



# Overview of jet physics at the EIC

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**Fudan University**

**JAQ2026**

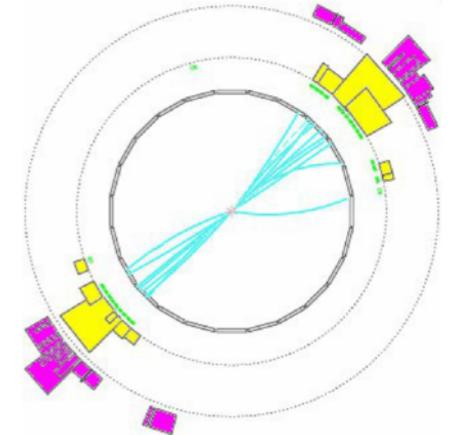
**CCNU**

**01.25.2026**

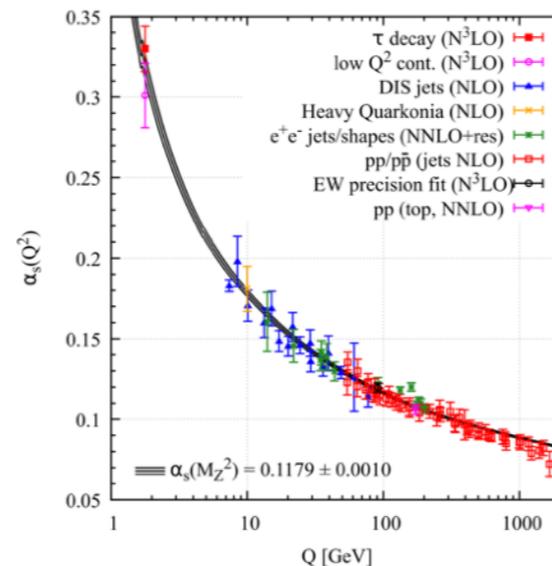
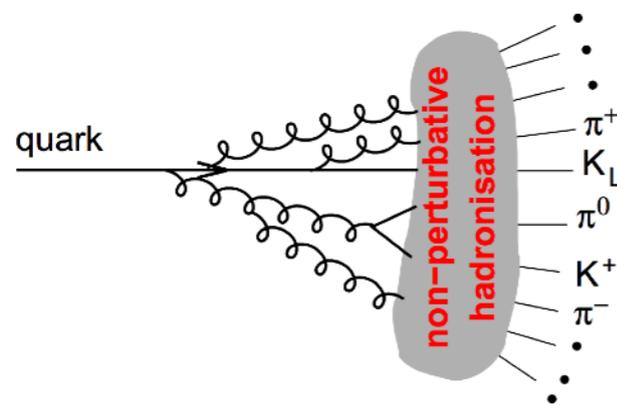
# QCD and jets

QCD: non-abelian Yang-Mills theory

$$\mathcal{L} = \sum_q \bar{\psi}_{q,a} (i\gamma^\mu \partial_\mu \delta_{ab} - g_s \gamma^\mu t_{ab}^C \mathcal{A}_\mu^C - m_q \delta_{ab}) \psi_{q,b} - \frac{1}{4} F_{\mu\nu}^A F^{A\mu\nu}$$



Parton (quark or gluon) fragmentation and hadronization



Jets are emergent property of QCD

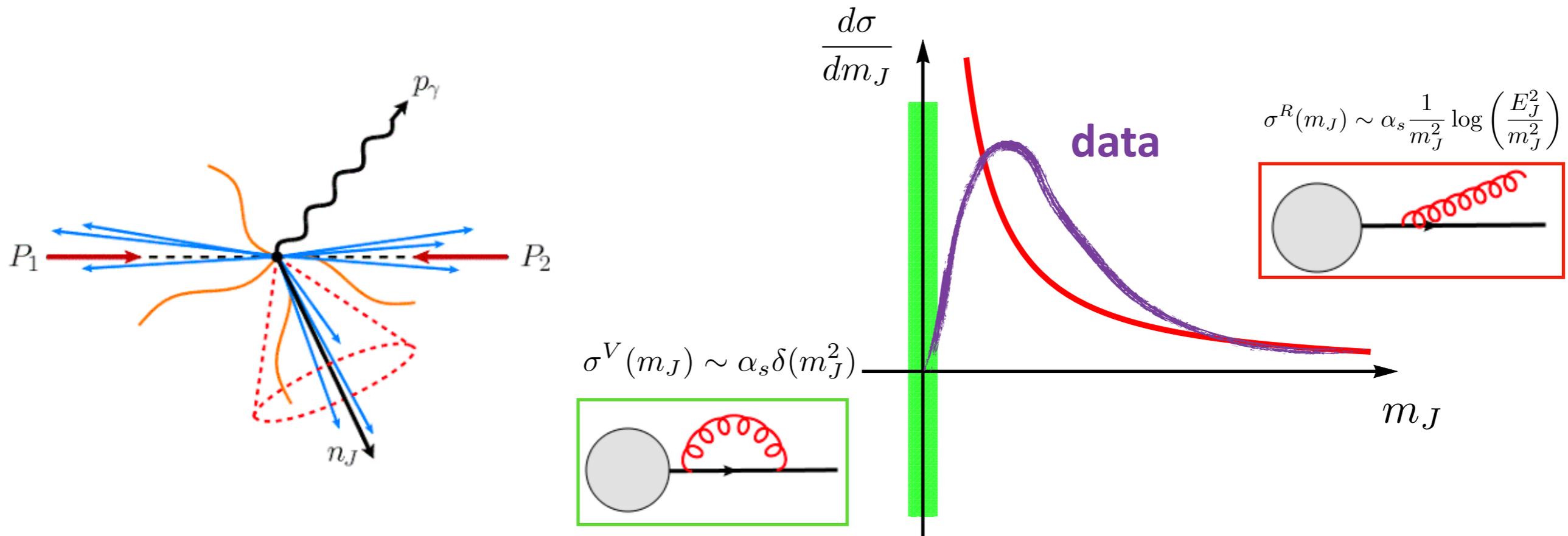
- Soft-collinear singularity
- Asymptotic freedom
- Color string breaks

Sterman, Weinberg '77

Dynamics of jets formation: from short to long distance in quantum field theory

$$J(\text{scale } \mu_2) \sim J(\text{scale } \mu_1) \exp \left[ \int_{\mu_1}^{\mu_2} \frac{d\mu'}{\mu'} \int dx P(x, \alpha_s(\mu')) \right]$$

# Jets evolution



- **Fixed order in  $\alpha_s$  fails if  $L \gg 1$**

- **Accounts for all terms  $\sim \alpha_s^n L^{2n}$**

- **All order results generally exponentiate**

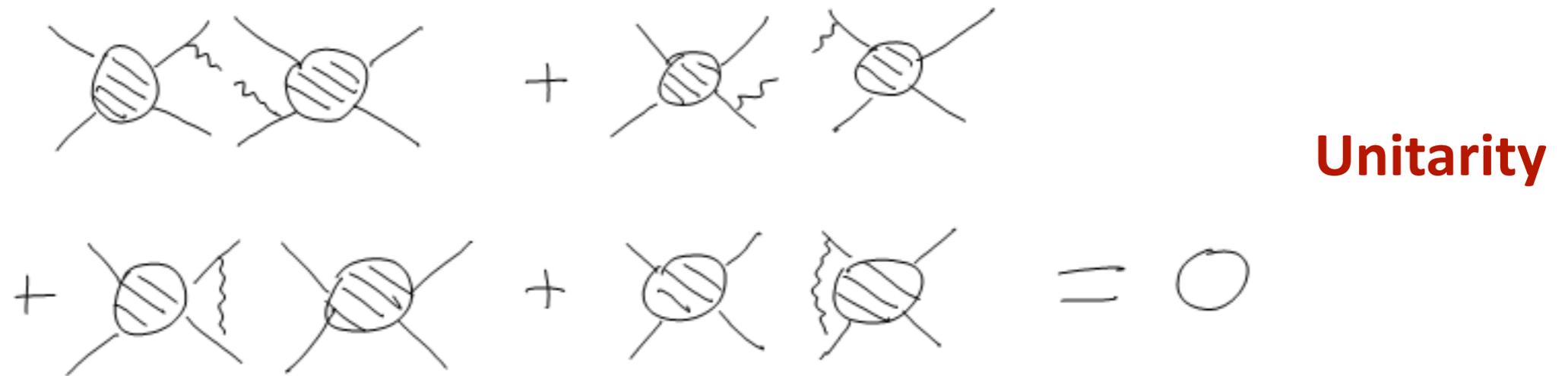
$$\frac{d\sigma}{dm_J} = \frac{d}{dm_J} \left[ \sigma_0 \exp\left(-\frac{\alpha_s C_F}{2\pi} L^2\right) \right]$$

$$L = \log(E_J^2/m_J^2)$$

$$\sigma \sim \sigma_0 \exp(\alpha_s L^2 + \alpha_s L + \alpha_s^2 L + \dots)$$

# Soft-collinear enhancement

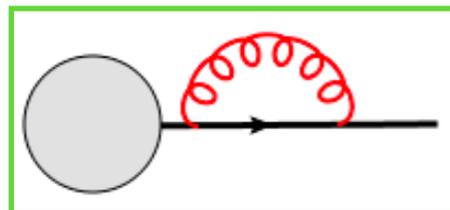
Real & virtual graphs cancel exactly in soft approximation if the real emissions are integrated over without restriction



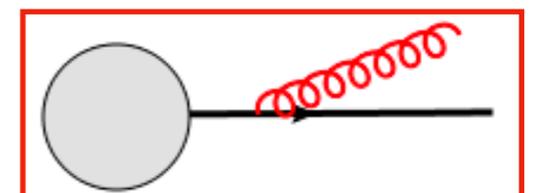
Weighting the real emissions induces a miscancellation and a logarithm

$$\alpha_s \int_0^Q \frac{dk_T}{k_T} - \alpha_s \int_0^\mu \frac{dk_T}{k_T} = \alpha_s \ln \frac{Q}{\mu}$$

Virtual loop



Real emission phase space if emissions forbidden above  $\mu$

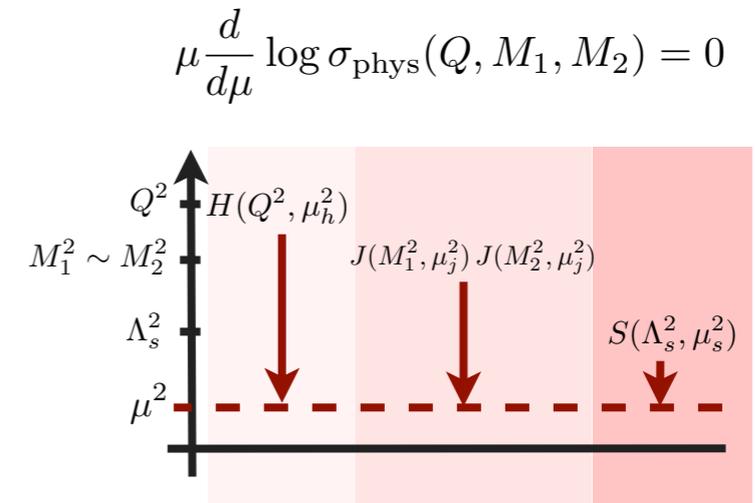


# Two general approaches to evolution

- **Top down:** all-order factorization theorems e.g. Collins-Soper-Sterman, Soft-Collinear Effective Theory, . . .

- All-order structure manifest

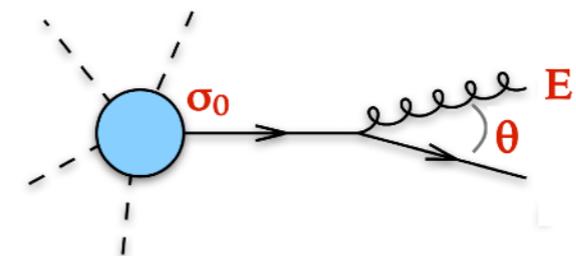
$$\sigma(Q, M_1, M_2) = H(Q^2, \mu) \cdot J(M_1^2, \mu) \otimes J(M_2^2, \mu) \otimes S(M_1^2 M_2^2 / Q^2, \mu)$$



- **Bottom up:** corrections to coherent branching. e.g. parton shower, . . .

- Simplifications at a given accuracy Lends itself to automation and Monte Carlo implementation

Probability of emitting gluon: 
$$P_g \simeq \frac{2\alpha_s C_F}{\pi} \int_{Q_0}^Q \frac{dE}{E} \int_{\frac{Q_0}{E}}^1 \frac{d\theta}{\theta}$$



Use a random number (r) to sample pT distribution

$$r = \exp \left[ -\frac{2\alpha_s C_F}{\pi} \ln^2 \frac{p_{T,\max}^2}{p_T^2} \right]$$

See H. T. Li's talk

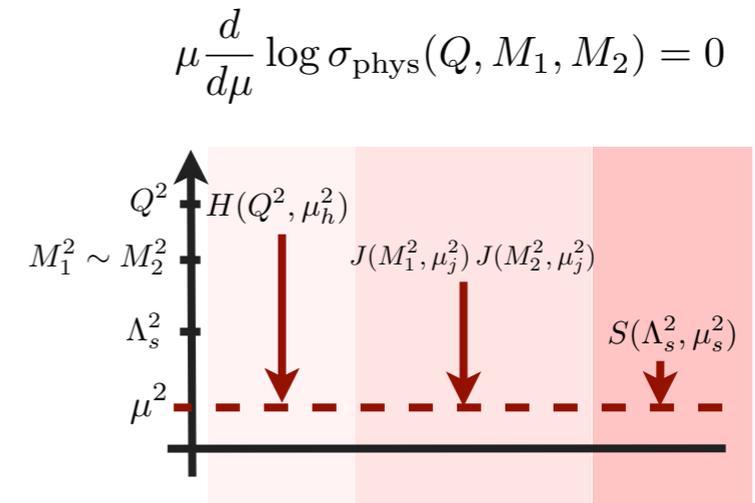
IHEP	ID	IDPDG	IST	M01	M02	DA1	DA2	P-X	P-Y	P-Z	ENERGY	MASS
9	UQRK	94	141	4	6	11	16	2.64	-9.83	592.2	590.2	-49.07
10	CONE	0	100	4	5	0	0	-0.27	0.96	0.1	1.0	0.00
11	GLUON	21	2	9	12	32	33	-1.02	3.59	5.6	6.7	0.75-
12	GLUON	21	2	9	13	34	35	0.25	1.46	3.6	4.0	0.75-
13	GLUON	21	2	9	14	36	37	-0.87	1.62	4.7	5.1	0.75-
14	GLUON	21	2	9	15	38	39	-0.81	4.17	3611.7	3611.7	0.75-
15	GLUON	21	2	9	16	40	41	-0.19	-1.01	1727.7	1727.7	0.75-
16	UD	2101	2	9	25	42	41	0.00	0.00	1054.6	1054.6	0.32-
17	GLUON	94	142	5	6	19	21	-2.23	0.44	-233.5	232.8	-18.36
18	CONE	0	100	5	8	0	0	0.77	0.64	0.2	1.0	0.00
19	GLUON	21	2	17	20	43	44	1.60	0.58	-2.1	2.8	0.75
20	UD	2101	2	17	21	45	44	0.00	0.00	-2687.6	2687.6	0.32
21	UQRK	2	2	17	32	46	45	0.63	-1.02	-4076.9	4076.9	0.32

