Status of RG-E inclusive analysis

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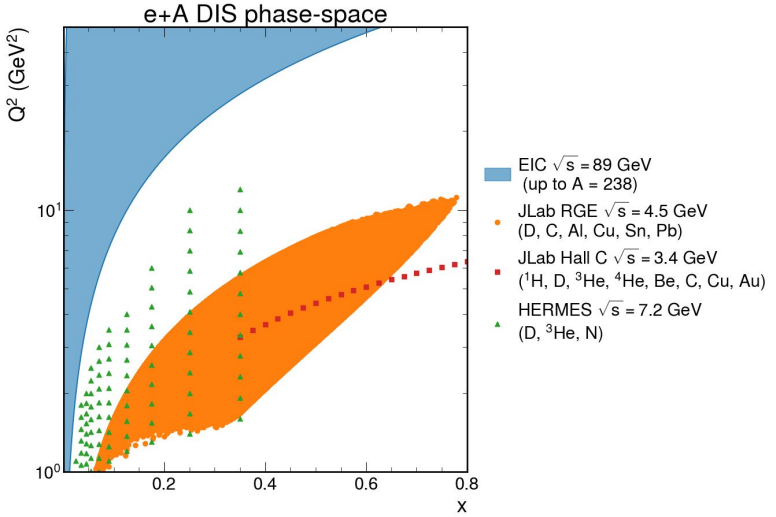
CLAS Collaboration Meeting
July 10th, 2025

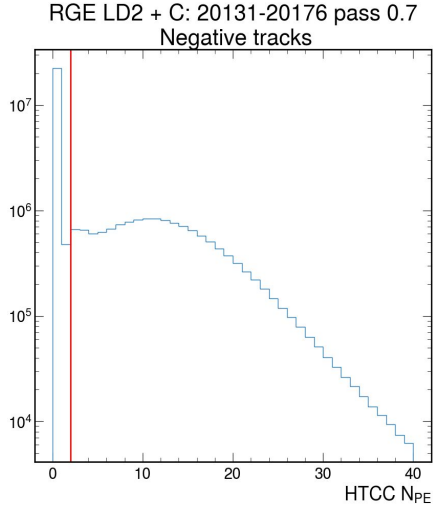
Overview of analysis

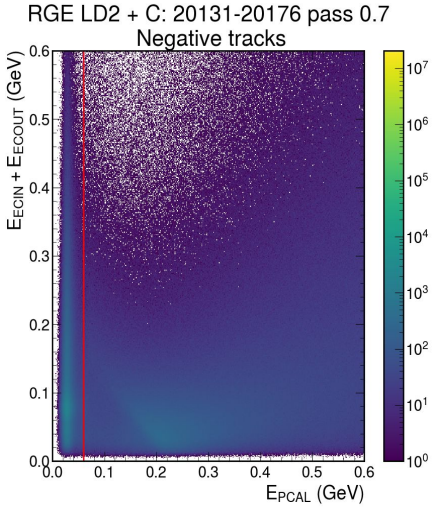
- Goal: $d\sigma/dxdQ^2$ for different nuclei with improved electron selection with RGE
- LD2 + C data from runs 20131-20176 pass 0.7
- Represents about 1% of the inbending LD2 + C data (25.8 mil./2.7 bil. events)



Event builder electrons

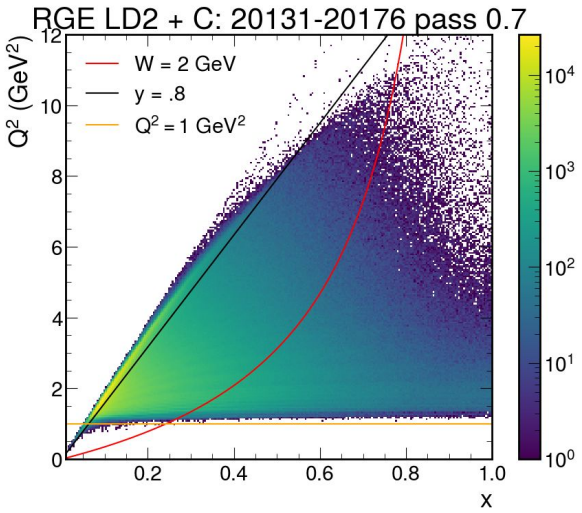
- Start with particles labelled as electrons by Event Builder
  - >2 photoelectrons in HTCC
  - >60 MeV in PCAL
  - Negative track
  - ±5σ cut on sampling fraction vs E_{dep}



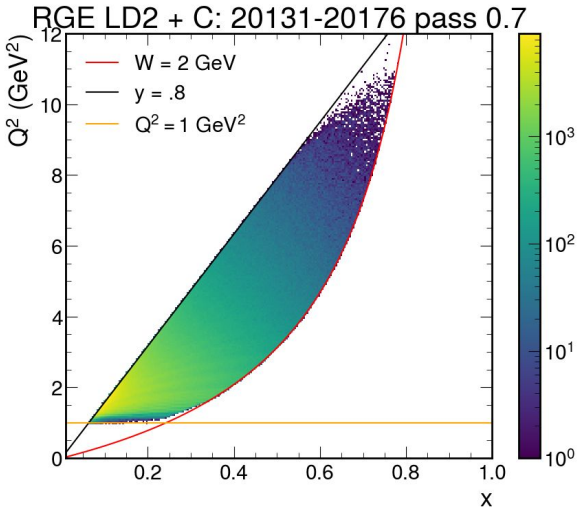


Additional cuts

- Status cut to ensure electron is in forward detector:
  - -4000 < status ≤ -2000
- DIS cuts:
  - $Q^2 > 1$ GeV^2
  - W > 2 GeV
  - y < 0.8
- Extra cuts:
  - θ > 5°
  - 2 GeV < p < 8 GeV
- Cuts follow procedures from RGA and RGM analysis notes



