Risk Assessment for Barrel EMC Performance Studies

EMC Session CM 17/2

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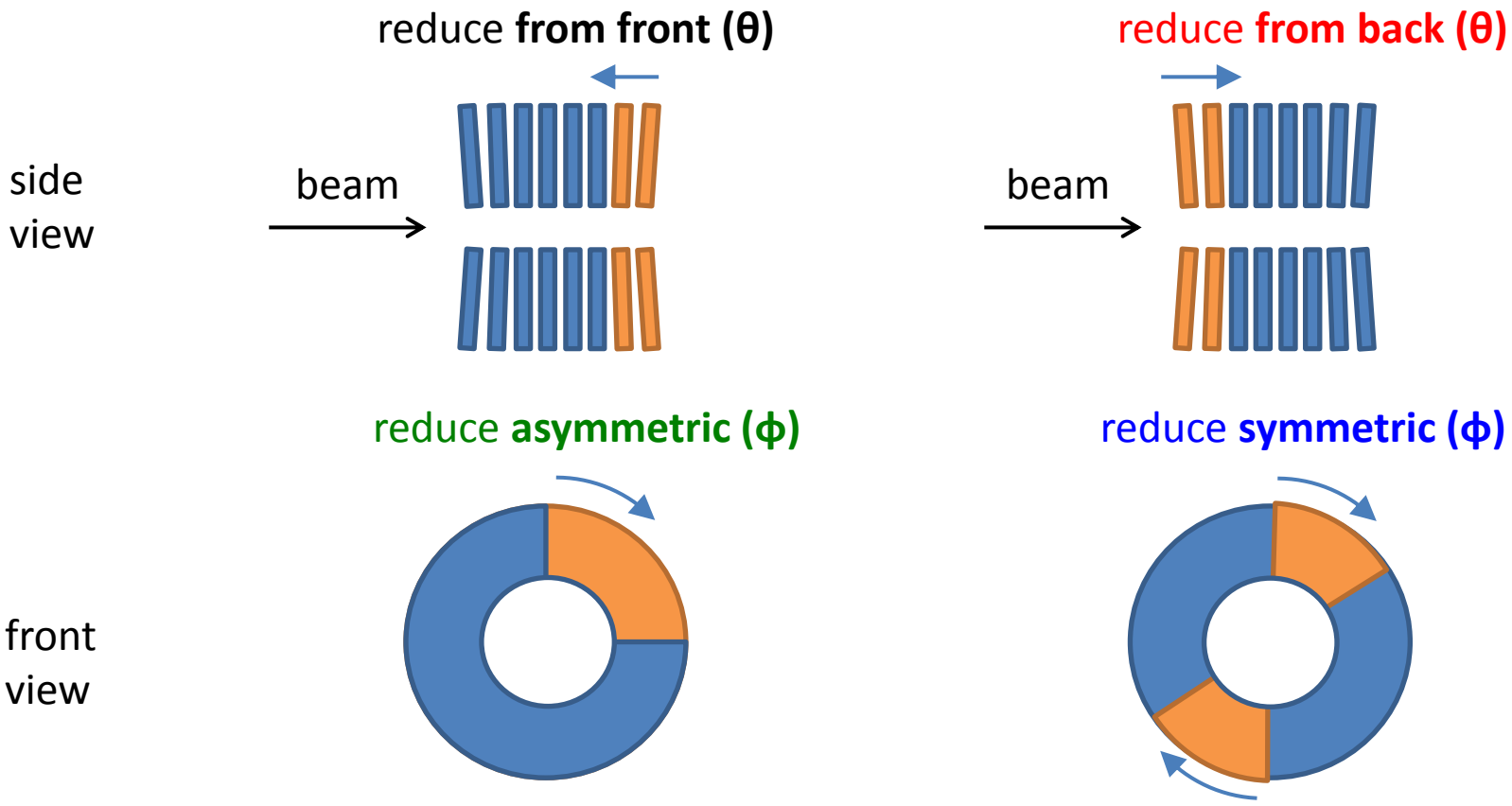
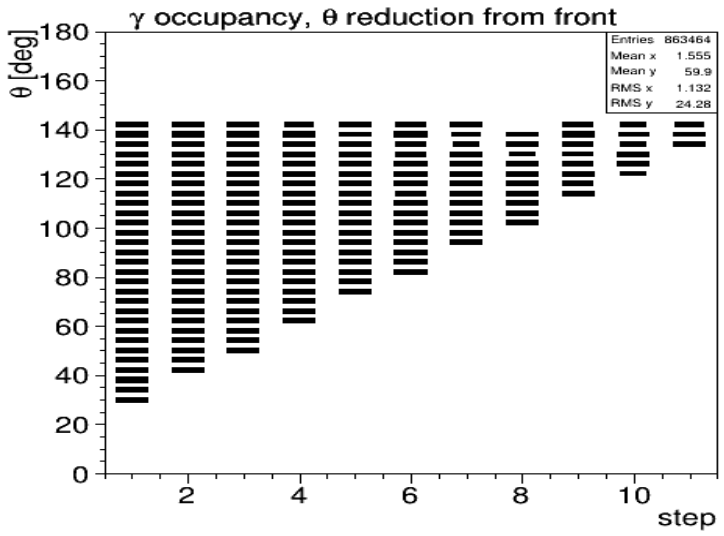
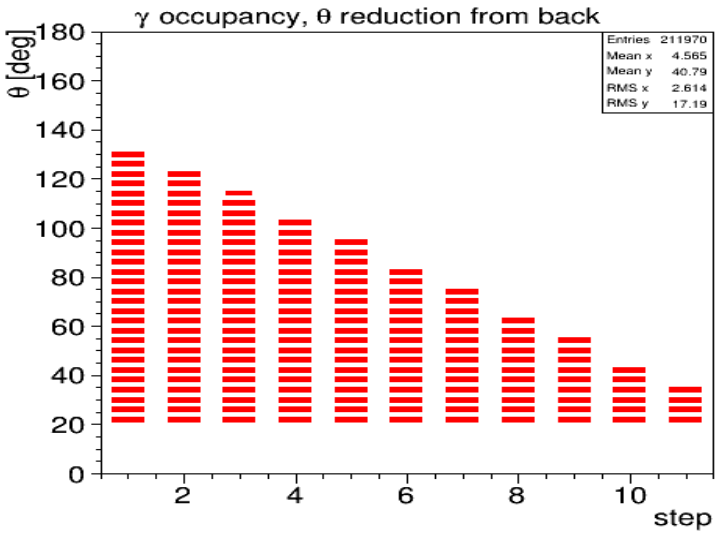
Risk Assessment for Barrel EMC

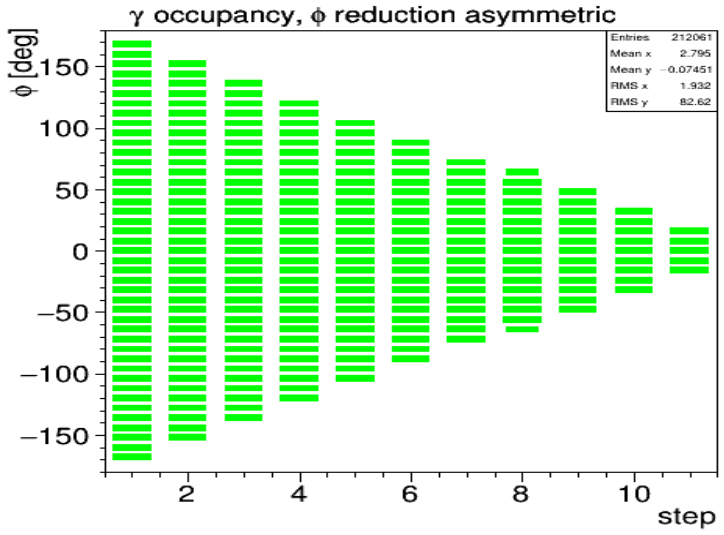
- Risk assessment issue:
  Impact of incomplete EMC Barrel to physics performance?
- 4 different ways of reduction (=leaving out crystals) studied

