$\gamma n \rightarrow \pi^- p$ from deuterium with GlueX

- Reaction: $\gamma n \rightarrow \pi^- p$
- Include the spectator proton: $\gamma d \rightarrow \pi^- p(p)$
- Motivation: -study the transition from quark-gluon to nucleon-meson D.O.F.

  -verify the predictions made by constituent counting rule (CCR)

  -at fixed c.m. angle, $d\sigma/dt \propto s^{-7}$

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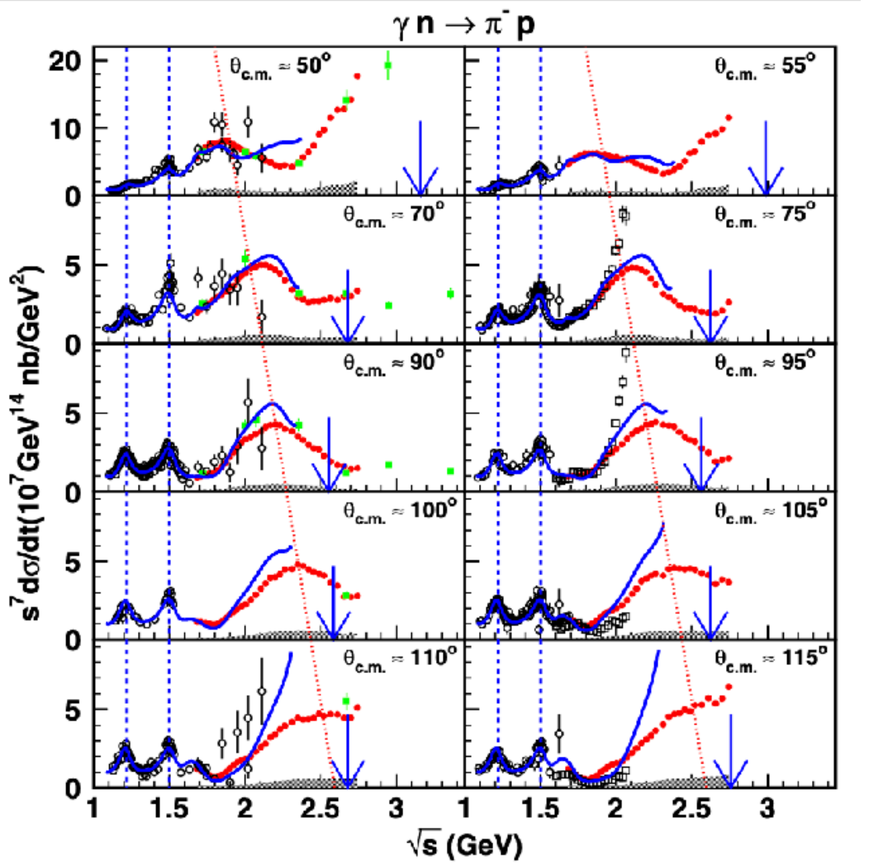
- CLAS 6 results (by W. Chen)
- Covered $\sqrt{s} = 1.8 - 2.5$ GeV($E_\gamma = 1.0 - 3.5$ GeV)
- Covered $\theta_{c.m.} = 50^\circ - 115^\circ$



$\gamma n \rightarrow \pi^- p$ from deuterium with GlueX

- Hope to extend this to higher energy with the SRC/CT dataset
- 5% data is used
- Event selection

  -1 positive and 1 negative tracks, no extra tracks or showers

  -kinematic fitting with P4 and vertex constraint, confidence level > 0.01

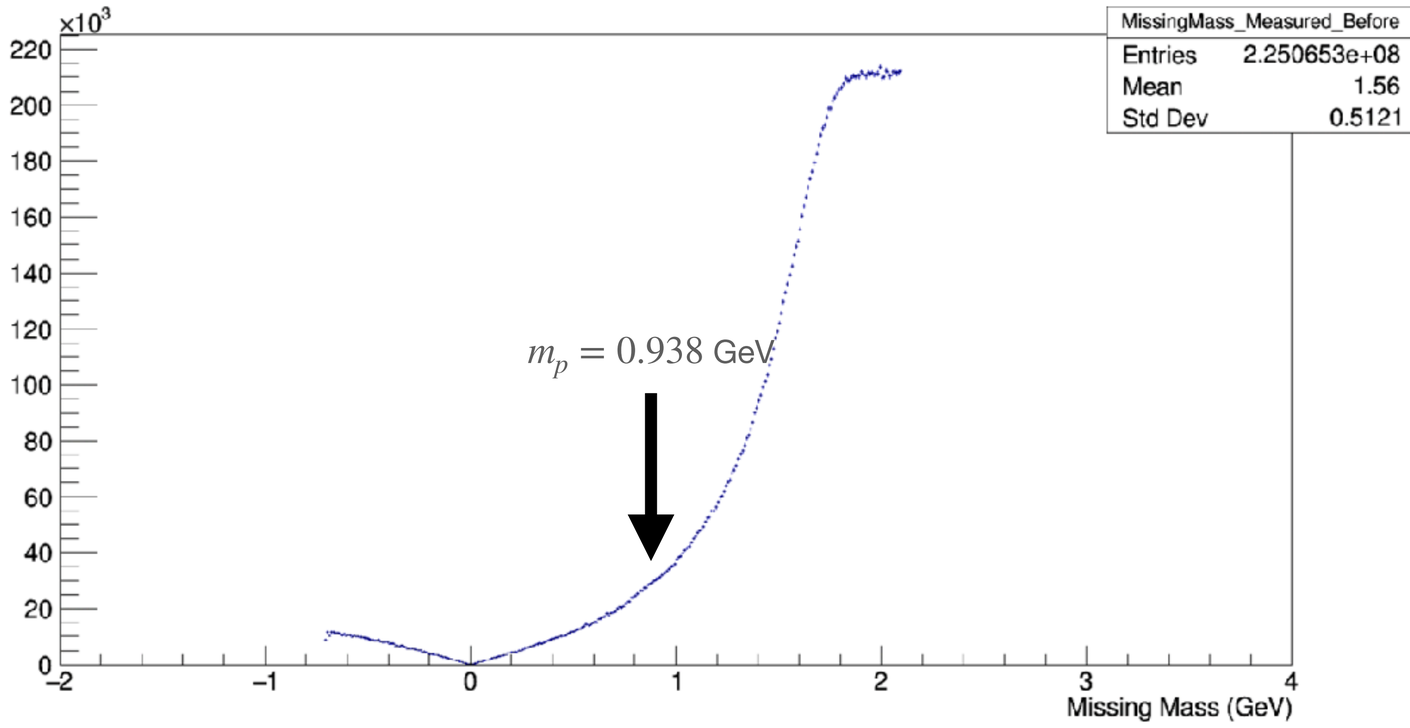
  -tagger accidental subtracted with 4 beam bunches on each side

