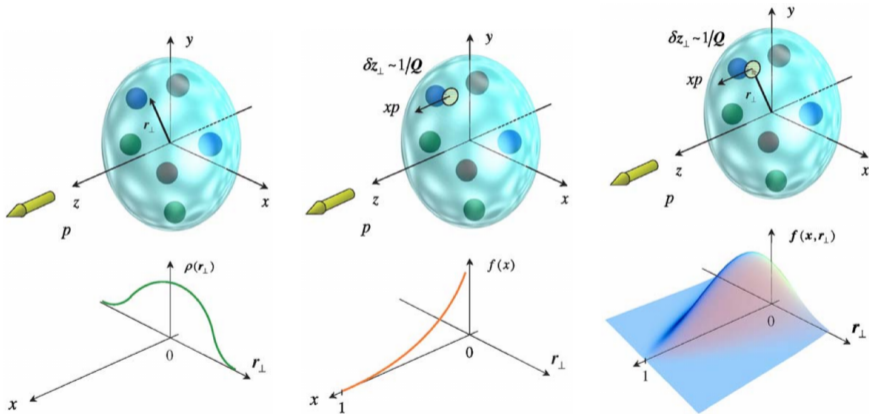eP DVMP at ePIC:
$J/\Psi \rightarrow \mu^+\mu^-$ Channel

ePIC Exclusive, Diffractive and Tagging Meeting
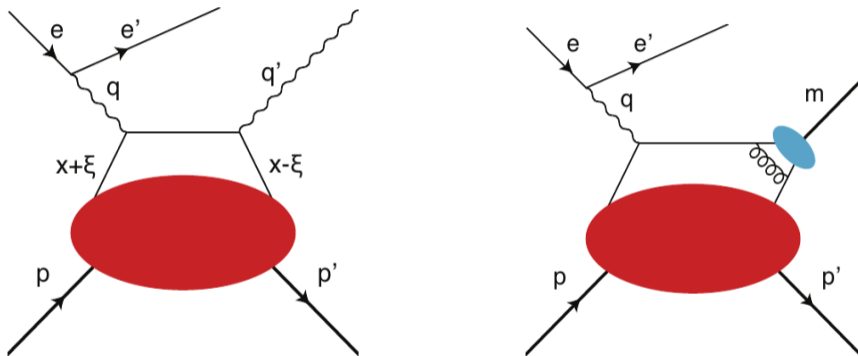
Stuart Fegan

University of York

May 13th, 2024
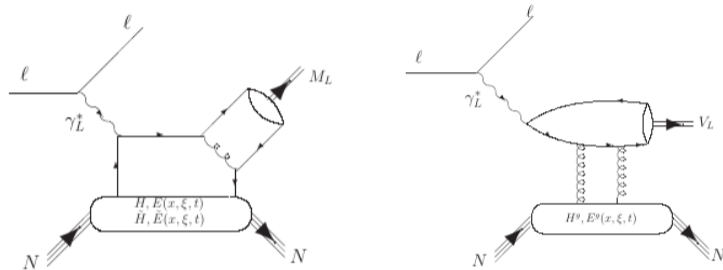
Motivation

Uncovering Hadron Structure With Generalised Parton Distributions, A.V. Belitsky and A.V. Radyushkin

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Accessing GPDs

- GPDs are experimentally accessed via DVCS (left) and DVMP (right)
- DVMP, Deeply Virtual Meson Production, is an analogous process to DVCS, where a meson is produced in the final state instead of a photon.
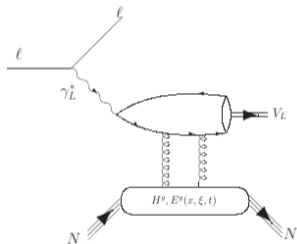
DVMP

arXiv:1511.04535

- Heavy vector mesons, such as J/Ψ and Υ, can probe gluon GPDs
- This can provide information about saturation by measuring the change in the spatial gluon distribution from low to high x_B
- However, this lies beyond kinematics of current facilities, e.g. Jefferson Lab

DVMP with Vector Mesons

arXiv:1511.04535

- Exclusive vector meson channel J/Ψ
- Current effort focussed on J/Ψ, but potential to expand to lower (ϕ) and higher mass vector mesons ($\psi(2s)$, Υ)
- Overall goal of evaluating ePIC performance against VM event generators, confirm feasibility of measurement and consider how this will happen in reality

DVMP Generators

lAger - Argonne generic l/A-event generator (S. Joosten)

- The lAger generator was used to produce event samples for the ECCE studies presented
- Modular accept-reject generator, capable of simulating both fixed target and collider kinematics
- Significant recent developmental effort in support of DVMP studies, with a focus on J/Ψ and Υ

