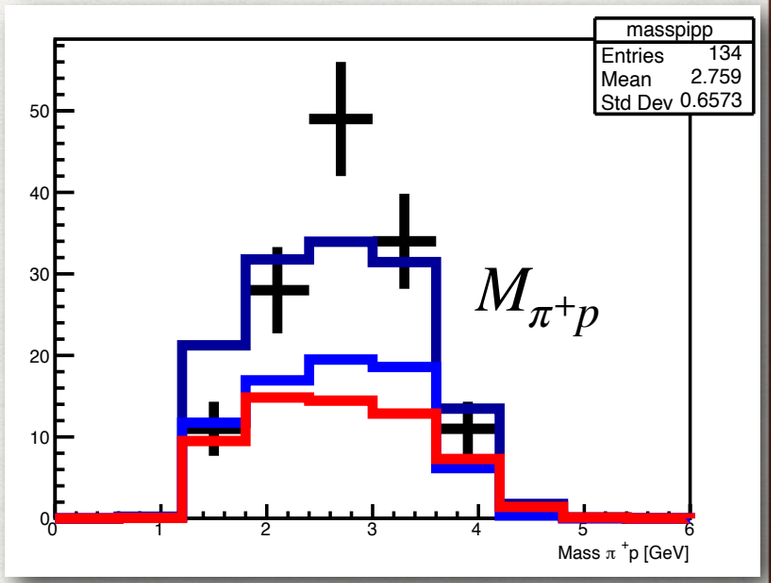
MF+SRC Simulation

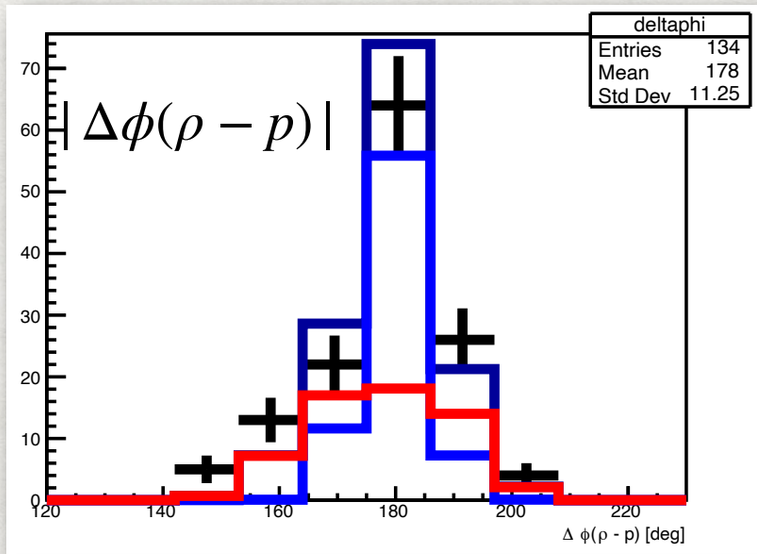
MF Simulation

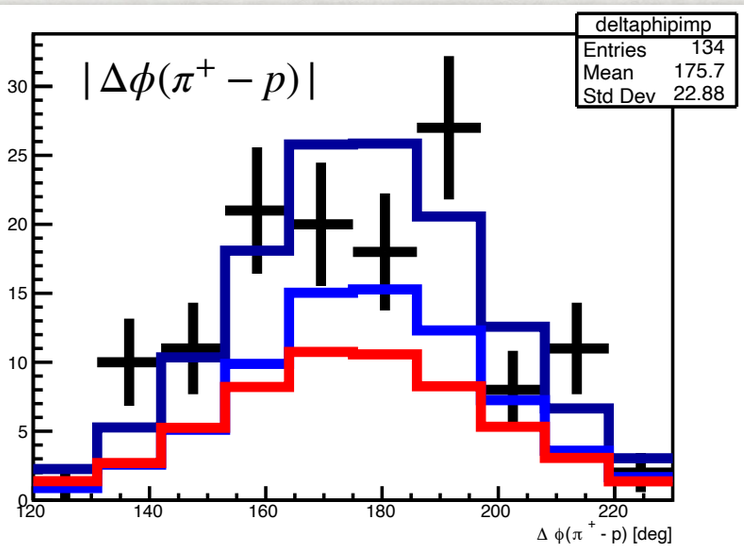
SRC Simulation

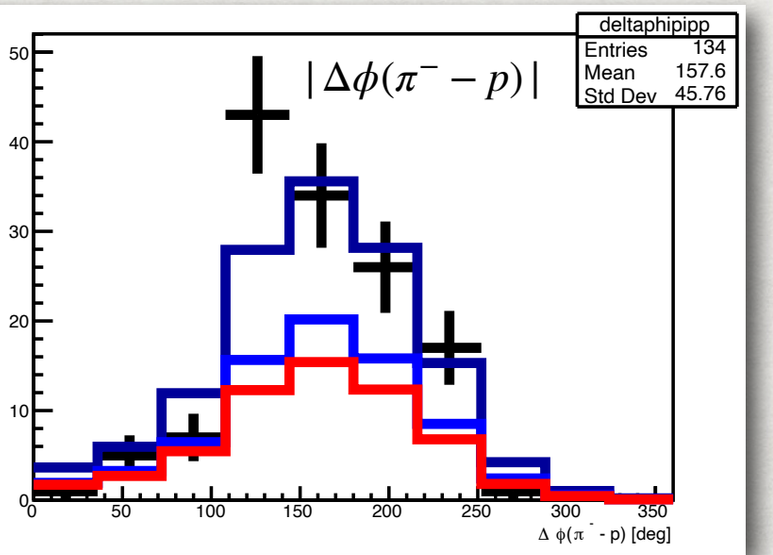




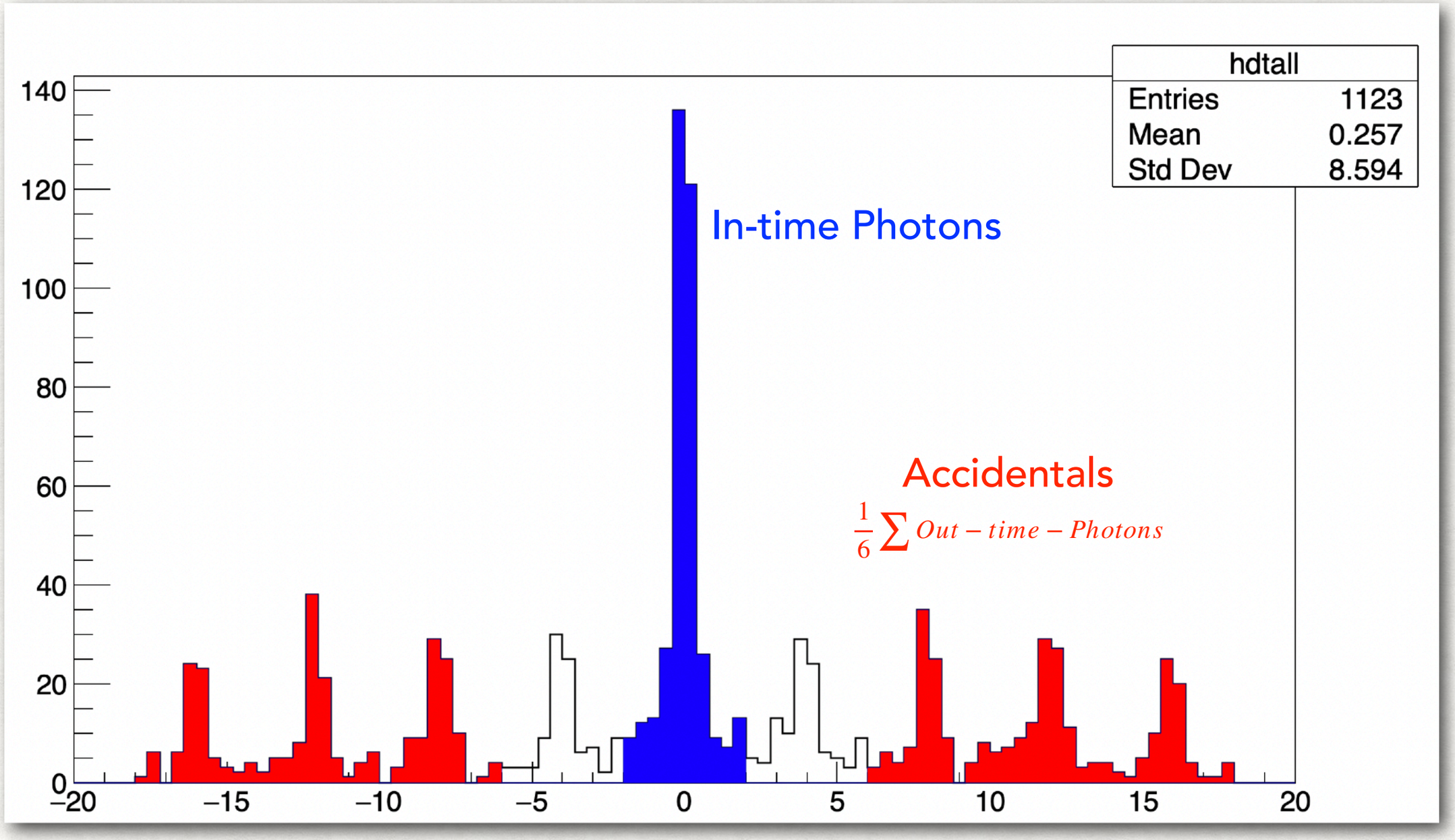








