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FEMC descoping studies with DVCS

O. Jevons

University of Glasgow

ePIC PAC meeting
15-Sept-26

WORLD
CHANGING
GLASGOW





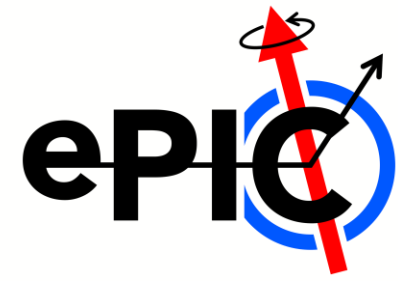
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FEMC descoping



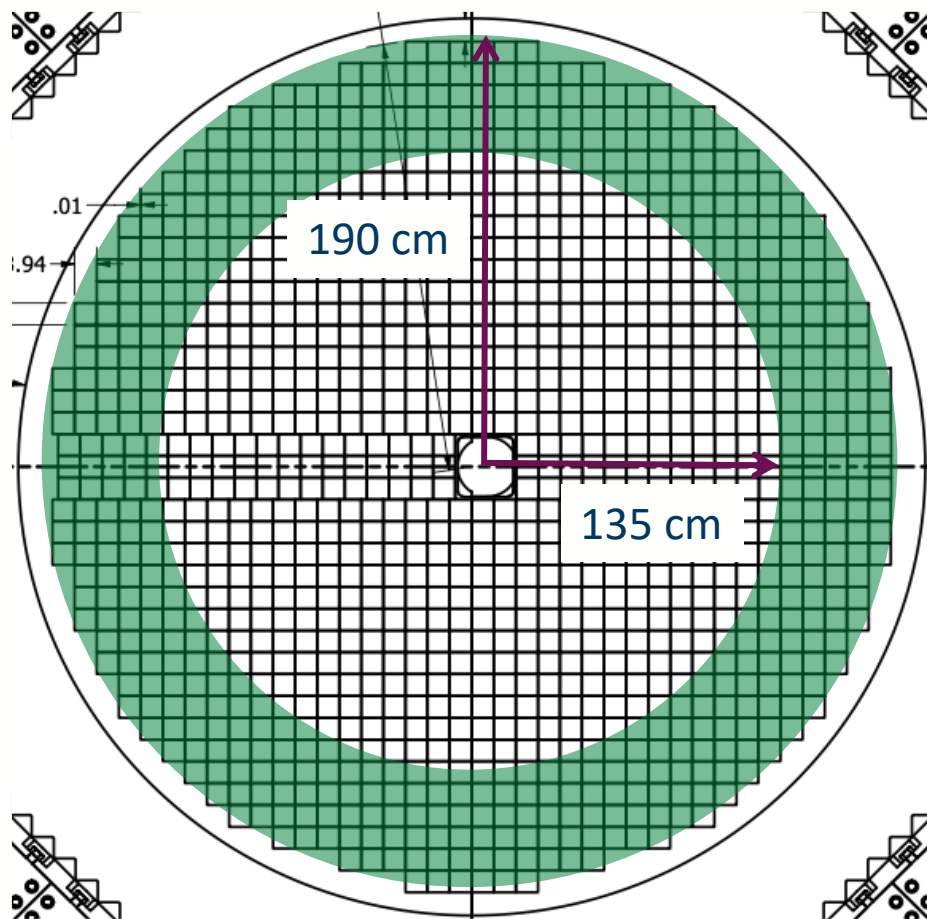
Justification



- Suggestions that project/detector groups are considering descope part of the FEMC.
 - (FEMC = forward endcap ECAL)
- No concrete plans made yet.
 - Working off suggestion of “50% drop in area”.
 - Tests based off radial cut.
- This study is preliminary and should not be used for a go/no-go to descope the FEMC.
 - Full ePIC simulations with reduced geometry will be needed first, before final conclusions can be drawn.



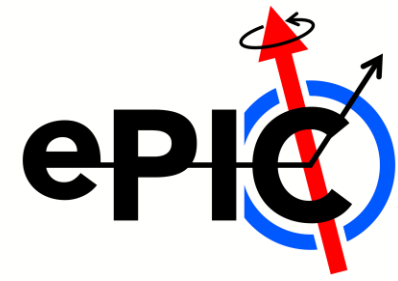
FEMC design (pre-TDR, table 3.51) ePIC



- Current FEMC design
 - Inner “radius”: 15 cm
 - Outer radius: 190 cm
- Reducing area by 50%
 - New radius: 135 cm
- Pseudorapidity coverage:
 - Default: $1.4 < \eta < 3.9$ (TDR)
 - New: $1.4 < \eta < 1.68$ (assuming removal of inner 50%)



How does this affect physics?



