

DIS Event shapes (1-jettiness and beyond) for EIC

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Electron-Ion Collider @ Snowmass

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In collaboration with

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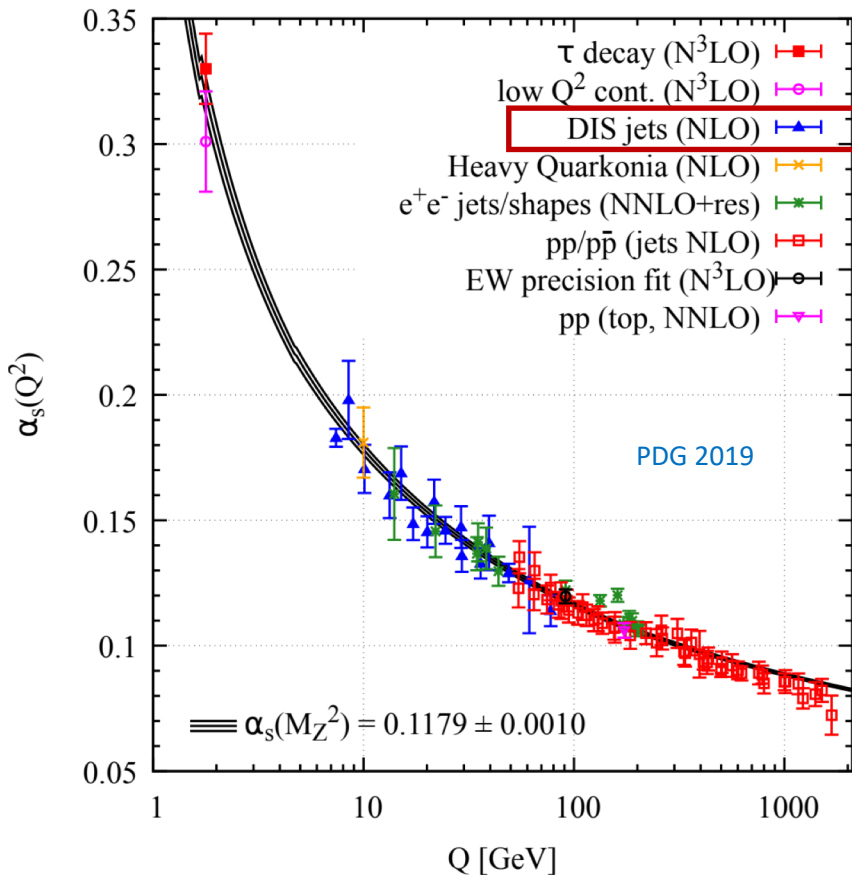
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Daekyoung Kang (Fudan U)

