Reaction Filter

- Reaction: $\gamma d \to \phi p(n) \to K^+K^-p(n)$ (1_45__11_12_14_m13)
- Combo construction

  -kinematic fitting with P4 and vertex constraint

  -4 beam bunches on each side

  -allows for 3 extra tracks and 999 extra showers
- Cuts:

  -timing cut for PID (BCAL, FCAL, TOF, ST)

  -dE/dx cut for PID (CDC)

  -missing mass squared cut: -0.5 GeV$^2 < MM^2 < 4.41$ GeV^2

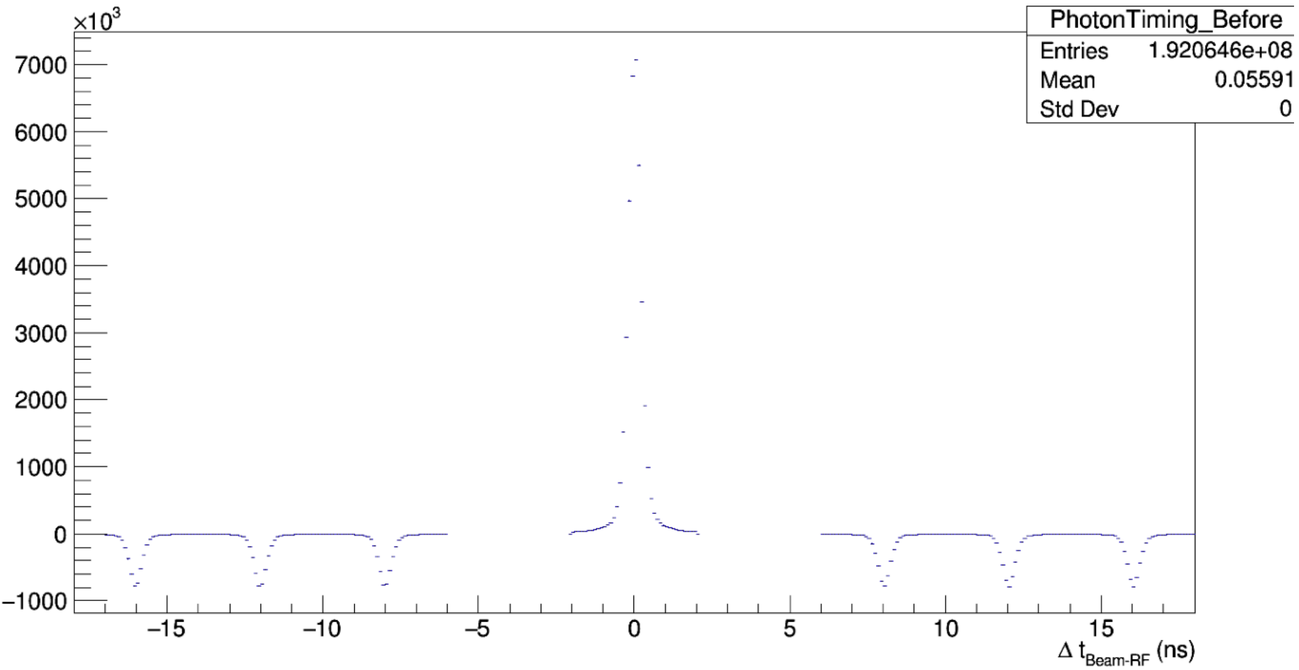
DSelector

- Tighter cuts to select the events
- Cut on measured values unless indicated
- Accidental subtraction applied on all the following histograms
- Beam bunch next to the main peak is discarded due to the leakage of in-time events
- 5% of deuterium data is used