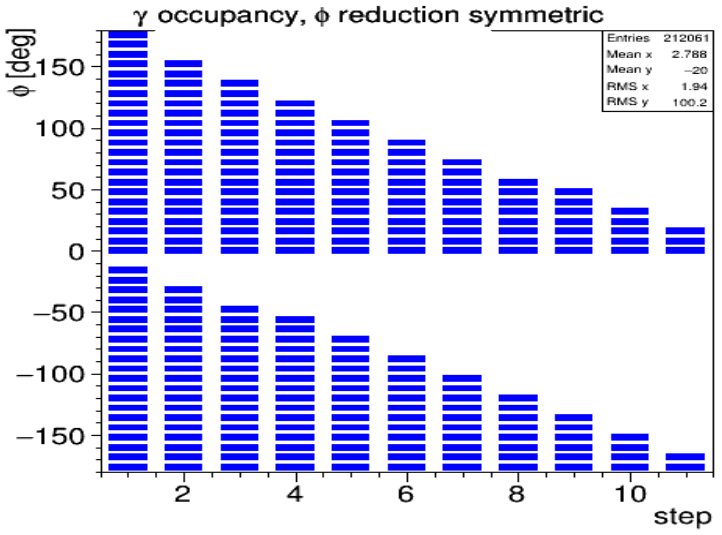


Angular Coverage









Physics Channels

Channels studied with Fast Sim:

- $p\bar{p} \to \tilde{\eta}_c \eta \to \chi_c \pi^0 \pi^0 (\gamma\gamma) \to J/\psi \gamma (\gamma\gamma)(\gamma\gamma)(\gamma\gamma) \to e^+ e^- \, 7\gamma$
  - Multi gamma final state
  - Impact on detection efficiency for photons
- $p\bar{p} \to J/\psi \pi^+ \pi^- \to e^+ e^- \pi^+ \pi^-$
  - Important benchmark channel (X-scan)
  - Impact on electron PID
- $p\bar{p} \to e^+ e^-$
  - Important for FF measurements
  - Impact on electron PID

$p\bar{p} \rightarrow \tilde{\eta}_c \eta$

For all 4 reduction scenarios:

- 100k signal events @ 15GeV/c for 11 reduction steps ($\Delta\theta = 10°$ and $\Delta\varphi = 30°$ each)

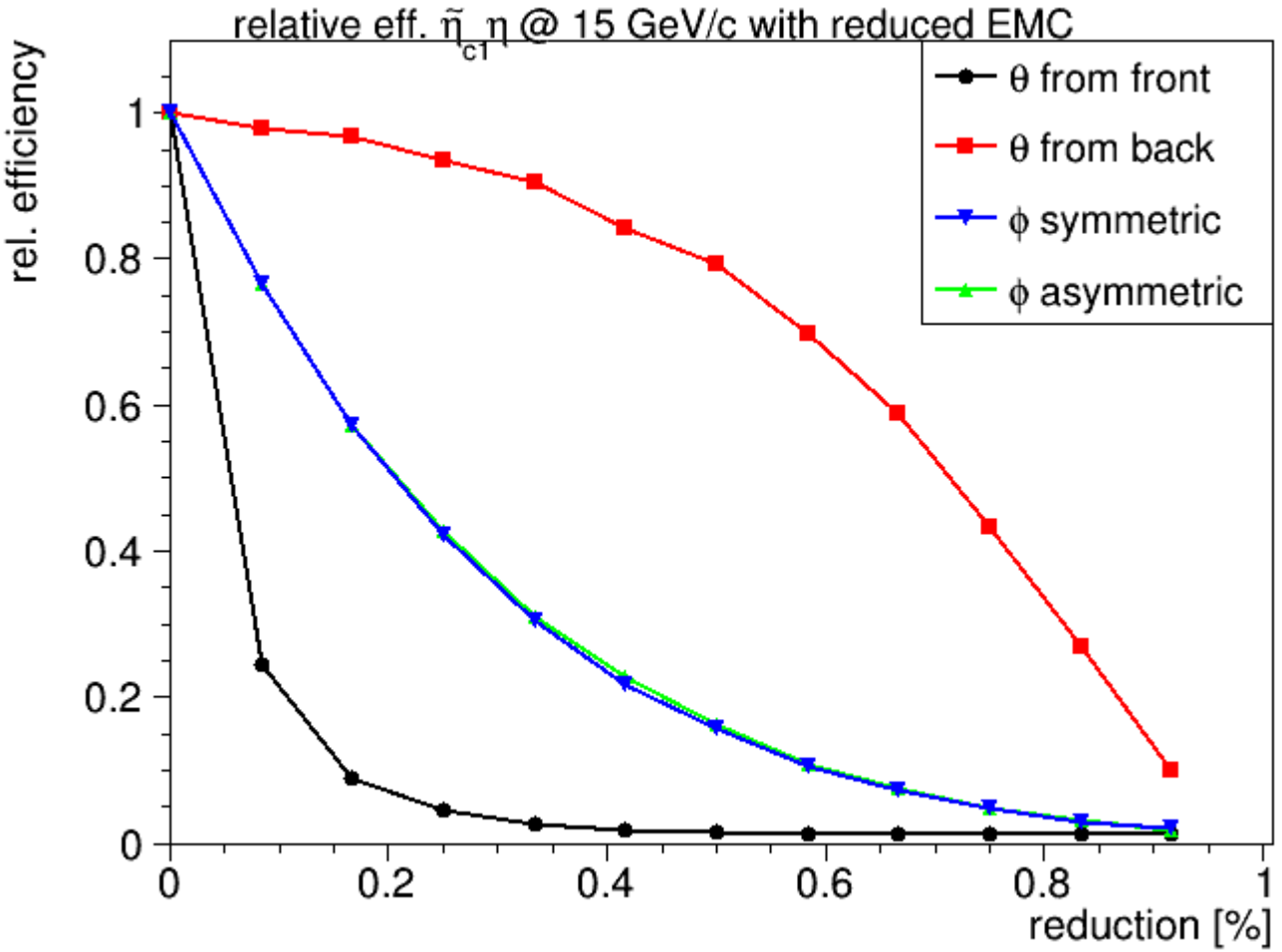
- Reconstruct full $p\bar{p}$ candidate with 4C fit; keep only best
- No PID cut for electrons

- Count number of fully reconstructed events

- Compute efficiency relative to full EMC barrel scenario

$p\bar{p} \rightarrow \tilde{\eta}_c \eta$ - Relative Efficiencies

- Removing from back is best, from front worst case
- No obvious difference between sym/asym removal in phi



$p\bar{p} \to J/\psi\pi^+\pi^-$

For all 4 reduction scenarios:

- Assumptions: σ_S=100nb, $B_{J/\psi}$=0.06, B_X=0.05, σ_B=50mb, t = 2d

- 100k signal + 10M (=2.3G filtered) DPM events @ 7 GeV/c for 11 reduction steps ($\Delta\theta = 10°$ and $\Delta\varphi = 30°$ each)

