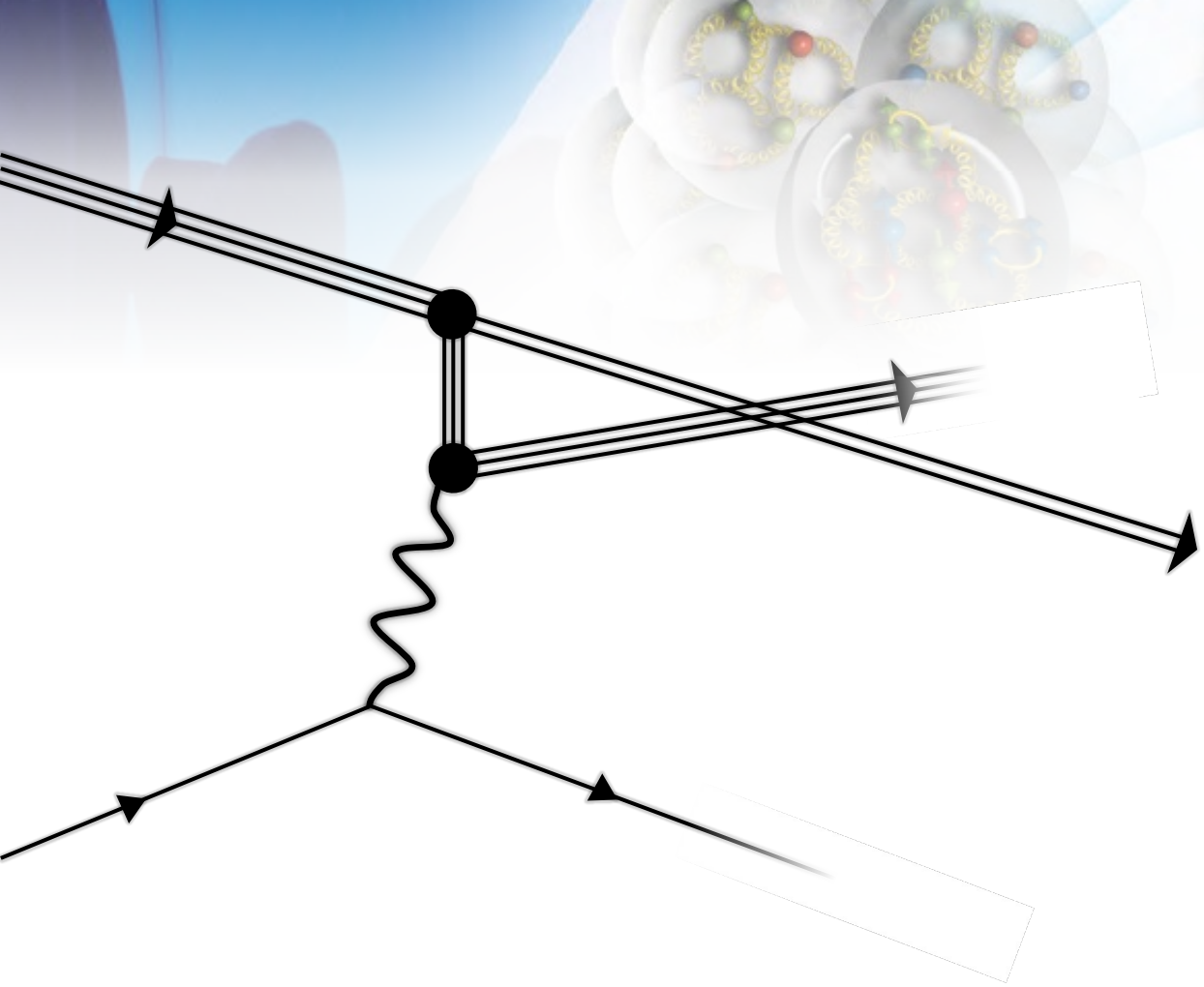


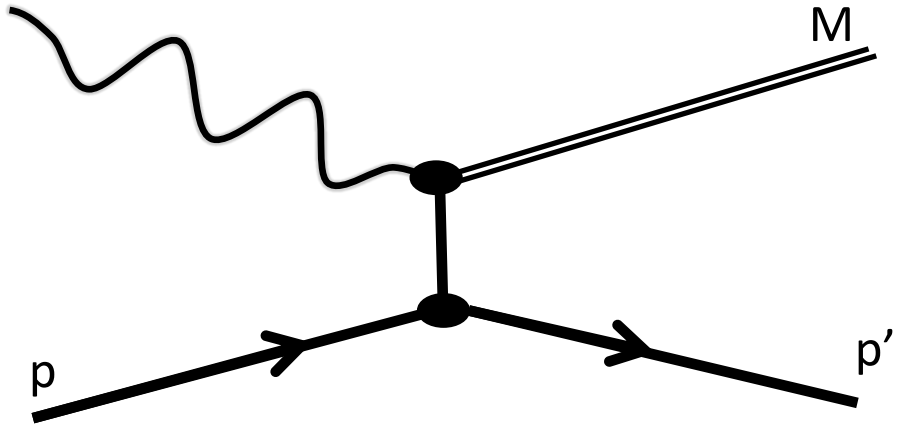
Update on *u*-channel EIC analyses

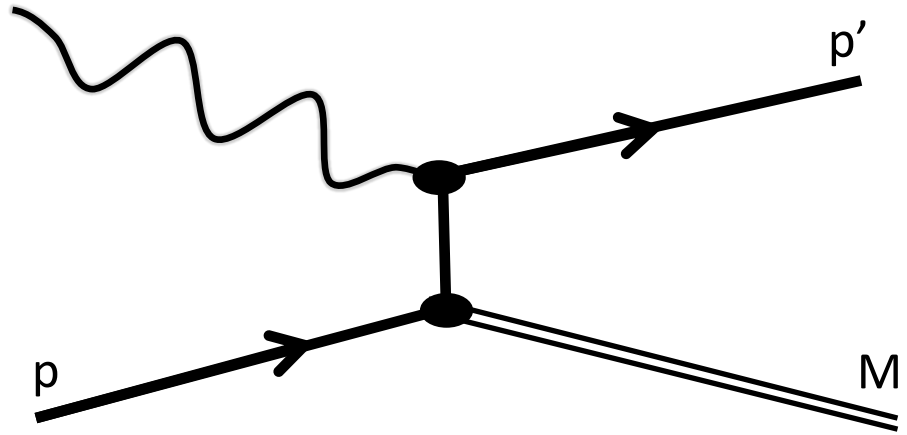
Zachary Sweger
University of California, Davis