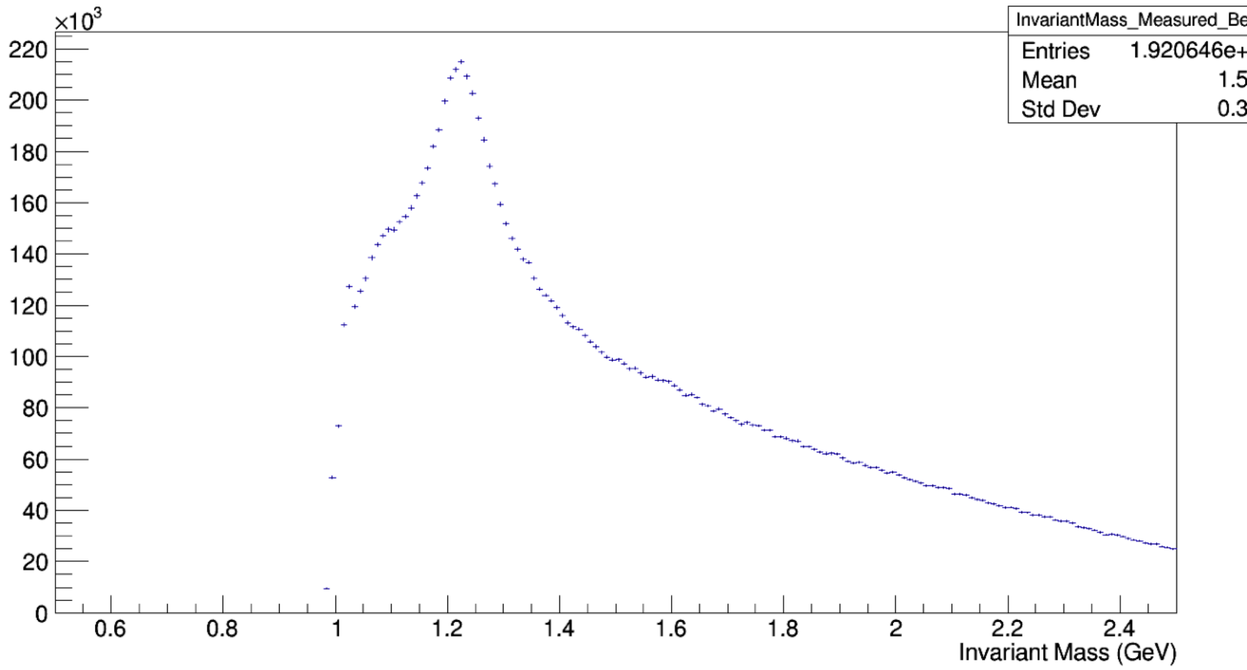
DSelector

- Before all cuts

Photon timing



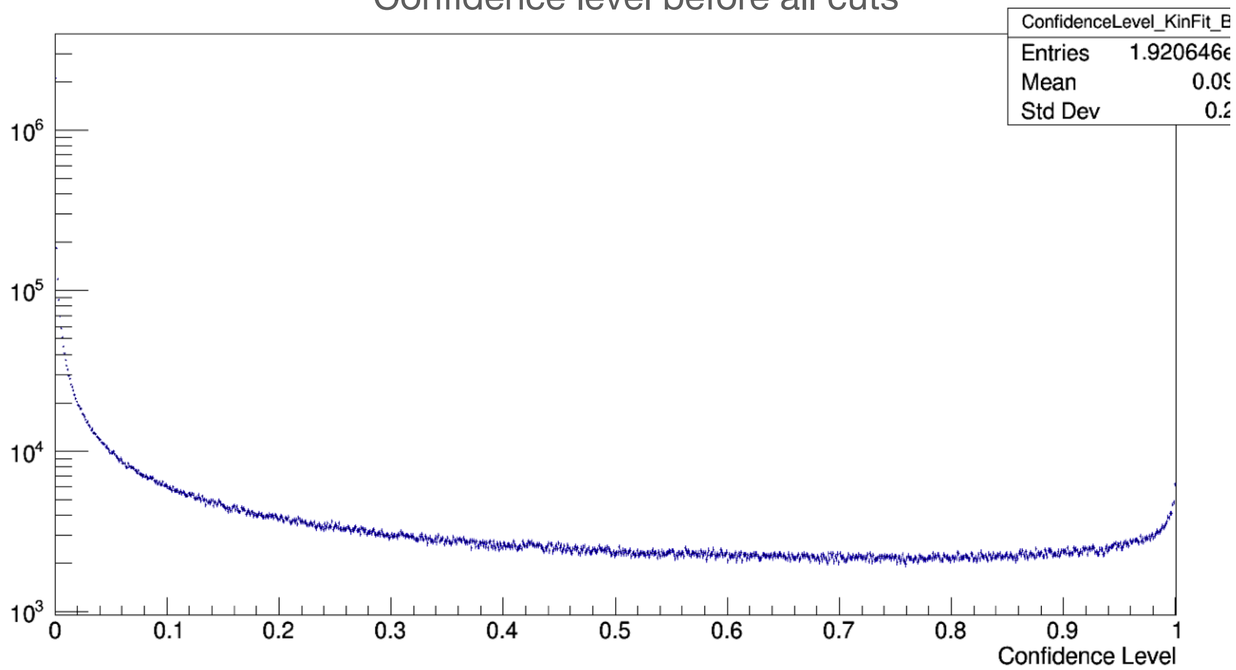
K^+K^- invariant mass before all cuts



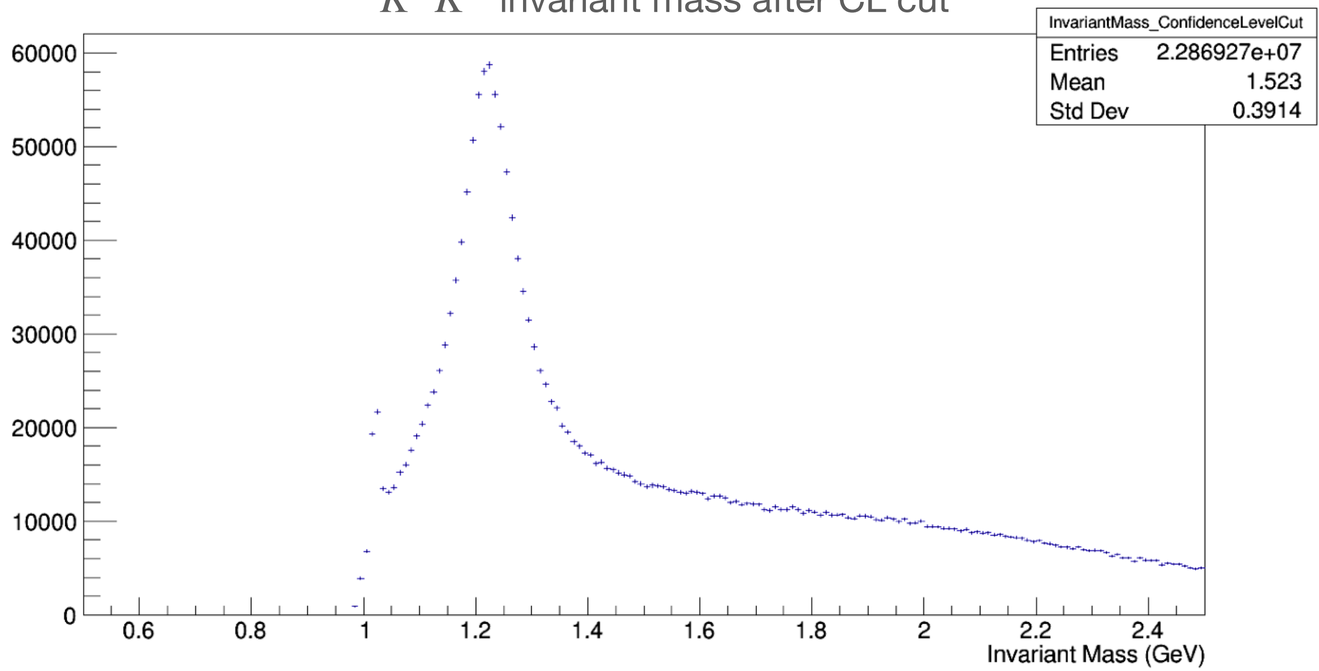
DSelector

- Confidence level cut: CL>0.1

Confidence level before all cuts



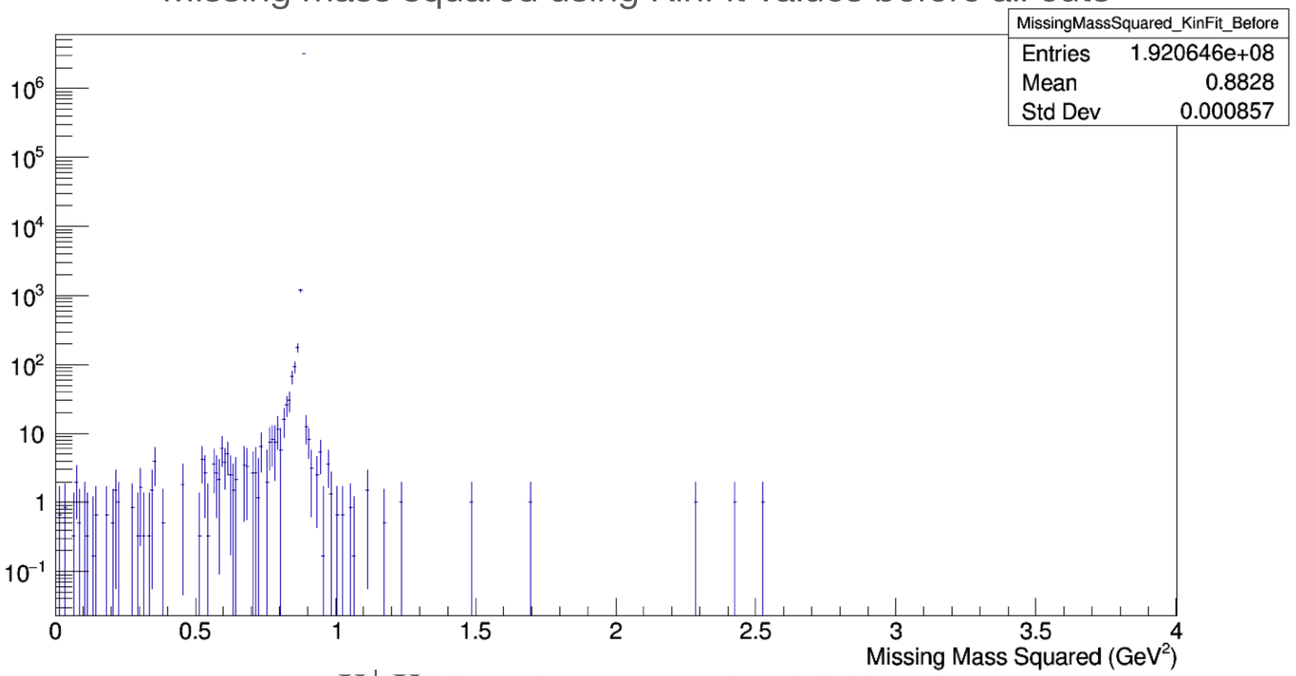
K^+K^- invariant mass after CL cut



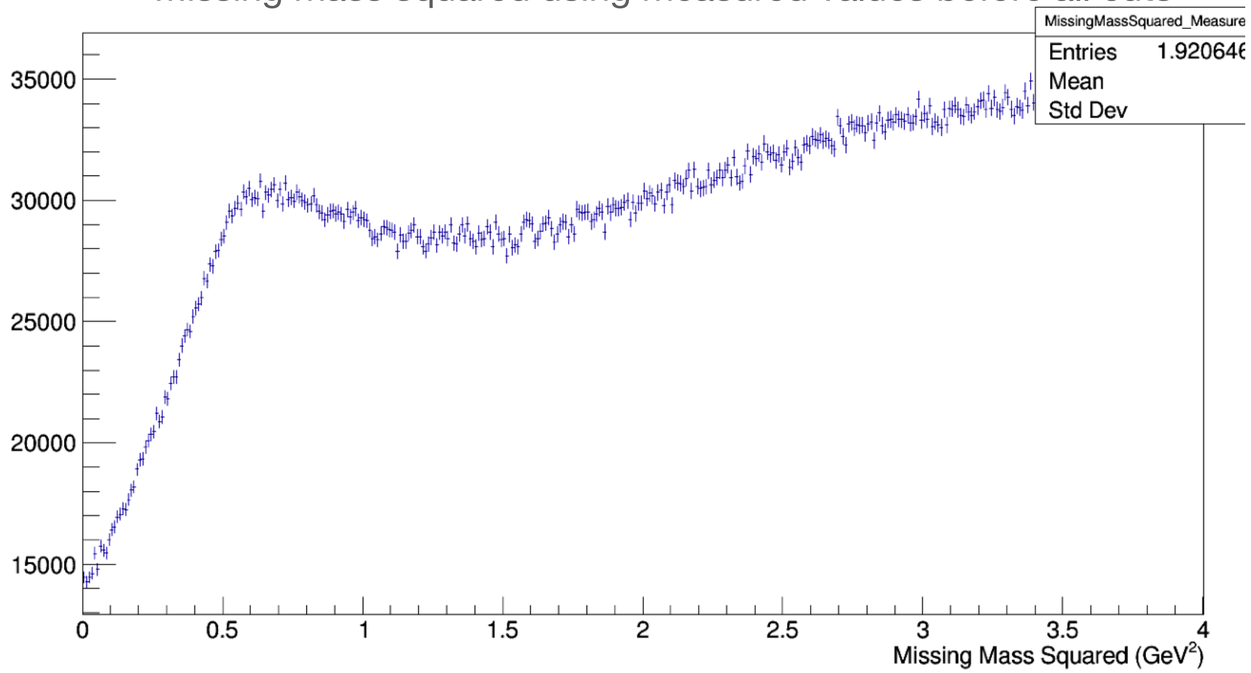
DSelector

- Missing mass squared cut:
  $-0.85\ \text{GeV}^2 < MM^2 < 0.95\ \text{GeV}^2$

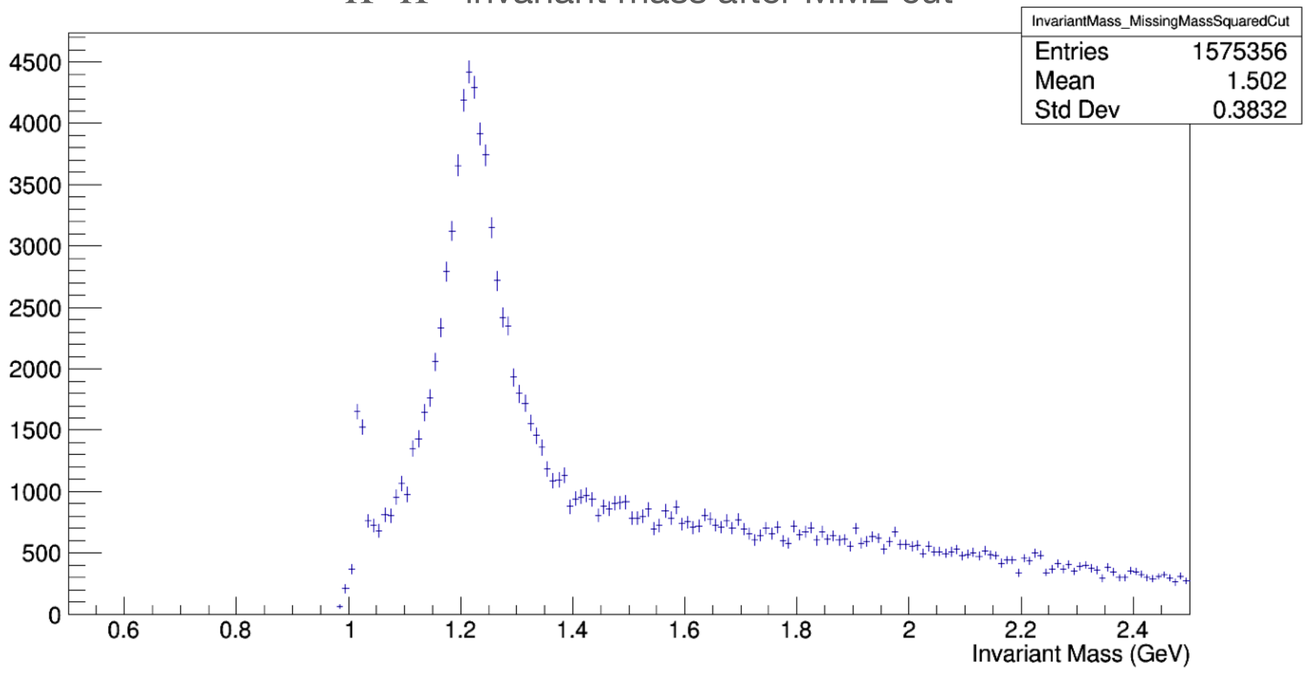
Missing mass squared using KinFit values before all cuts



