1-jettiness at the EIC, first look & plans

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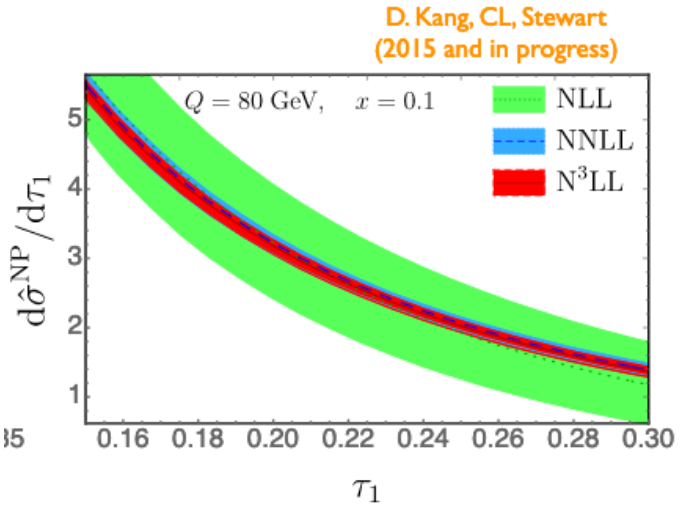
study for the YR in collaboration with Peter Jacobs (LBNL) and Sookhyun Lee (University of Michigan, Ann Arbor)

N³LL calculations of 1-jettiness in DIS



DIS 1-jettiness calculations resummed to N³LL accuracy in progress

Calculation uncertainty of the order of 1%, sensitivity to α_S (and PDFs)
(to be compared to inclusive/dijet extractions in DIS with uncertainties of ~10%)

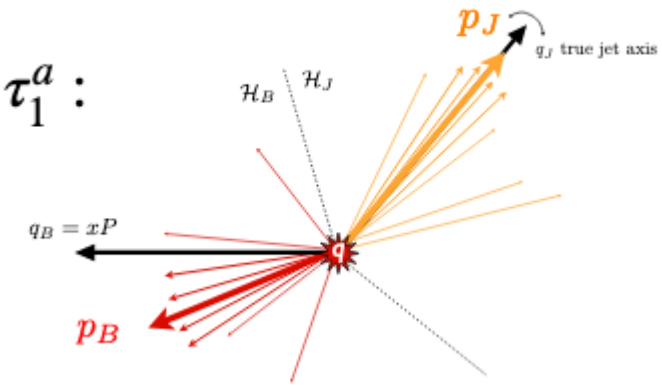
See last presentation by Christopher Lee:
https://indico.bnl.gov/event/8238/contributions/36464/attachments/27517/42105/EICUG_2020_Apr_06.pdf

And some related references:
https://arxiv.org/pdf/1407.6706.pdf
https://arxiv.org/pdf/1303.6952.pdf

Great opportunity and great challenge, can we carry out the measurement with similarly high precision?
Goal for YR: determine and document what level of precision it requires in terms of instrumental design and other measurement parameters

1-jettiness definition

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



qB and qJ are 4-vectors along the nuclear beam and the jet directions respectively

The observable is a scalar product of 4-vectors, frame invariant.

τ_1->0 : 2 jets, one along the beam direction from ISR from the proton
τ_1->1: >2 jets in the final state

