Dijet photoproduction in lepton-nucleus scattering at the EIC

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- Dijet photoproduction in eA scattering at the EIC provides information on QCD structure of nuclei, in particular, nuclear PDFs, which is complimentary to that in eA DIS. This has been exploited in ultraperipheral collisions (UPCs) of heavy ions at the LHC.

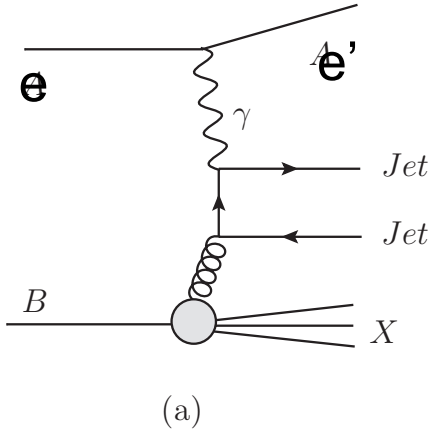
- Using NLO pQCD and nCTEQ15 and EPPS16 nPDFs, we calculate the eA → e+2jets+X cross section and establish the following kinematic reaches: $5 < \overline{p}_T < 20$ GeV, $-2 < \overline{\eta} < 3$, $0.03 < x_\gamma^{obs} < 1$, $0.01 < x_A^{obs} < 1$.

- The ratio of the cross sections on a nucleus and the proton exhibits the x_A^{obs} dependence similar to that of the ratio of the gluon densities $g_A(x,\mu^2)/[Ag_p(x,\mu^2)]$ with 10-20% nuclear modifications.

EIC Opportunities for Snowmass, Jan 25-29, 2021

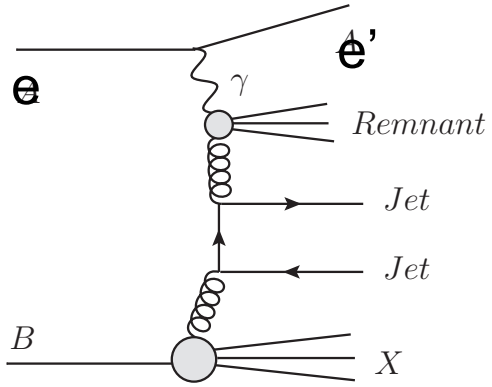
Dijet photoproduction in NLO pQCD

direct photon



(a)

resolved photon



(b)

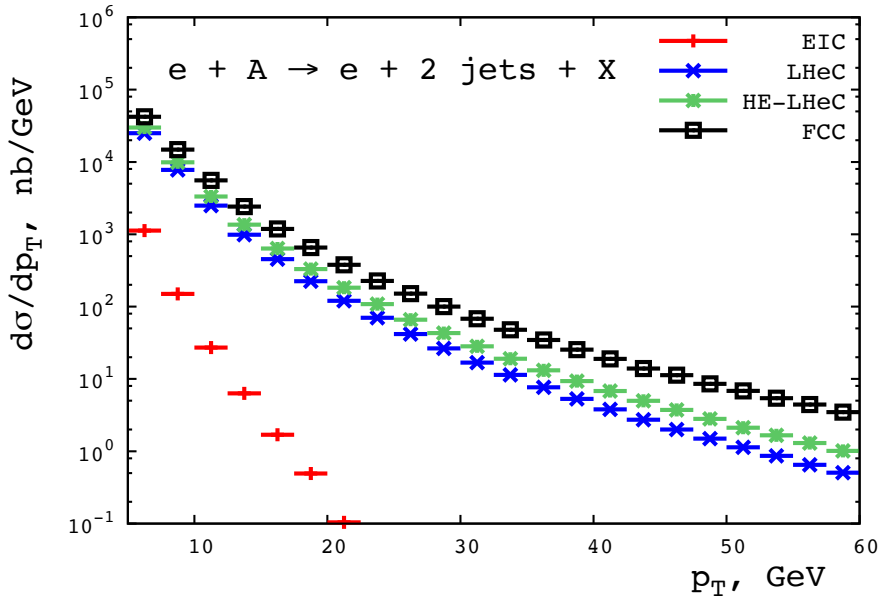
$$d\sigma(eA \to e{+}2\text{jets}{+}X) = \sum_{a,b} \int dy \int dx_\gamma \int dx_A f_{\gamma/e}(y) f_{a/\gamma}(x_\gamma, \mu^2) f_{b/B}(x_A, \mu^2) d\hat{\sigma}(ab \to \text{jets})$$

