Reconstructed data in six bins over the lepton scattering angle

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Runs used for analysis

The following runs were used for this analysis:
electron runs number: 7909 - 7949 (41 runs)
positron runs number: 7950 - 7992 (44 runs)
The tracks on WC were selected with the $0 < \chi^2 < 30$.
Both $e^- p$ and $e^+ p$ runs were analized over the six θ_{lepton} angular bins: 10^o - 20^o - 25^o - 30^o - 40^o - 50^o - 90^o

Filtering of the elastic events

Momentum balance and Z_{ver} difference based functional:

$$|P_x^L + P_x^R| + |P_y^L + P_y^R| + |P_z^L + P_z^R - E_0| + |Z_{ver}^L - Z_{ver}^R|$$

has been minimized over all left-right combinations of the tracks. The only one left-right pair of tracks for certain event.

General cuts

The global event topology cut used for this analysis:

- $(N_L^{ToF} > 0.AND.N_R^{ToF} > 0).\text{AND}.(N_L^{WC} > 0.AND.N_R^{WC} > 0)$
- $e^- p$ **combination**
  Signal topology is selected with:
  $WC_{type}^L = e^-.AND.WC_{type}^R = e^+(\text{or proton})$ .OR.
  $WC_{type}^R = e^-.AND.WC_{type}^L = e^+(\text{or proton})$
  Background topology:
  $(WC_{type}^L = e^+(\text{or proton}))$ $.AND.(WC_{type}^R = e^+(\text{or proton}))$
- $e^+ p$ **combination**
  Signal:
  $WC_{type}^L = e^+(\text{or proton})$ $.AND.WC_{type}^R = e^+(\text{or proton})$
  Backgroud:
  $WC_{type}^L = e^-$ $.OR.WC_{type}^R = e^-$

PID

PID for this analysis is based:

- on particle type provided by WC reconstructed bending angle, which is different for positive and negative charged tracks. Possible presense of e.g. charged pions in our data is not excluded (small fraction as to MC?)$\rightarrow$ **valid for** $e^{-}p$ **combination**
- on squared mass distribution defined via ToF and WC, then the closenest of ToF hit and WC track should be checked$\rightarrow$ **valid for both** $e^{\pm}p$ **combinations**

Specific cuts

The following set of cuts were used:

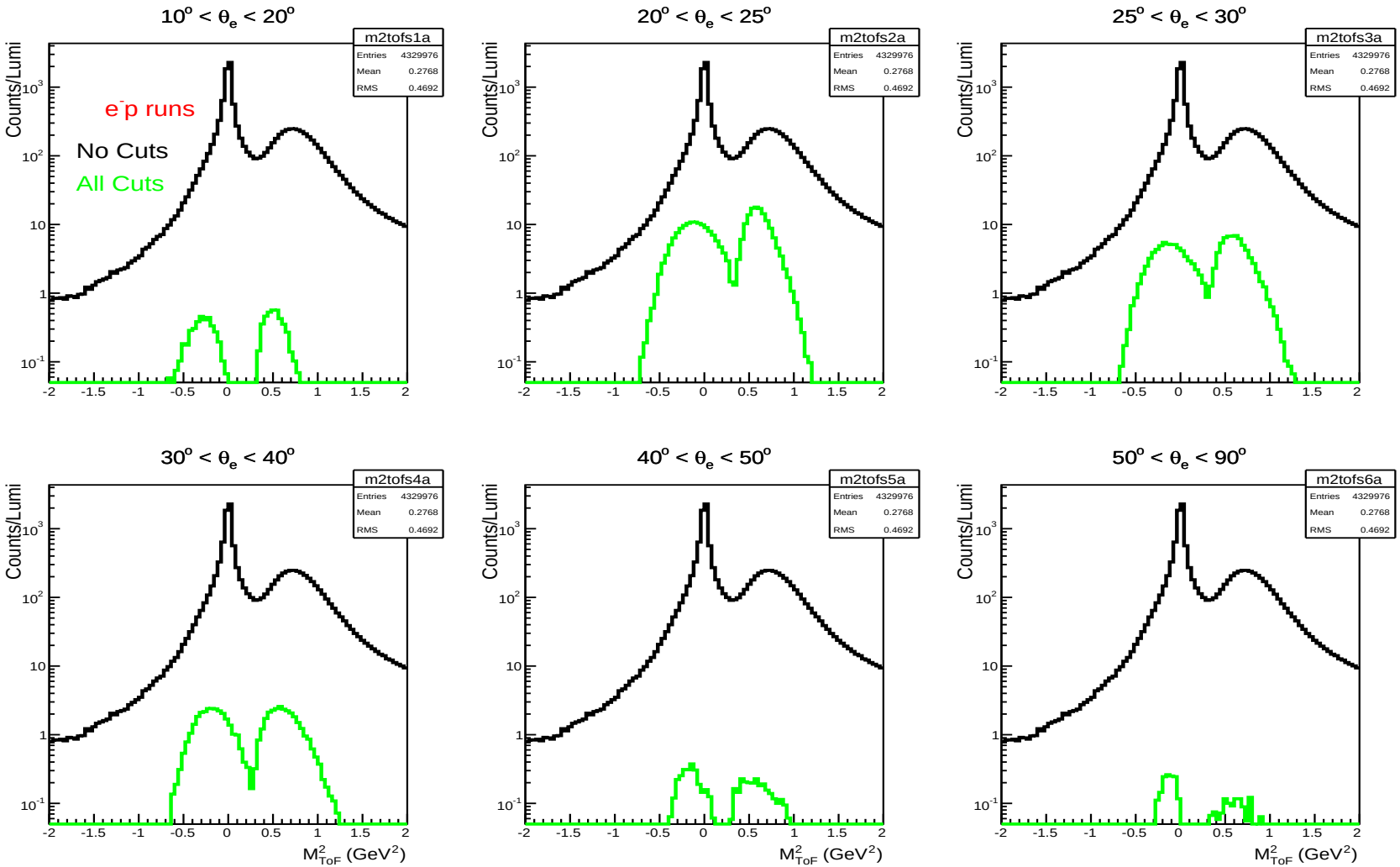
- Difference between Z_{vertex} position for right and left tracks . AND. $|Zv^{L,R}| < 350mm$ (Cut1)
- Closenest of ToF hit and corresponding WC track was checked with the difference of the ToF bar number, as well with the difference of the hit Y-position defined via ToF and WC (Cut2)
- Coplanarity: as a difference between ϕ_{WC} for left and right tracks to be equal to π (Cut3)
- Difference between the observed and expected proton momnetum: $|P_p - P_l \sin\theta_l / \sin\theta_p|$ (Cut4)