Supported in part by

Contributions to Meson Production

t-channel **vs** **u-channel**

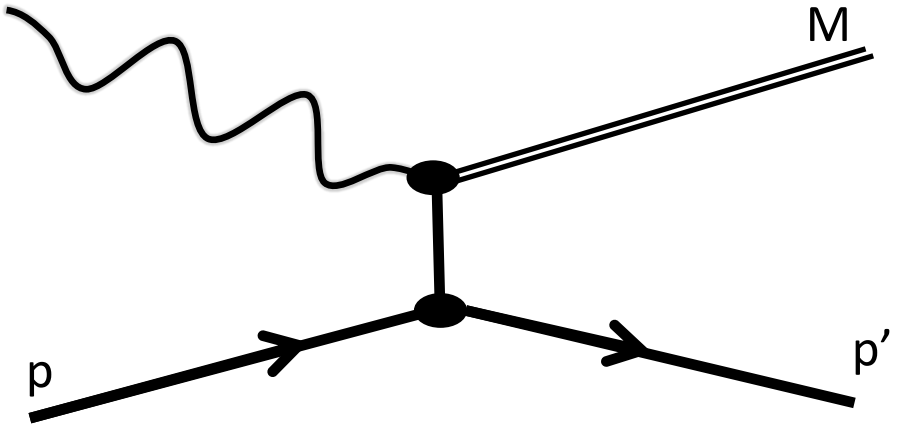


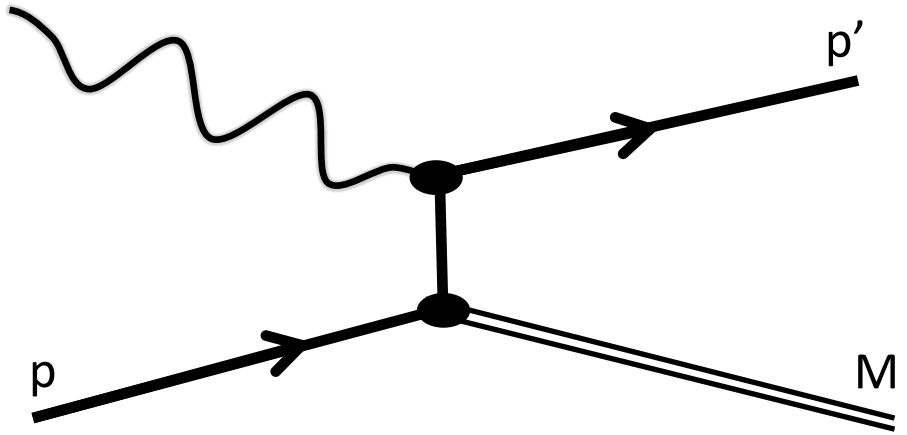


Contributions to Meson Production

t-channel **vs** **u-channel**

- proton momentum slightly modified

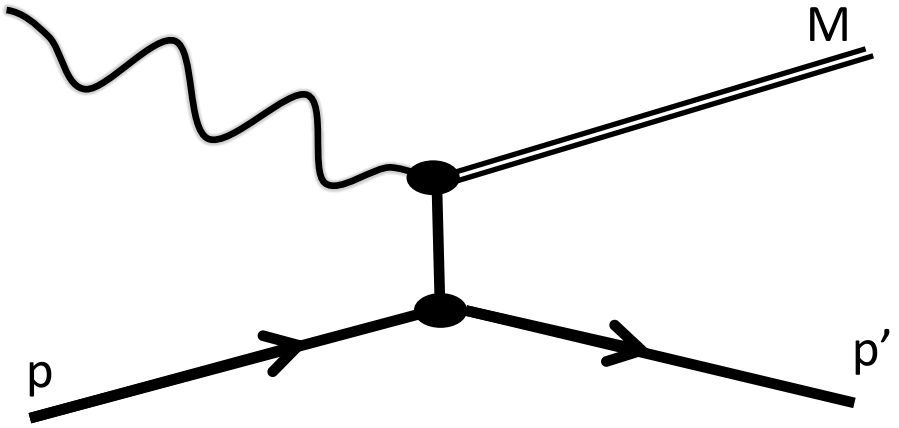


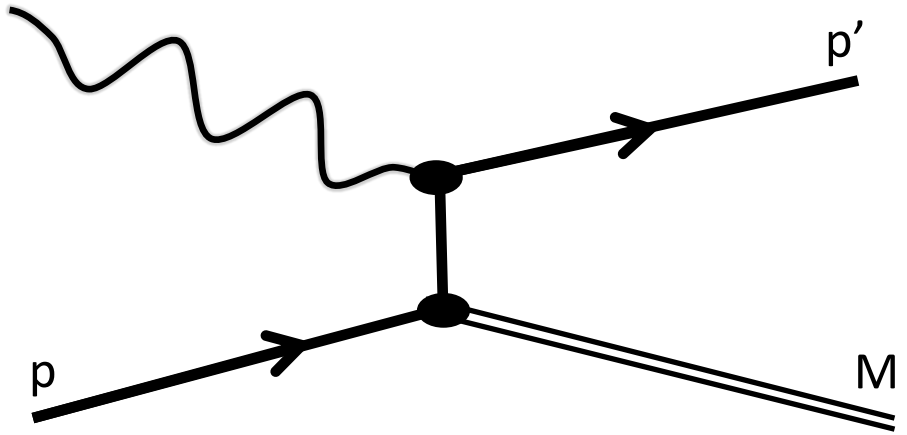


Contributions to Meson Production

t-channel **vs** **u-channel**

- proton momentum slightly modified
- meson produced near midrapidity





Contributions to Meson Production

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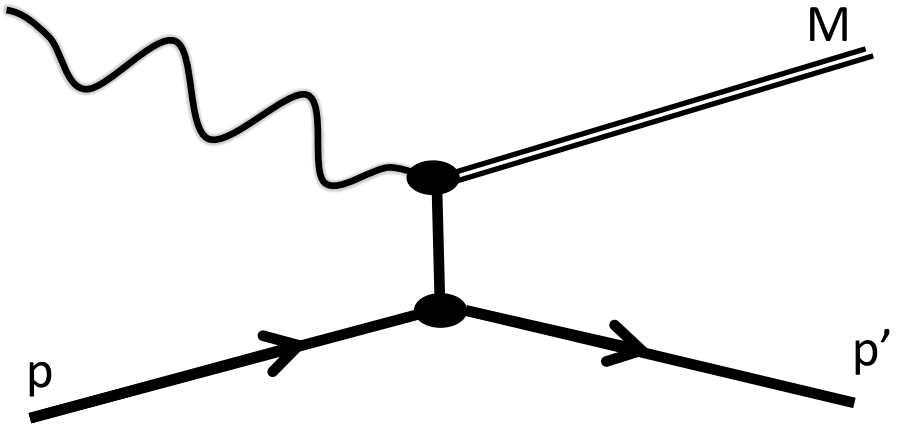
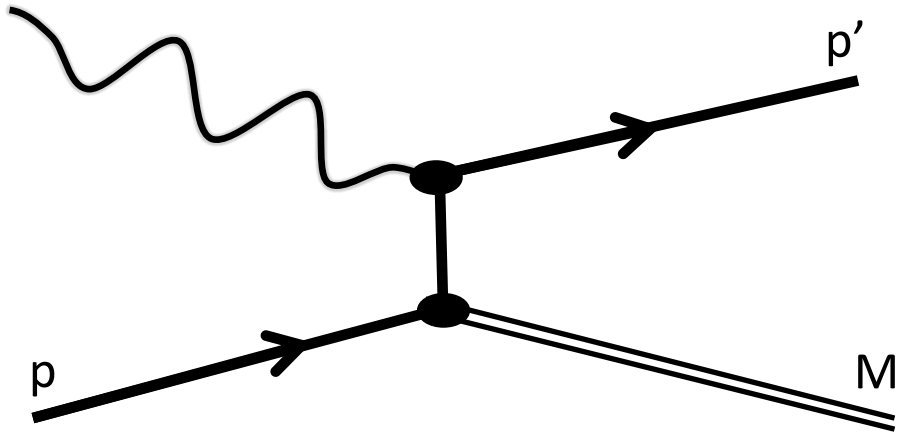
t-channel **vs** **u-channel**

- proton momentum slightly modified
- meson produced near midrapidity
- relatively large cross section





Contributions to Meson Production

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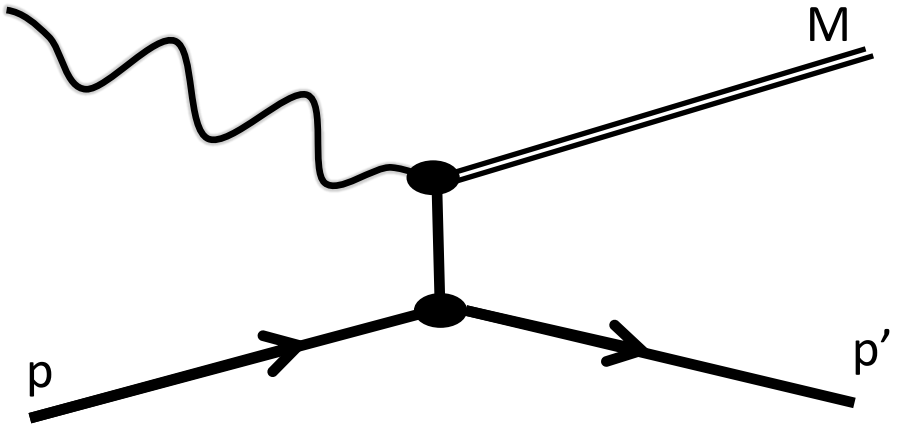
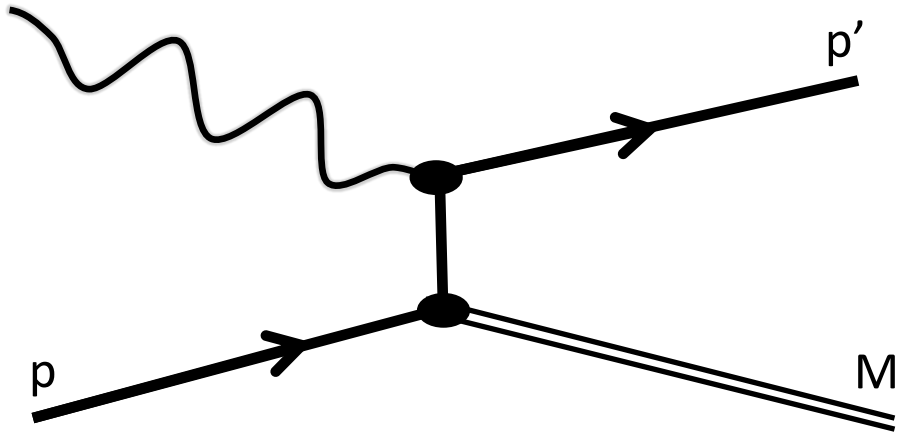
- relatively large cross section

- proton momentum largely modified





Contributions to Meson Production

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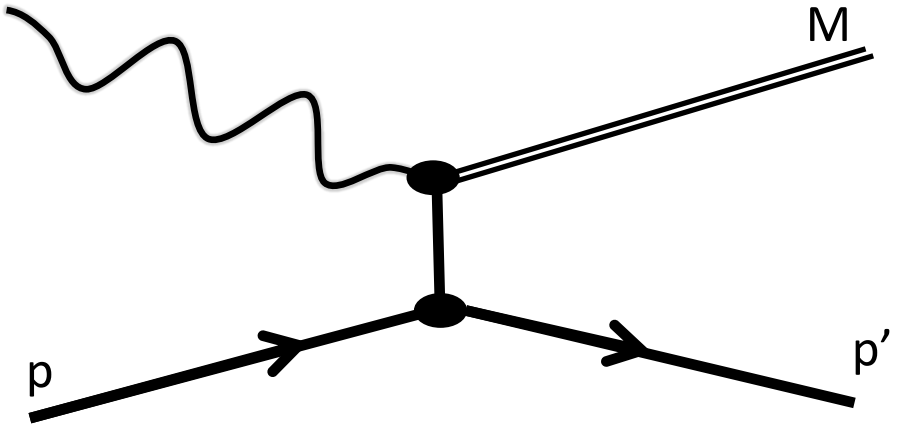
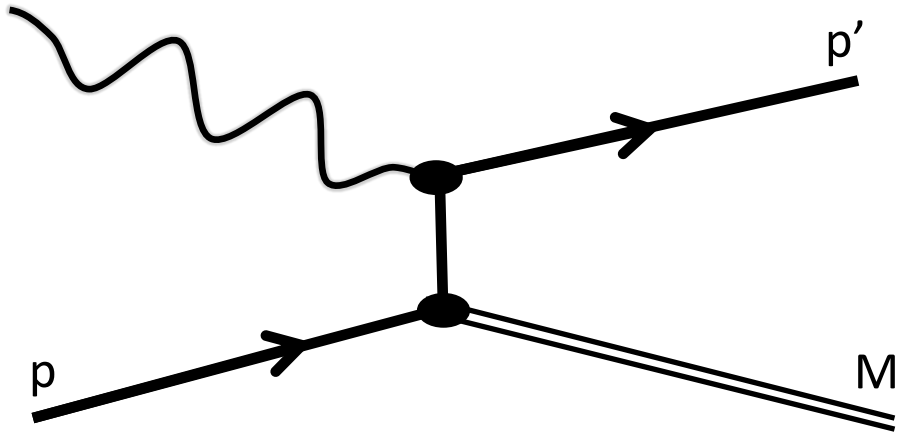