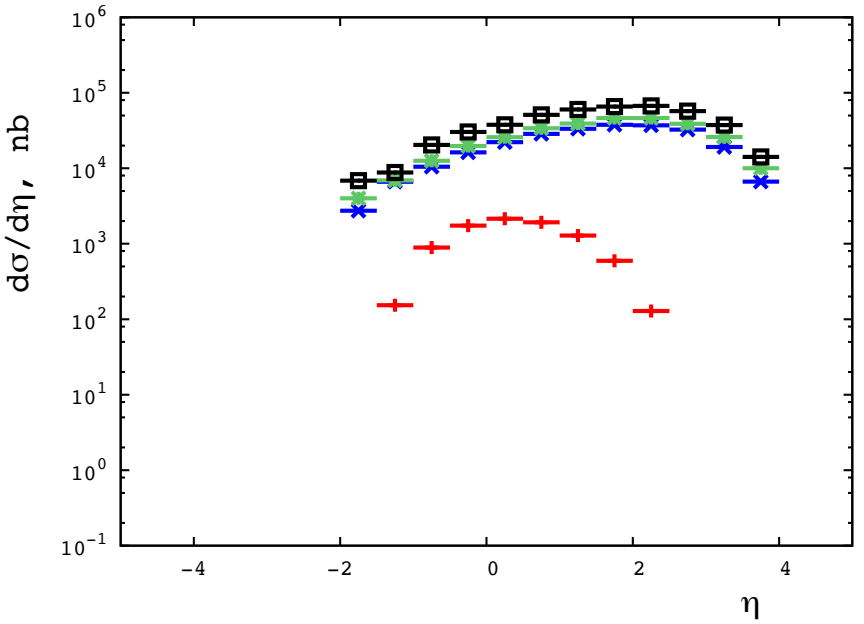
- NLO pQCD calculations with the following input:
  - $f_{\gamma/e}(y)$ is the photon flux in WW approximation
  - $f_{a/\gamma}(x\gamma)$ is the photon PDF, used GRV HO fit
  - $f_{b/B}(x_A)$ is the nuclear PDF, used nCTEQ15 and EPPS16
  - σ (ab → jets) is the hard cross section at NLO
- Anti-kT jet algorithm with R=0.4
- Predictions for distributions in dijet average transverse momentum $\overline{p}_T = (p_{T1}+p_{T2})/2$, average rapidity $\overline{\eta} = (\eta_1+\eta_2)/2$, and observed parton momentum fractions in the photon and nucleus, $x\gamma^{obs}$ and x_A^{obs}.