# Two general approaches to evolution

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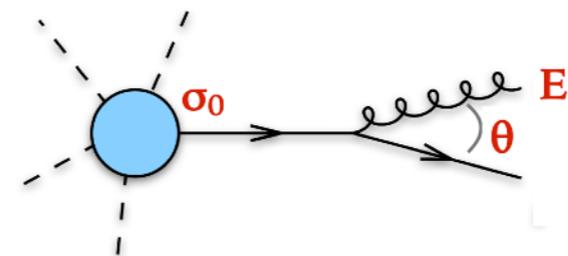
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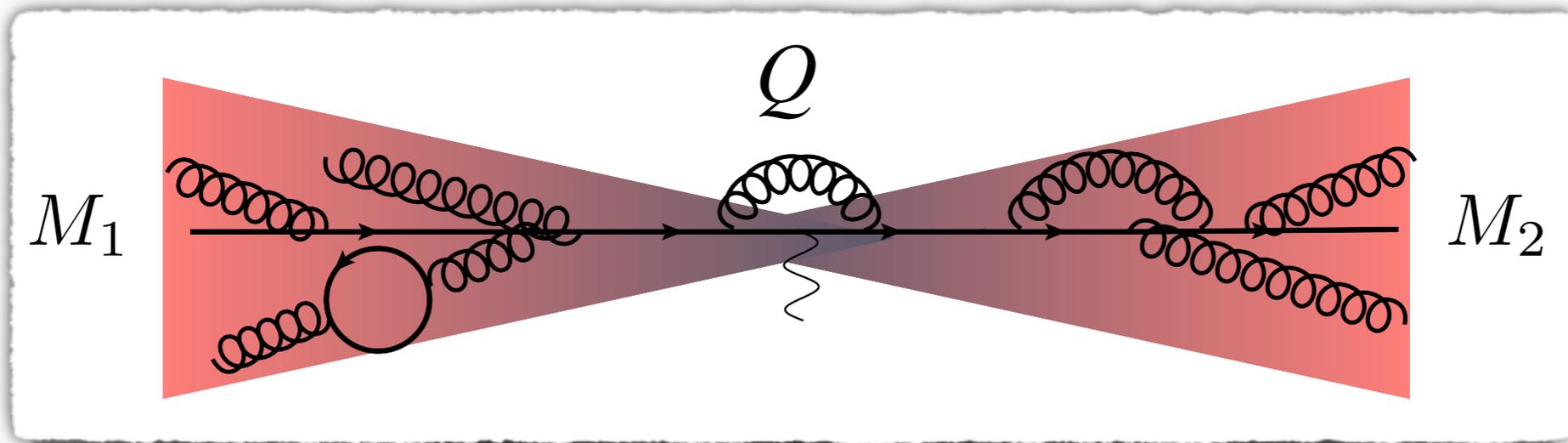
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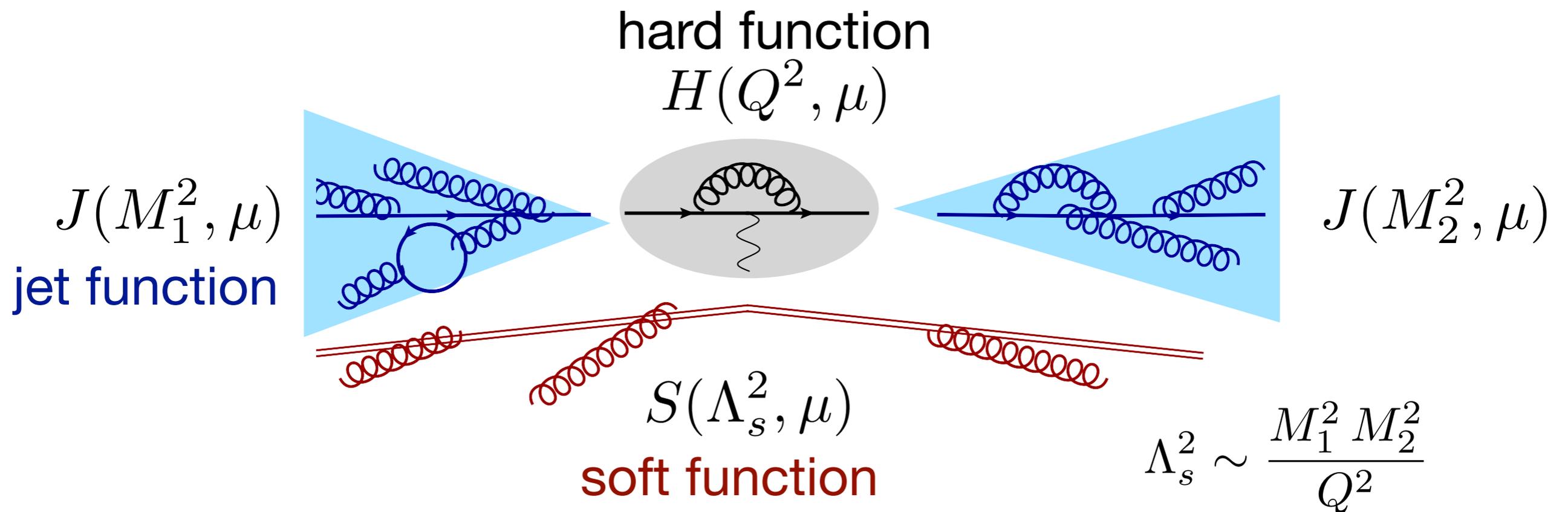
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# Soft-Collinear Factorization



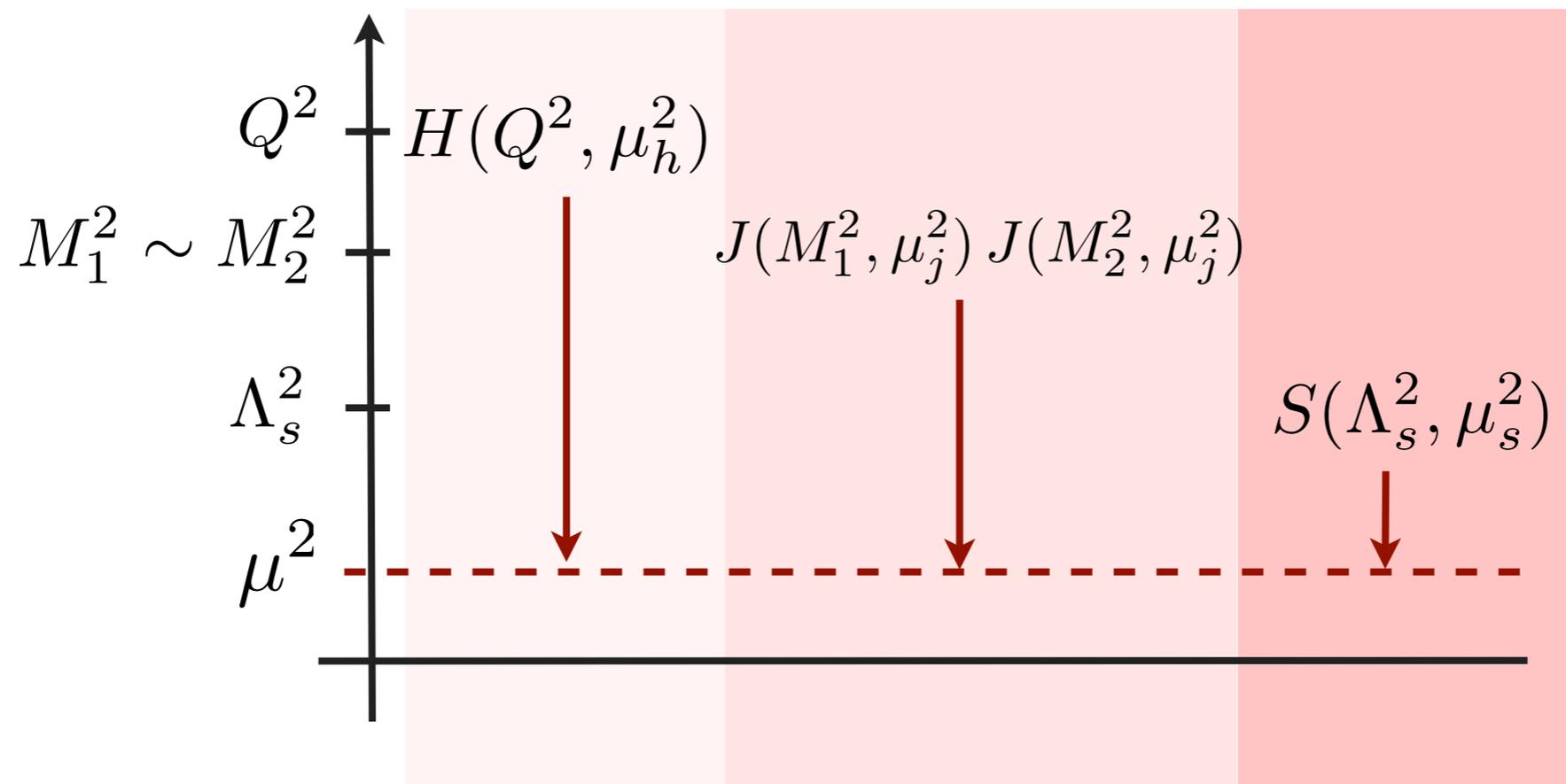
For  $M_1 \sim M_2 \ll Q$  the cross section  $\sigma_{\text{phys}}(Q, M_1, M_2)$  factorizes:



# All-order evolution equation

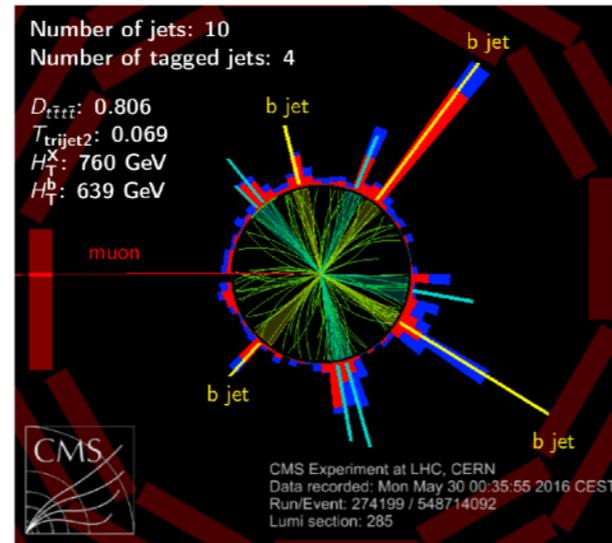
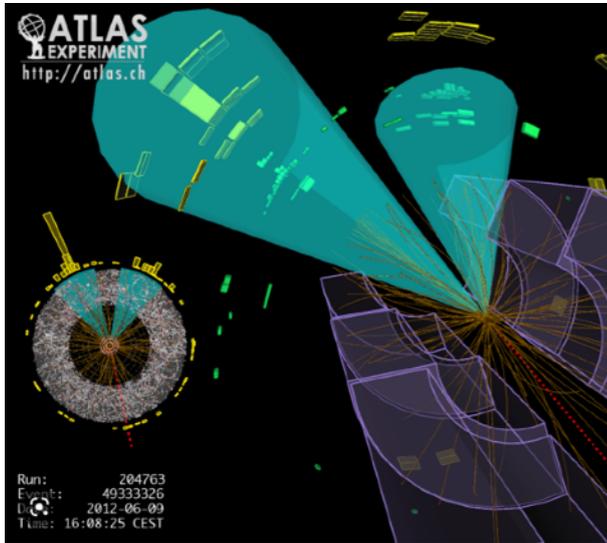
$$\mu \frac{d}{d\mu} \log \sigma_{\text{phys}}(Q, M_1, M_2) = 0$$

Evaluate each part at its characteristic scale, evolve to common reference scale  $\mu$



# Jets at the LHC

Jets are produced copiously at the LHC



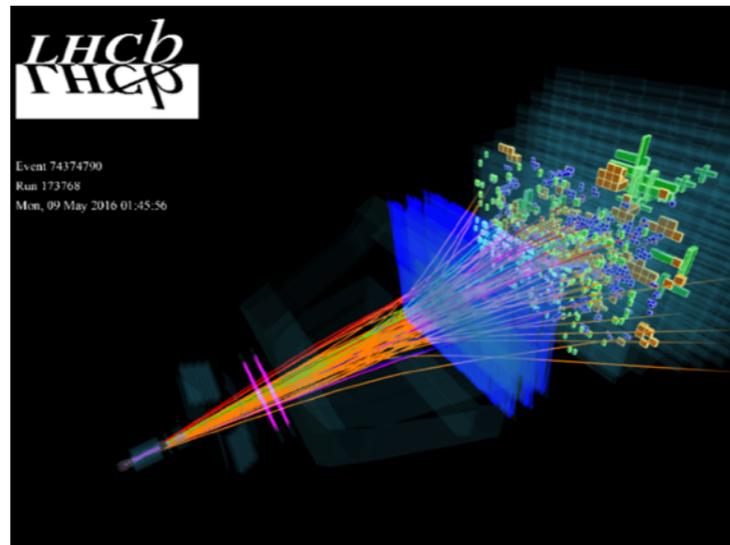
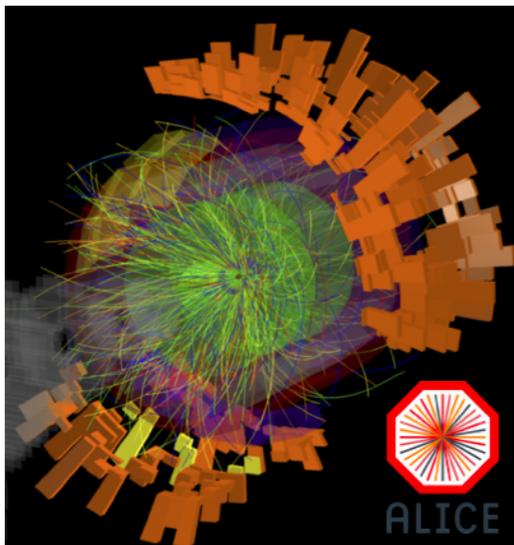
Not jets (QED jets?):  $e \mu \gamma$