  -standard GlueX PID cuts (timing and dE/dx)

$\gamma n \rightarrow \pi^- p$ from deuterium with GlueX

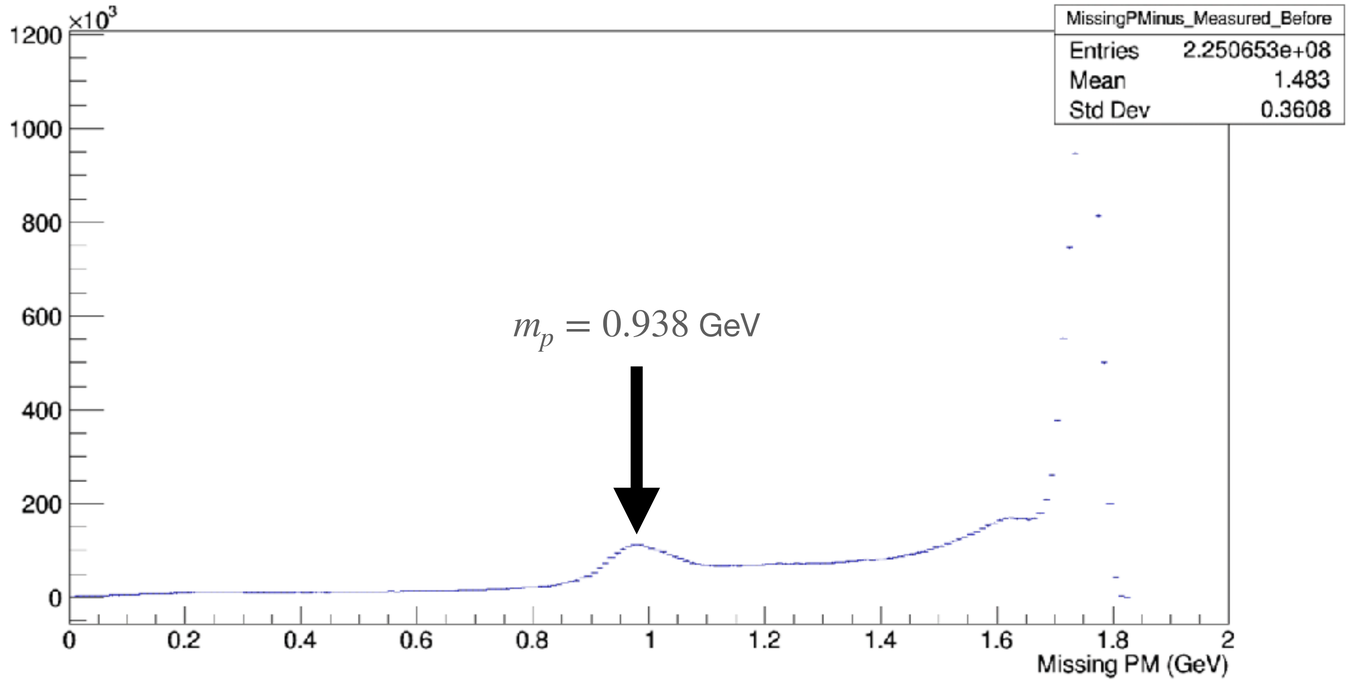
- Event selection based on the missing particle
- Calculated undetected spectator proton:
  $P_{miss} = P_\gamma + P_d - P_\pi - P_p, P_d = (m_d,0,0,0)$
- Missing mass distribution
- No peak around proton mass
- Might due to the limited