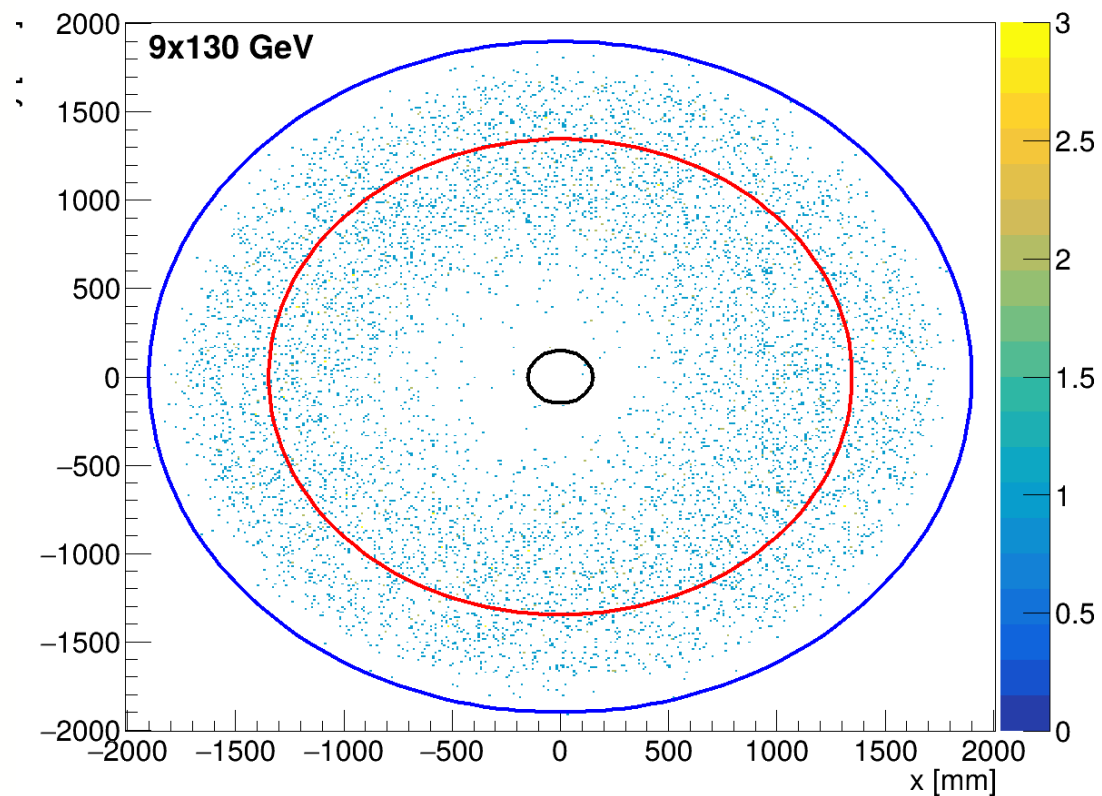
- Using DVCS as an example channel (relatively representative of the Exclusive, Diffractive and Tagging PWG)
 - Scattered electron goes in the backwards direction
 - Scattered proton goes into the far forward subsystems
 - **Only affects hadrons produced in the interaction.**
- DVCS: single real photon
 - Looking at 2 cases: cutting inner 50% and cutting outer 50% of FEMC



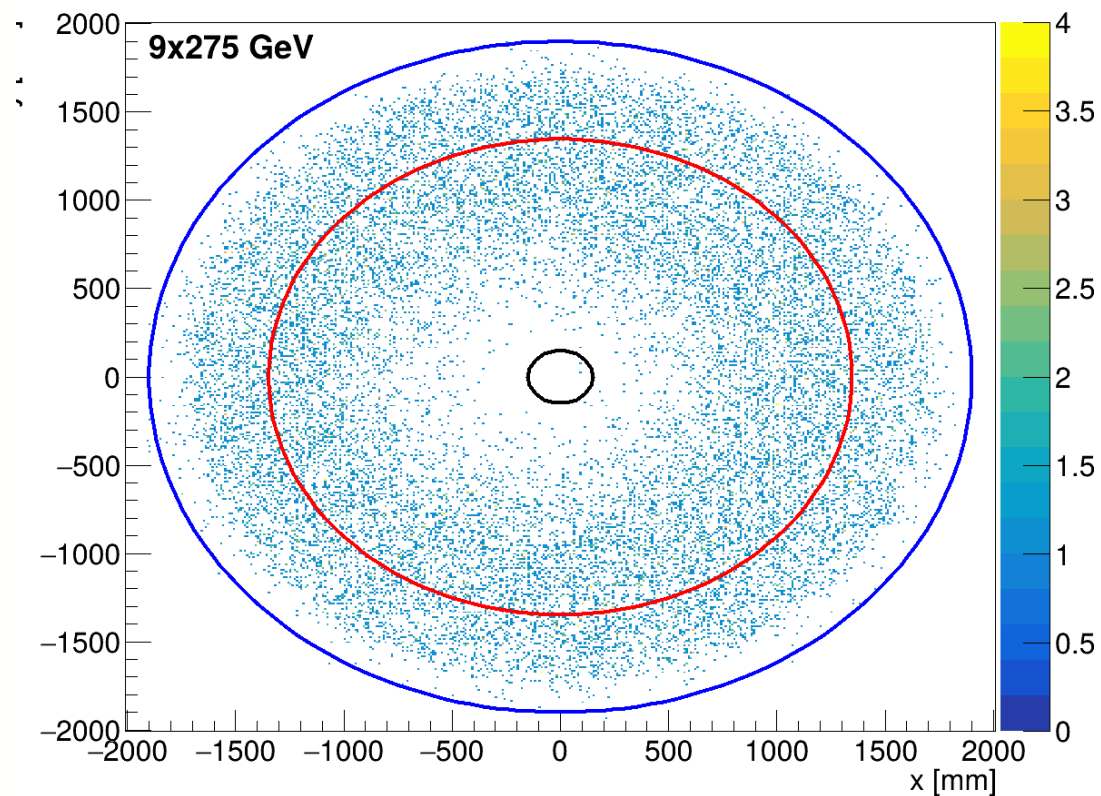
FEMC occupancies



All forward neutral clusters ($z > 3500$ mm)



All forward neutral clusters ($z > 3500$ mm)