The ePIC Study

- Looking at $J/\Psi \to \mu^+\mu^-$
- Analogous to UNH study of $J/\Psi \to e^+e^-$
- Building upon the ECCE study (NIM A 1052, 168238 (2023))
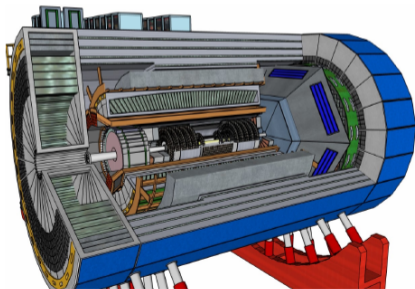
- See UNH presentations for details, but essentially samples of $J/\Psi \to e^+e^-$ events from eP collisions, generated in lAger at various kinematics
- Passed through ePIC detector geometry and evaluating feasibility of reconstructing J/Ψ DVMP

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The ePIC Study

Same idea here, but on $J/\Psi \to \mu^+\mu^-$

- $\mu^+\mu^-$ offers a complimentary approach to e^+e^-
- Similar branching fraction
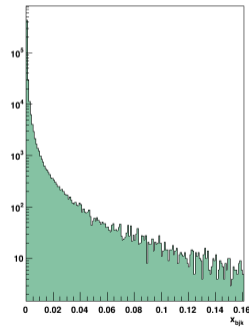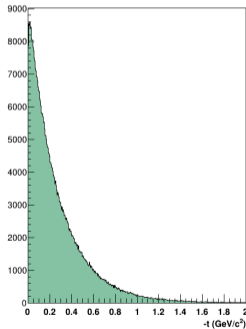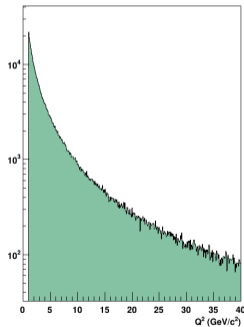- $\mu^+\mu^-$ decay avoids potential ambiguity in separating decay lepton from scattered electron

The approcah:

- Use lAger to generate $J/\Psi \to \mu^+\mu^-$ samples and evaluate feasibility of measurement
- Starting with $10fb^{-1}$ samples at 10 on 100 GeV and 18 on 275 GeV settings
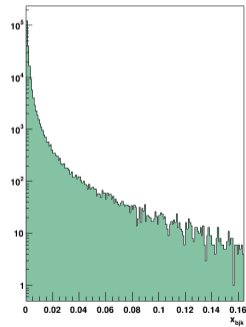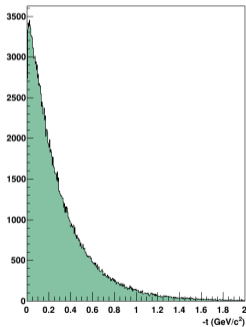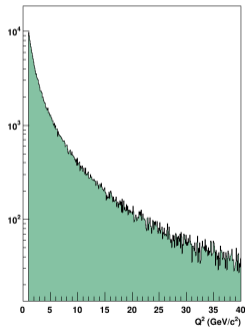
Event Samples

- $10 fb^{-1}$ of $J/\Psi \rightarrow e^{+} e^{-}$ at 18 on 275 GeV eP

Event Samples

- $10 fb^{-1}$ of $J/\Psi \to \mu^+\mu^-$ at 10 on 100 GeV eP collisions

To-do List

- Pass these samples through ePIC reconstruction
- Evaluate basic kinematic variables in reconstructed events ($Q^2, -t, x_{bjk}$)
- Like the e^+e^- channel, drill into details of where the final state particles are being seen, e.g. η distrubutions to separate barrel and endcap events
- Reconstruct cross section to evaluate ability to realise multi-dimensional binning
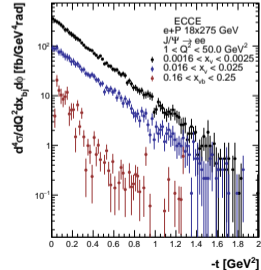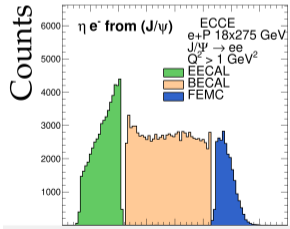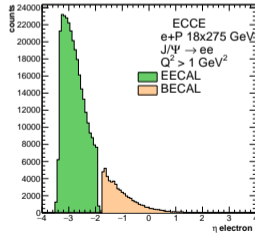
Status

- Creating test job for ePIC reconstruction
- Building macros to analyse reconstructed files
- Plots coming soon