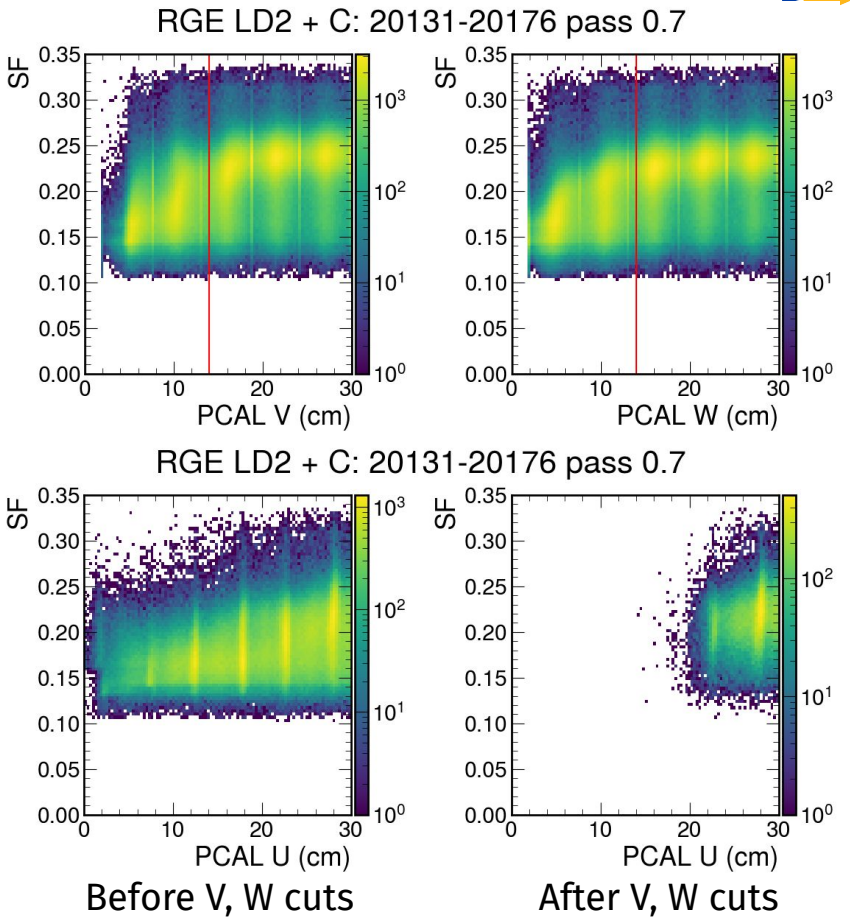
Before DIS and extra cuts



After DIS and extra cuts

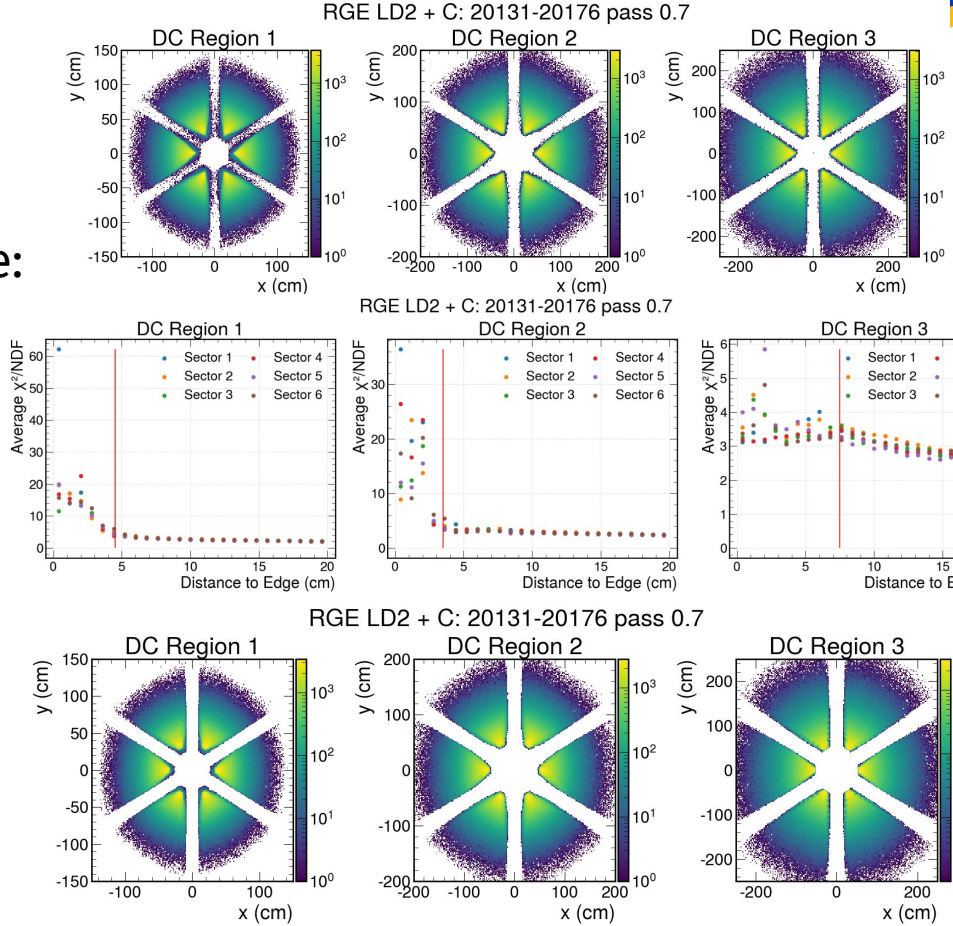
PCAL fiducial cuts

- Decrease in sampling fraction near the edges of the PCAL
- Remove edge effects by cutting out non-constant electron SF area:
  - PCAL V > 14 cm, PCAL W > 14 cm



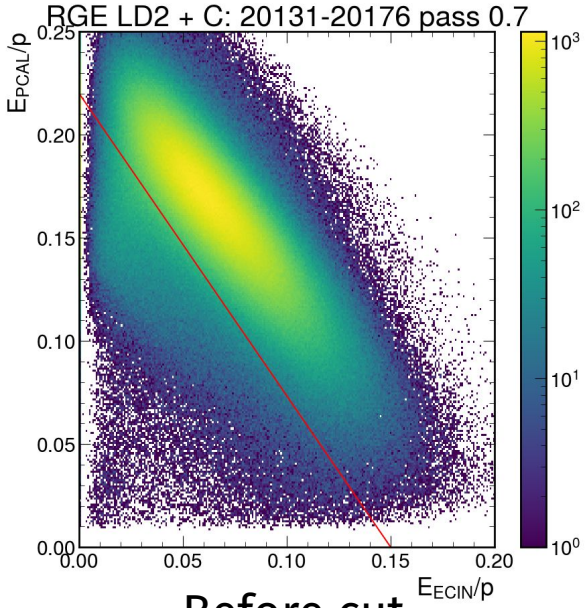
DC fiducial cuts

- Remove tracks with high χ^2/NDF
- Cut on track distance to DC edge:
  - Region 1: Distance > 4.5 cm
  - Region 2: Distance > 3.5 cm
  - Region 3: Distance > 7.5 cm