Missing mass squared using measured values before all cuts



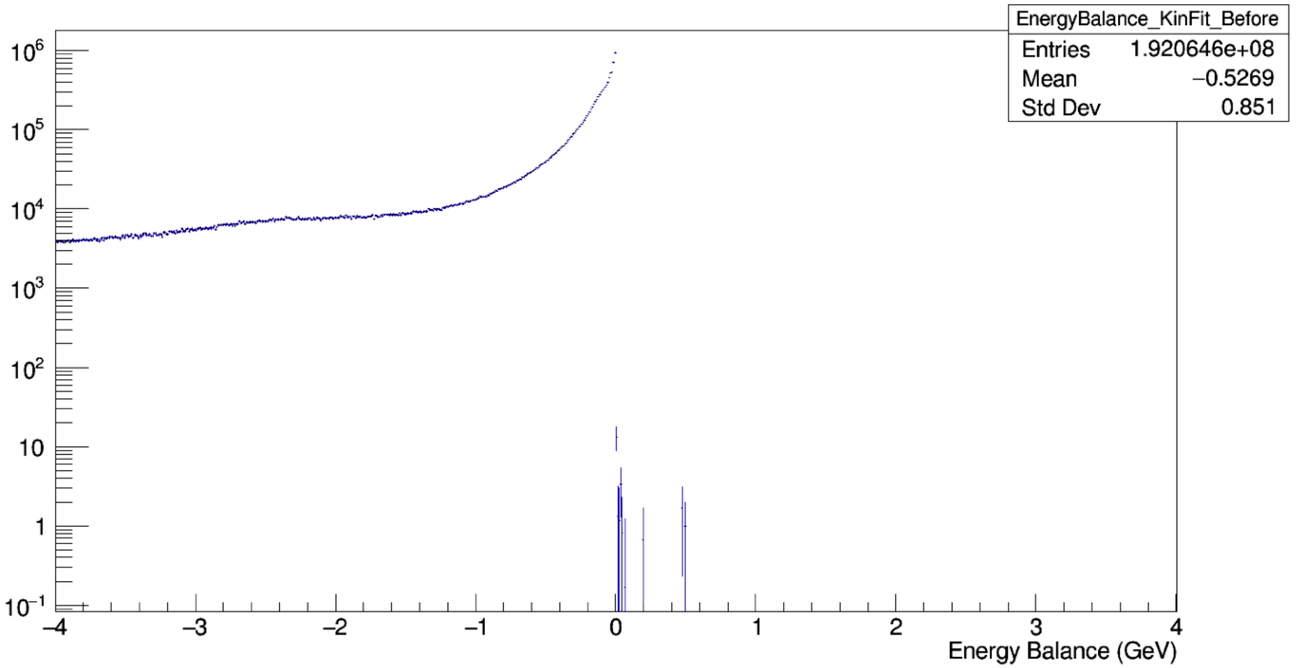
K^+K^- invariant mass after MM2 cut



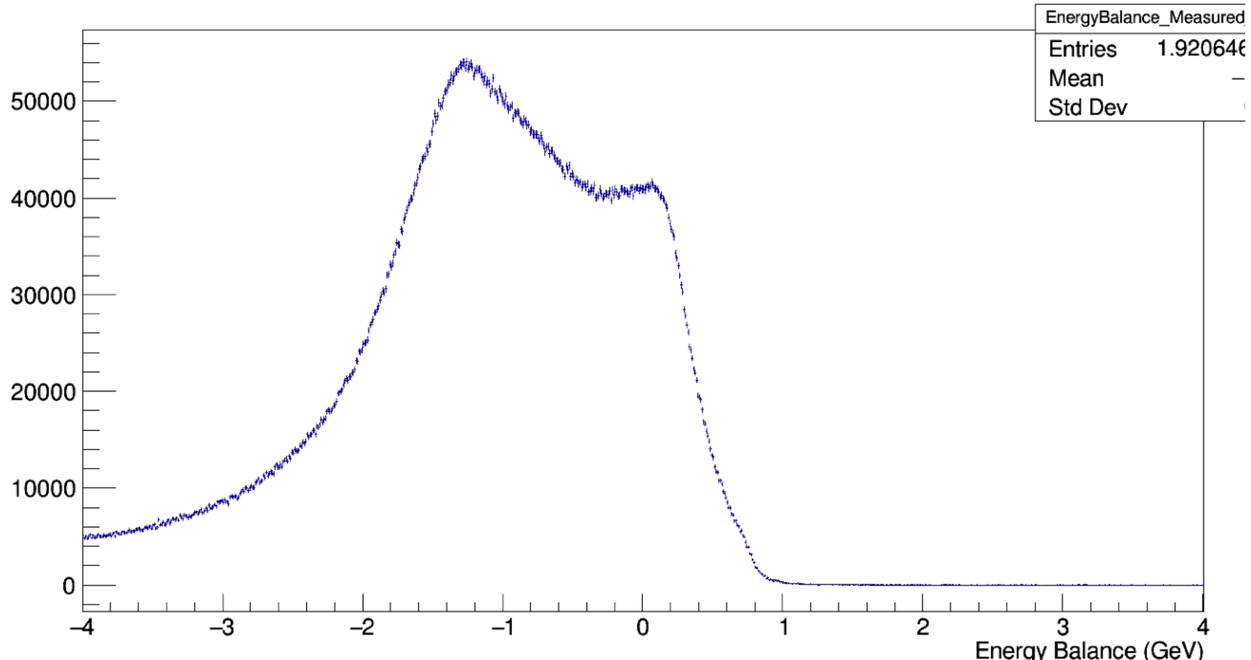
DSelector

- Energy balance cut:
  $|E_\phi + E_p - E_\gamma - m_p| < 1$ GeV

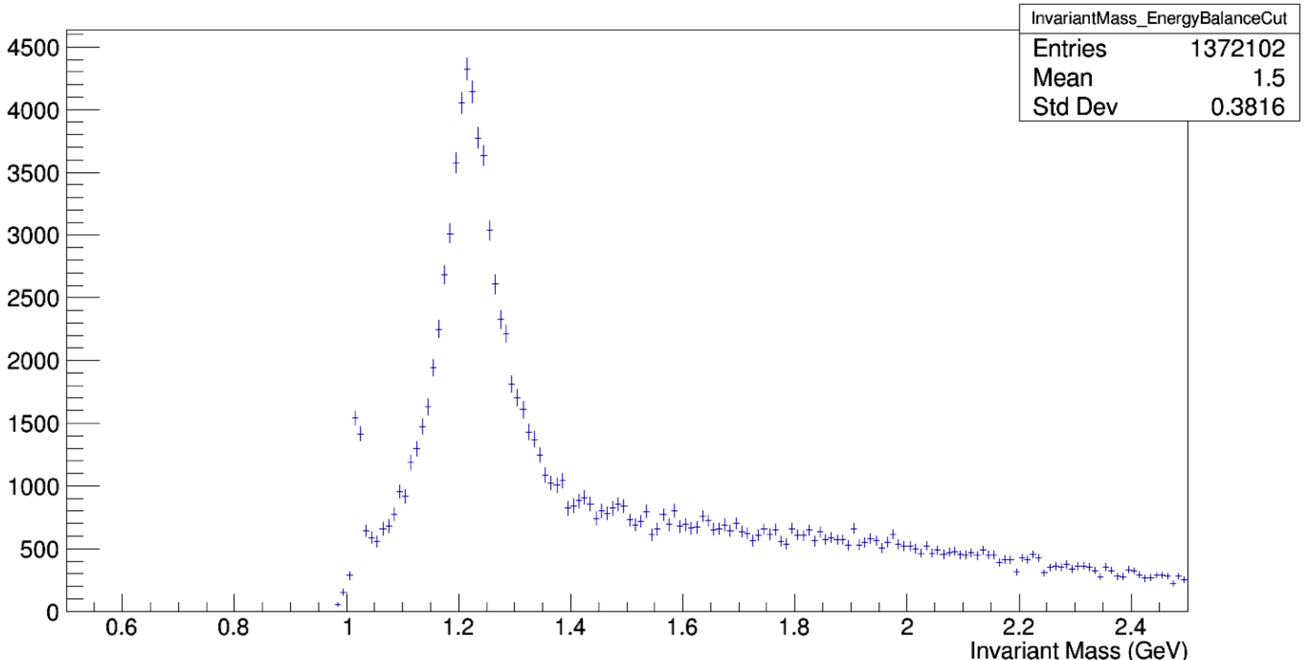
Energy balance using KinFit values before all cuts



Energy balance using measured values before all cuts



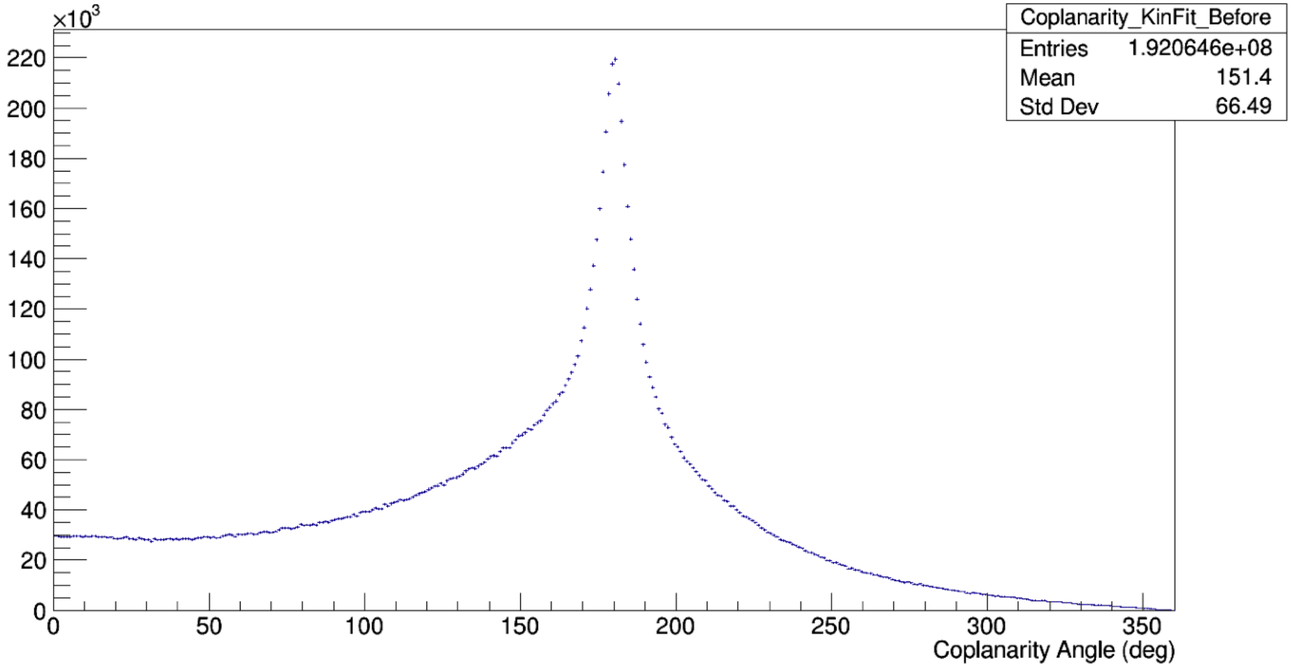
K^+K^- invariant mass after energy balance cut



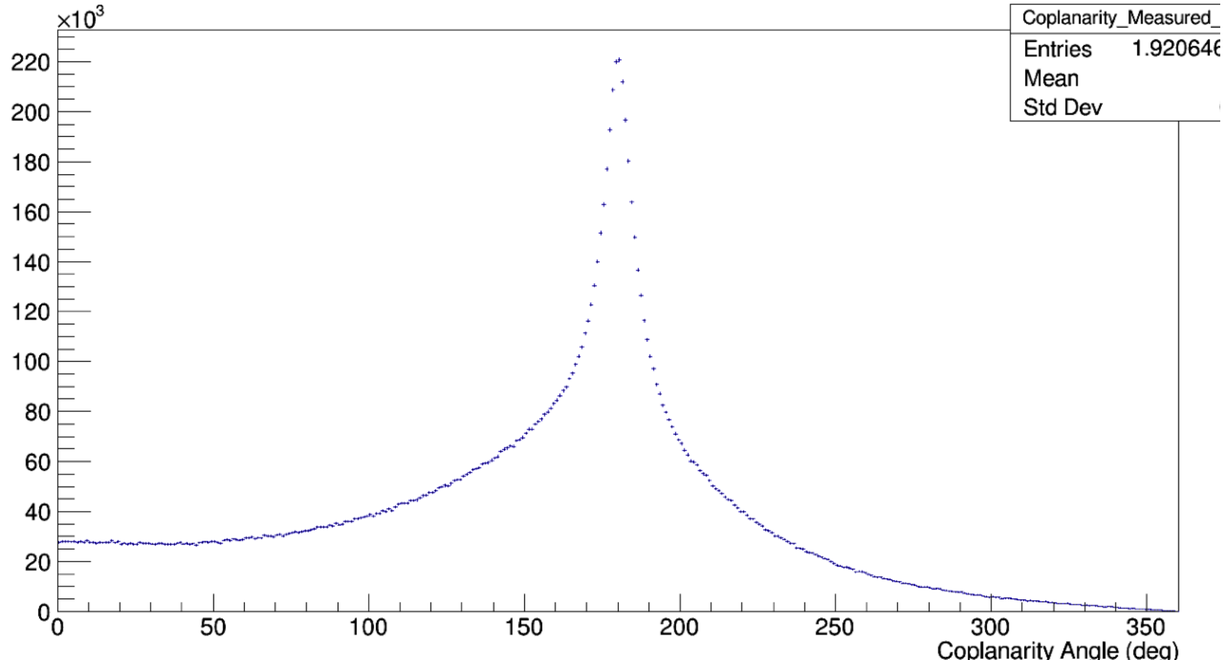
DSelector

- Coplanarity cut:
  $170^\circ < |\phi_\phi - \phi_p| < 190^\circ$

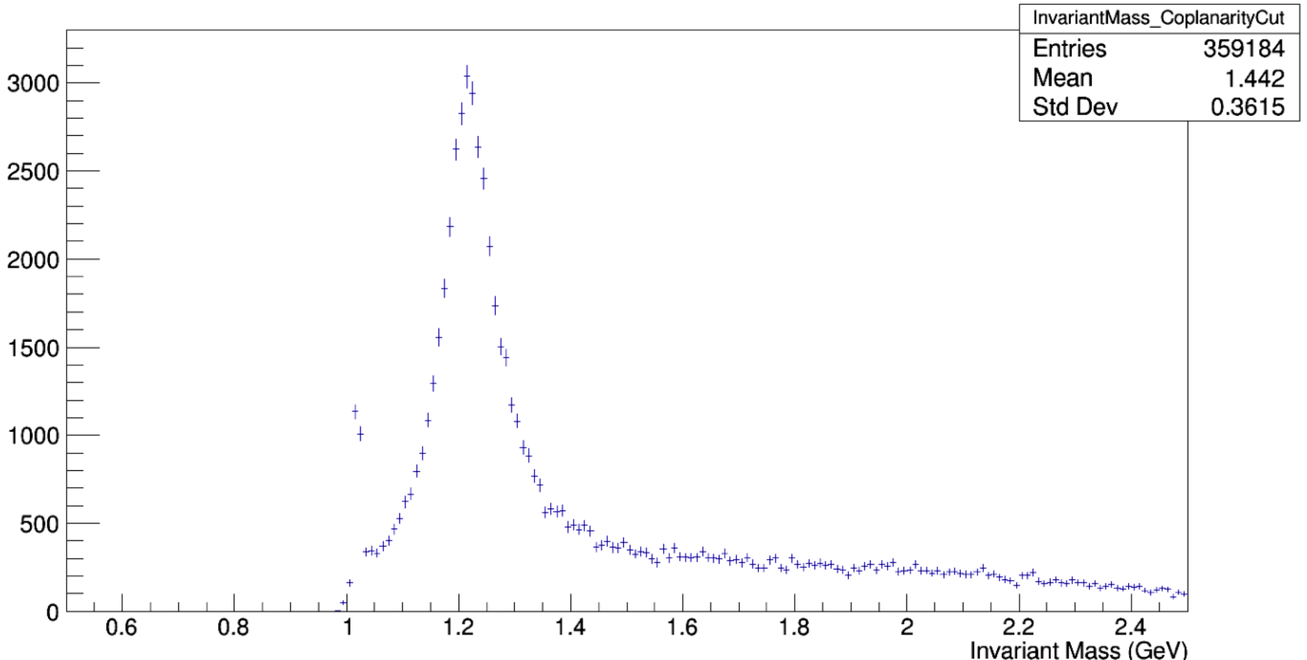
Coplanarity using KinFit values before all cuts