Specific cuts

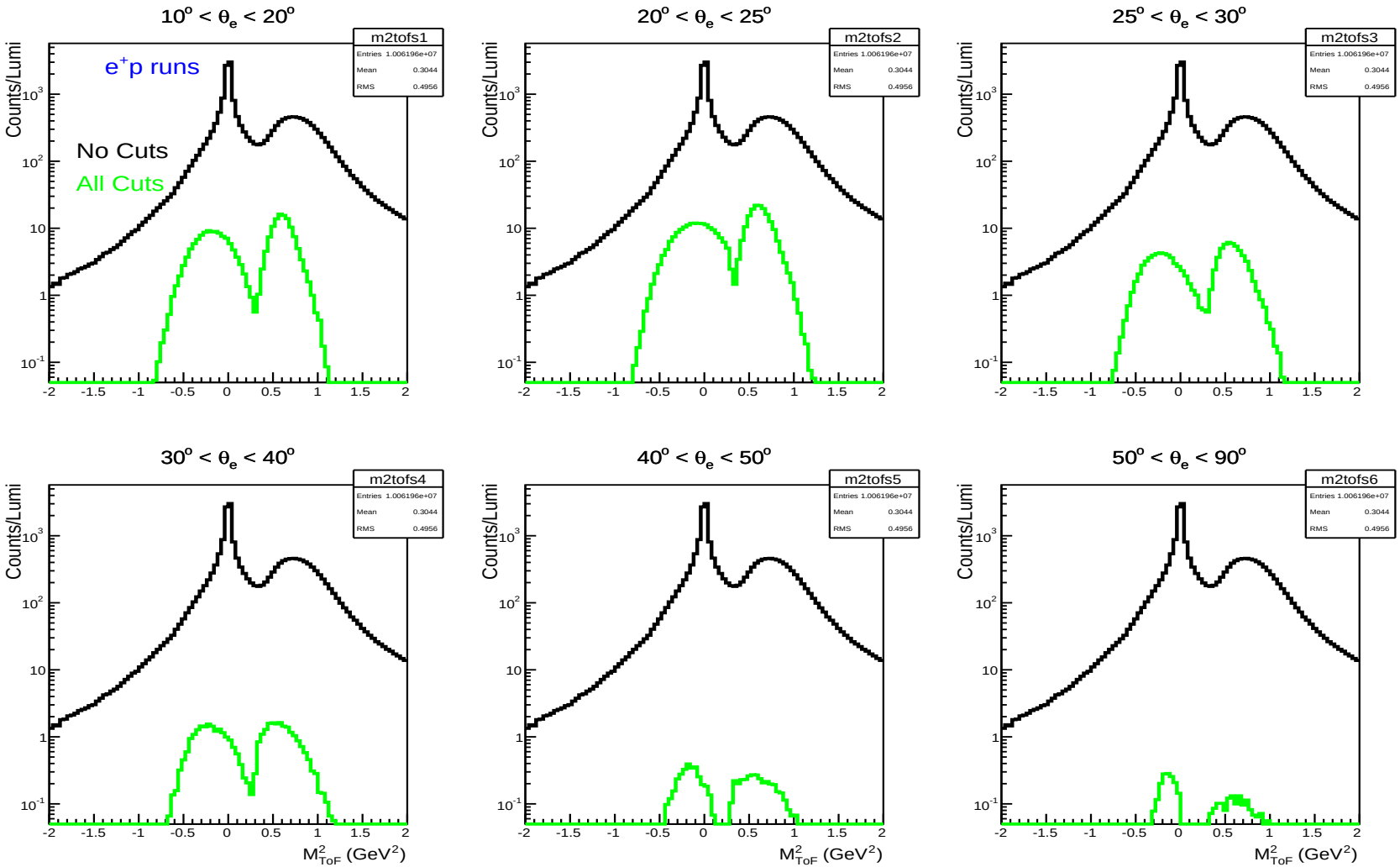
- Difference of the differences between the observed and expected beam energy and scattered lepton energy - Δ^-:
  $E_b^{exp} = m_p(ctg(\theta_l)ctg(\theta_p) - 1)$, $E_b^{obs} = P_z^l + P_z^p$
  $\Delta_{E_b} = E_b^{exp} - E_b^{obs}$, $E'_{exp} = E_b^{exp}/(1. + 2 * E_b^{exp} * sin(\theta_e/2)^2/m_p)$
  $E'_{obs} = P^l$, $\Delta_{E'} = E'_{exp} - E'_{obs}$
  $\Delta^- = \Delta_{E_b} - \Delta_{E'}$ (Cut5)
- Sum of the differences between the observed and expected beam energy and scattered lepton energy - Δ^+:
  $\Delta^+ = \Delta_{E_b} + \Delta_{E'}$ (Cut6)
- In addition to JLab cuts we can apply $E_b^{exp} \approx 2\ GeV$! (Cut7)

Metioned above distributions were fitted with Gaussian and general cut within 3σ was applied.

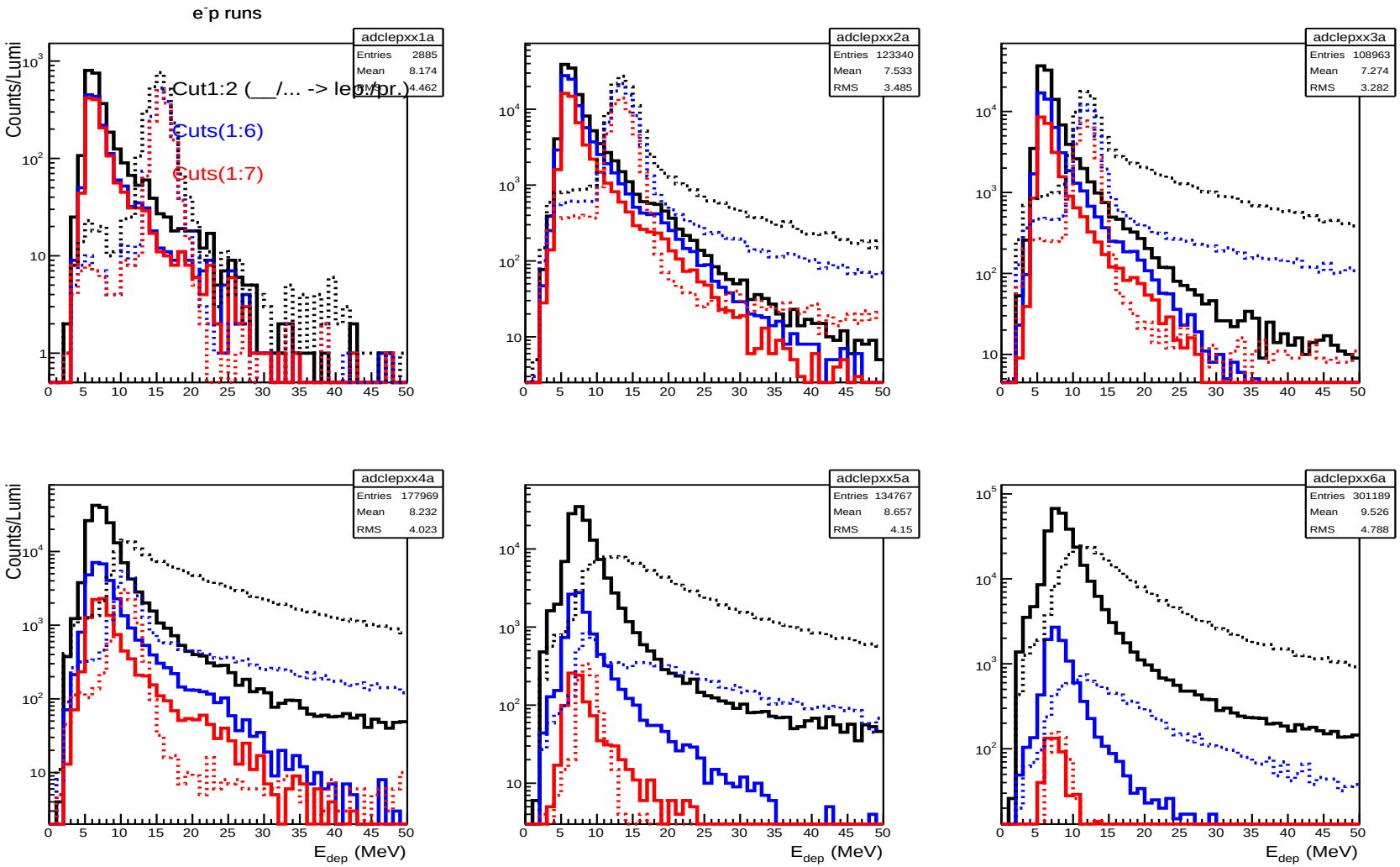
Results: M^2_{ToF} distributions at 6 $\theta_{lep.}$ bins for $e^- p$ runs