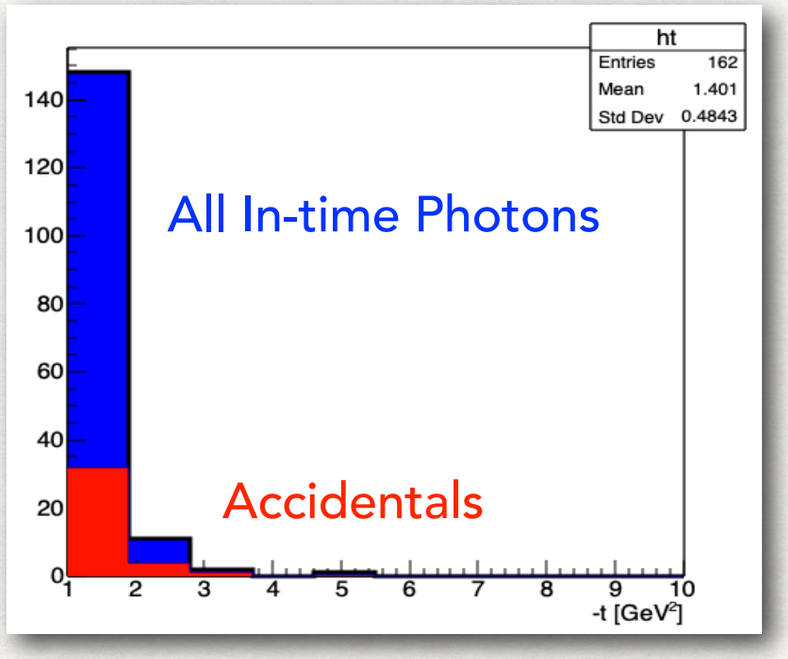
ACCIDENTALS SUBTRACTION



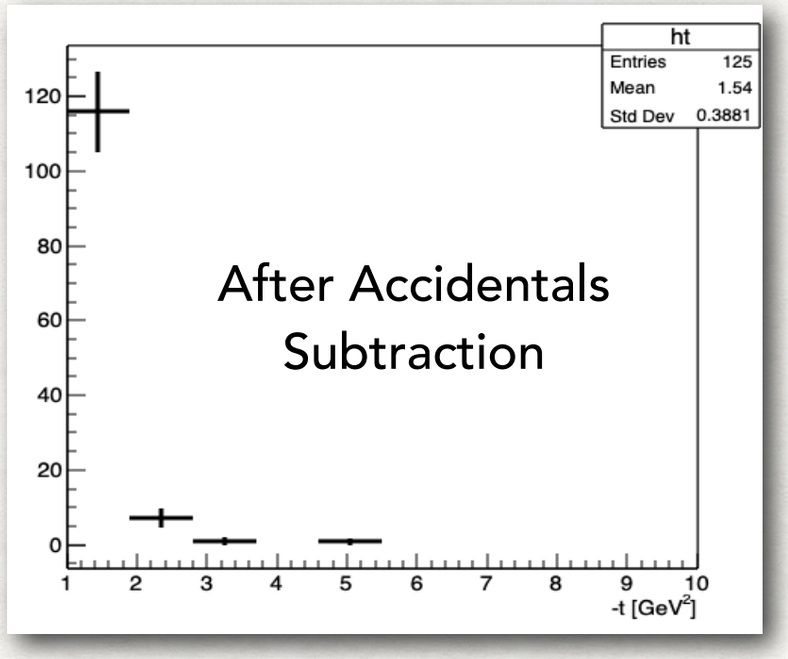
Only in-time photons are selected

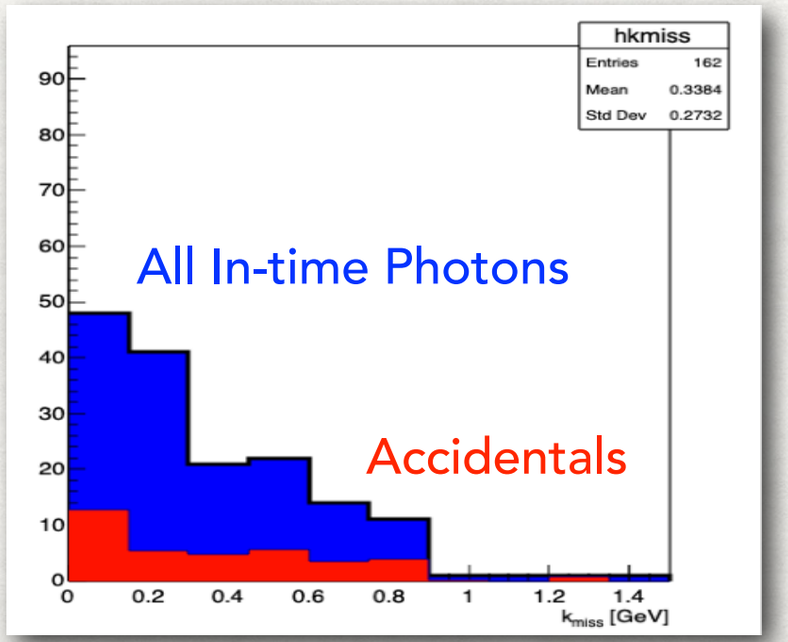
ACCIDENTALS SUBTRACTION

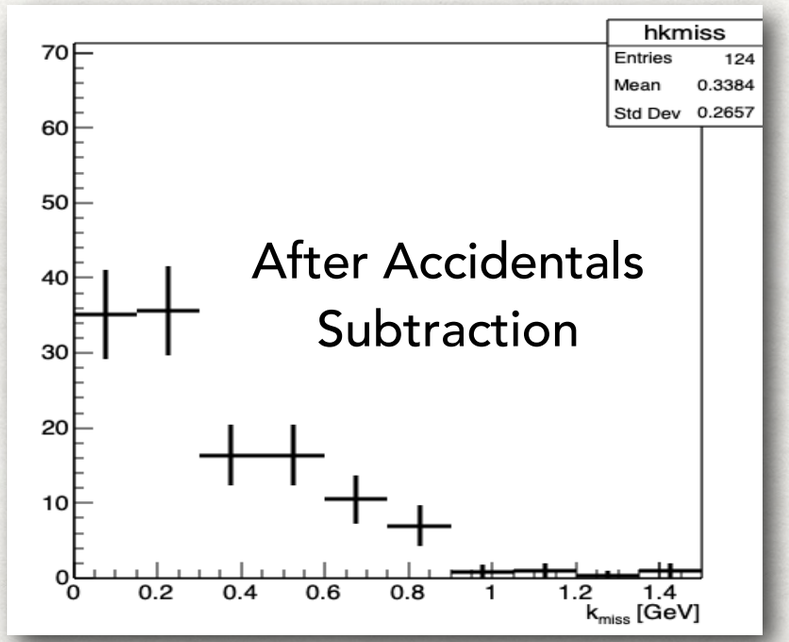
EXAMPLE



After Accidental Subtraction