Coplanarity using measured values before all cuts

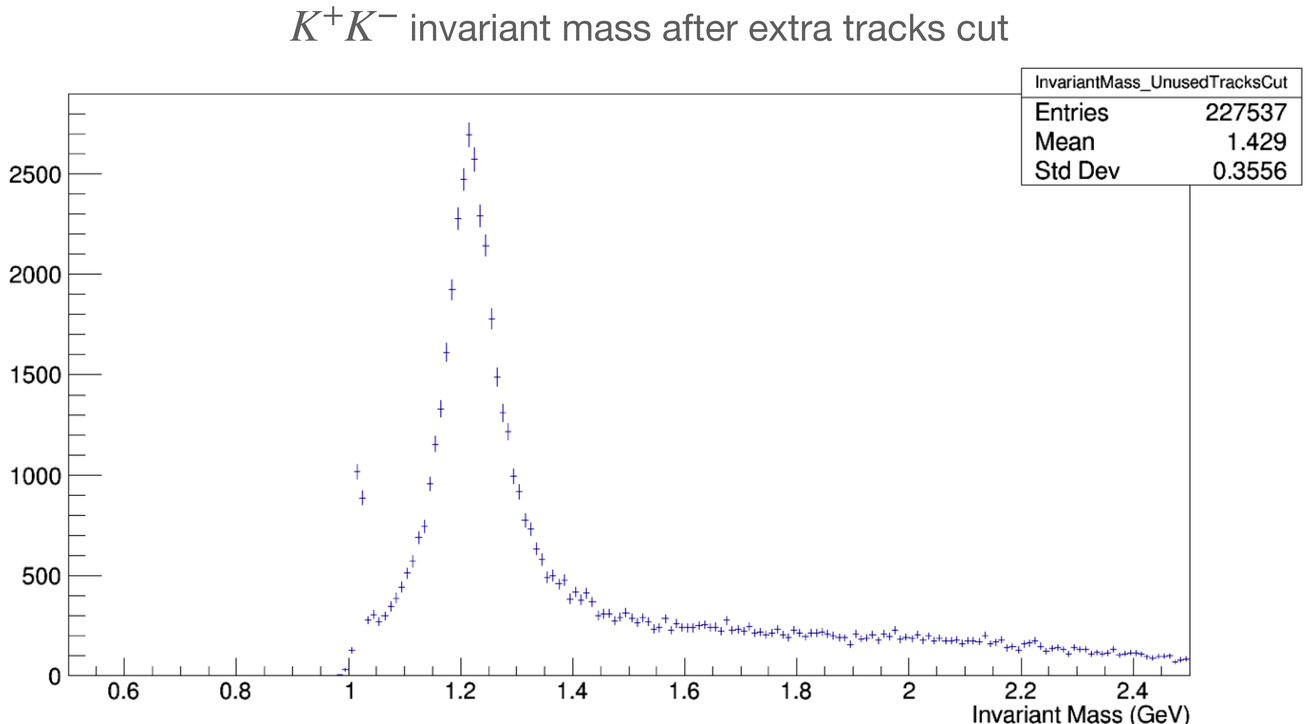


K^+K^- invariant mass after coplanarity cut



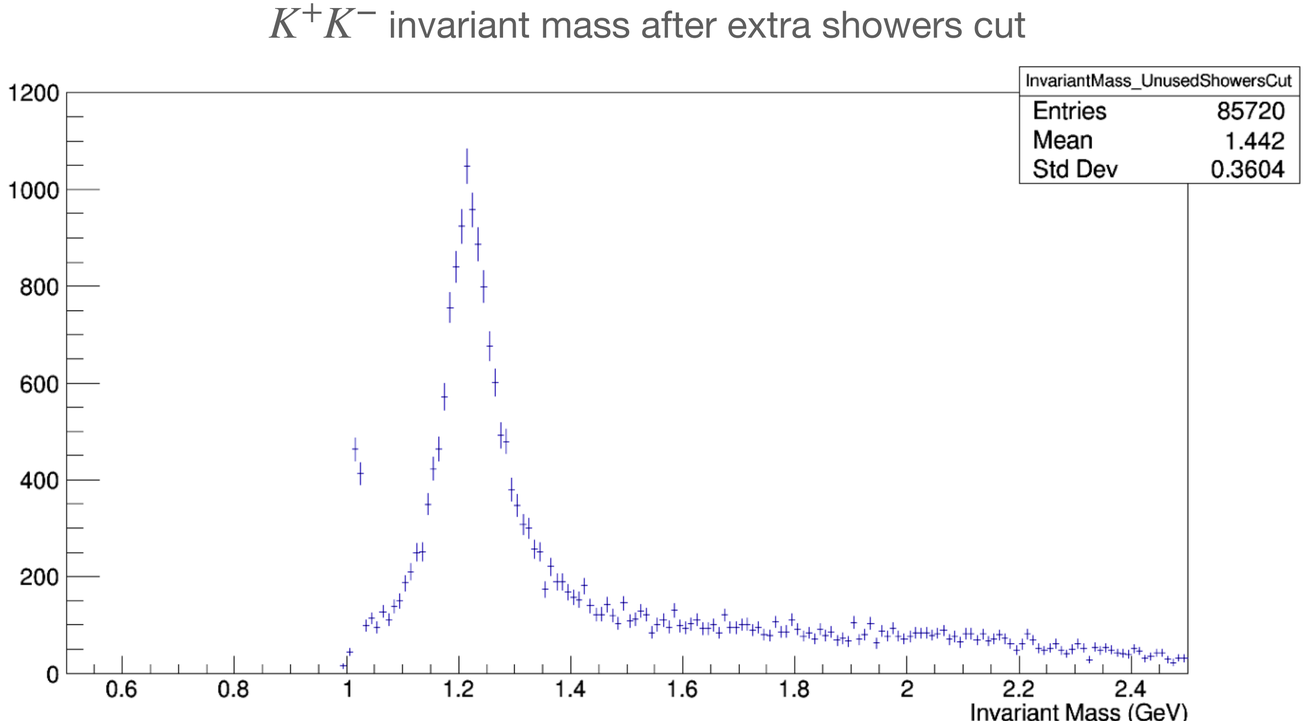
DSelector

- Extra tracks cut: no extra tracks



DSelector

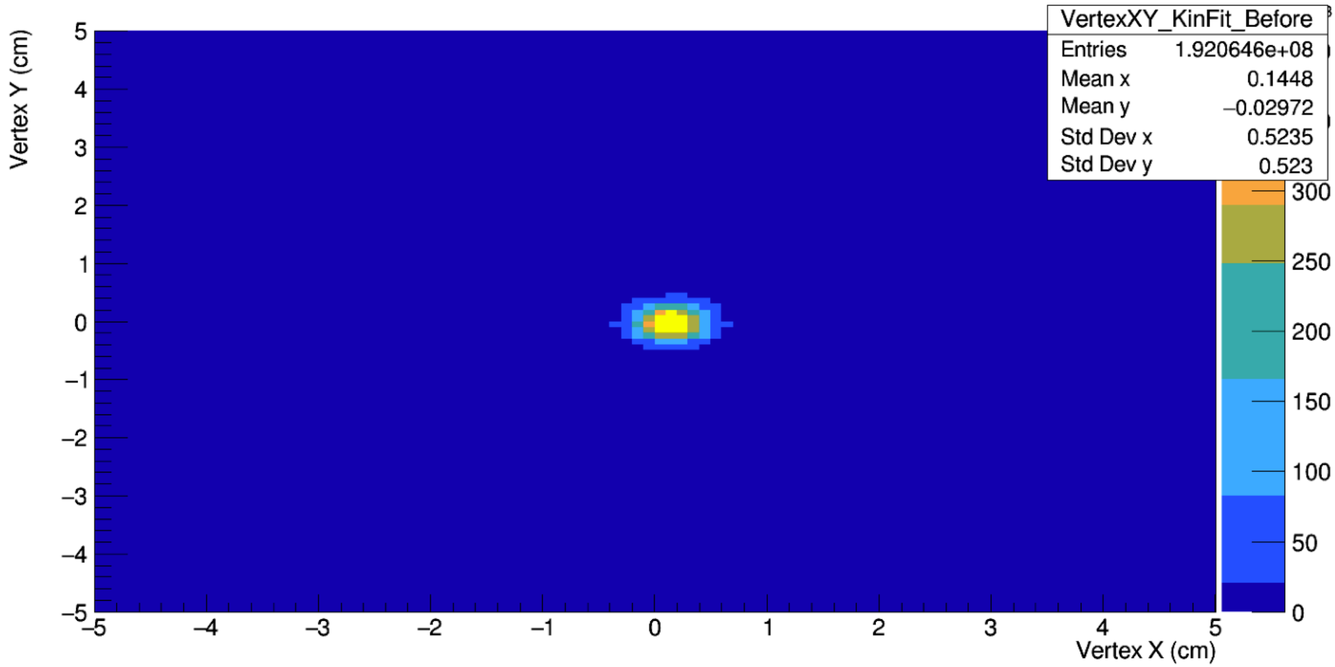
- Extra showers cut: no extra showers



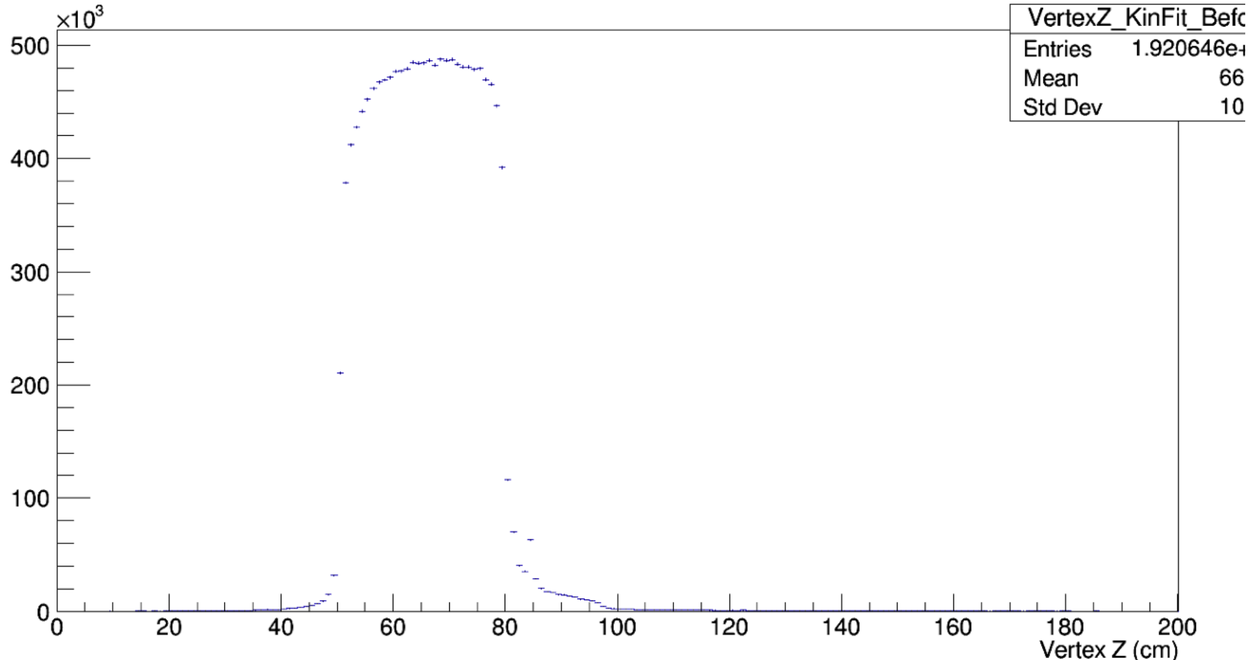
DSelector

- Production vertex (KinFit) cut:
  $51\ \text{cm} < z < 76\ \text{cm}$,
  $r = \sqrt{x^2 + y^2} < 1\ \text{cm}$

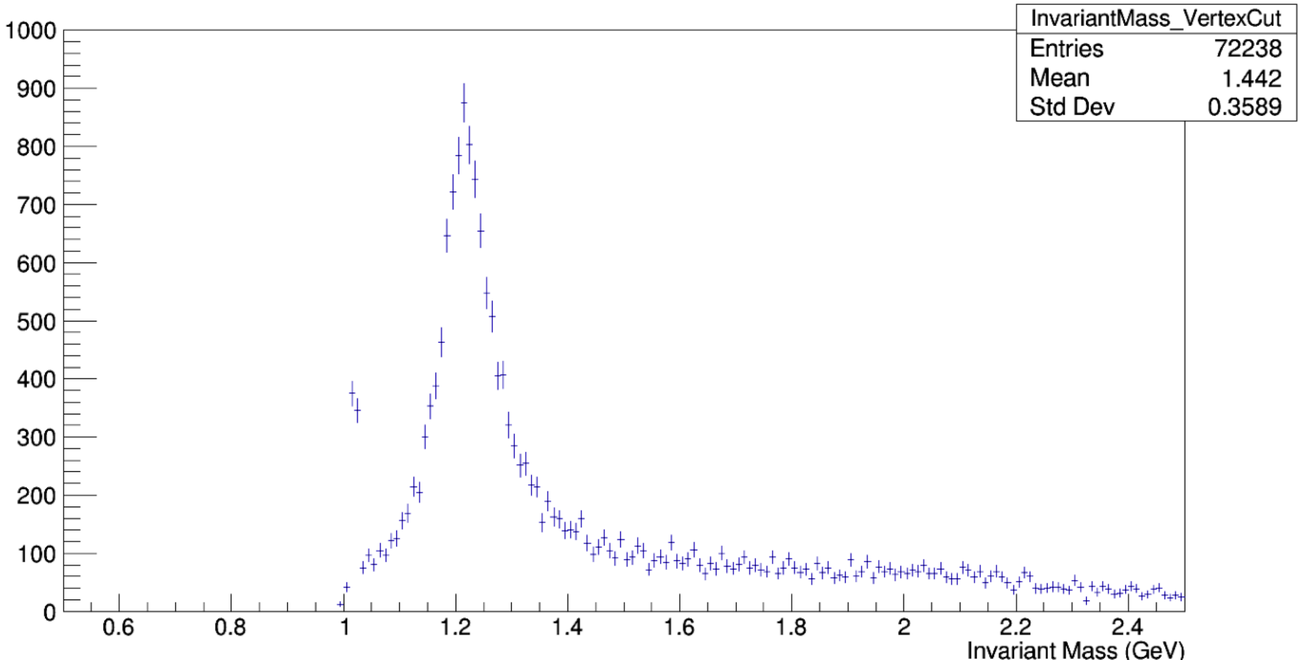
Vertex x vs y using KinFit values before all cuts