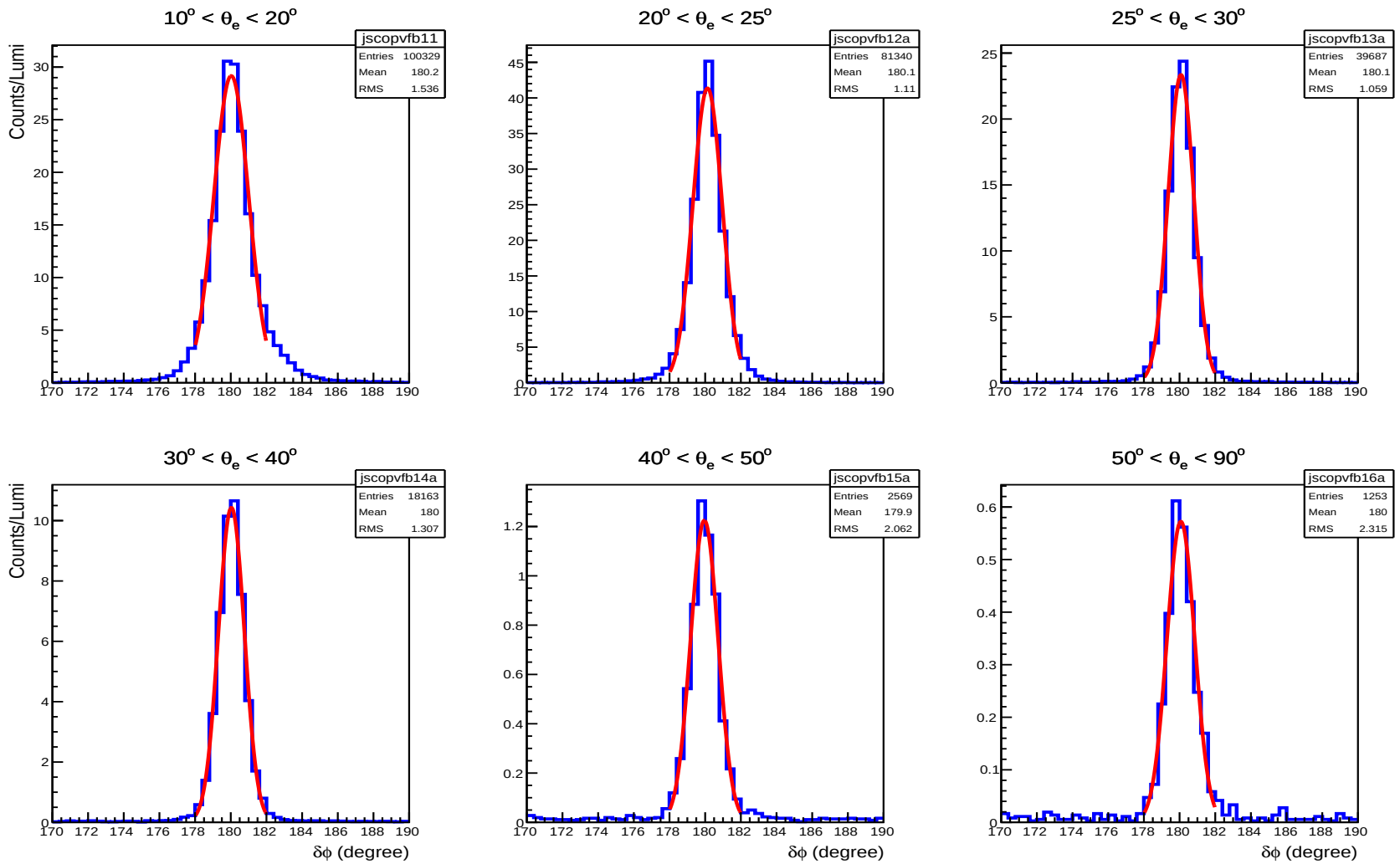
Results: M^2_{ToF} distributions at 6 $\theta_{lep.}$ bins for e^+p runs



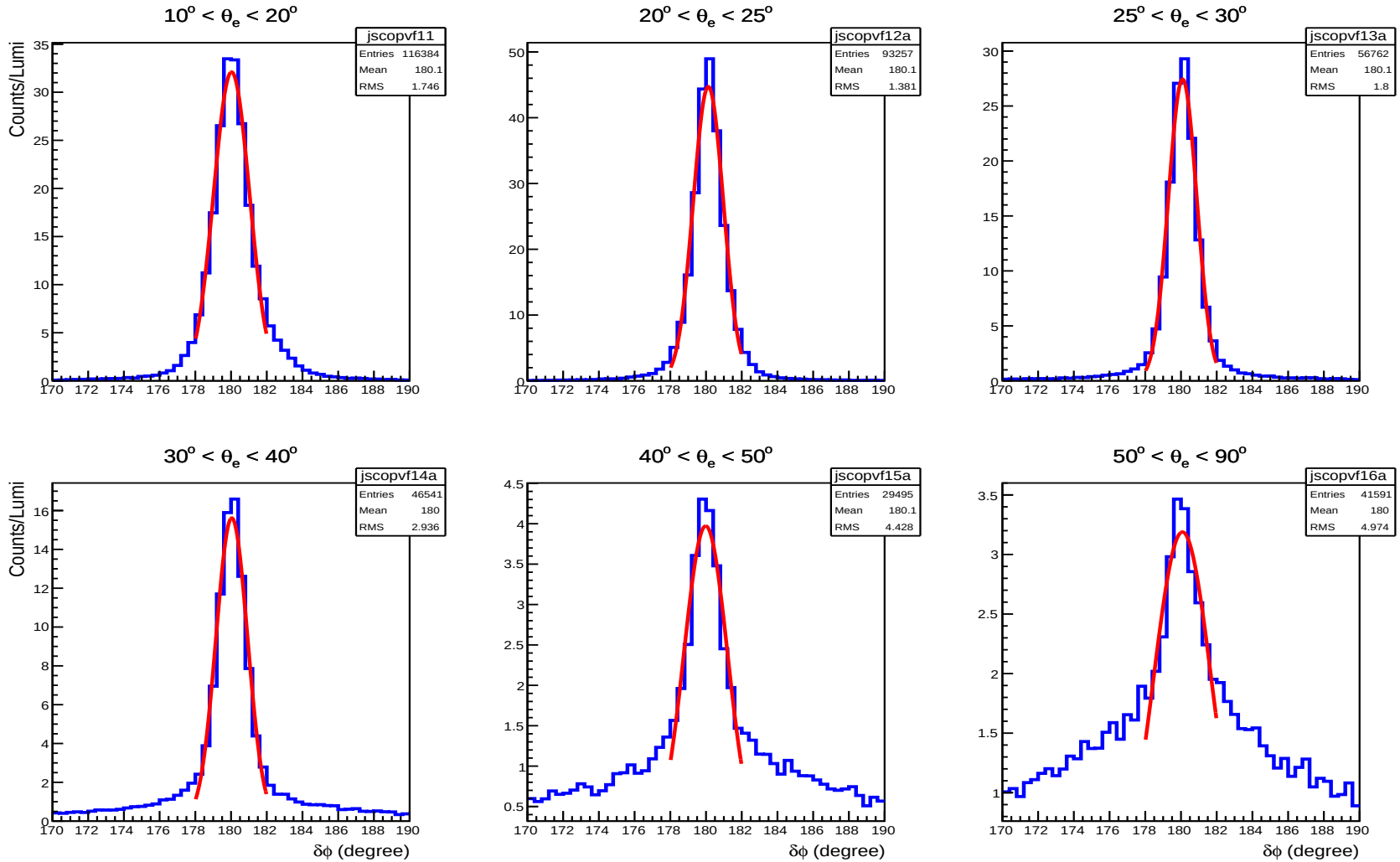
Results: E_{dep}/ADC distributions at 6 $\theta_{lep.}$ bins for $e^- p$ runs



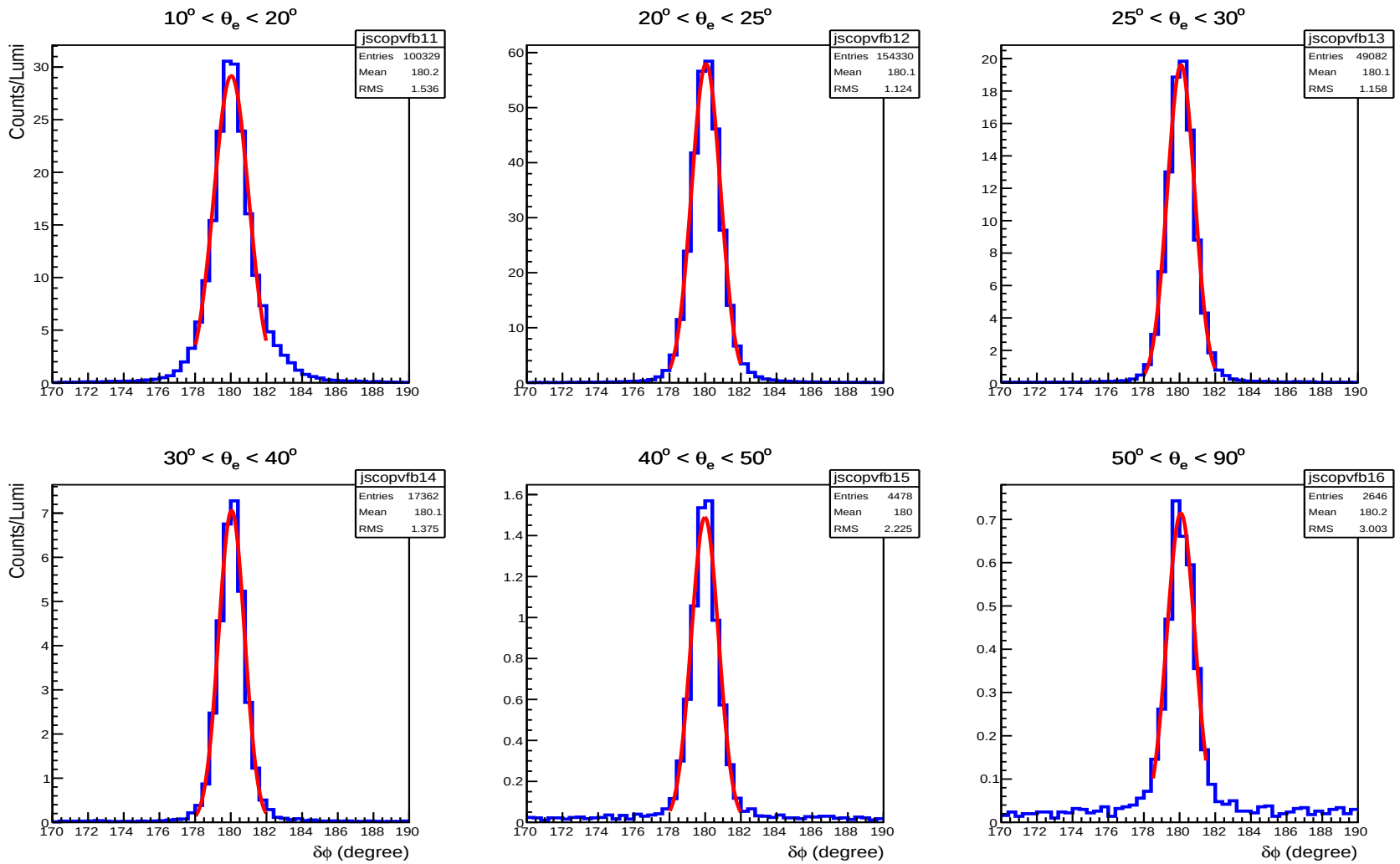
Results: $\Delta\phi$ distributions at 6 $\theta_{lep.}$ bins for $e^- p$ runs with 1,2,4,5,6,7 cuts applied