Tau jets:  $\tau$

Light Jets:  $u d s g$

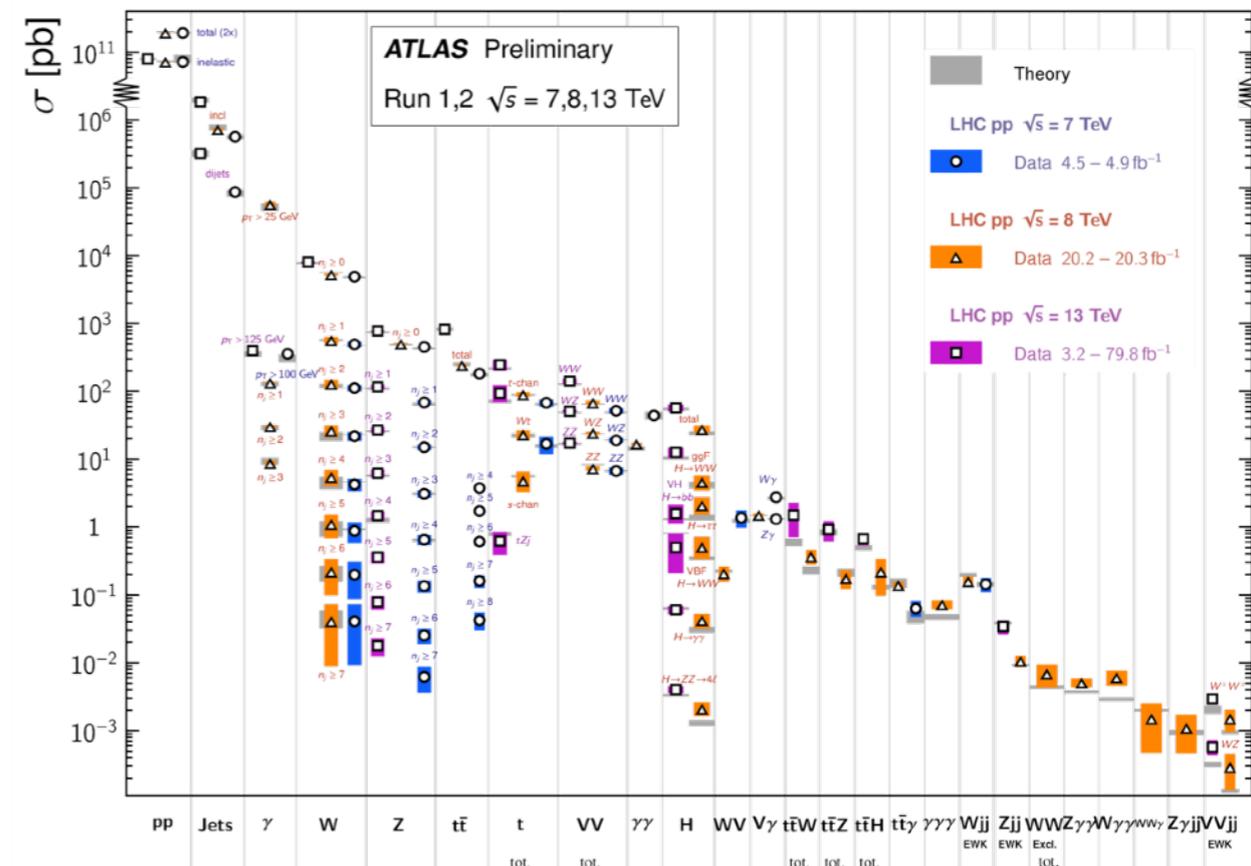
Heavy Jets:  $c b$

Fat Jets:  $W Z H t$



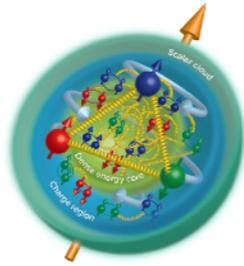
Standard Model Production Cross Section Measurements

Status: July 2018

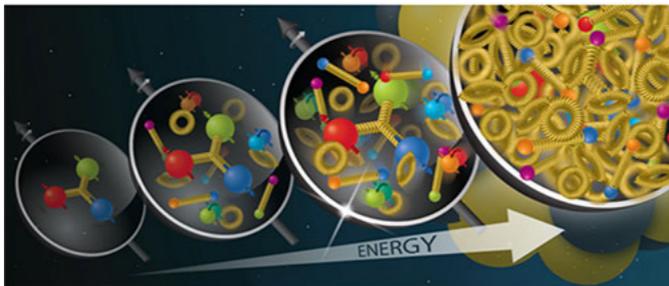


# EIC physics

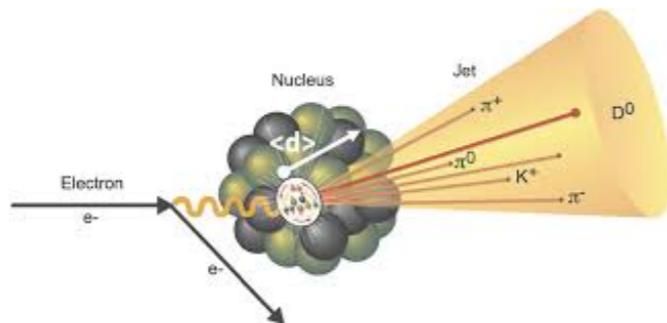
- Quantum Imaging of protons and nuclei



- A new form of matter - color glass condensate



- Hadronization in cold nuclear matter



## EIC wish list

### Regarding DATA

- Measure cross-sections instead of ratios for a more dedicated analysis
- Release both QED corrected and uncorrected data
- Develop method for unbinned cross-sections

### Regarding PDFs, FFs and other distributions

- Replication of PDF4LHC and HERA efforts for EIC : PDF4EIC
- Perform global NNLO analysis of polarized PDFs
- Impact of QED corrections on polarized PDFs
- Perform global analysis of DVCS
- Generate threshold resummed PDFs and FFs
- New set of photon PDFs (existing are outdated)

### Regarding Perturbative corrections (QCD/QED)

- Jets in DIS: matched NNLO +  $q_T$  resummation
- DIS with QED/EW corrections
- Calculations for dihadron production

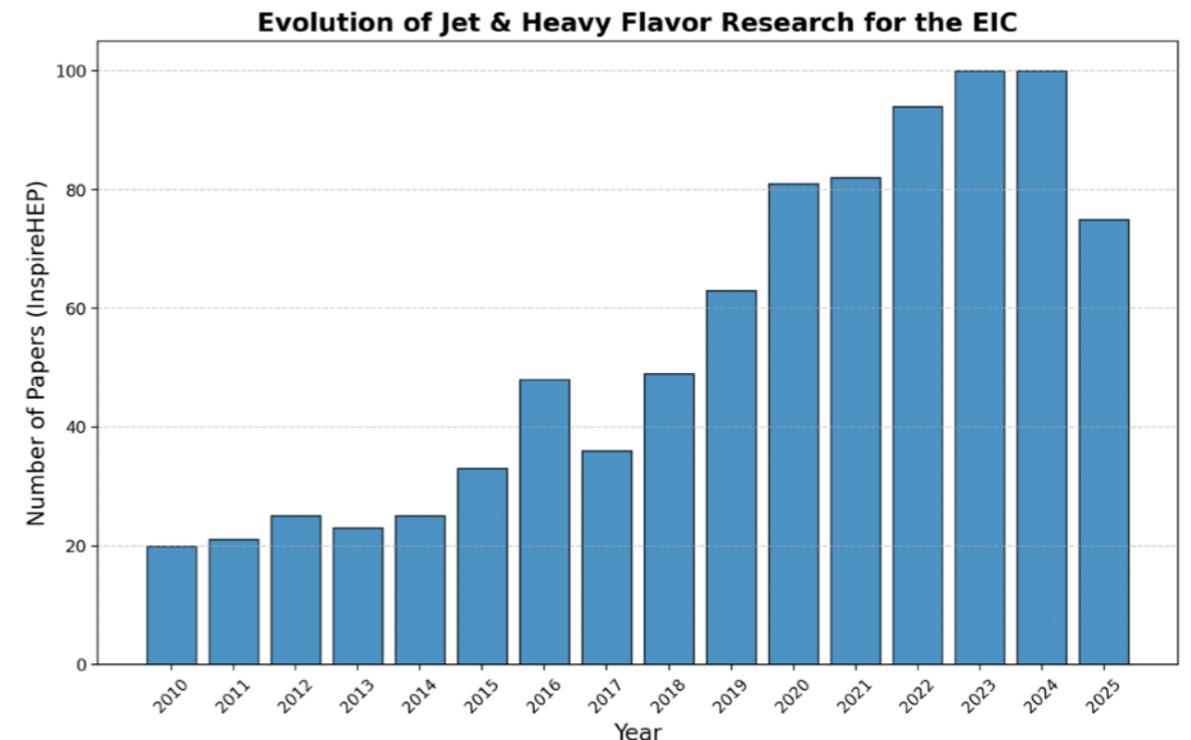
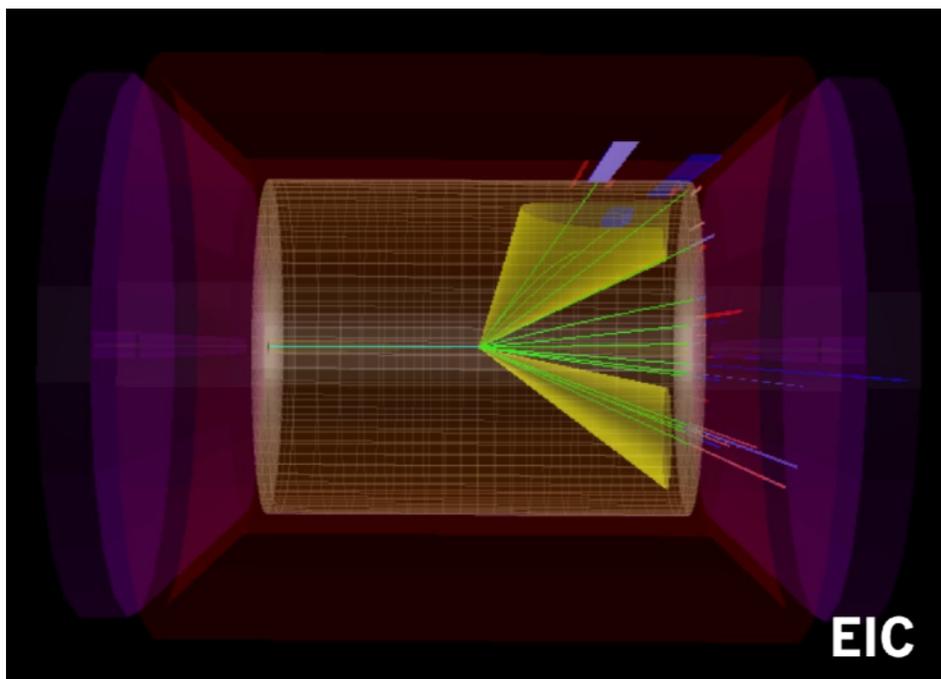
### Regarding Theoretical Issues

- Discuss (non)universality of TMDs
- Search for ideal observables to measure Wigner distribution
- Role of lattice in PDFs (in two slides!)
- Studies for  $\Lambda$  polarization at EIC
- $N^*$ ,  $\Delta$  electro-couplings at  $Q^2 > \text{GeV}^2$
- Proton structure functions from transition regime to DIS
- Small- $x$  dipole and quadrupole amplitudes

**Jets are useful tools in all three directions**

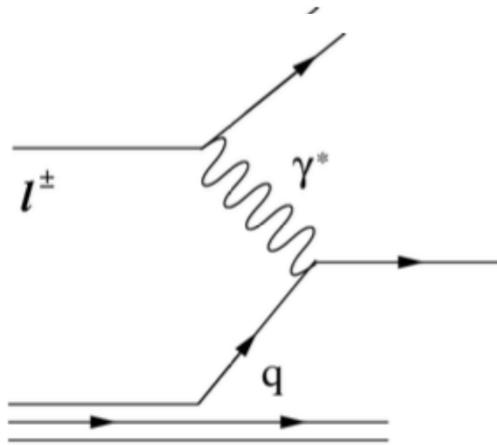
# Jet physics at the EIC

- **High luminosity**
  - **1000 higher luminosity than HERA**
- **Jets with polarization**
  - **EIC will produce the first-ever jets in polarized electron-hadron scattering**
- **Cleanliness vs. Complexity**
  - **Low transverse momentum**
  - **Significantly reduced underlying event contamination**
  - **Fewer particles and moderate energies per jet compared to LHC**