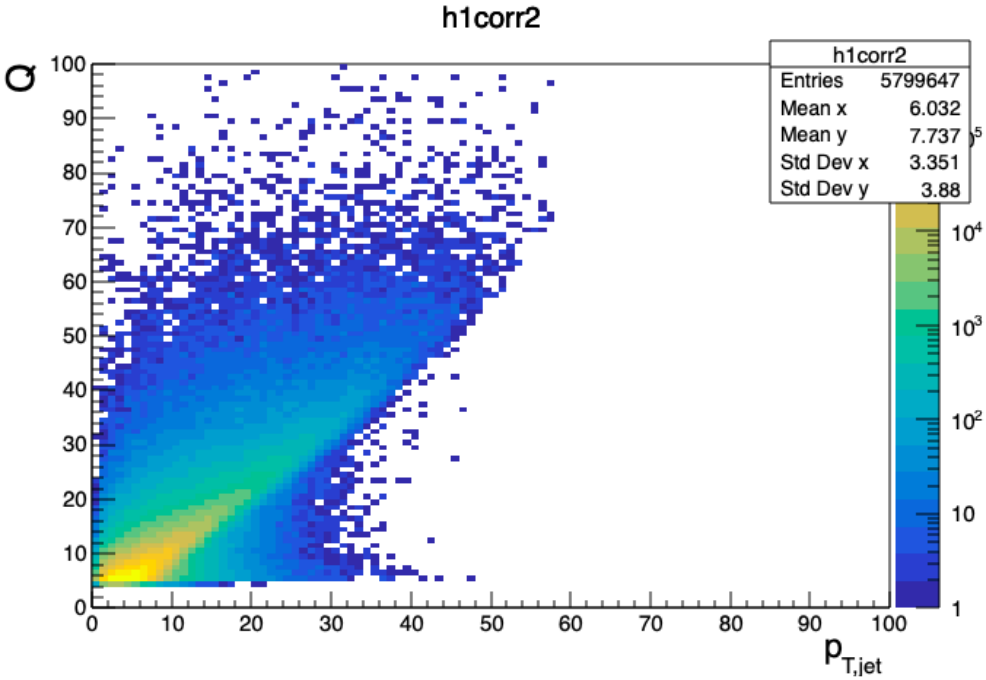
Key points

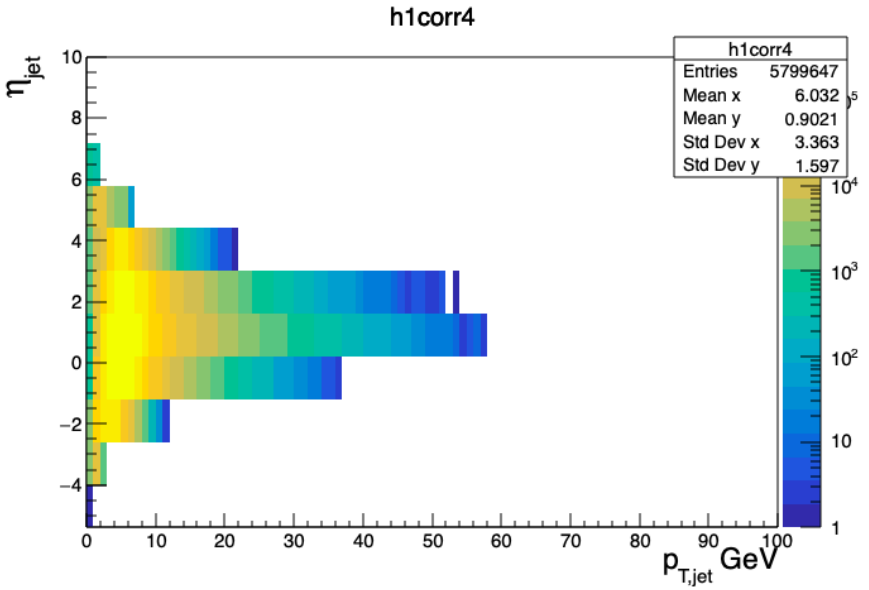
-Globalness? impact of experimental η,θ cutoffs
-Impact of non-perfect PID (pion mass assumption)
-Tracking limitations
-Impact of low momentum cutoffs for tracks imposed by the magnetic field
-Limitations induced by the response of the hadronic and electromagnetic calorimetry
-Explore different modes of measurment (track-only, track+EMCAL, track+EMCAL+HCAL)

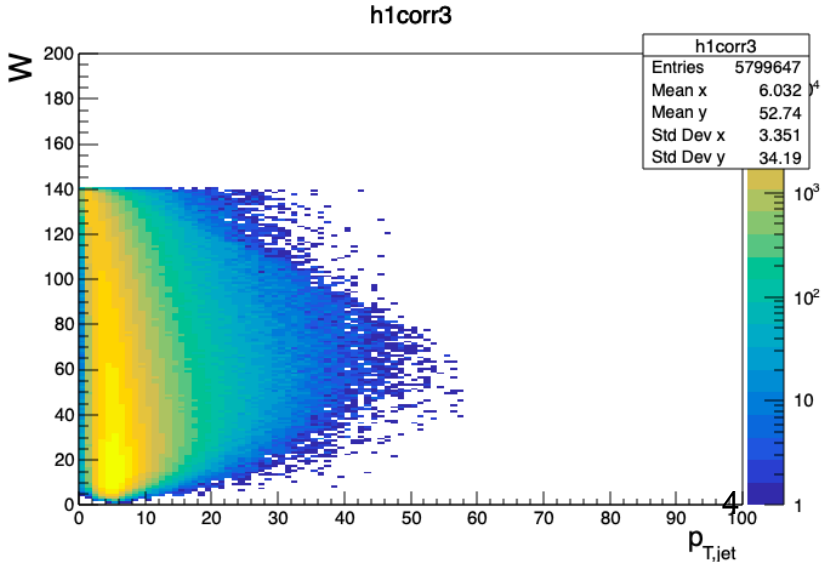
Our goal

Estimate a final τ_1 cross section uncertainty considering all possible sources of experimental systematics: positron energy calibration, uncertainty of the hadronic energy scale, tracking efficiency uncertainty, model dependency of correction factors, unfolding uncertainties, lumi determination etc

