Exclusive reactions working group

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EIC YR Workshop, Berkeley

Section 8.4: detector requirements from exclusive reactions

**Big thank you
to all the working group contributors!**

- This presentation will follow structure of YR section
  $\implies$ but focus on specific points
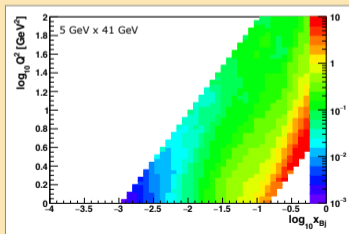- Few studies/subsections still need to be polished

Section 8.4 table of contents

DVCS and exclusive production of π^0 in ep
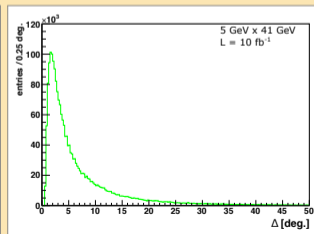
- 2 generators: MILOU & GK-model-based "toyMC"

- Kinematics for γ and π^0 at different beam energies

- EMCal at $|\eta| < 3.5 \sim$OK

- More important: π^0 vs γ separation
  (e.g. angular resolution)
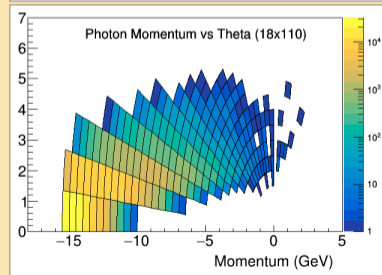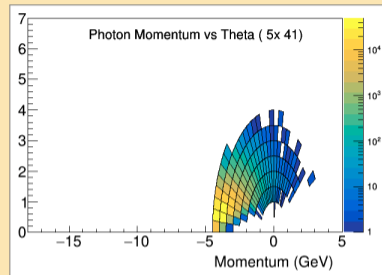

(Red: DVCS γ Green: γ from π^0)
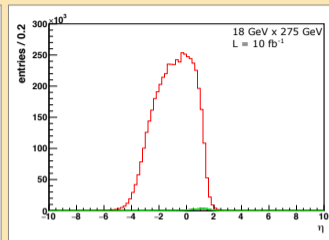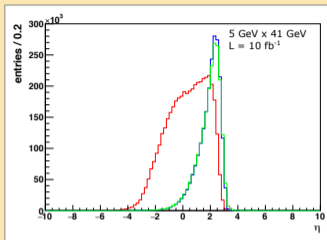
(x-cl π^0 / DVCS γ ratio)

(Opening angle $\pi^0 \to \gamma\gamma$)

DVCS off helium

- Developed new generator `TOPEG`
  (The Orsay-Perugia Event Generator)

- Challenge: detect d/He in Roman Pot at low p_T
  - We assume down to $p_T = 0.2$ GeV
    (even this misses most of statistics)
  - Want to detect at least up to 1st minimum at
    - $-t \approx 0.7$ GeV^2 (d)
    - $-t \approx 0.42$ GeV^2 (^{3}He)
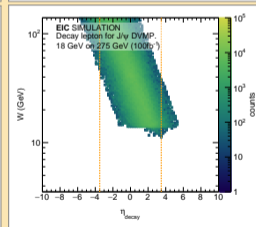   - $-t \approx 0.48$ GeV^2 (^{4}He)

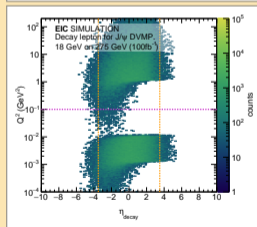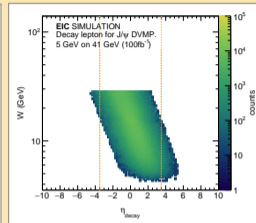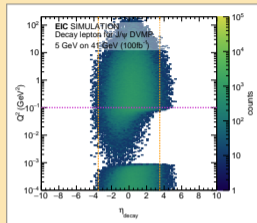- Also minimum γ angle (backward) critical

Exclusive vector meson production in *ep*

- IAger generator, based on VMD model
  (PHOTOS rad. corr. + GRAPE-DILEPTON for $\ell^+\ell^-$ bkg)
- $|\eta| < 3.5 \sim$ sufficient
  (Note gap in Q^2 from e' between central detector and low-Q^2 tagger)