Vertex z using KinFit values before all cuts



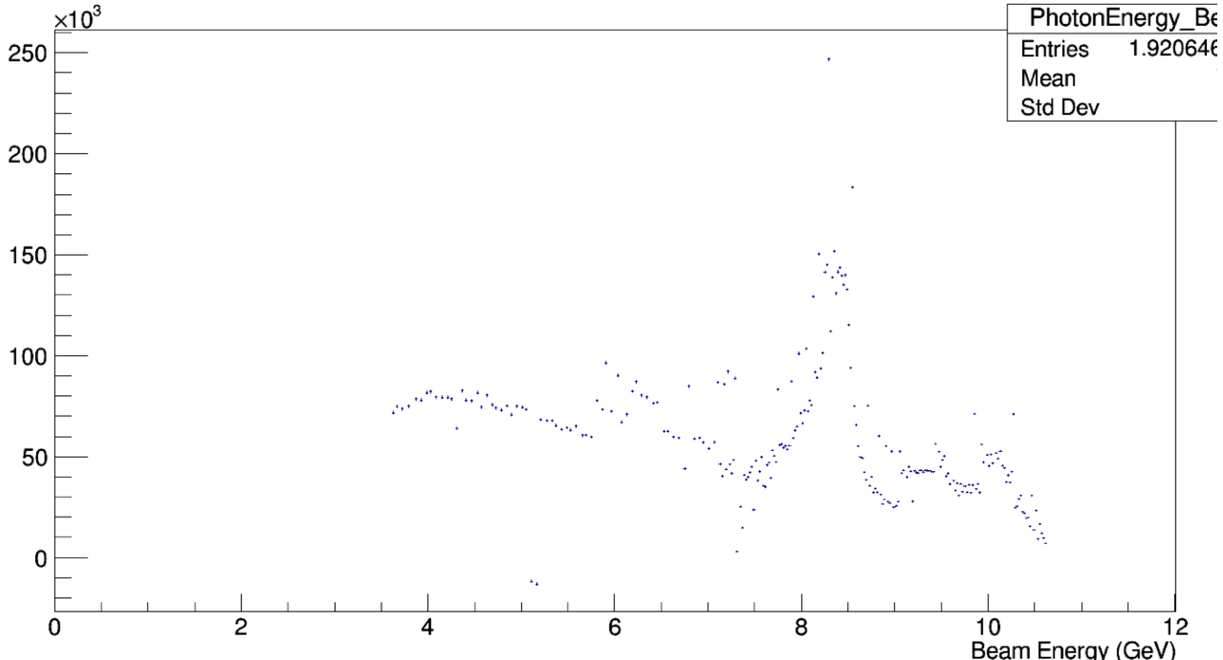
K^+K^- invariant mass after coplanarity cut



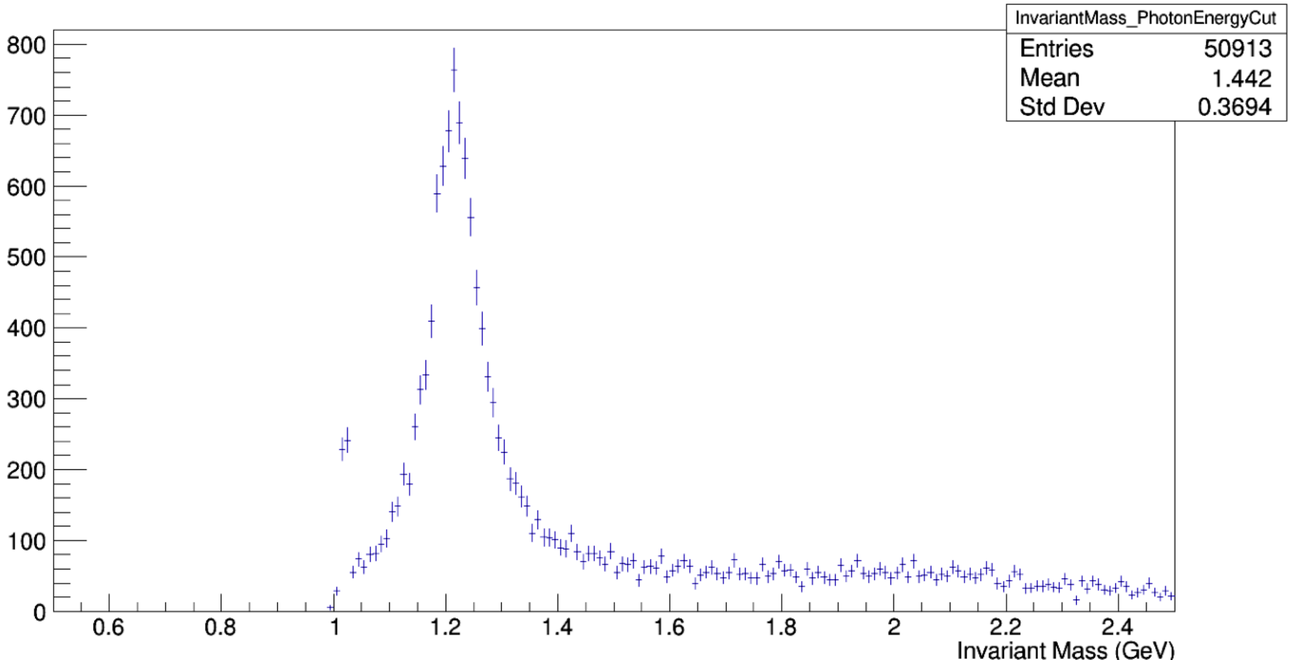
DSelector

- Beam energy cut: 6 GeV $< E_\gamma <$ 11 GeV

Photon energy using measured values before all cuts



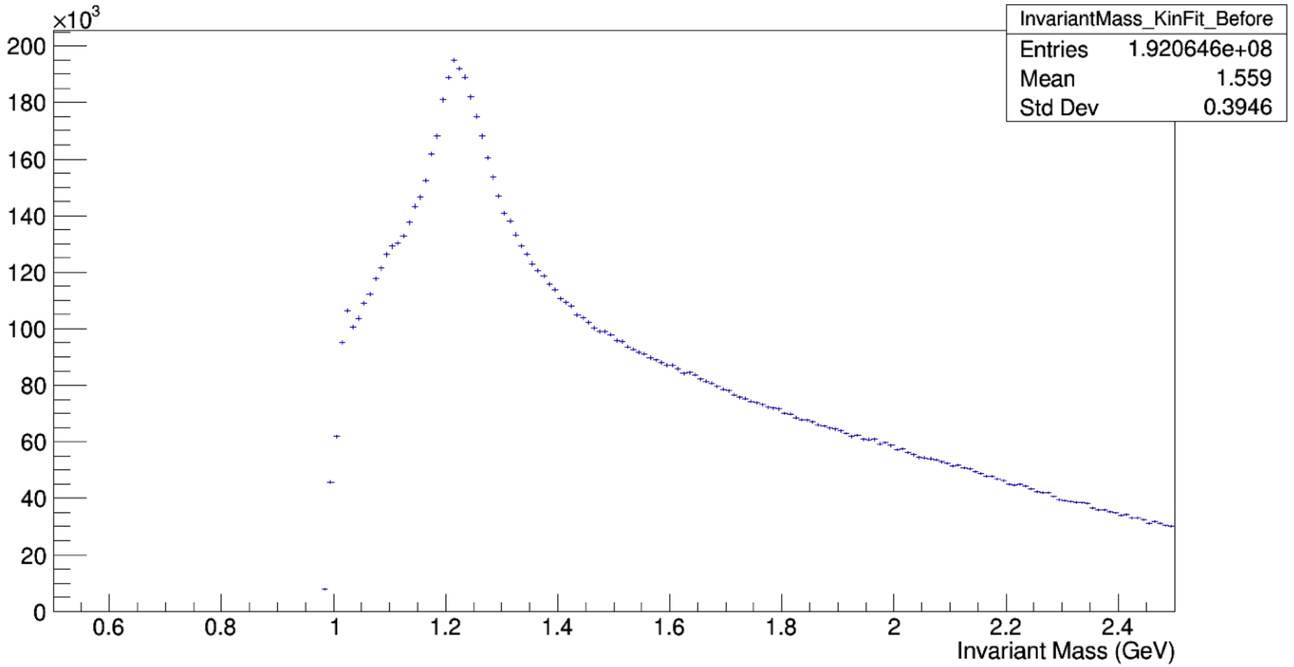
K^+K^- invariant mass after photon energy cut



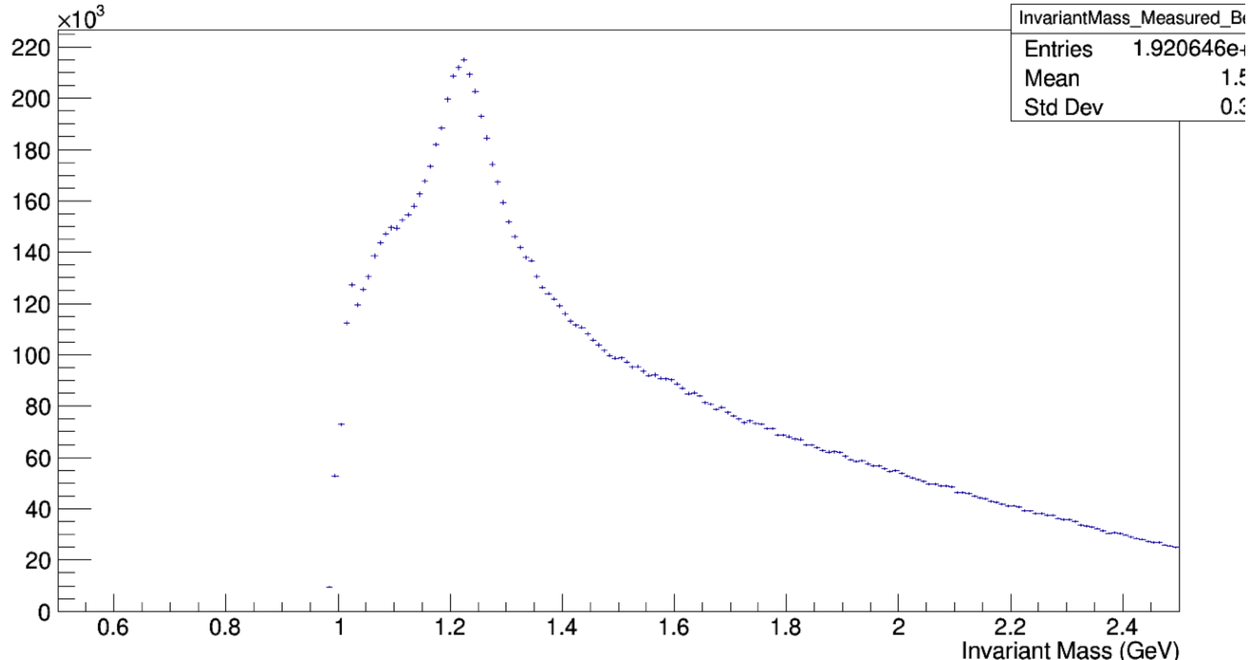
DSelector

- Invariant mass cut:
  $1\ \text{GeV} < m_{\phi} < 1.04\ \text{GeV}$

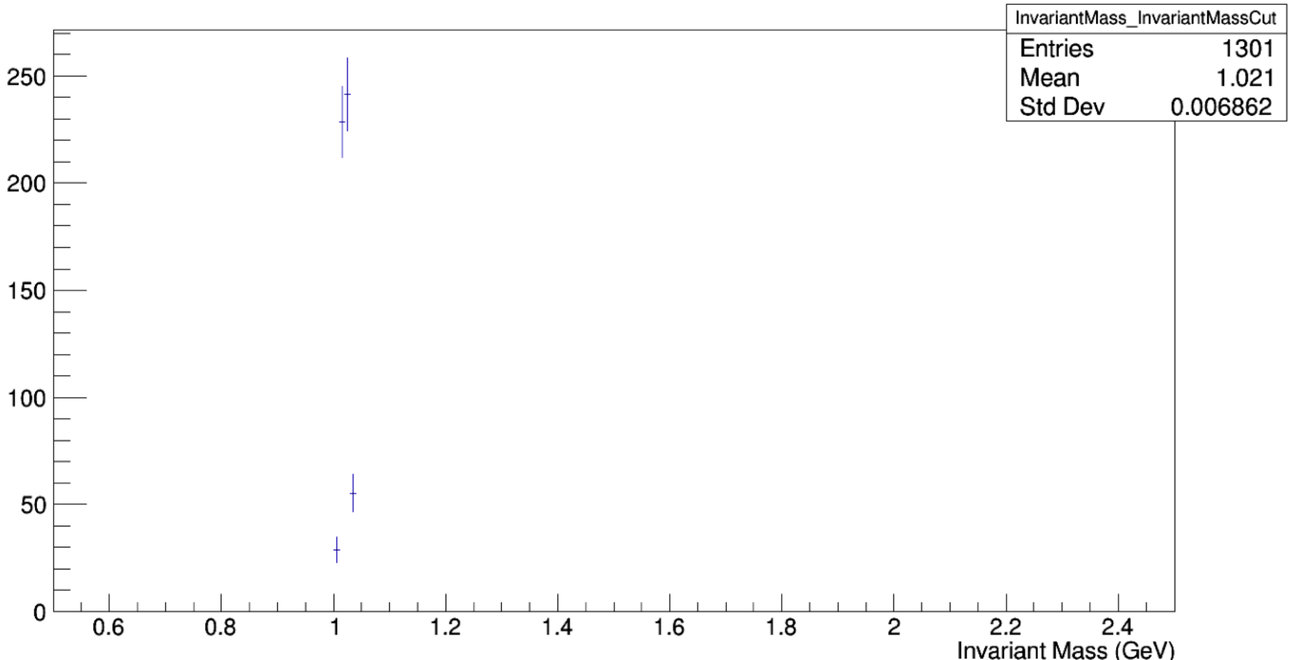
Invariant mass using KinFit values before all cuts