- proton momentum largely modified
- meson produced near beam proton’s momentum



Contributions to Meson Production

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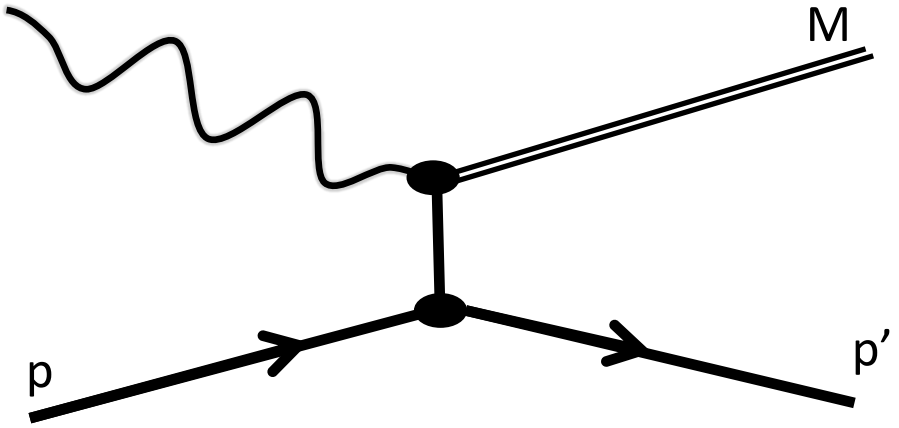
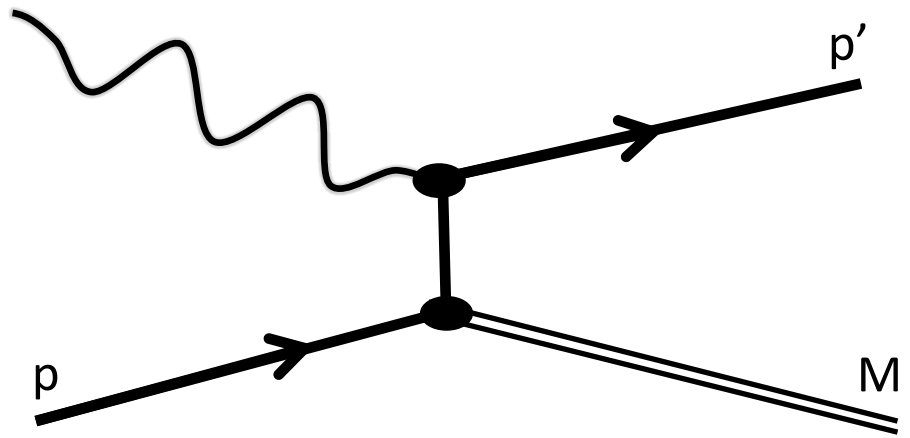
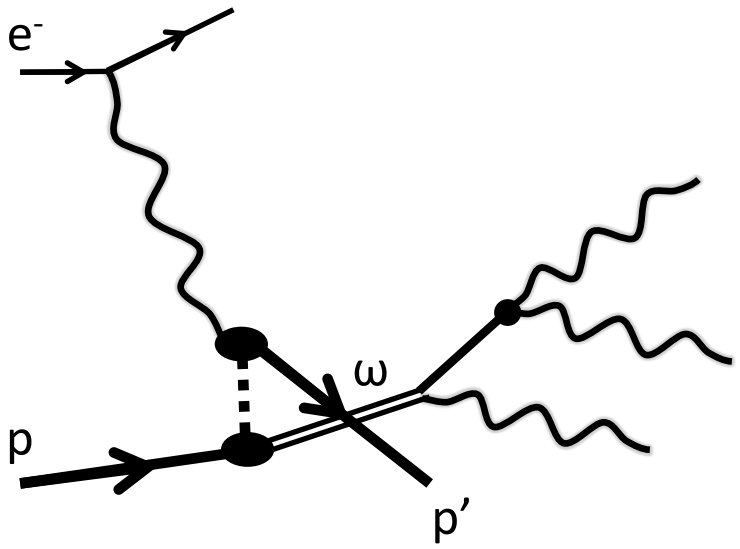


- proton momentum largely modified
- meson produced near beam proton’s momentum
- suppressed cross section (1/10-1/100 of t-channel)



u-channel Processes Requiring ZDC

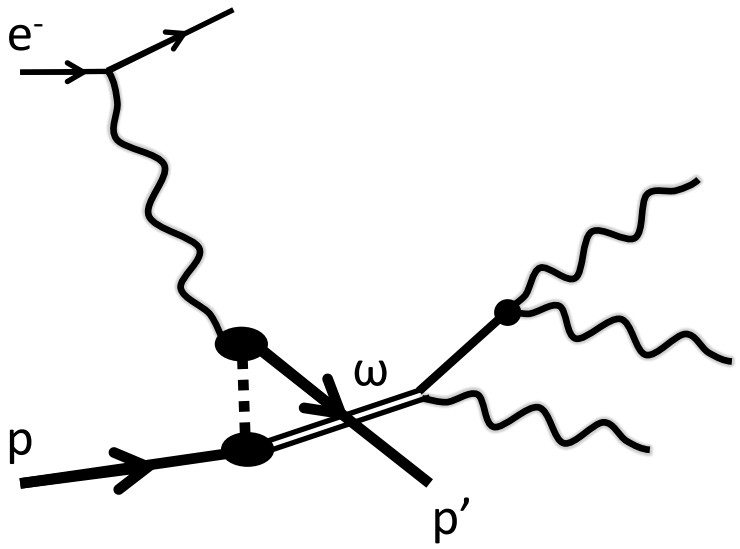
- Omega meson production: $\omega \rightarrow \gamma\gamma\gamma$ Phys. Rev. C 106, 015204 (2022)

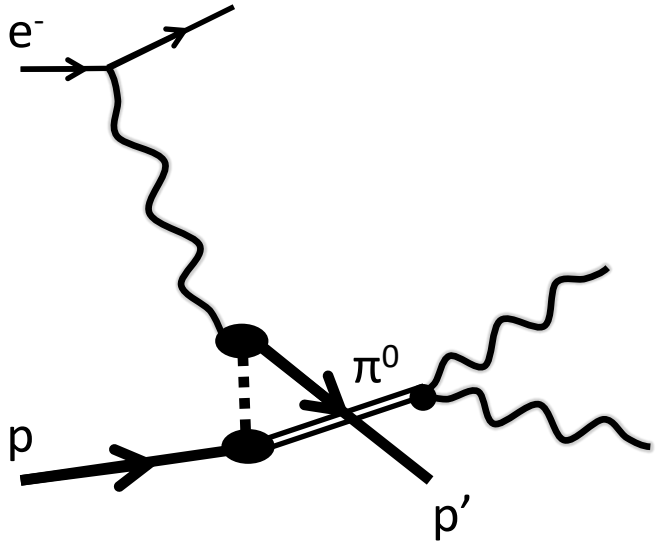


u-channel Processes Requiring ZDC

- Omega meson production: $\omega \rightarrow \gamma\gamma\gamma$
- Pion production: $\pi^0 \rightarrow \gamma\gamma$

} Phys. Rev. C 106, 015204 (2022)
} Phys. Rev. C 108, 055205 (2023)





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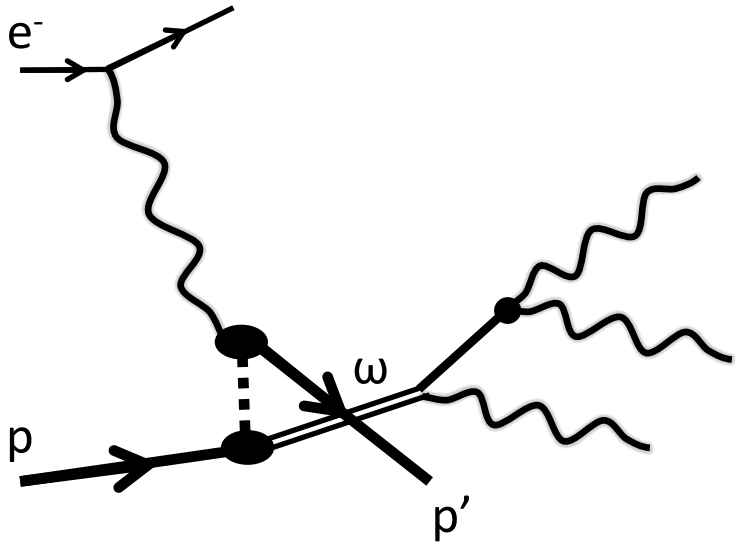
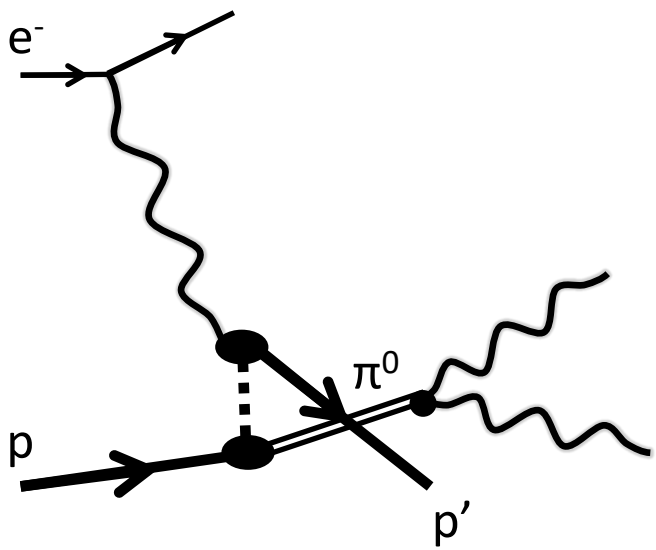
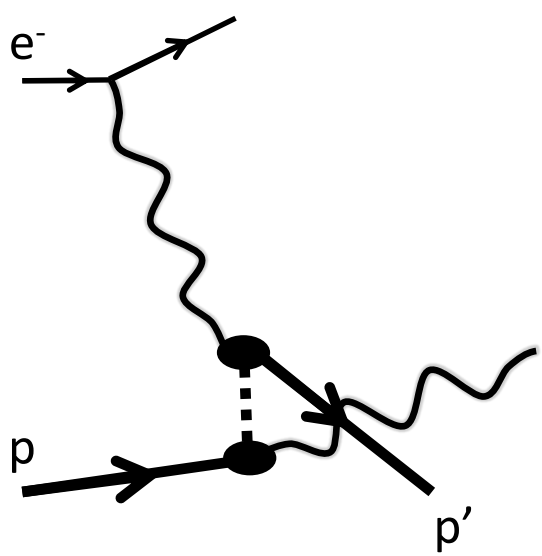
- DVCS: γ

} Phys. Rev. C 106, 015204 (2022)

} Phys. Rev. C 108, 055205 (2023)







