ONLINE ANALYSIS

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

NATHALY SANTIESTEBAN
NOV 4/2021

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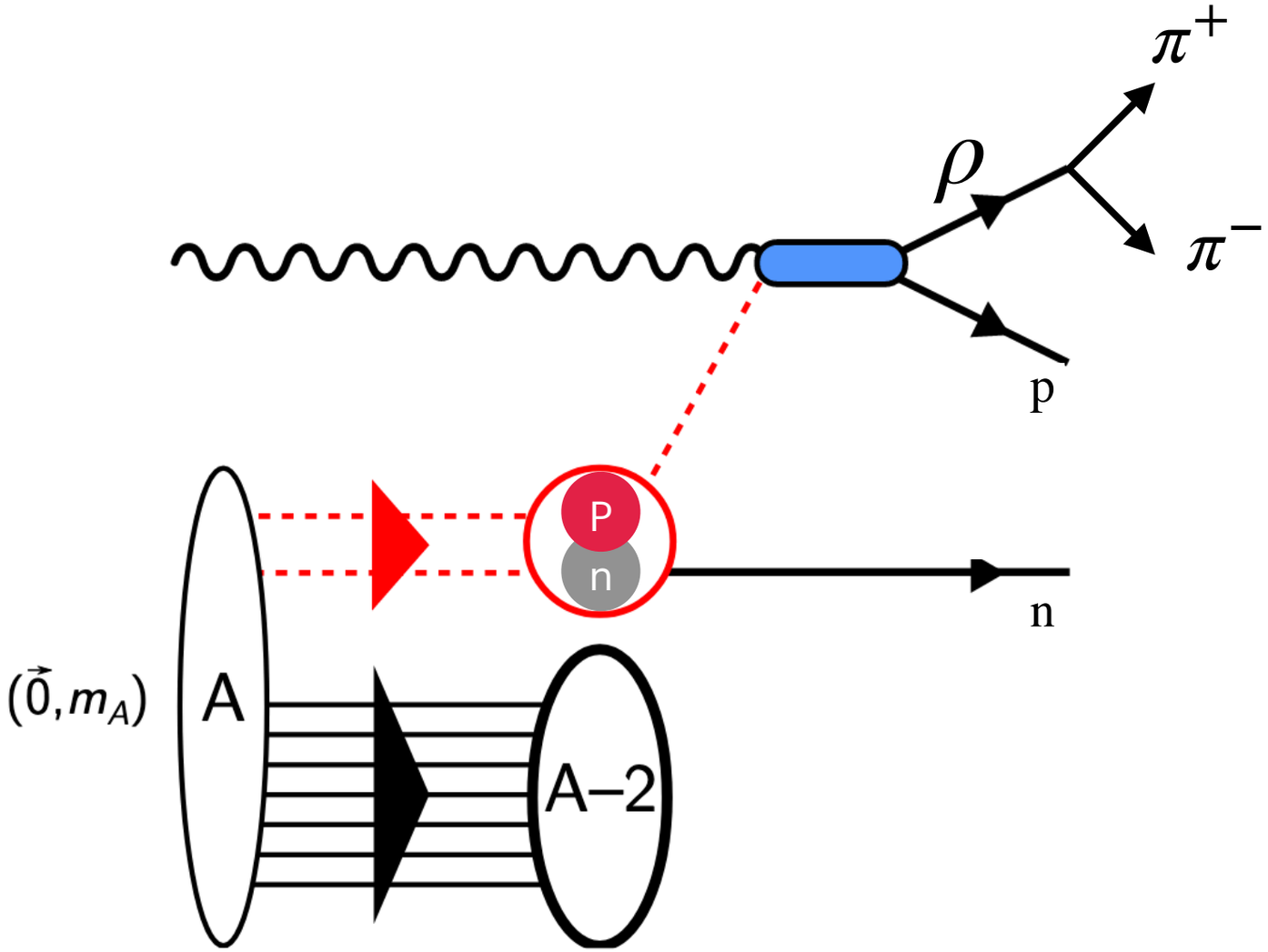

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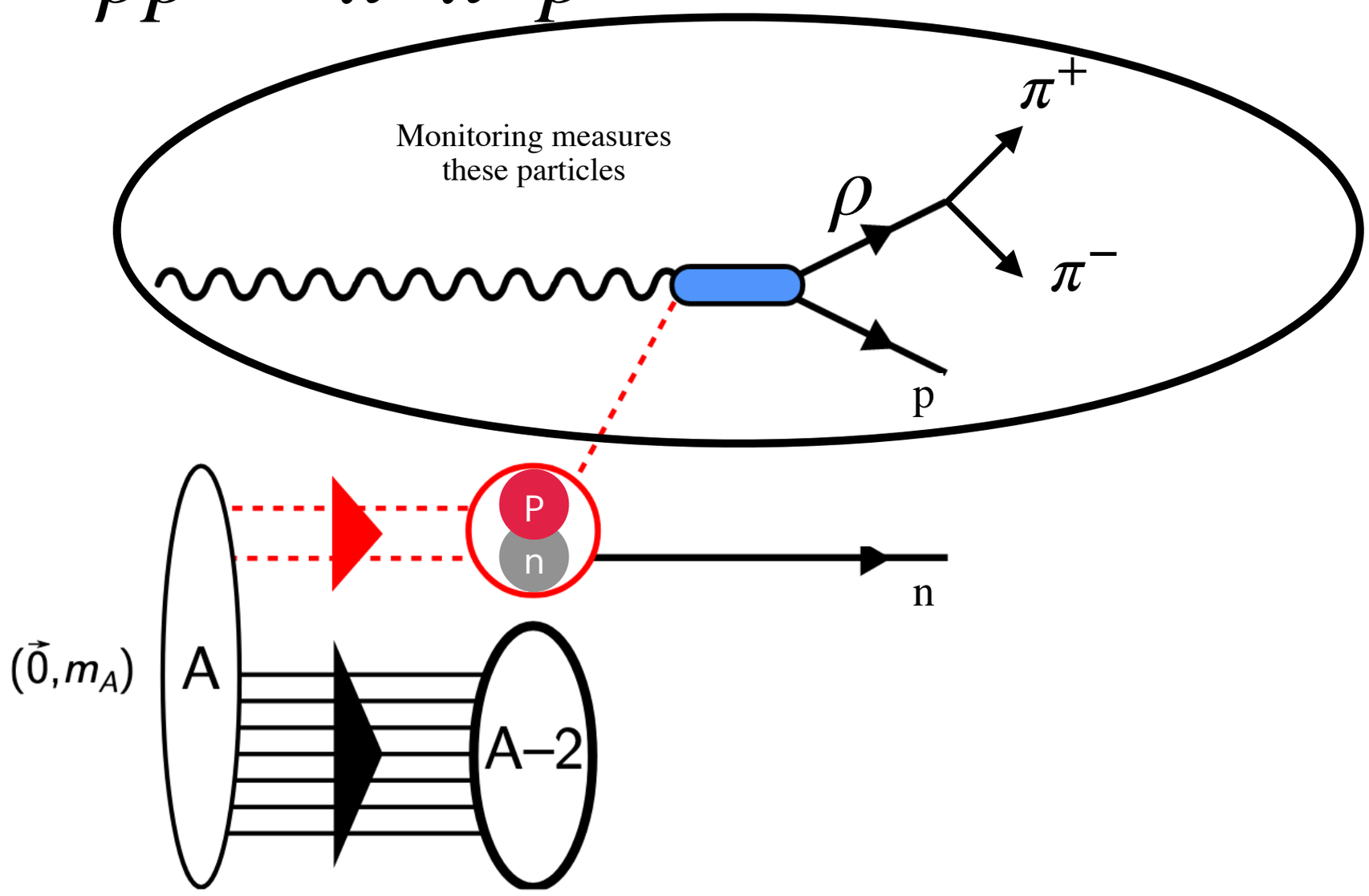