Invariant mass using measured values before all cuts

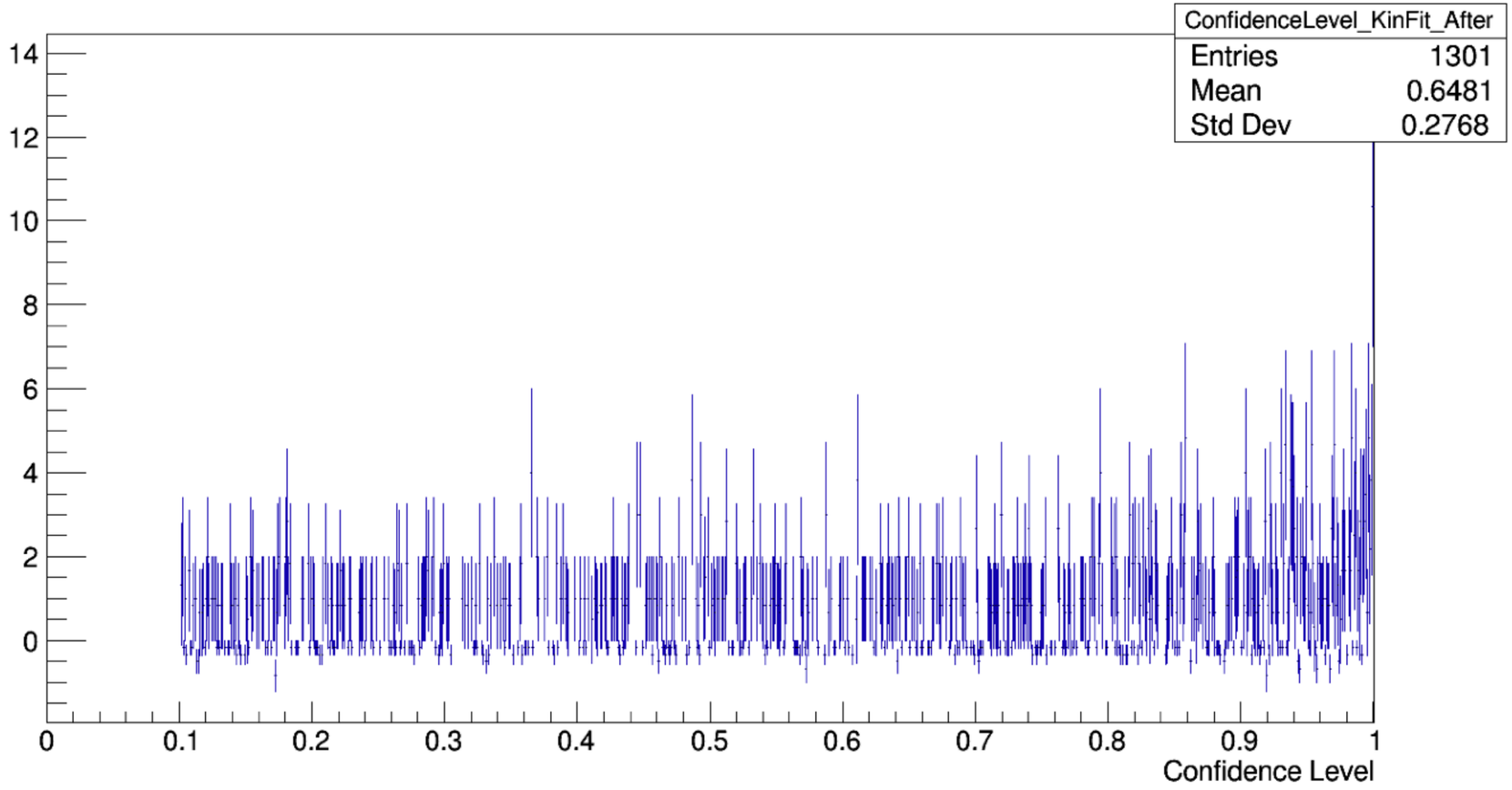


K^+K^- invariant mass after invariant mass cut



DSelector

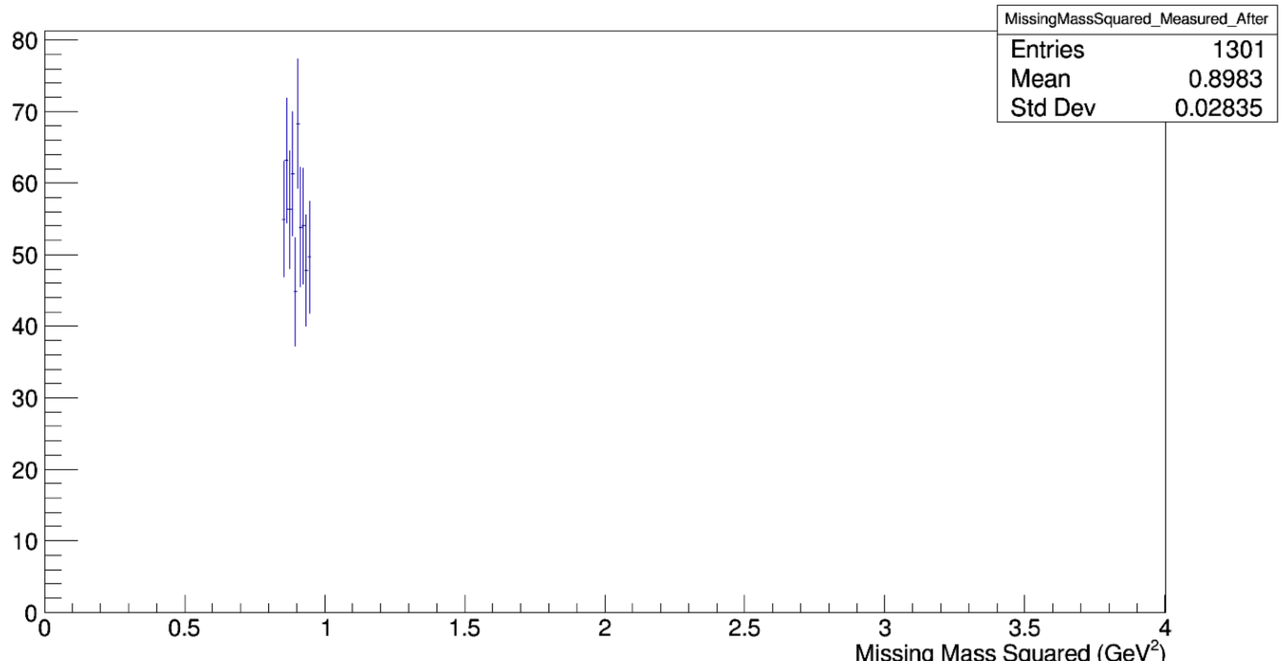
- Selected $\gamma d \rightarrow \phi p(n) \rightarrow K^+K^-p(n)$ events
- Confidence level



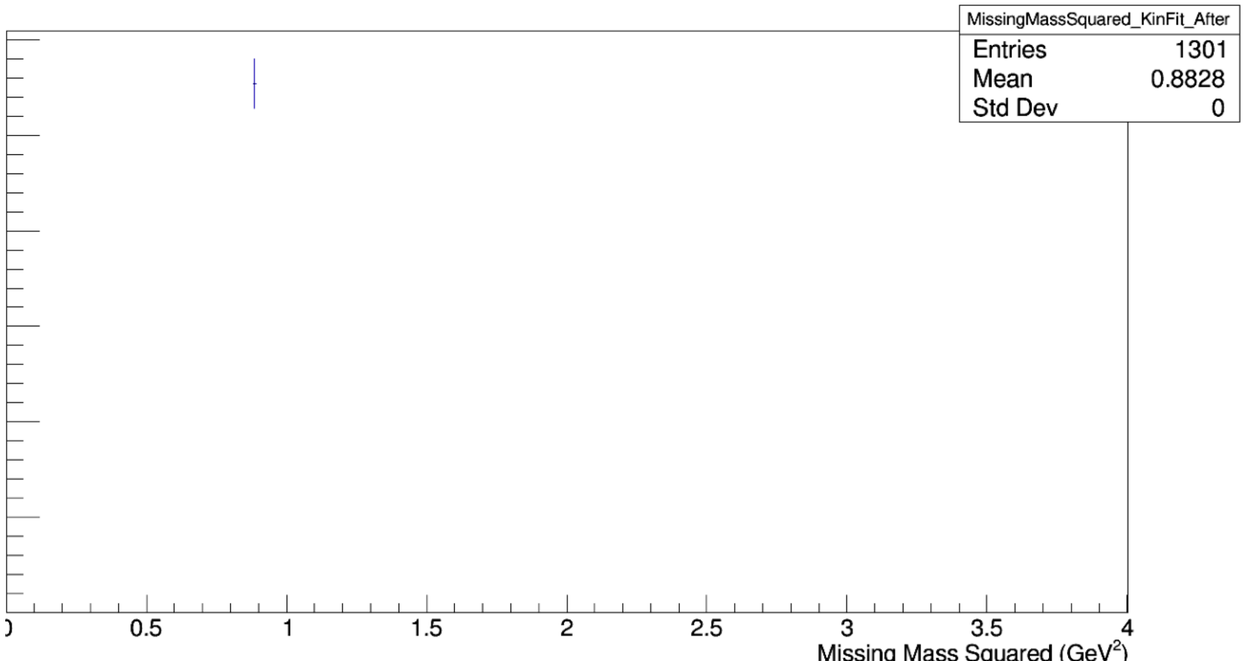
DSelector

- Selected $\gamma d \rightarrow \phi p(n) \rightarrow K^+K^-p(n)$ events
- Missing mass squared