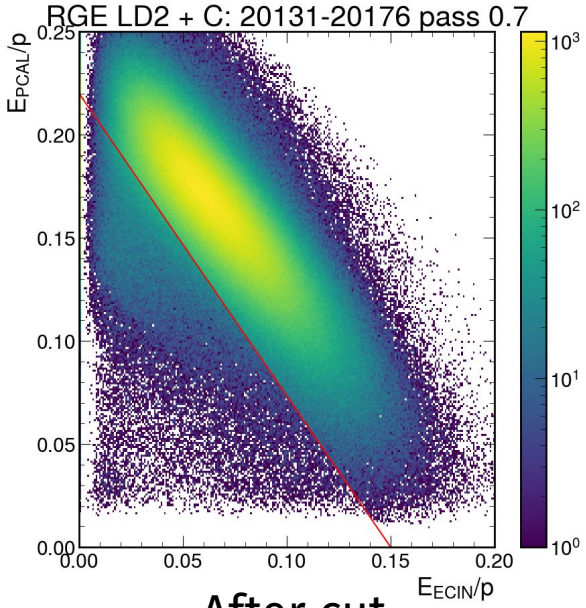


Partial sampling fraction cut

- Remove high energy pions by removing >4.5 GeV particles below linear region



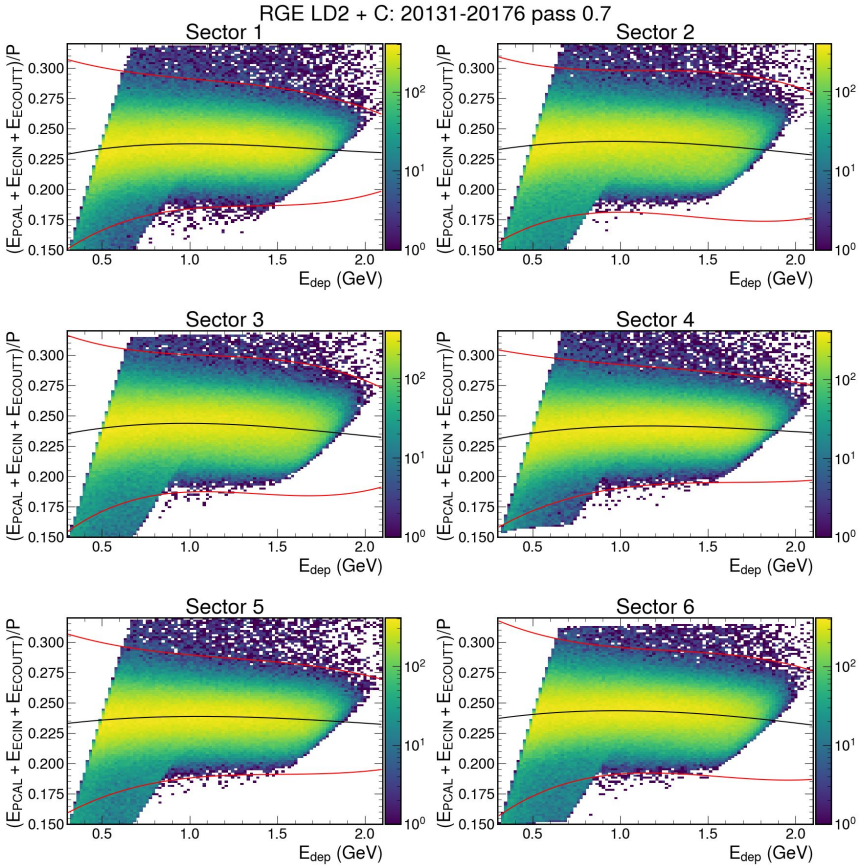
Before cut



After cut

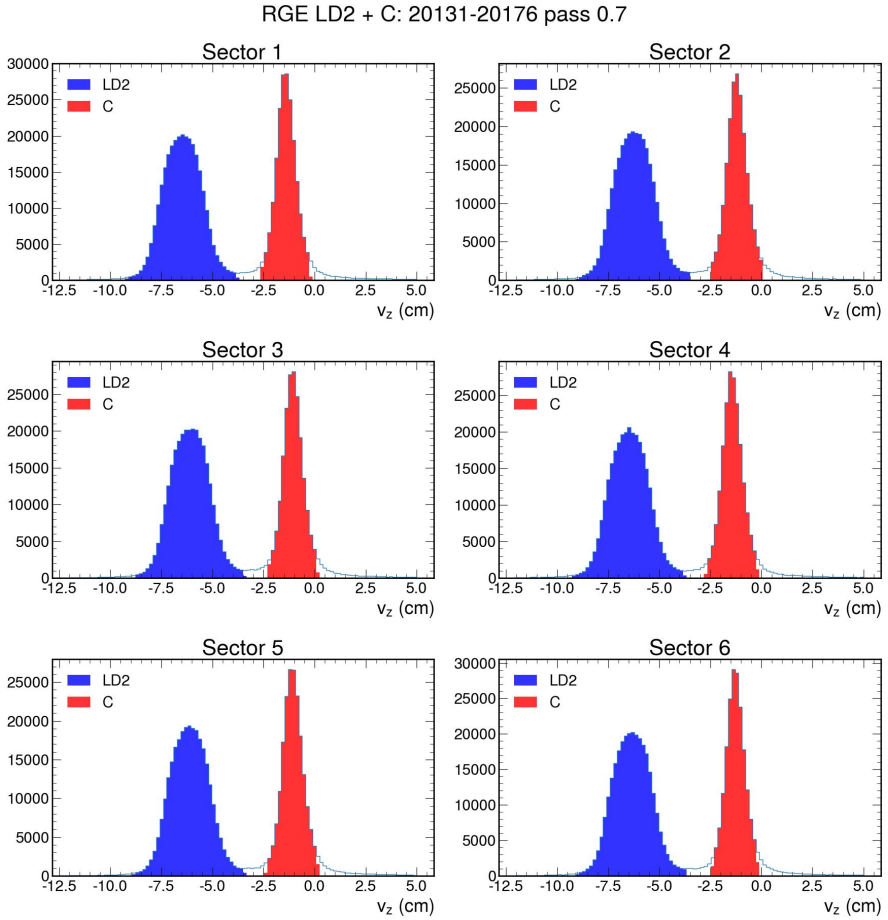
SF vs. E_{dep} cut

- Tighten sampling fraction vs. E_{dep} to $\mu \pm 3.5\sigma$
- Fit sampling fraction distribution in every E_{dep} bin with a Gaussian
- Fit Gaussian mean and standard deviations with a trinomial