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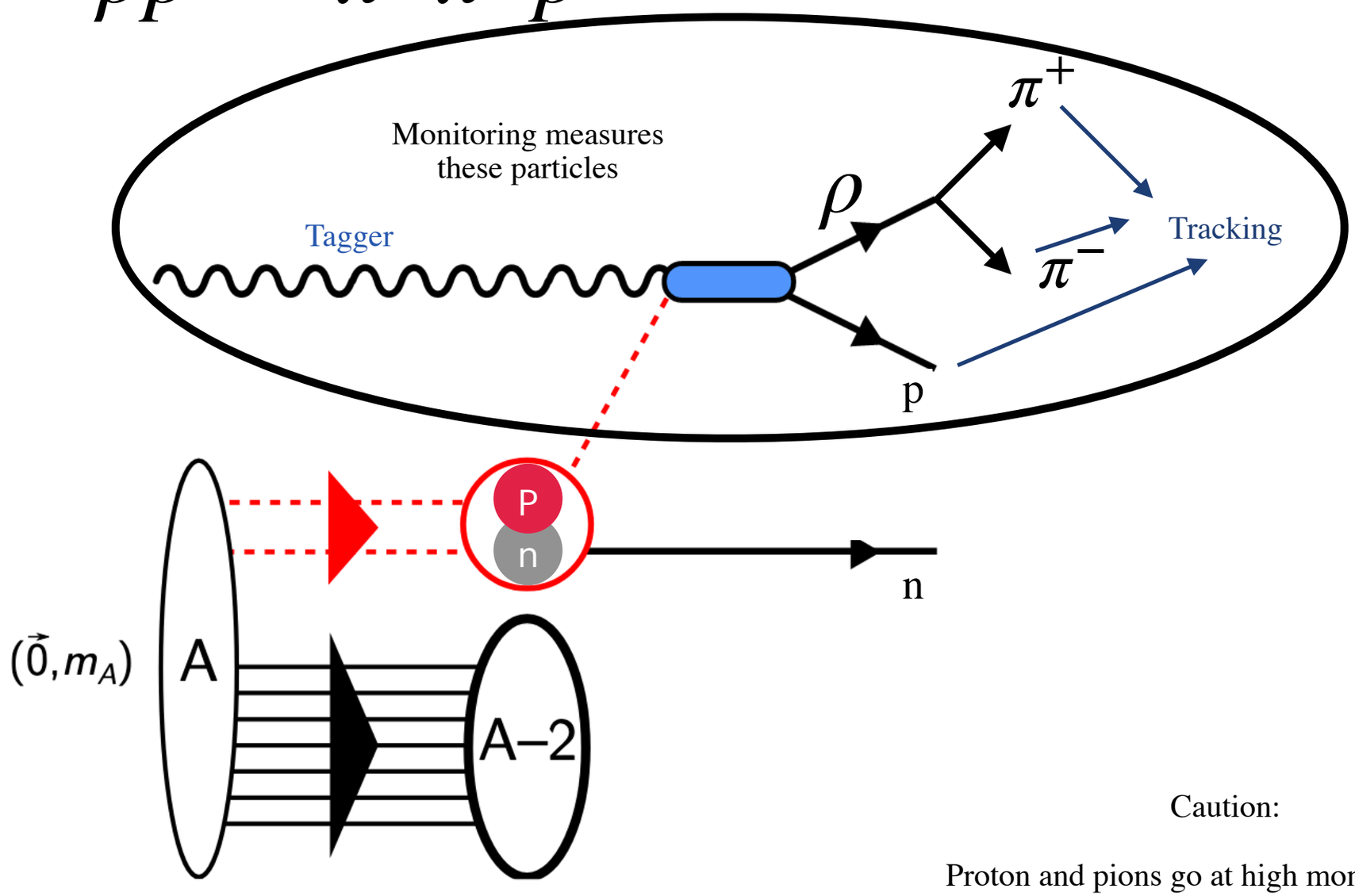

Caution:

Proton and pions go at high momentum and
PID can't be performed.

Monitoring is based in kinematics: Angle correlations
Meson Mass

Part I: Plugin

Based in three concepts:

1. Only three tracks events: 2 positive and 1 negative

2. The particles have a probability > 0 to be a proton, pi+ and pi-, based on tracking fitting. Since there are many events can have a probability for both positive tracks to be proton and pi+, both hypothesis are stored.

3. A vertex fit is performed and the events with CL > 0 of having the three particles from the same vertex are stored.

Part I: Plugin

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3. A vertex fit is performed and the events with CL > 0 of having the three particles from the same vertex are stored.

Output:

Root file with position, momentum and energy information of all hypothesis and beam (photon) energy and timing.

1. Location of the plugin:

   https://github.com/JeffersonLab/halld_recon/tree/master/src/plugins/Analysis/src-ct/1p2pi

2. How is it run?

   It is run automatically with all the other Monitoring plugins.
   It takes a few hours to get the results, when in the Incoming Data ver 01 is available in the plot browser,
   the root files will be available.

3. Location of the output (root files):

```
/cache/halld/offline_monitoring/RunPeriod-2021-08/ver01/tree_1p2pi/
```

Part II: Reconstruction

Goal: Take the raw information from rho, proton and beam and form high level plots: t, Kmiss, …..

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1. Reconstruct the rho events

- Mass of the reconstructed rho: $0.5 < m_\rho < 2.$ [GeV]

- Coplanarity between ρ and p: $160 < \Delta\phi(\rho - p) < 200$ deg

- Reconstructed Energies in the range that are expected for $E_\gamma > 7GeV$
  $E_\rho + E_p > 7GeV$

- Only selects the single hypothesis that follows these requirements. If both hypothesis get the requirements, the event is discarded.

Part II: Reconstruction

Goal: Take the raw information from rho, proton and beam and form high level plots: t, Kmiss, …..

1. Reconstruct the rho events

Done by the script: protonrho_candidates.C

Output:

Rootfiles with all the information of the event: Momentum, t, s, u, Kmiss, Pmiss, ….

Location:

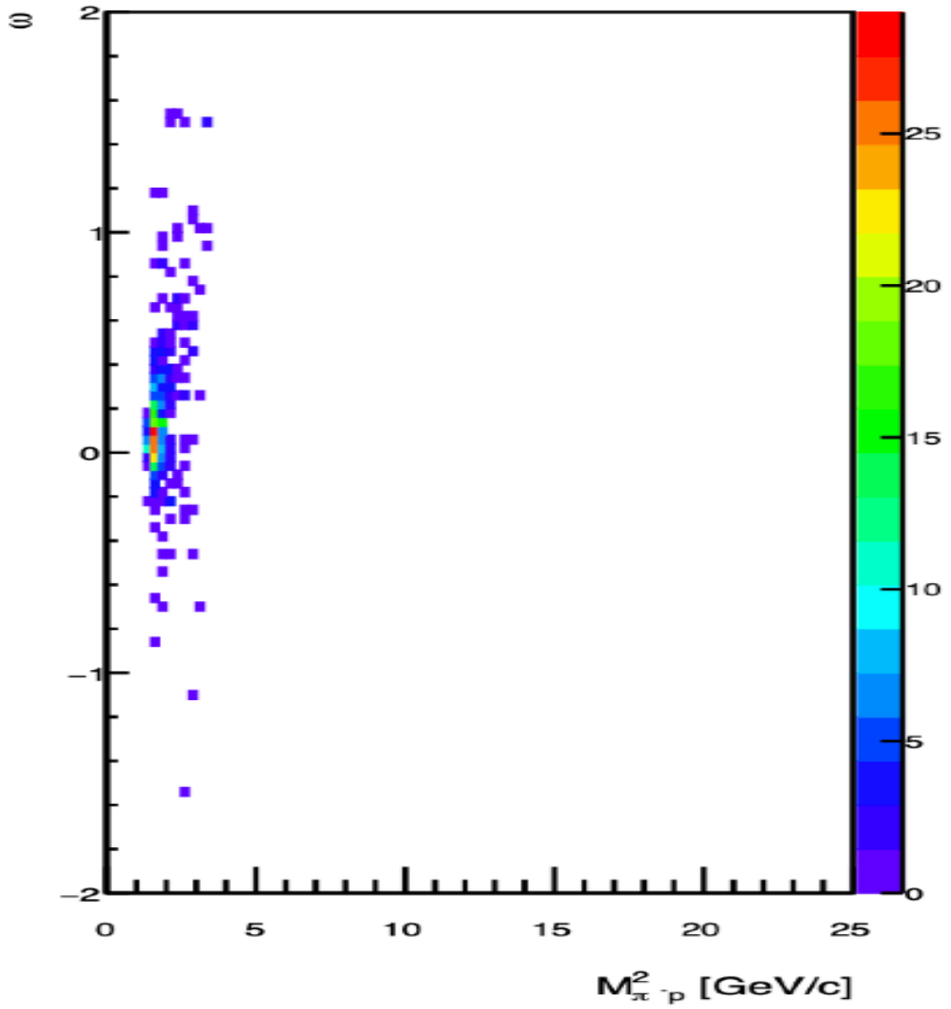
/work/halld2/home/src-ct/offline_monitoring/RunPeriod-2021-08/ver01/proton_rho0