Using measured values



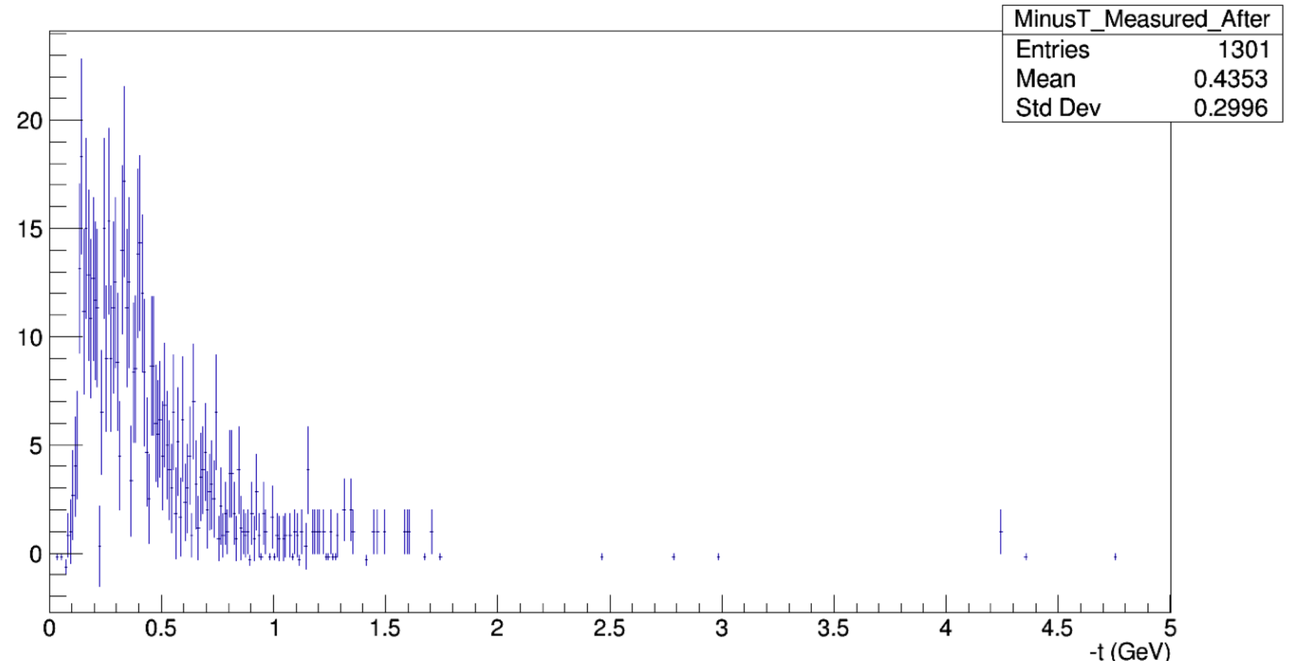
Using KinFit values



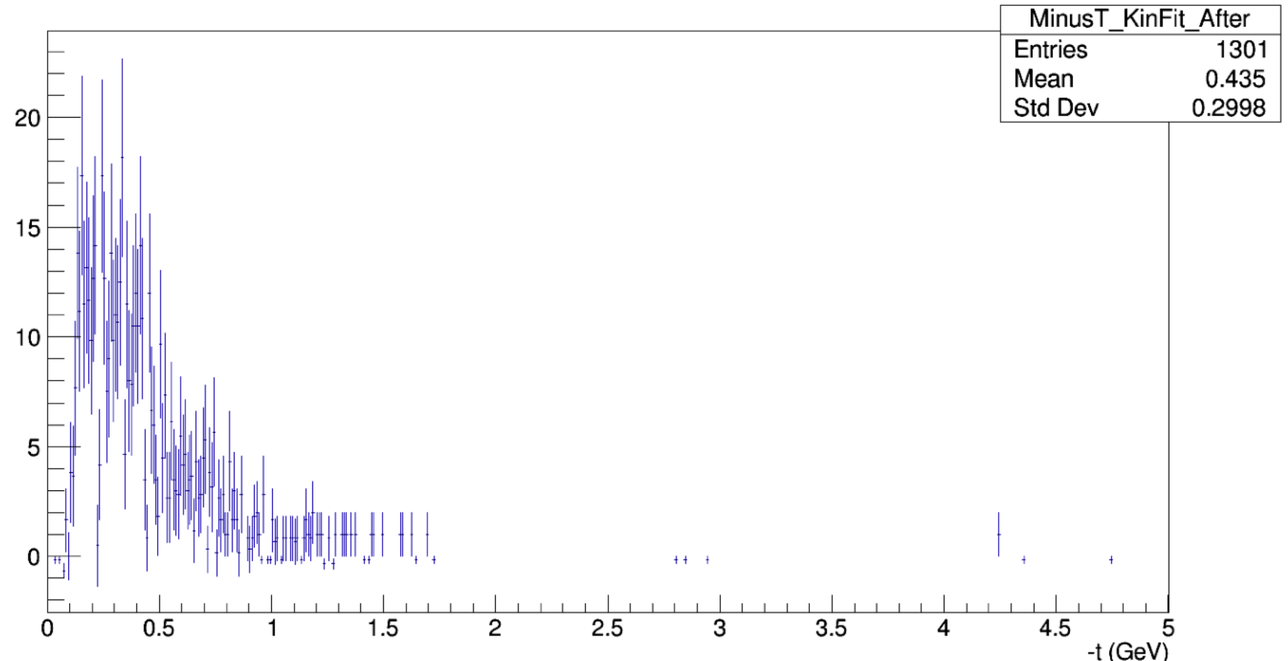
DSelector

- Selected $\gamma d \rightarrow \phi p(n) \rightarrow K^+K^-p(n)$ events
- -t

Using measured values



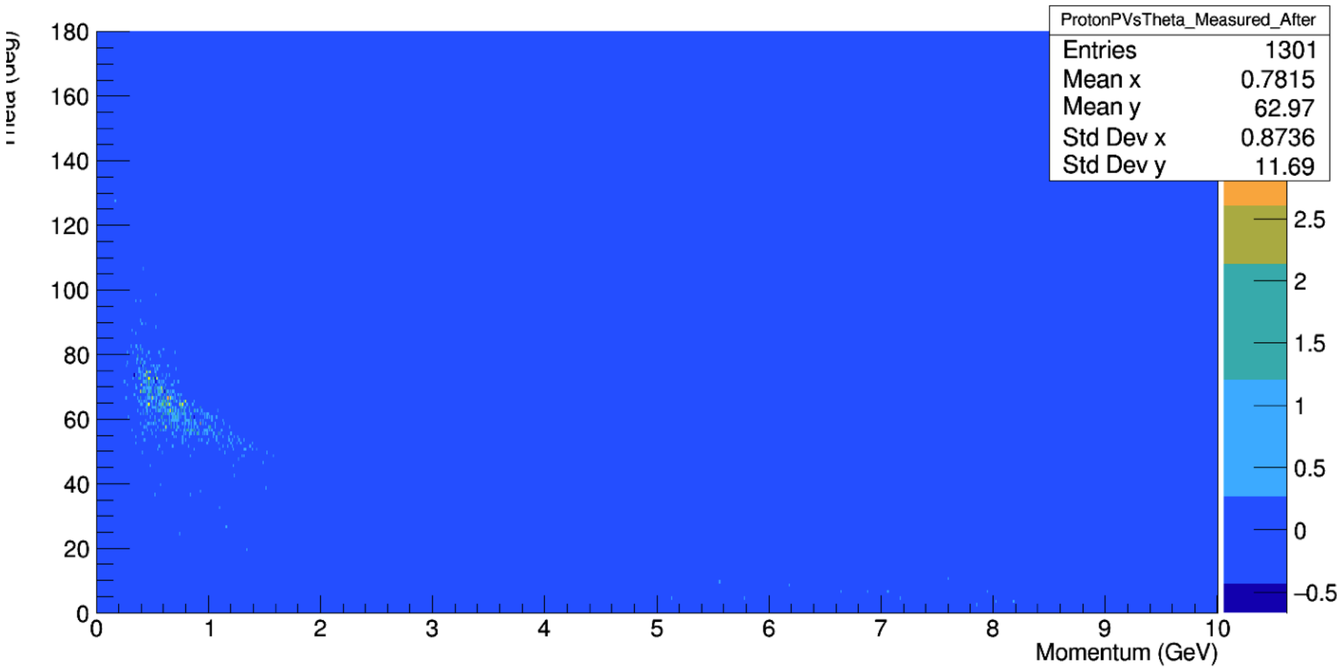
Using KinFit values



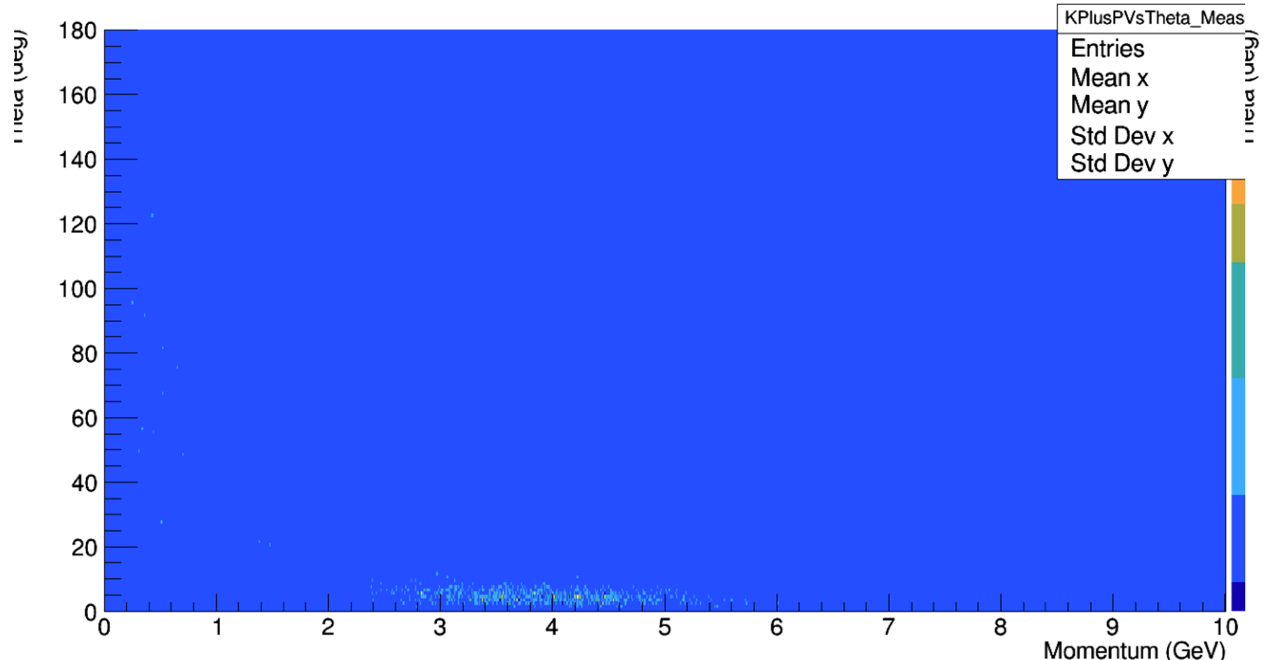
DSelector

- Selected
  $\gamma d \rightarrow \phi p(n) \rightarrow K^+K^-p(n)$ events
- Particle kinematics (measured)

