Gluon Sivers updates

Liang Zheng

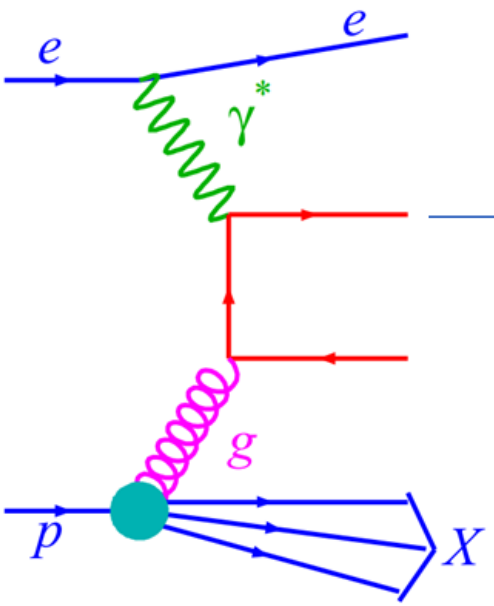
Plan

- Optimize our jet measurement with WTA jet axis (negative result)
- Explore the detector requirement from the gluon Sivers measurement
  - Minimum track p_T
  - Track efficiency
  - Detector resolution
  - Granularity

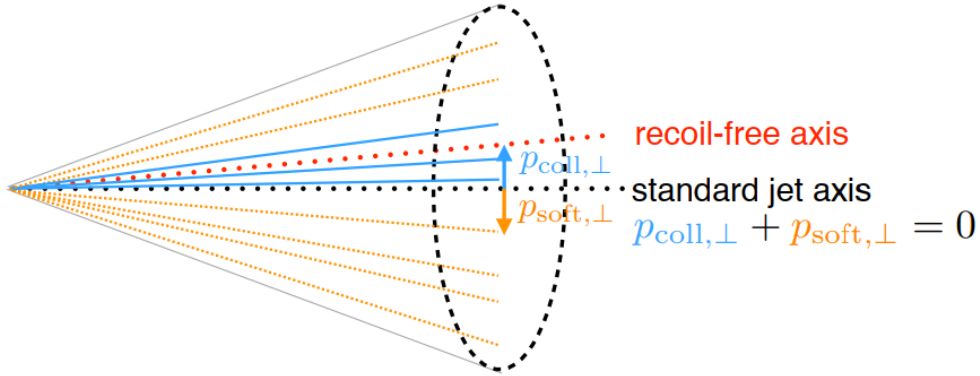
fastjet

Final state particles

- Anti-kT E_scheme → Reassign axis to the most energetic constituent (p, E unchanged, only direction)
  - "E_scheme"
  - "WTA axis"
- Anti-kT WTA_pt_scheme
  - "WTA_pt_scheme"



soft radiation



D. Neil et.al. JHEP 1901 (2019) 067

WTA jet axis is "recoil-free" from soft radiations.