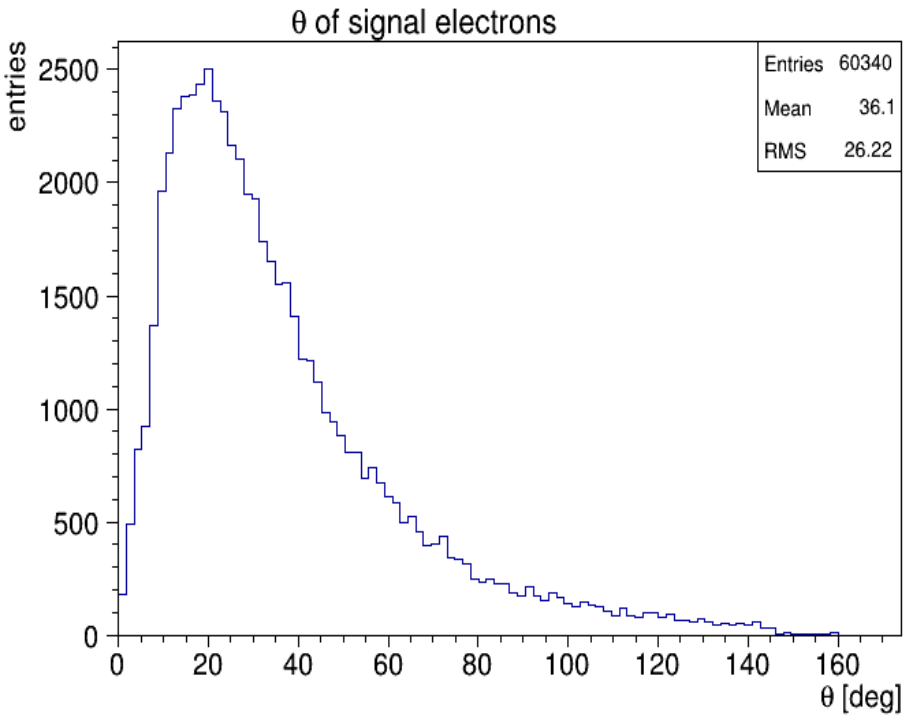
- Reconstruct full $p\bar{p}$ candidate with 4C fit (χ^2<50); keep best
- Apply electron PID selection (P > 0.5, P > 0.8)

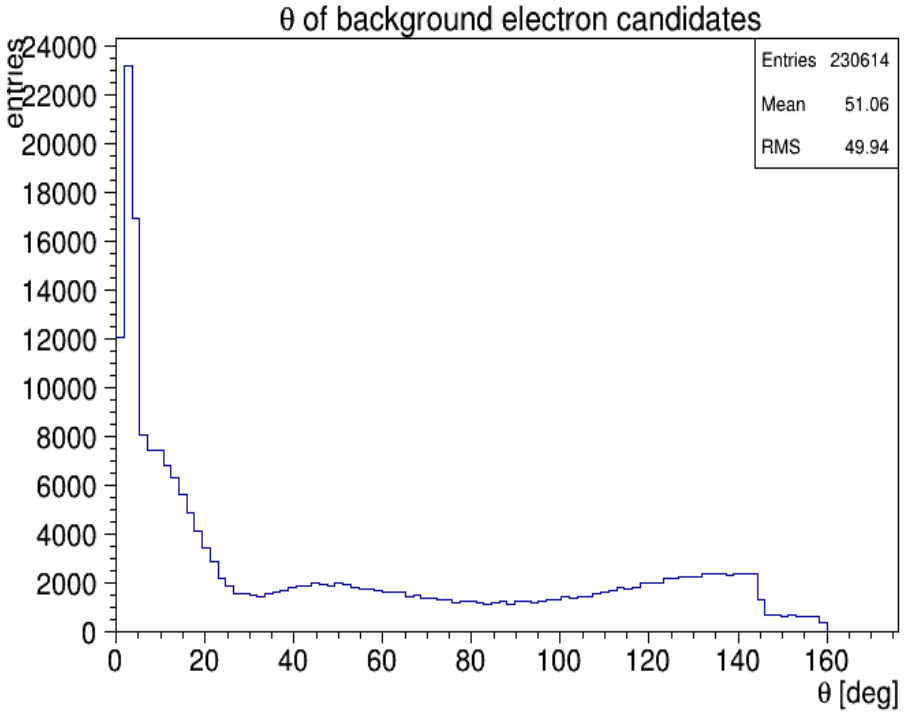
- Count number of fully reconstructed events

- Compute efficiency and BG increase relative to full EMC
- Compute significance S/sqrt(S+B) based on total S and B

$p\bar{p} \rightarrow J/\psi\pi^+\pi^-$

- Theta distributions for signal and background



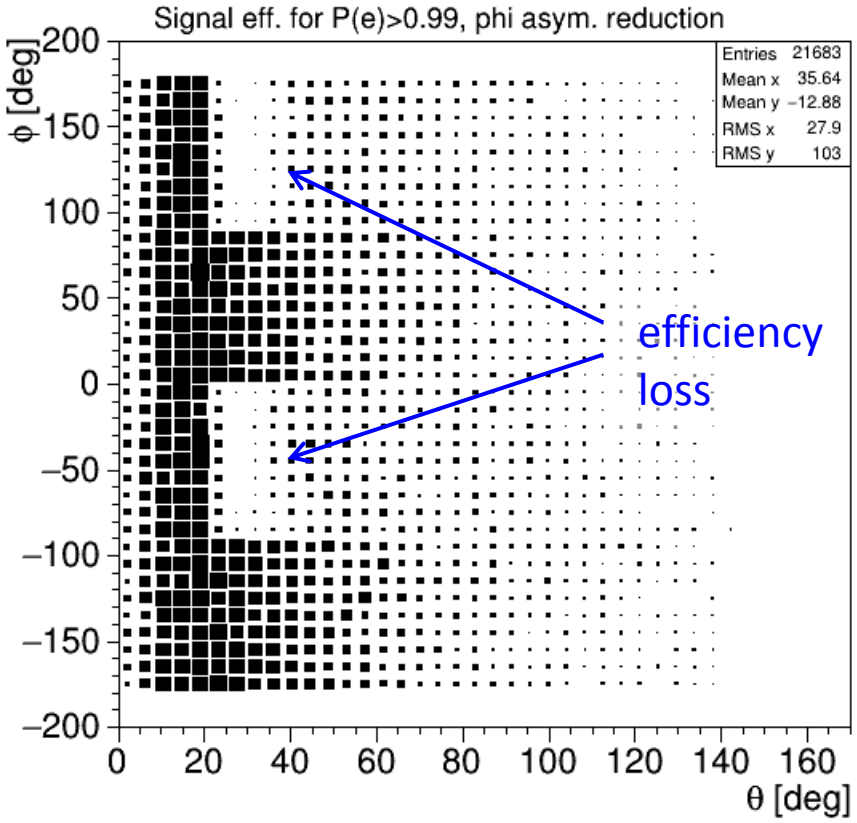


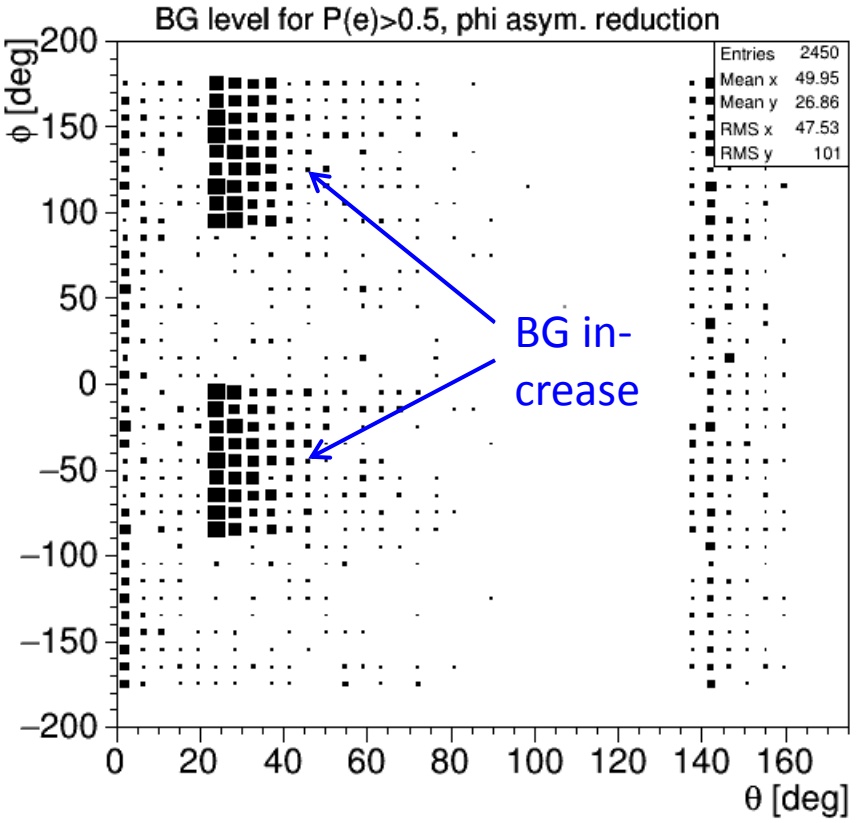
$p\bar{p} \rightarrow J/\psi\pi^+\pi^-$ - Effect PID cut