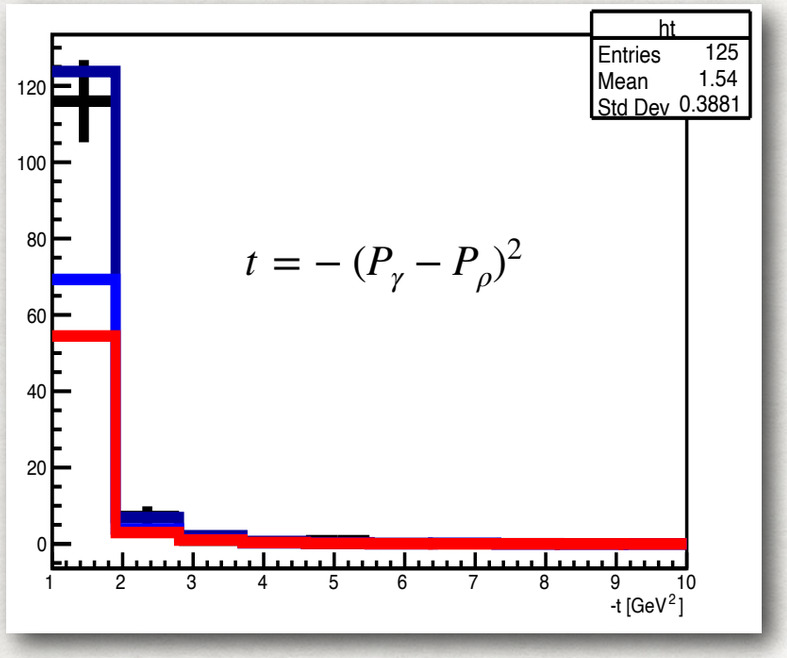


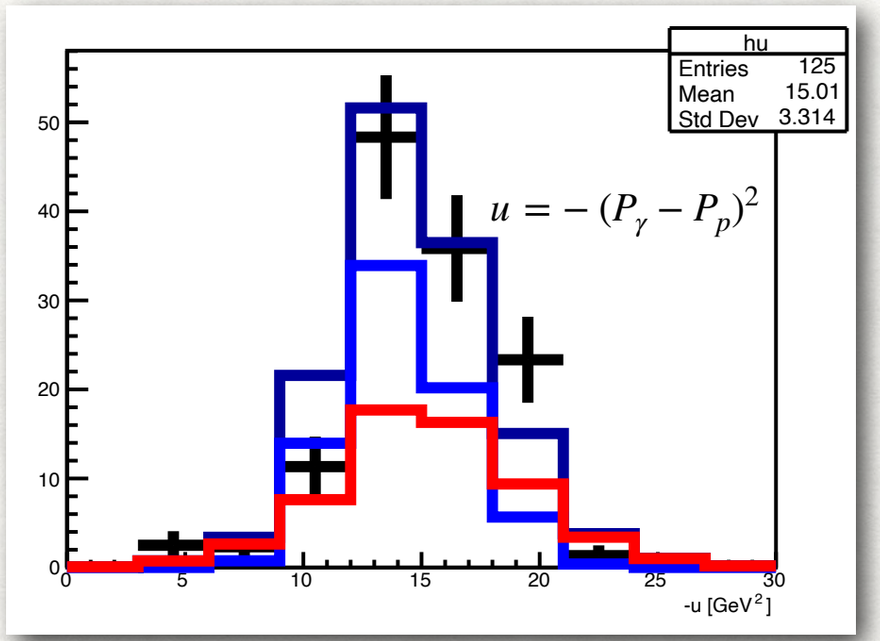


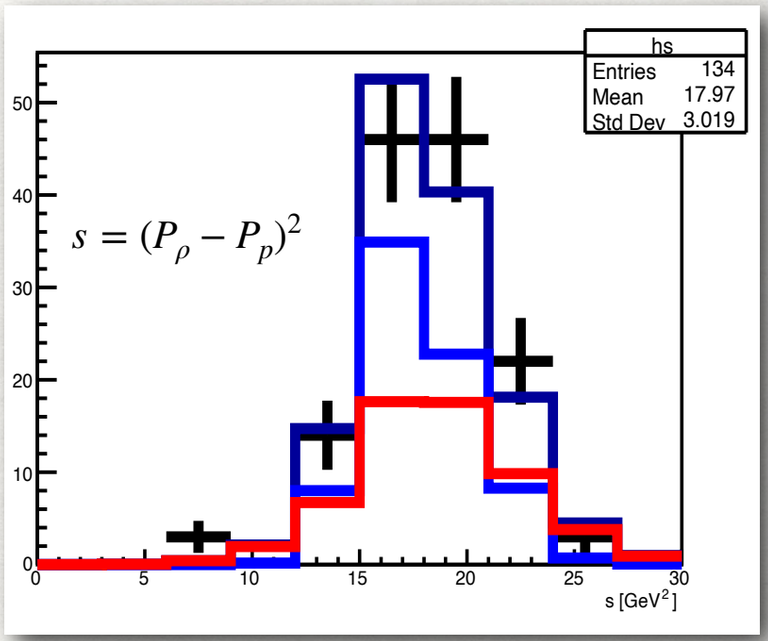


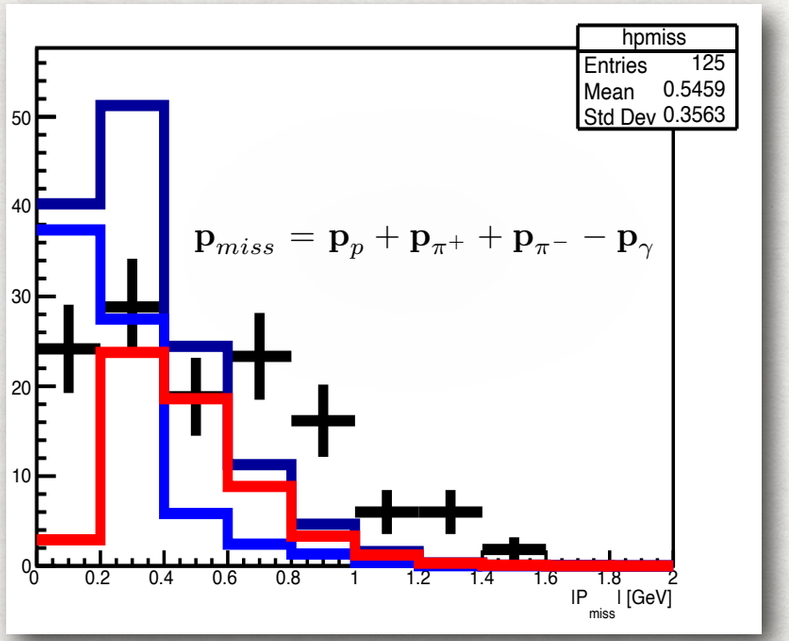
DATA VS SIMULATION

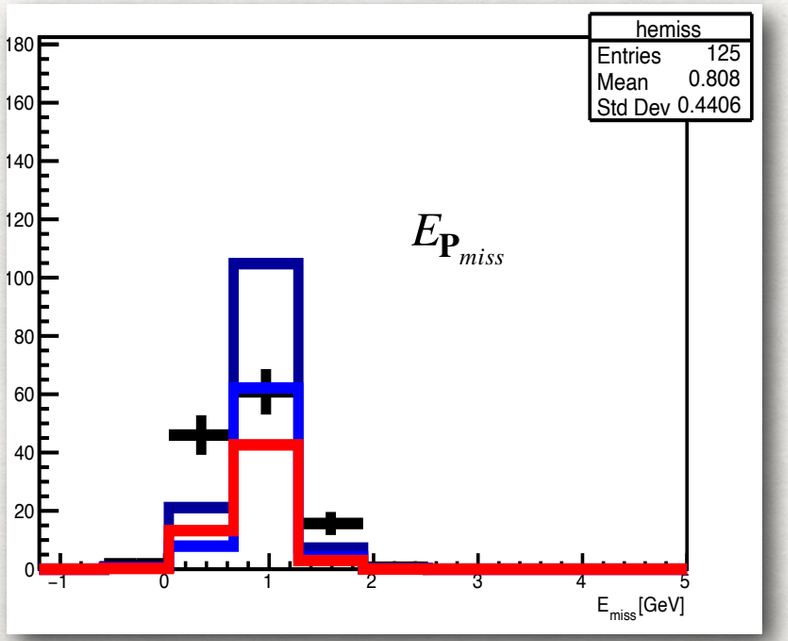
+ Data
MF+SRC Simulation
MF Simulation
SRC Simulation