After this is generated
The simulation has shown many misidentified proton - pip

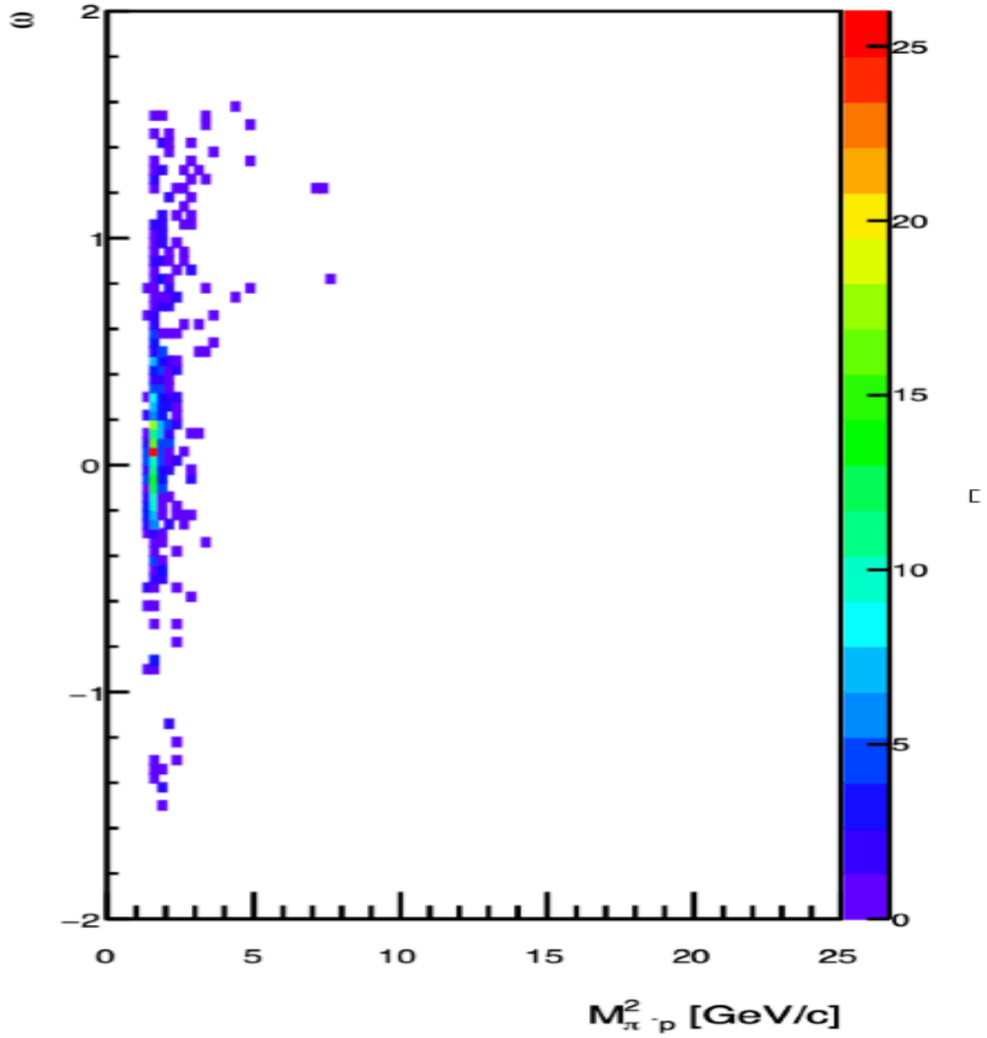
2. Final Selection

- $1 < -t < 10$ GeV2, $-u > 2$ GeV2
- $\omega > m^2_{\pi^- p}/10 - 0.3$: This cut was based on studies of the simulation. It cleans the sample of misidentified events.

Example of simulated events reconstructed by purposely exchange of PiPlus <-> Proton



ω is the angle in the Van Hove Plots



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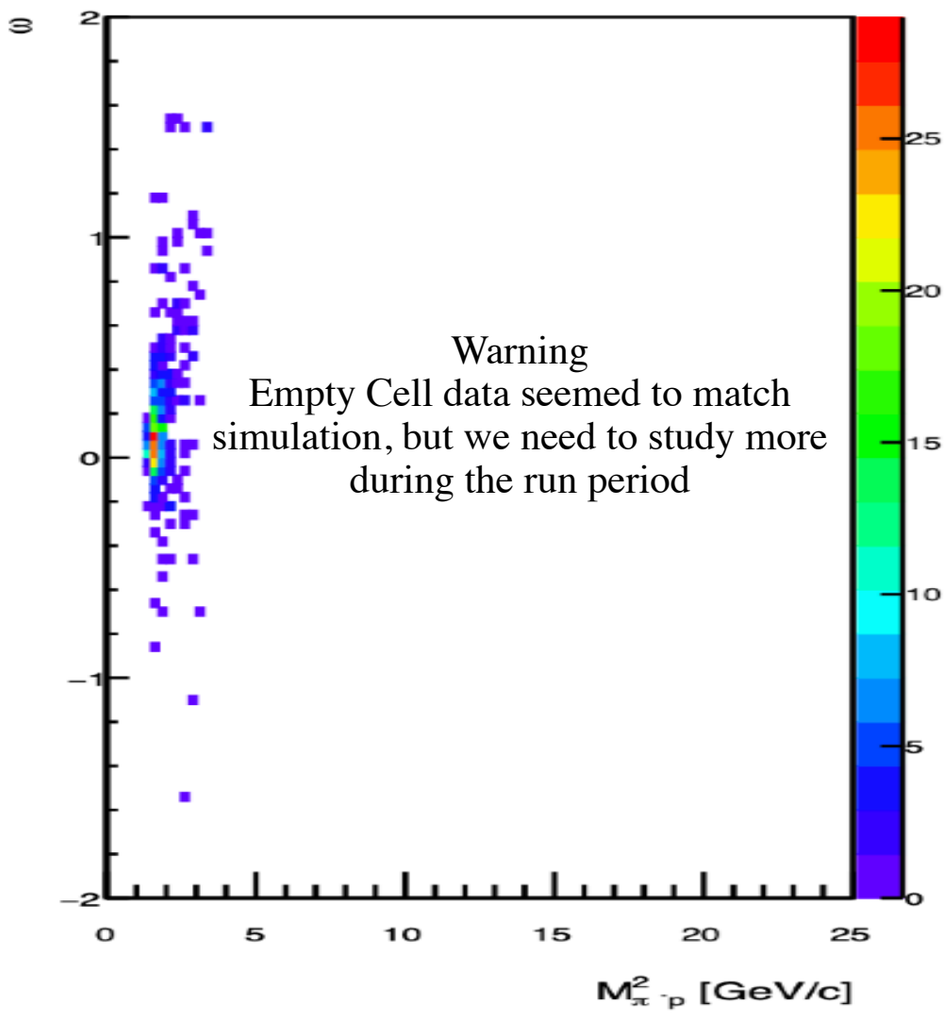

