Kinematics of exclusive measurements with EIC

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Plan for discussion

Go over different types of processes/final states

Summarize physics objectives

Discuss rough outlines of kinematics, starting from proposition

Identify questions for quantitative study

Considerations

- Same process can address different physics at small/large x (e.g. DVCS). Need to be clear about objectives!
- Some kinematic boundaries are determined by counting rates (e.g. high Q^2)
- Focus on role of CM energy and need for lower energies

  CM energy dependence of exclusive cross sections and observables?

  Methods for exclusive event reconstruction at $y \ll 1$?

- Focus on t-coverage needed for physics objectives

Kinematics of exclusive measurements with EIC

Types of processes for discussion

- DVCS
- Vector mesons $J/\psi, \phi, \rho^0$ ("diffractive")
- Pseudoscalar and charged vector mesons $\pi, \eta, K, K^*, \rho^+$ ("nondiffractive")
- Coherent processes on light and heavy nuclei
- High-t and backward processes
- High-mass photoproduction TCS
- $N \to N^*$ transitions (considerations specific to N^*)

Follows organization of Yellow Report. Questions? Comments?

Deeply virtual Compton scattering DVCS

Physics: Valence quark GPDs spin/flavor at $x \gtrsim 0.1$
Sea quark and gluon GPDs at $x \lesssim 0.1$
Dispersion relations ($=$ integrals over ν) connect Im/Re, D-term $\leftrightarrow$ EM tensor
Transverse imaging of nucleon

Kinematics (proposed):

x(low) $=$ kin limit, $\quad$ x(high) $=$ 0.1? 0.3?

Q^2(low) $\sim$ 1 GeV^2, $\quad$ Q^2(high) $=$ rate limit $=$ few 10 GeV^2

Δ_T(low) $=$ 0, $\quad$ Δ_T(high) $=$ 1-2 GeV?

Questions:

How important is lower CM energy for DVCS event reconstruction and observables?

How important is Δ_T coverage at zero and large values?

Vector meson production J/ψ, ϕ, ρ^0

Physics: Gluon GPDs $J/\psi, \phi$; gluon + singlet quark GPDs ρ^0
Transverse imaging, t-dependence of gluon form factor
Soft-hard transition as function of Q^2
"Diffractive" channels, high rates at small x

Kinematics (proposed):

x(low) = kin limit, x(high) $\sim$ 0.1?

Q^2(low) = 0, Q^2(high) = few 10 GeV^2 = rate limit

Δ_T(low) = 0, Δ_T(high) = 2-3 GeV?

Comments:

Aim to measure all channels at same (x, Q^2) for comparative studies

Special case: Near-threshold production of heavy quarkonia, incl. Υ.
High-t process! Benefits of lower CM energy?

Pseudoscalar and charged vectors $\pi, \eta, K, K^*, \rho^+$

Physics: Quark GPDs valence/sea, flavor separation, helicity and transversity
Emergence of Regge dynamics from QCD
Unexplored at $x < 0.1$, soft or hard regime
"Nondiffractive" channels, rates drop at small x, more challenging

Kinematics (proposed):

x(low) = rate limit, x(high) $\sim$ 0.1? 0.3?

Q^2(low) = 0, Q^2(high) = few 10 GeV^2 = rate limit

Δ_T(low) = 0, Δ_T(high) $\sim$ 1 GeV?

Comments:

Can we separate L/T through ϕ-dependent response functions?

Advantages of lower CM energy?

Coherent processes on light nuclei

Physics: Nuclear quark GPDs $x \gtrsim 0.1$, spin structures, transverse imaging
Nuclear gluon GPDs $x \ll 0.1$, nuclear shadowing as function of impact parameter
Nuclear targets with spin-0, 1/2, 1
Possible processes DVCS, J/ψ, others

Kinematics (proposed):

x(low) $\sim 10^{-3}$ $\quad$ x(high) $\sim$ 0.1?

Q^2(low) $\sim$ 1 GeV^2, $\quad$ Q^2(high) $=$ few 10 GeV^2 $=$ rate limit

Δ_T(low) $= 0$, $\quad$ Δ_T(high) $\sim$ few 100 MeV?

Comments/questions:

Need Δ_T coverage from 0 to $\sim$ few 100 MeV, good resolution

Beam momentum smearing effects likely important [→ this afternoon]

Advantages of lower CM energy?

Coherent processes on heavy nuclei

Physics: Nuclear gluon GPD $x \ll 0.1$, nuclear shadowing as function of impact parameter, possibly saturation effects
Possible processes $J/\psi, \phi$, others

Kinematics (proposed):

x(low) $\sim$ kin limit x(high) $\sim$ 0.01

Q^2(low) $\sim$ 0, Q^2(high) $=$ few GeV^2?

Δ_T(low) $=$ 0, Δ_T(high) $\sim$ 100 MeV?

Comments/questions:

Coherent process identified by veto detection of nuclear breakup

Beam momentum smearing effects essential [→ this afternoon]

Δ_T measurement through vector meson?

Likely very challenging measurement