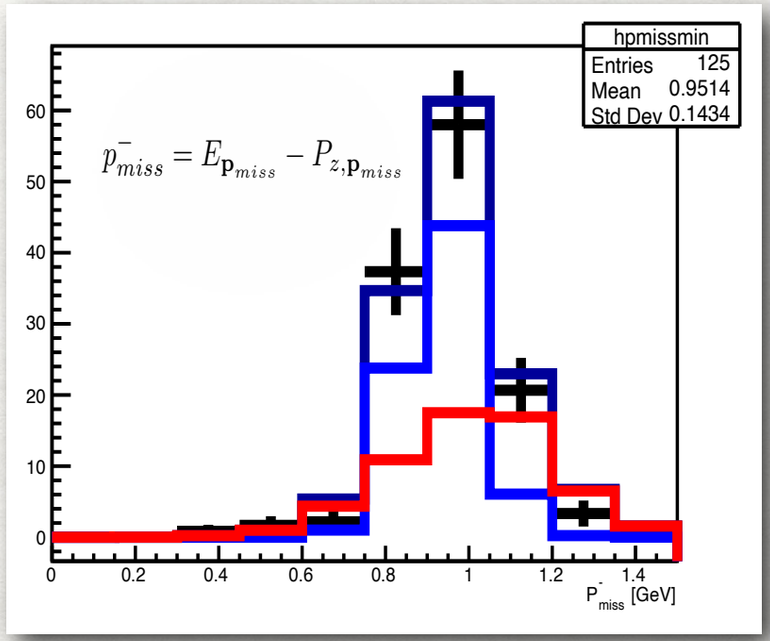






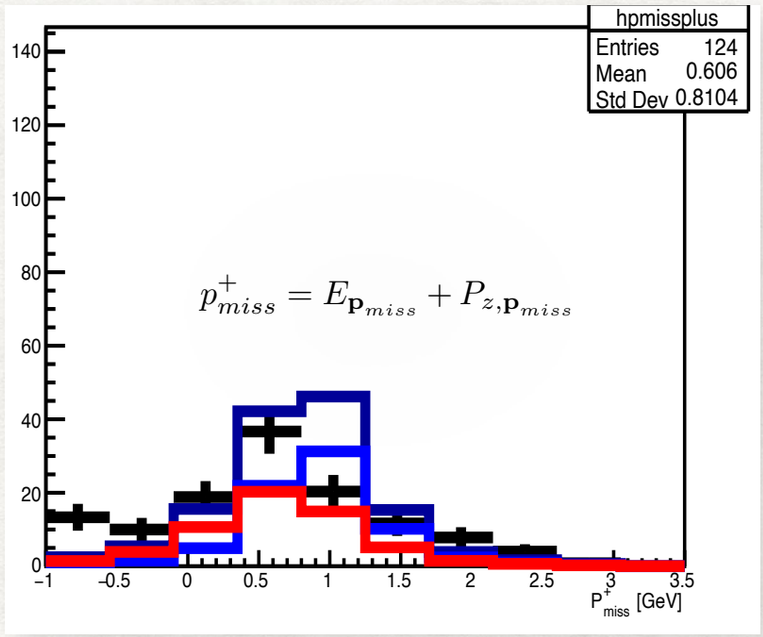


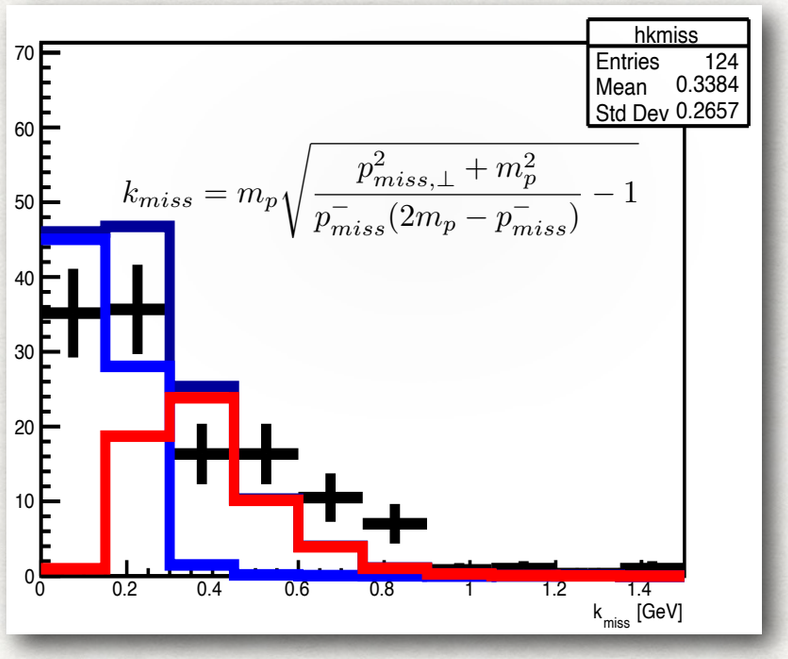


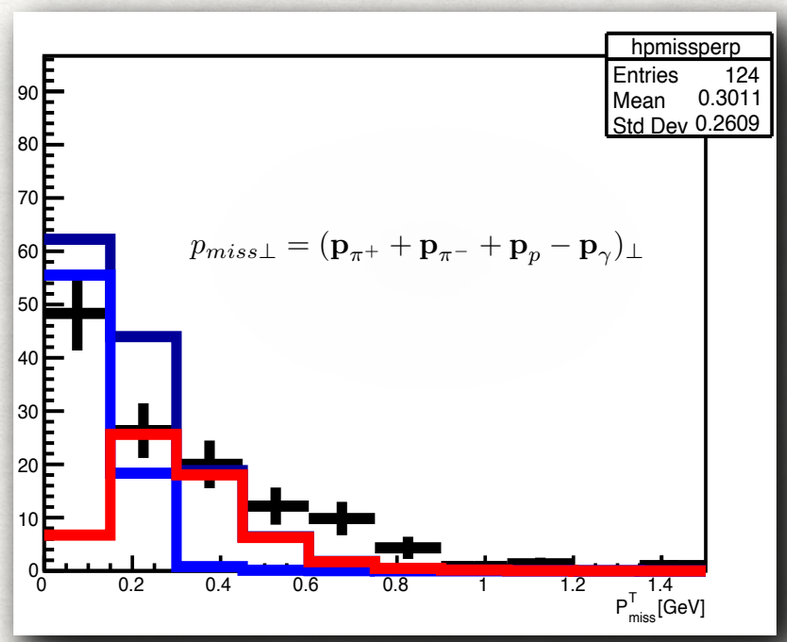


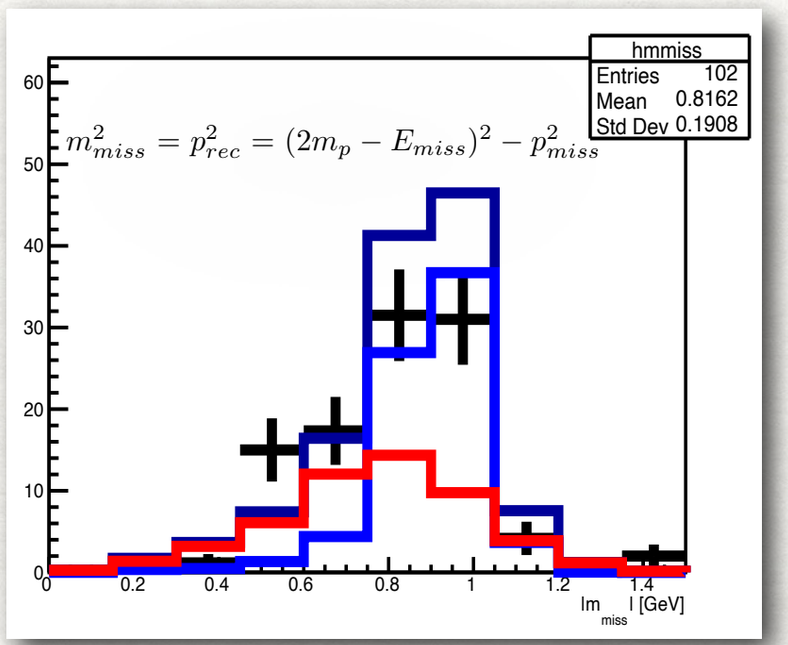
DATA VS SIMULATION

+ Data
MF+SRC Simulation