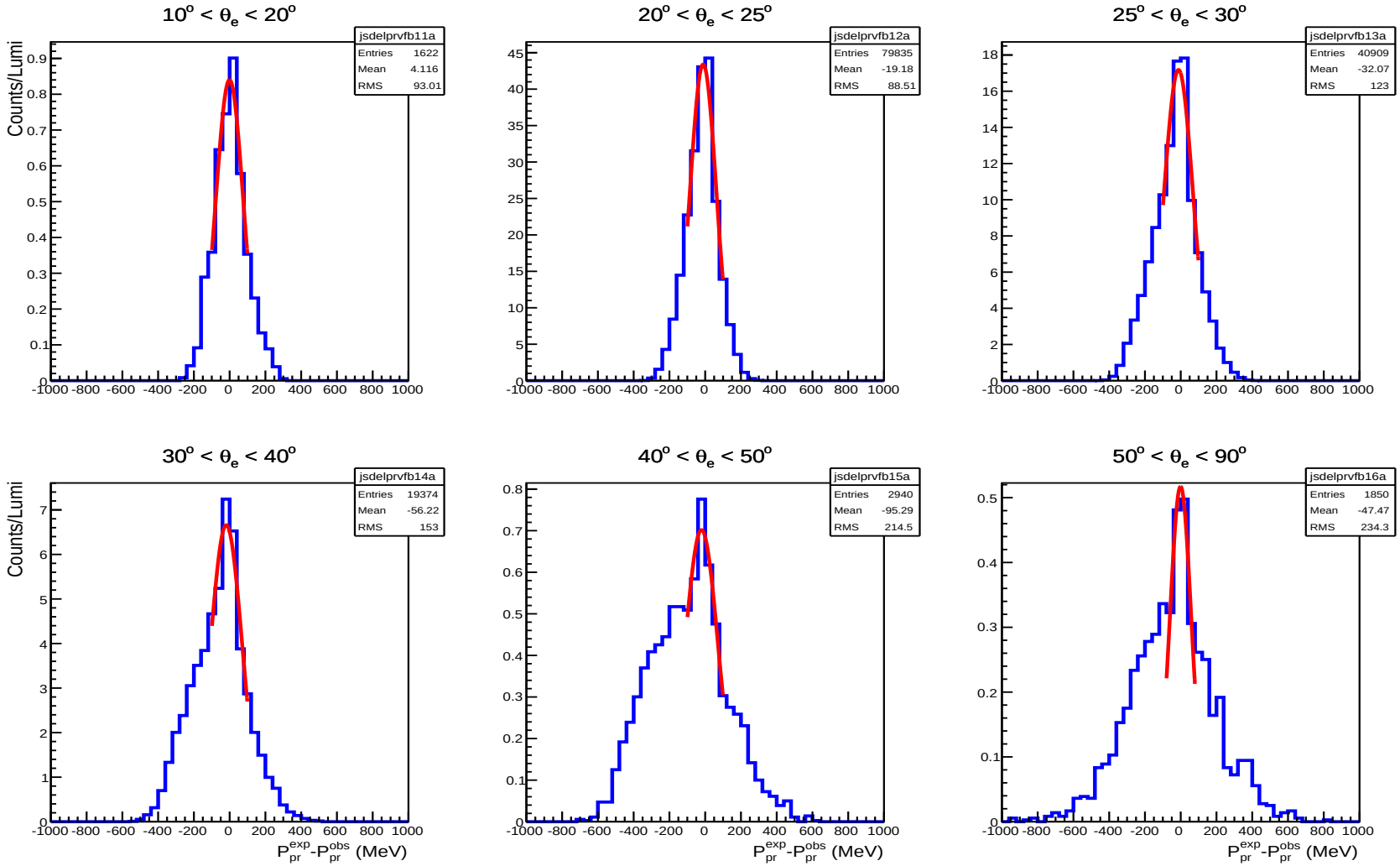
Results: $\Delta\phi$ distributions at 6 $\theta_{lep.}$ bins for $e^- p$ runs with 1,2,4,5,6 cuts applied



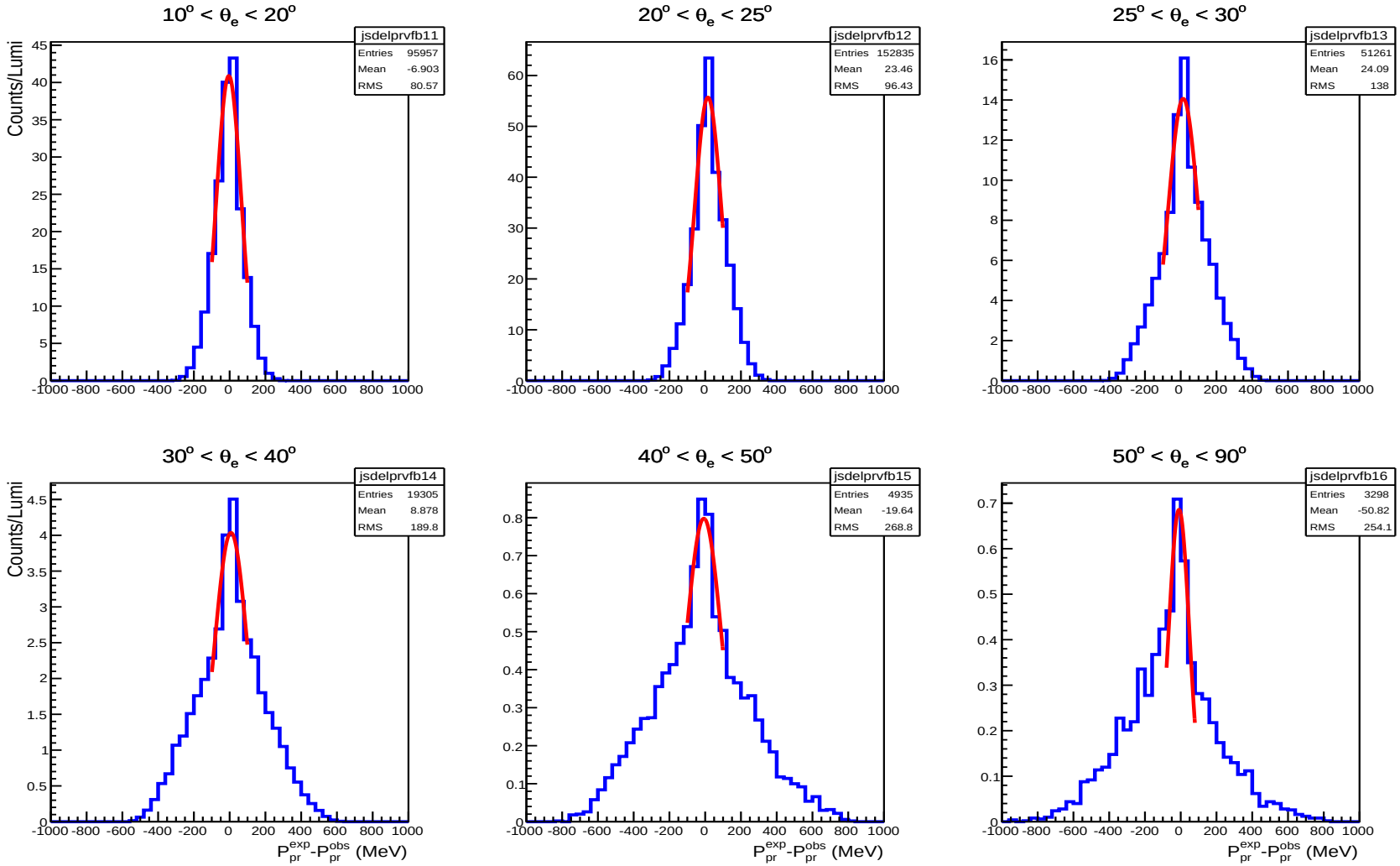
Results: $\Delta\phi$ distributions at 6 $\theta_{lep.}$ bins for e^+p runs with 1,2,4,5,6,7 cuts applied