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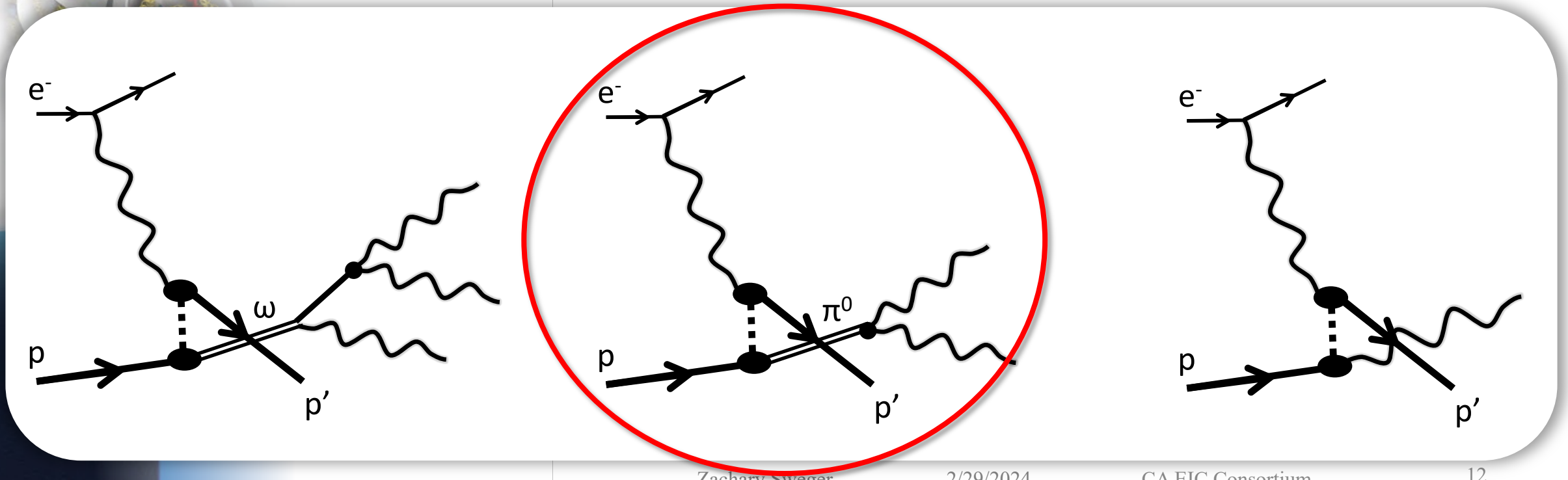
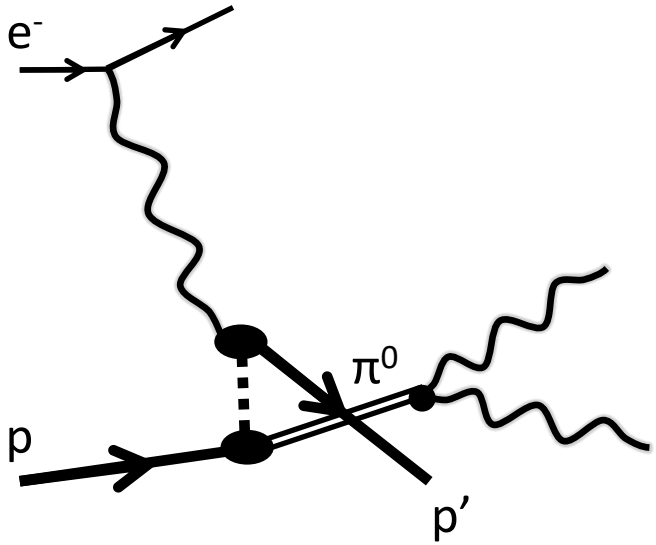
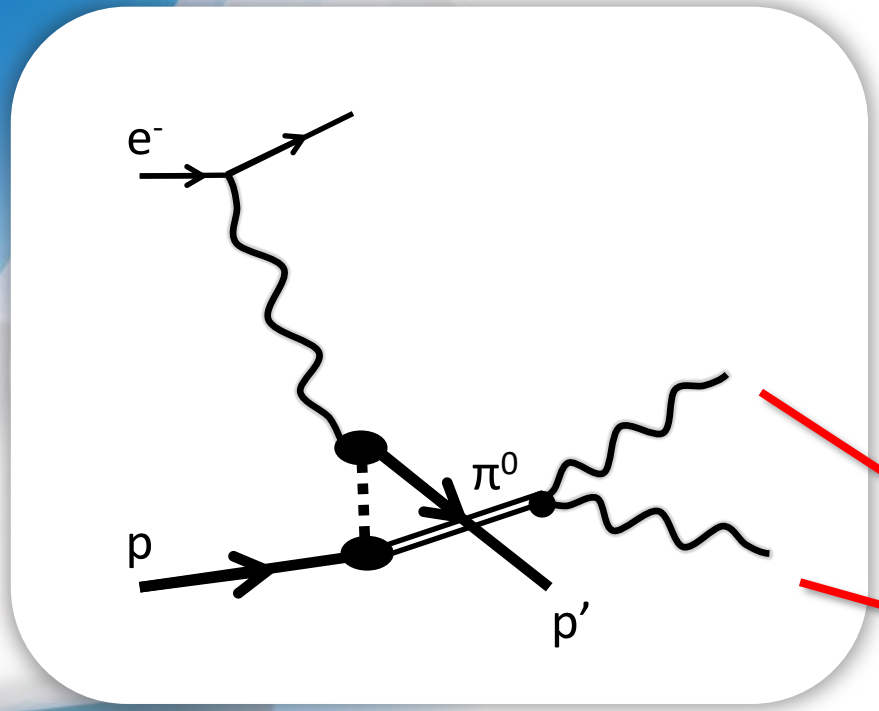


Backward π^0s in ZDC

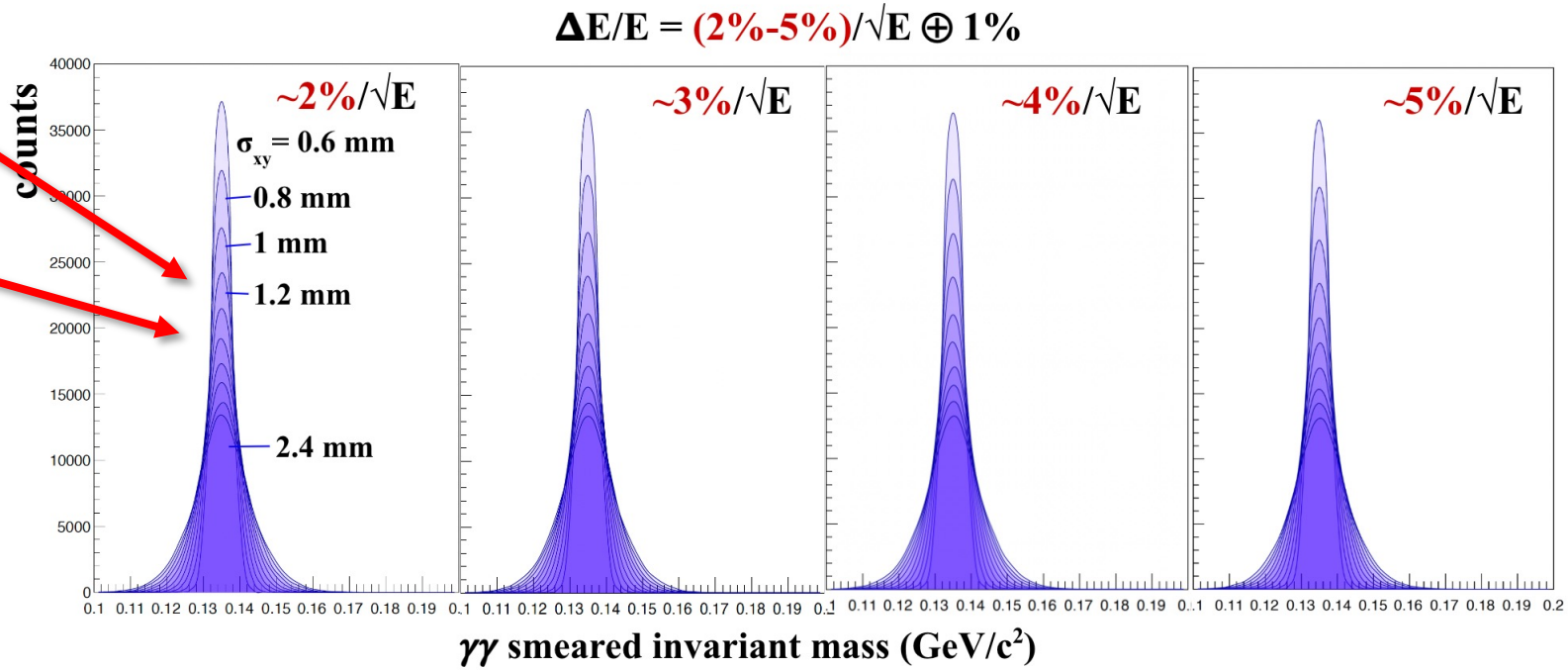


- At the last consortium meeting, I described how we developed a model of the *u*-channel cross section at EIC kinematics
- Edited eSTARlight to produce this channel
- Made event samples for the simulation campaigns
- These samples are now run in each campaign and can be found on S3:
  - eictest/EPIC/RECO/23.12.0/epic_craterlake/EXCLUSIVE/UCHANNEL_PI0/18x275
- But no clustering yet!

Backward π^0s in ZDC



- Can we use the samples for now to evaluate importance of position and energy resolution?
- We can take these two photons within ZDC acceptance and smear their kinematics



π^0 Resolution in ZDC

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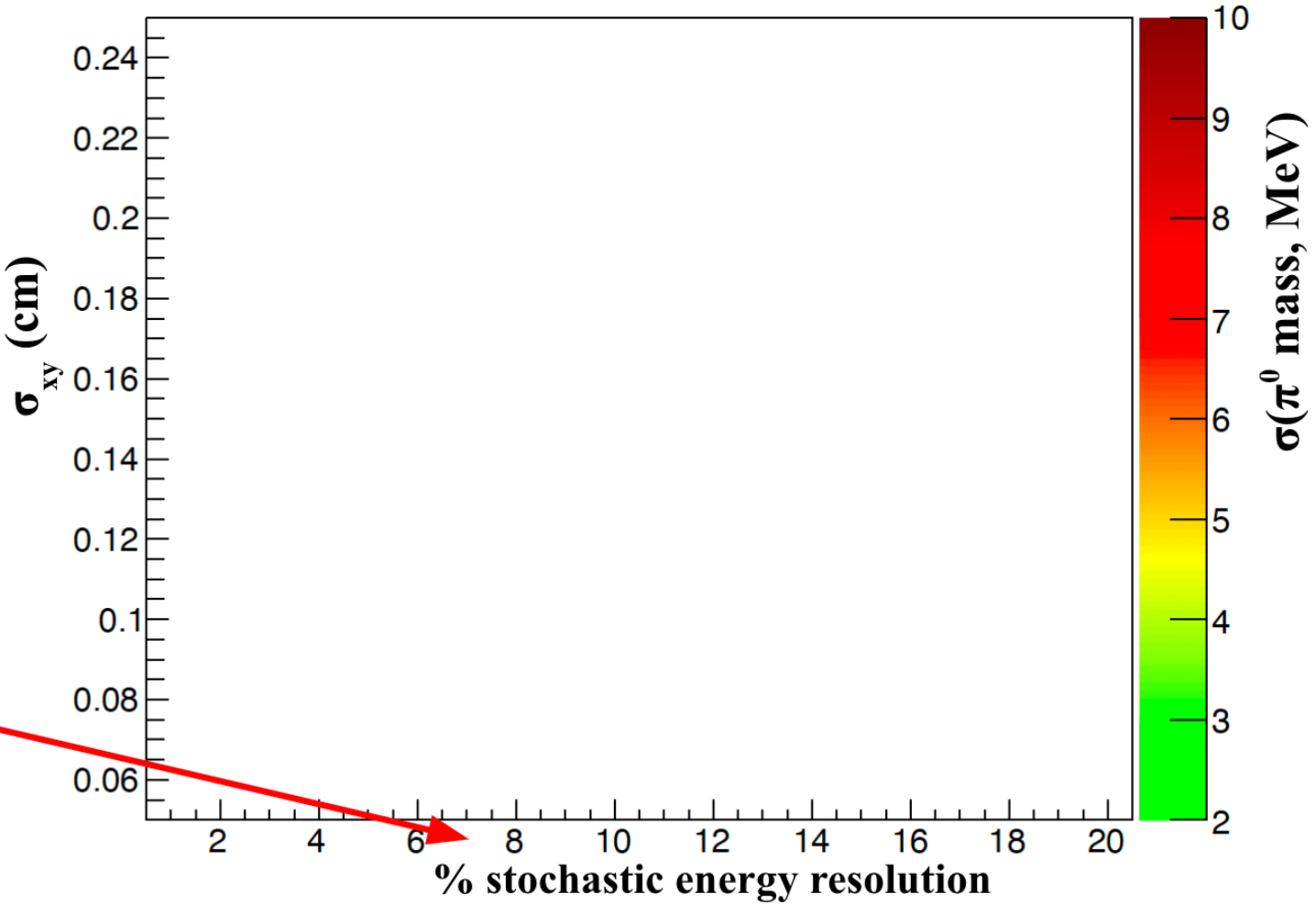
π^0 was reconstructed with various position resolutions σ_{xy}