MF Simulation
SRC Simulation









COMPARING PROTON AND NUCLEAR TARGETS

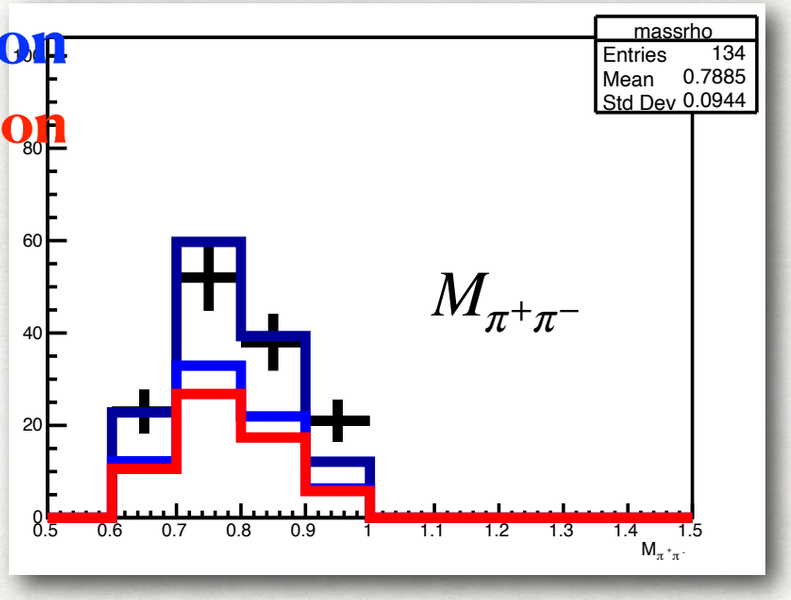
+ **Data**

MF+SRC Simulation

MF Simulation

SRC Simulation

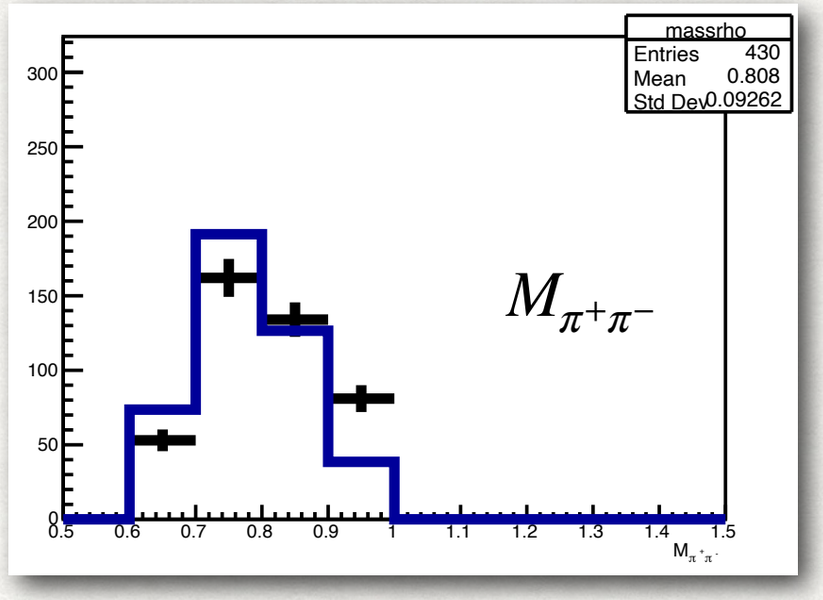
- 79.8 cm < Z_{vertex} < 85 cm