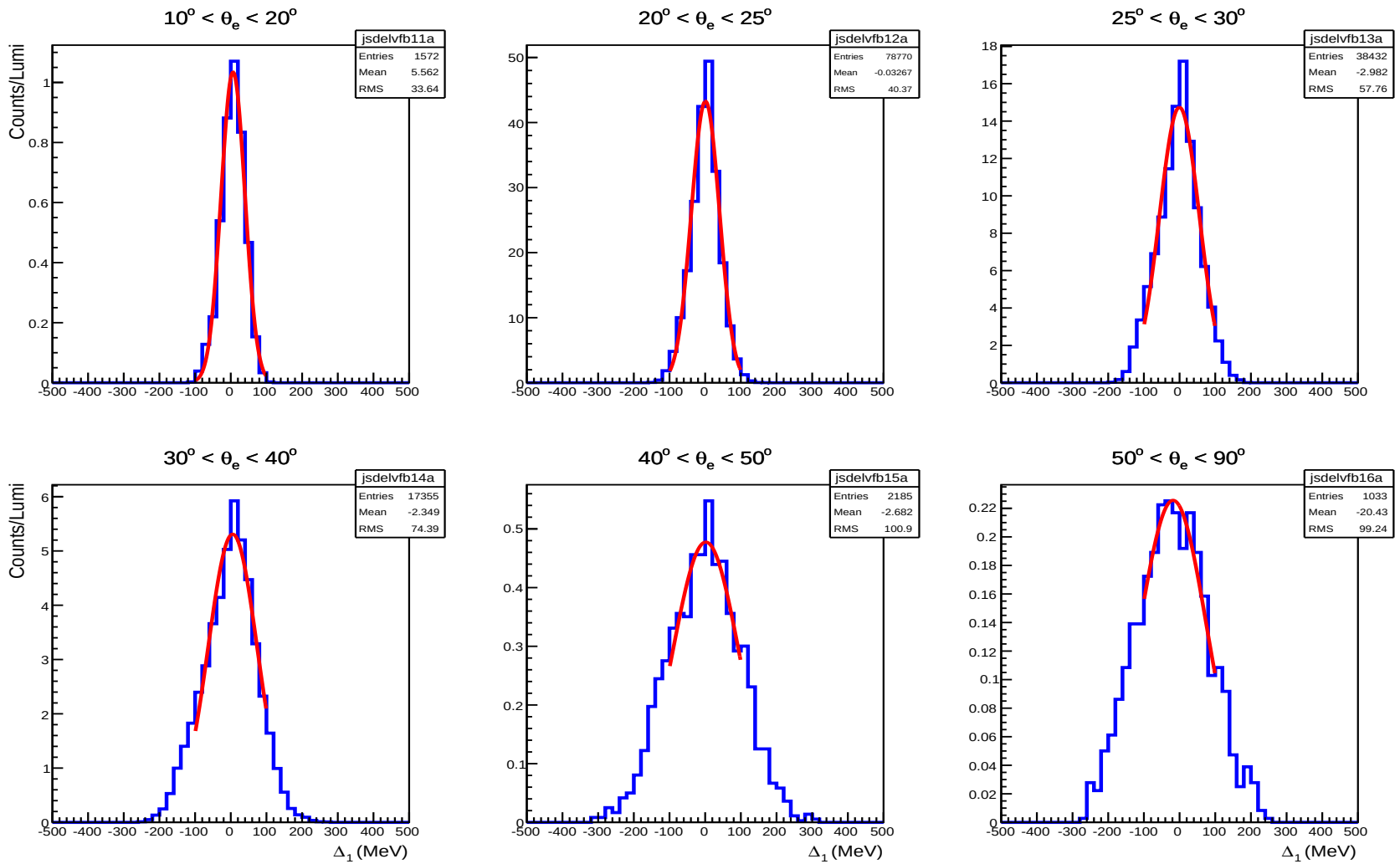
Results: ΔP_{pr} distributions at 6 $\theta_{lep.}$ bins for $e^- p$ runs with 1,2,3,5,6,7 cuts applied



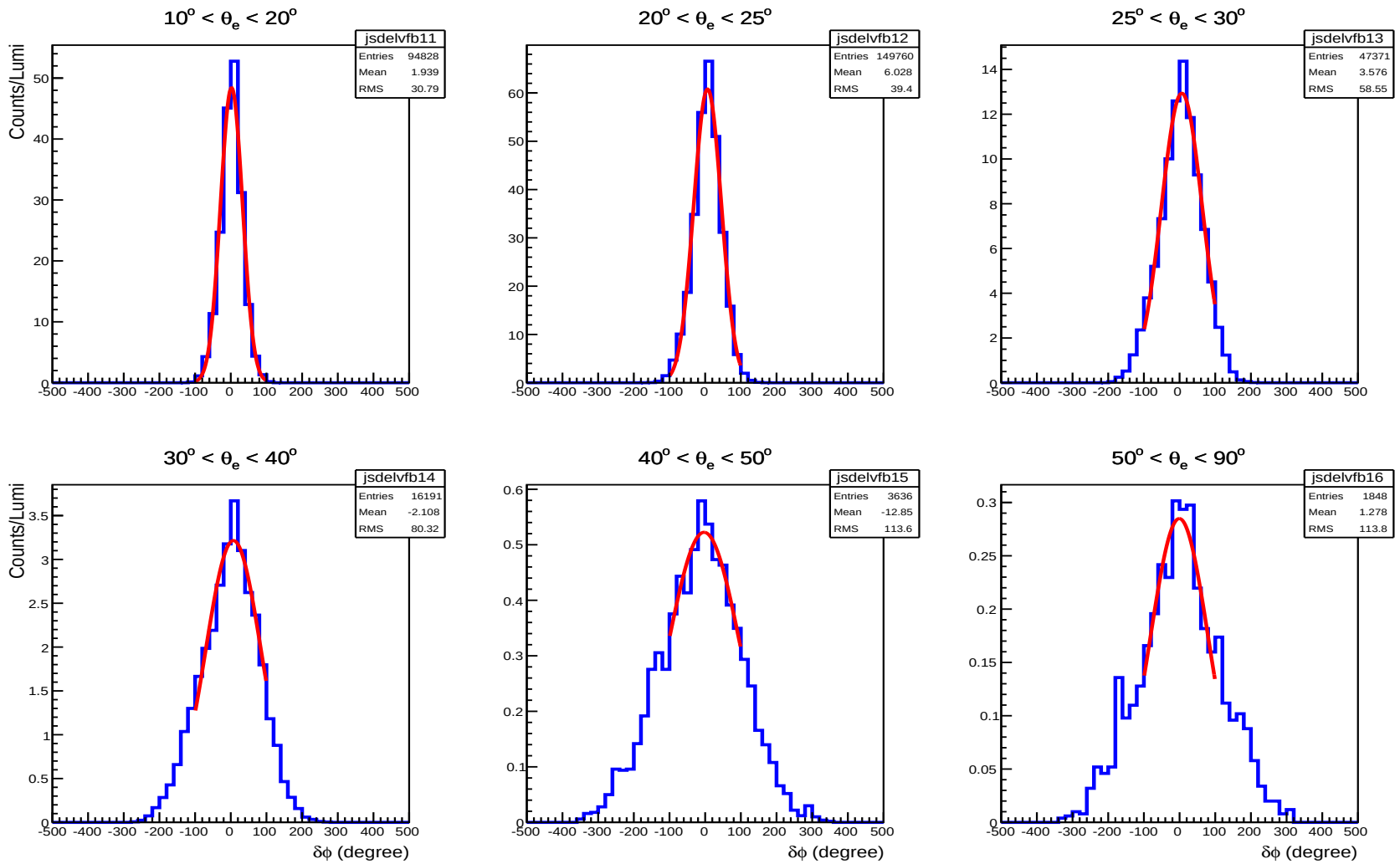
Results: ΔP_{pr} distributions at 6 $\theta_{lep.}$ bins for e^+p runs with 1,2,3,5,6,7 cuts applied