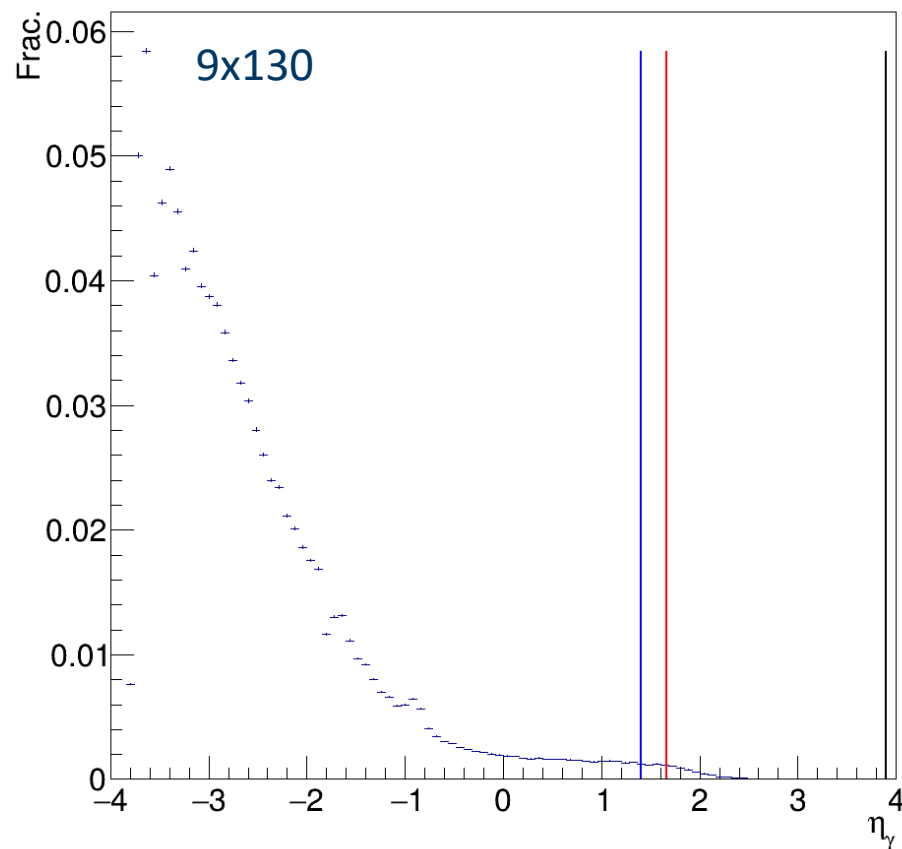




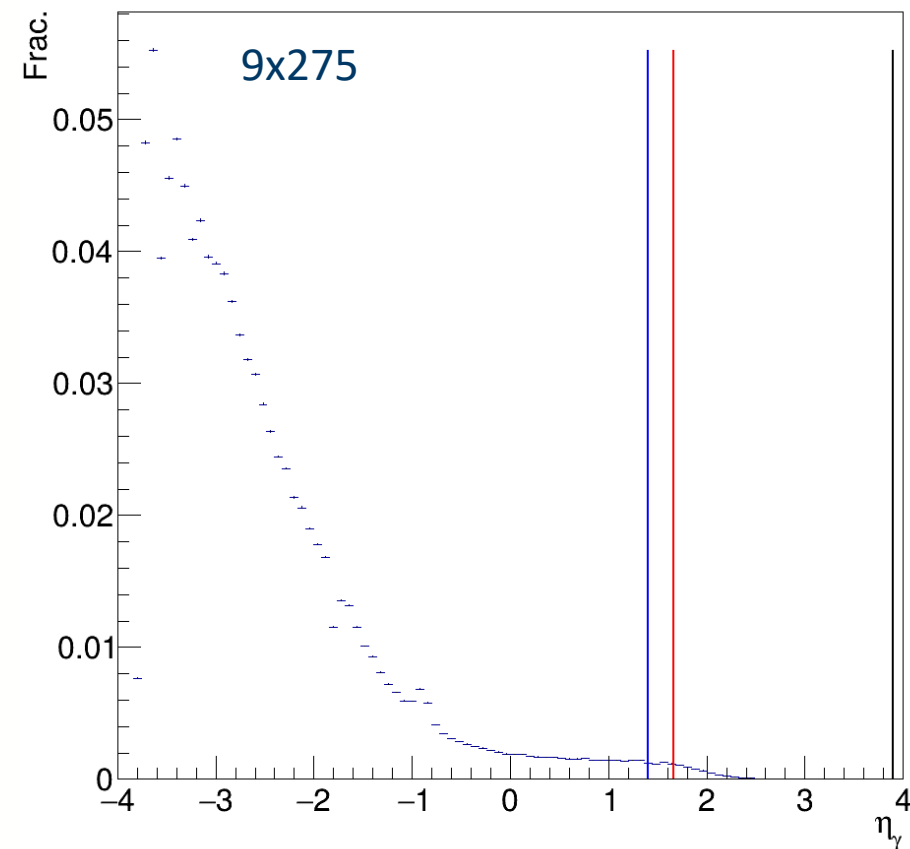
γ pseudorapidity



Fraction of all reco. γ