- Effect of PID cut on signal & background

Signal: P(e)>0.99

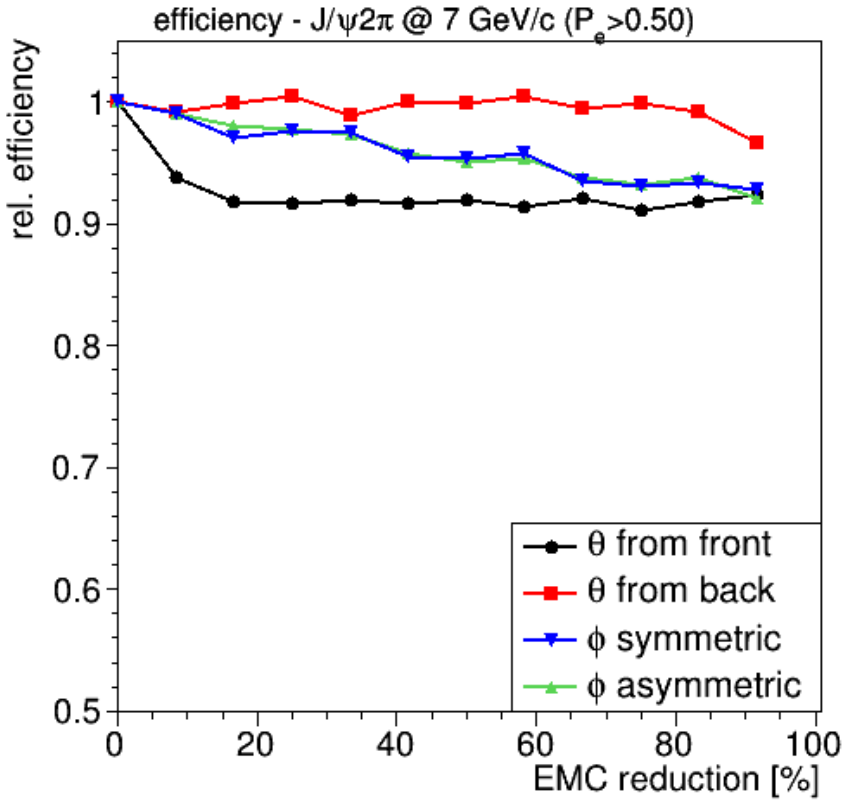
Background: P(e)>0.5

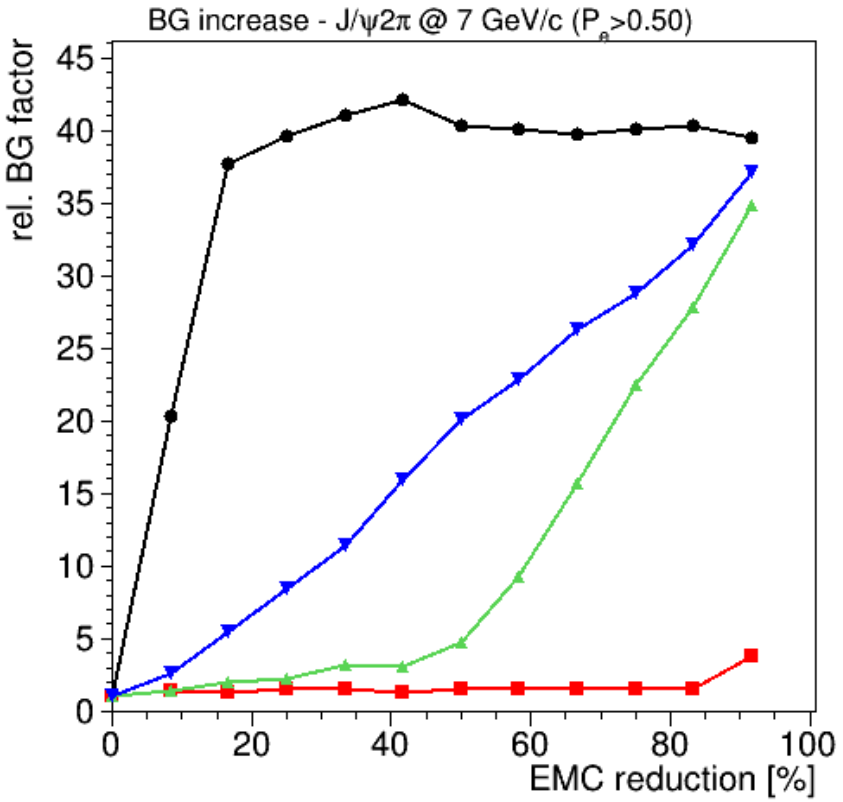




$p\bar{p} \rightarrow J/\psi\pi^+\pi^-$ - Eff, BG level

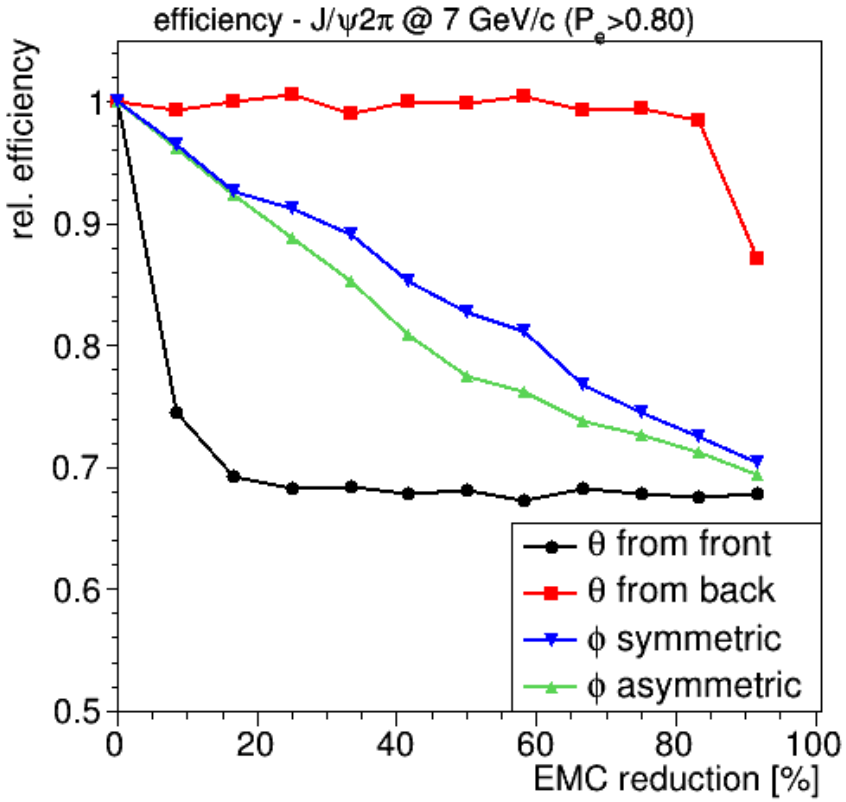
- PID $\mathbf{P_e > 0.5}$
  - Signal efficiency doesn't drop strongly
  - BG level θ red.: front worst, back quite robust
  - BG level φ red.: asymmetric better than symmetric reduction