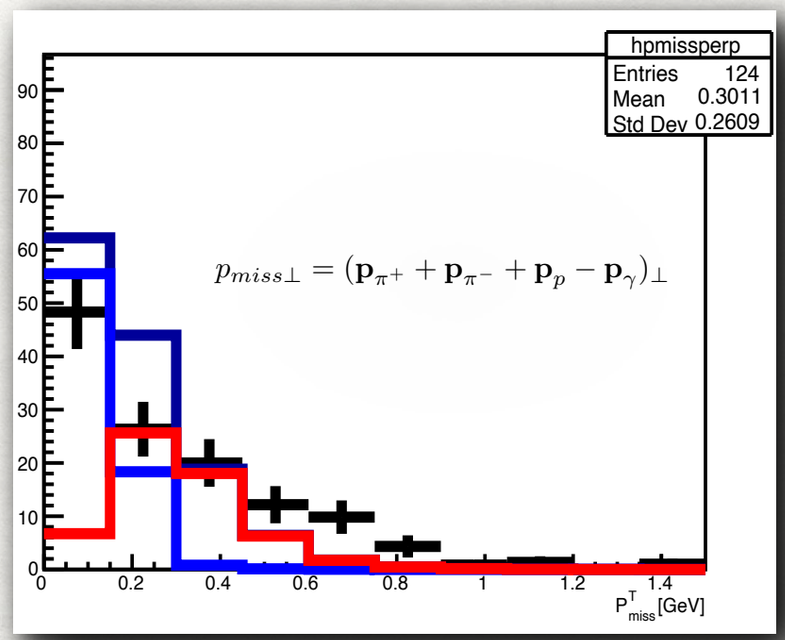


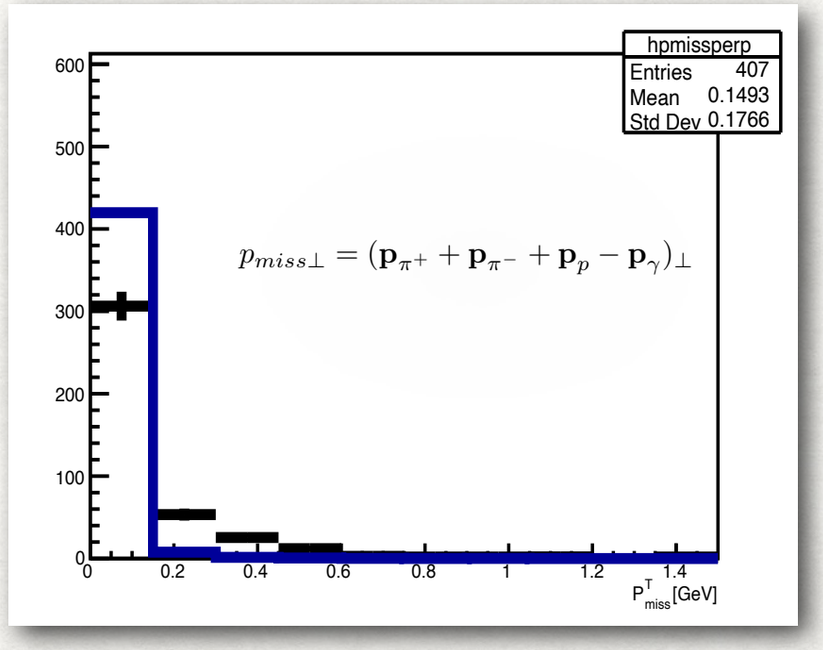
+ **Data**

Proton Simulation

- 60 cm < Z_{vertex} < 70 cm







COMPARING PROTON AND NUCLEAR TARGETS

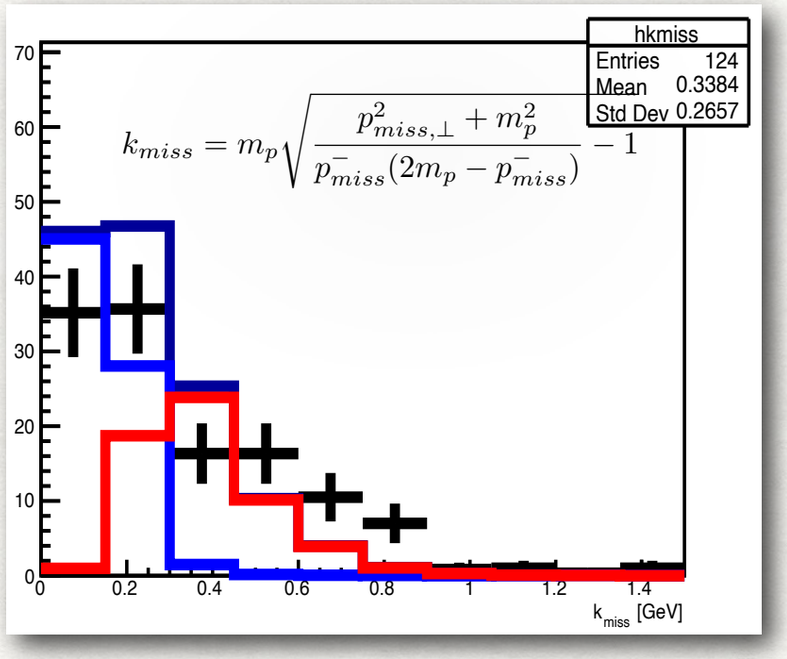
+ **Data**

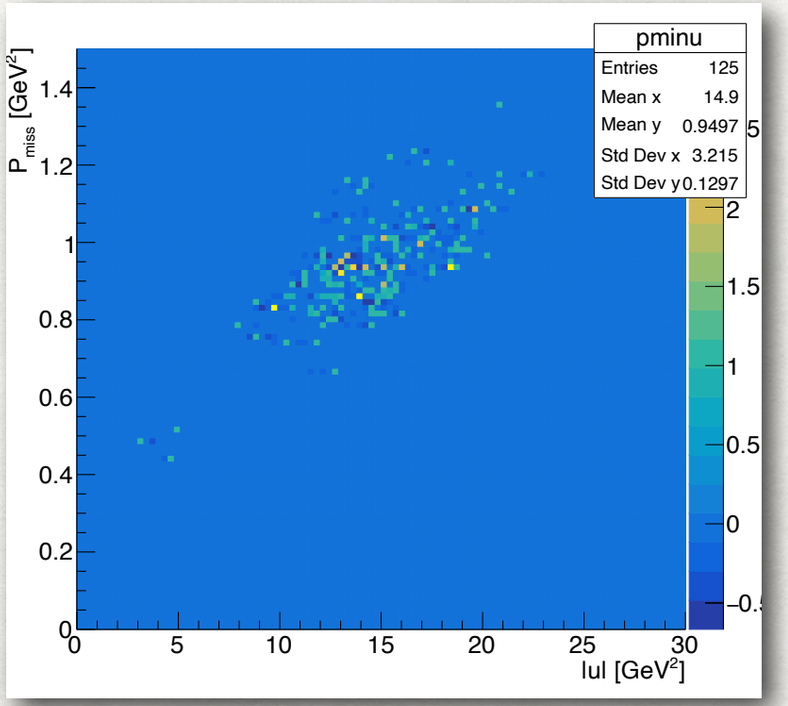