For each position resolution, the stochastic energy resolution term was varied

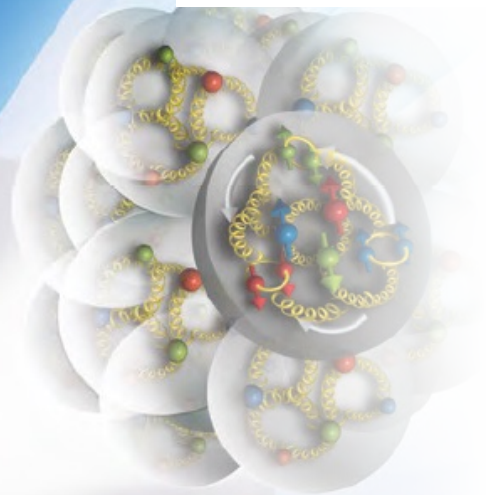
$$\Delta E/E = (1\%\text{-}20\%)/\sqrt{E} \oplus 1\%$$

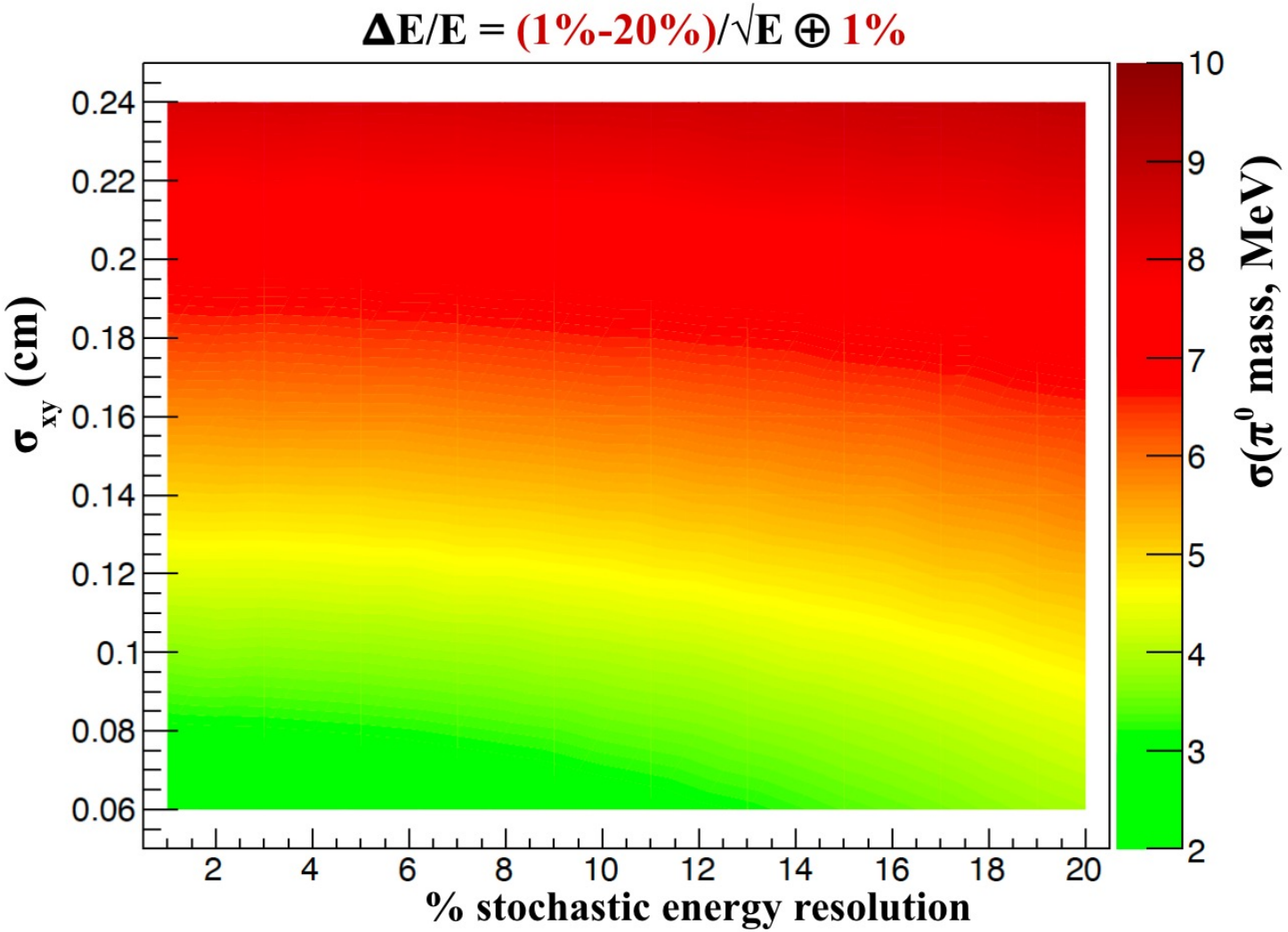
The standard deviation of the mass peak is represented on the color axis in MeV



π^0 Resolution in ZDC, ($\oplus$1%)

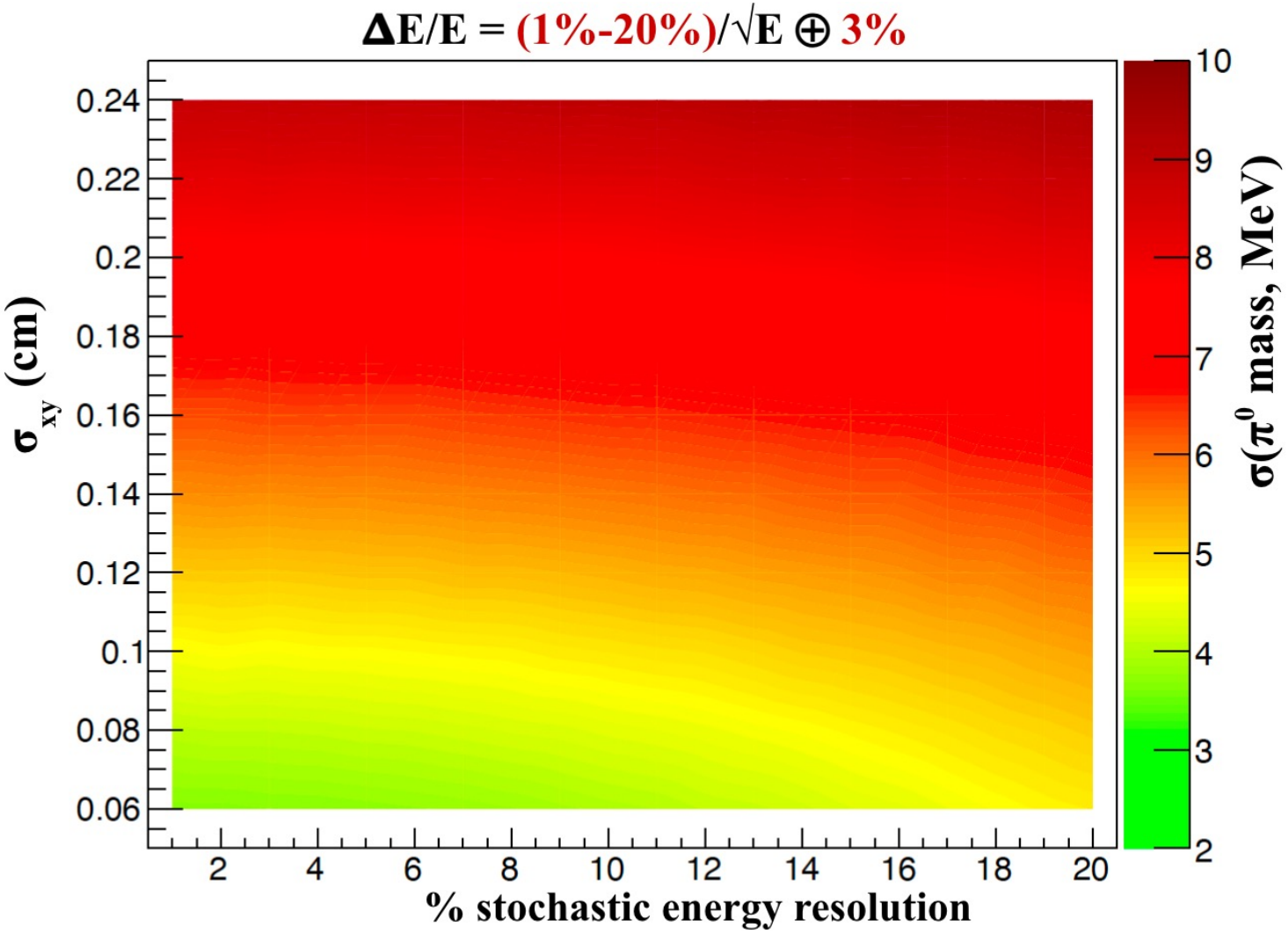
- Position resolution drives reconstruction resolution





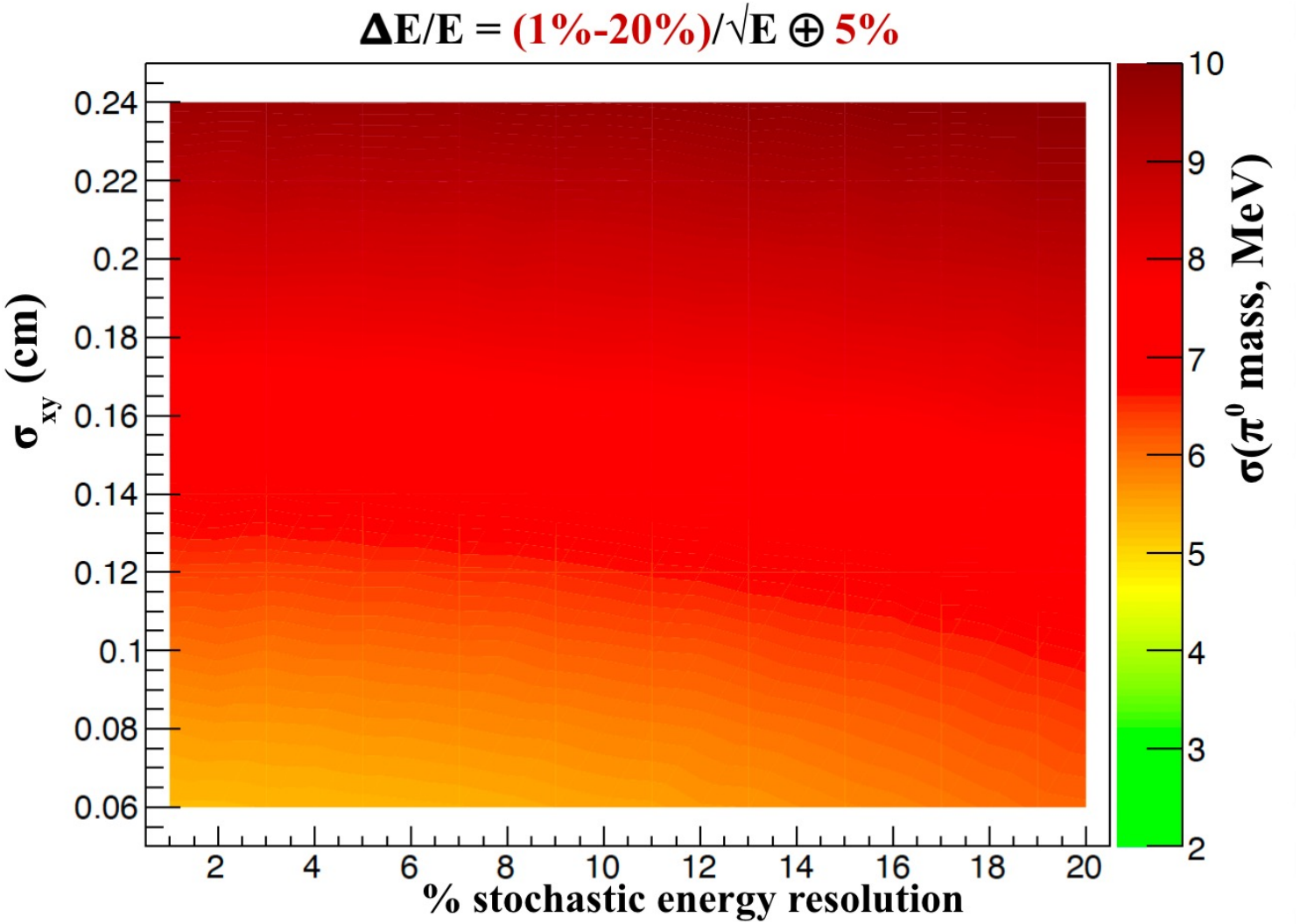
π^0 Resolution in ZDC, ($\oplus$3%)