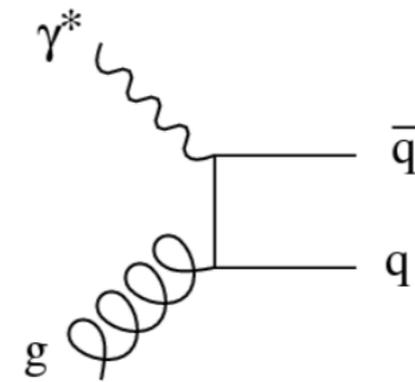


# Jets production at the EIC

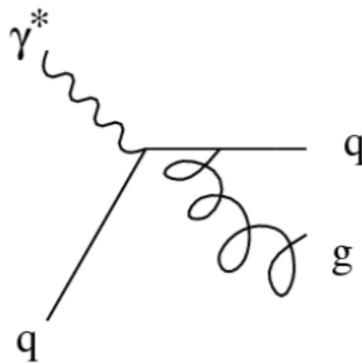
## DIS



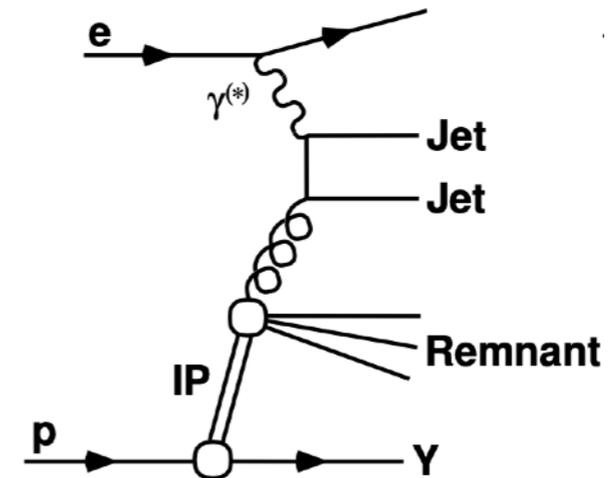
## Photon-gluon fusion



## Compton scattering

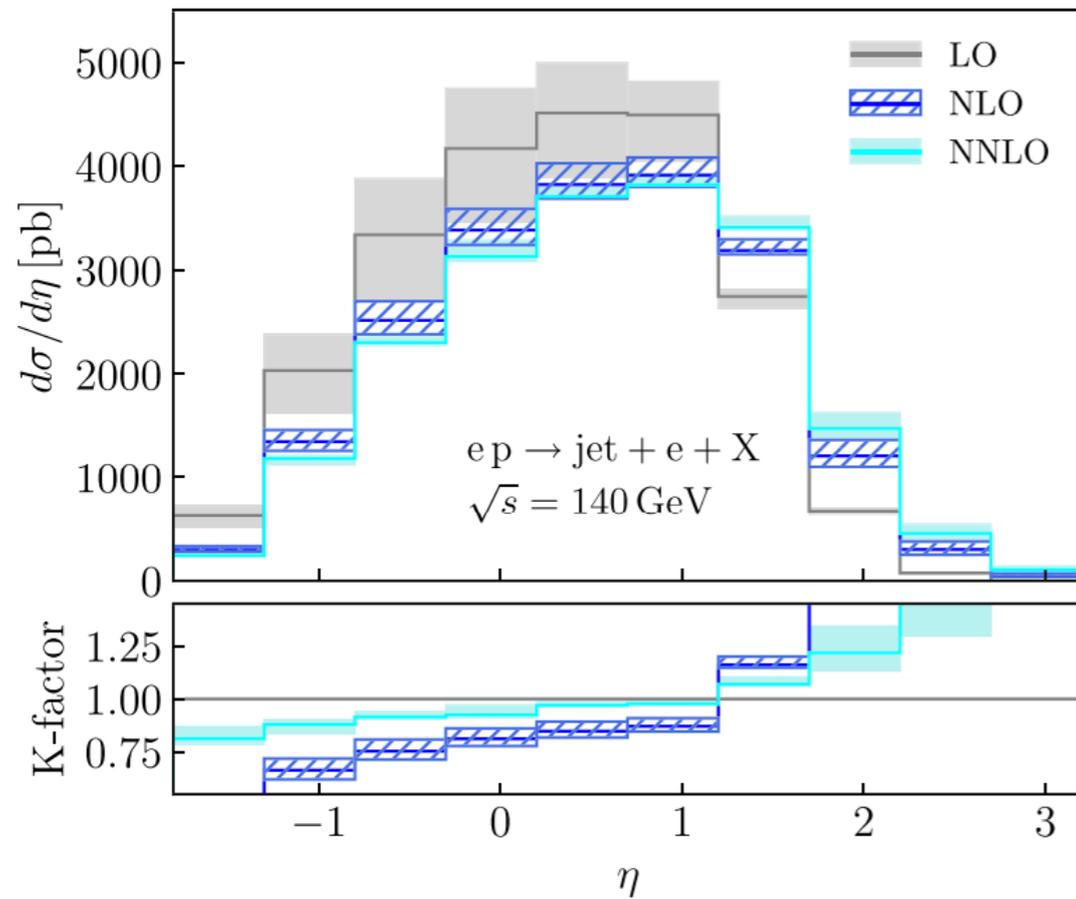


## Diffraction

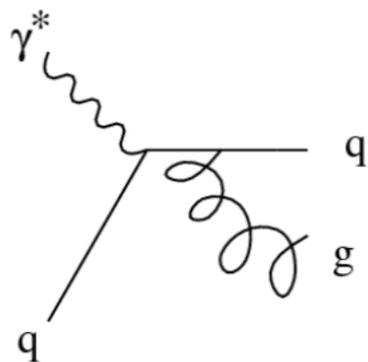


# 1D Imaging: Jets cross section @ EIC—NNLO frontier

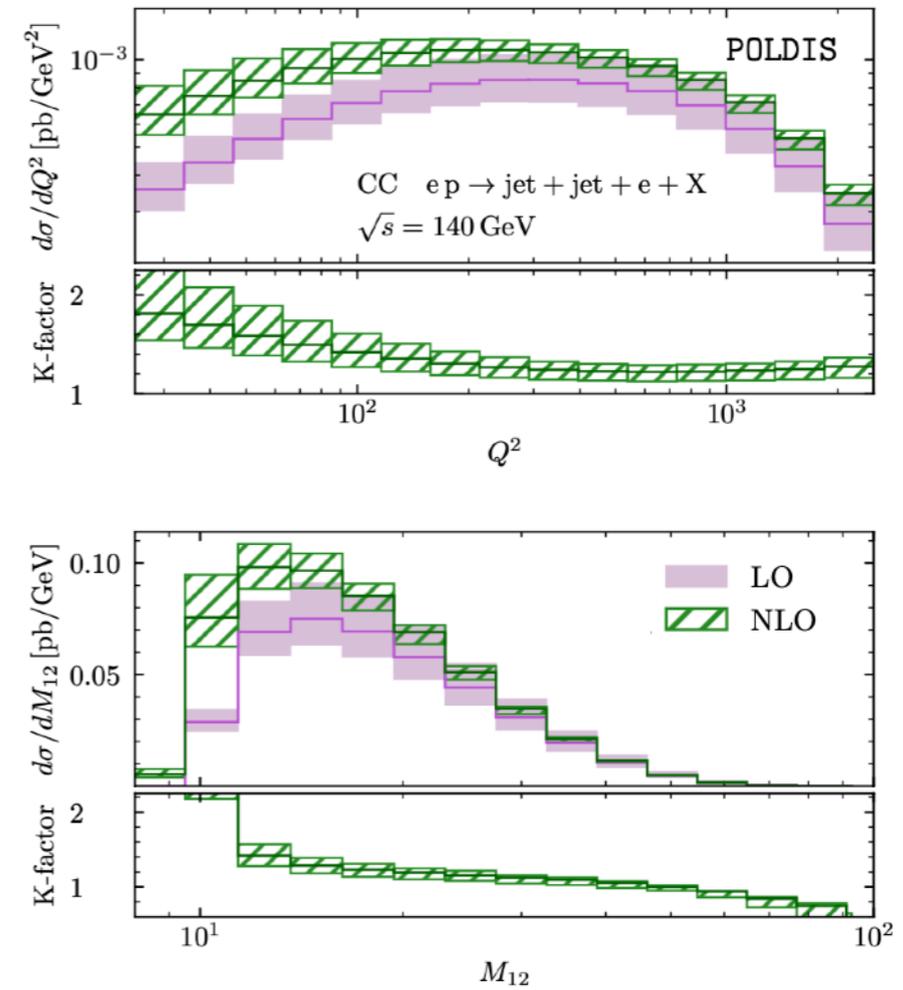
$$\vec{e} + \vec{p} \rightarrow j + X$$



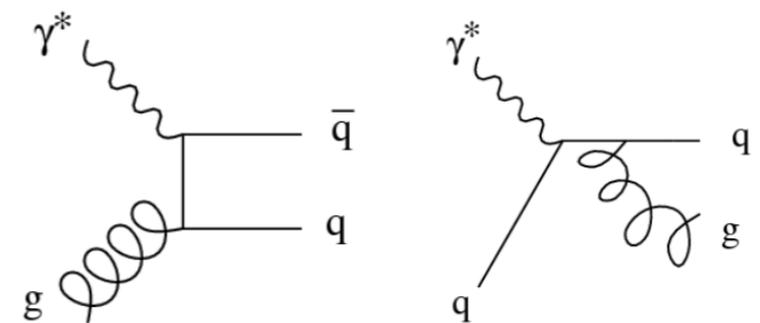
Borsa, de Florian, Pedron, '20, '21



$$e + \vec{p} \rightarrow e + j_1 + j_2 + X$$

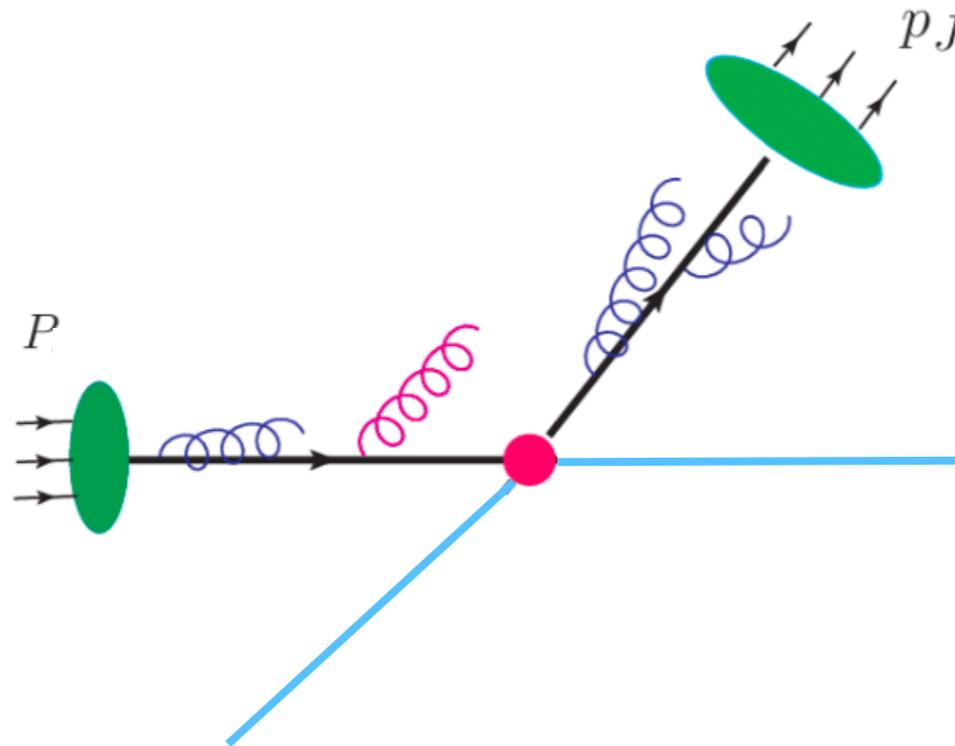


Borsa, de Florian, Pedron, '21



# Collinear factorization formula

$$d\sigma_{ep \rightarrow eJX} = \sum_i \int dx f_i(x) d\sigma_{ei \rightarrow eJX}(xP) F_J(P_J) [1 + \mathcal{O}(\Lambda_{\text{QCD}}^2/Q^2)]$$



**A key challenge in precision QCD calculations is handling infrared (IR) divergences, which must cancel between real and virtual emissions.**

# Two main approaches for the cancellation of IR divergences

- **Slicing**

$$\int |\mathcal{M}|^2 F_J d\phi_d = \int_0^\delta [|\mathcal{M}|^2 F_J d\phi_d]_{\text{sing}} + \int_\delta^1 |\mathcal{M}|^2 F_J d\phi_4 + \mathcal{O}(\delta)$$

- **Non-local in phase space;**
- **Large cancellations between singular and regular terms;**
- **Straightforward to implement;**

- **Subtraction**

$$\int |\mathcal{M}|^2 F_J d\phi_d = \int [|\mathcal{M}|^2 F_J - S] d\phi_4 + \int S d\phi_d$$

- **Local in phase space;**
- **Potentially, offers better numerical stability;**
- **More difficult conceptually;**

# qT-slicing for multi-jets

Fu, Rahn, DYS, Waalewijn, Wu PRL135 (2025) 171903

- $p_T^n$  -weighted recombination scheme

$$p_{t,r} = p_{t,i} + p_{t,j},$$

$$\phi_r = (w_i \phi_i + w_j \phi_j) / (w_i + w_j)$$

$$y_r = (w_i y_i + w_j y_j) / (w_i + w_j)$$

$$w_i = p_t^n \quad n \rightarrow \infty$$

**Winner-take-all scheme**

(Bertolini, Chan, Thaler '13)



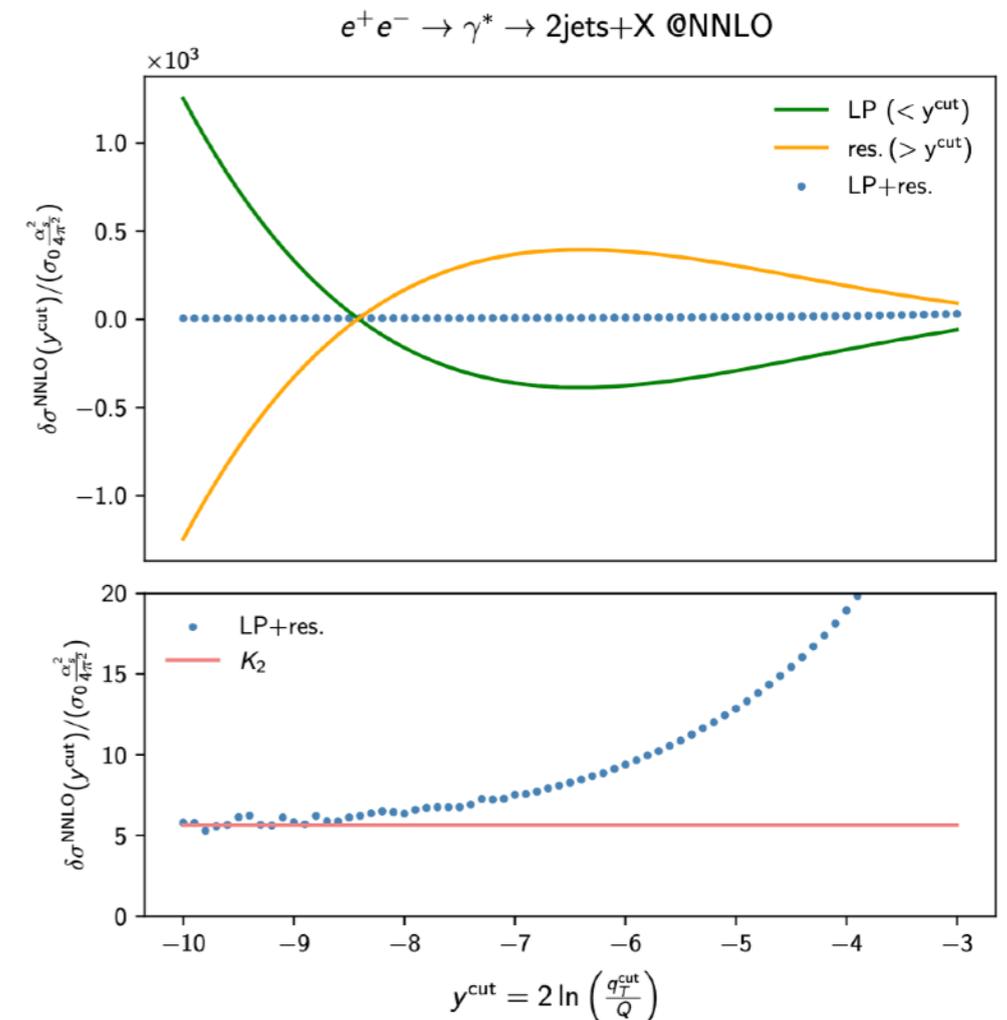
- We propose two ways of extending qT slicing to processes with jets: **The key ingredient is the use of a recoil-free WTA jet axis**

- **Azimuthal decorrelation:  $\delta\phi$  or  $q_x$**

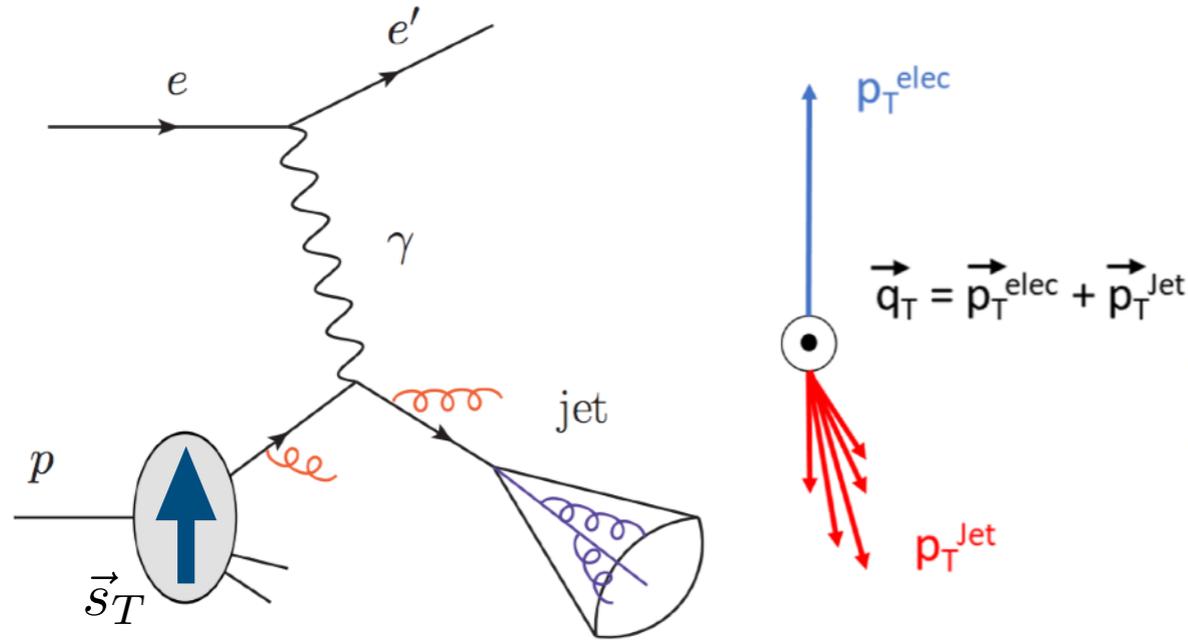
$$q_x = p_{x,1} + p_{x,2}$$

- **Total transverse momentum qT**

$$\vec{q}_T = \sum_{i=\text{jets}, V, \dots} \vec{p}_{T,i}$$



# QCD jets and 3D proton imaging at the EIC



- Recent investigations at both the RHIC and LHC have validated jets as effective tools for probing the spin structure of the nucleon.