First look, jet kinematics in the lab frame



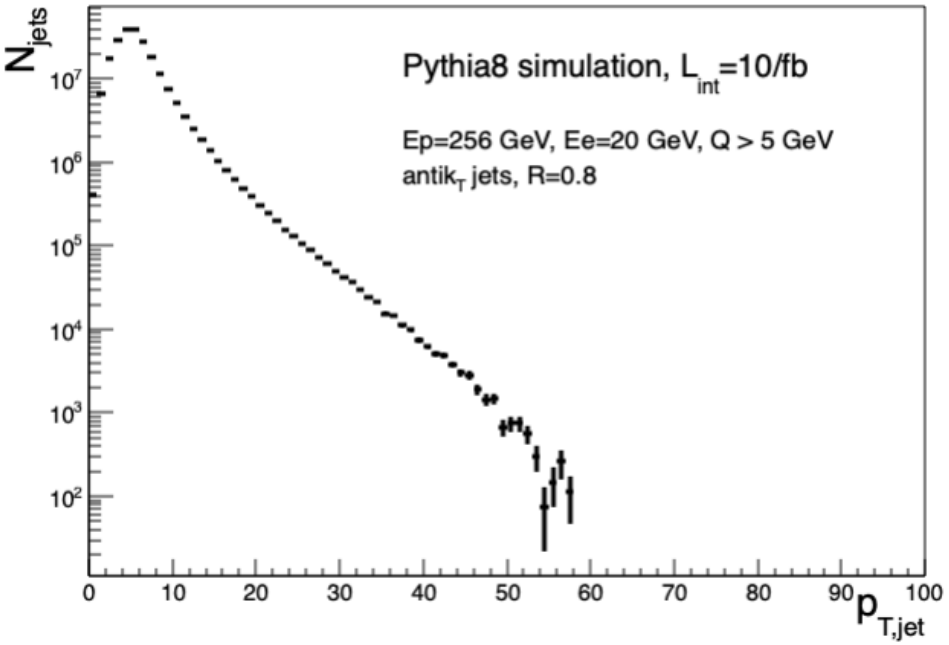


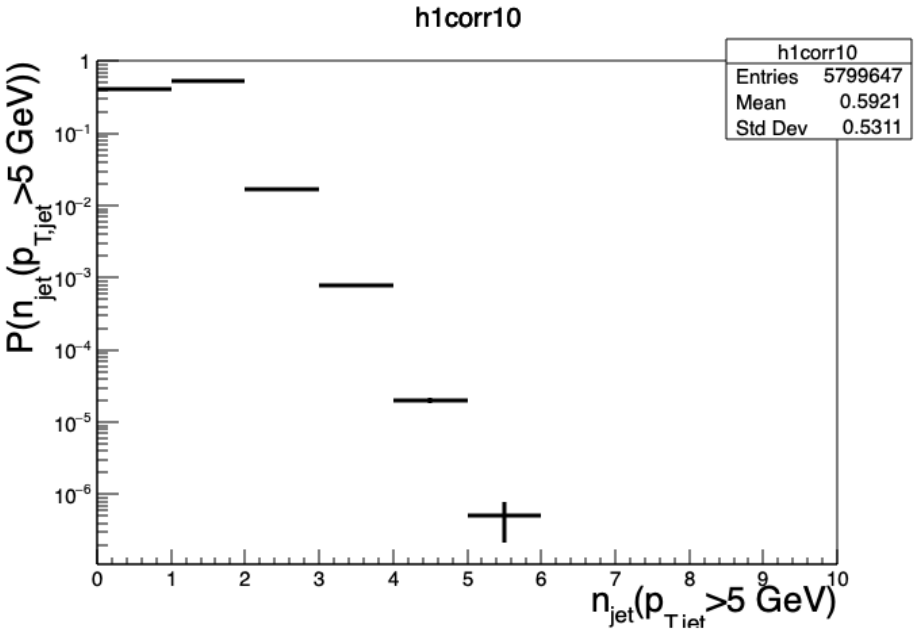


jet pT correlated with Q
(low-Q^2 photoproduction removed by requiring Q^2>25 GeV^2)