- Position resolution drives reconstruction resolution
- Degradation of the constant term degrades resolution faster than stochastic term



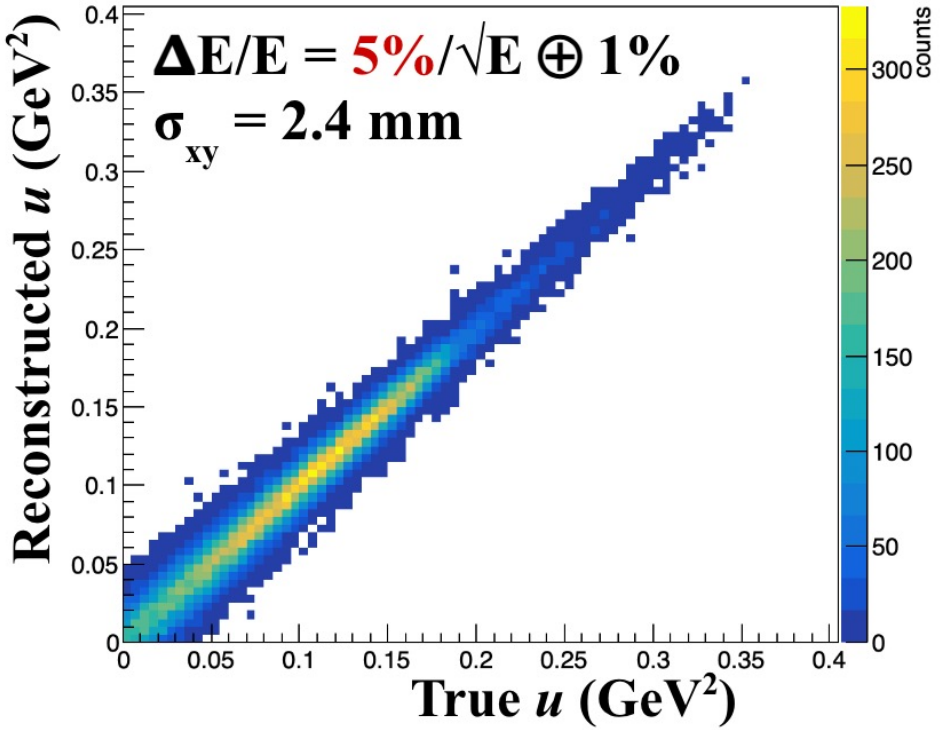
π^0 Resolution in ZDC, ($\oplus$5%)

- Position resolution drives reconstruction resolution
- Degradation of the constant term degrades resolution faster than stochastic term

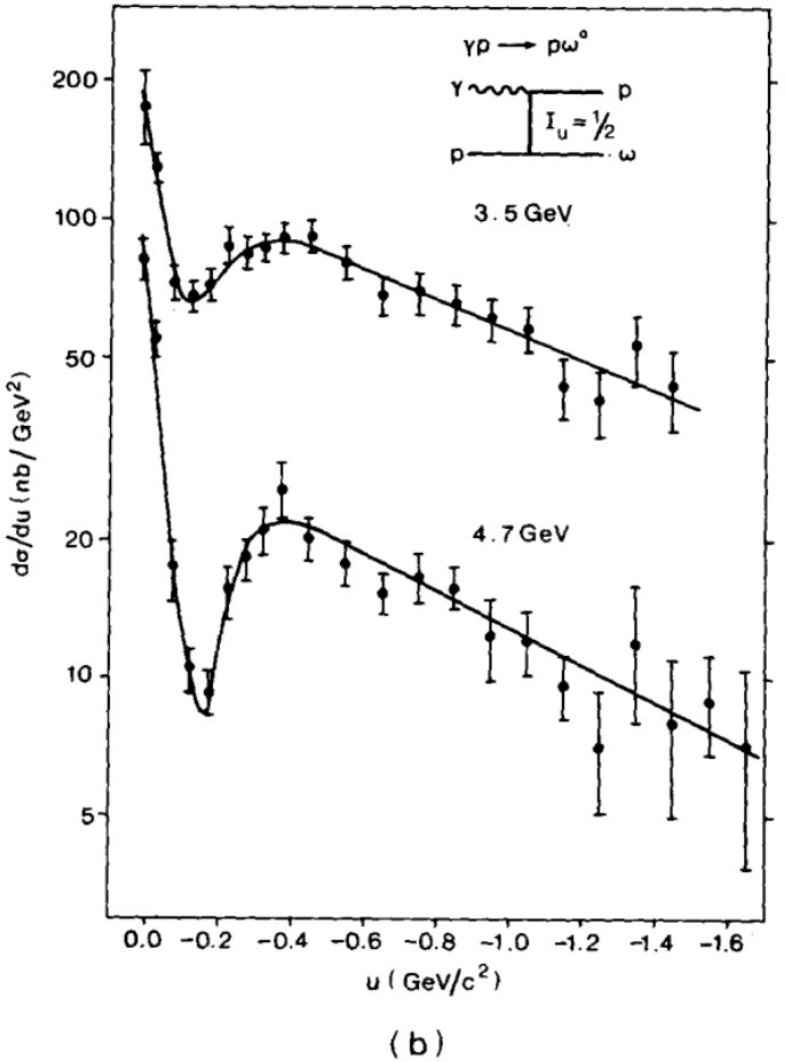


u Resolution in ZDC

- We aim to measure backward cross sections as a function of the Mandelstam $u = (p_{proton\ beam} - p_{meson})^2$
- So the ability to reliably measure the true u value will determine how useful these measurements are
- We would like $\sigma(u) < \sim 0.05\ GeV^2$

