Diffractive dijet at EIC (require high luminosity)

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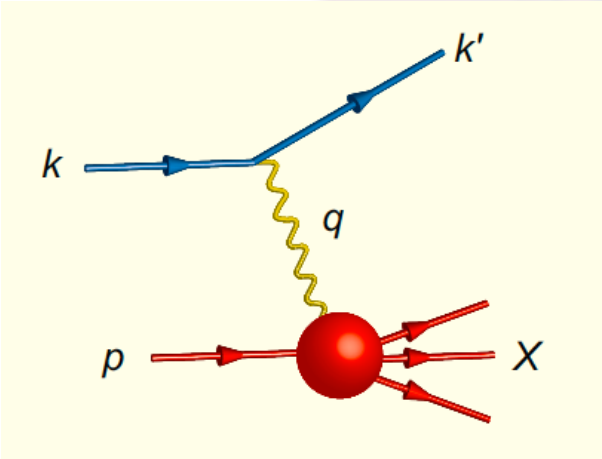
Basics



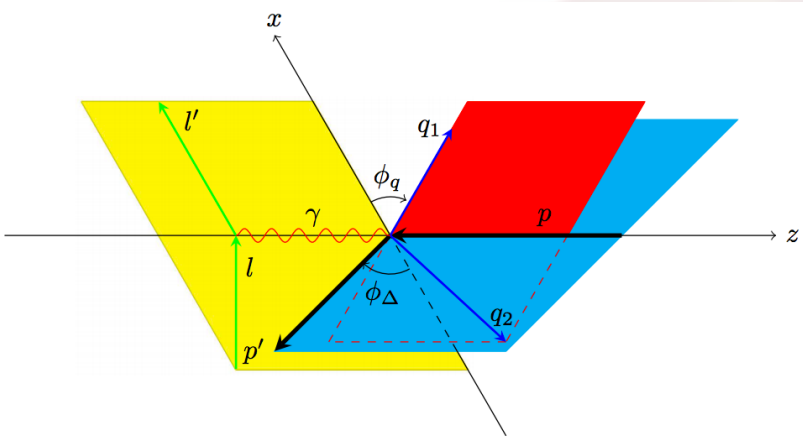
- Inclusive DIS
  - Parton distributions
- Semi-inclusive DIS, measure additional hadron in final state
  - Kt-dependence
- Exclusive Processes, measure recoiled nucleon
  - Nucleon tomography
- Parity violating process

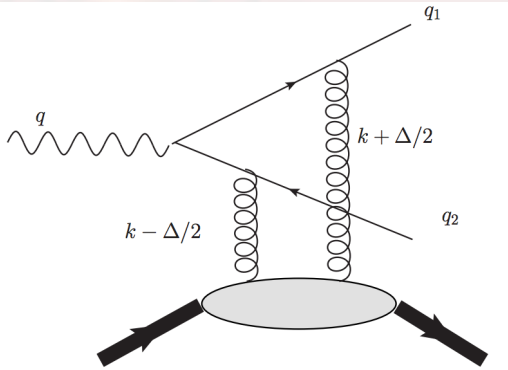
Luminosity requirement

Diffractive Dijet to Probe Gluon Tomography

- Contribute to the key physics goals at the EIC
  - Spin/tomography of nucleon, e.g., probe the Gluon GPD Ji's talk
  - Gluon Orbital Angular Momentum
  - Small-x gluon saturation
  - …

Hunting the Gluon Orbital Angular Momentum





$$A_{\sin(\phi_q-\phi_\Delta)} \propto \frac{(\bar{z}-z)|\vec{q}_\perp||\vec{\Delta}_\perp|}{\vec{q}_\perp^{\,2}+\mu^2}\,\mathcal{L}_g(\xi,t)$$

- Twist-three effects, depending on the gluon OAM distribution
- More quantitative studies needed to show the impact from EIC measurements
- To constrain the gluon OAM from the future experimental data, an inverse problem