- Jets are complementary to standard SIDIS extractions of TMDs

- Jet measurements allow independent constraints on TMD PDFs and FFs from a single measurement

- Azimuthal correlation between jet and lepton sensitive to TMD PDFs (X. Liu, Ringer, Vogelsang, Yuan '19, Arratia, Kang, Prokudin, Ringer, '20; Kang, Lee, DYS, Zhao, '21 ...)

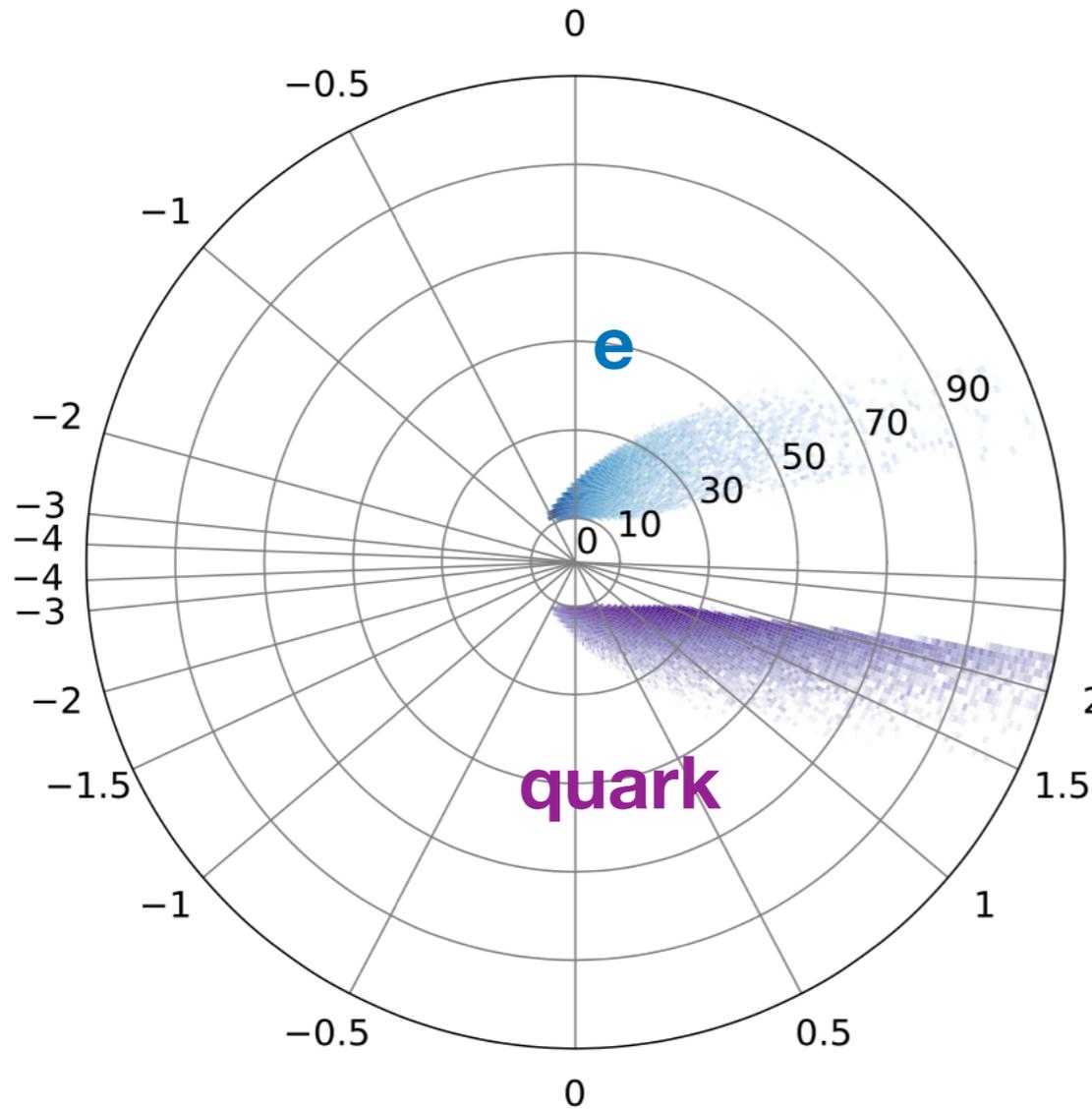
Leading Quark TMDPDFs Nucleon Spin Quark Spin

		Quark Polarization		
		Un-Polarized (U)	Longitudinally Polarized (L)	Transversely Polarized (T)
Nucleon Polarization	U	$f_1 = \text{Unpolarized}$		$h_1^\perp = \text{Boer-Mulders}$
	L		$g_1 = \text{Helicity}$	$h_{1L}^\perp = \text{Worm-gear}$
	T	$f_{1T}^\perp = \text{Sivers}$	$g_{1T}^\perp = \text{Worm-gear}$	$h_1 = \text{Transversity}$ $h_{1T}^\perp = \text{Pretzelosity}$

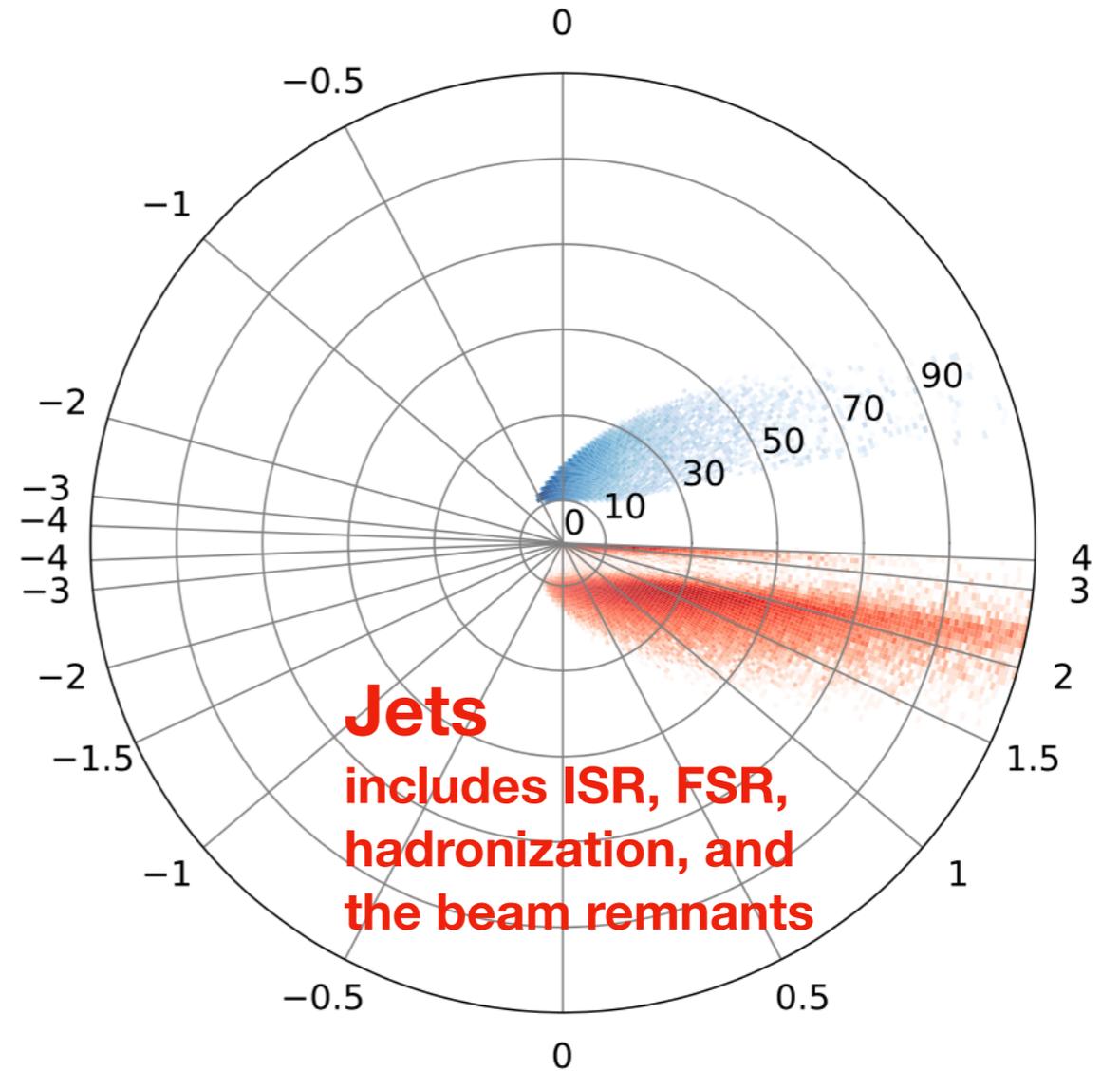
# Simulation results

Arratia, Kang, Prokudin, Ringer '19

10 + 275 GeV,  
 $0.1 < y < 0.85, p_T^e > 10 \text{ GeV}$

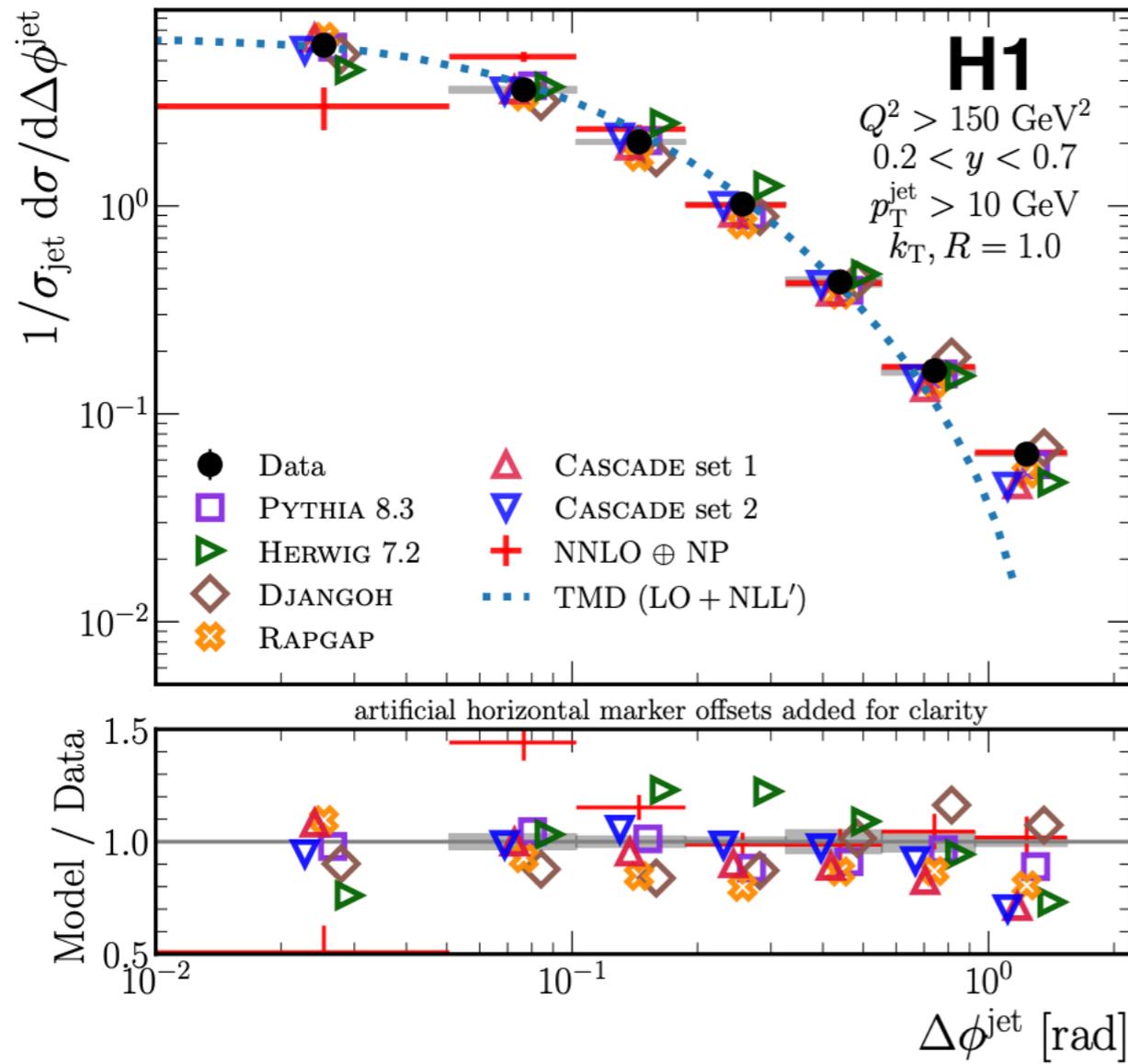


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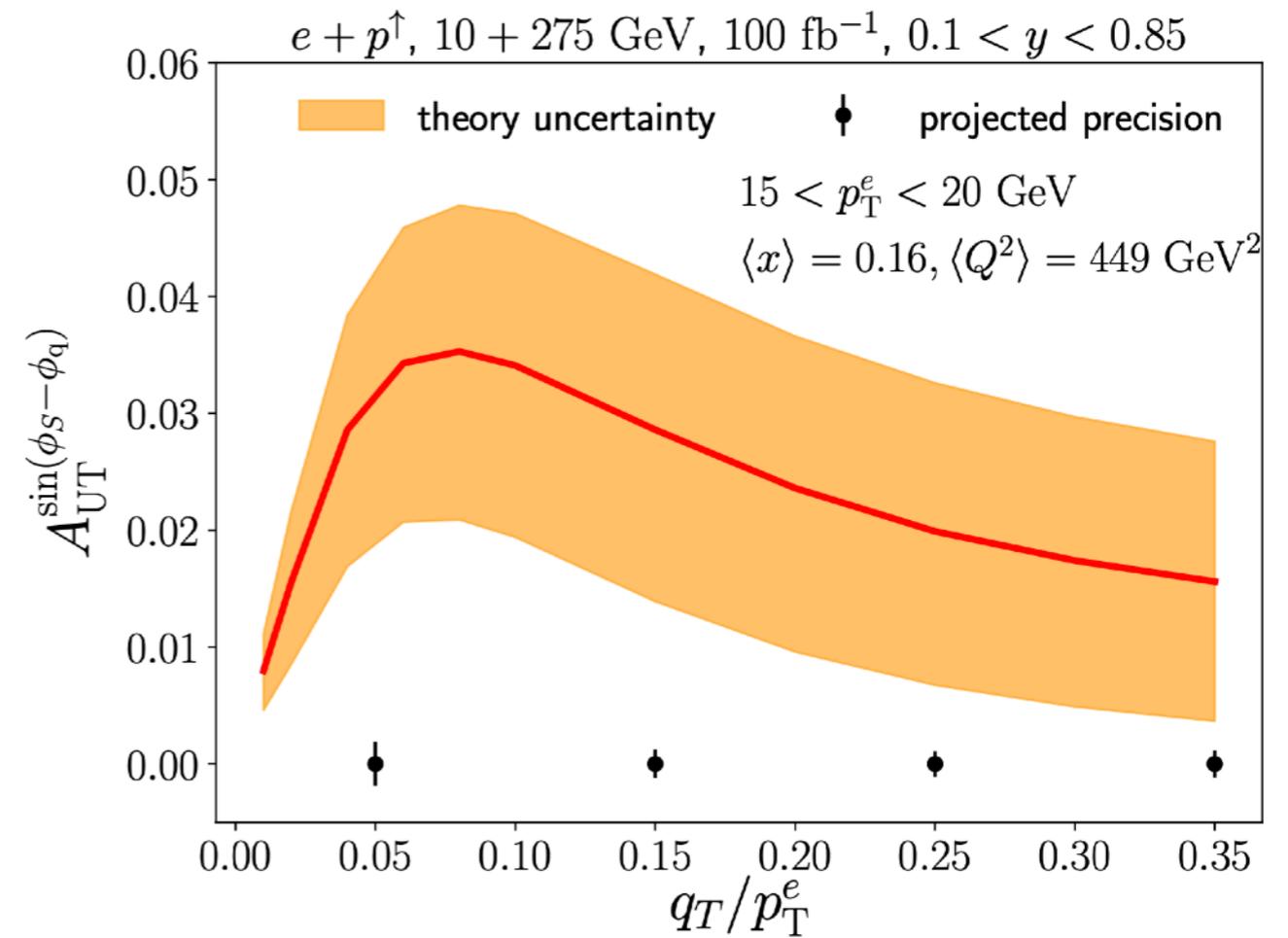