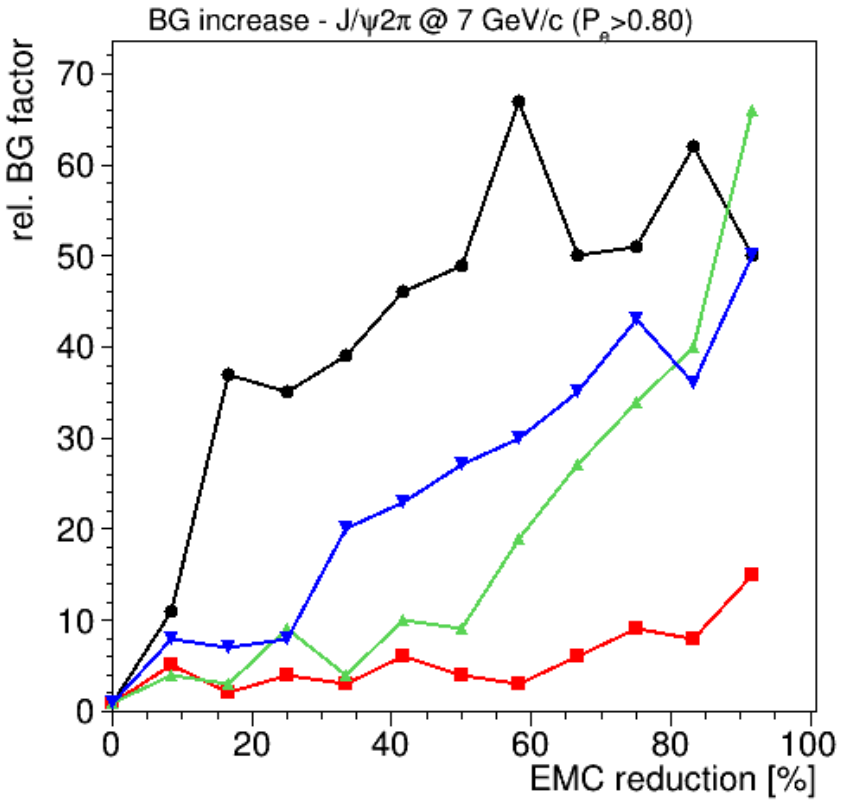




$p\bar{p} \rightarrow J/\psi\pi^+\pi^-$ - Eff, BG level

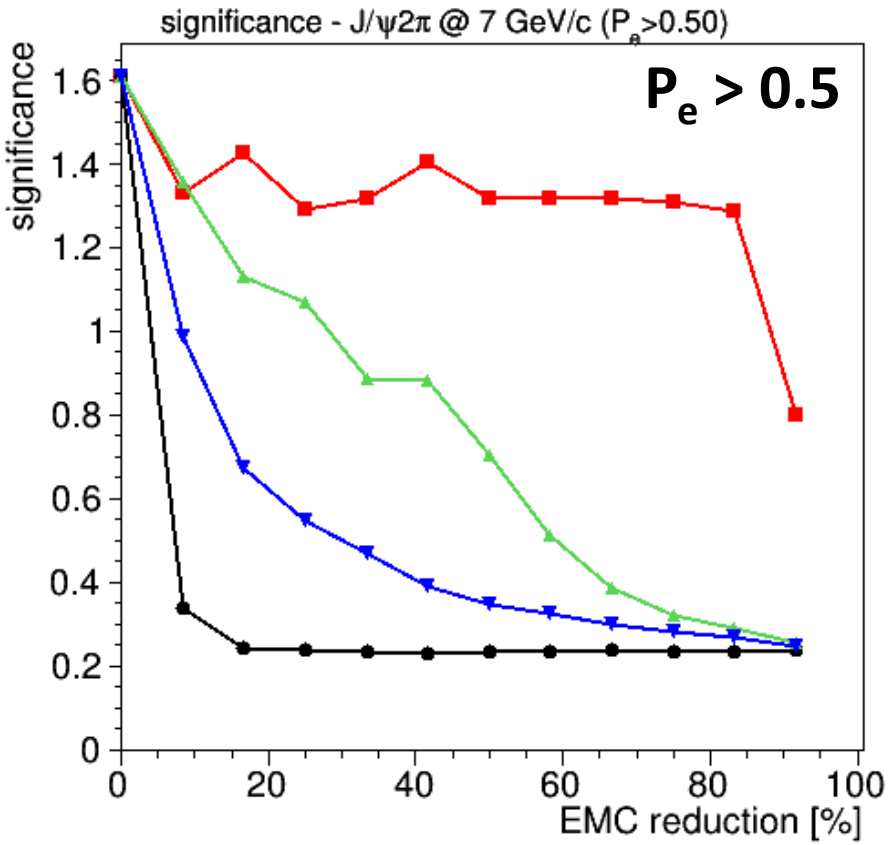
- PID $\mathbf{P_e > 0.8}$
  - Stronger efficiency decrease due to PID cut down to relat. 70%
  - BG level θ red.: front worst, back quite robust
  - BG level φ red.: asymmetric better than symmetric reduction

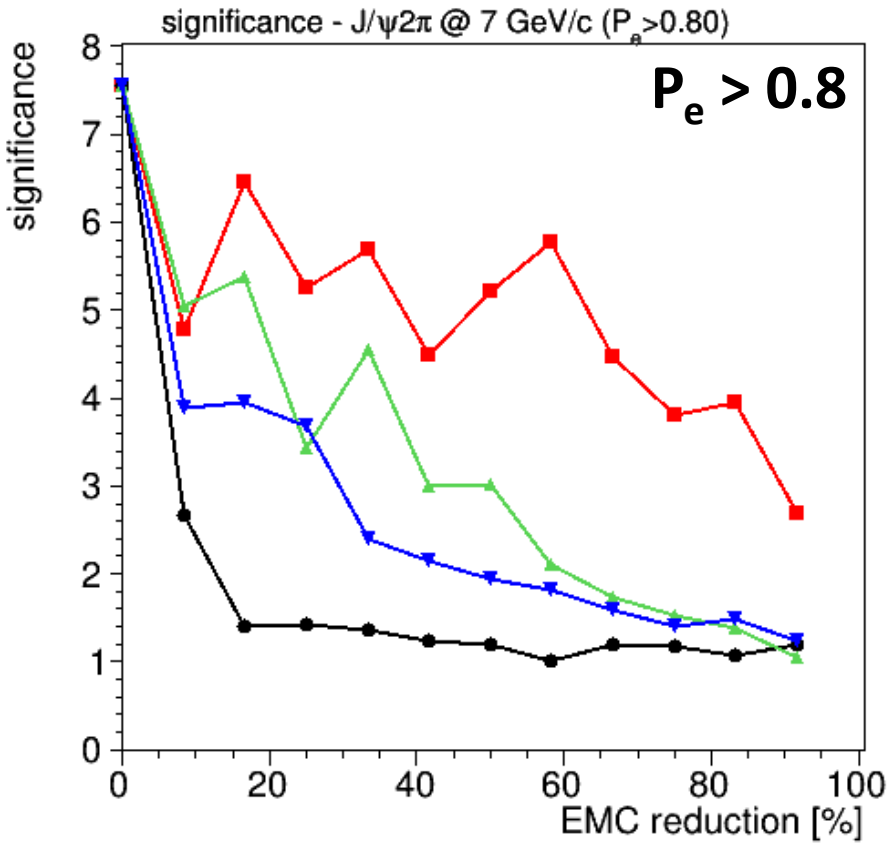




$p\bar{p} \rightarrow J/\psi\pi^+\pi^-$ - Significance

- Significance level almost constant for back reduction
- Strong drop (factor 7!) for reduction from front
- Better use asymmetric than symmetric reduction





$p\bar{p} \rightarrow e^+e^-$

For all 4 reduction scenarios:

- Assumptions:
  σ_S = 3 fb, $\sigma_{B1}(\pi^+\pi^-)$ = 1μb, $\sigma_{B2}(\pi^+\pi^-\pi^0)$ = 33μb, L_{int} = 2/fb

- 100k signal + 10M 2π + 10M 3π events @ 10 GeV/c for 11 reduction steps ($\Delta\theta = 10°$ and $\Delta\varphi = 30°$ each)