Fraction of all reco. γ

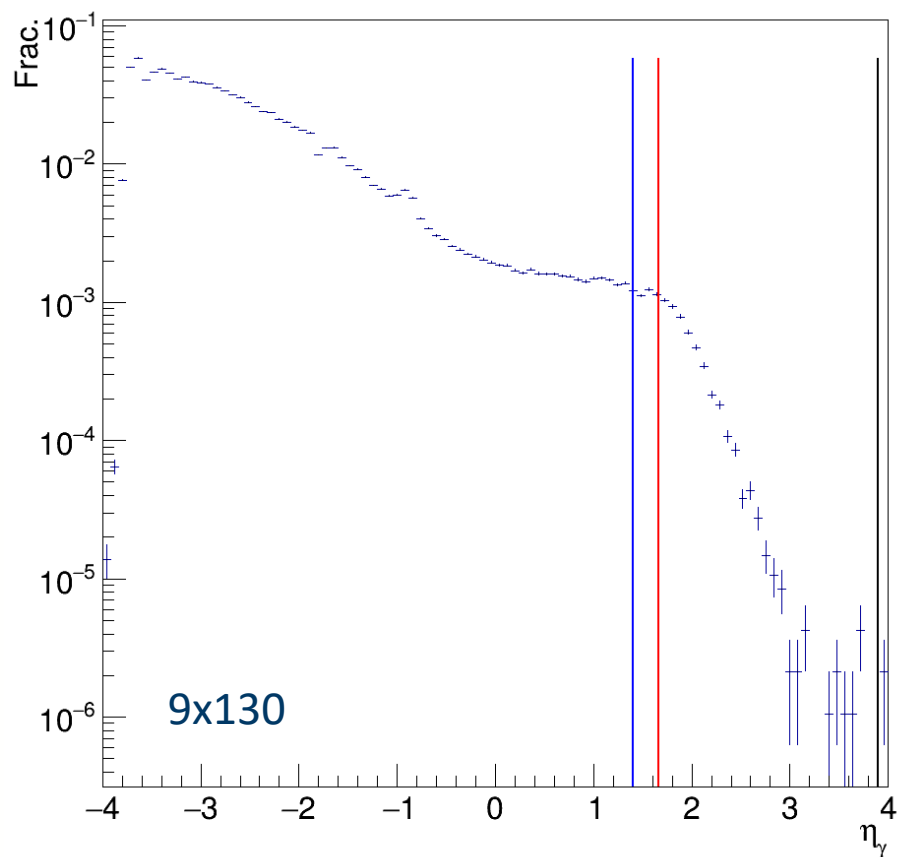




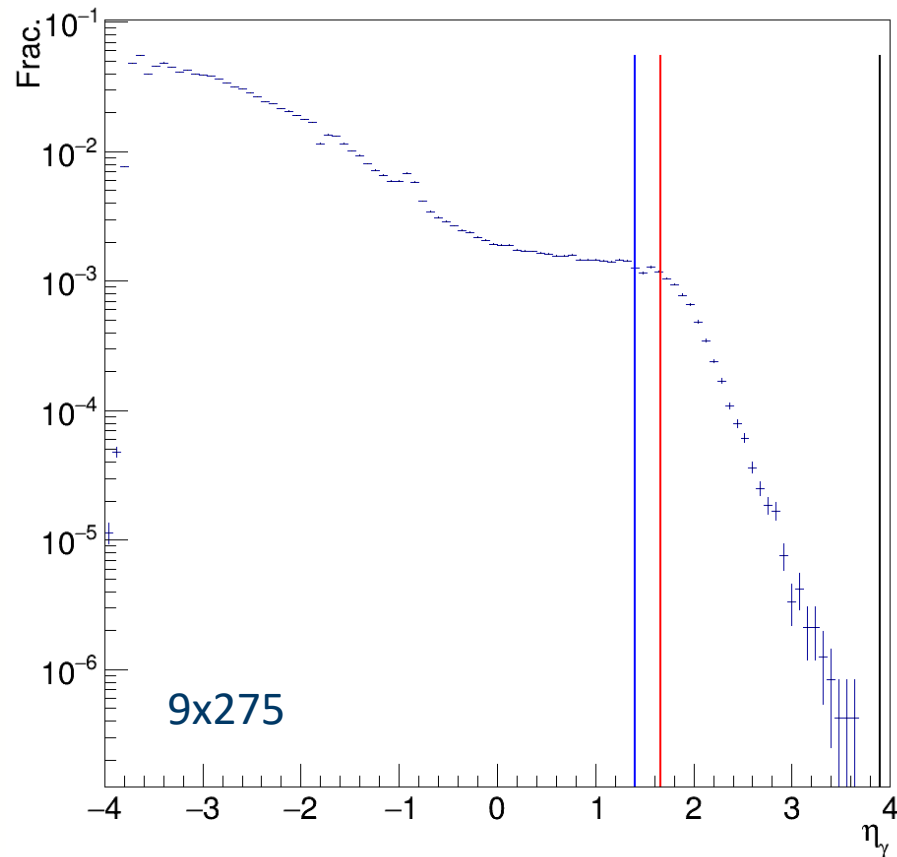
γ pseudorapidity (log scale)