Target selection

- Fit z vertex distribution with sum of two Gaussians
- LD2: $\mu_{LD2} \pm 3\sigma_{LD2}$
- C: $\mu_{C} \pm 5\sigma_{C}$



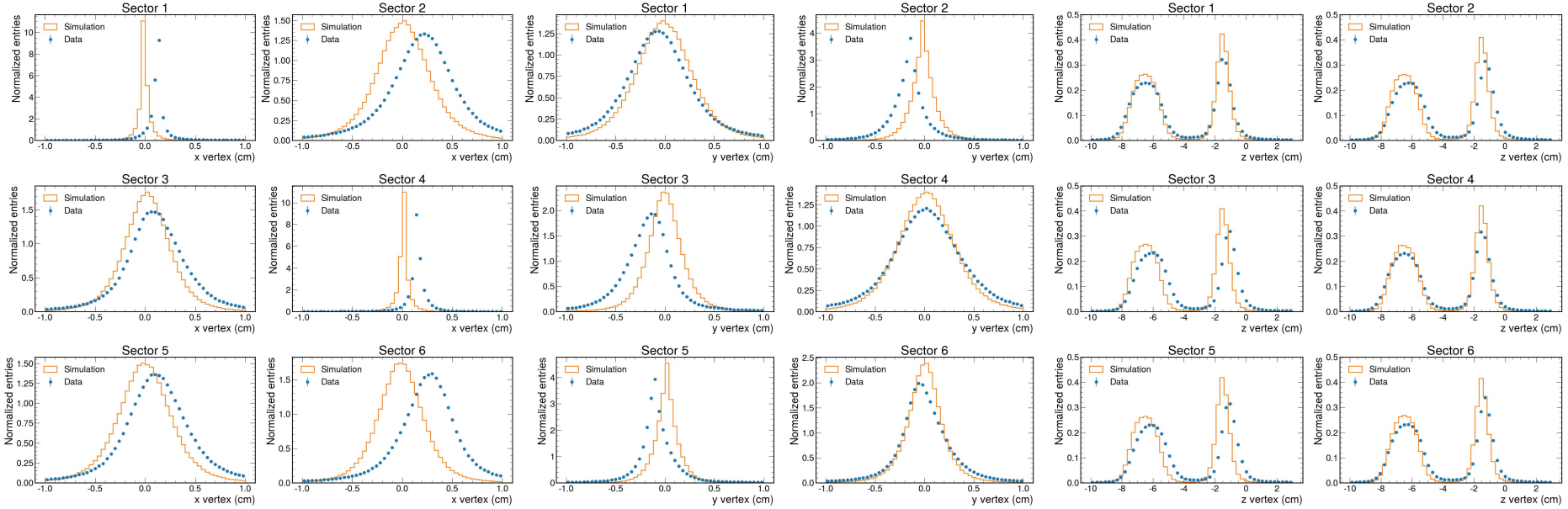
Fraction of particles removed

- 7.6% of particles are labelled as electrons by Event Builder
- Go from ~112.7 million particles to ~8.8 million e^- to ~2.9 million e^-

Cut Name	% of Event Builder electrons remaining after cut
Status cut	99.1%
DIS cuts and extra kinematic cuts	58.7%
PCAL & DC fiducial cuts	39.9%
Partial sampling fraction cut	38.2%
SF vs. E_{dep} cut	37.5%
Vertex cuts	33.9%

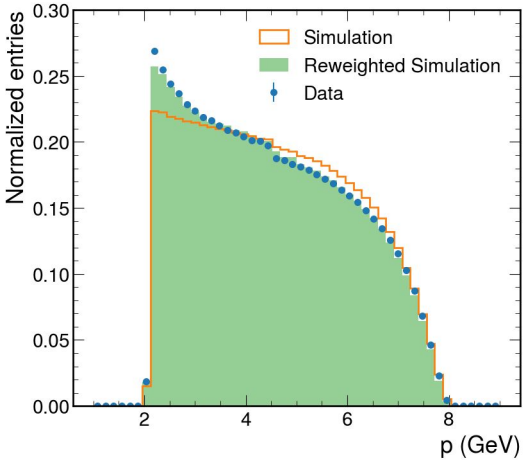
Vertex distributions

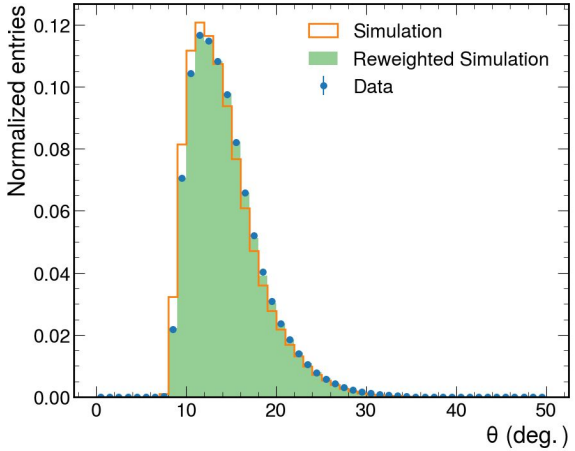
- Using clasdis simulation data for comparison to data (pass 0.7)

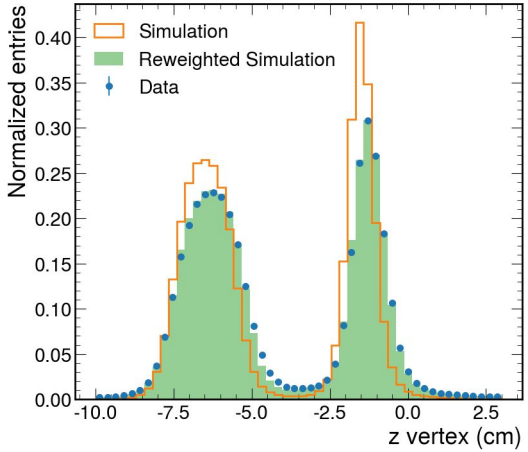


Comparing Monte Carlo to Data

- Reweighting simulation to data (pass 0.7)
- Discrepancies between data and simulation seem consistent with previous analyses (e.g. RGA)