Other notes

- Threshold Υ photoproduction:
 would prefer more backward electron acceptance

Exclusive vector meson production in *ep*

- ▶ IAger generator, based on VMD model
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- ▶ Threshold Υ photoproduction:
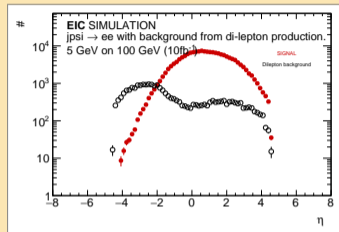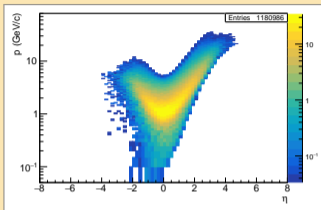 would prefer more backward electron
  acceptance
- ▶ Case for muon detection:
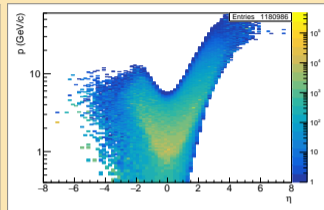 - ▶ Tracking resolution (for t)
  - ▶ Combinatorial background
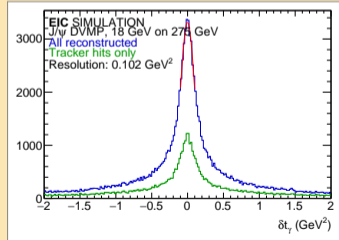
Timelike Compton Scattering

- MC implementation using GK model and PARTONS
- Signal similar to exclusive J/Ψ, but without the peak, large BH background
- Combinatorial background reduction from muons even more important
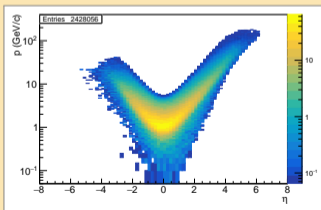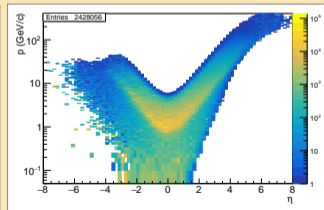
5 GeV on 41 GeV:

(TCS)　　　(BH)

18 GeV on 275 GeV:

(TCS)　　　(BH)

Exclusive vector meson production in *eA*

- MC generators Sartre, BeAGLE
- Meson decay kinematics ∼ *ep*, but no nucleus in Roman Pot
  ⟹ *t* from central detector:
  - tracking precision
  - minimum detectable p_T
    (ϕ, ρ, ω photoproduction: down to $p_T \sim 0$)
- Ensure exclusivity (=veto incoherent) *p*,*n* not enough ⟹ need forward photon detection
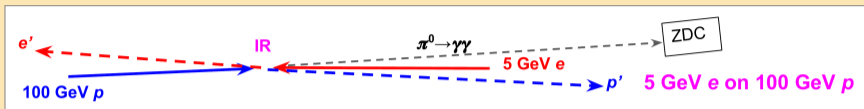 (Must be quantified still)

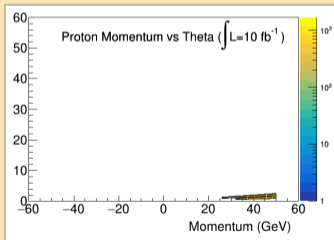(Incoherent suppression required:)
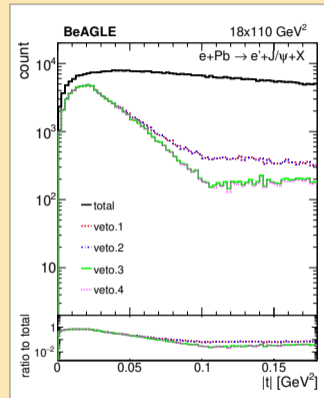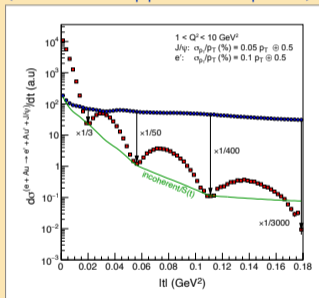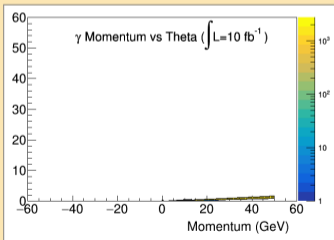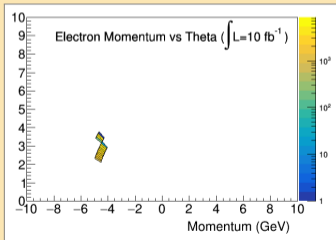