  resolution of GlueX



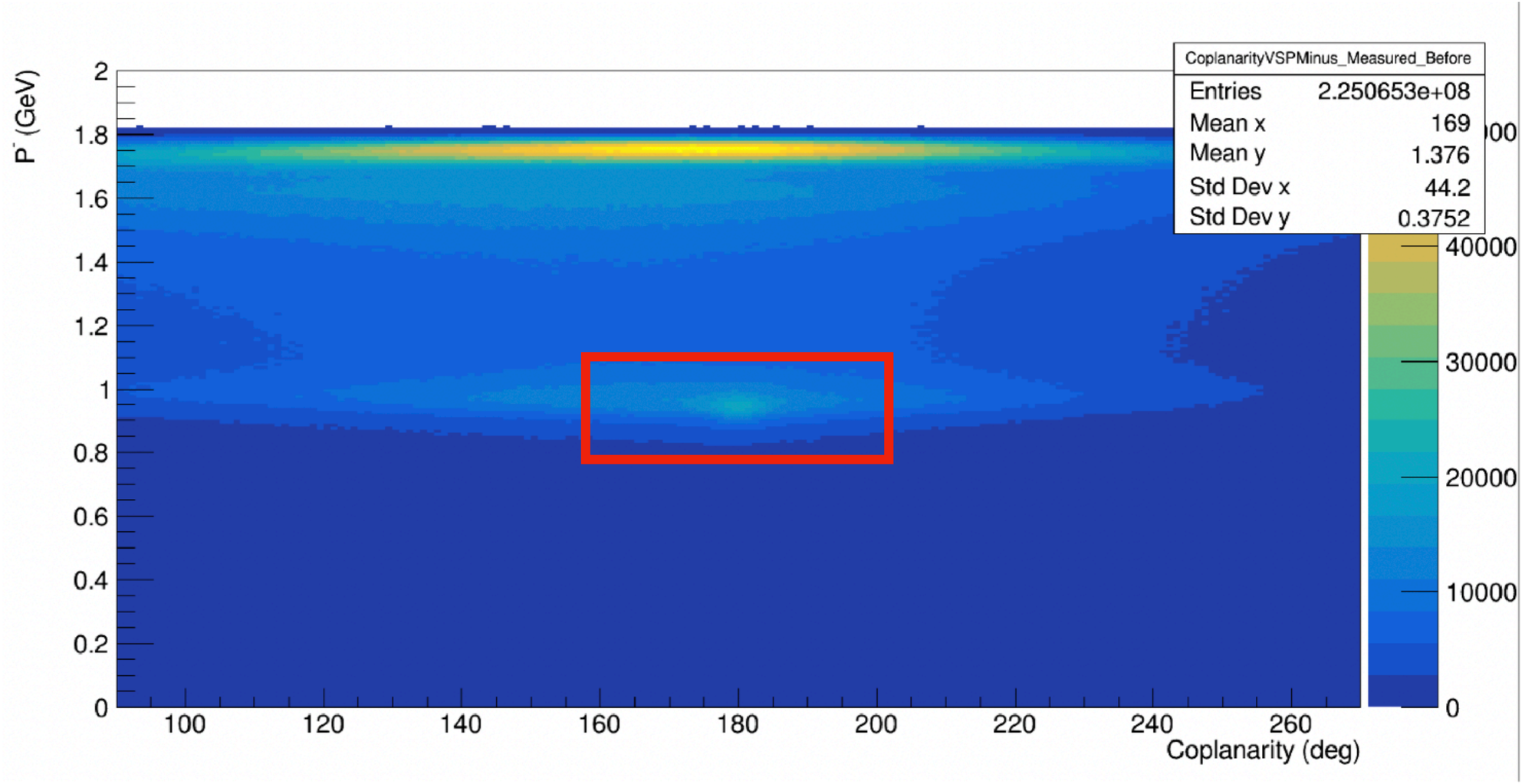
$\gamma n \rightarrow \pi^- p$ from deuterium with GlueX

- Light-front frame is used instead
- $p^- = E - p_z, p^+ = E + p_z, p_x$ and p_y are kept
- P^- has better resolution due to the cancellation of terms in error propagation
- For quasi-free nucleons, $P^- \approx m_N$
- Signal peak is spotted



$\gamma n \rightarrow \pi^- p$ from deuterium with GlueX

- $P^-_{missing}$ vs coplanarity angle



$\gamma n \rightarrow \pi^- p$ from deuterium with GlueX

- Event selection

  -1 positive and 1 negative tracks, no extra tracks or showers

  -kinematic fitting with P4 and vertex constraint, confidence level > 0.01

  -tagger accidental subtracted with 4 beam bunches on each side

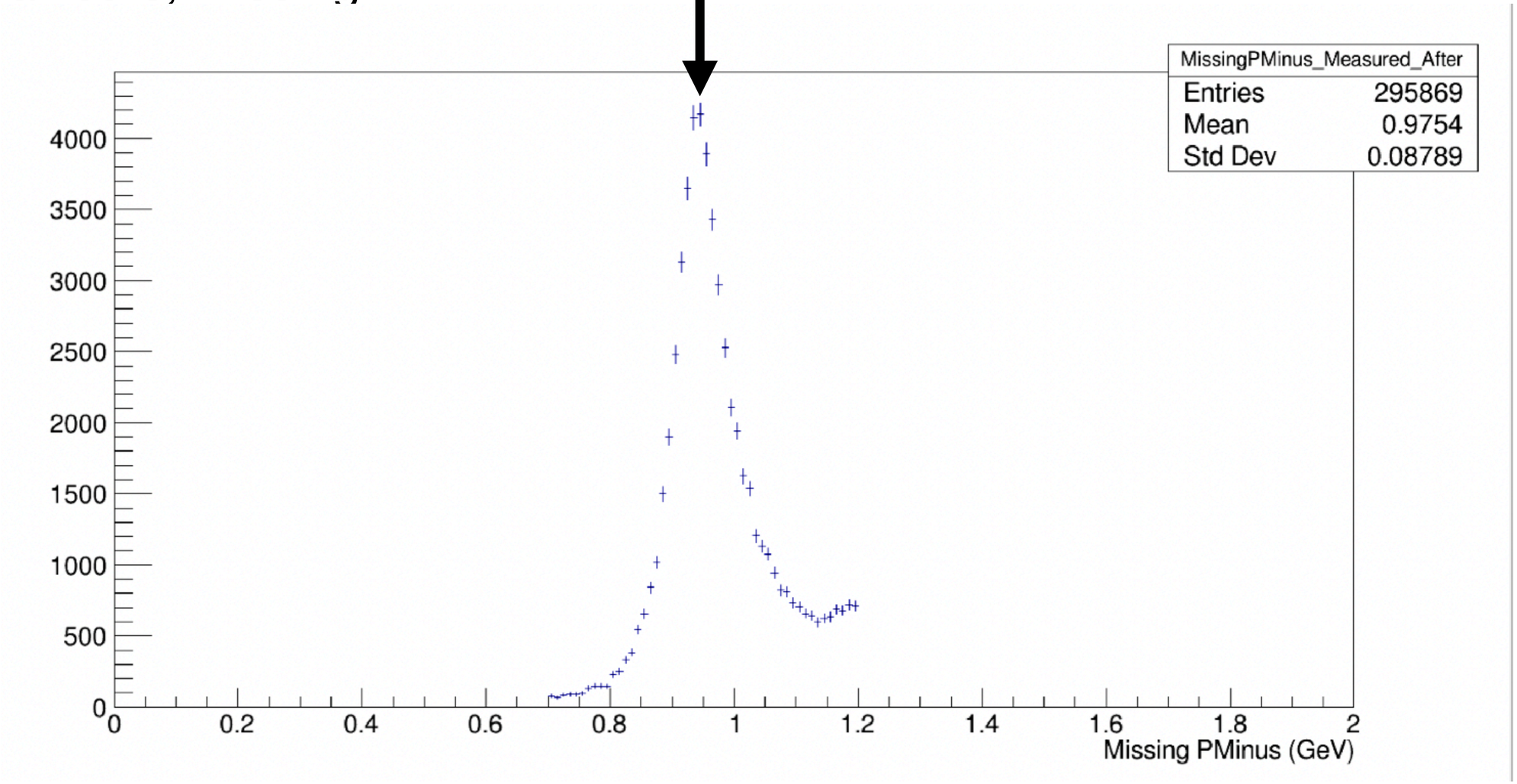
  -standard GlueX PID cuts (timing and dE/dx)