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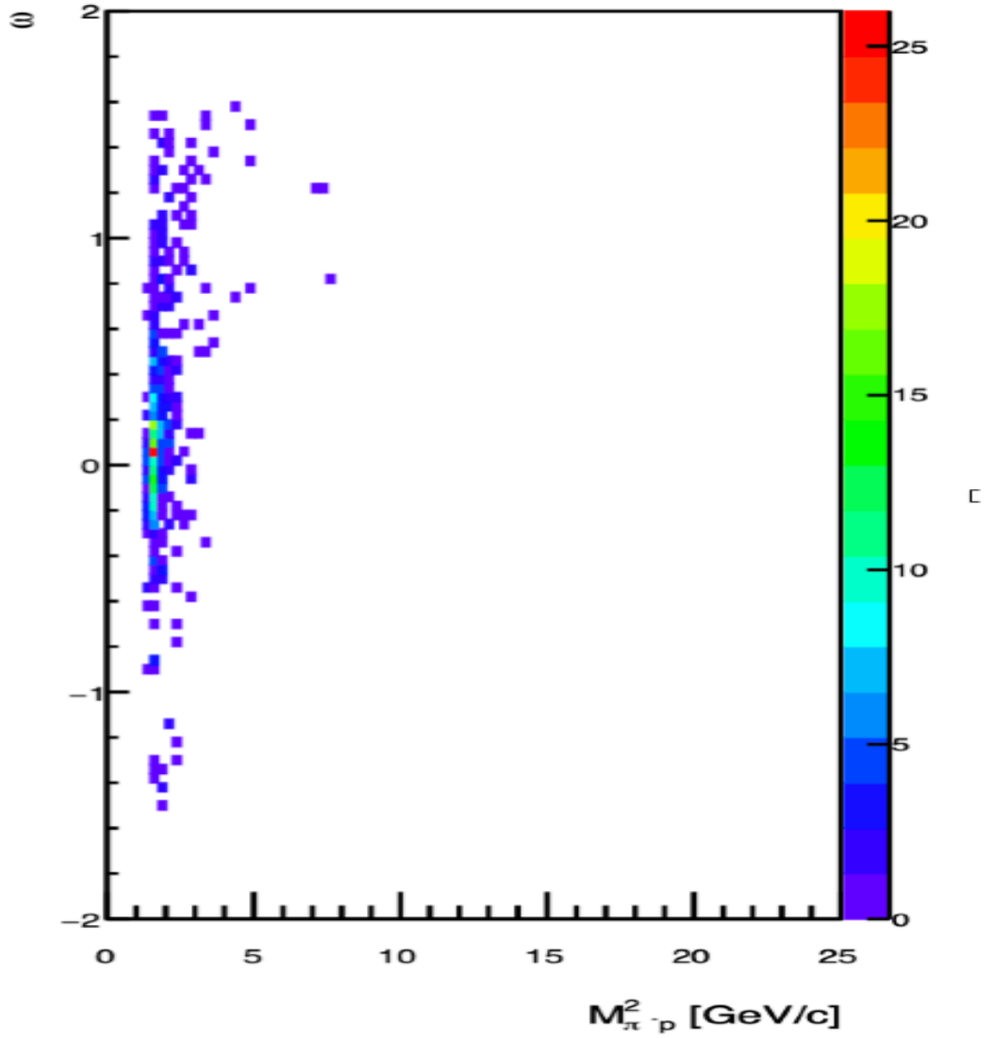

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- $1 < -t < 10$ GeV2, $-u > 2$ GeV2
- $\omega > m^2_{\pi^- p}/10 - 0.3$: This cut was based on studies of the simulation. It cleans the sample of misidentified events.
- Energy Balance $|\Delta E| < 1 GeV$
- Mass of the reconstructed rho: $0.6 < m_\rho < 1.$ [GeV]

Output:

Pdf file with a summary of all the plots

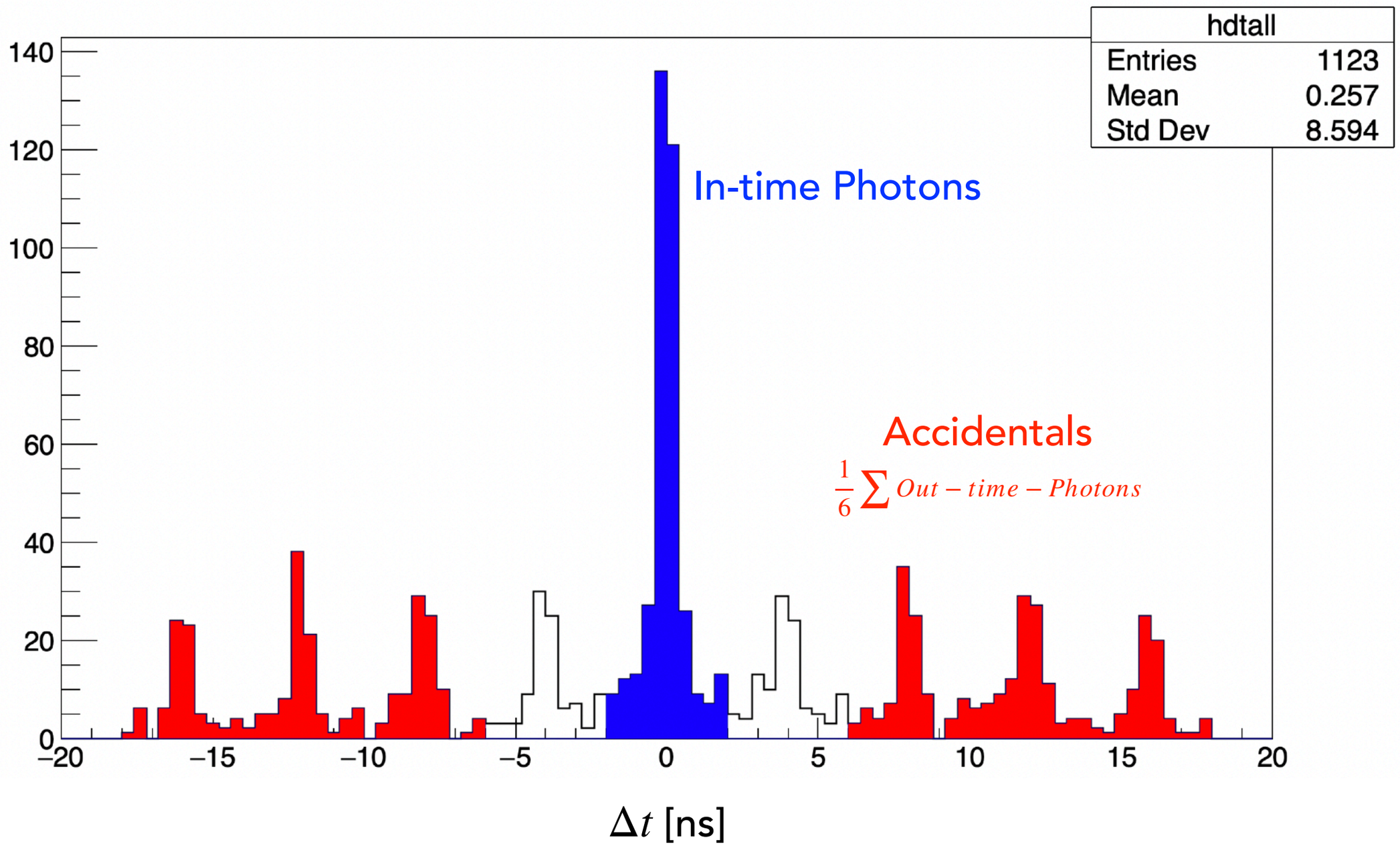
Location:

/work/halld2/home/src-ct/offline_monitoring/RunPeriod-2021-08/ver01/proton_rho0

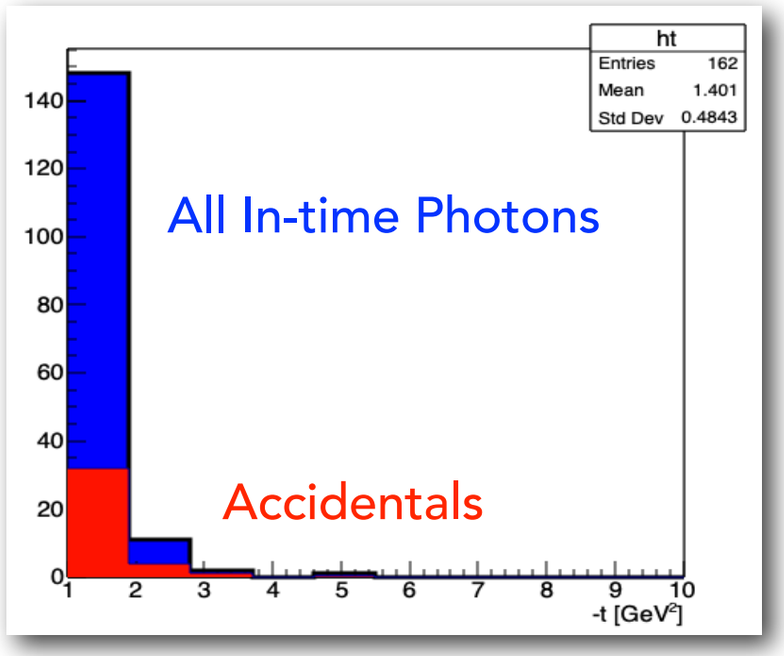
Examples

Empty Cell vs simulation

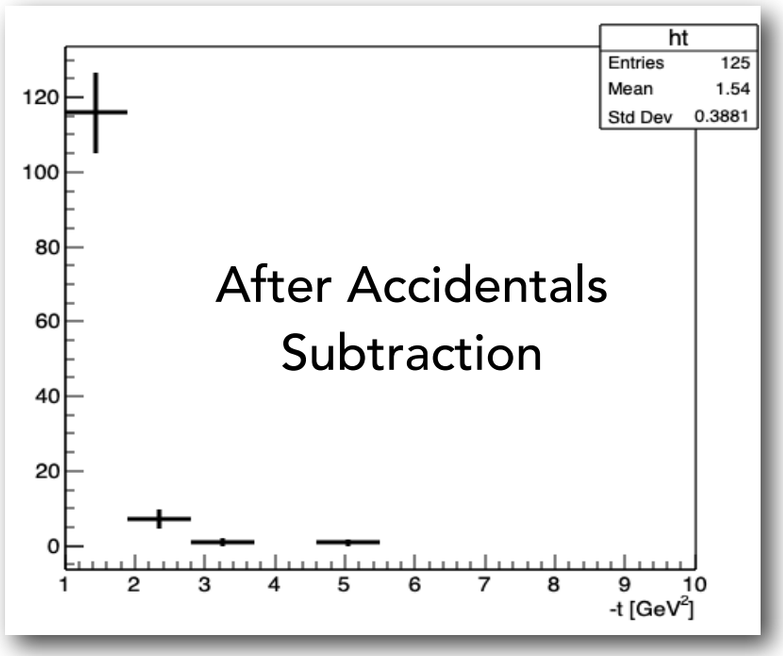
Of all variables that required the beam energy, the accidentals are subtracted:

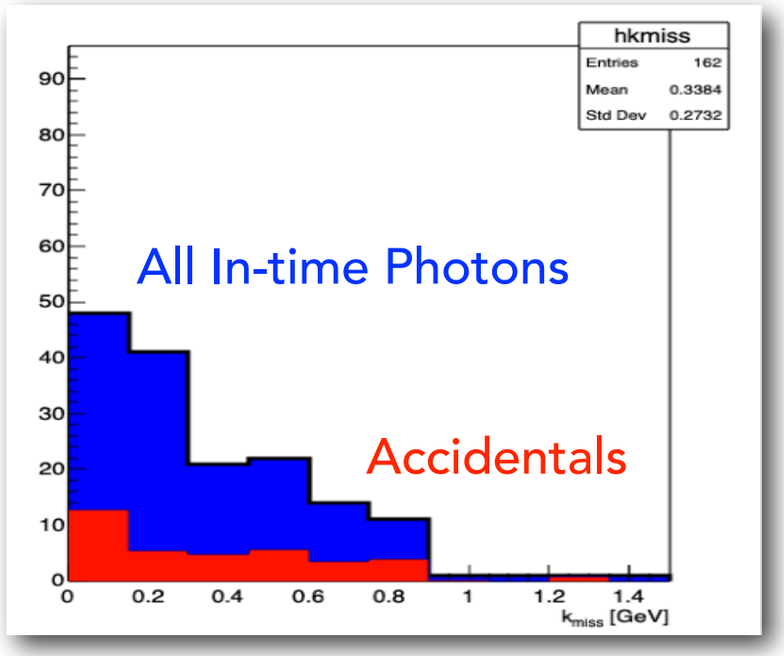


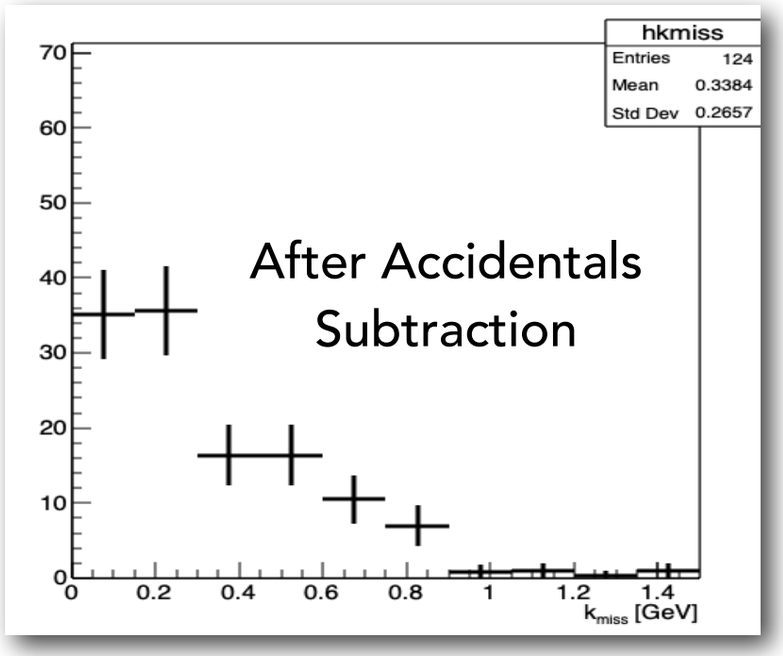
Only in-time photons are selected



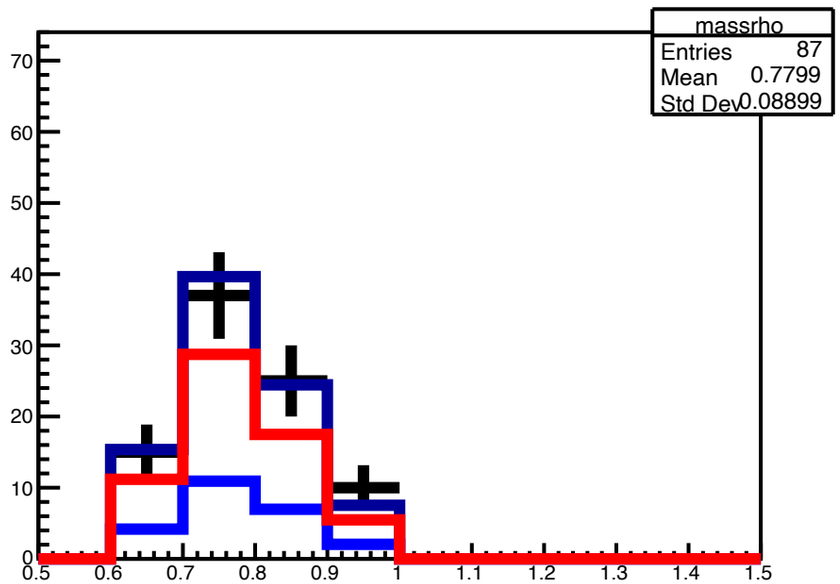
After Accidental Subtraction







Note: The simulation is area normalized to match the data



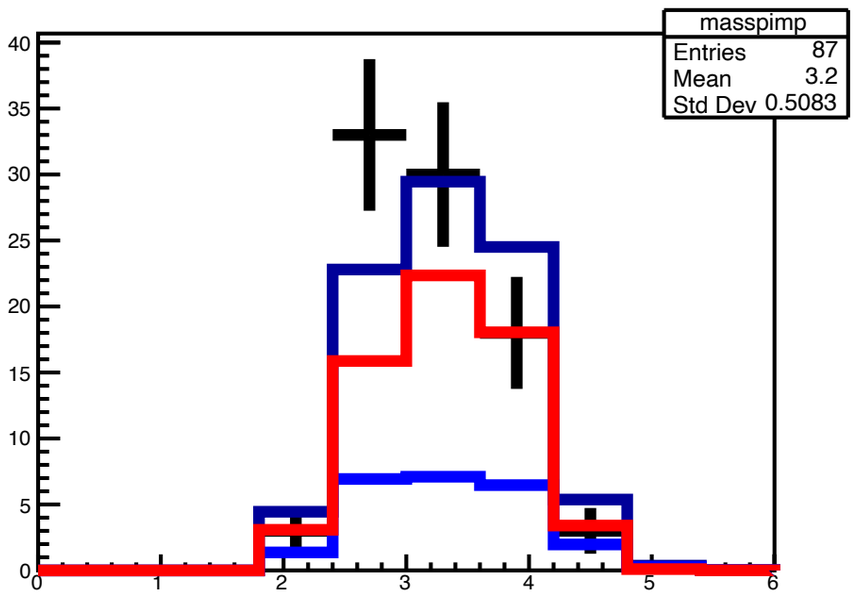
$M_{\pi^+\pi^-}[GeV]$

+ **Data**

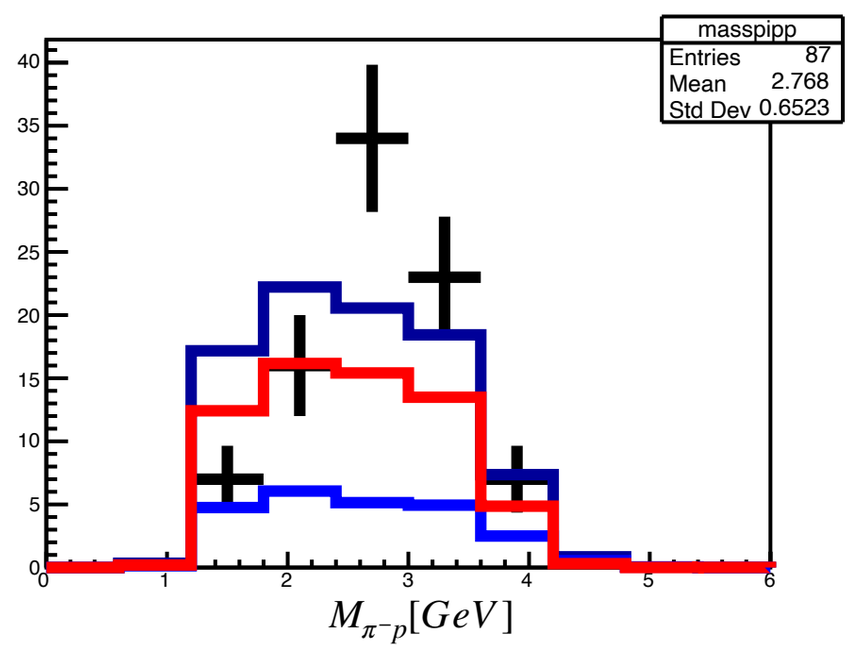
MF+SRC Simulation

MF Simulation

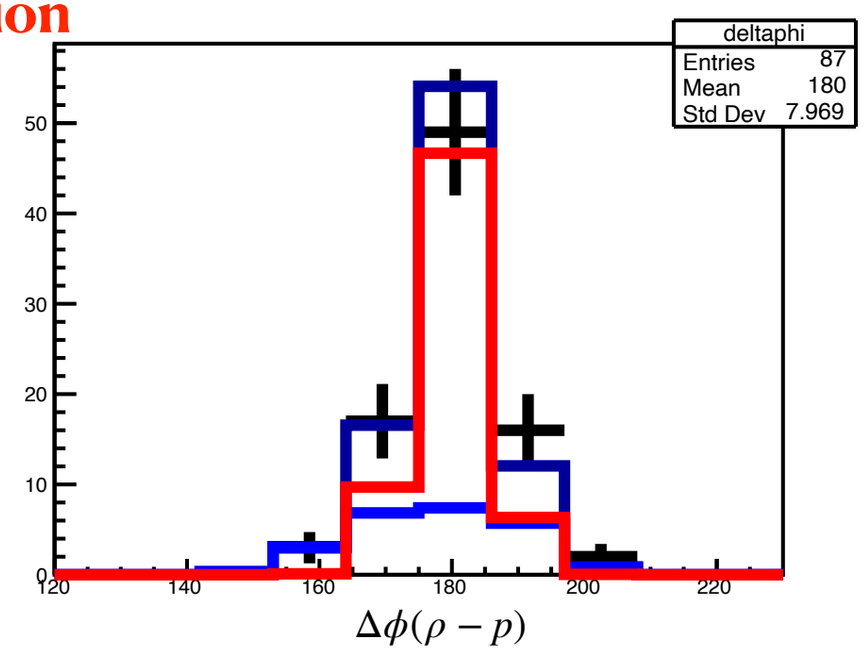
SRC Simulation



$M_{\pi^-p}[GeV]$

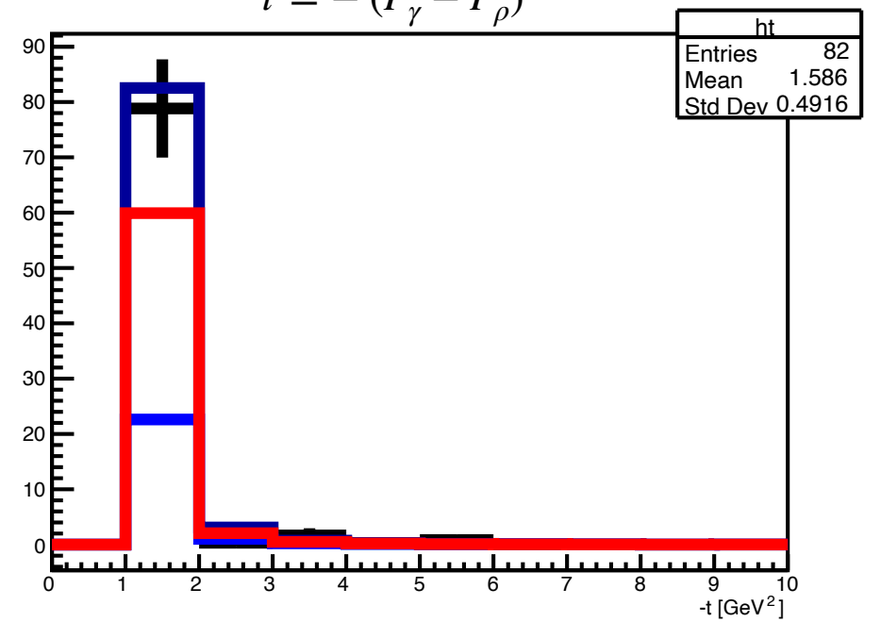