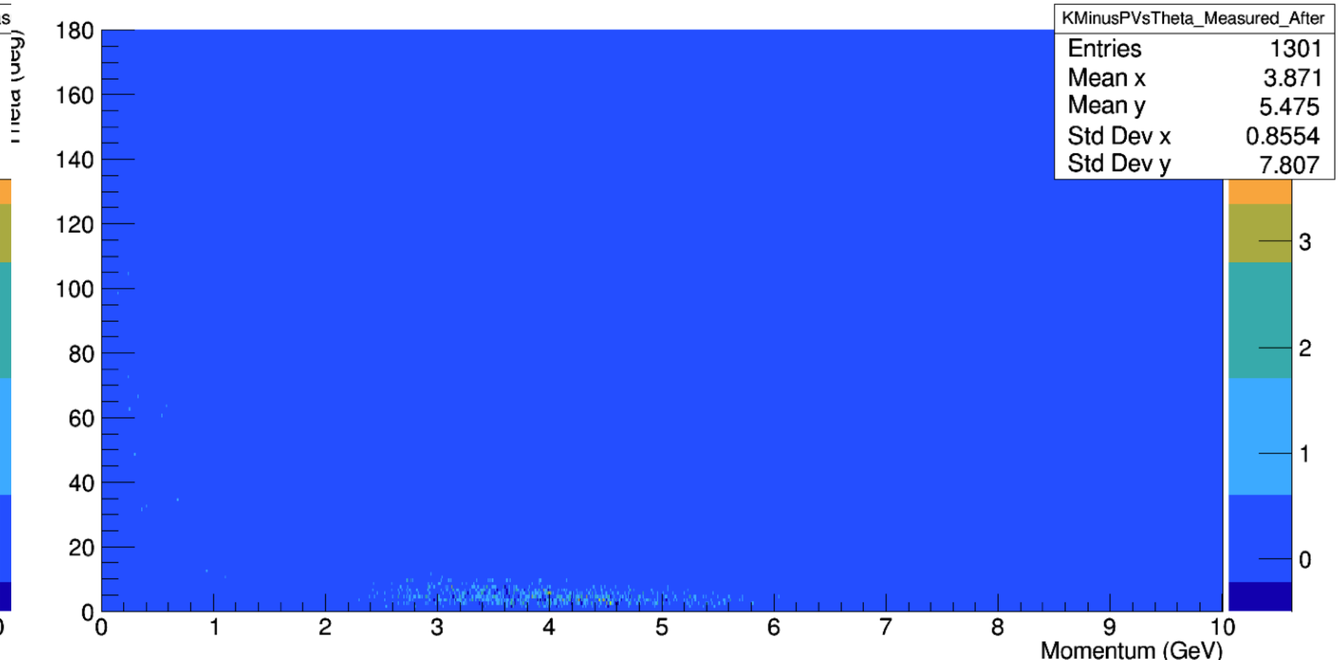
p



K^+



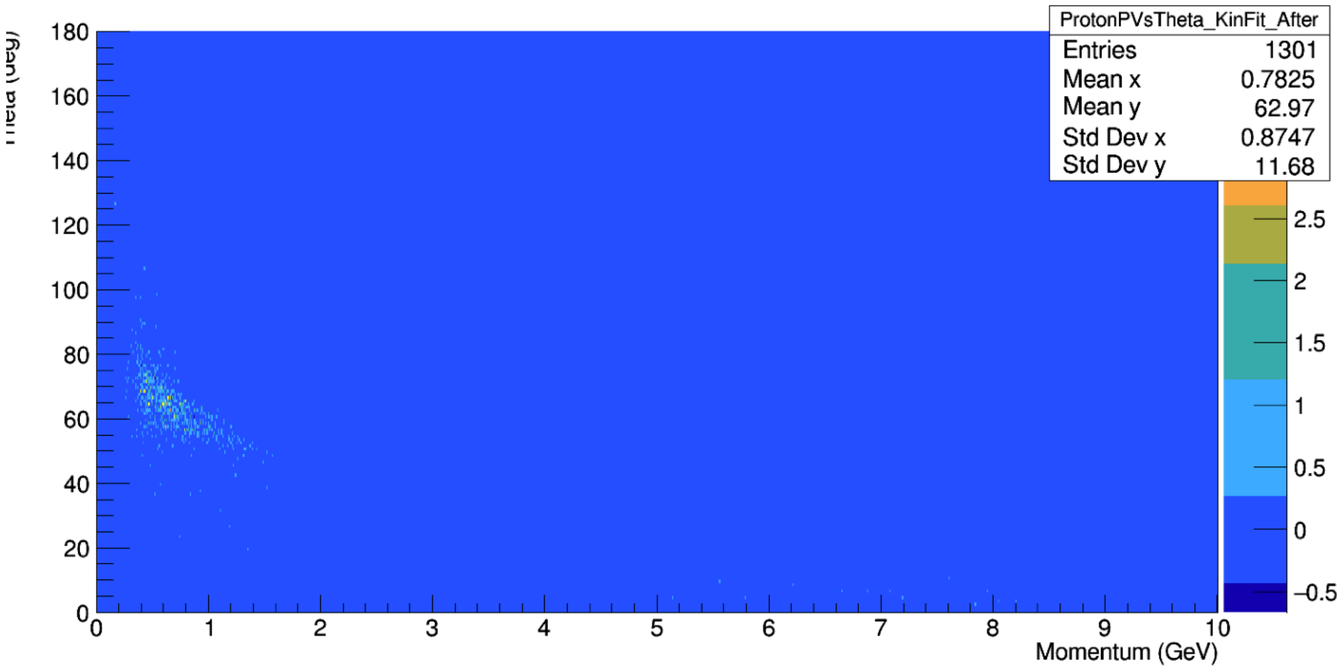
K^-



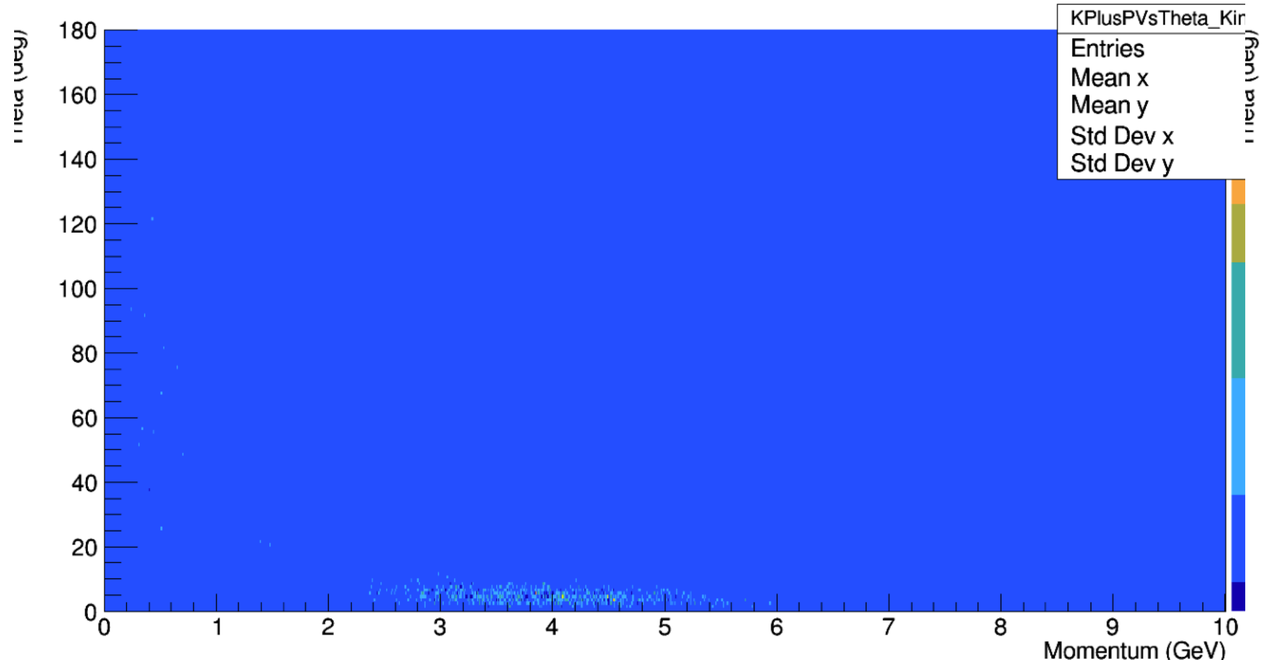
DSelector

- Selected
  $\gamma d \rightarrow \phi p(n) \rightarrow K^+K^-p(n)$ events
- Particle kinematics (KinFit)

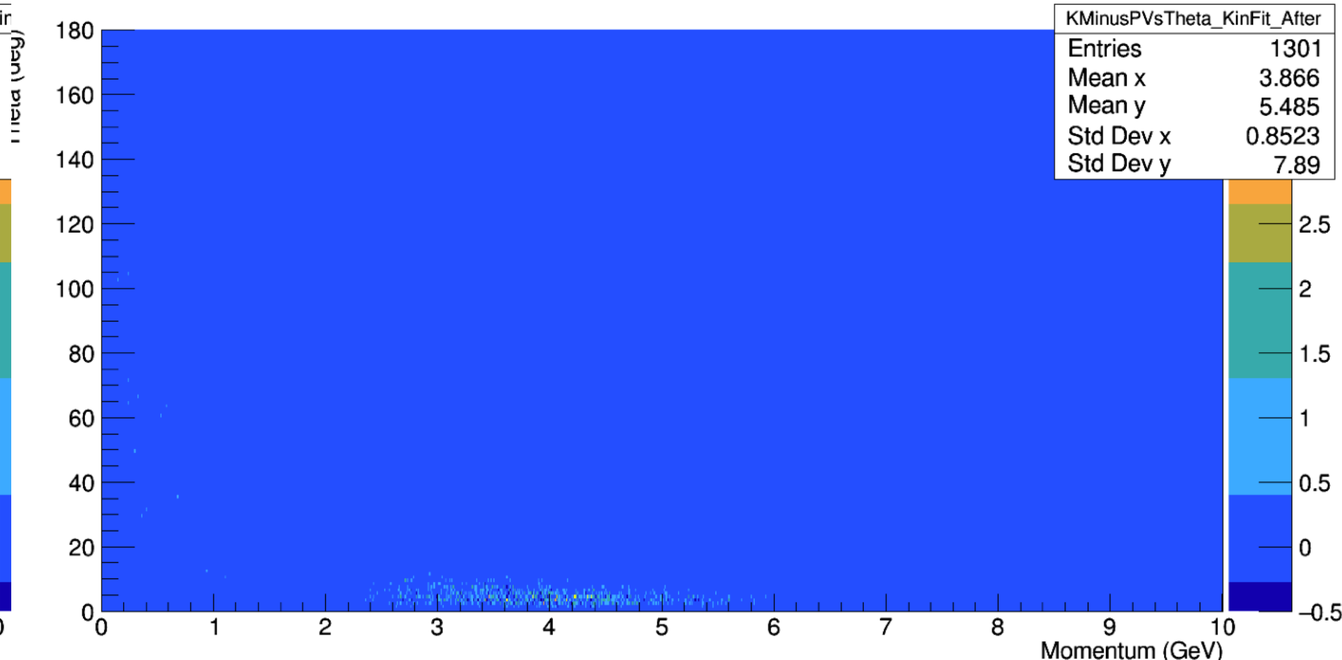
p



K^+

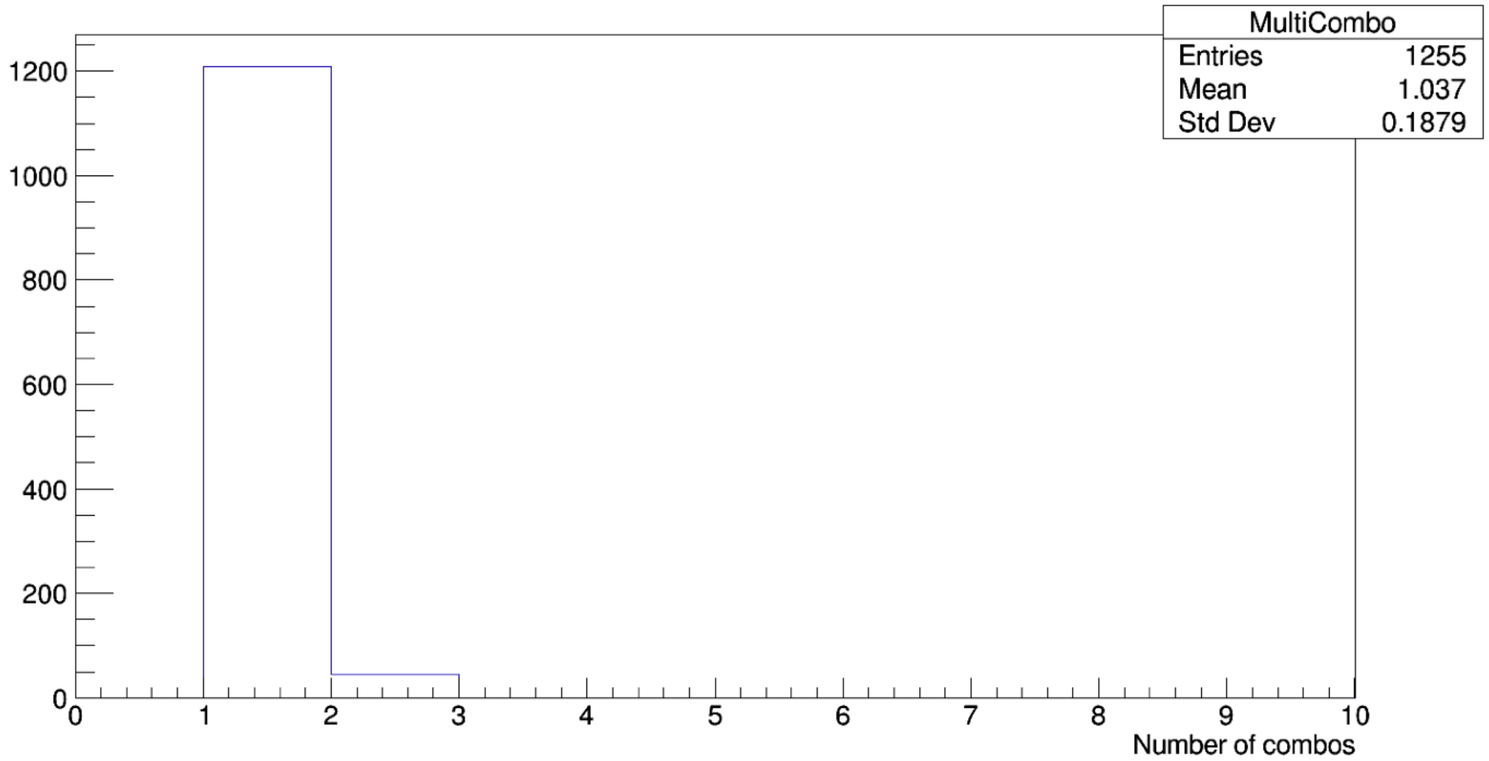


K^-



DSelector

- Selected
  $\gamma d \to \phi p(n) \to K^+K^-p(n)$ events
- Surviving combos per event



DSelector

- Plans for next step
- Plot the kinematics of the missing neutron / initial state proton
- Cut based on comparing the CL of $\gamma d \to K^+K^-p(n)$ and $\gamma d \to \pi^+\pi^-p(n)$
- Cut on the $\Lambda(1520) \to pK^-$ mass, unused shower energy and more?
- Simulation of the signal (ϕ) and the background (ρ^0) events
- Look at production from neutron $\gamma d \to K^+K^-n(p)$ and coherent $\gamma d \to K^+K^-(d)$