MF+SRC Simulation

MF Simulation

SRC Simulation

- 79.8 cm < Z_{vertex} < 85 cm

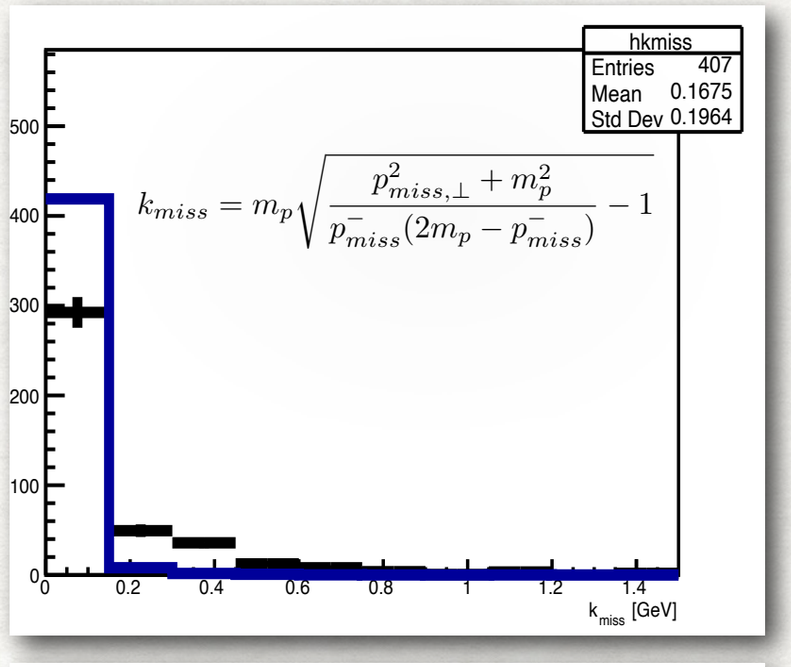


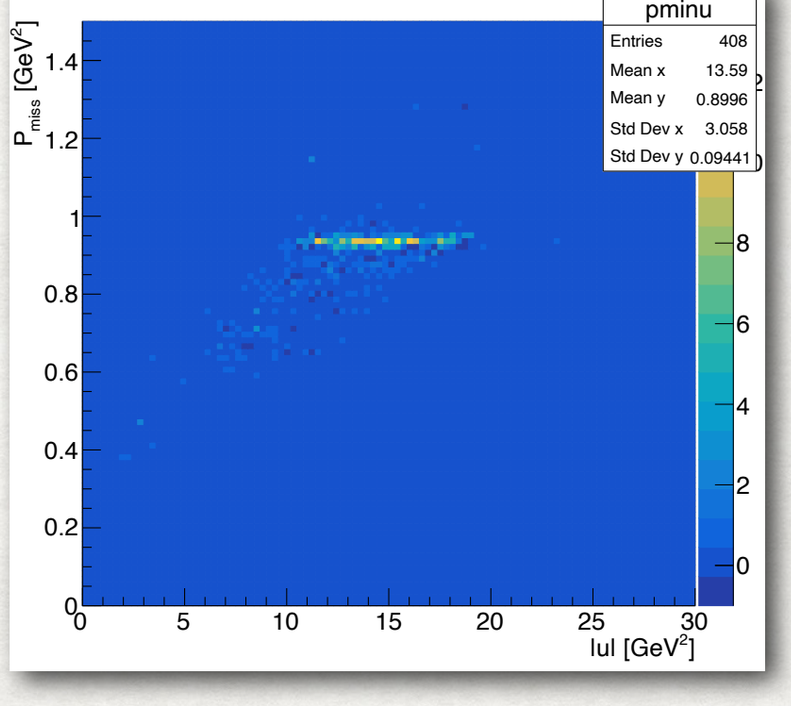


+ **Data**

Proton Simulation

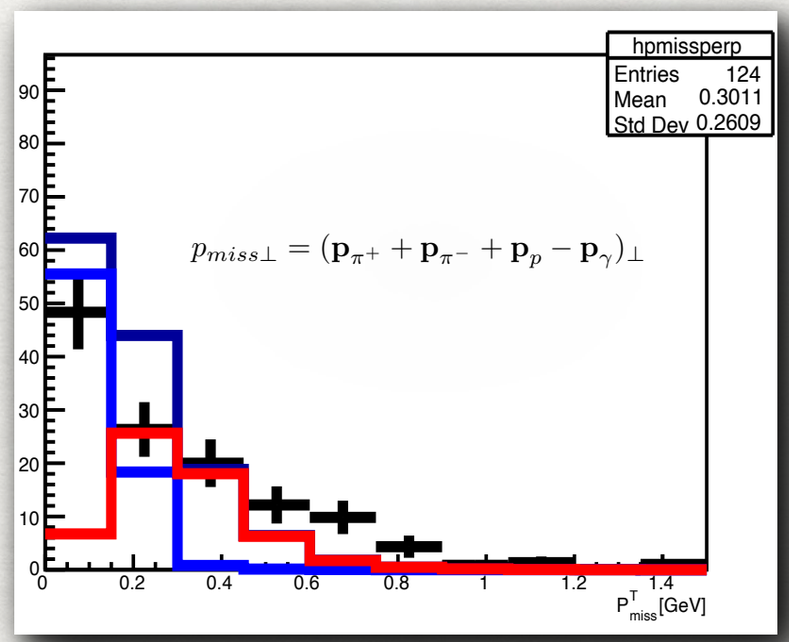