  -Missing P^- : $0.7 \text{ GeV} < P^-_{missing} < 1.2 \text{ GeV}$

  -Coplanarity angle: $150^\circ < |\phi_\pi - \phi_p| < 210^\circ$

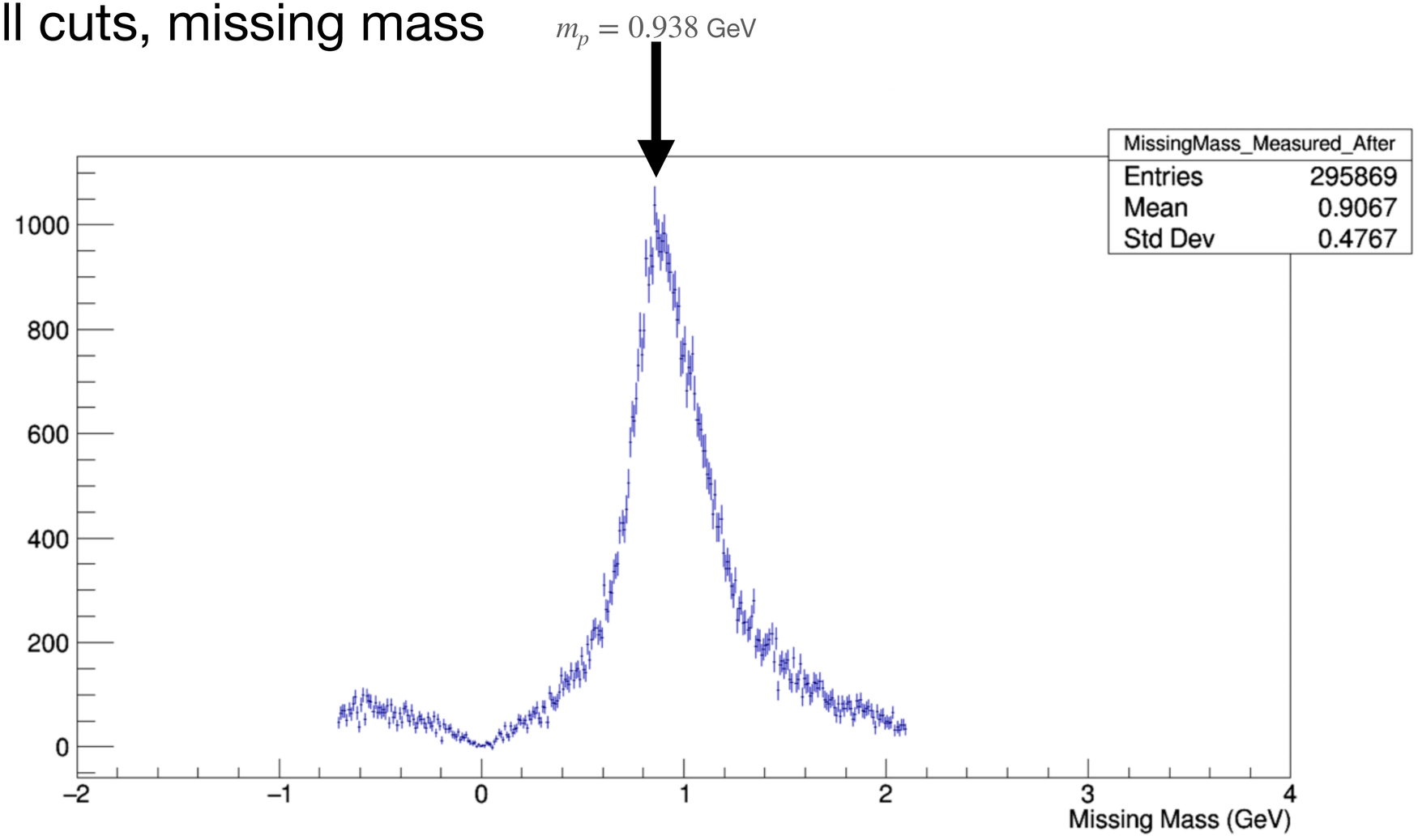
$\gamma n \rightarrow \pi^- p$ from deuterium with GlueX