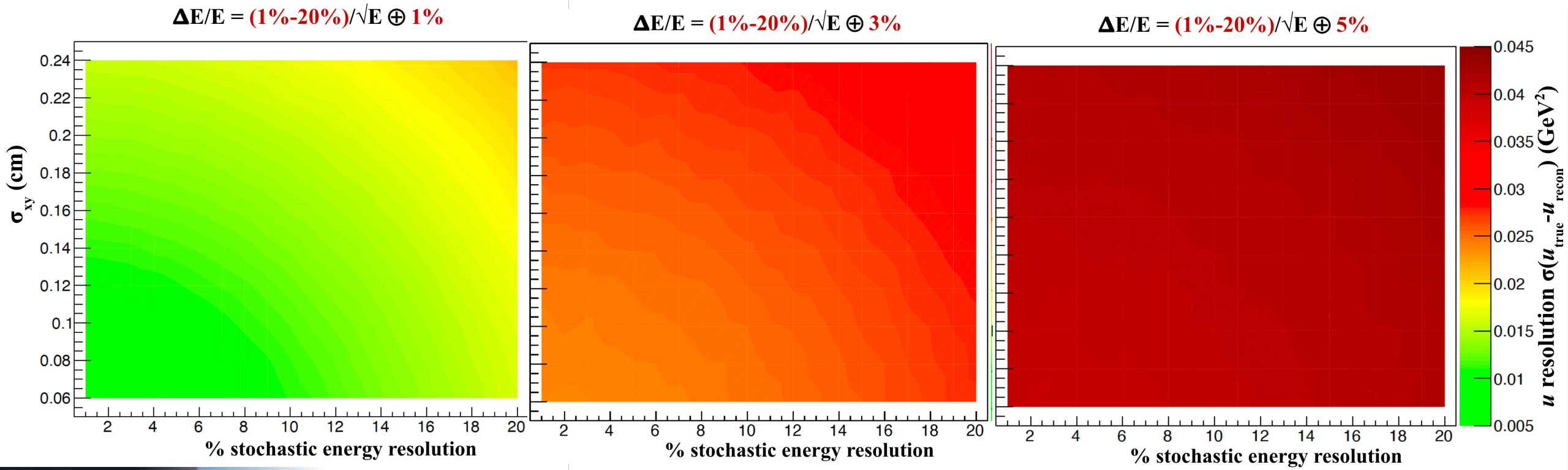


R. W. Clifft et al., Phys. Lett. B 72, 144 (1977)



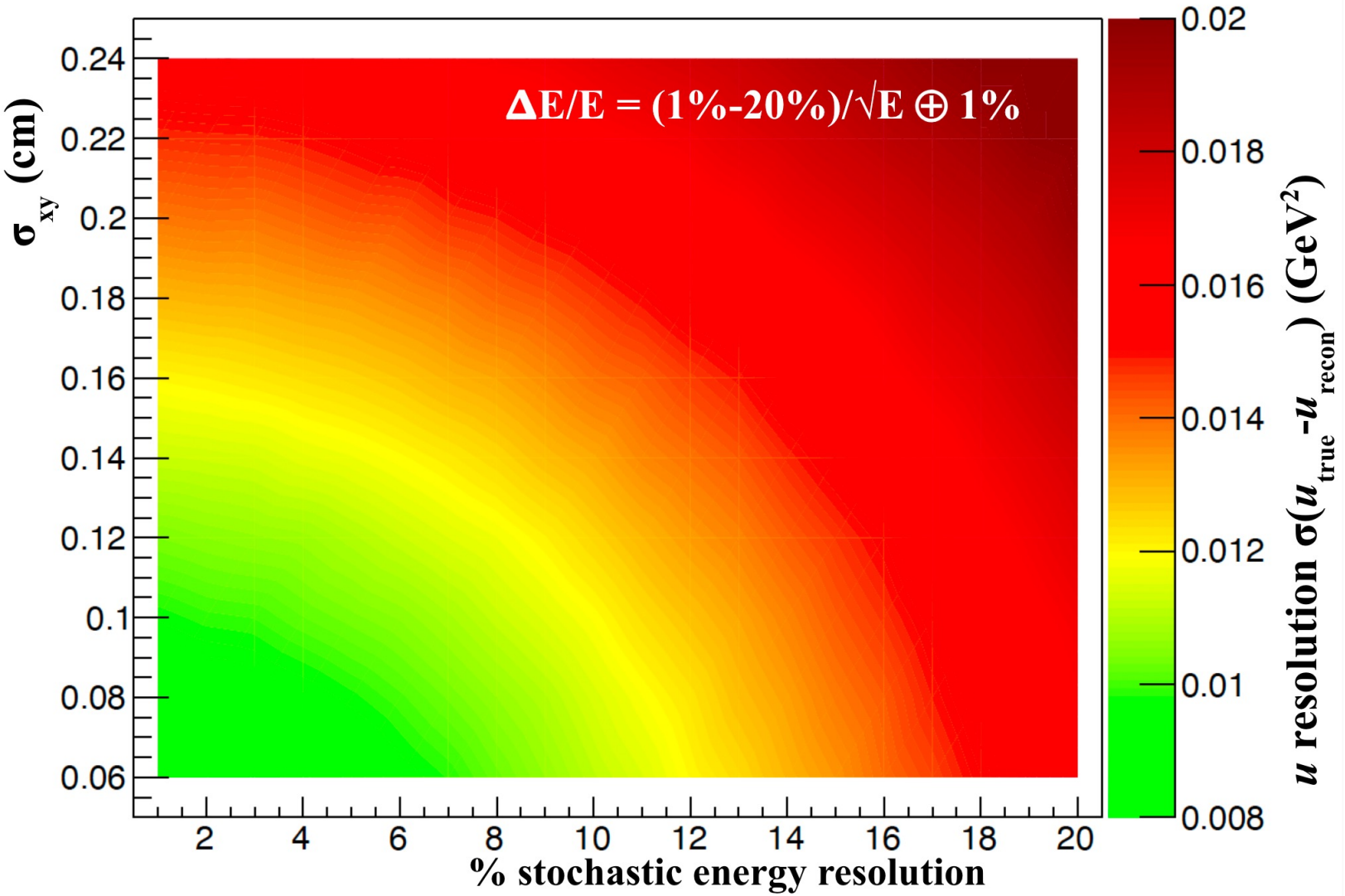
u Resolution in ZDC

- *u* reconstruction resolution degraded primarily by worsening constant efficiency term

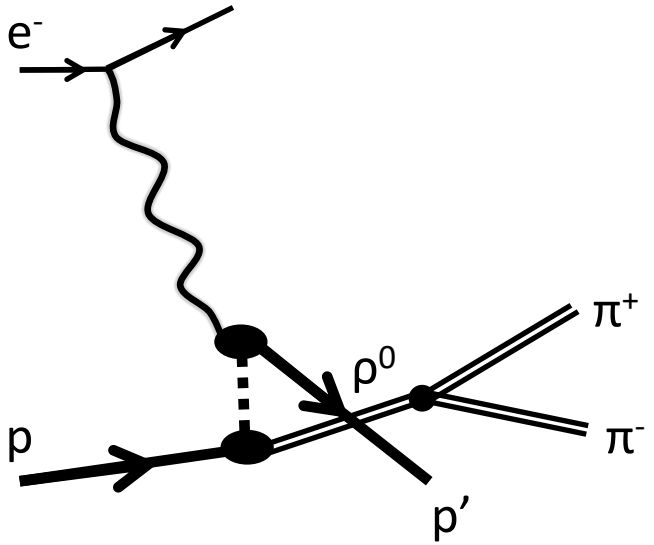


u Resolution Zoomed

- By zooming in on the resolution, we see that a drop in position resolution is easily mitigated by improvements in the stochastic energy term

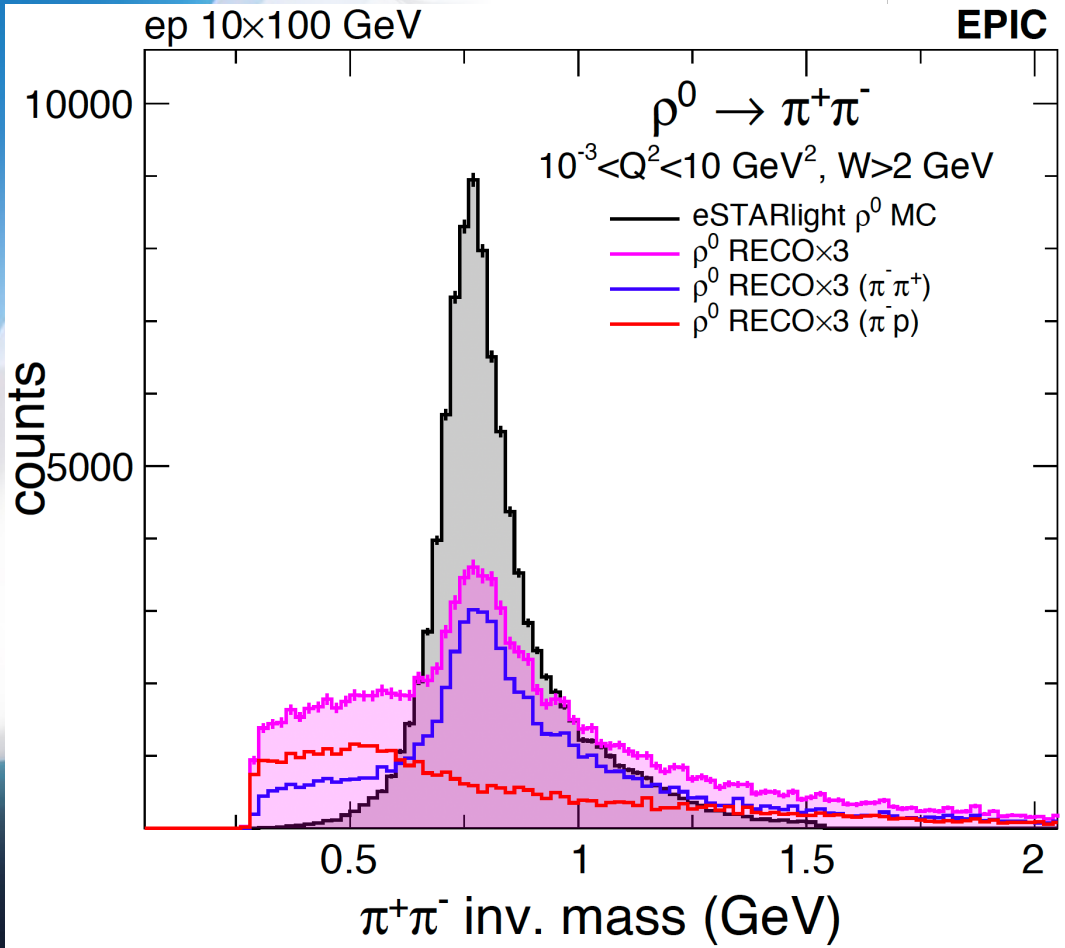


u-channel $\rho^0 \rightarrow \pi^+\pi^-$ in B0



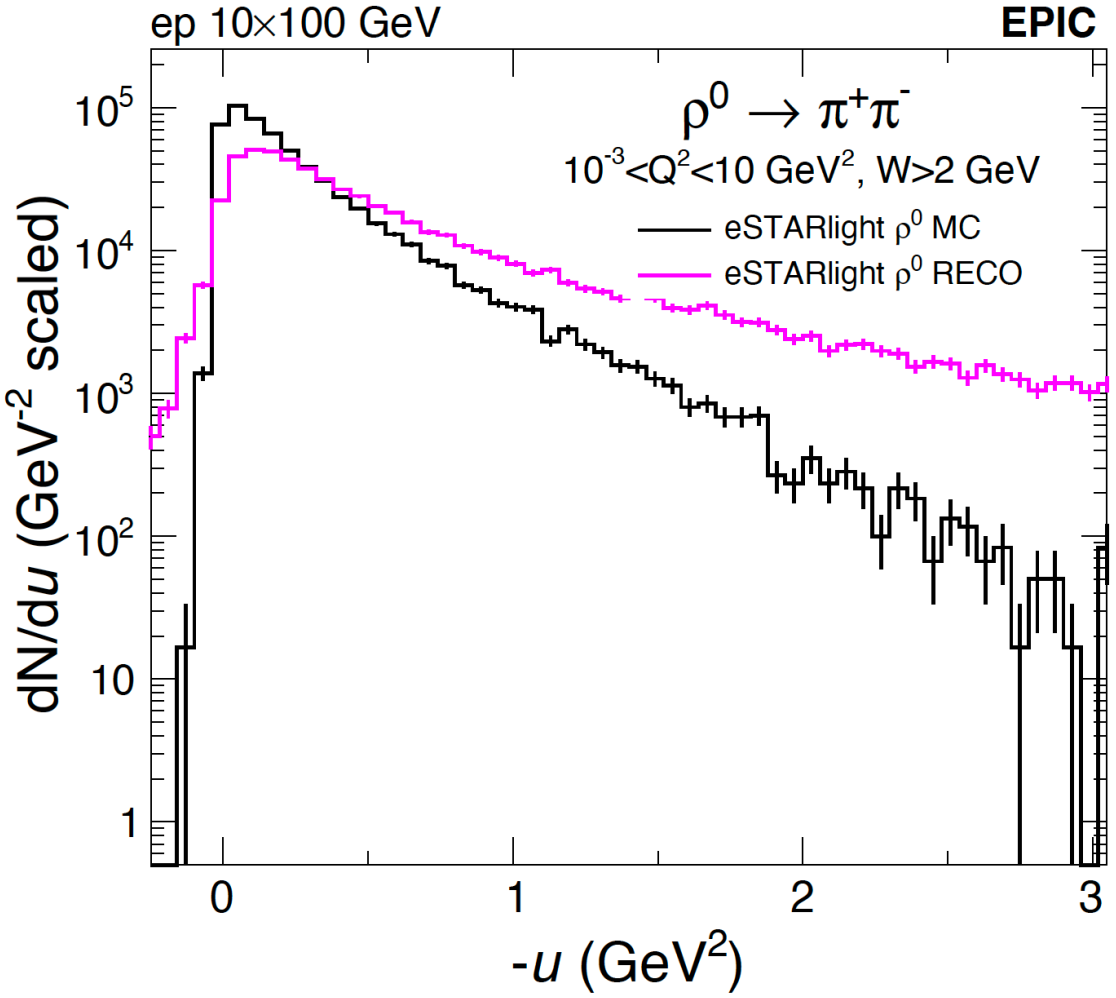
- We also developed model for backward ρ production
- Edited eSTARlight to produce this channel
- Made event samples for the simulation campaigns
- These samples are now run in each campaign and can be found on S3:
  - eictest/EPIC/RECO/23.12.0/epic_craterlake/EXCLUSIVE/UCHANNEL_RHO/10x100
- These charged pions land in the B0 and we do have B0 tracking!