**The jet distribution matches the struck-quark kinematics**

# Theory predictions and measurements in DIS



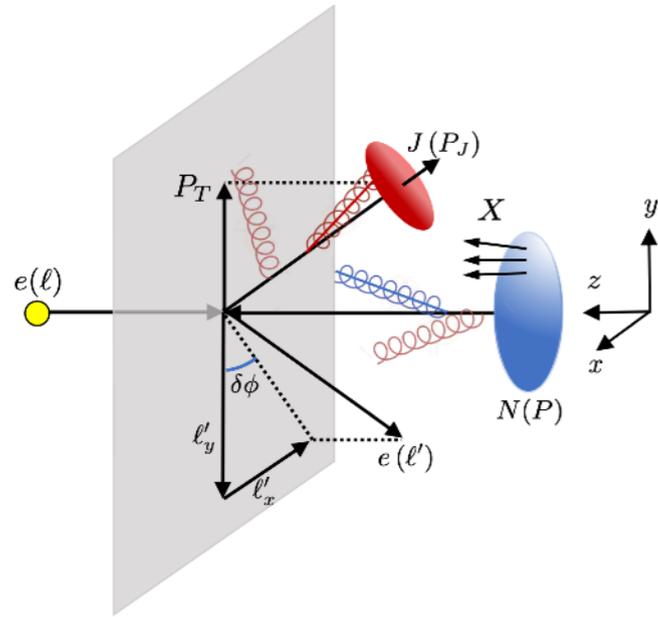
H1 collaboration, '22



Arratia, Kang, Prokudin, Ringer '19

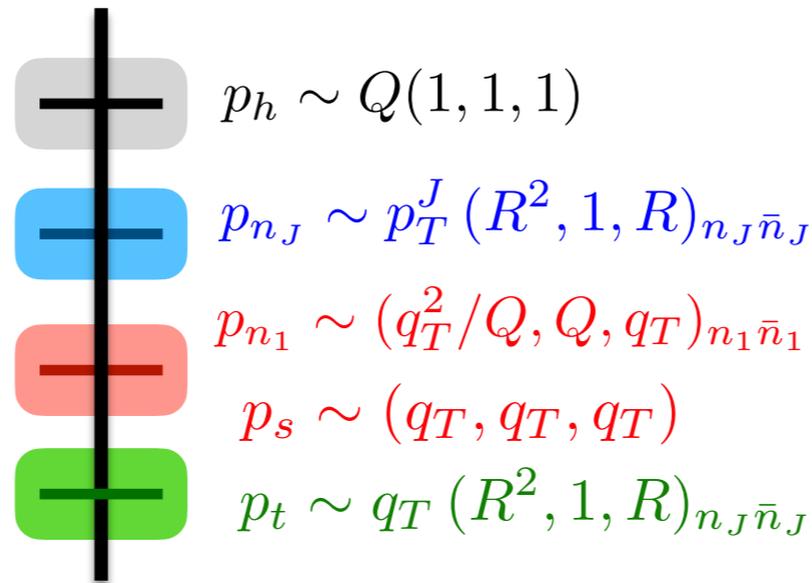
# TMD factorization for electron-jet correlation

$$e(\ell) + N(P) \rightarrow e(\ell') + J(P_J) + X$$



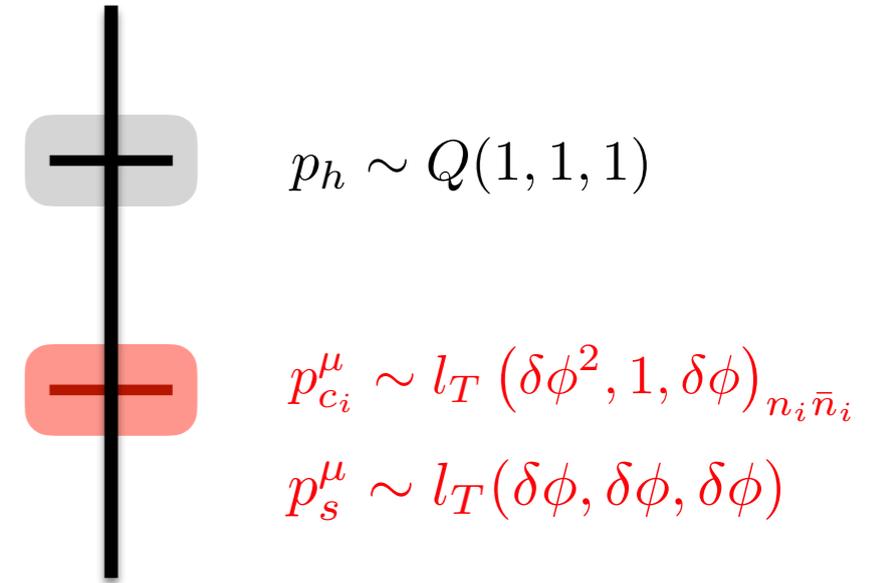
Lab frame

TMD in the limit:  $Q \gg q_T$ ,  
 $1 \gg R$



X. Liu, Ringer, Vogelsang, Yuan '19

*1 >> R is not necessary at the EIC*  
TMD in back to back limit:  $Q \gg q_T \sim l_T \delta\phi$  (WTA jets)



Fang, Ke, DYS, Terry '23

Following the standard steps in SCET and CSS, the TMD factorization theorem for WTA jets

$$\frac{d\sigma}{d^2\ell'_T dy d\delta\phi} = \frac{\sigma_0 \ell'_T}{1-y} H(Q, \mu) \int_0^\infty \frac{db}{\pi} \cos(bl'_T \delta\phi) \sum_q e_q^2 f_{q/N}(x_B, b, \mu, \zeta_f) J_q(b, \mu, \zeta_J)$$

Hard factor

Fourier transformation  
in 1-dim

TMD PDF

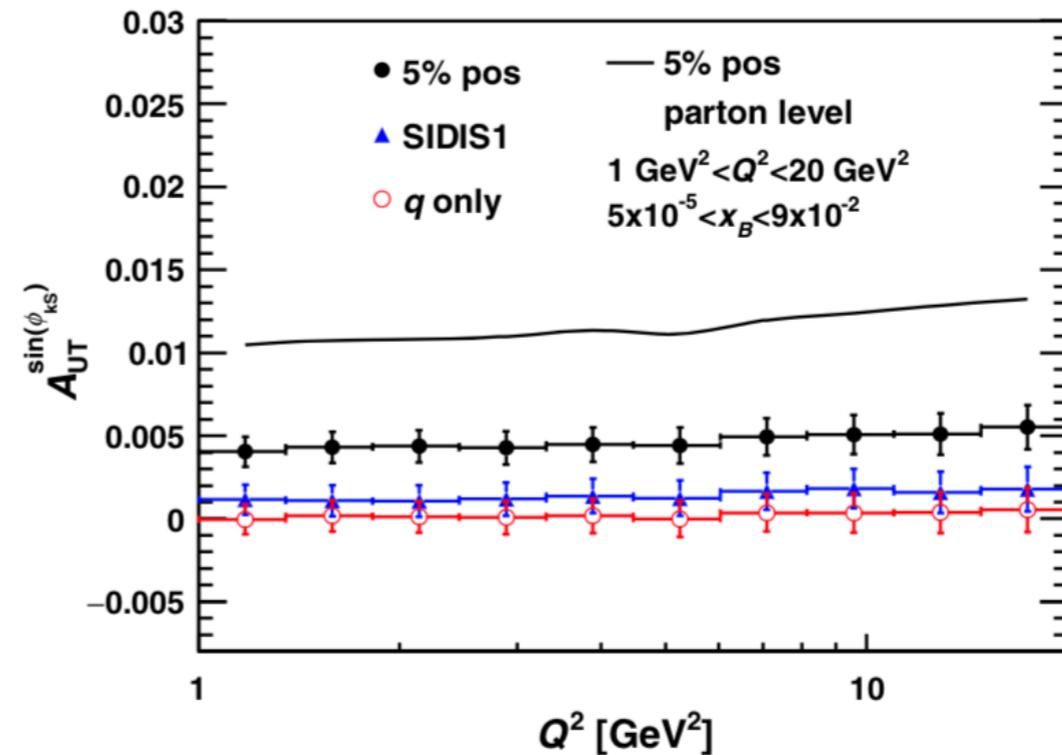
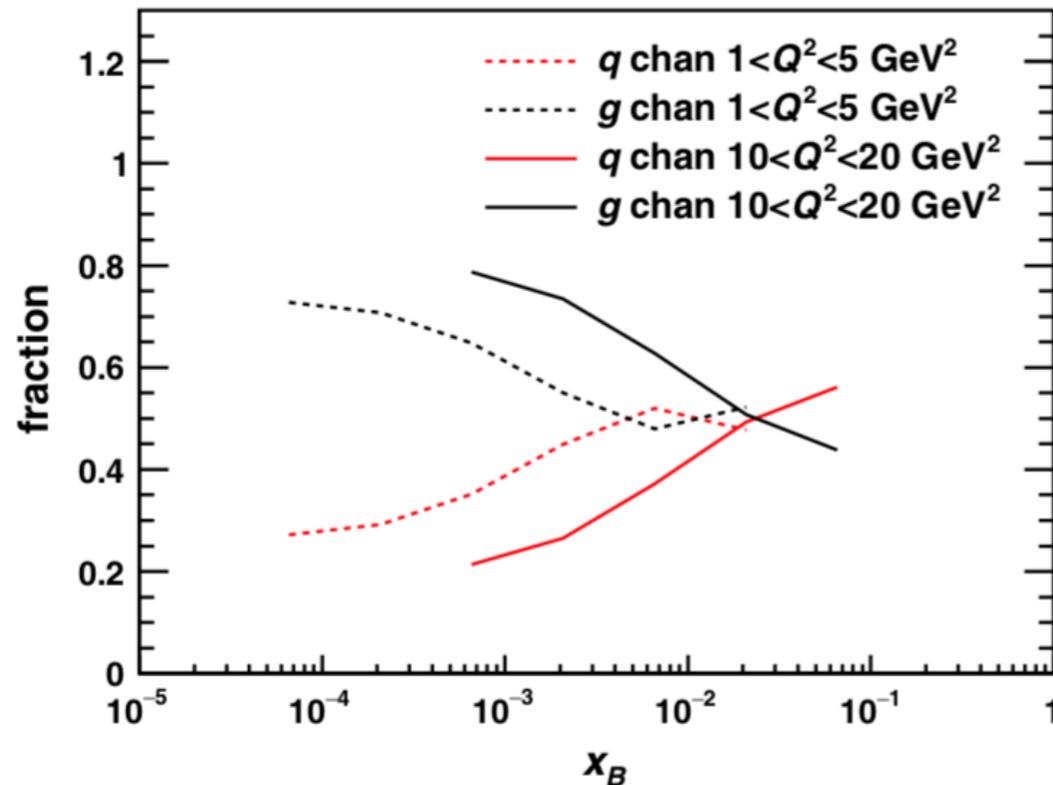
Jet function

# Gluon TMDs in di-jet at the EIC

At the EIC , accessing of gluon TMDs via high- $p_T$  dihadron, open charm, and dijet has been investigated using PYTHIA and reweighing methods in Zheng, Aschenauer, Lee, Xiao, Yin '18 ...

- They find that dijet process is the most promising channel

At the LO di-jet production in DIS involves two processes:  $\gamma^* q \rightarrow qg$      $\gamma^* g \rightarrow q\bar{q}$

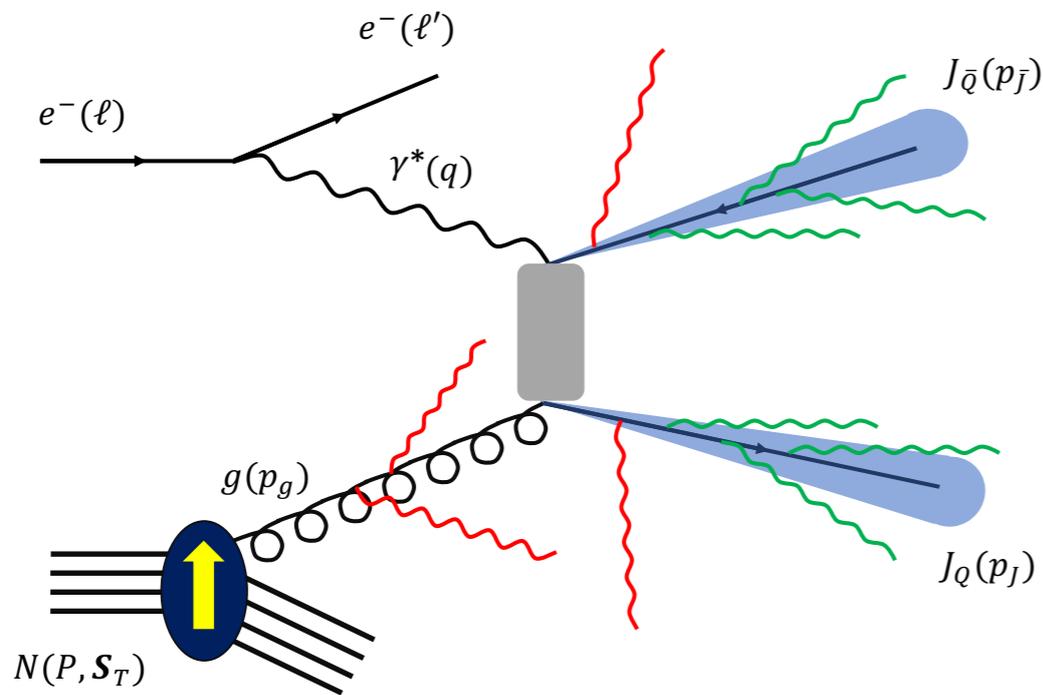


- to distinguish different TMDs
  - jet charge tagging “different quark TMDs” Kang, Liu, Mantry, DYS '20 PRL)
  - Heavy-flavor tagging, where quark-channel starts to contribute beyond the LO (Kang, Reiten, DYS, Terry '20 JHEP)

# TMD factorization for heavy-flavor dijet production in DIS

(Kang, Reiten, DYS, Terry '20 JHEP)

$$e(\ell) + N(P, S_T) \rightarrow e(\ell') + J_Q(p_J) + J_{\bar{Q}}(p_{\bar{J}}) + X$$



In the Breit frame, the dijet imbalance is defined as  $q_T = p_{JT} + p_{\bar{J}T}$

$$q_T R \ll q_T \lesssim m_Q \lesssim p_T R \ll p_T$$

R: Jet radius

$M_Q$ : heavy quark mass

Also see W. J Xing's talk

the factorized form of the spin-independent cross section (SCET<sub>M</sub>)