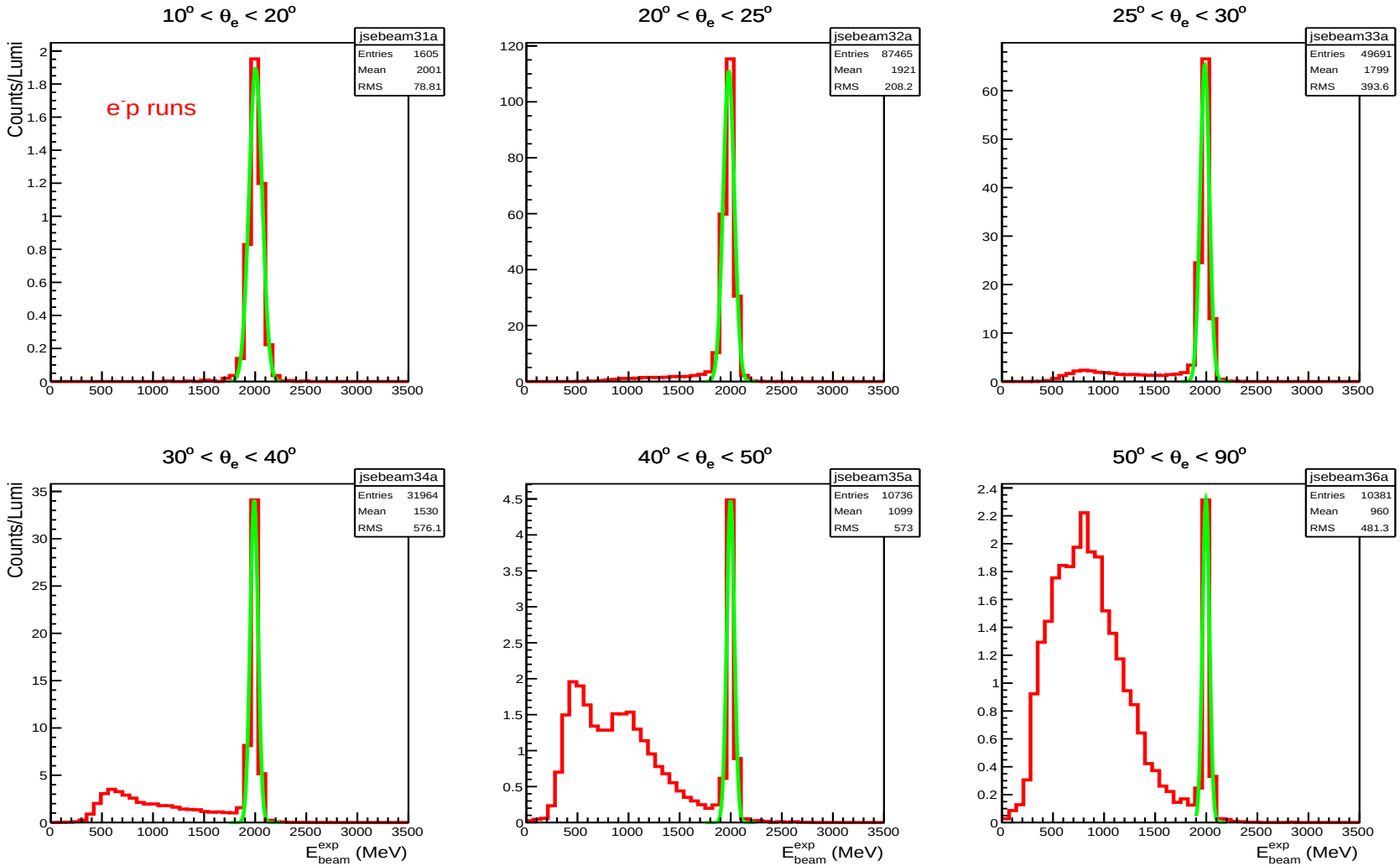
Results: Δ^- distributions at 6 $\theta_{lep.}$ bins for e^-p runs with 1,2,3,4,6,7 cuts applied



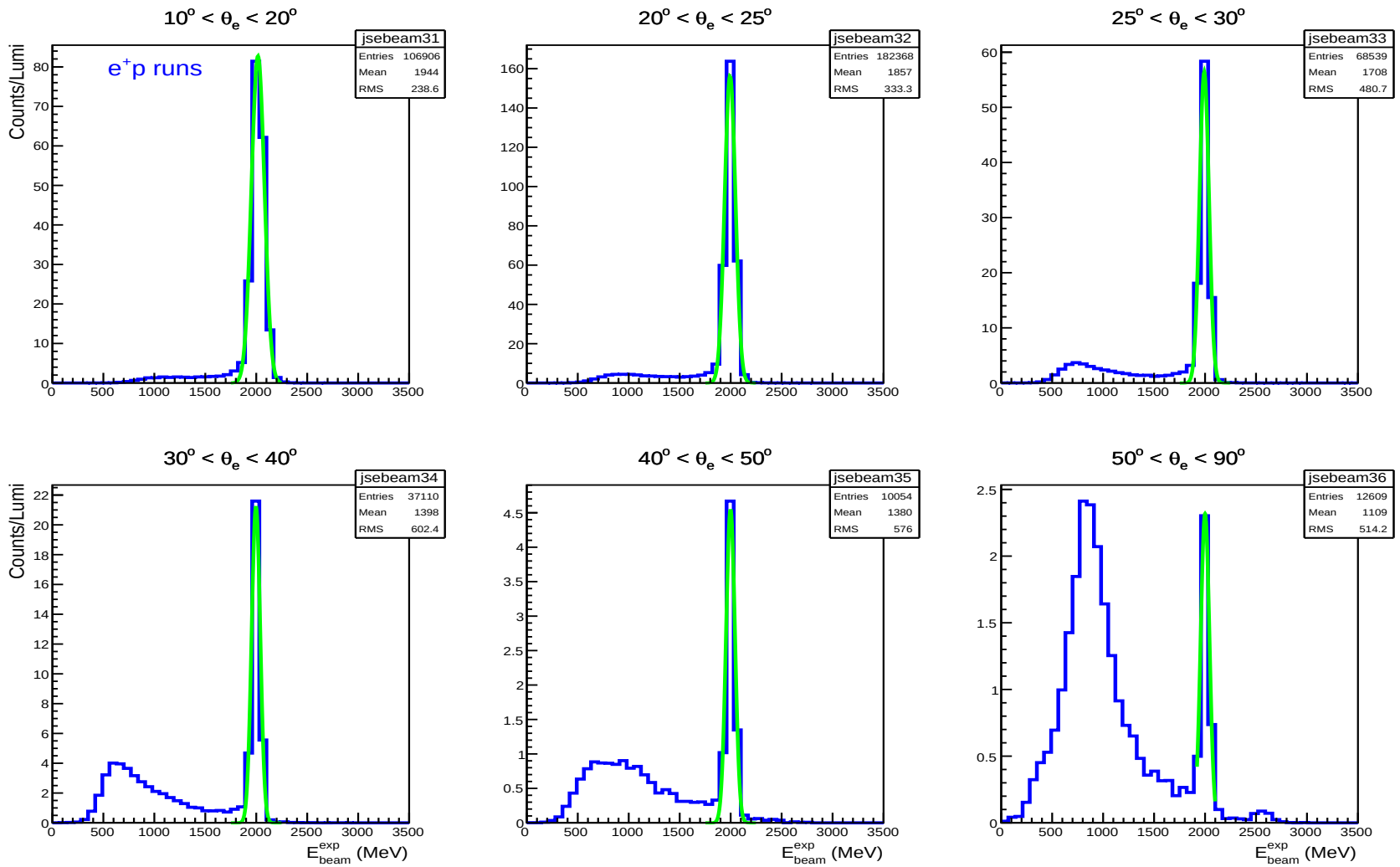
Results: Δ^- distributions at 6 $\theta_{lep.}$ bins for e^+p runs with 1,2,3,4,6,7 cuts applied