Fraction of all reco. γ



Fraction of all reco. γ

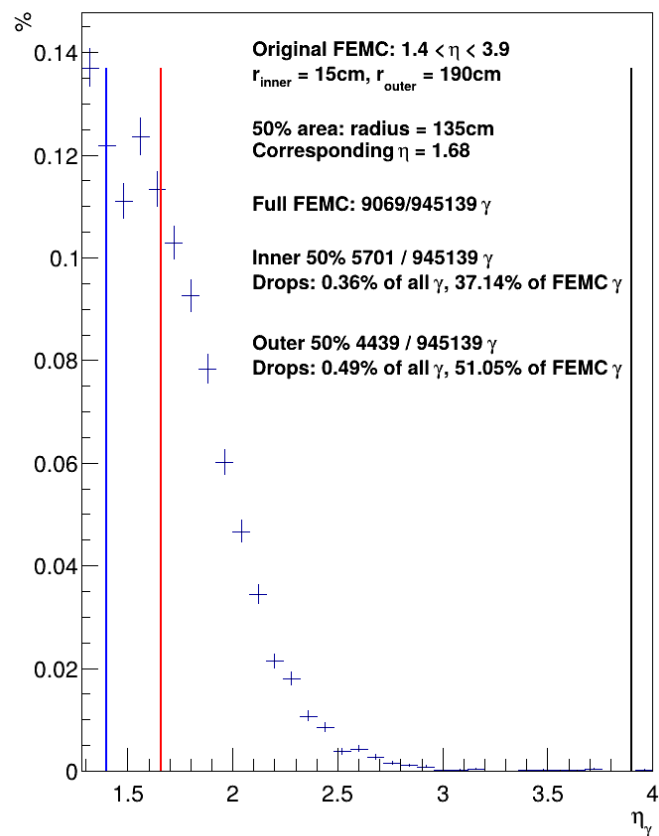




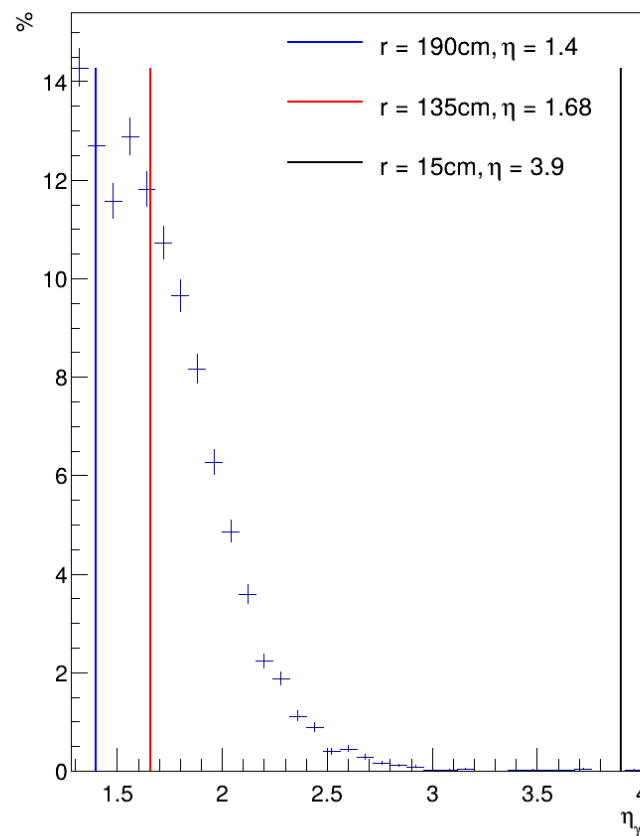
Focus on FEMC (9x130)