- After all cuts, missing P^-



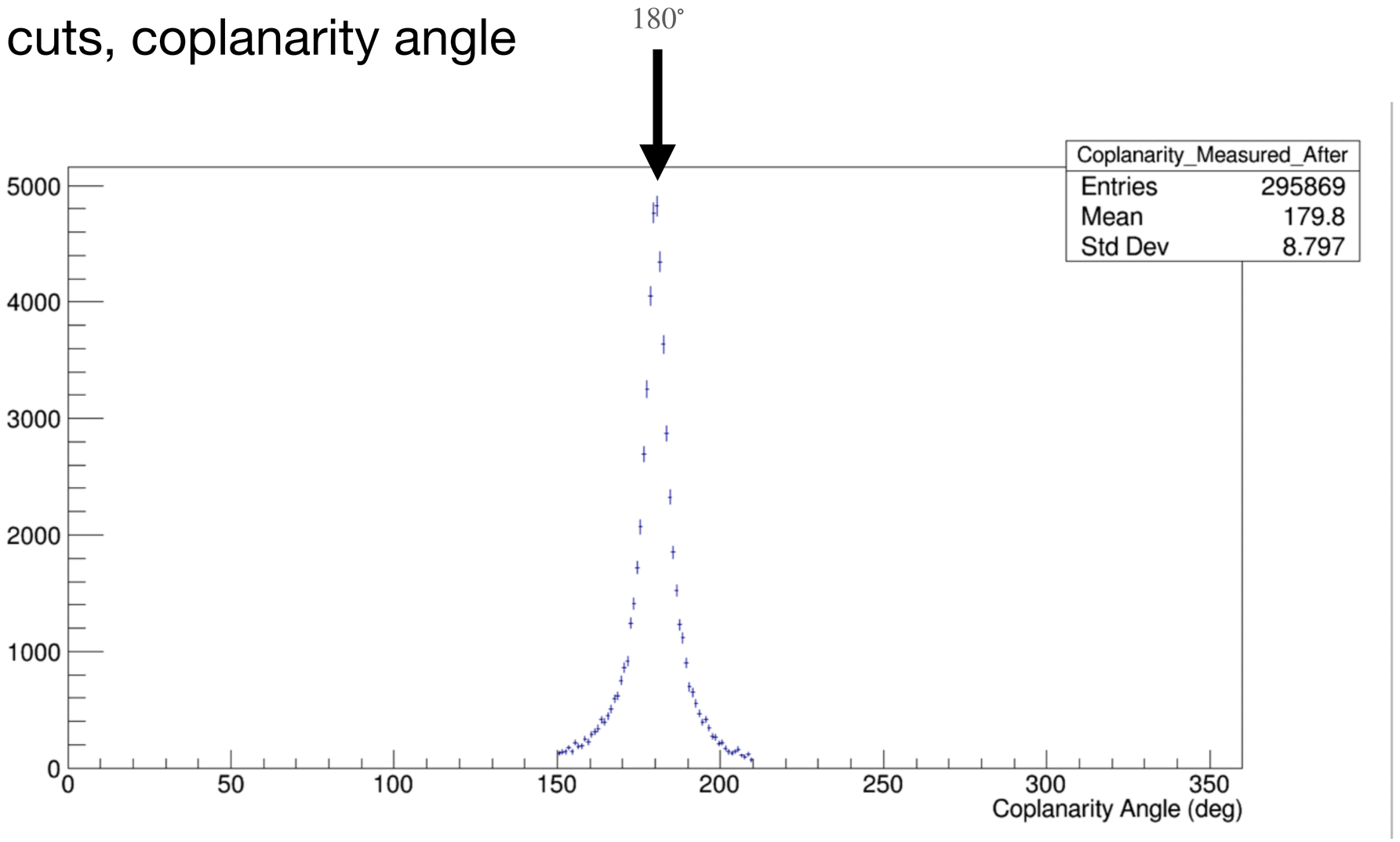
$\gamma n \rightarrow \pi^- p$ from deuterium with GlueX

- After all cuts, missing mass



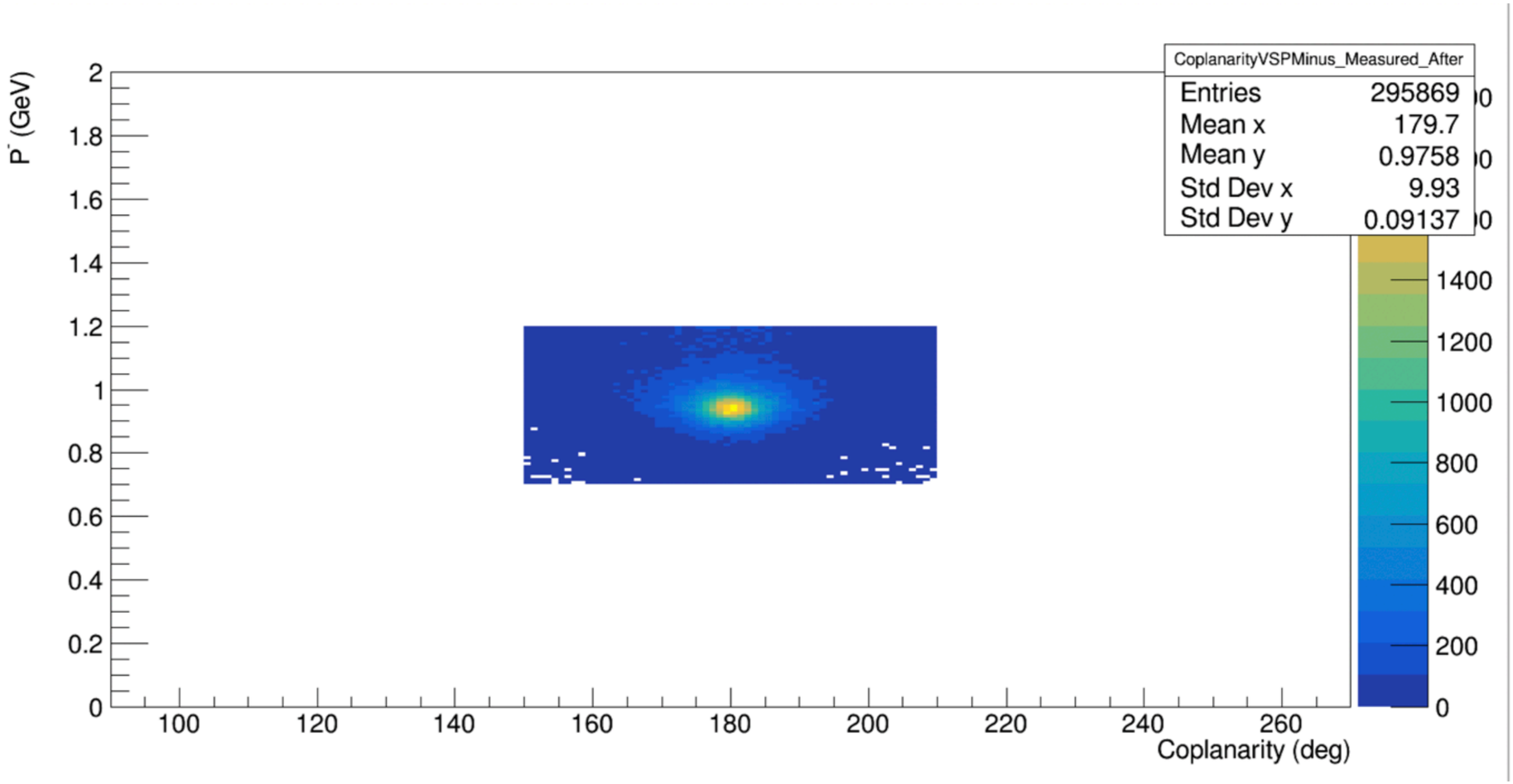
$\gamma n \rightarrow \pi^- p$ from deuterium with GlueX