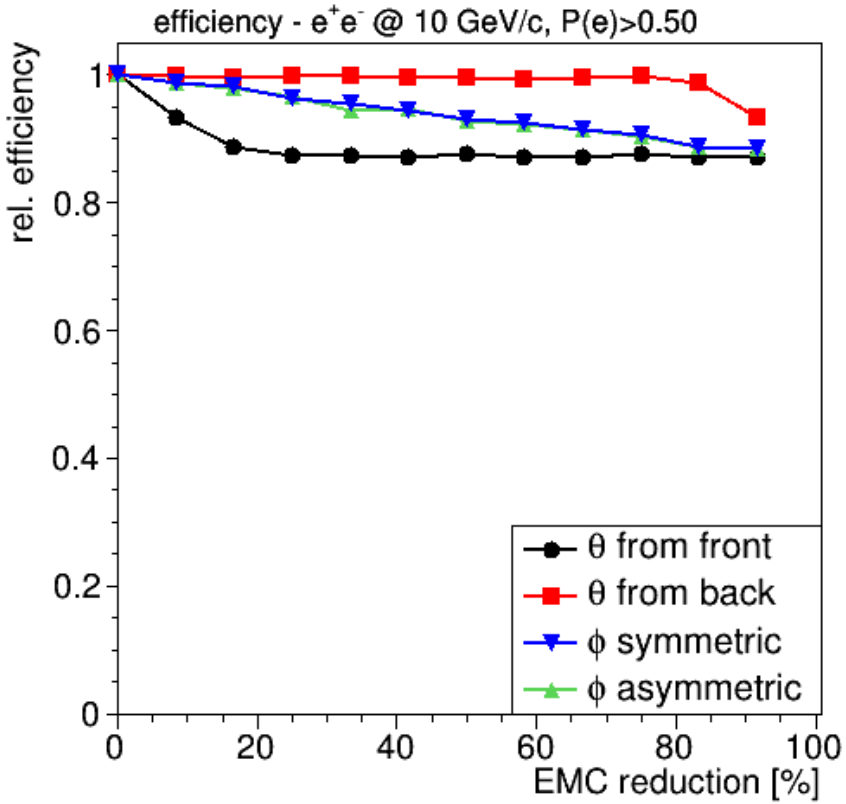
- Reconstruct full $p\bar{p}$ candidate with 4C fit (χ^2<100); keep best
- Apply electron PID selection (P > 0.5, P > 0.8)

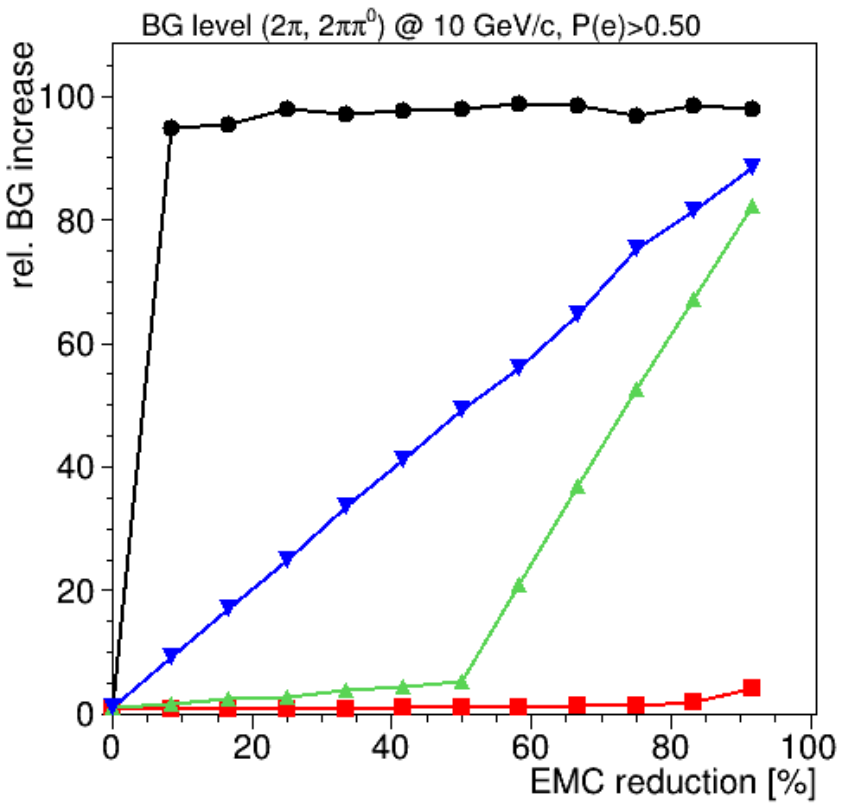
- Count number of fully reconstructed events

- Compute efficiency and BG increase relative to full EMC
- Compute significance S/sqrt(S+B) based on total S and B

$p\bar{p} \rightarrow e^+e^-$ - Eff, BG level

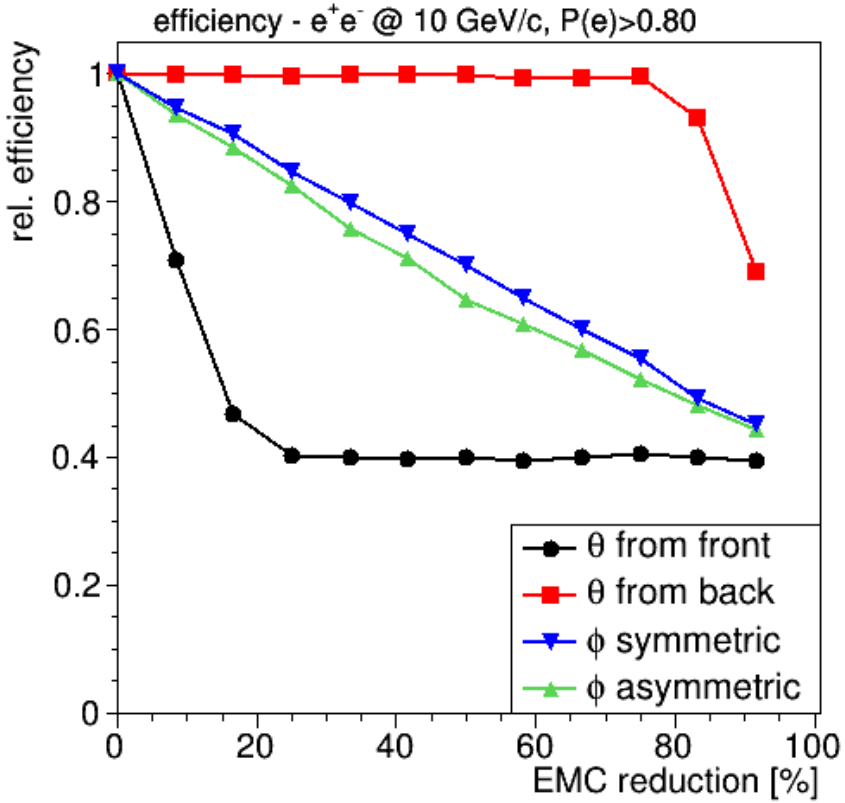
- PID $\mathbf{P_e > 0.5}$
  - Similar to $J/\psi\pi^+\pi^-$: Signal efficiency doesn't drop strongly
  - BG level θ red.: front reduction worst, back red. quite robust
  - BG level φ red.: asymmetric better than symmetric reduction