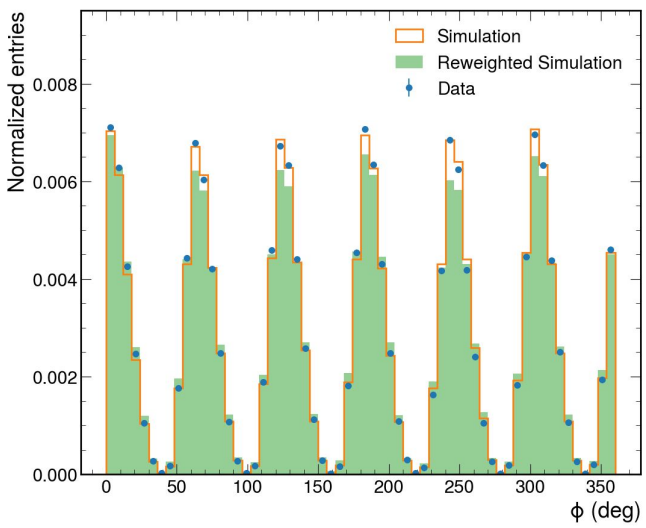


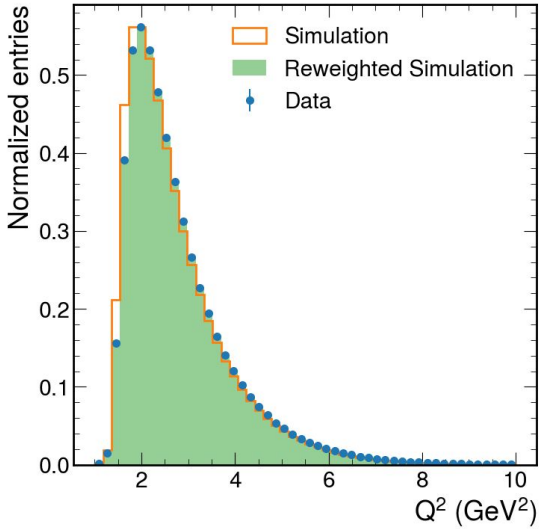


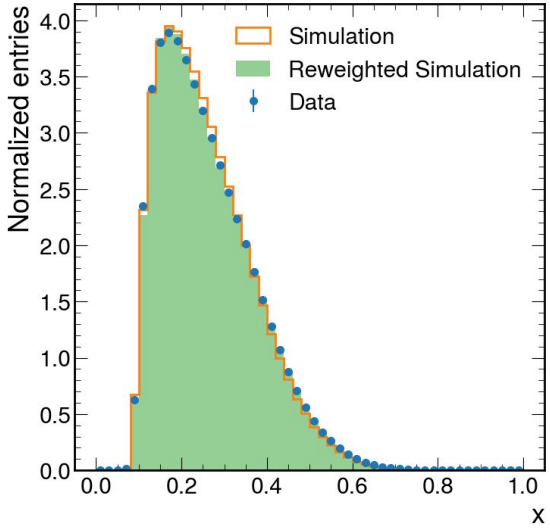


Comparing Monte Carlo to Data

- Will do unfolding with a version of Iterative Bayesian Unfolding
  - IBU used in “Inclusive Electron Scattering in the Resonance Region off a Hydrogen Target with CLAS12” (arXiv:2501.14996)
  - IBU version we'll use detailed here: R. Milton, et al., *JINST* 20, P05034 (2025)

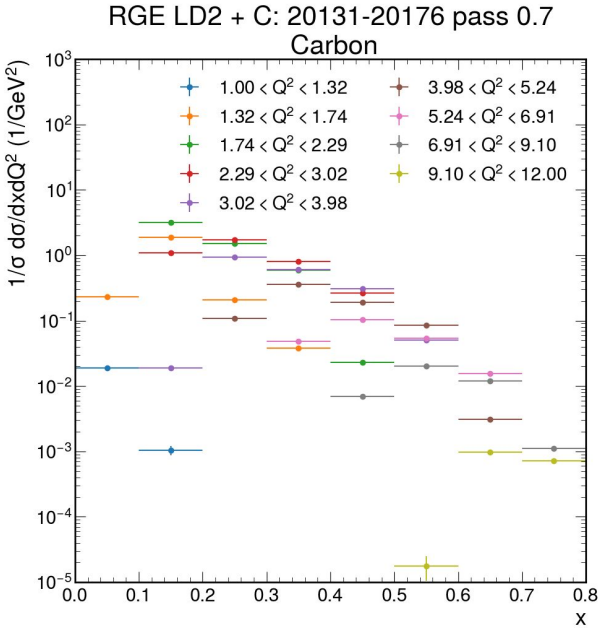


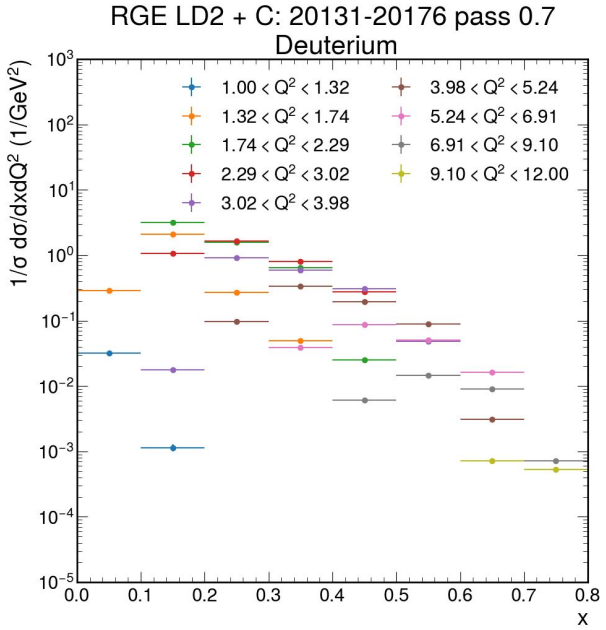




Differential cross sections

- After our cuts and target selection, can plot cross sections
- Still needed: Acceptance corrections/unfolding, radiative corrections