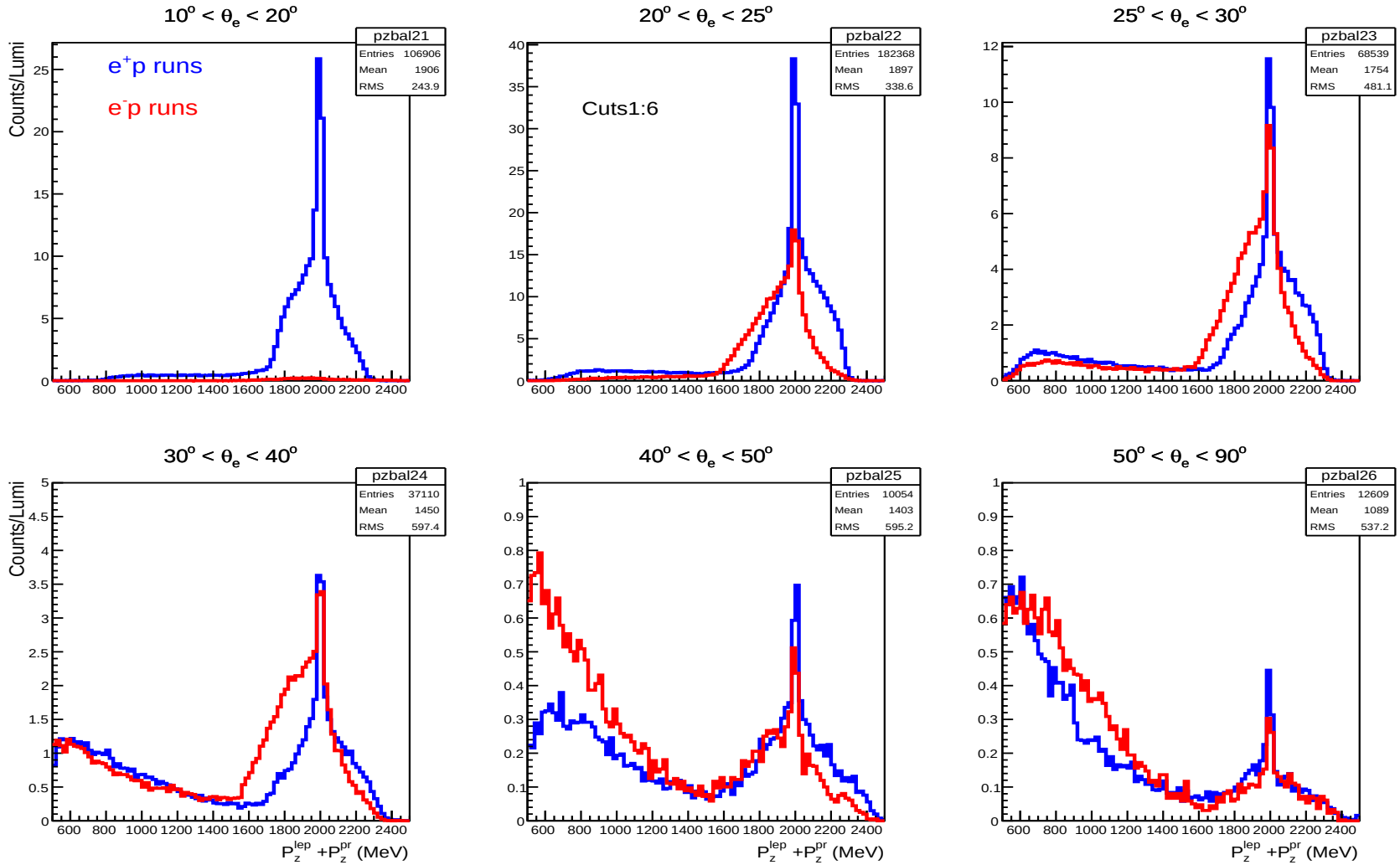
Results: E_0^{exp} distributions at 6 $\theta_{lep.}$ bins for $e^- p$ runs with 1,2,3,4,5,6 cuts applied



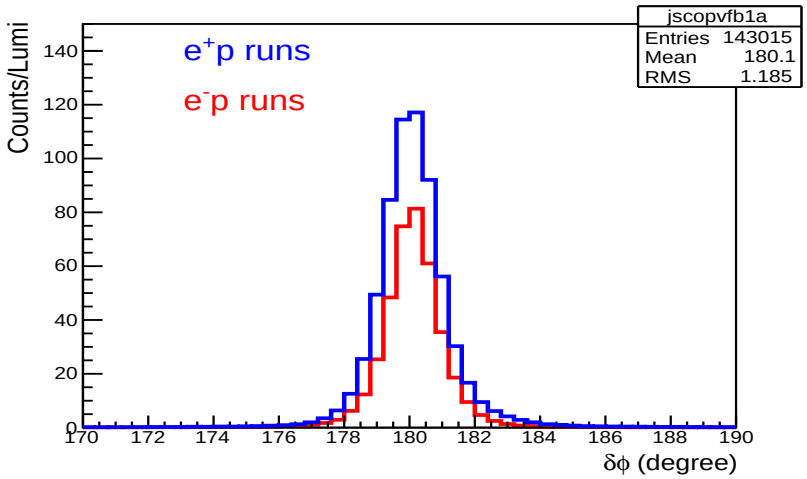
Results: E_0^{exp} distributions at 6 $\theta_{lep.}$ bins for e^+p runs with 1,2,3,4,5,6 cuts applied

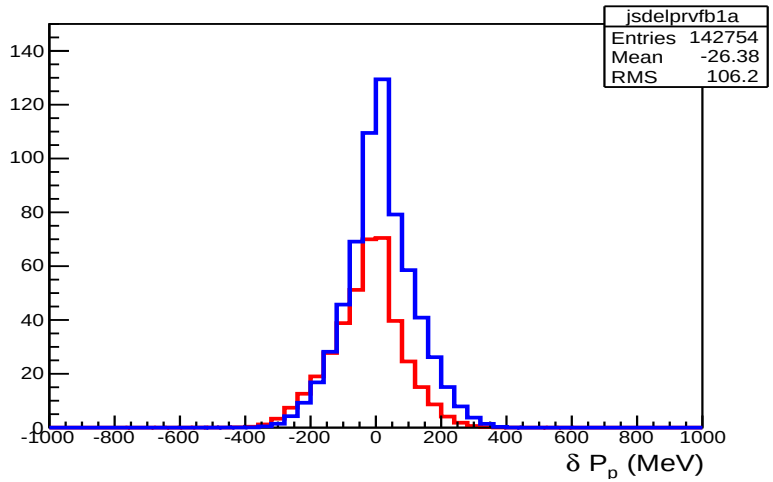


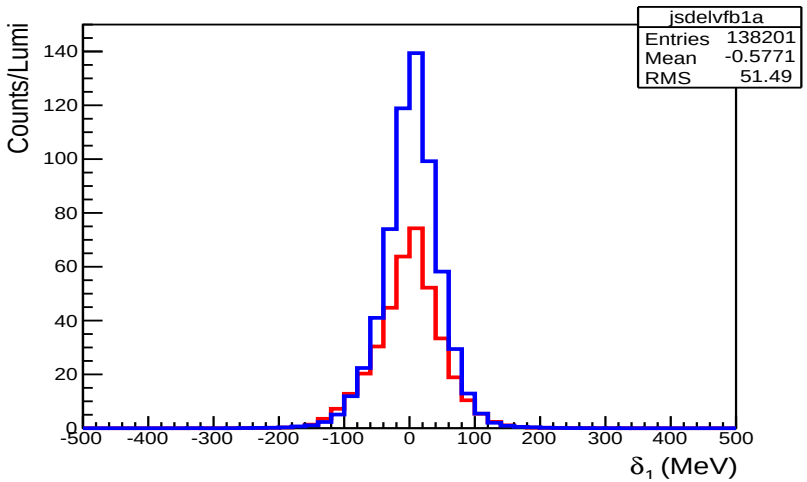
Results: Reconstructed $P_z^{lep} + P_z^{pr}$ distributions at 6 θ_{lep}. bins for $e^- p$ and $e^+ p$ runs with 1,2,3,4,5,6 cuts applied

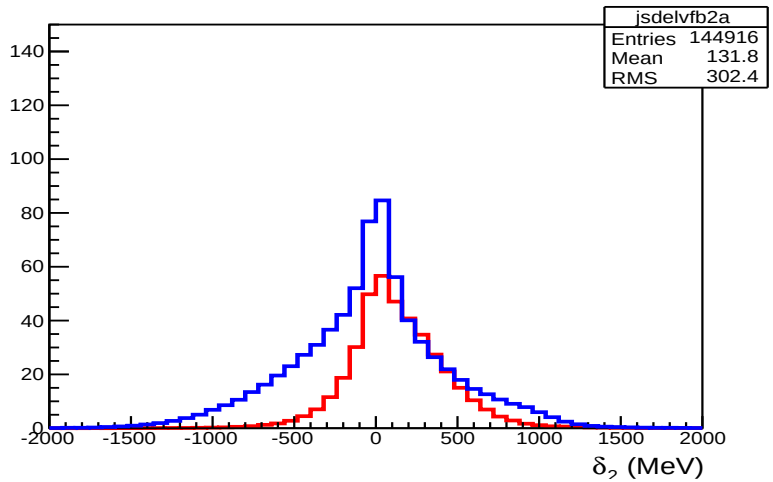


Results: $\Delta\phi, \Delta P_{pr}, \Delta^{-} and \Delta^{+}$ distributions for $e^{-}p$ and $e^{+}p$ runs integrated over θ_{lepton}