- 60 cm < Z_{vertex} < 70 cm



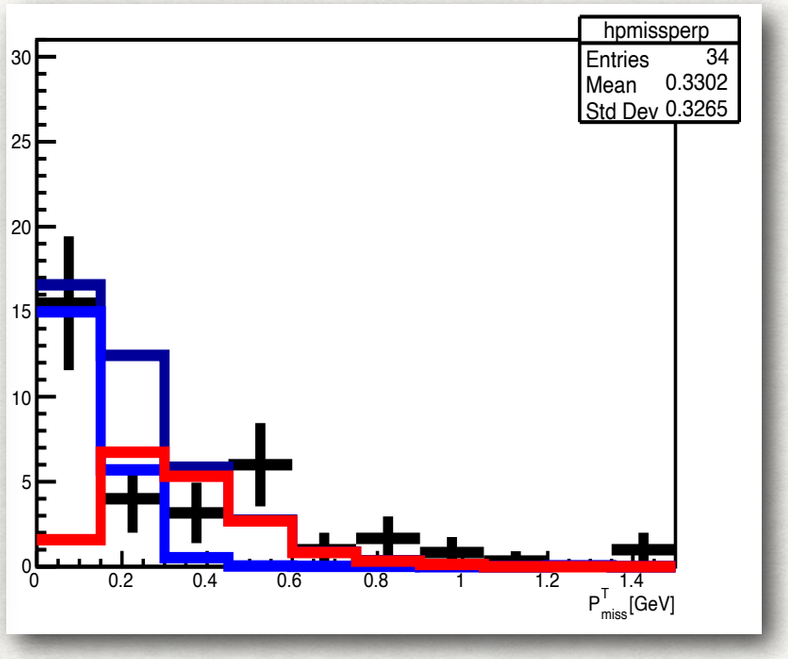
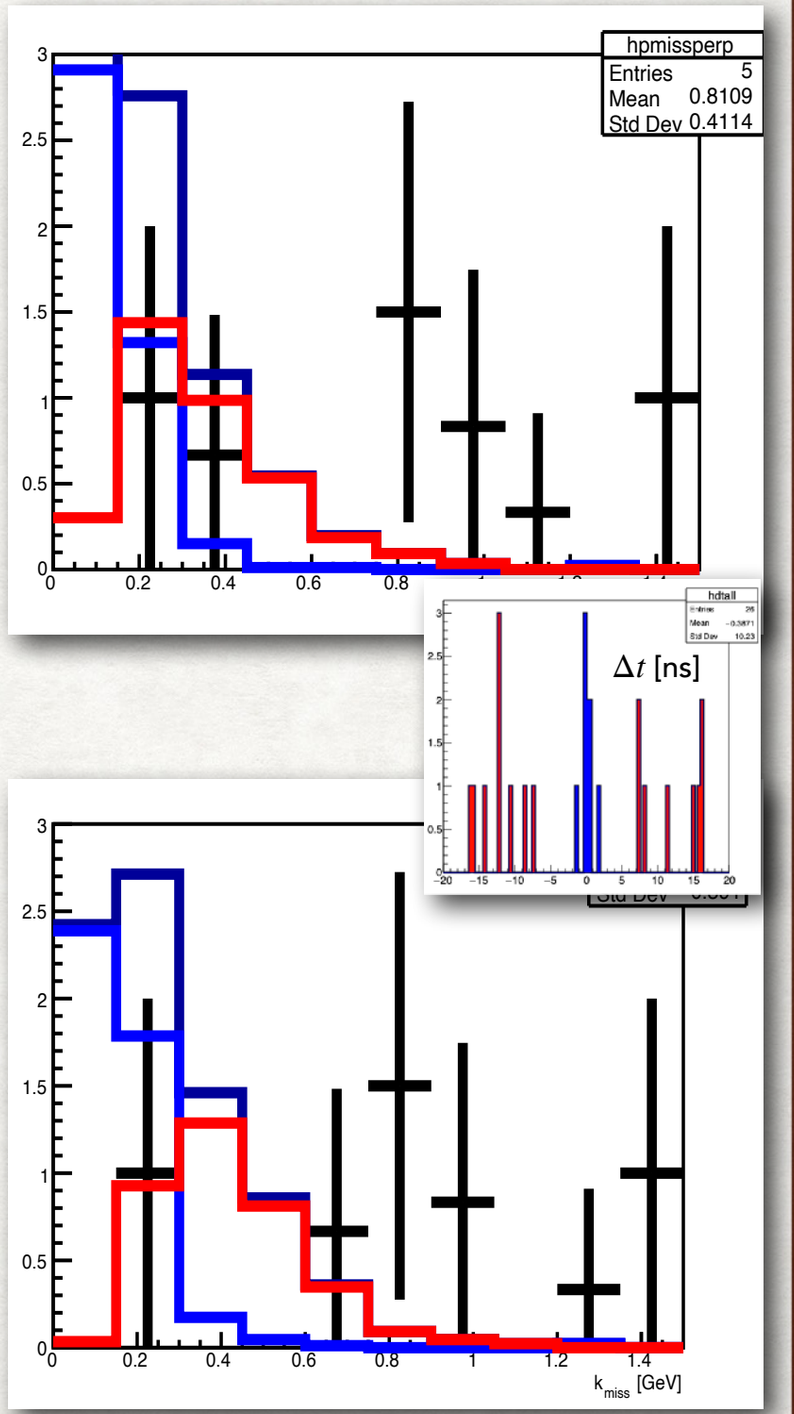
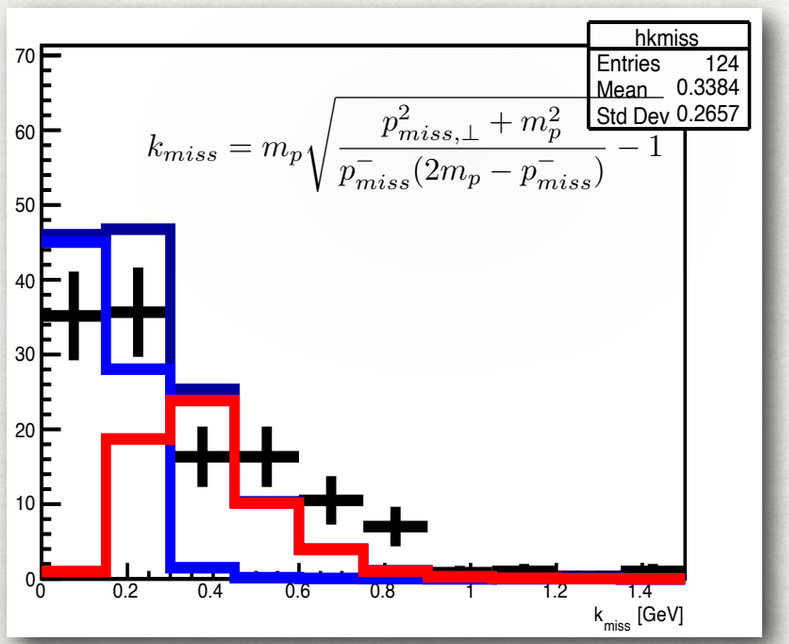
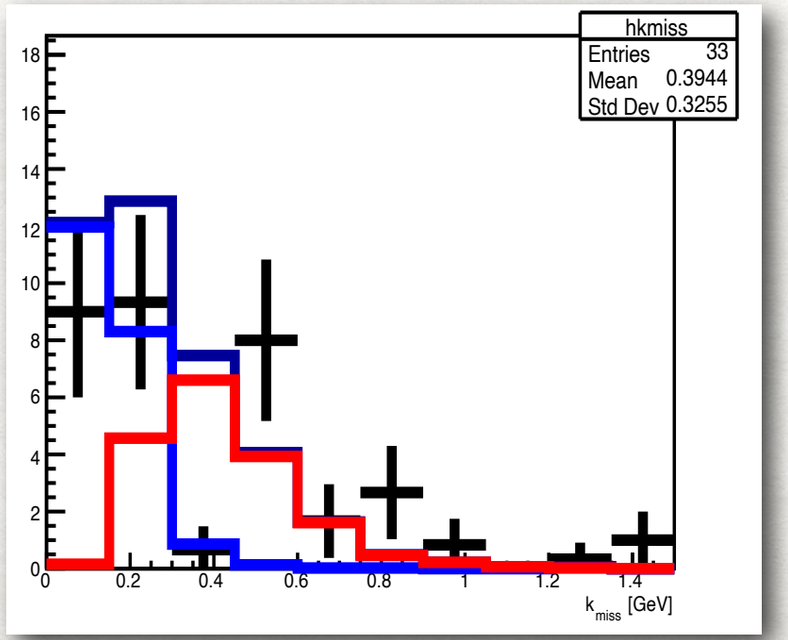


VARYING $|t|$ CUT

$t > -1GeV^2$



$t > -1.5GeV^2$



$t > -2GeV^2$