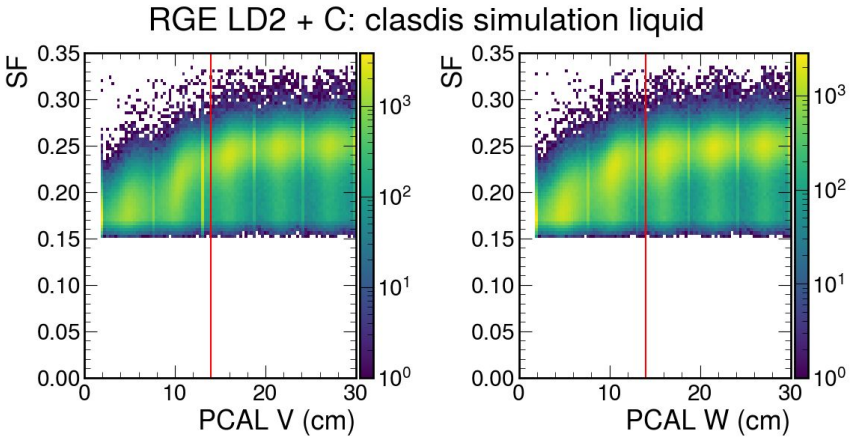
Summary

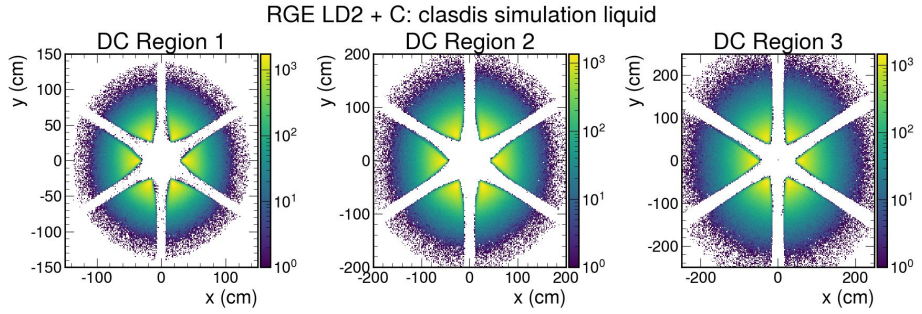
- Interested in $d\sigma/dxdQ^2$ of nuclei
- Refined the Event Builder electron identification with fiducial cuts and selection cuts
- Monte Carlo comparison is looking reasonable based on previous analyses
- Next step is to apply acceptance corrections/unfolding and radiative corrections
- Working on a common analysis note to detail electron selection

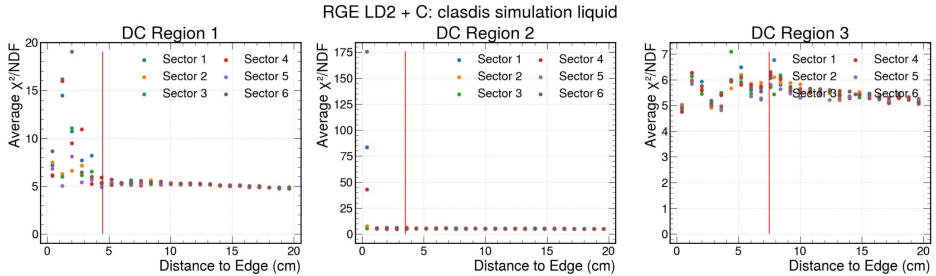
Thank you!