- After all cuts, coplanarity angle



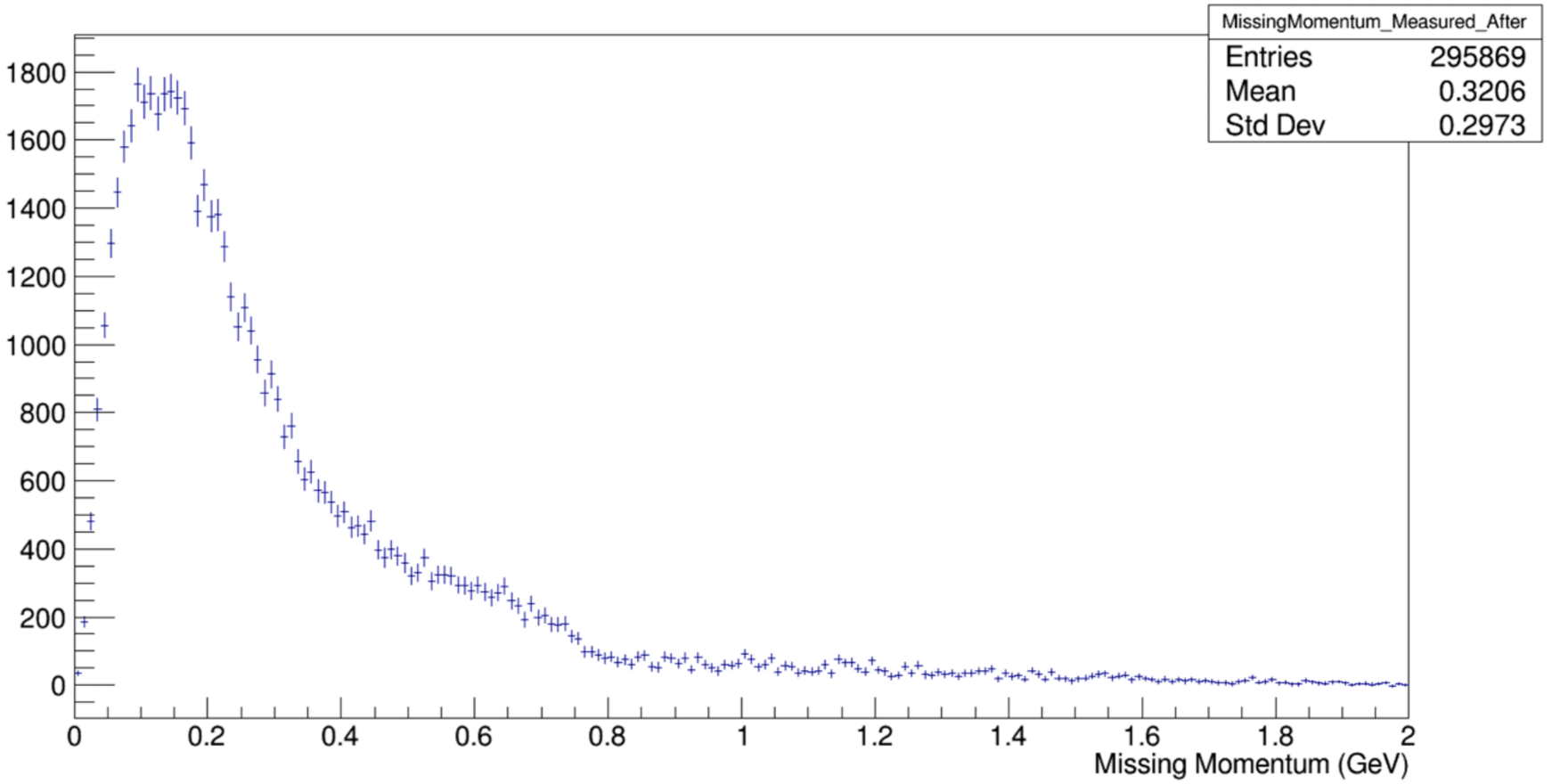
$\gamma n \rightarrow \pi^- p$ from deuterium with GlueX