Jet axis change

In photon-hadron c.m.s frame

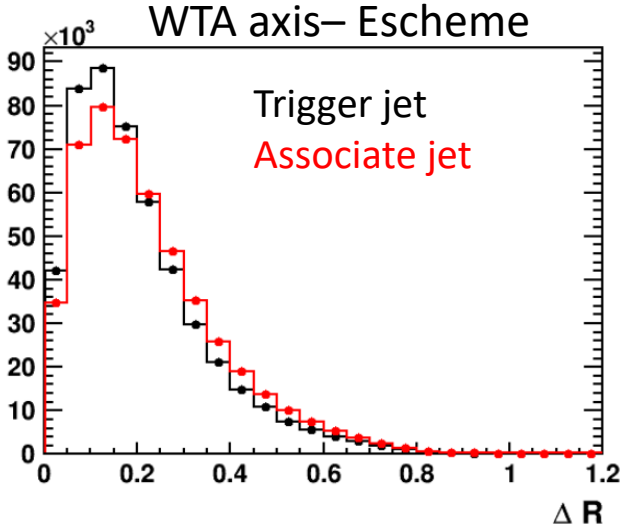
Jet reconstruction

R=1, All final state particles, p_T>250 MeV

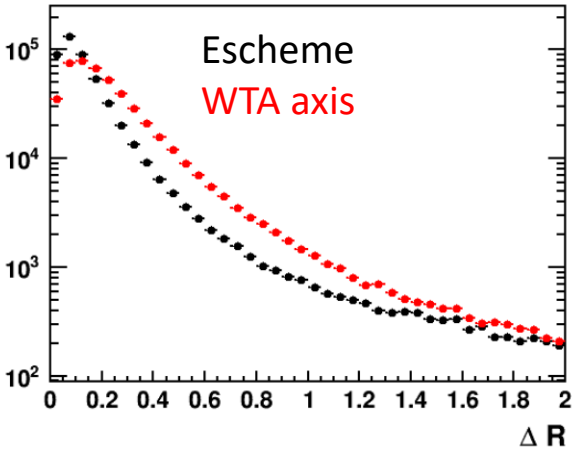
$$\Delta R = \sqrt{\Delta\eta^2 - \Delta\phi^2}$$

- WTA jet axis shifts almost 0.2 relative to E scheme jet axis in both trigger/associate jet in η-ϕ space
- Jet axis correlation to parton axis becomes weaker in WTA

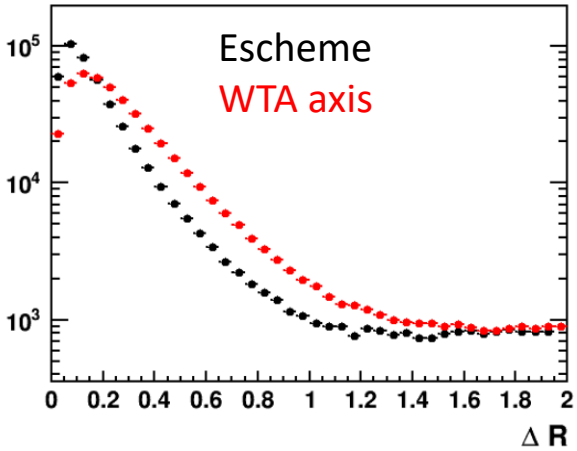
WTA axis– Escheme



Trigger Jet – Parton



Associate Jet – Parton

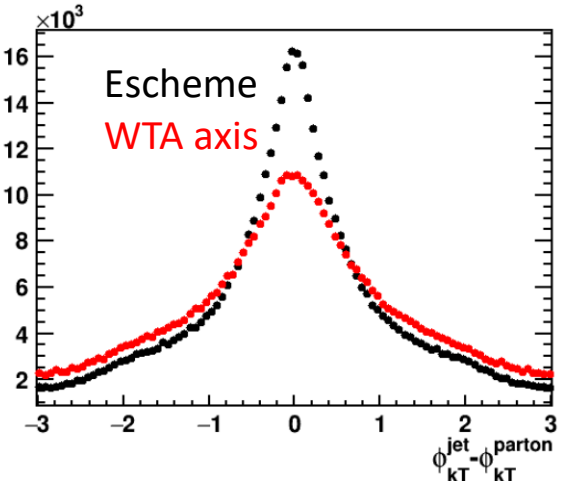


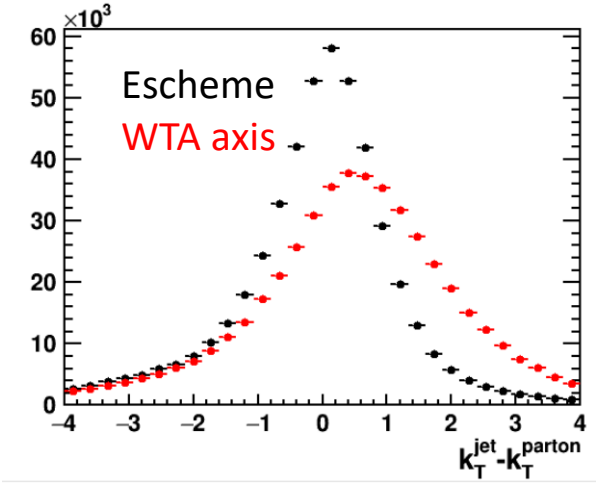
Connection to underlying parton kinematics