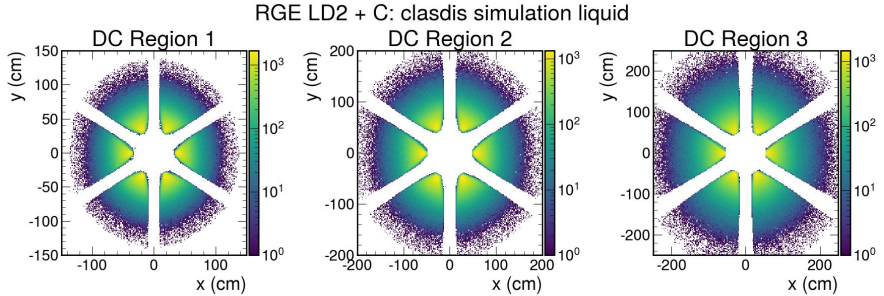
Backup

Simulation fiducial cuts

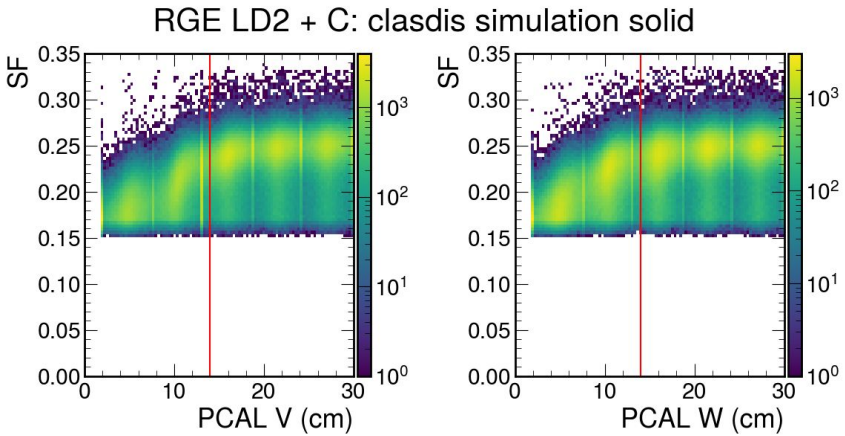


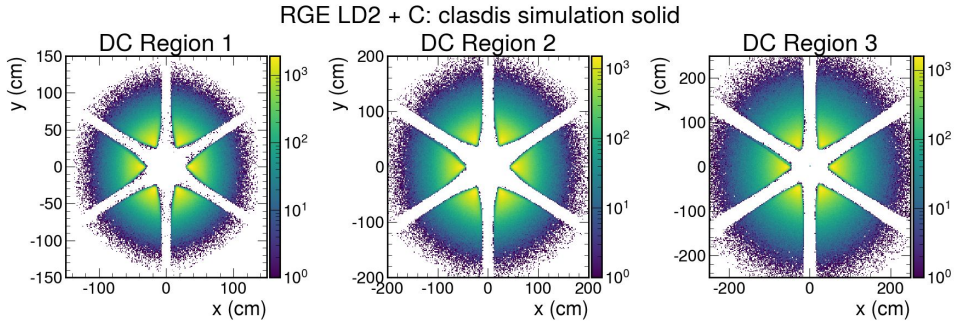


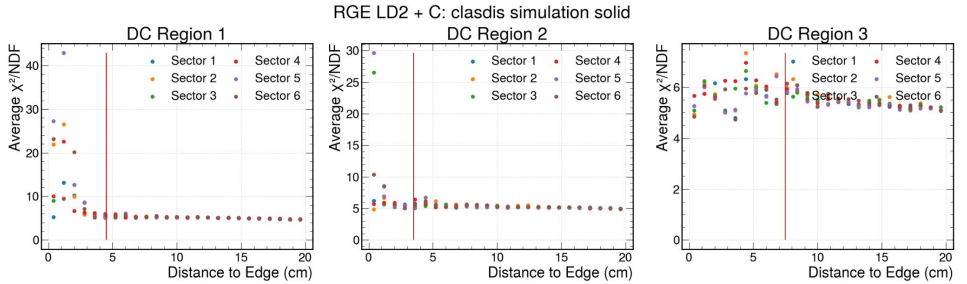


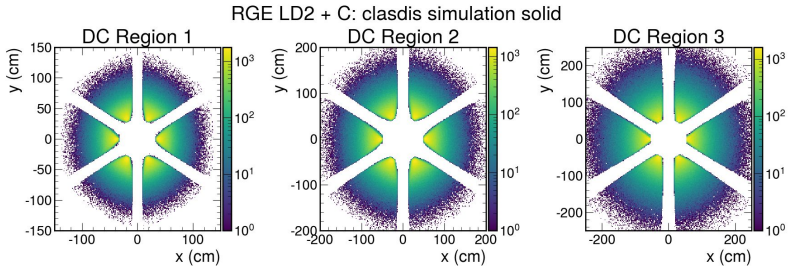


Simulation fiducial cuts

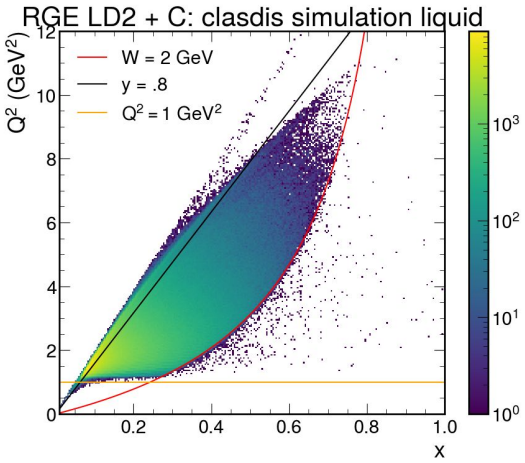


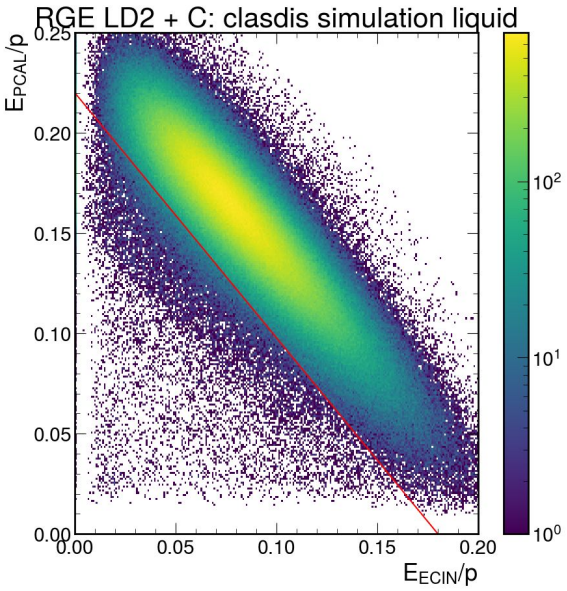


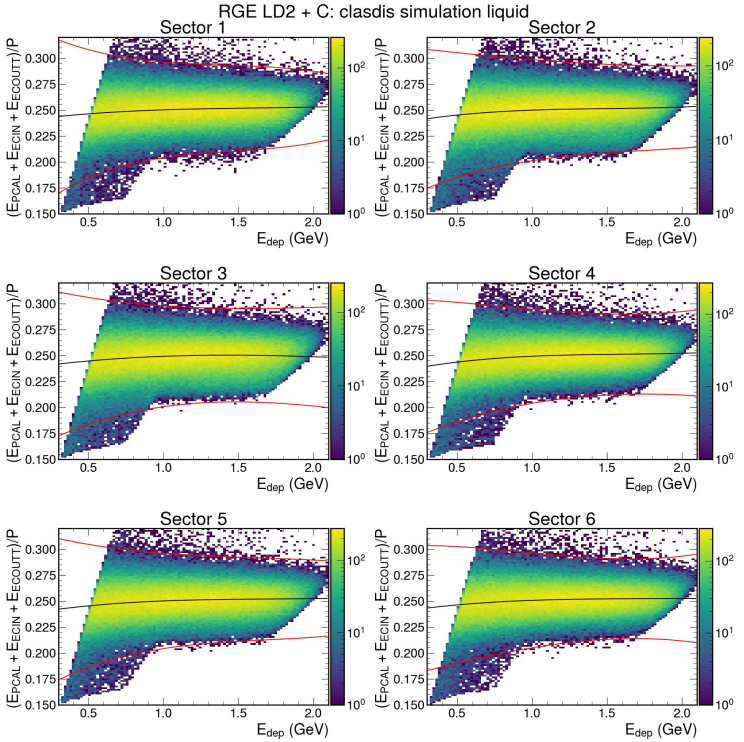