Ji,Yuan,Zhao, arXiv:1612.02438
Hatta,Nakagawa,Yuan,Zhao, arXiv:1612.02445

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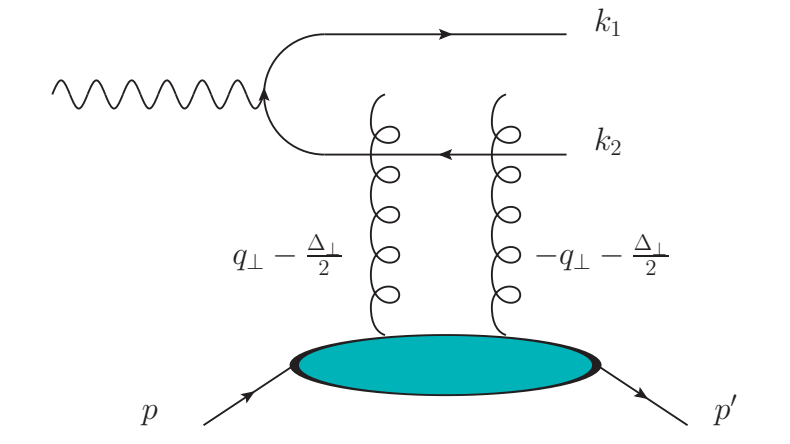
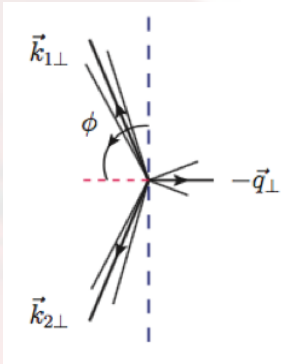
Nucleon/Nucleus Tomography at Small-x