$M_{\pi^-p}[GeV]$

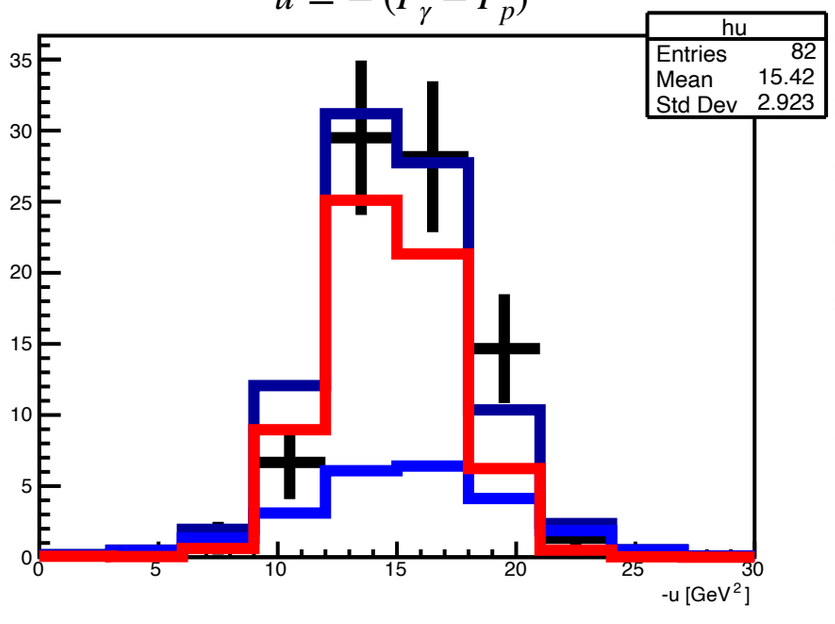


$\Delta\phi(\rho - p)$

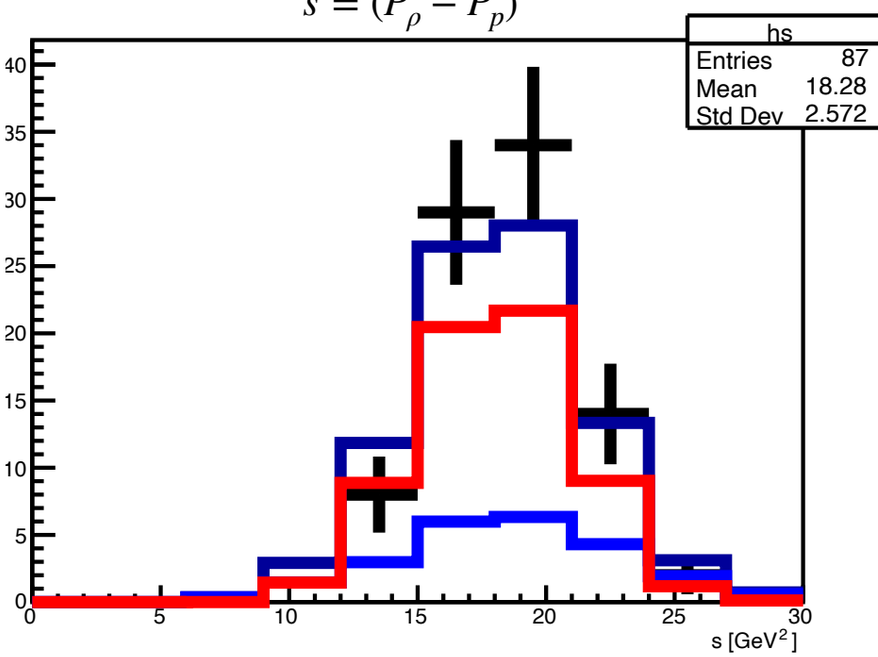
$t = -(P_\gamma - P_\rho)^2$



$u = -(P_\gamma - P_p)^2$



$s = (P_\rho - P_p)^2$



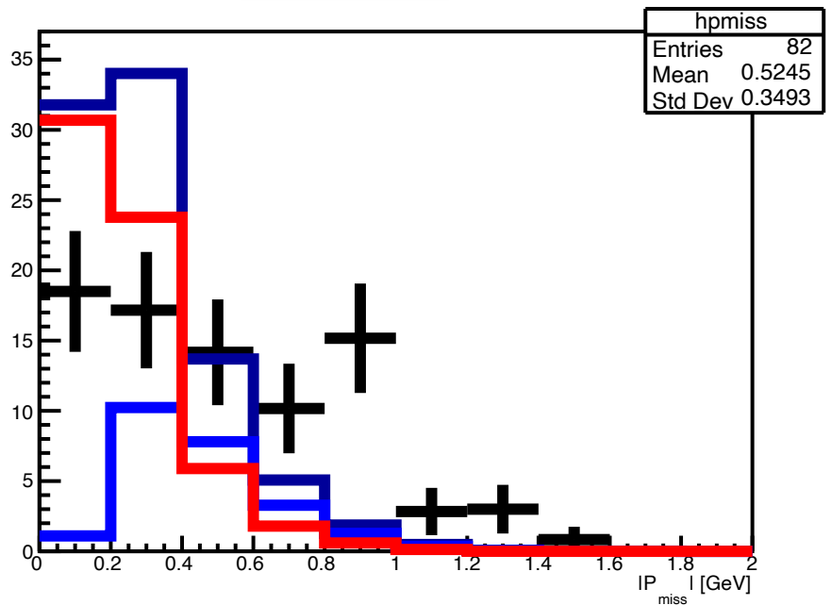
+ **Data**

MF+SRC Simulation

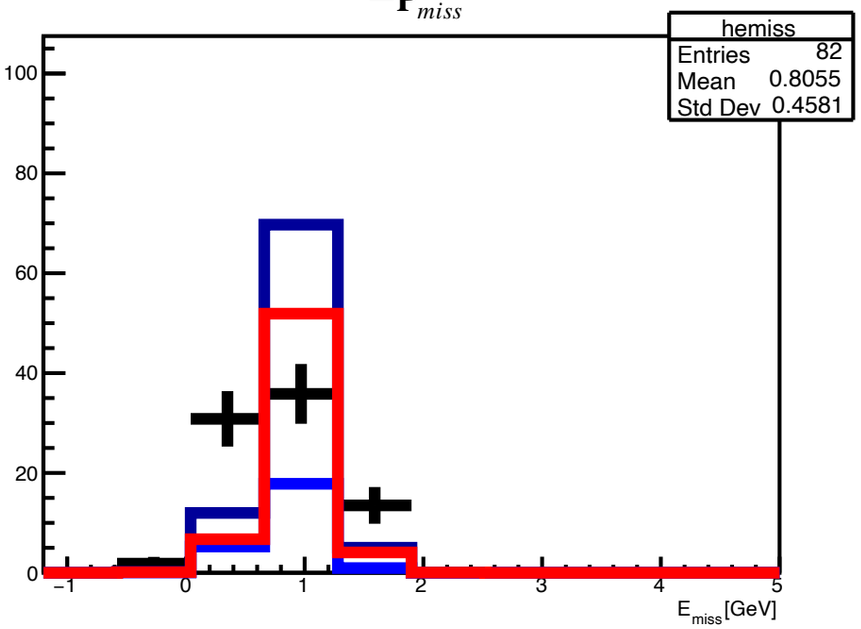
MF Simulation

SRC Simulation

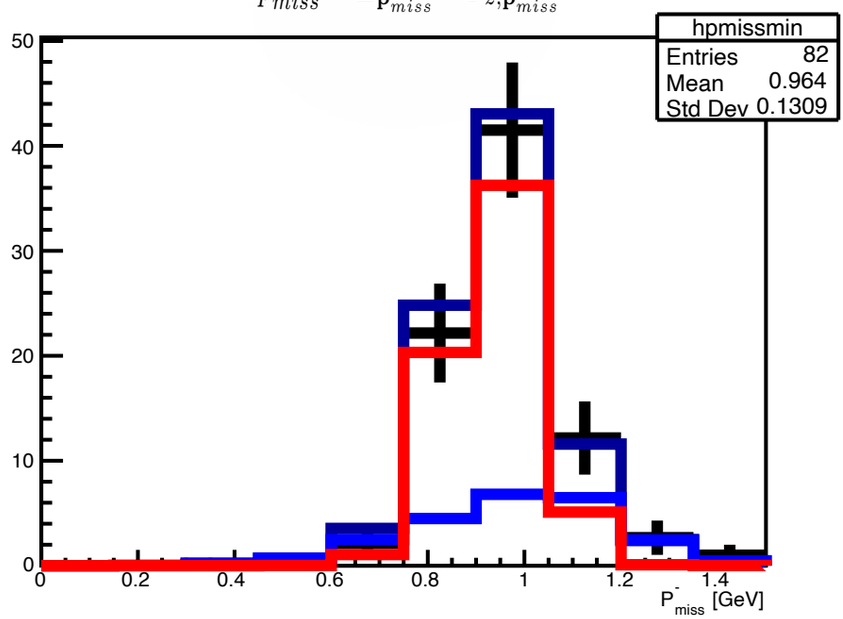
$\mathbf{p}_{miss} = \mathbf{p}_p + \mathbf{p}_{\pi^+} + \mathbf{p}_{\pi^-} - \mathbf{p}_\gamma$