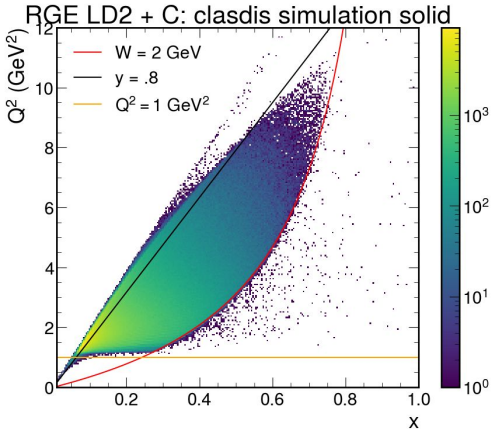
Simulation electron selection

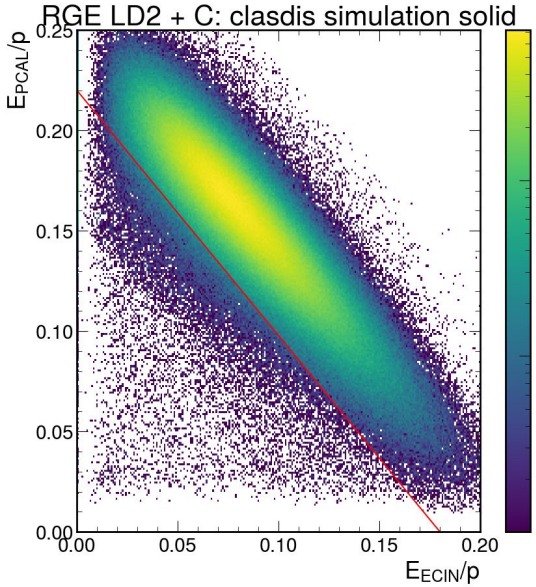


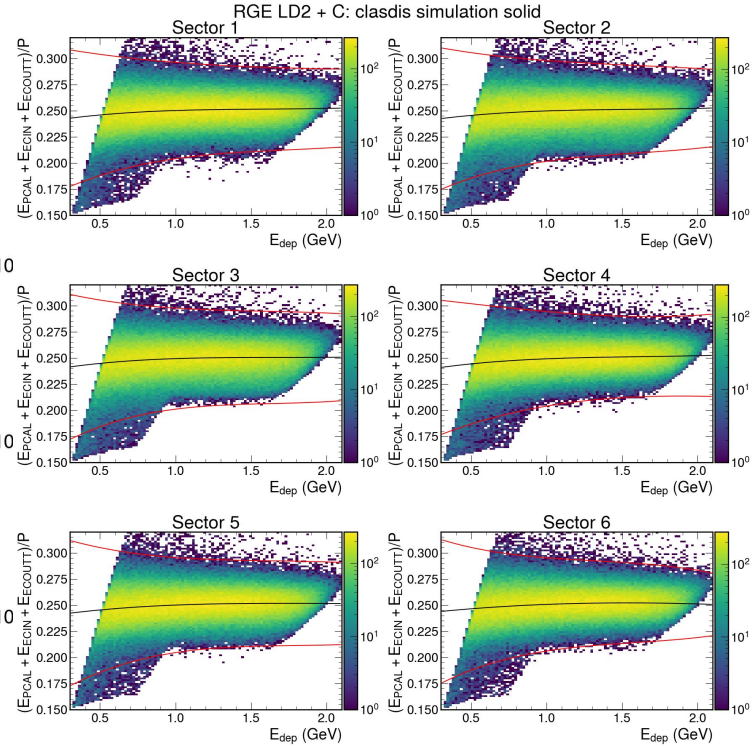




Simulation electron selection







RGA MC distributions

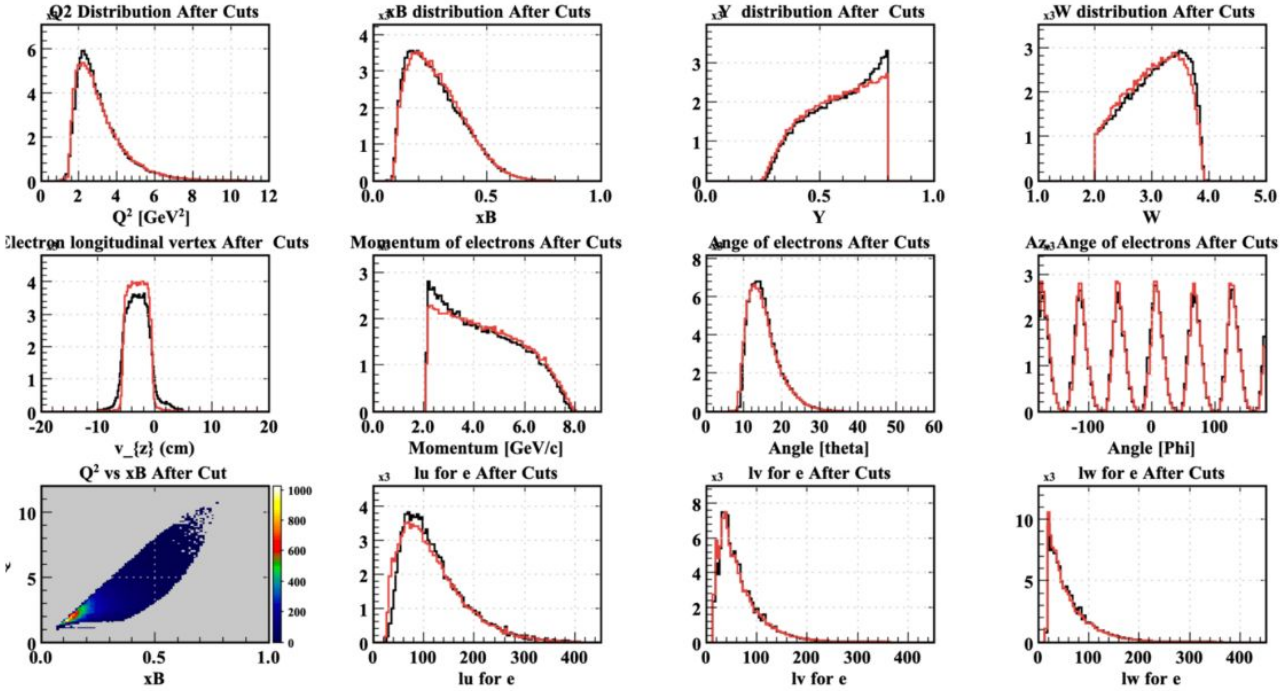


Figure 60: Comparison between pass1 cooked data [black] and MC [red] with torus -1, for the different variables of the scattered electron.