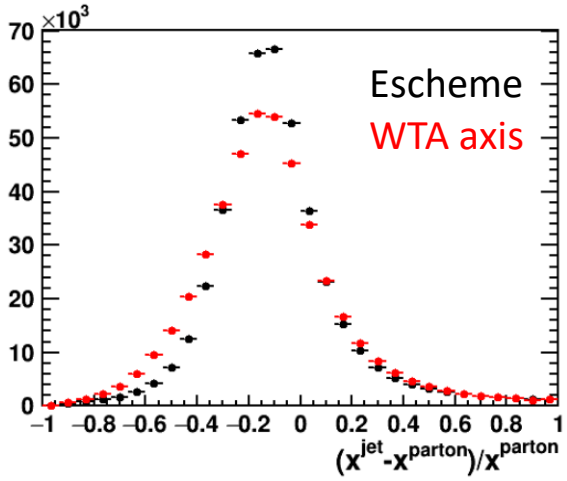
In photon-hadron c.m.s frame

$$\vec{k}_T = \vec{p}_{T1} + \vec{p}_{T2}$$

- Jet k_T angular correlation to parton gets broadening in WTA than in E-scheme
- Jet k_T value gets shifted and broadened in WTA
- Parton momentum fraction x slightly shifts to negative region in WTA







Dijet axis systematics in PGF

$\gamma^* g \rightarrow \boxed{q\bar{q}}$ Before Final Shower parton(BFS)

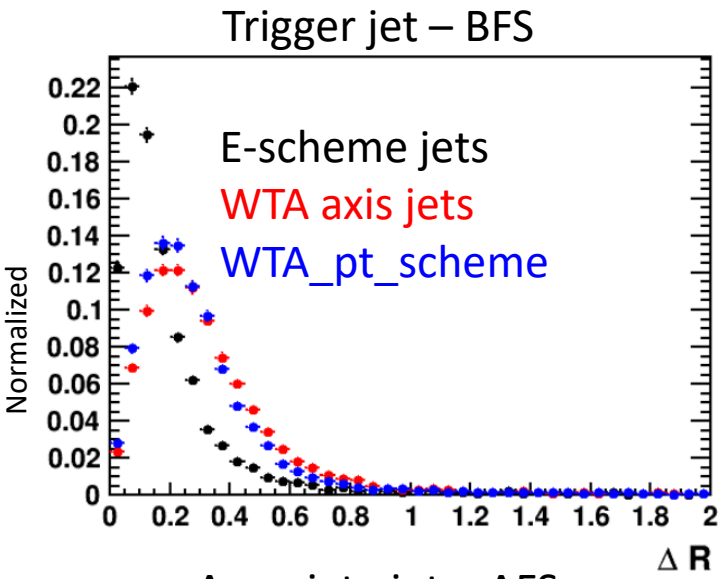
$q \rightarrow \boxed{q}g$ After Final Shower parton(AFS)