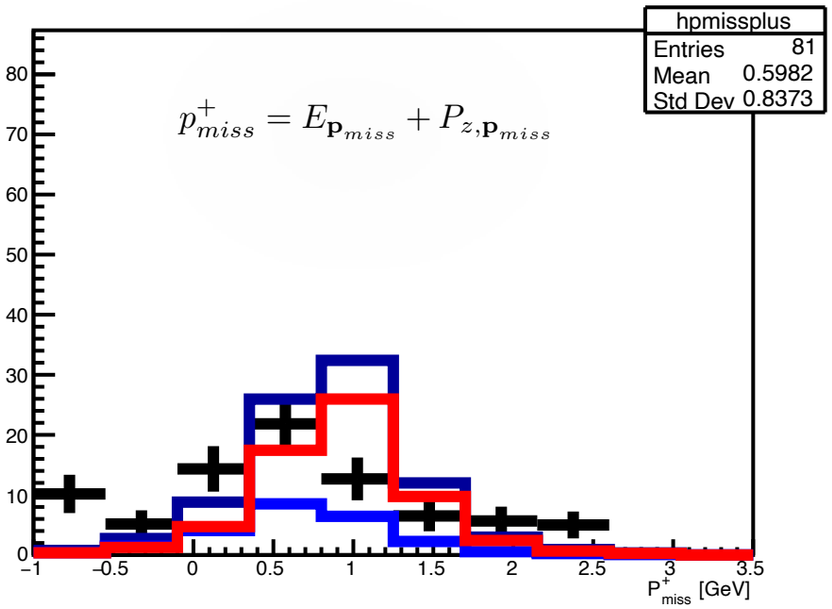


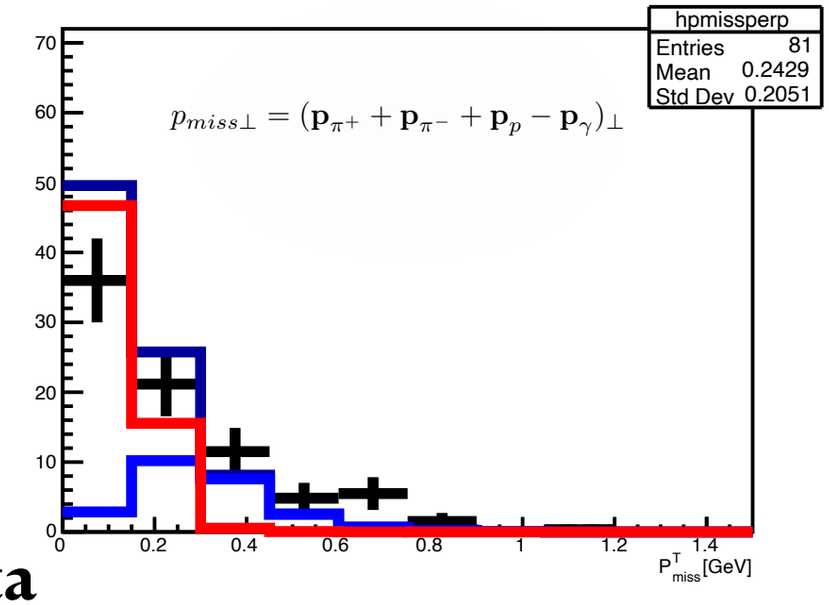
$E_{\mathbf{P}_{miss}}$



$p^-_{miss} = E_{\mathbf{p}_{miss}} - P_{z,\mathbf{p}_{miss}}$







+ Data

MF+SRC Simulation

MF Simulation

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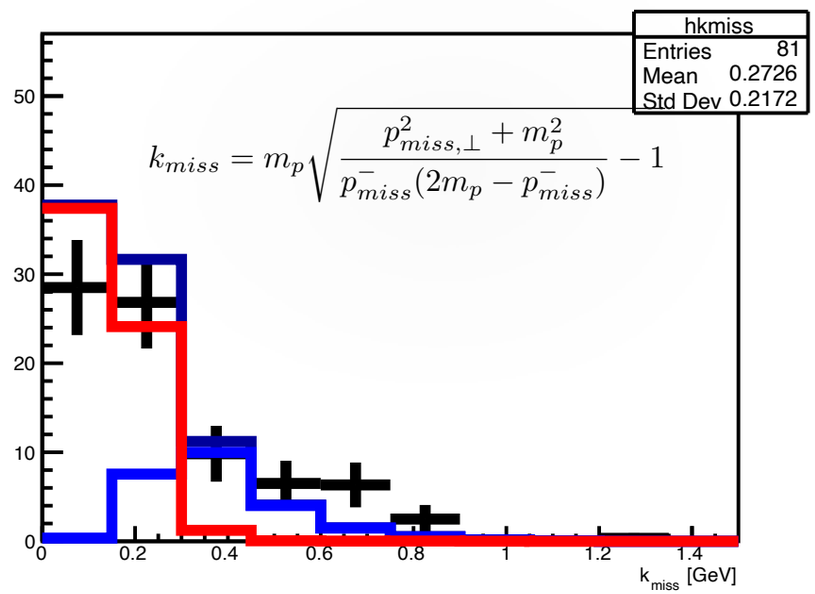

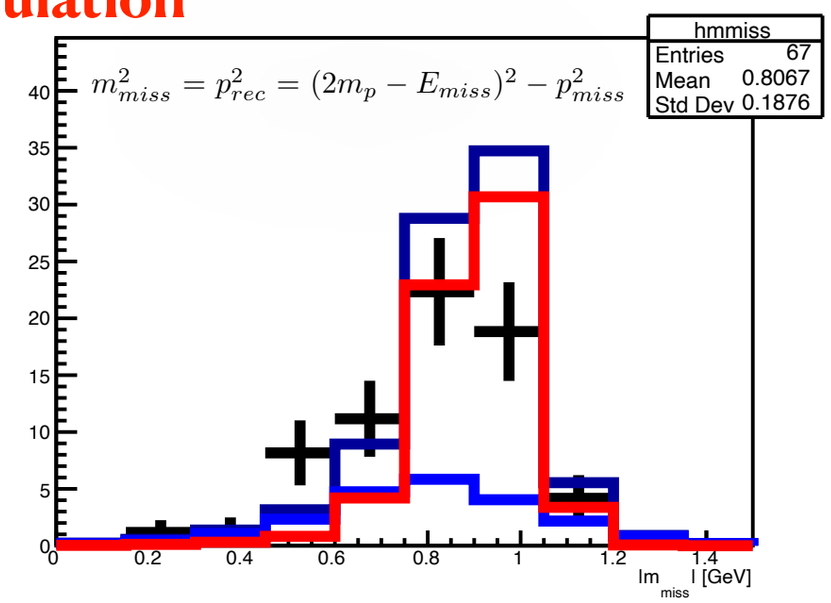

Analysis script for rho0 is located in:

/w/halld-scshelf2101/halld2/home/src-ct/HallD_SRC-CT_Analysis/analysis_scripts/proton_rho0

ifarm1801.jlab.org> ls
rootalias.h -> Input parameters for the final candidates
style.h -> Plotting style
Input_constants.h
protonrho_candidates.h -> Input parameters for the protonrho candidates

protonrho_candidates.C -> Produces the tree with the candidates
final_candidatesrho.C -> Produces the plots

rho0_src_events.txt -> has a summary of total and src events for all runs

run_rho0 -> runs all the scripts

How to run it:

sh run_rho0 Runnumber

-t>1 GeV All	-t>1.5 GeV All	-t>2 GeV All	-t>1 GeV SRC	-t>1.5 GeV SRC	-t>2 GeV SRC
6	2	1	2	0	0

This values will be printed in the screen and have to be uploaded to the spreadsheet