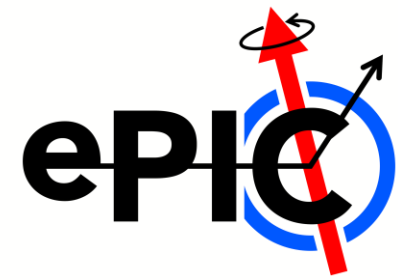
Fraction of all reco. γ



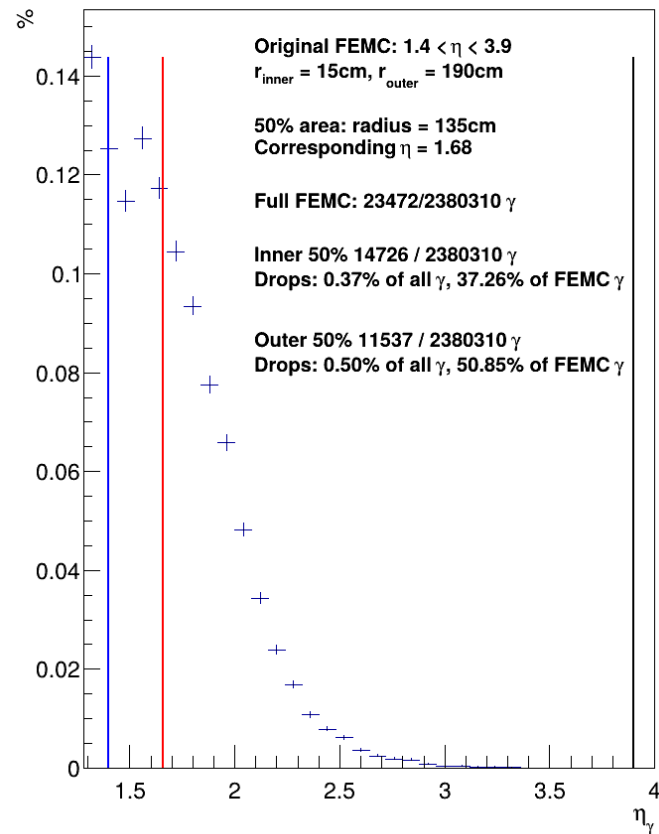
Fraction of FEMC reco. γ



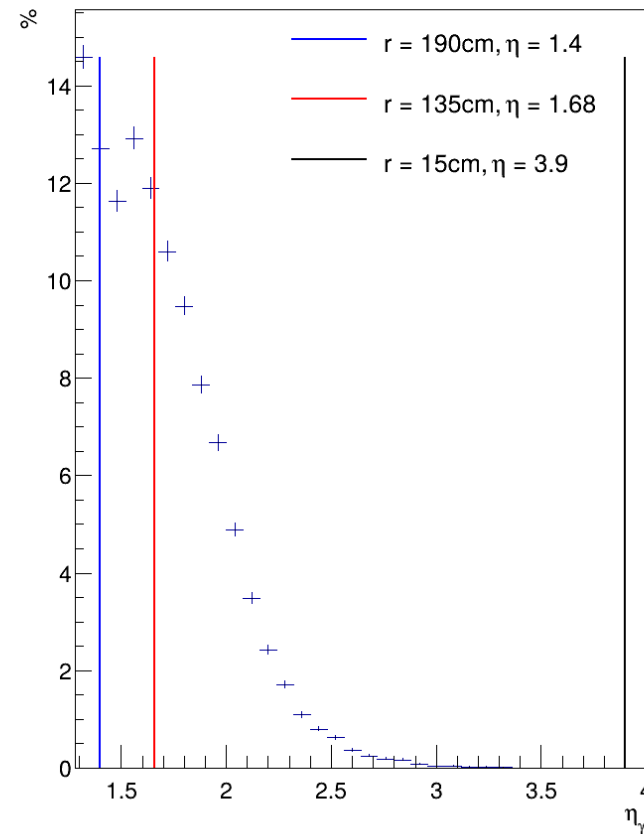
Focus on FEMC (9x275)



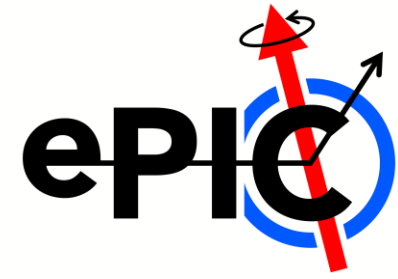
Fraction of all reco. γ



Fraction of FEMC reco. γ



Broad stroke effects



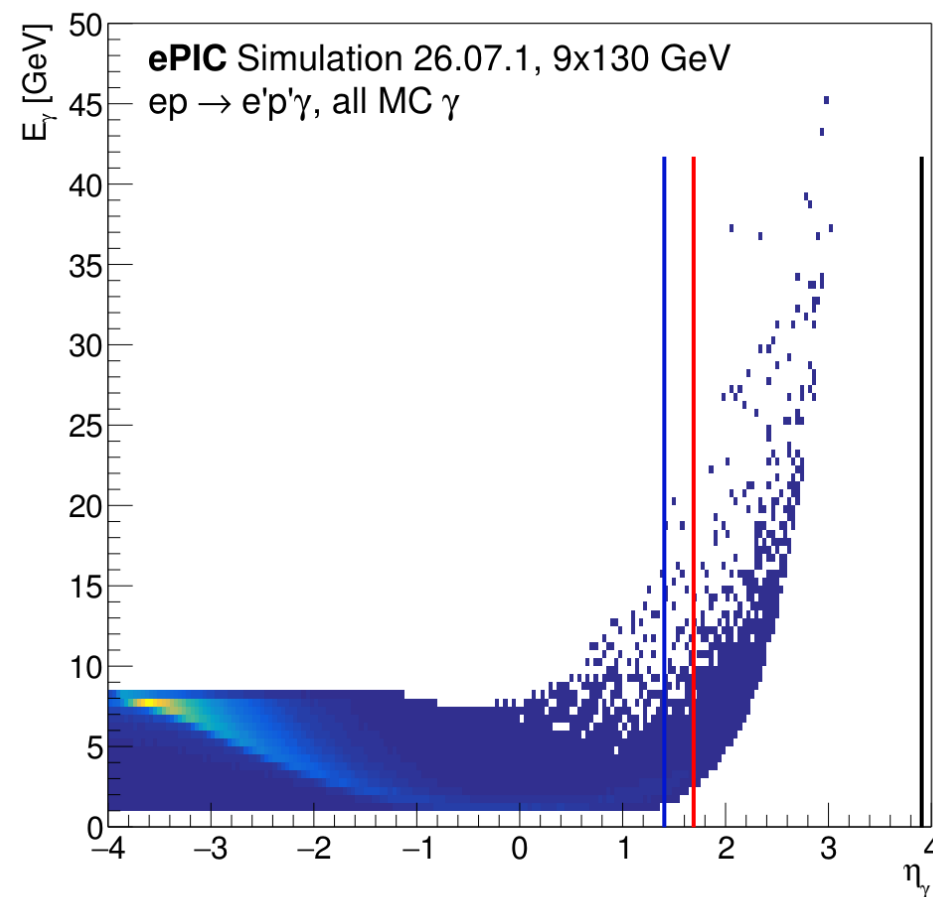
- Small effect when compared to all photons.
 - FEMC cut removes no more than 0.5% of all photons.
 - Would cut ~40-50% of detected forward photons.
- Other subsystems?
 - Barrel ECAL: $-1.71 < \eta < 1.31$ (table 3.44) → **No overlap with FEMC**
 - Forward HCAL: $1.2 < \eta < 3.5$ (blocks) / $3.5 < \eta < 4.9$ (insert)
 - Will be able to detect particles missed by FEMC cut
- Any other dependencies of the photons?