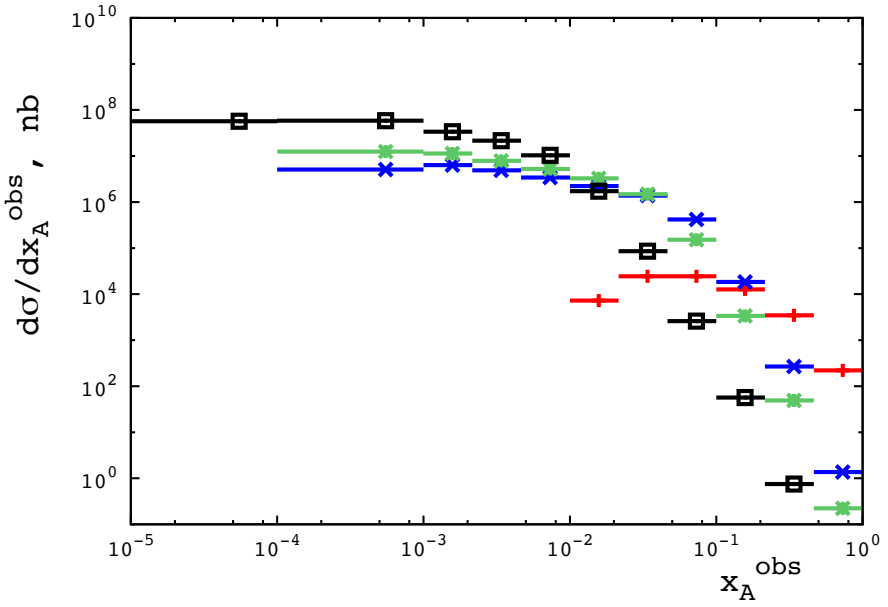
$$x_\gamma^{\text{obs}} = \frac{p_{T,1}e^{-\eta_1} + p_{T,2}e^{-\eta_2}}{2yE_e}$$

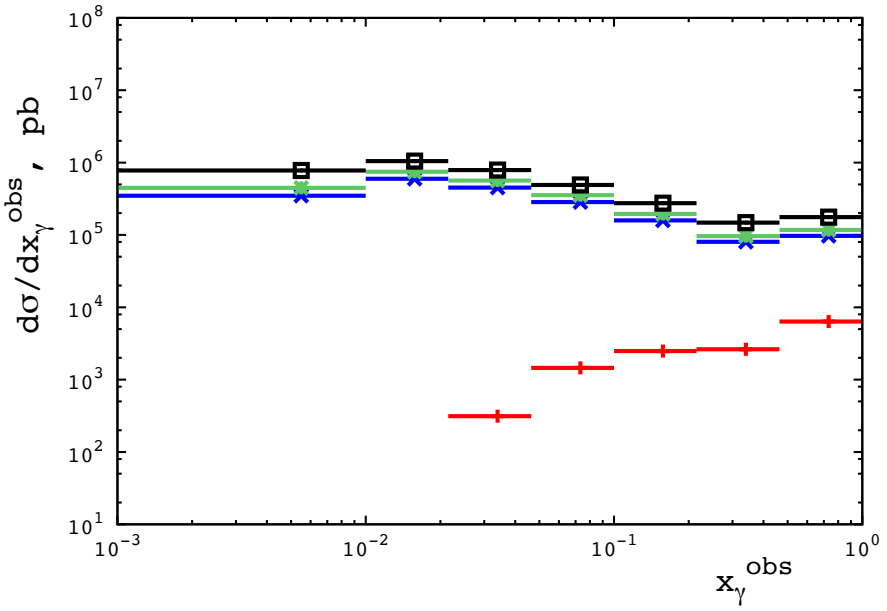
$$x_A^{\text{obs}} = \frac{p_{T,1}e^{\eta_1} + p_{T,2}e^{\eta_2}}{2E_A},$$