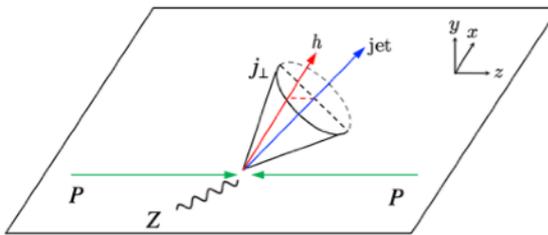
$$d\sigma^{UU} \sim H(Q, p_T) J_Q(p_T R, m_Q) J_{\bar{Q}}(p_T R, m_Q) S(\lambda_T) f_g(k_T) S_Q^c(l_{QT}) S_{\bar{Q}}^c(l_{\bar{Q}T}) \delta^{(2)}(k_T + \lambda_T + l_{QT} + l_{\bar{Q}T} - q_T)$$

- Hard, **soft** and **TMD** functions are the same as light-jet cases, since  $p_T \gg m_Q$
- **Jet** and **collinear-soft** functions are new, which receive finite quark mass correction

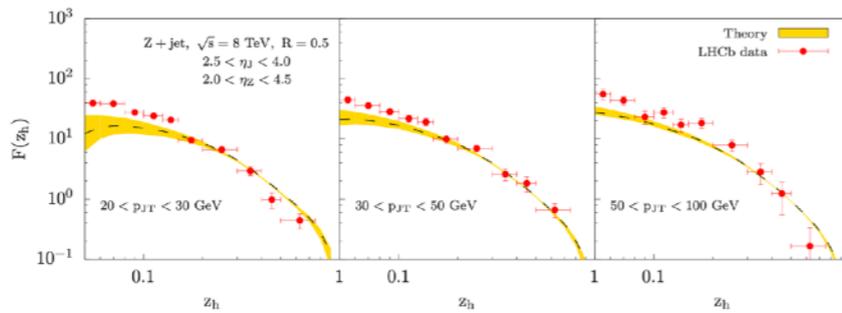
# Jet fragmentation function: hadron inside jets

E.g. Hadrons produced inside Z-tagged jets in proton-proton collisions

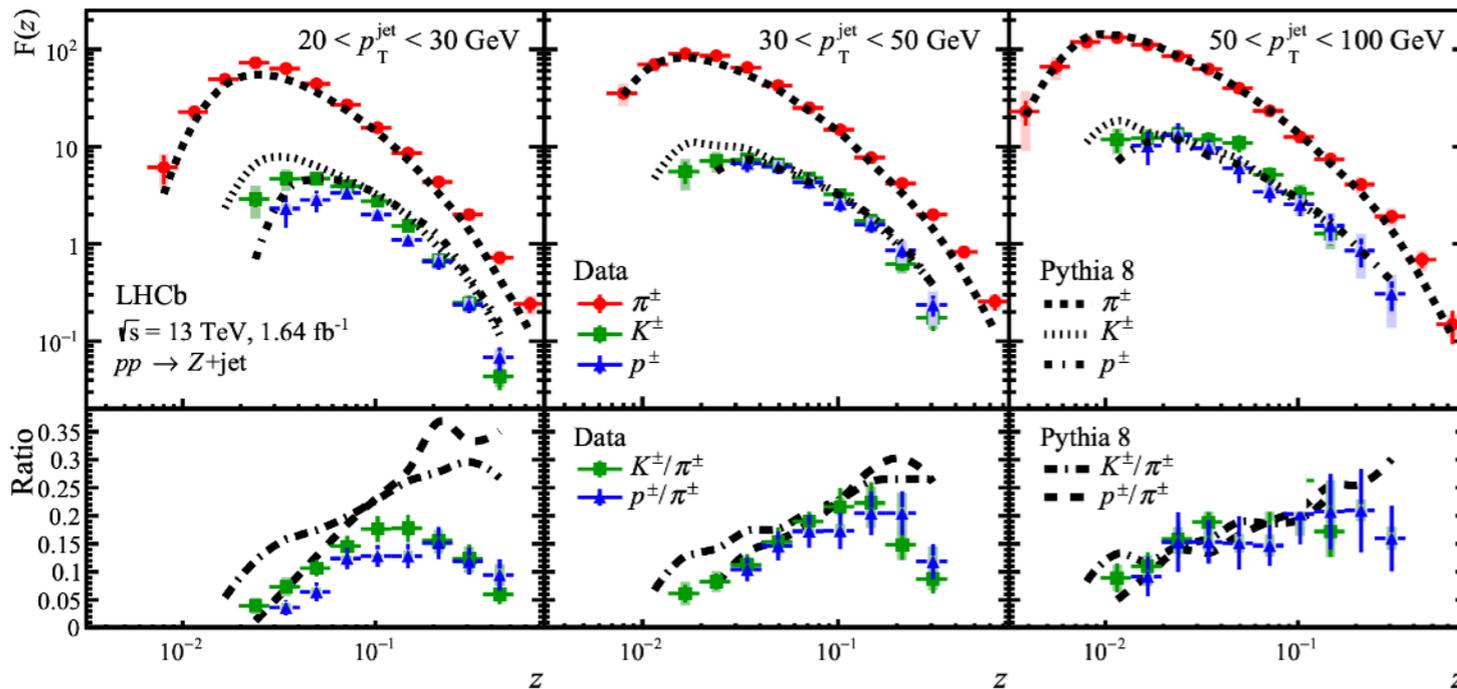
$$p(p_A) + p(p_B) \rightarrow Z(\eta_Z, \mathbf{p}_{ZT}) + \text{jet}(\eta_J, \mathbf{p}_{JT}, R) h(z_h, \mathbf{j}_\perp) + X$$



Kang, Lee, Terry, Xing '19



LHCb '22



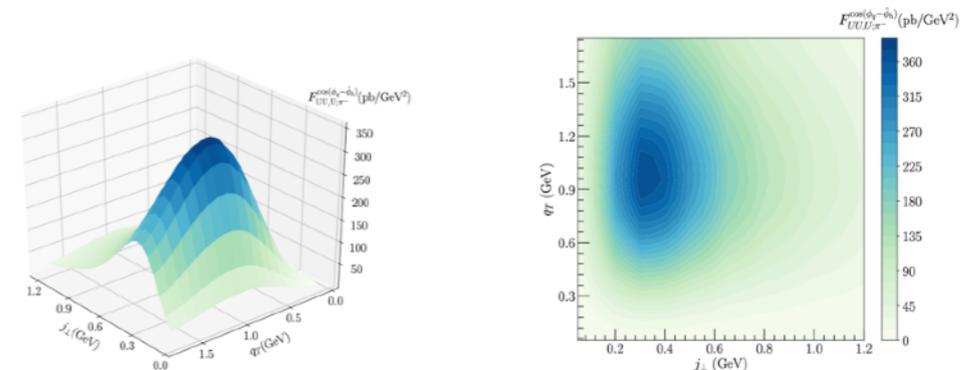
Polarized hadrons inside a jet

Leading Quark TMDFFs Hadron Spin Quark Spin

		Quark Polarization		
		Un-Polarized (U)	Longitudinally Polarized (L)	Transversely Polarized (T)
Unpolarized (or Spin 0) Hadrons		$D_1 = \text{Unpolarized}$		$H_1^\perp = \text{Collins}$
	L		$G_1 = \text{Helicity}$	$H_{1L}^\perp$
Polarized Hadrons	T	$D_{1T}^\perp = \text{Polarizing FF}$	$G_{1T}^\perp$	$H_1 = \text{Transversity}$ $H_{1T}^\perp$

Kang, Lee, DYS, Zhao '22

$$\Delta_{\text{jet}}^{h/q}(z_h, \mathbf{j}_\perp, S_h) = \frac{1}{2} \left\{ \left( D_1 - \frac{\epsilon_T^{ij} j_\perp^i S_h^j}{z_h M_h} D_{1T}^\perp \right) \not{n}_J + \left( \lambda_h G_{1L} - \frac{\mathbf{j}_\perp \cdot \mathbf{S}_{h\perp}}{z_h M_h} G_{1T} \right) \gamma_5 \not{n}_J - i \sigma^{i\mu} n_{J,\mu} \left( \mathcal{H}_1 S_{h\perp}^i \gamma_5 - i \mathcal{H}_1^\perp \frac{j_\perp^i}{z_h M_h} - \mathcal{H}_{1L}^\perp \frac{\lambda_h j_\perp^i}{z_h M_h} \gamma_5 + \mathcal{H}_{1T}^\perp \frac{\mathbf{j}_\perp \cdot \mathbf{S}_{h\perp} j_\perp^i - \frac{1}{2} j_\perp^2 S_{h\perp}^i}{z_h^2 M_h^2} \gamma_5 \right) \right\},$$

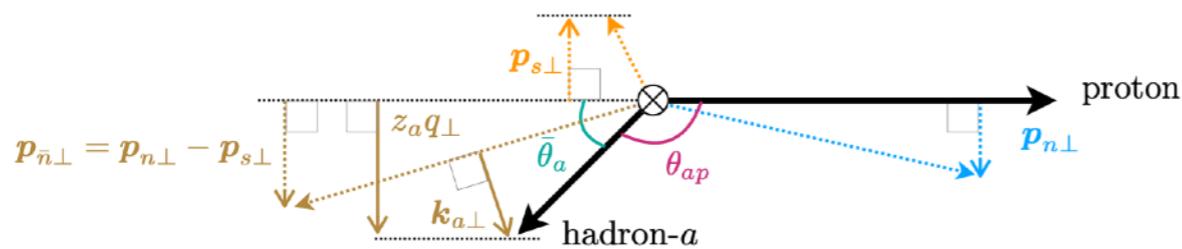


# Advanced correlators & event shapes

- **Energy correlators: complementary way to study nucleon tomography without fragmentation functions.** Basham, Brown, Ellis, Love 1978, Moulton, Zhu '25 a recent review

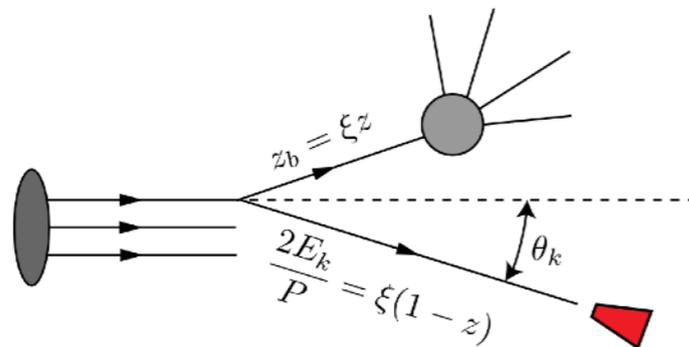
Also see W. B. Zhao... 's talks

- **Breit frame advantage: naturally separates target and current fragmentation regions** Li, Makris, Vitev '21



$$EEC_{\text{DIS}}(\tau) \equiv \frac{1}{2} \sum_a \int d\theta_a dz_a z_a \frac{1}{\sigma} \frac{d\sigma}{d\theta_{ap} d\phi_{ap} dz_a} \delta\left(\tau - \frac{1 + \cos\theta_{ap}}{2}\right)$$

- **Nucleon energy correlators: Encode microscopic details like parton angular distributions and collinear splitting to all orders** X. Liu, & H. Zhu '23, H. Liu, X. Liu, J. Pan, F. Yuan, H. Zhu '23 ...



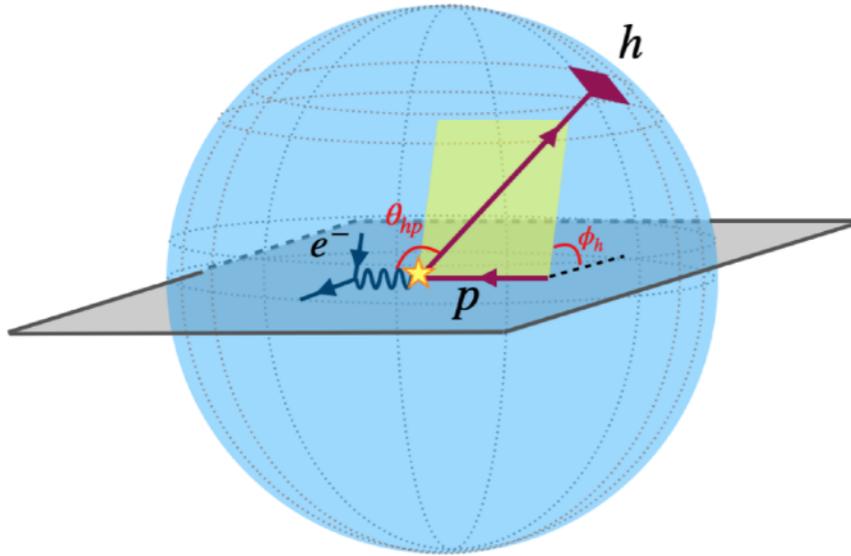
$$f_{q,n}(z, \{\Omega_1, \dots, \Omega_n\}) = \int \frac{dy_-}{8\pi} e^{-izP^+ \frac{y_-}{2}} \times \langle P | \bar{\psi}_i(0, y_-, \mathbf{0}_T) \gamma_+ \mathcal{E}(\Omega_1) \dots \mathcal{E}(\Omega_n) \psi_i(0, 0, \mathbf{0}_T) | P \rangle.$$

# Polarized EEC at the EIC

Kang, Lee, DYS, Zhao '24

We extend the understanding of the EEC in the back-to-back by considering azimuthal asymmetries associated with the EEC

$$\text{EEC}_{\text{DIS}}(\tau, \phi) \equiv \frac{1}{\sigma} \frac{d\Sigma_{\text{DIS}}}{d\tau d\phi} = \frac{1}{2} \sum_a \int d\theta_a dz_a z_a \frac{1}{\sigma} \frac{d\sigma}{d\theta_{ap} d\phi_{ap} dz_a} \delta\left(\tau - \left(\frac{1 + \cos\theta_{ap}}{2}\right)\right) \delta(\phi - \phi_{ap}).$$



$$\begin{aligned} \frac{d\Sigma_{\text{DIS}}}{dx dy d\tau d\phi} = & \frac{2\pi\alpha_{\text{em}}^2}{Q^2} \frac{1 + (1-y)^2}{y} \int d^2\mathbf{q}_T \delta(\tau - \frac{\mathbf{q}_T^2}{Q^2}) \delta(\phi - \phi_{qT}) \int \frac{db b}{2\pi} \left\{ \mathcal{F}_{UU} \right. \\ & + \cos(2\phi_{qT}) \frac{2(1-y)}{1 + (1-y)^2} \mathcal{F}_{UU}^{\cos(2\phi_{qT})} + S_{\parallel} \sin(2\phi_{qT}) \frac{2(1-y)}{1 + (1-y)^2} \mathcal{F}_{UL}^{\sin(2\phi_{qT})} \\ & + |\mathbf{S}_{\perp}| \left[ \sin(\phi_{qT} - \phi_s) \mathcal{F}_{UT}^{\sin(\phi_{qT} - \phi_s)} + \sin(\phi_{qT} + \phi_s) \frac{2(1-y)}{1 + (1-y)^2} \mathcal{F}_{UT}^{\sin(\phi_{qT} + \phi_s)} \right. \\ & \left. + \sin(3\phi_{qT} - \phi_s) \frac{2(1-y)}{1 + (1-y)^2} \mathcal{F}_{UT}^{\sin(3\phi_{qT} - \phi_s)} \right] \\ & \left. + \lambda_e \left[ S_{\parallel} \frac{y(2-y)}{1 + (1-y)^2} \mathcal{F}_{LL} + |\mathbf{S}_{\perp}| \cos(\phi_{qT} - \phi_s) \mathcal{F}_{LT}^{\cos(\phi_{qT} - \phi_s)} \right] \right\} \end{aligned}$$

Leading Quark TMDPDFs Nucleon Spin Quark Spin

		Quark Polarization		
		Un-Polarized (U)	Longitudinally Polarized (L)	Transversely Polarized (T)
Nucleon Polarization	U	$f_1 = \text{Unpolarized}$		$h_1^{\perp} = \text{Boer-Mulders}$
	L		$g_1 = \text{Helicity}$	$h_{1L}^{\perp} = \text{Worm-gear}$
	T	$f_{1T}^{\perp} = \text{Sivers}$	$g_{1T}^{\perp} = \text{Worm-gear}$	$h_1 = \text{Transversity}$ $h_{1T}^{\perp} = \text{Pretzelosity}$

New probe for all TMDPDFs

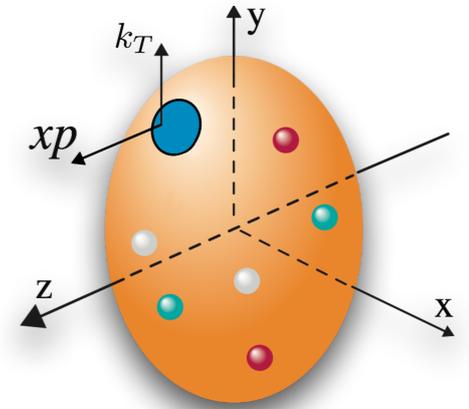
# Nucleon tomography with N-jettiness

S. Fang, S. Lin, DYS, J. Zhou PRL136(2026)021901

- Transverse momentum distributions (TMDs) of nucleon encode the quantum correlations between hadron polarization and the motion and polarization of quarks and gluons inside it.