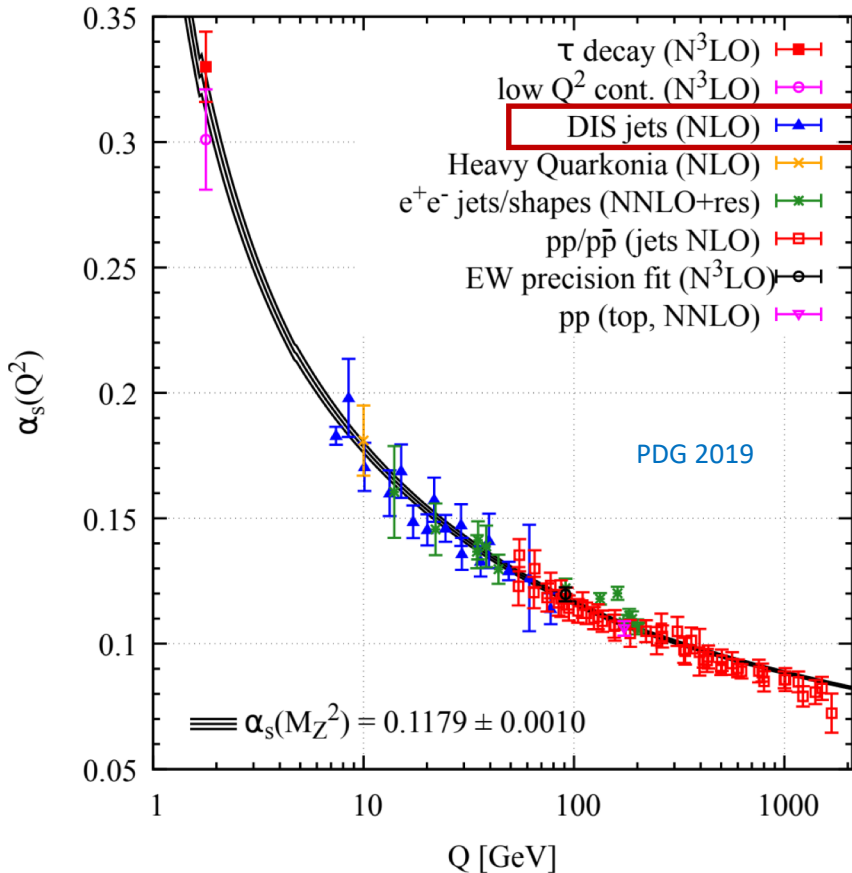


Precision measurements of running α_s



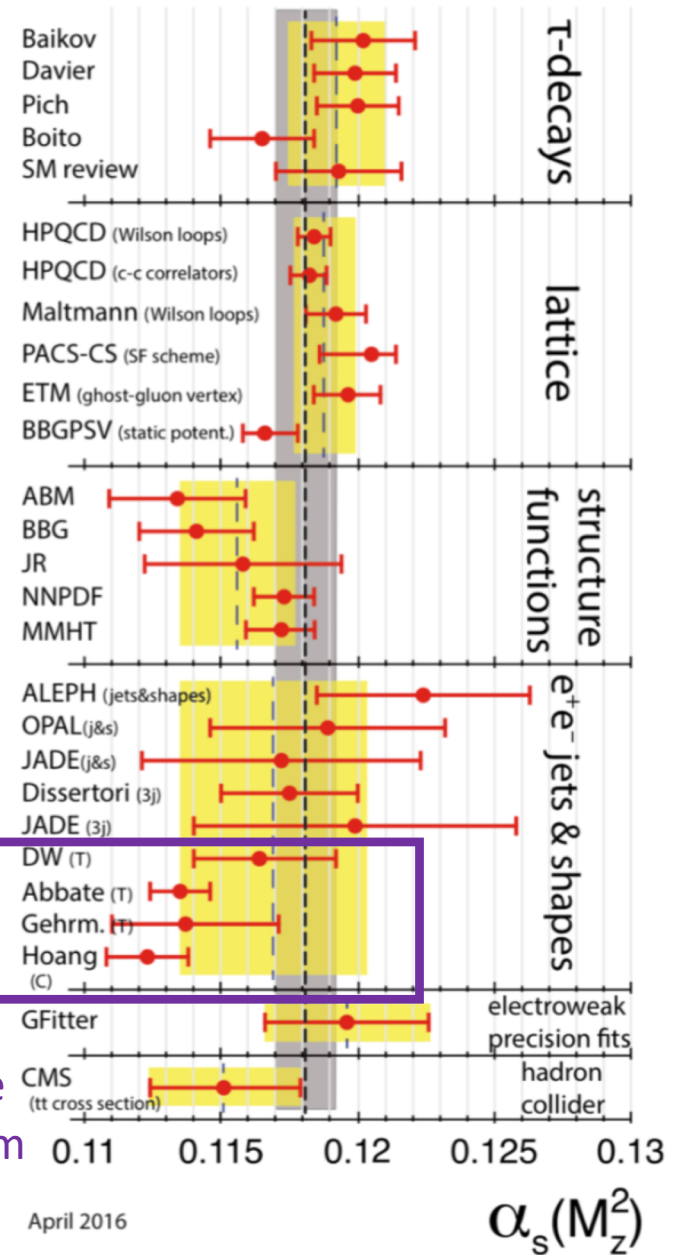
Large uncertainties dominated by theory

Precision measurements of running α_s



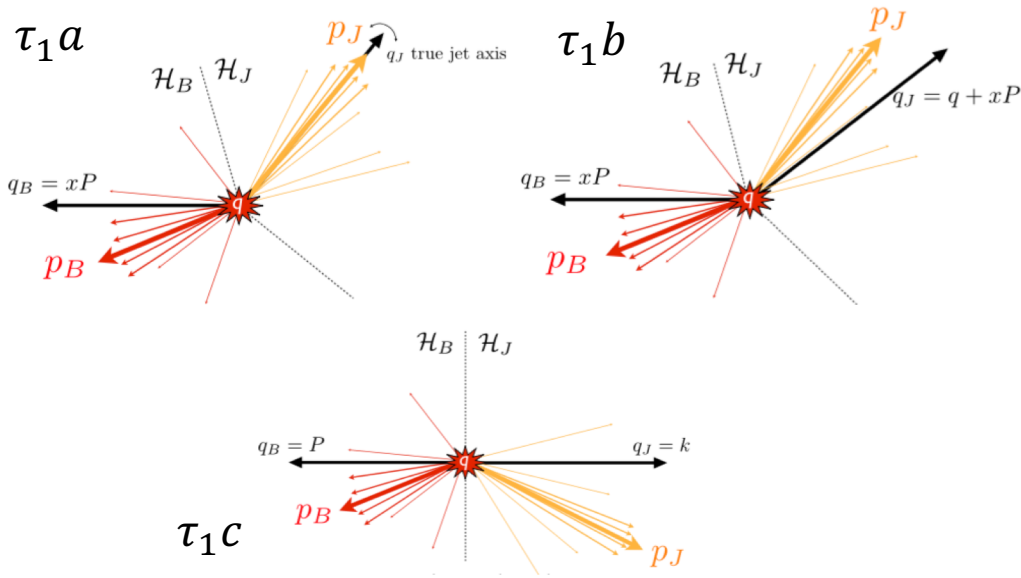
Large uncertainties dominated by theory

Event Shapes : relatively large deviations from lattice results