NLO QCD predictions for EIC@92 GeV



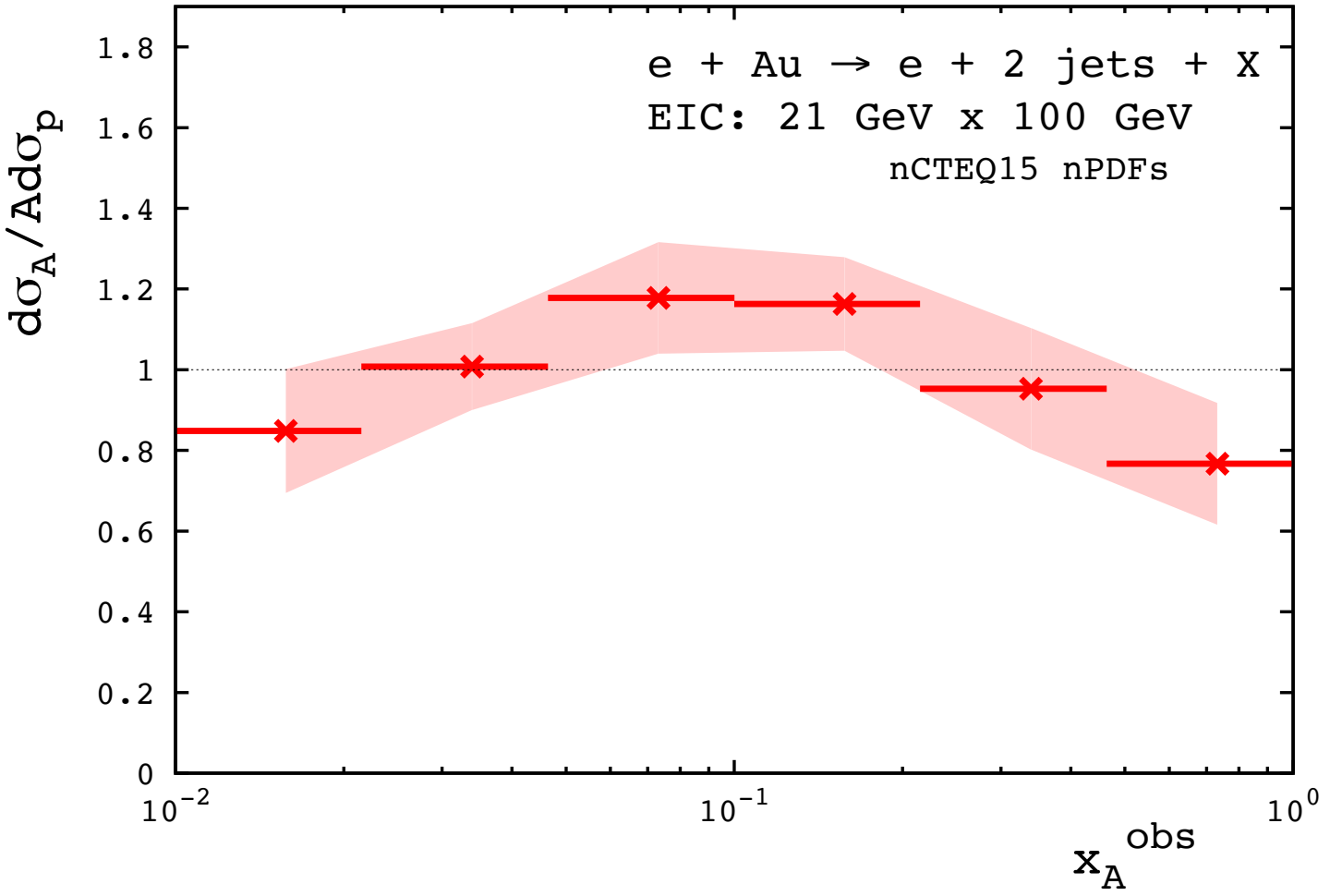






- Kinematic reaches: $5 < \bar{p}_T < 20$ GeV, $-2 < \bar{\eta} < 3$, $0.03 < x\gamma^{obs} < 1$, $0.01 < x_A^{obs} < 1$
- Kinematic coverage dramatically expands for LHeC, HE-LHeC, and FCC.

Nuclear modifications of the dijet cross section



- Dijet cross section ratio repeats the ratio of the gluon distributions $g_A(x,\mu^2)/[Ag_p(x,\mu^2)]$
- Similar behavior with nCTEQ15 and EPPS16 nPDFs.
- Nuclear modifications are 10-20% effect.
- Statistical uncertainty of these measurements is expected to be 1-2% → this process can be used to reduce uncertainties of nPDFs.