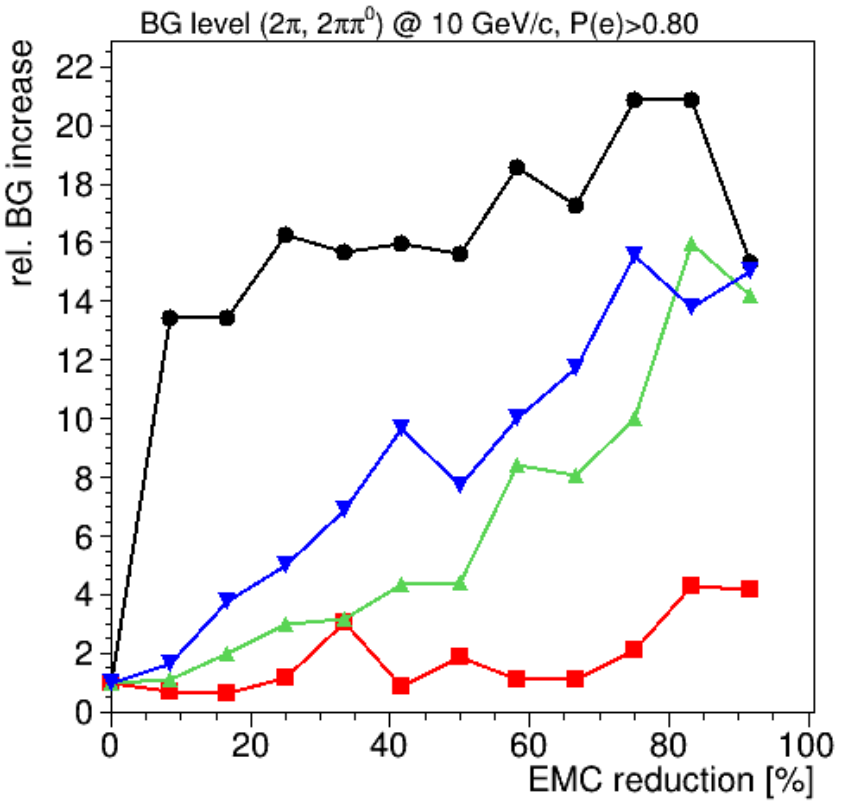




$p\bar{p} \rightarrow e^+e^-$ - Eff, BG level

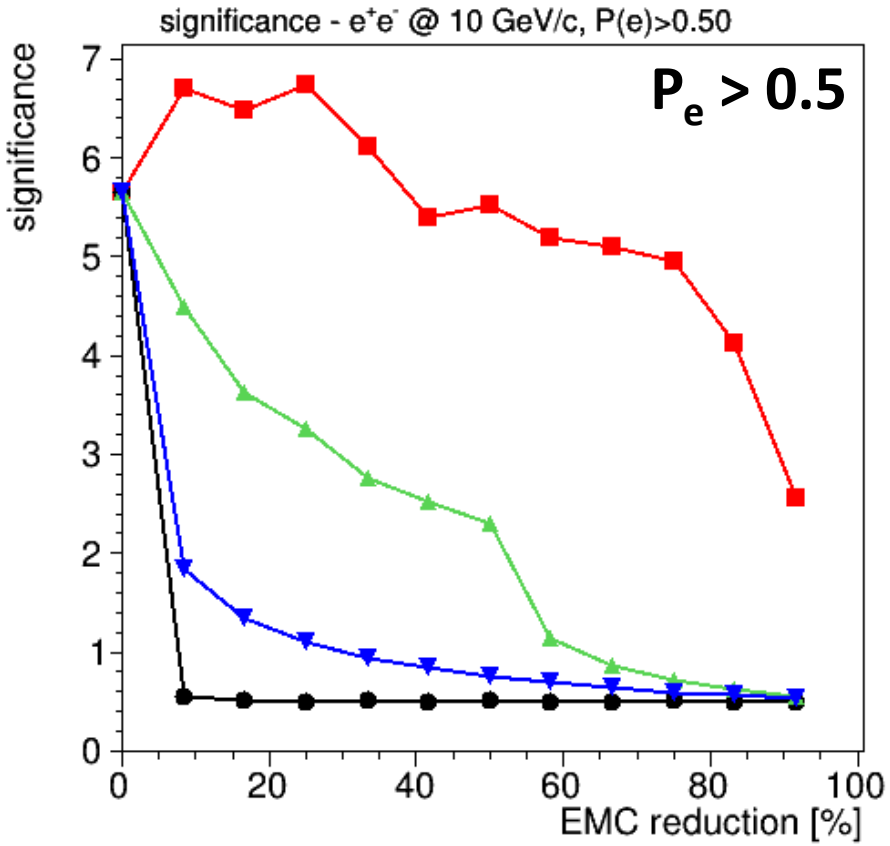
- PID $\mathbf{P_e > 0.8}$
  - Stronger efficiency decrease due to PID cut down to relat. 40%
  - BG level θ red.: front worst, back quite robust
  - BG level φ red.: asymmetric better than symmetric reduction

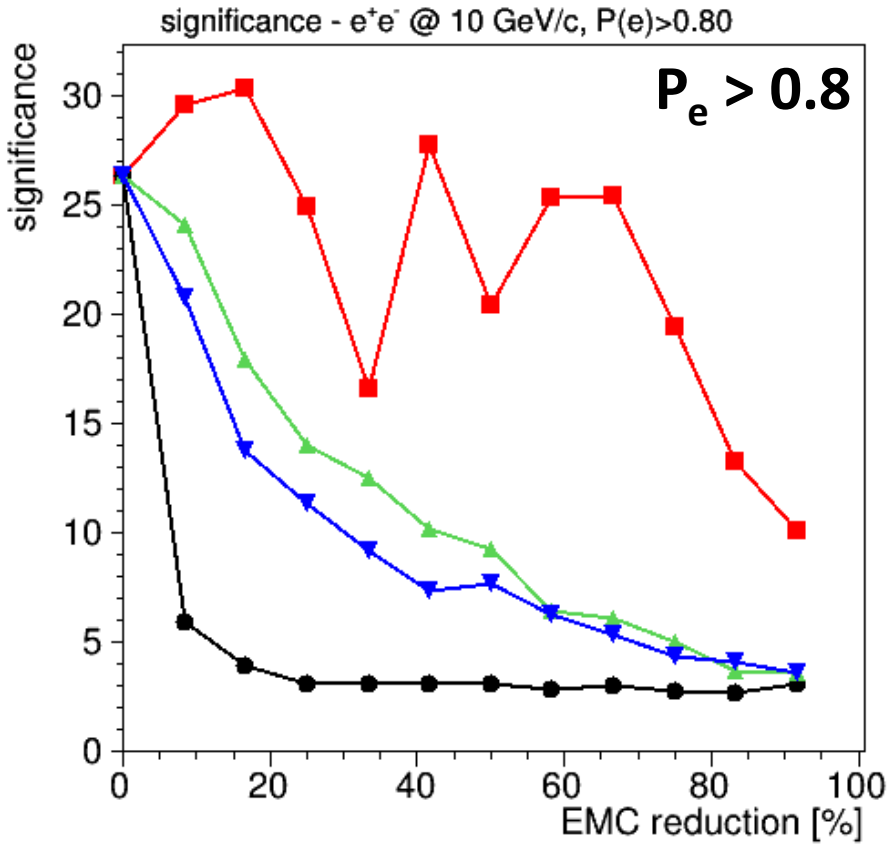




$p\bar{p} \rightarrow e^+e^-$ - Significance

- Significance level almost constant for back reduction
- Strong drop (factor 10) for reduction from front
- Better use asymmetric than symmetric reduction