1-jettiness in DIS

D. Kang, C. Lee, I. Stewart (2013)
 also Z. Kang, Liu, Mantry, Qiu (2012, 2013)



$$\tau_1 = \frac{2}{Q^2} \sum_{i \in X} \min\{q_B \cdot p_i, q_J \cdot p_i\}$$

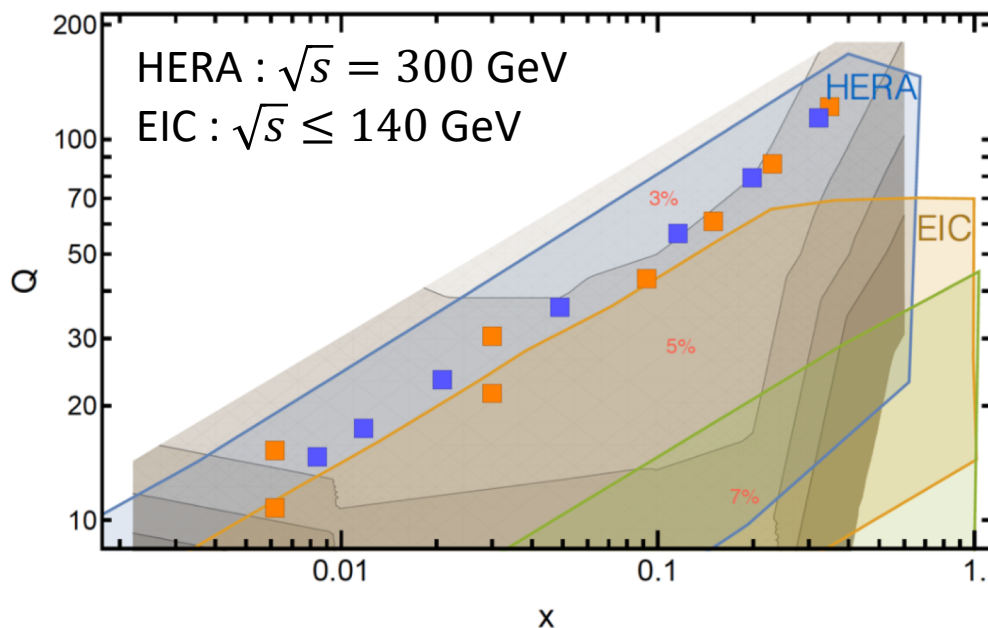
A global shape measuring degree to which final state is 1-jet (+ beam ISR jet) - like.