u-channel $\rho^0 \rightarrow \pi^+\pi^-$ in B0



- We can use ρ reconstruction resolution to benchmark B0 performance
- I am working on this benchmark for the TDR (either official TDR for B0 performance or supplemental physics report published alongside TDR)
- Much to do still
  - evaluate exclusivity cuts
  - check efficiency, both π in acceptance
  - quantify beam pipe effects

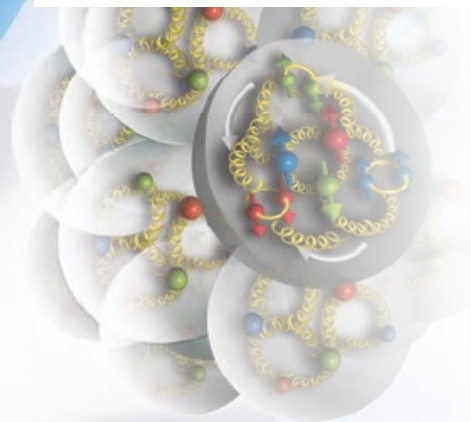
u-channel $\rho^0 \rightarrow \pi^+\pi^-$ in B0

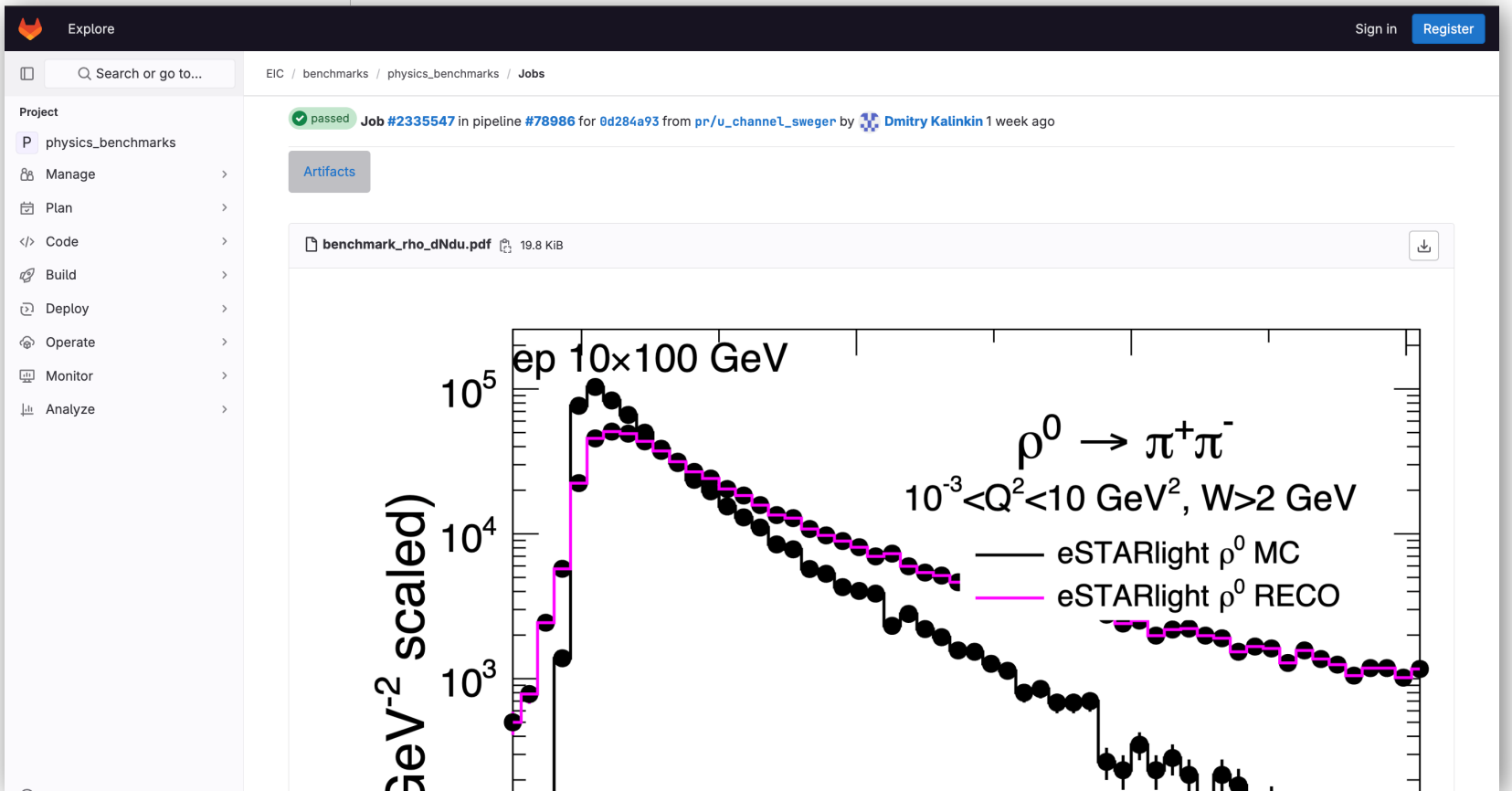


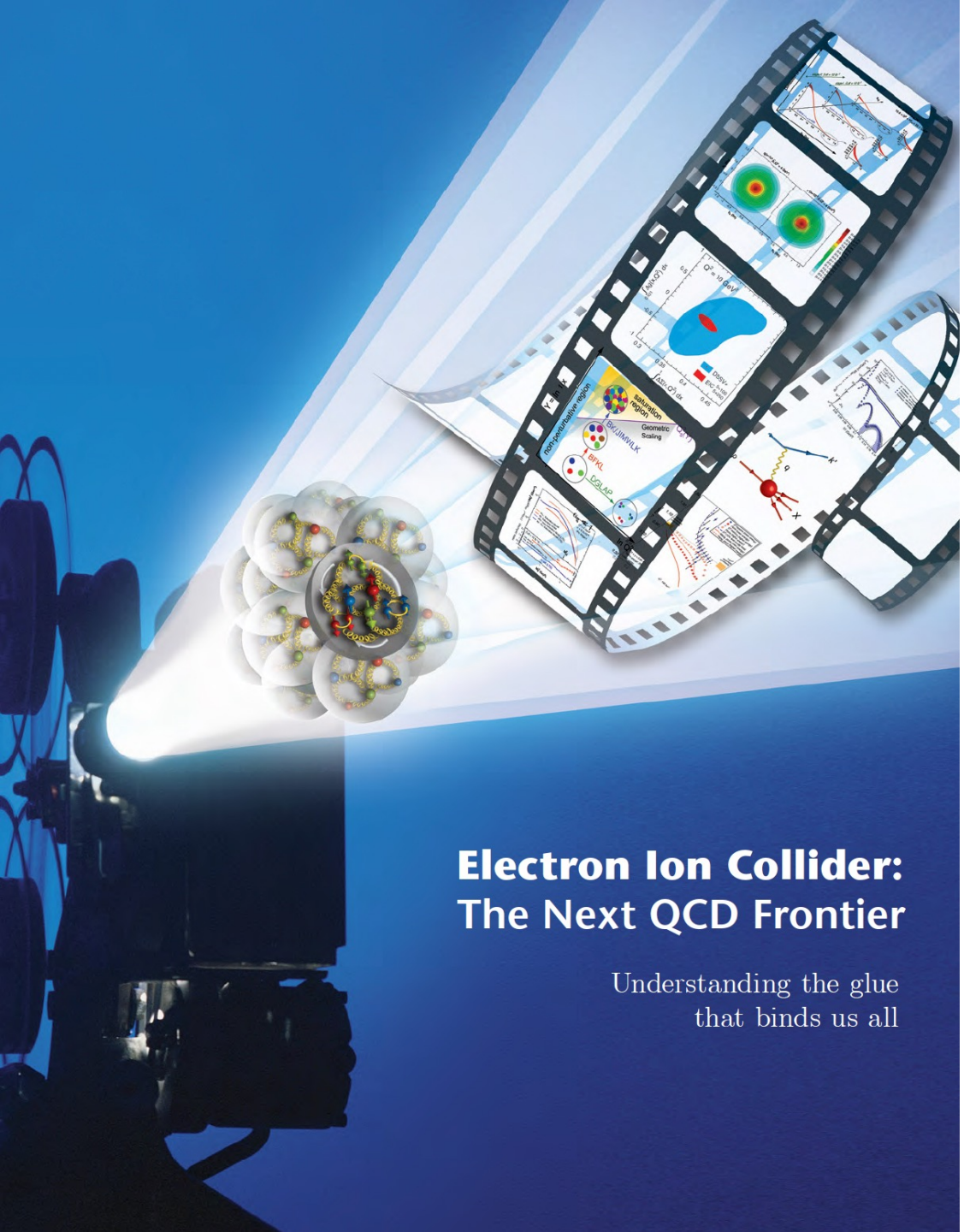
- Mandelstam u reco. in B0 will be another benchmark plot
- Much to do again:
  - u vs u_{reco} evaluation
  - evaluate exclusivity cuts
  - contamination/background study

u-channel $\rho^0 \rightarrow \pi^+\pi^-$ in B0

- Following EPIC workfest, I've been incorporating ρ benchmark into official framework
- We want these benchmarks to pull recent detector simulations, re-run tracking/reco when algorithms updated, update plots with each push to GitHub
- These benchmarks are maturing, run in GitLab CI framework, but not done yet







Conclusions

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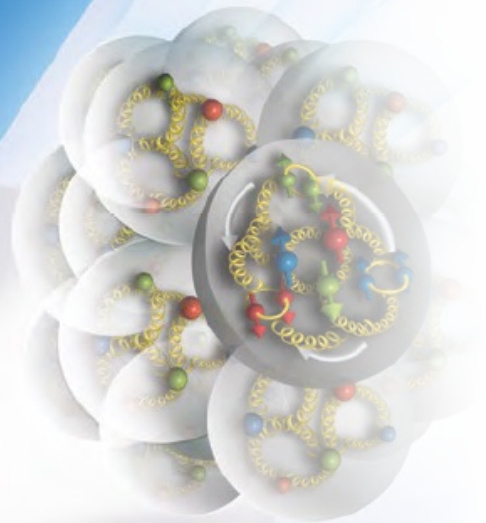
- *u*-channel production involves large momentum transfers and may have implications for baryon stopping and nuclear tomography
- We've simulated various channels: ρ, ω, γ, π^0
- These channels can inform requirements for far-forward detectors like B0 and ZDC
- These are in Exclusive/Diffractive/Tagging group's list of channels for TDR plots by June
- I need to
  - Finalize ρ benchmark plots and integration
  - Use upcoming simulation campaign with clustering to develop π^0 benchmark in ZDC
- I'd like to
  - develop ω and DVCS benchmark plots to round-out a u-channel subsection for supplemental TDR physics publication



Thank you for your attention!

zwsweger@ucdavis.edu