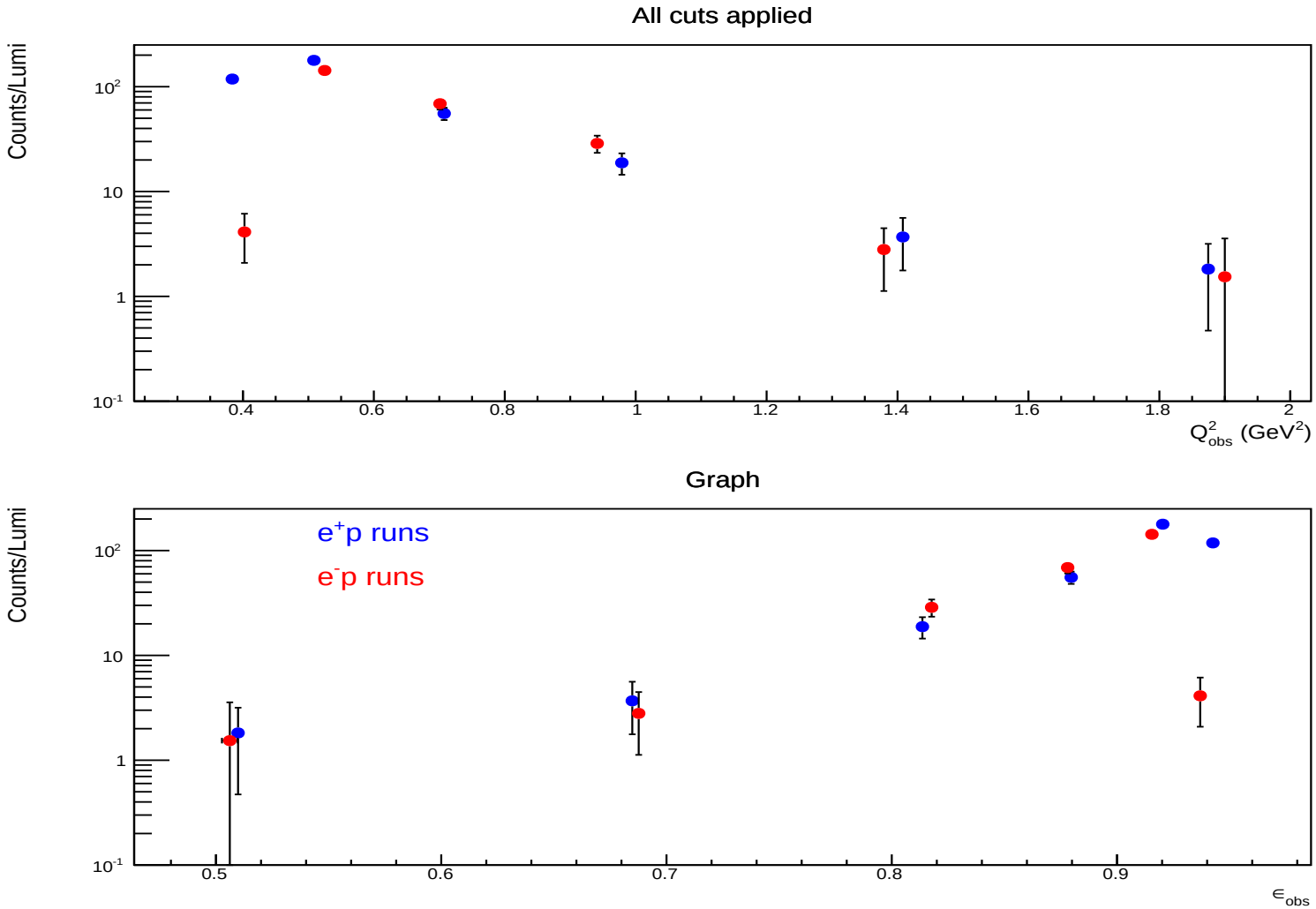




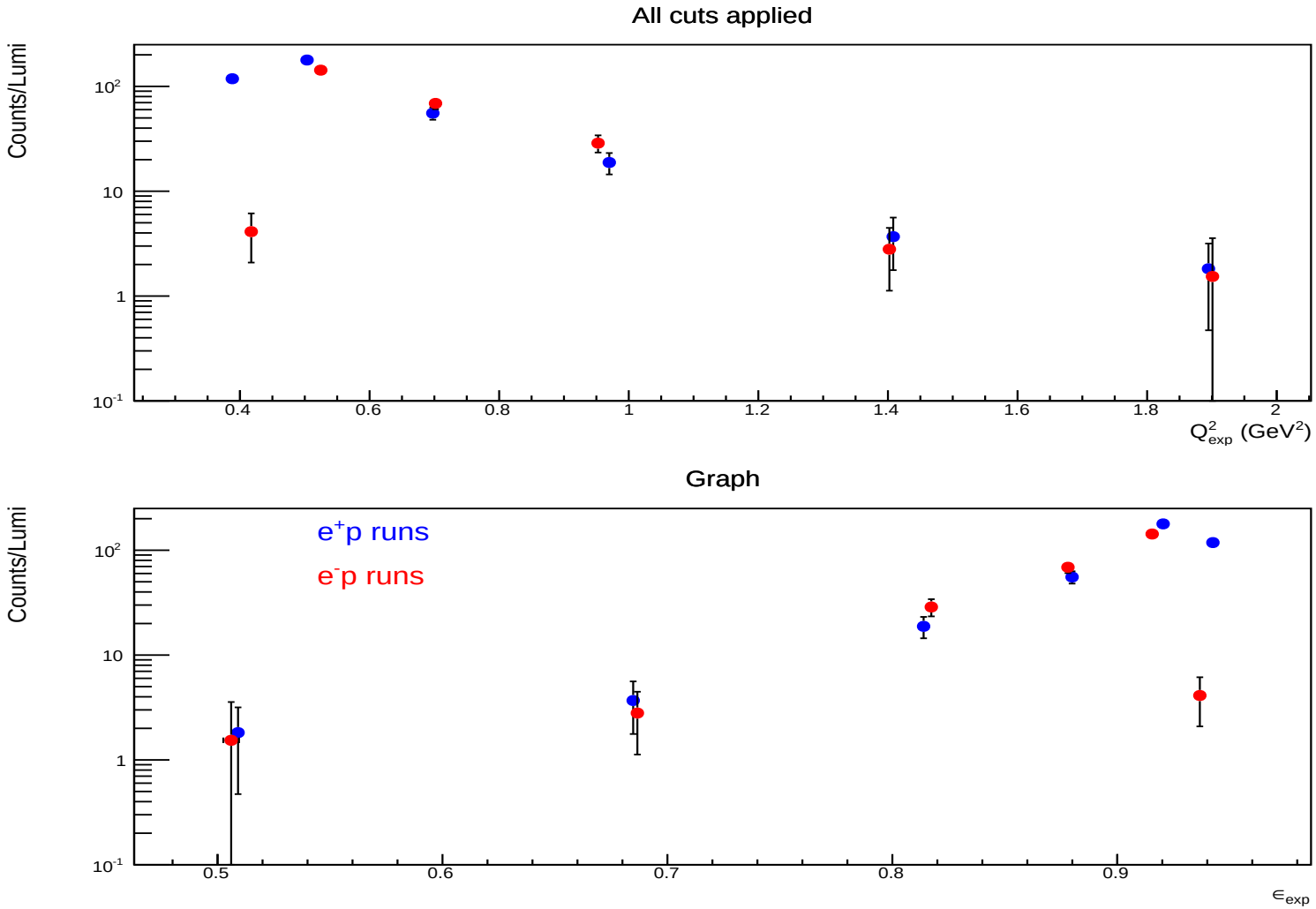




Results: Q^2_{obs} and ϵ_{obs} distributions for $e^- p$ and $e^+ p$ runs derived from θ_{lepton} bins



Results: Q^2_{exp} and ϵ_{exp} distributions for e^-p and e^+p runs derived from θ_{lepton} bins



Conclusions/Outlook

- Elastic cuts were optimized for each θ_{lepton} bin
- Still the sizes of angular bins should be optimized (with MC, later with the full data sample)
- Estimate acceptance as a function of θ_{lepton} with all applied cuts (MC)
- Develope Gaussian+polynomial fitting procedure for all applied cuts in order to make the background subtraction before the ratio
- Produce the acceptance (RC)/background corrected ratio