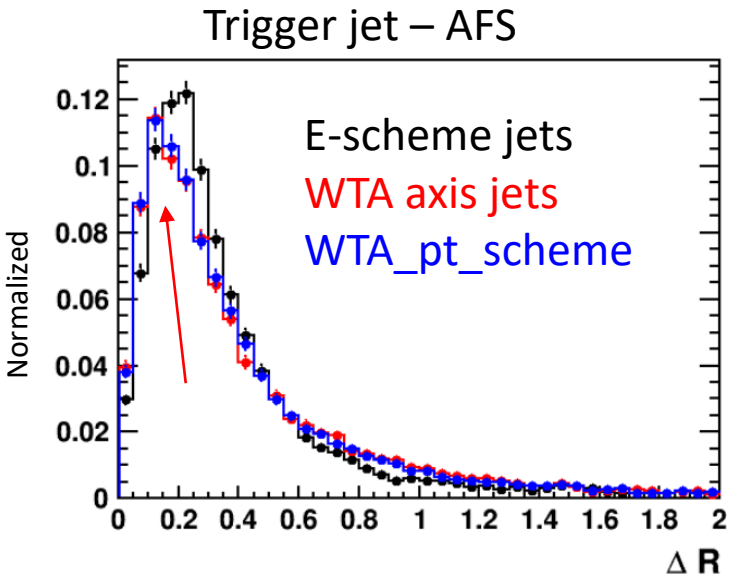
Jet reconstruction

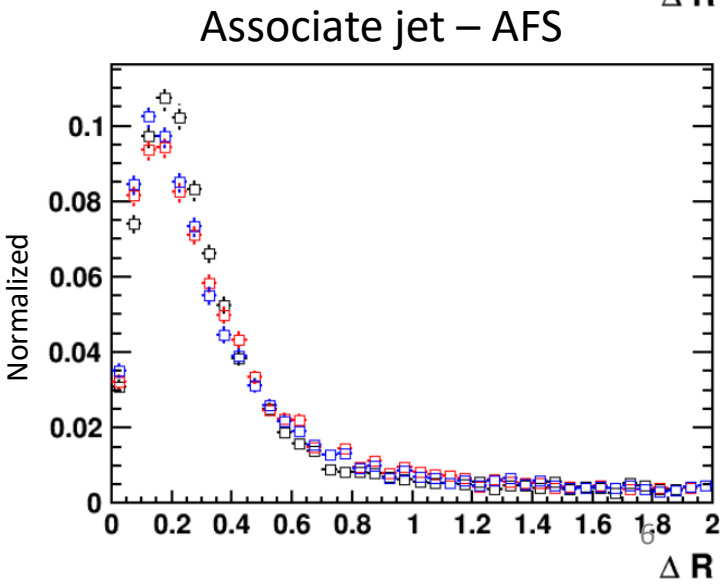
R=1, All final state particles, p_T>250 MeV

PGF, Q^2>1, $p_{T\,trig}^{jet}$>4.5, $p_{T\,assc}^{jet}$>4, ΔR(BFS-AFS)>0.2

E-scheme jets collimation with BFS, WTA jets aligned with AFS, if AFS and BFS are far from each other





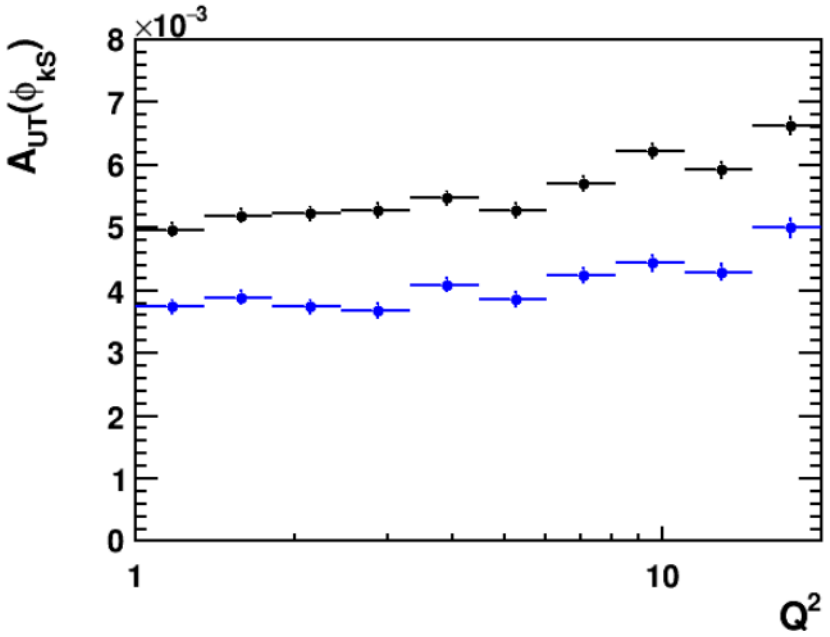


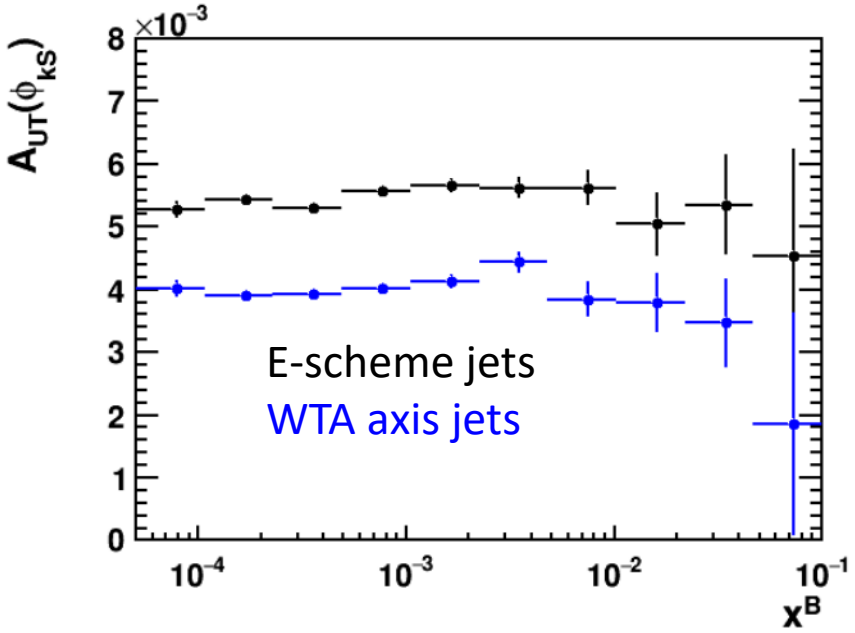
Dijet single spin asymmetry with WTA jet axis