Motivation:

N³LL resummed high precision prediction expected in theory; if similar precision achievable experimentally, can measure running of α_s down to low Q^2

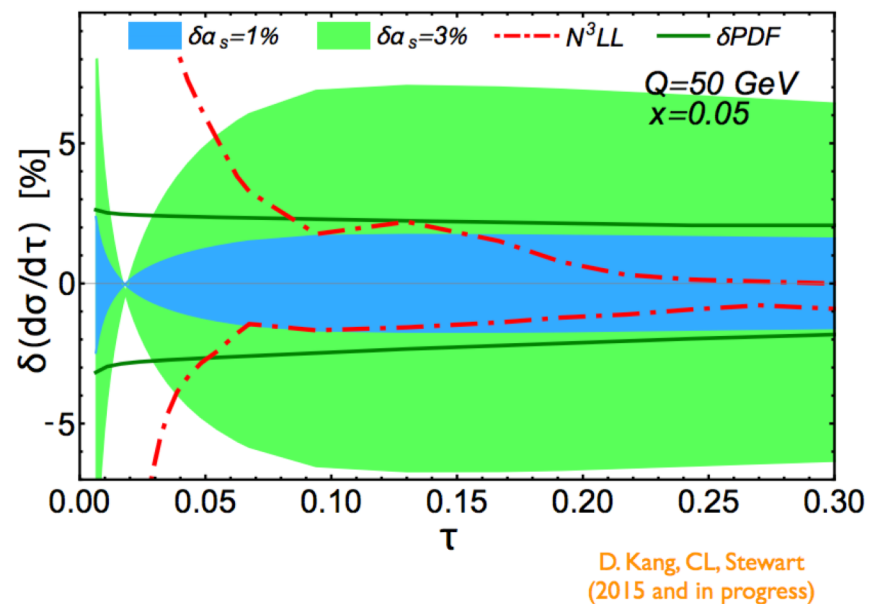
1-jettiness at EIC

Current theoretical uncertainty
vs. HERA or EIC coverage:

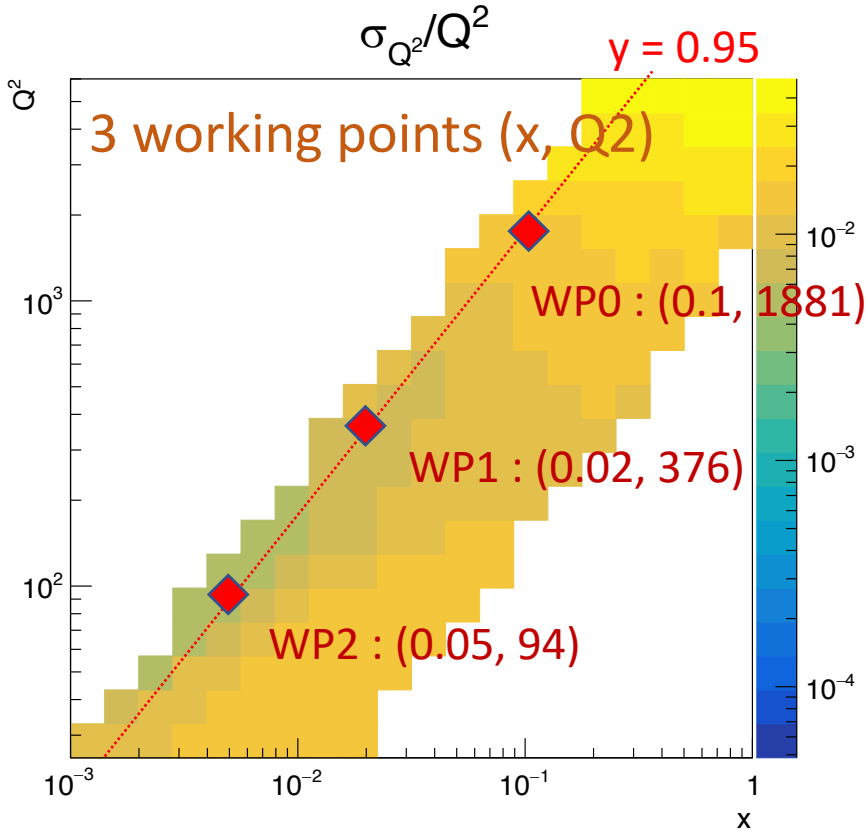


From EIC YR Jets & HF WG meeting (C. Lee)