Hatta-Xiao-Yuan,1601.01585



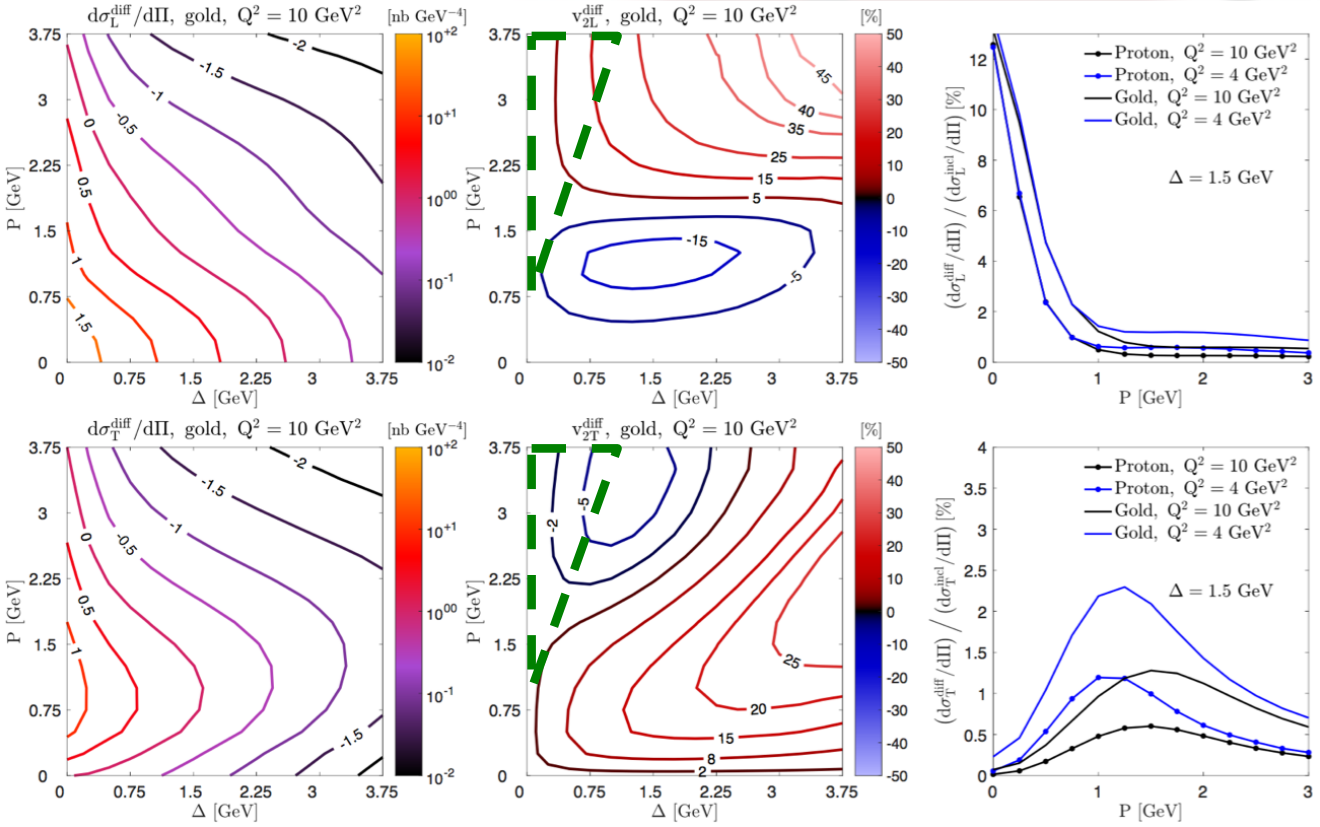
cos(2ϕ) anisotropy

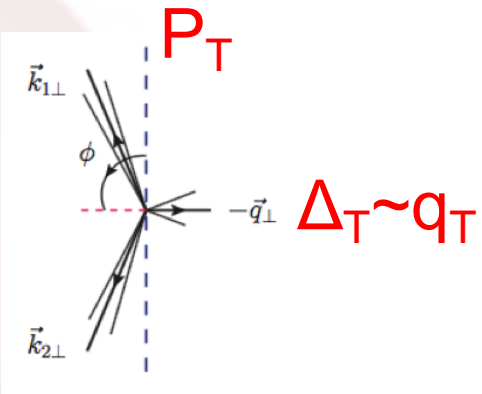
- In the Breit frame, by measuring the recoil of final state proton, one can access Δ_T. By measuring jets momenta, one can approximately access q_T.
- The diffractive dijet cross section is proportional to the square of the Wigner distribution → nucleon/nucleus tomography

$$x\mathcal{W}_g^T(x,|\vec{q}_\perp|,|\vec{b}_\perp|) + 2\cos(2\phi)x\mathcal{W}_g^\epsilon(x,|\vec{q}_\perp|,|\vec{b}_\perp|)$$

↳ **Anisotropy ~ few %**

This has generated a lot of interests…





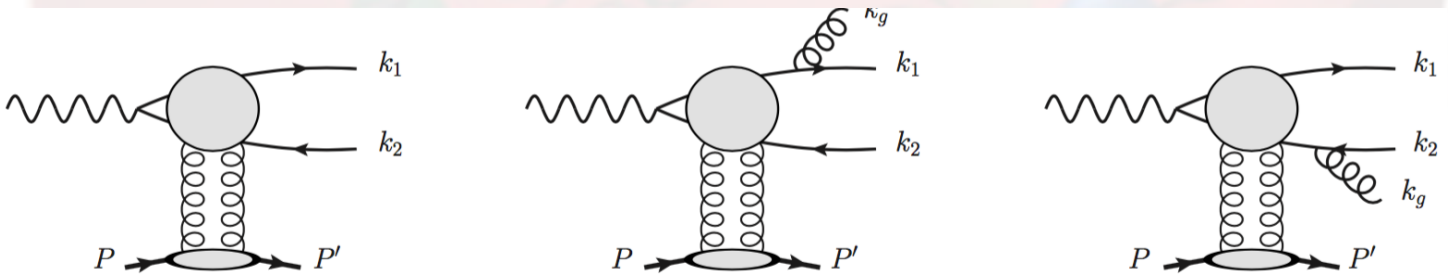
CGC calculations: Mäntysaari-Mueller-Salazar-Schenke, 1912.05586, 1902.05087

QCD from gluon radiation

- Gluon radiation tends to be aligned with the jet direction

$$S_J(q_\perp) = \delta(q_\perp) + \frac{\alpha_s}{2\pi^2}\int dy_g \left(\frac{k_1\cdot k_2}{k_1\cdot k_g k_2\cdot k_g}\right)_{\vec{q}_\perp=-\vec{k}_{g\perp}}$$

$$S_{J0}(|q_\perp|) + 2\cos(2\phi)S_{J2}(|q_\perp|) + \cdots$$



Catani-Grazzini-Sargsyan, 1703.08468; Hatta-Xiao-Yuan-Zhou, 2010.10774

More broad context of quantum interference effects, Chen, Moult, Zhu, 2011.02492

Leading power contributions, explicit result at α_s

$$S_J(q_\perp) = S_{J0}(|q_\perp|) + 2\cos(2\phi) S_{J2}(|q_\perp|)$$

$$S_{J0}(q_\perp) = \delta(q_\perp) + \frac{\alpha_0}{\pi}\frac{1}{q_\perp^2}\,, \quad S_{J2}(q_\perp) = \frac{\alpha_2}{\pi}\frac{1}{q_\perp^2}\,,$$

where

$$\alpha_0 = \frac{\alpha_s C_F}{2\pi} 2\ln\frac{a_0}{R^2}\,, \quad \alpha_2 = \frac{\alpha_s C_F}{2\pi} 2\ln\frac{a_2}{R^2}\,.$$