E_γ vs η_γ

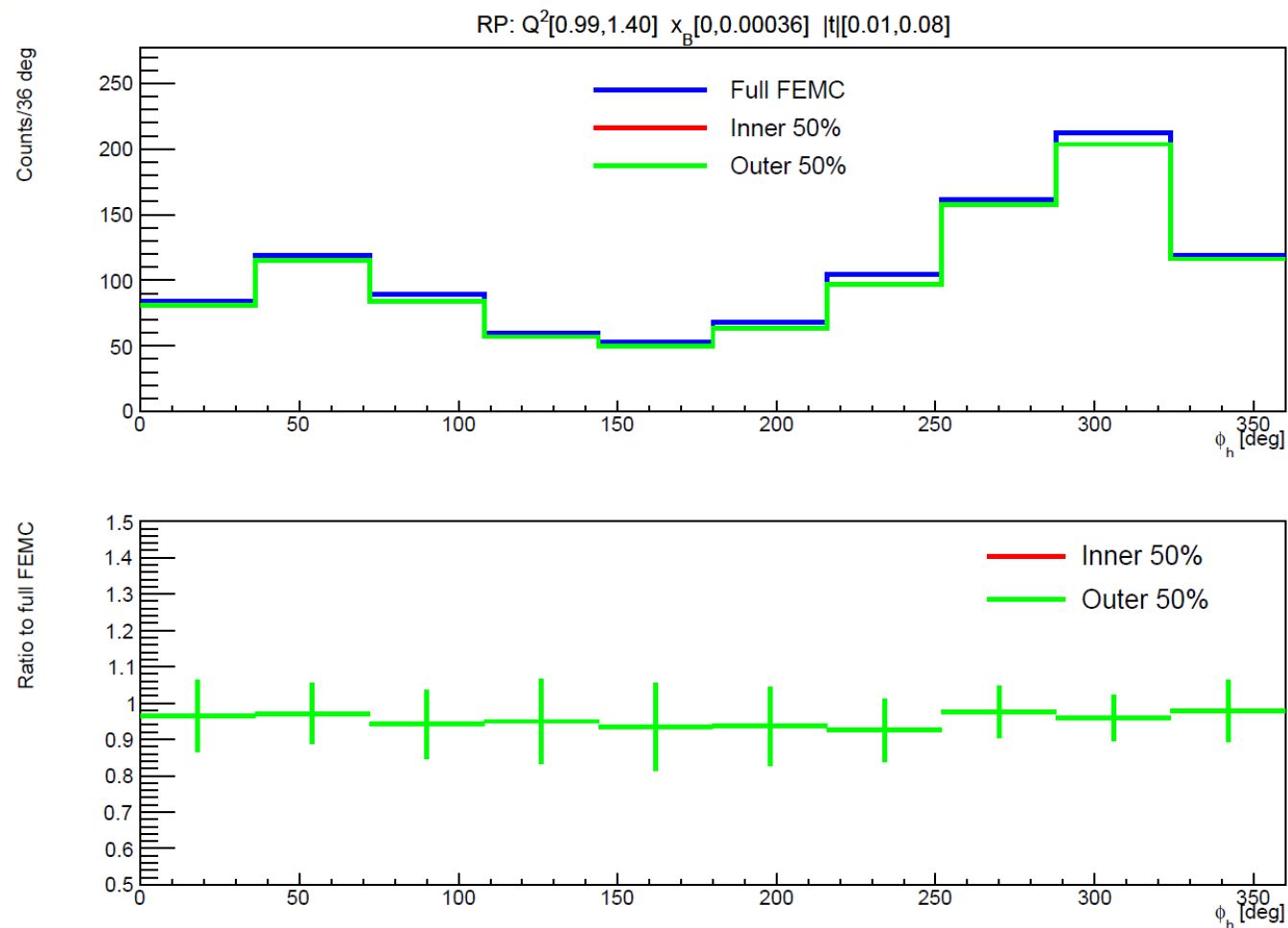


- DVCS photons with energy > 10 GeV will be disproportionately affected.





