Exclusive & Tagging WG Update

Salvatore Fazio, Spencer Klein and Daria Sokhan

Presented at the ATHENA biweekly meeting,
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- Weekly meetings Fridays at 12:30 Eastern US Time
  - https://indico.bnl.gov/category/368/
- Golden Channels and key measurements
  - Backgrounds
- Recent group presentations/discussions
- Monte Carlo production readiness

Golden channels

- A mixture of reactions that stress different aspects of the detector, both central and forward.
- Incoherent DVCS on deuteron (γ + p + n)
  - π^0 + Bethe-Heitler background (1 γ vs. 2 γ separation)
- Timelike Compton Scattering (e^+e^-)
  - More challenging than exclusive J/ψ
- ϕ in eA (central K^+K^- + intact/dissociated ion)
  - Show that we can see 2nd or 3rd minimum
    - Needed to remove windowing artifacts in Fourier transform
- Υ in ep (central e^+e^- or $\mu^+\mu^-$)
  - Need decent mass resolution to resolve Υ peaks
- Backward/u-channel production of ω-> $\pi^0\gamma$
  - Challenges forward (hadron-going) calorimetry
- Spectroscopy of J/ψ $\pi^+\pi^-$ channel

Process/performance matrix

Process	Key Meas	Key Plots	Physics Message	Detector Performance Plots
Incoherent DVCS	Signal:background	?		Ability to see & reject 2nd photon from π^0
Φ in eA	Coherent $d\sigma/dt$ minima	M_{KK}, coherent $d\sigma/dt$	Appearance of shadowing vs. Q^2	ϕ acceptance at low Q^2, rejection of exclusive ρ^0 (PID+ p resolution), t-resolution and separation of coherent and incoherent events
Υ in ep	Threshold production?	M_{ll}. For both ee and $\mu\mu$?		M_{ll}; ability to separate 3 Υ peaks
Timelike Compton Scattering				
Backward production of ω	$d\sigma/du$, $d\sigma/dW_{\gamma p}$, $d\sigma/dy$, ω polarization	Variables at left	Characterize backward production at EIC conditions	Acceptance at forward rapidity
J/ψ $\pi^+\pi^-$	Final state mass resolution	Invariant mass	Good sensitivity to peaks	Invariant mass

In progress!

Last week's group presentations/discussions

- Athira Vijyakumar: Event reconstruction and background subtraction for elastic J/ψ production
  - Different methods of determining Q^2, x and y
    - Which is best -> which detector/accelerator parameters matter
  - Separating coherent and incoherent production
  - Differences in how BeAGLE and Sartre handle nuclear breakup
- Zhangbu Xu: Separating exclusive VM channels: case for low momentum PID
  - Misidentified exclusive ρ^0 + direct $\pi\pi$ is a background for ϕ-> K^+K^-
    - Amount depends on relative abundance + width of mass peak
    - PID (LGAD silicon TOF) may be needed to reduce this background
- Derek Glazier and Justin Stevens: Spectroscopy golden channels
  - Recommended $ep \rightarrow J/\psi\pi^+\pi^- e' p'$ as golden channel
    - Through X and Y intermediate states

Monte Carlo production readiness

- For vector meson final states, we have an abundance of codes: Sartre, BeAGLE, eSTARlight and lager
  - Do they agree? Do they agree with HERA data
    - Sartre, BeAGLE have different approaches to nuclear breakup
    - We don't want to confuse differences between different detector simulations from different proposals with differences between different event generators
  - Discussions have started with the EIC software group (Markus Diefenthaler) about event generator comparisons
- For the other golden channels, we have at least one route to signal simulations on the required time scale
  - EpIC for DVCS and TCS
  - The spectroscopy group has simulations for $ep \rightarrow J/\psi\pi^+\pi^-e'p'$
  - eSTARlight can simulate u-channel/backward production
    - Not yet in main distribution
- Background simulation plans are much less robust

Summary and Issues

- We have selected a diverse set of golden channels
  - We have production plans for all of the signal simulations
  - We still need to understand the differences between different vector meson Monte Carlo generators
    - Separating coherent and incoherent interactions (i. e. detecting nuclear breakup) is a key performance metric.
      - There are large uncertainties in modelling this, and is is likely that different generators disagree.
  - Some of the generators for other final states should be exercised more
- We are still thinking about backgrounds
  - Backgrounds were not discussed in the White Paper or Yellow Report, so we have some work to do.
  - Background simulation plans are less robust