Jet reconstruction

R=1, All final state particles, p_T>250 MeV

$1<Q^2<20$, $0.01<y<0.95$, $p_{T\,trig}^{jet}>4.5$, $p_{T\,assc}^{jet}>4$





Stronger dilution with WTA axis.

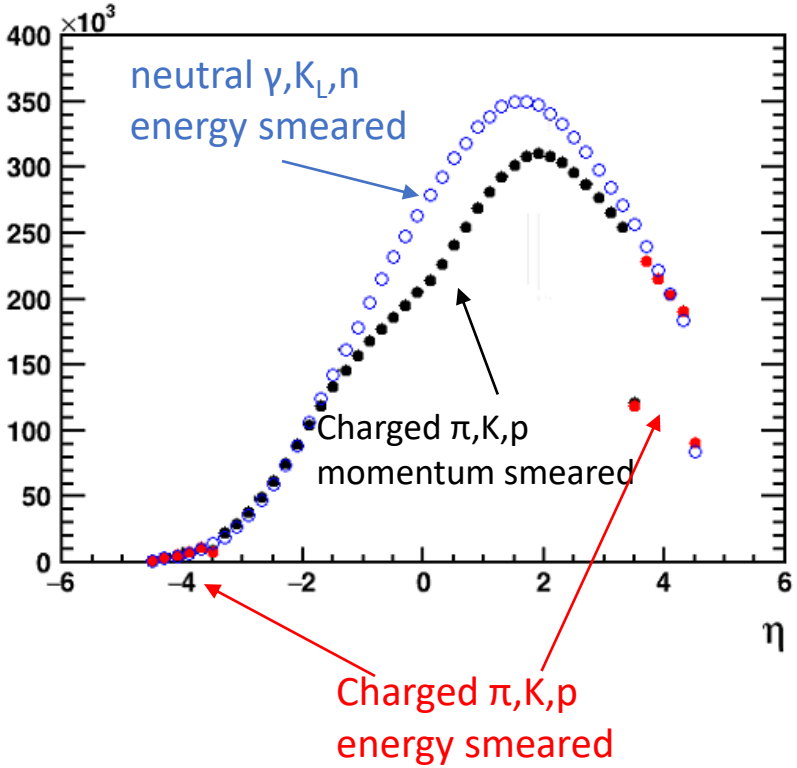
Detector response on jet with eic-smear

https://gitlab.com/eic/eic-smear/-/blob/master/scripts/smearBeAST.cxx

A final state particle is smeared either in momentum or energy, perfect PID assumed.

p/direction smeared -> E =sqrt(p^2+m^2)
E smeared -> p=sqrt(E^2-m^2) direction unchanged

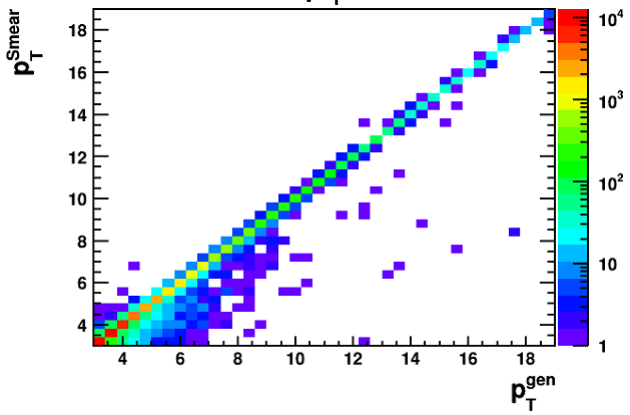
- Track efficiency can be inserted before taking out the smeared information
- Granularity can be embedded during momentum assignment for the energy smeared particles