Binned data: low x



Blue – full FEMC

Red – keeping inner
50%

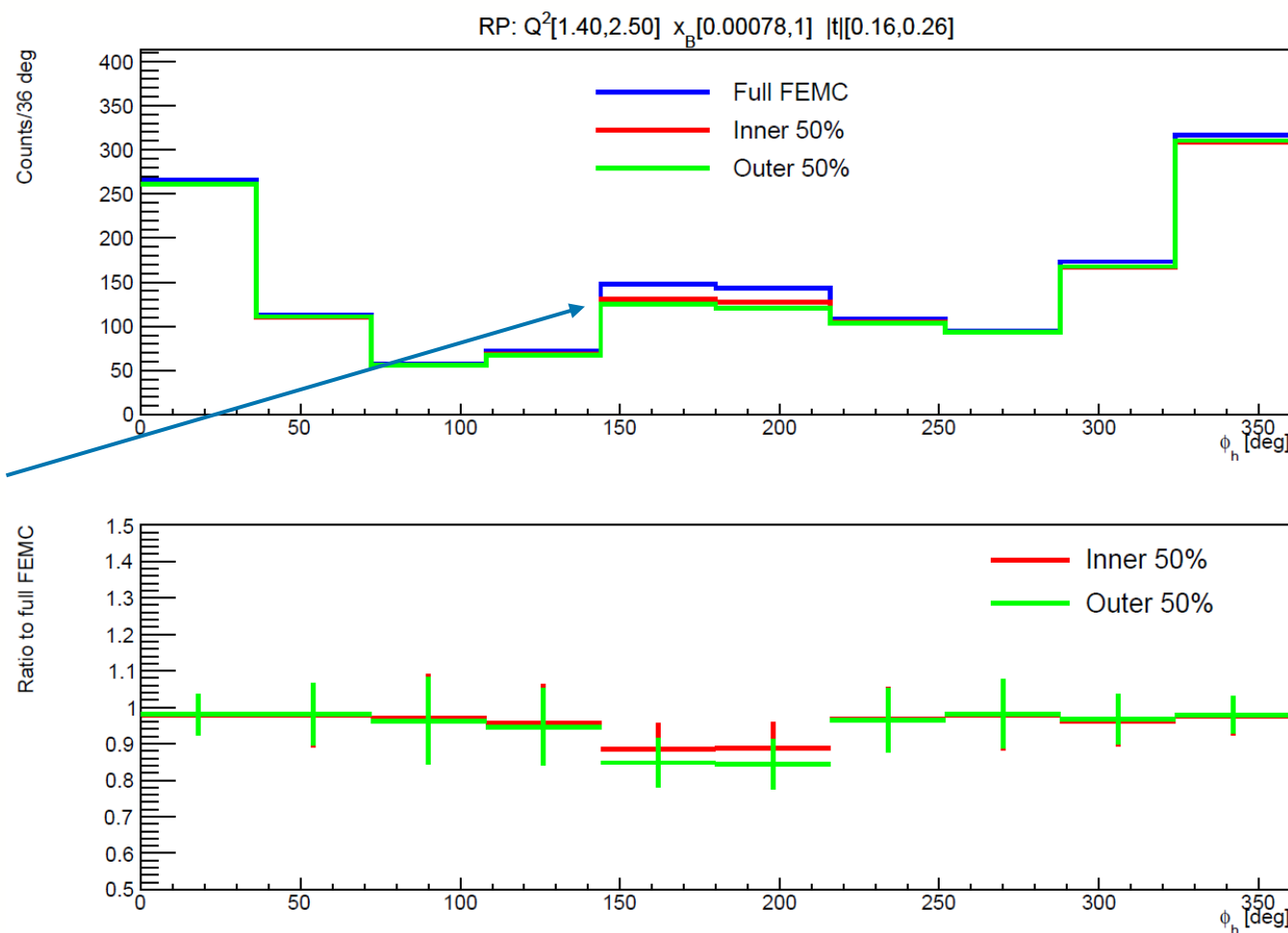
Green – Keeping
outer 50%

Binned data: high x



BH dominates at 0/360 degrees.

Asymmetries come out at ~180 degrees.

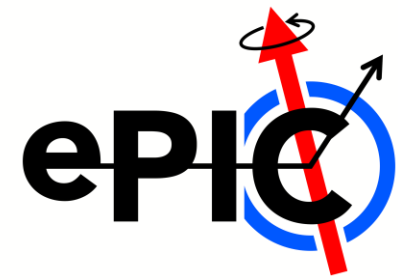


Blue – full FEMC

Red – keeping inner 50%

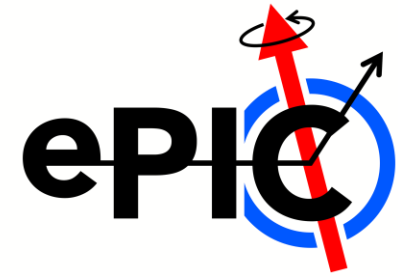
Green – Keeping outer 50%

Effect on binned data



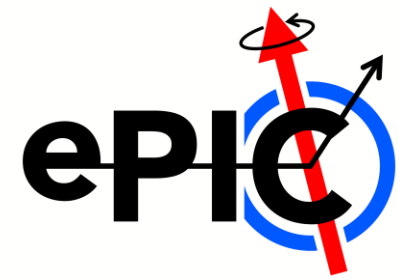
- For vast majority of bins, doesn't matter which 50% of FEMC is removed.
 - Drops overall statistics by ~few %.
 - Corresponds to small absolute change.
 - Ratio of reduced:full FEMC counts within errors of 1 for most bins.
- Most prominent effect seen in highest x bin for each Q2 range.
 - Largest drop seen at $\phi_h \sim 180^\circ$
 - Cutting FEMC 50% cuts ~15-20% of events at $|t| > 0.15 \text{ GeV}^2$
 - Larger drop in statistics if keeping outer 50% vs keeping inner 50%

Conclusions (1)



- Reducing the FEMC area by 50% will impact the highest energy DVCS photons most.
- Drops event statistics by $\sim 15\%$ at $\phi_h \sim 180^\circ$, high- x , mid/high- t .
 - Outside that region (low- x , $\phi_h \neq 180^\circ$), ratio of reduced:full FEMC ~ 1
 - Will hurt Q^2/x_B region between HERA/Jlab coverage
 - Part of the justification for building EIC – want to span gap that currently exists.
 - Statistics affected more if inner 50% is dropped than if outer 50%

Conclusions (2)



- Will directly affect other channels more significantly.
 - Within EDT: $DV\pi^0P$ much worse
 - Daughter γ peak in FEMC coverage.
 - DVMP is key background to DVCS.
 - VM (ρ , J/ψ) $\rightarrow e^+e^-$
 - Forward daughters.
 - Using ECAL clusters for PID – this would not be possible.
 - Meson spectroscopy
 - Any states which decay to γ/π^0
- Other channels/PWGs?

NEED FULL SIMULATIONS WITH
REDUCED GEOMETRY BEFORE
FINAL CONCLUSIONS CAN BE
DRAWN