In the small-R limit, <cos(2ϕ)> goes to 1

Additional gluon radiation contributions,

- In the momentum space, it will be a convolution
  - $q_T = k_{g1} + k_{g2} + \ldots$
  - Dominant contributions will be ϕ-independent
- It is convenient to perform resummation in Fourier-b space

$$\widetilde{S}_J(b_\perp) = \int d^2 q_\perp e^{iq_\perp \cdot b_\perp} S_J(q_\perp)$$
$$= \widetilde{S}_{J0}(|b_\perp|) - 2\cos(2\phi_b)\widetilde{S}_{J2}(|b_\perp|) + \cdots$$

$$\widetilde{S}_{J0}(b_\perp) = 1 + \alpha_0 \ln(\mu_b^2/P_\perp^2)\ , \quad \widetilde{S}_{J2}(b_\perp) = \alpha_2$$

All order resummation, in Fourier-b space

$$\widetilde{S}_{J0}(b_\perp) = e^{-\Gamma_0(b_\perp)} \;,\quad \widetilde{S}_{J2}(b_\perp) = \alpha_2 e^{-\Gamma_0(b_\perp)} \qquad \Gamma_0(b_\perp) = \int_{\mu_b^2}^{P_\perp^2} \frac{d\mu^2}{\mu^2}\alpha_0$$

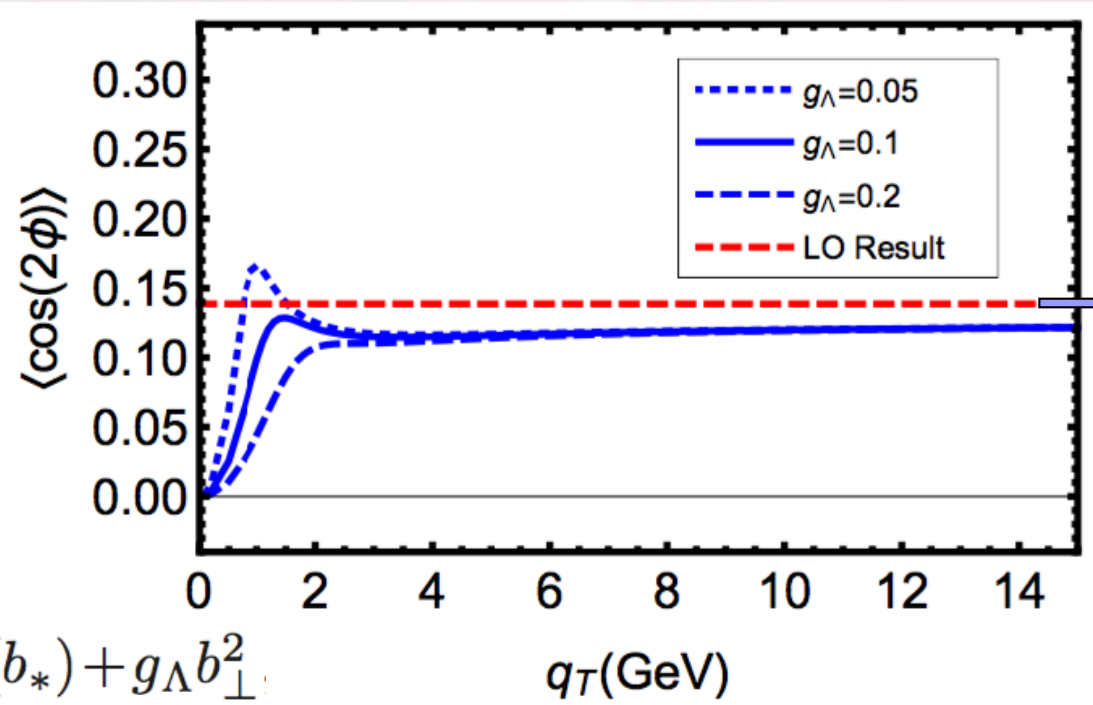
CMS

Kinematics:

P_T~35GeV

R=0.4

y_1=y_2



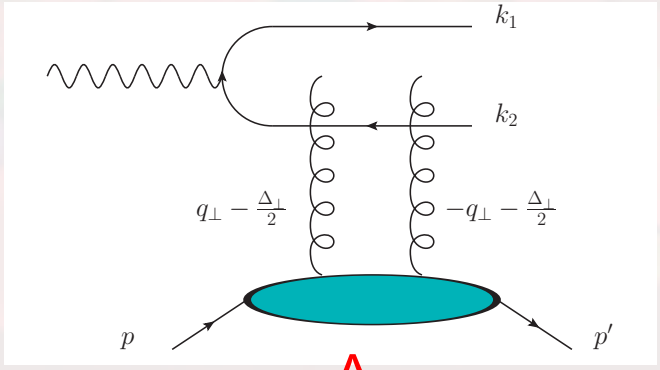
$\alpha_2/\alpha_0 \approx 0.14$

Non-pert. input:

$$\Gamma_0(b_\perp) \Longrightarrow \Gamma_0(b_*) + g_\Lambda b_\perp^2$$

Comments

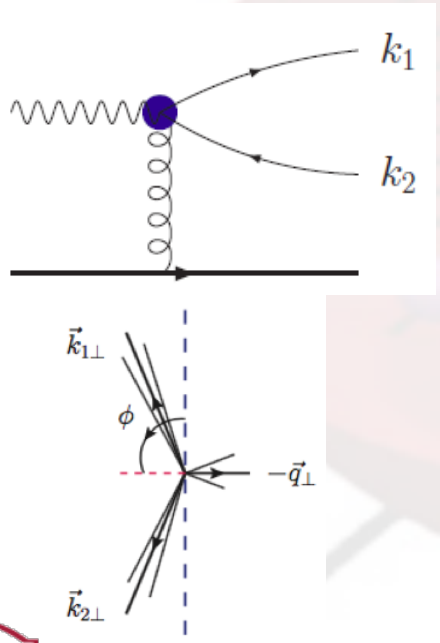
- To avoid the soft gluon radiation contribution, we need to reconstruct nucleon/nucleus recoil momentum to study the tomography

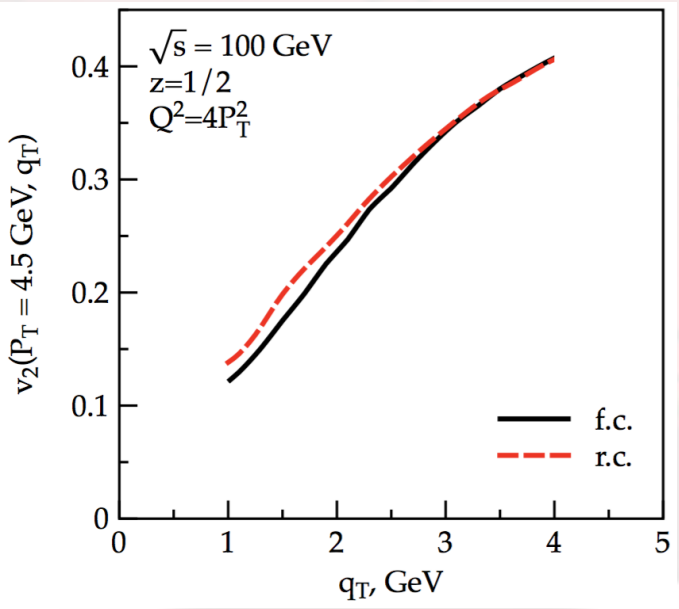


Δ_T

Cos(2ϕ) anisotropy has been widely applied for EIC…

- Probe the linearly polarized gluon distribution calculation





CGC calculation: Dumitru-Lappi-Skokov, 1508.04438

see also,
Boer-Brodsky-Mulders-Pisano 1011.4225
Metz-Zhou, 1105.1991
Boer et al., 1702.08195, 1605.07934
Mantysaari et al., 1902.05087, 1912.05586

Discussions

- For jet measurements, we need tracking
  - Kinematic reach, more studies needed
- For exclusive observables, we need measurement on the recoiled nucleon
  - Detector requirement
  - Luminosity requirement
- …