Jets populate the forward region.
A cut on particle.eta()>4 will be applied to suppress contributions from beam particles

First look, jet spectrum in the lab frame



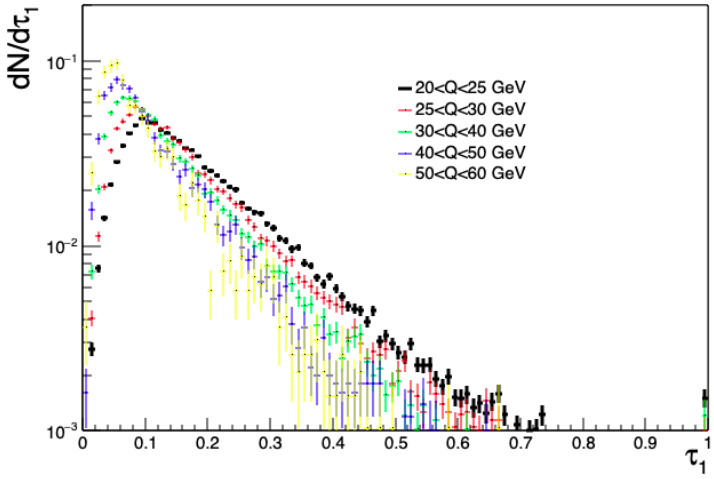


~10.e7 jets with p_T>10 GeV, integrated over EIC time

Most of the events have a single(non-ISR) jet with p_T>5 GeV
The conditional probability to have a secon jet with p_T>5 is of the order of 1%

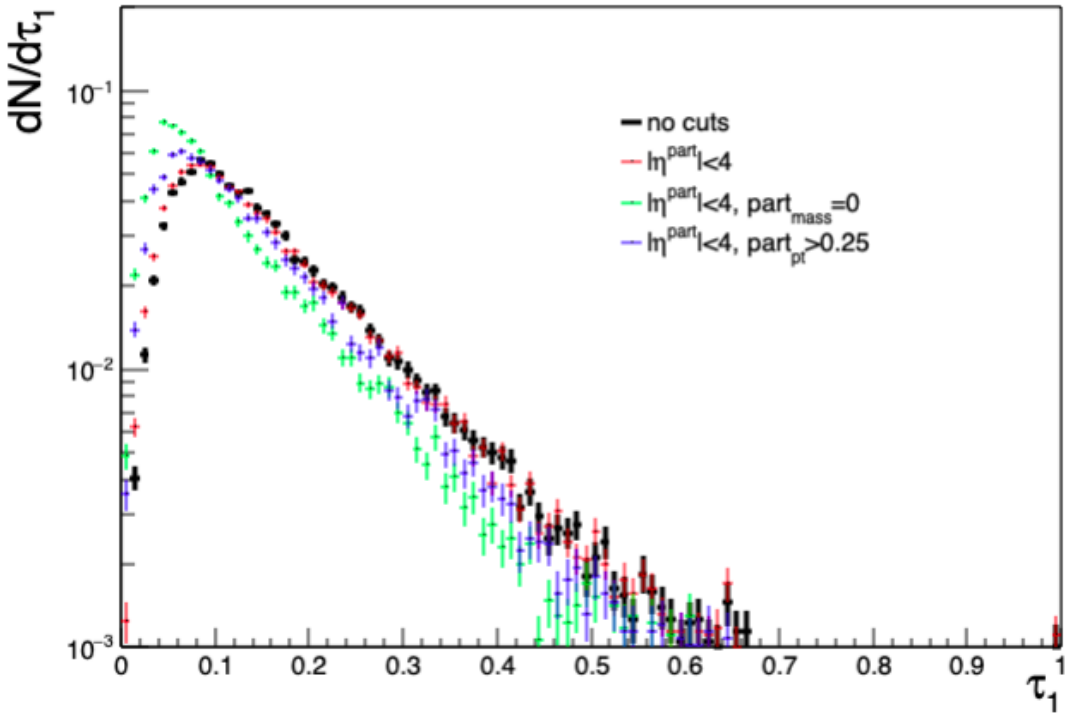
First look, 1-jettiness in the lab frame

Q dependence



The higher Q^2, the more the particles are aligned along the jet and the beam direction

25<Q<30 GeV



Simple studies on particle mass and particle cutoff dependence, ongoing
More realistic detector studies using DELPHES will follow