Spin-dependent cross section: 
$$\frac{d\sigma(\vec{s}_T)}{d\mathcal{PS}} = F_{UU} + \sin(\phi_s - \phi_q) F_{UT}^{\sin(\phi_s - \phi_q)}$$

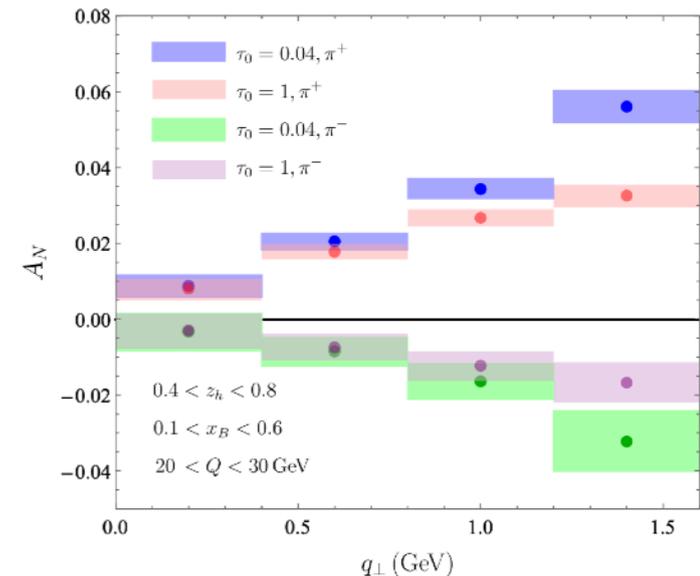
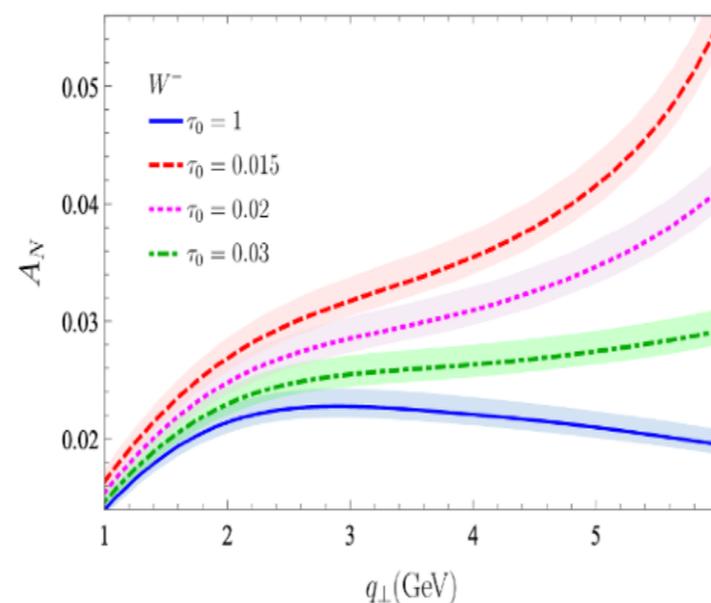
quark TMDs:  $f_q(x, k_T)$   $\frac{1}{M} \epsilon_{\alpha\beta} s_T^\alpha k_T^\beta f_{1T}^{\perp q}(x, k_T)$



- However, at high energies, gluon radiation acts as environmental noise, causing quantum decoherence (Sudakov suppression) that obscures these signals.
- We introduce N-jettiness into a tunable resolution scale for quantum coherence

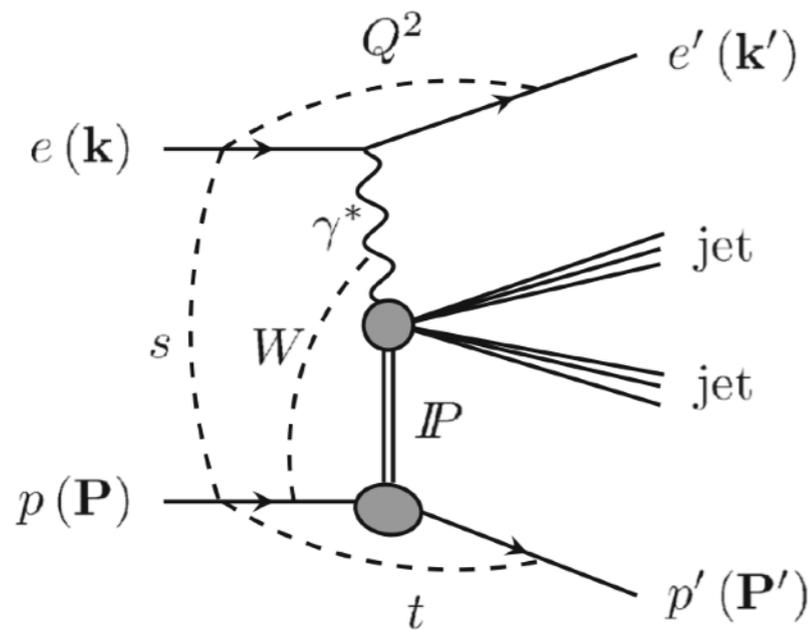
$$\tau \equiv \frac{2}{Q^2} \sum_i \min\{p_a \cdot l_i, p_b \cdot l_i\}$$

- This framework predicts an order-unity enhancement of spin asymmetries

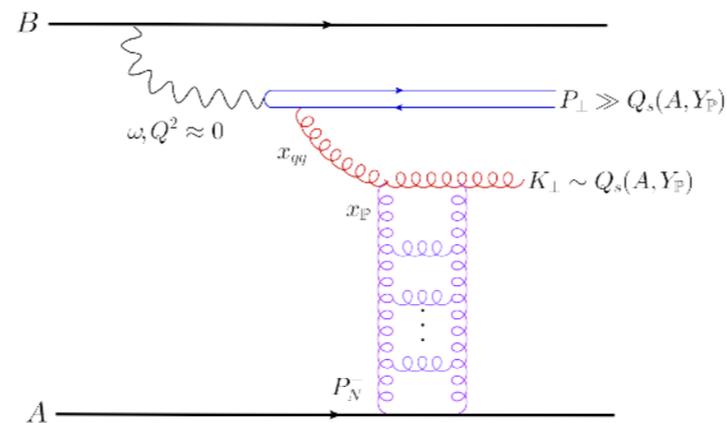


# Diffractive dijets photo-production

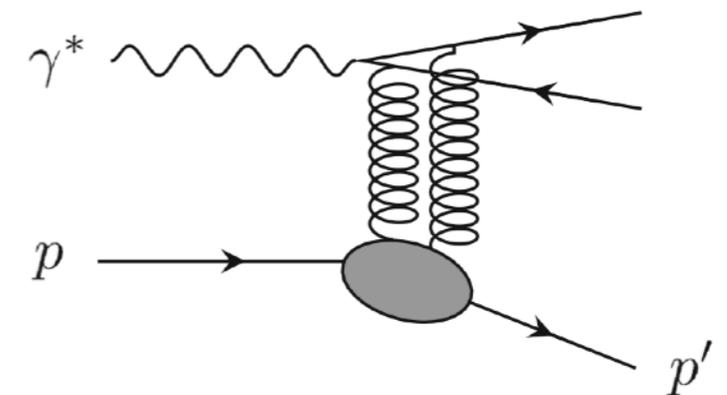
- Diffractive di-jet production provide rich information on nucleon internal structure.



diffractive production of (2+1) jets



diffractive production of exclusive dijets



- In cases of diffractive tri-jet production, where a semi-hard gluon is emitted towards the target direction and remains undetected, the experimental signature of this process becomes indistinguishable from that of exclusive di-jet production.
- Recent studies have shown that the cross section for coherent tri-jet photo-production significantly surpasses that of exclusive di-jet production [Iancu, Mueller & Triantafyllopoulos '21](#)
- The production of color octet hard quark-anti-quark dijets enables the emission of soft gluons from the initial state. This mechanism significantly influences the total transverse momentum  $q_{\perp}$  distribution of the dijet.

# TMD resummation for diffractive dijets photo-production

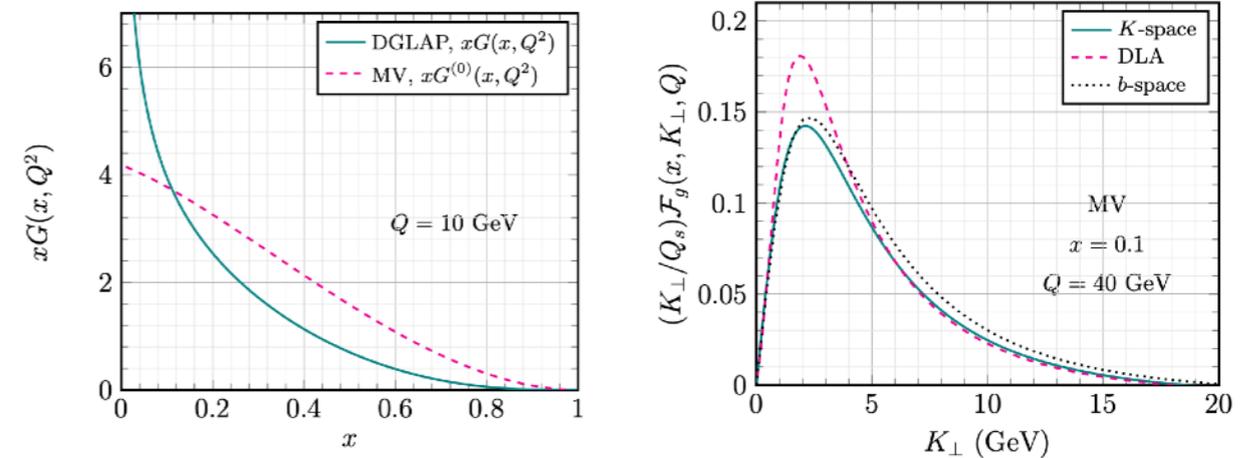
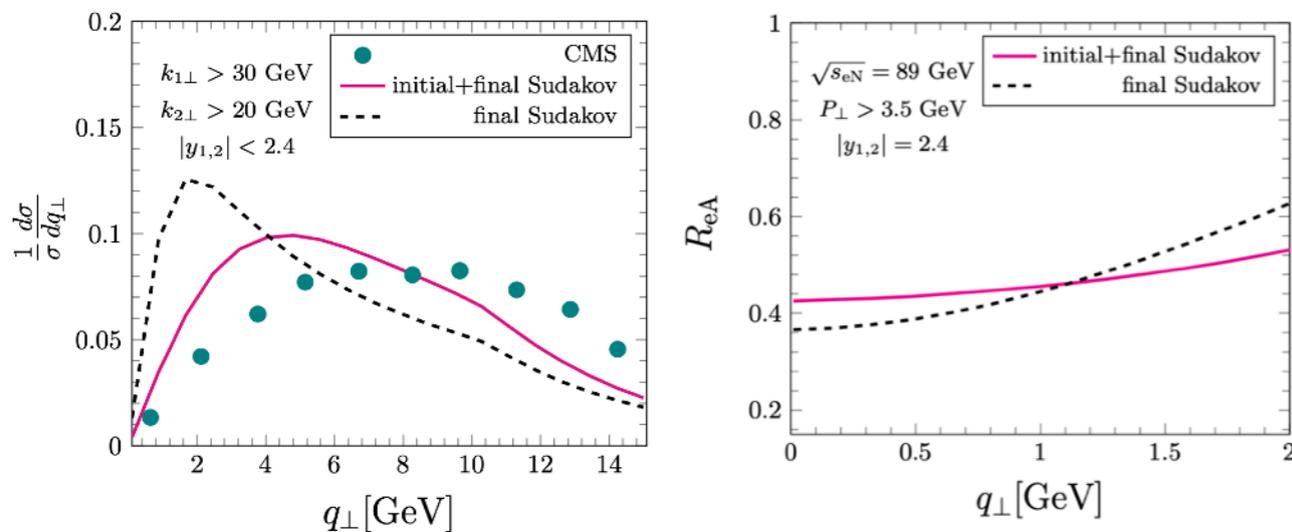
DYS, Shi, Zhang, Zhou, Zhou '24, Iancu, Triantafyllopoulos, Wei, Yuan '25

- The CGC calculation has been studied in Iancu, Mueller & Triantafyllopoulos '21; Iancu, Mueller, Triantafyllopoulos, & S. Y. Wei '23
- We assume that the standard TMD factorization framework in the back-to-back region

$$\frac{d\sigma}{dy_1 dy_2 d^2\mathbf{P}_\perp d^2\mathbf{q}_\perp} = \sigma_0 x_\gamma f_\gamma(x_\gamma) \int \frac{d^2\mathbf{b}_\perp}{(2\pi)^2} e^{i\mathbf{q}_\perp \cdot \mathbf{b}_\perp} e^{-\text{Sud}_{\text{pert}}(b_\perp)} \tilde{S}^{\text{rem}}(\mathbf{b}_\perp, \mu_b) \\ \times \int d^2\mathbf{k}_\perp e^{-i\mathbf{b}_\perp \cdot \mathbf{k}_\perp} \int \frac{dx_{\mathbb{P}}}{x_{\mathbb{P}}} x_g G_{\mathbb{P}}(x_g, x_{\mathbb{P}}, k_\perp),$$

DYS, Y. Shi, C. Zhang, J. Zhou, Y. Zhou '24

Iancu, Triantafyllopoulos, Wei, Yuan '25



- Incorporating the color-octet channel offers a more accurate representation of the data

- Full quantum evolution including the DGLAP evolution

# Summary

- **Jets are essential to understand hadronization and the mass and spin puzzles of the nucleon at the EIC**
- **The EIC paradigm shift: moving from "discovery" to "precision" tomography of the nucleon.**
- **Unique capabilities: Versatility in polarized beams and center-of-mass energies unlocks novel spin observables.**
- **Collaborative need: Integration of nucleon structures, jets, global fitting, event generators, small-x, and heavy ion physicists.**

**Thank you**