- After all cuts, coplanarity angle vs P^-



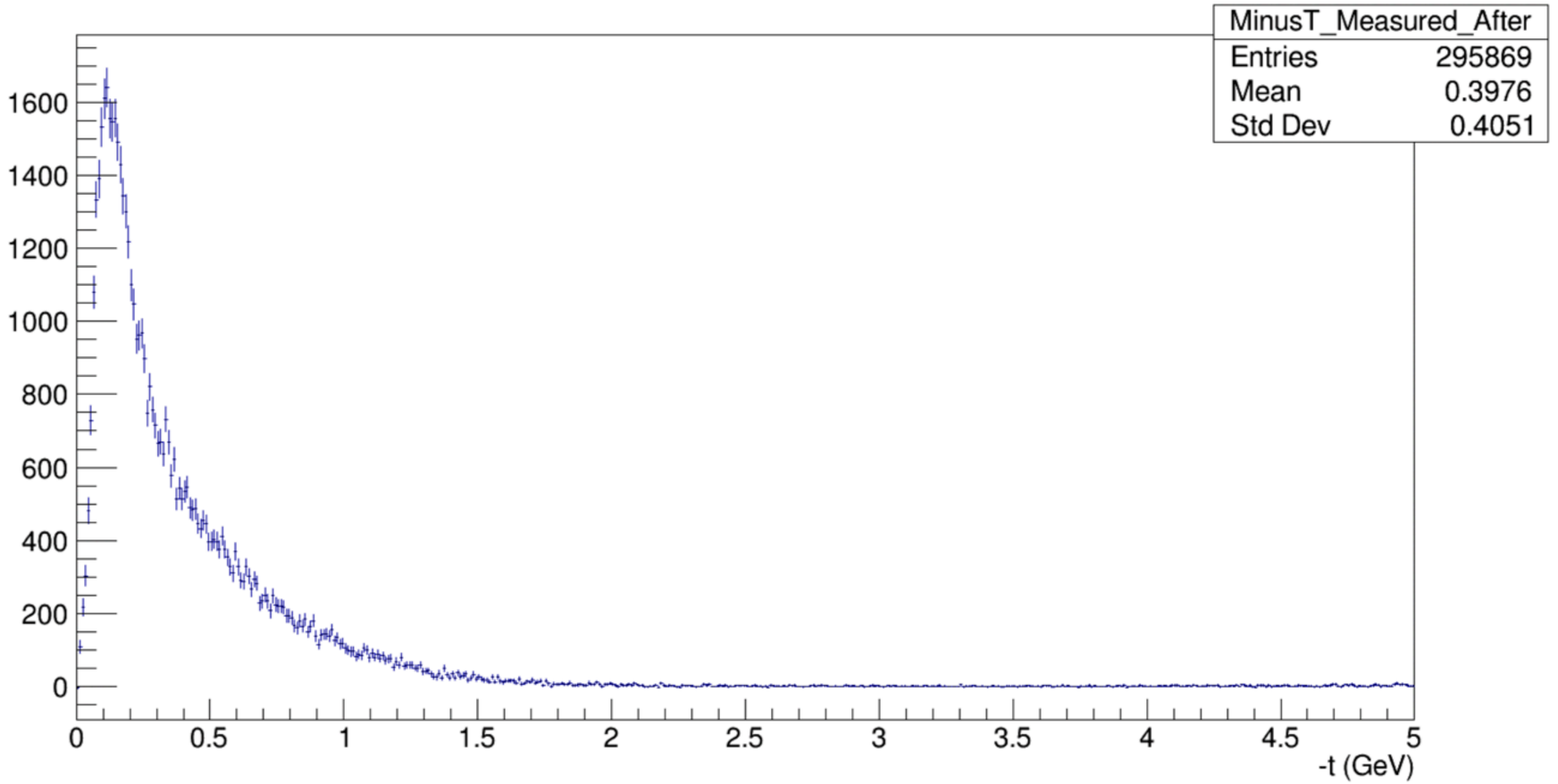
$\gamma n \rightarrow \pi^- p$ from deuterium with GlueX

- After all cuts, missing momentum



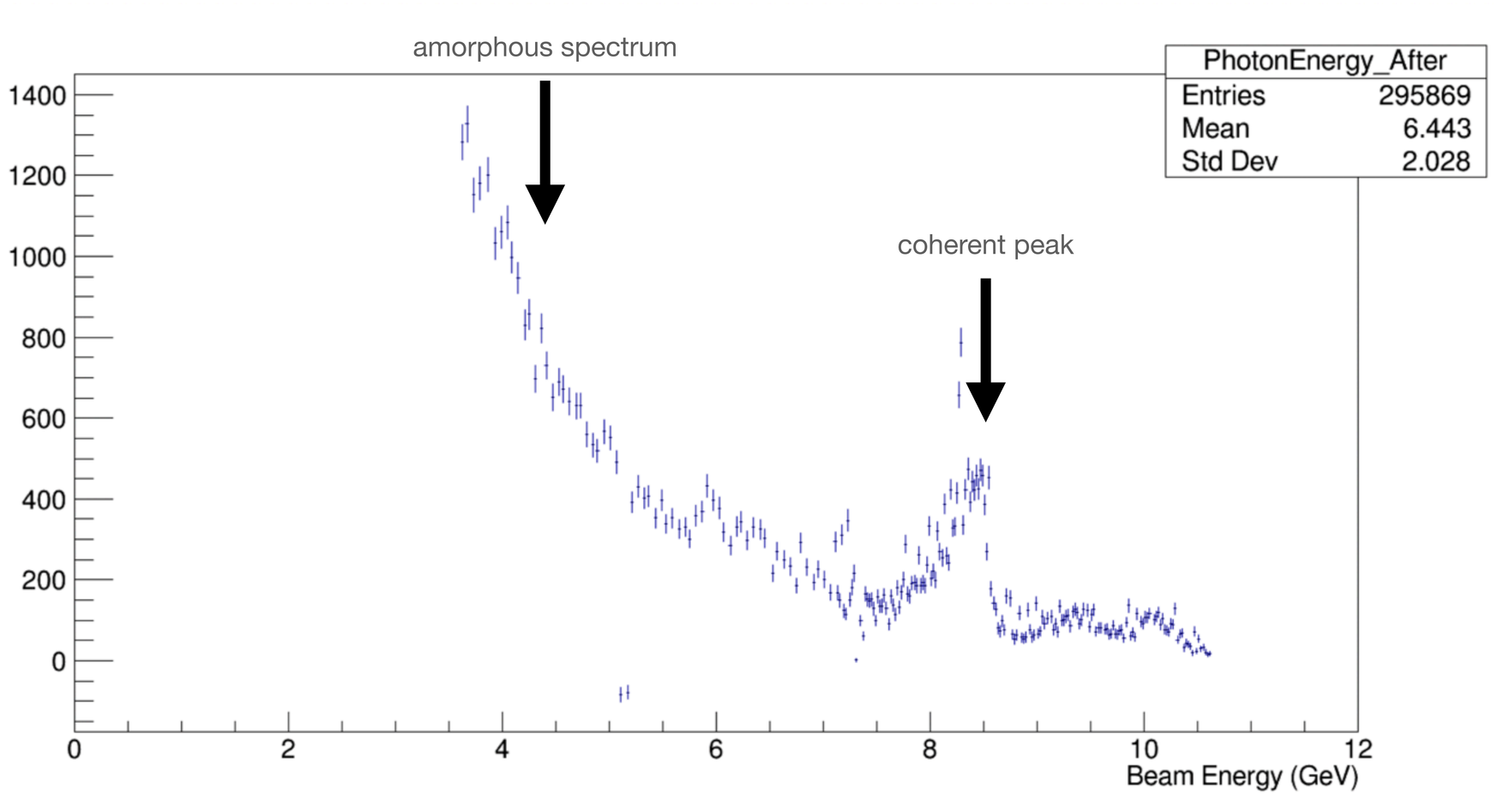
$\gamma n \rightarrow \pi^{-} p$ from deuterium with GlueX