Current theoretical uncertainty on the order of 1%
sensitivity to α_s and PDF uncertainties:



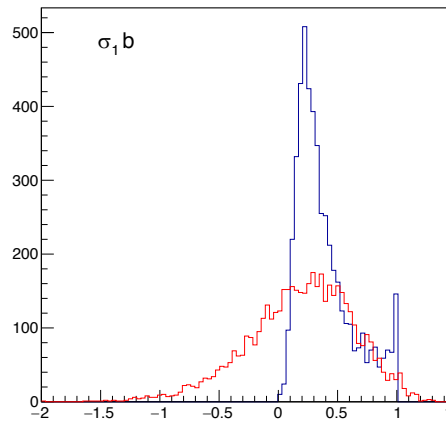
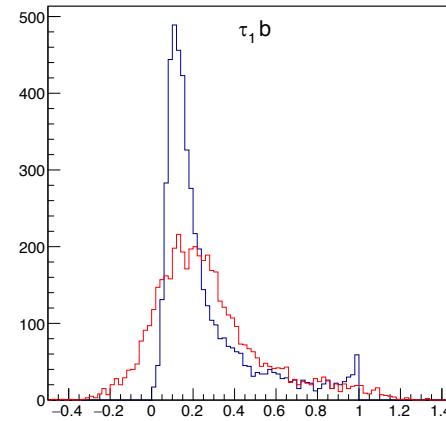
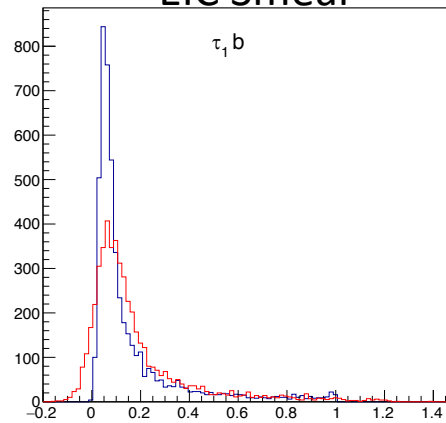
1-jettiness at EIC



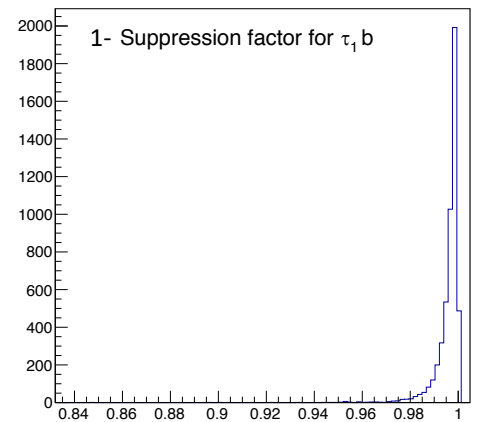
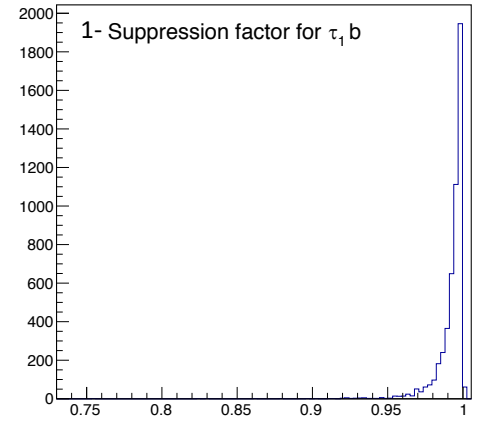
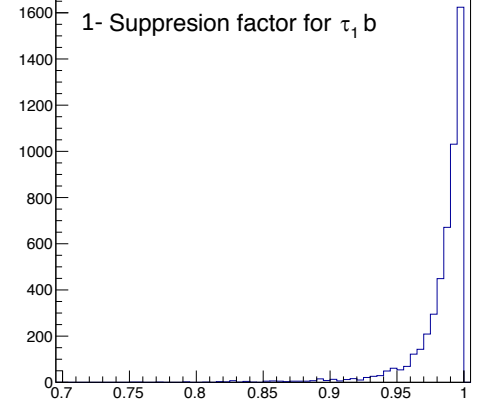
- Left : τ_{1b} resolution.
- Right : τ_{1b} (1 - suppression factor), where suppression factor is defined by loss of τ caused by requiring $|\eta| < 3.5$.