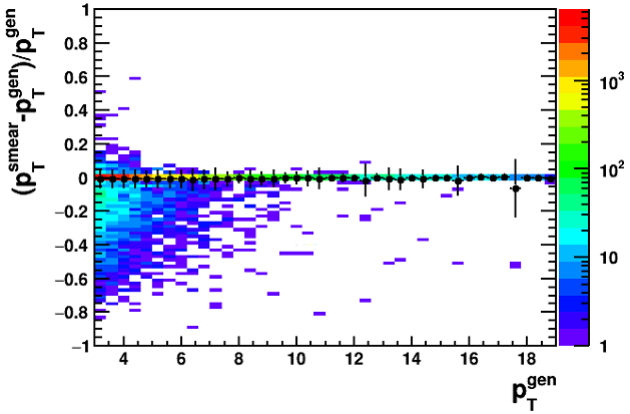


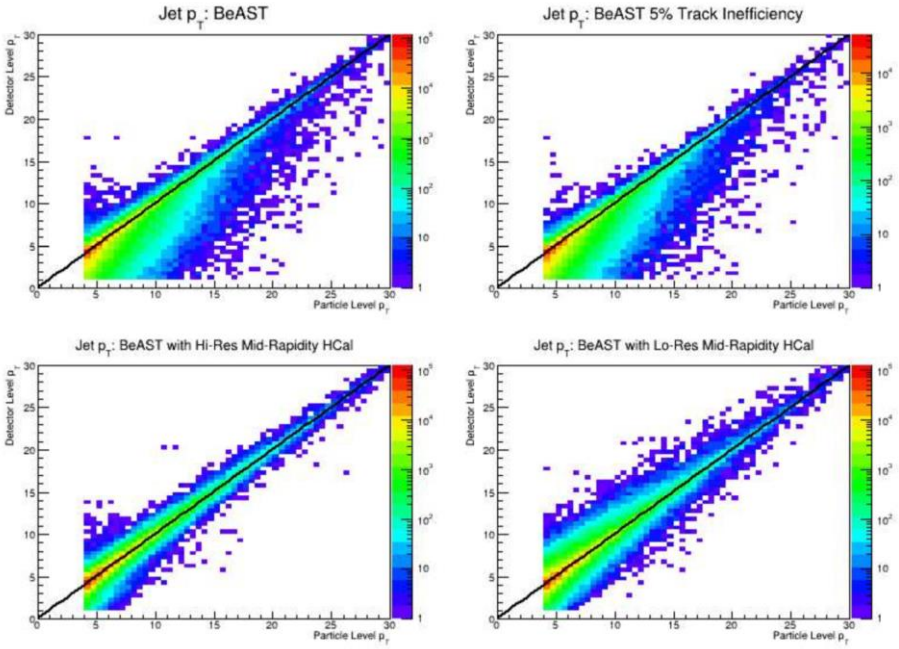
Detector response on jet with eic-smear

ep 20x100, $W^2>4$, $Q^2>1$, $0.1<y<0.85$
Jet reconstruction
R=1, All final state particles, $p_T>250$ MeV

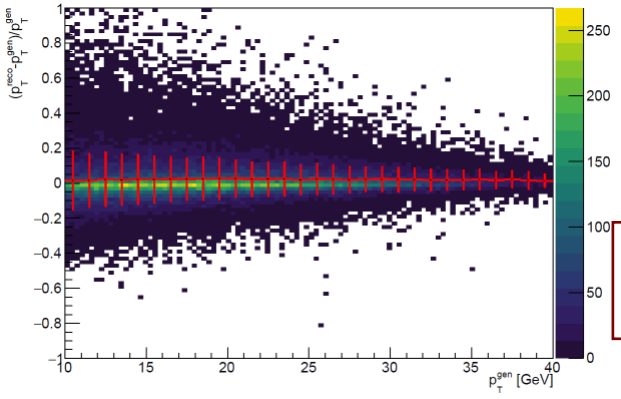
Jet p_T







From B. Page



From M. Arratia
PYTHIA8+DELPHES