(Incoherent suppression achieved with *p*,*n* detection)
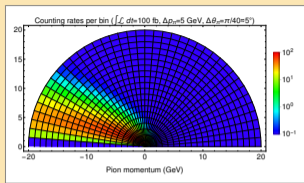
u-channel exclusive electroproduction of π^0

- Close to u_{min}: peculiar kinematics where π^0 takes most of p beam momentum
- See π^0 in ZDC
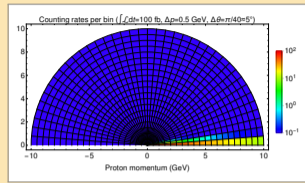- Proposal for dedicated proton tagger at $\eta \sim 4$

X-cl charged current π^- & Deep x-cl π^+

Charged current π^-
- ▶ Cross section small, but reachable with 100 fb^{-1}
- ▶ Challenge: background, ν missing energy reconstruction $\Longrightarrow$ hermeticity!
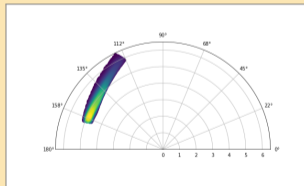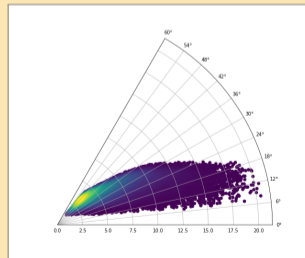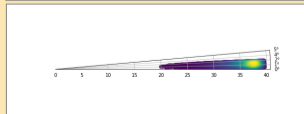

(π^-)

(p)

Deep exclusive π^+
- ▶ Neutron in ZDC
- ▶ π^+ and e' more central

(e')

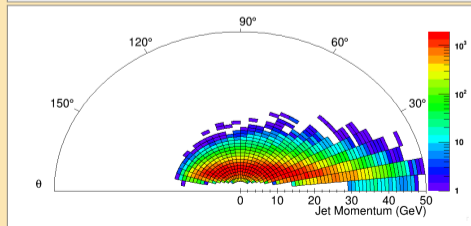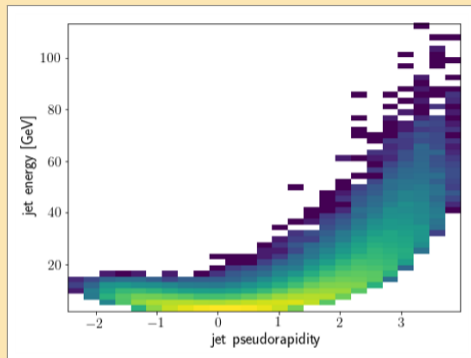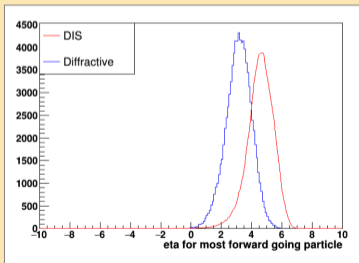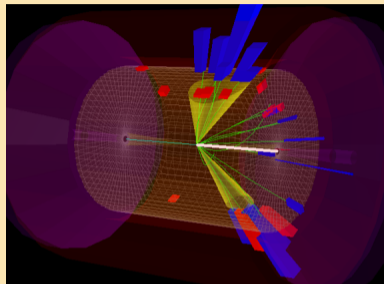(n)

(π^+)

Diffractive dijets

- Pythia 8.244 simulation
  (18 GeV on 275 GeV)
- Need large HCal η coverage
  (study for $|\eta| < 4$ and $|\eta| < 3$)
  - Jet reconstruction
  - Rapidity gap

Conclusions

Improvements to boost physics reach

- ▶ Larger tracker acceptance
- ▶ Higher ECal resolution
- ▶ Muon identification

Very generically "exclusive = measure all particles"

$\implies$ want to maximize acceptance in η !

Critical points for specific physics topics:

- ▶ Large HCal coverage for Jets
- ▶ Good separation between π^0 and γ for DVCS
- ▶ Photons in the far forward detector to suppress incoherent processes
- ▶ Roman Pots going to very low $-t$ (i.e. p_T) for light ions