SOOKHYUN LEE (University of Michigan, Ann Ar

EIC Smear



Perfect PID & no smear

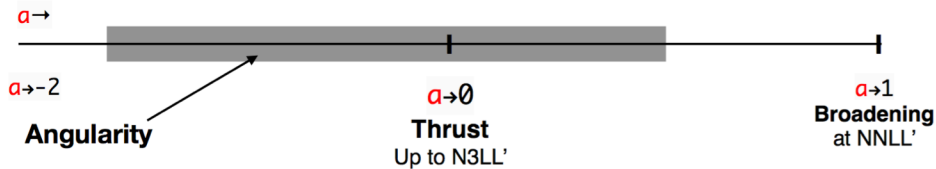


Beyond 1-jettiness at EIC

DIS angularity from Jets @ EIC workshop
(T. Maji & D. Kang)

$$\tau_a = \frac{2}{Q} \sum_{i \in \mathcal{X}} |\mathbf{p}_{\perp}^i| e^{-|\eta_i|(1-a)}$$

—C. F. Berger, T. Kucs and G. F. Sterman' 2003



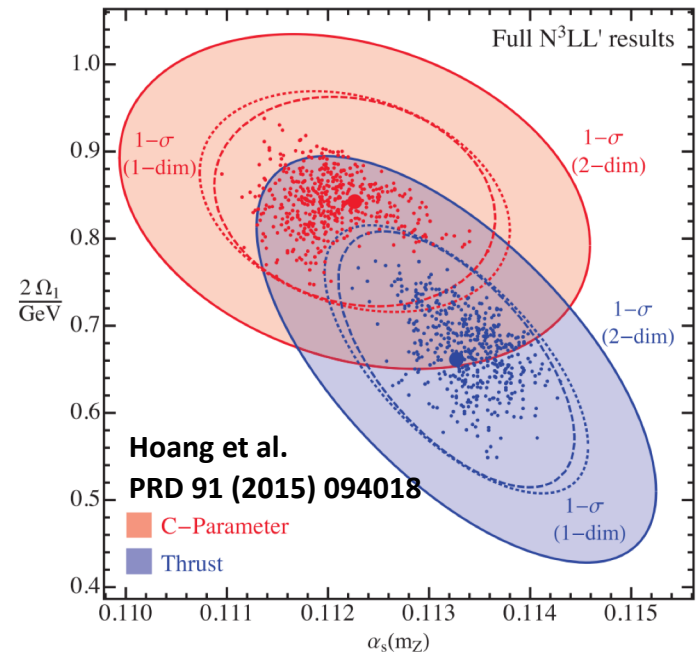
- Depends on a continuous parameter “a”

$a \rightarrow 0$: Thrust

$a \rightarrow 1$: Jet Broadening

- Provides access from *thrust* to *jet broadening* in a continuous manner
- A more general event shape!

C-parameter vs. Thrust global fit



- DIS angularity – reconcile large deviations of thrust global fit from lattice results.
- C-parameter – test of universality of power corrections

Summary & Plans

- Detector requirement studies in progress for EIC Yellow Report
 - Basic kinematics studies completed
 - kinematic reach, statistics limited by luminosity
 - Performance criteria for observables identified
 - x & Q^2 resolutions, τ_1 resolution and missing particle suppression factors
 - Distortions in tau measurements due to detector effects WIP
 - Hadronic calorimeter resolution: energy and position of hadrons
 - Particle identification, tracking
 - Modes of measurements
 - Exploration of unfolding to correct smearing due to various resolution factors
- Theory development
 - Theoretical uncertainties for 1-jettiness at EIC: finalization WIP by Daekyoung/Chris
- Beyond 1-jettiness
 - Preliminary DIS angularity cross section calculation at NNLL accuracy presented.
 - Experimental studies planned to cover this generalization.