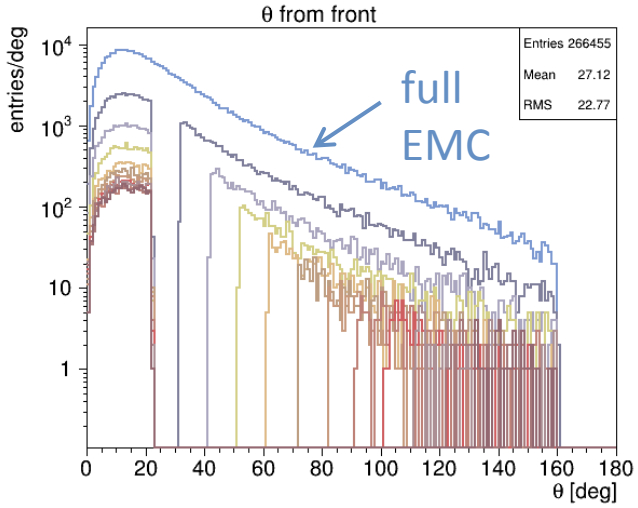
Summary & Conclusion

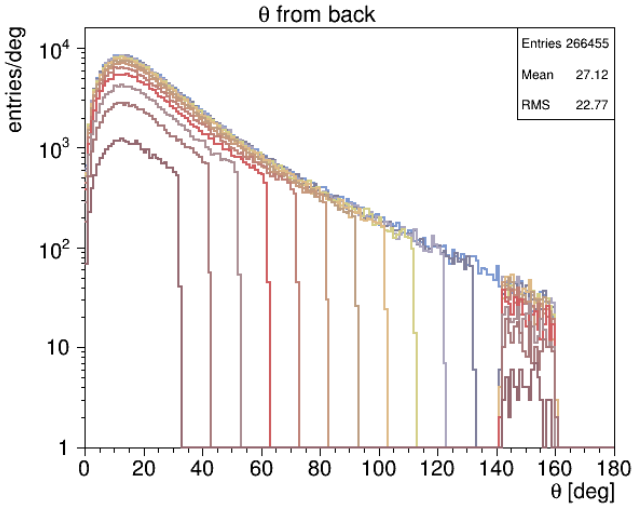
- Simulated (FastSim) three physics channels to investigate performance with reduced Barrel EMC
- 4 different cases of reduction applied
- Results:
  - Best case: reduce from back side (at large θ) of EMC
  - Inbetween: leave out EMC slices in φ, better asymmetric at one side than symmetric from both sides
  - Worst case: reduce form front side (at low θ) from EMC

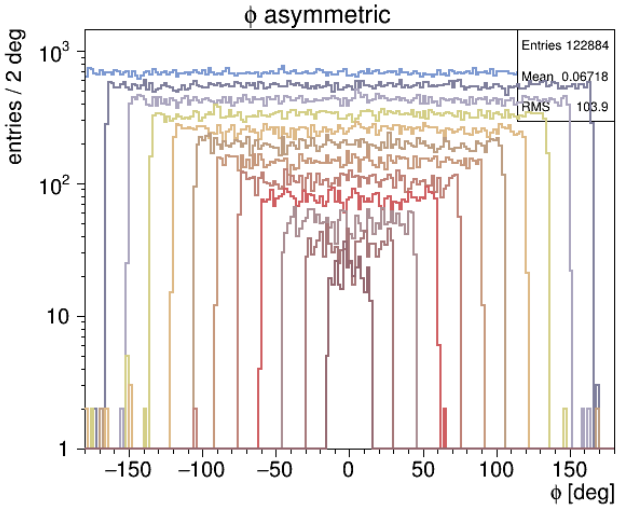
BACKUP

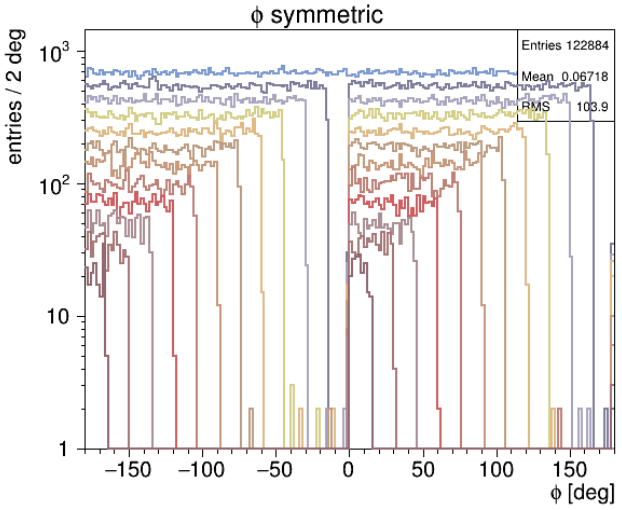
$p\bar{p} \rightarrow \tilde{\eta}_c \eta$ - Residual γ from full reco cands

- Photon distr. for all reduction scenarios from full reco cands
- Colors represent different reduction steps



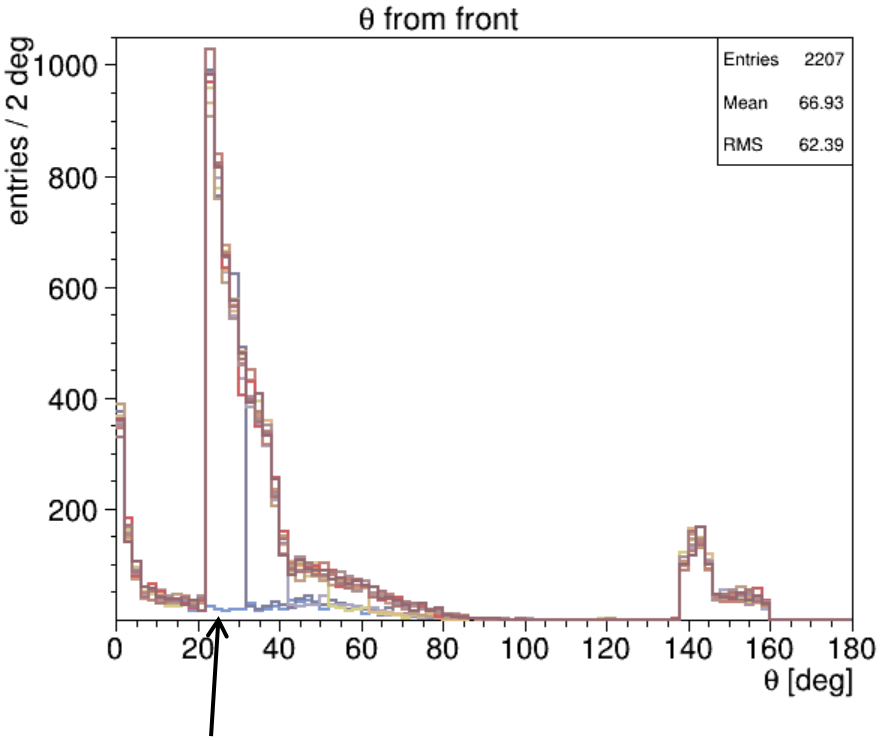


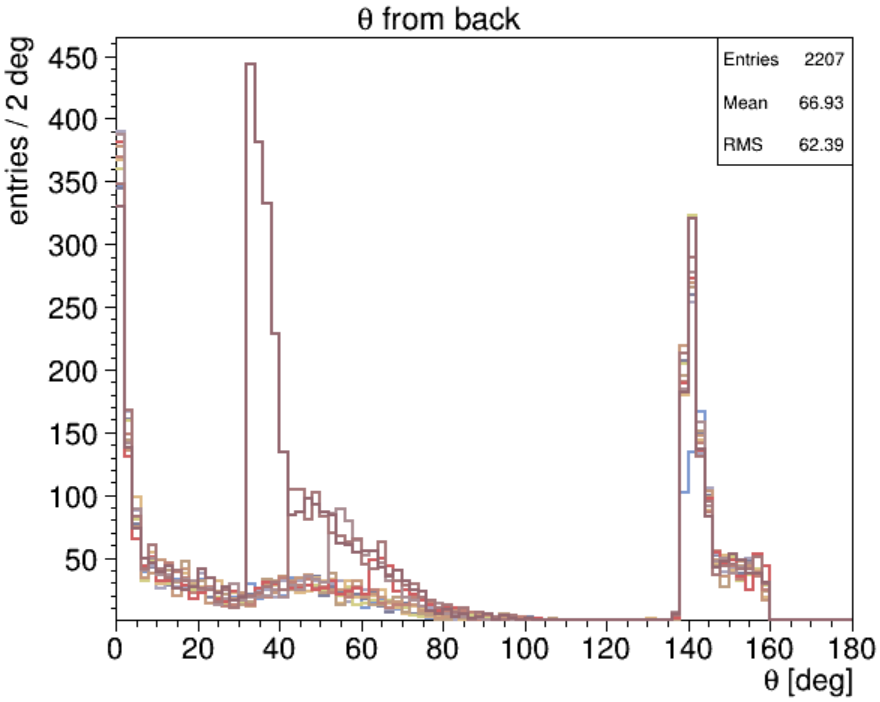




$p\bar{p} \rightarrow J/\psi\pi^+\pi^-$

- Background feedthrough in theta with PID P_e>0.5 for all 11 reduction steps





This flat one is from full EMC