- After all cuts, -t



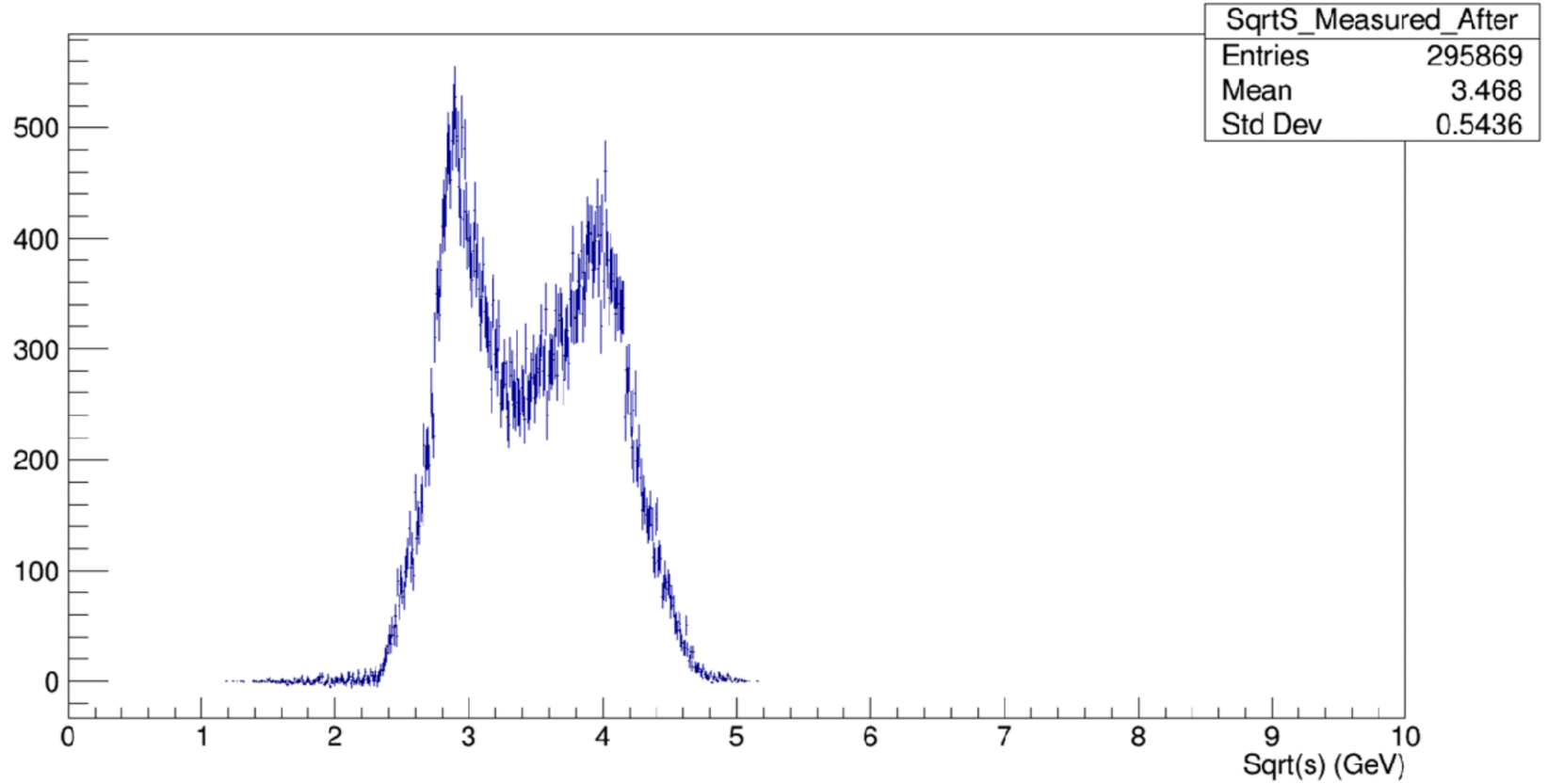
$\gamma n \rightarrow \pi^- p$ from deuterium with GlueX

- After all cuts, photon energy



$\gamma n \rightarrow \pi^- p$ from deuterium with GlueX

- After all cuts, $\sqrt{s}$
- 2.5-5 GeV can be accessed



$\gamma n \rightarrow \pi^- p$ from deuterium with GlueX

- Backup
- $\gamma n \rightarrow \pi^- p$ or $\gamma d \rightarrow \pi^- p(p)$
- Spectator proton: $P_{miss} = P_\gamma + P_d - P_\pi - P_p$
- Initial state neutron: $P_n = P_\pi + P_p - P_\gamma$
- $P_{missing} + P_n = P_d = (m_d, 0, 0, 0)$