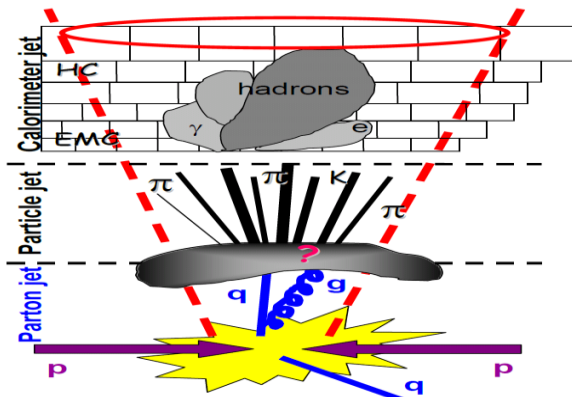


# Jet Fragmentation towards an EIC (update)

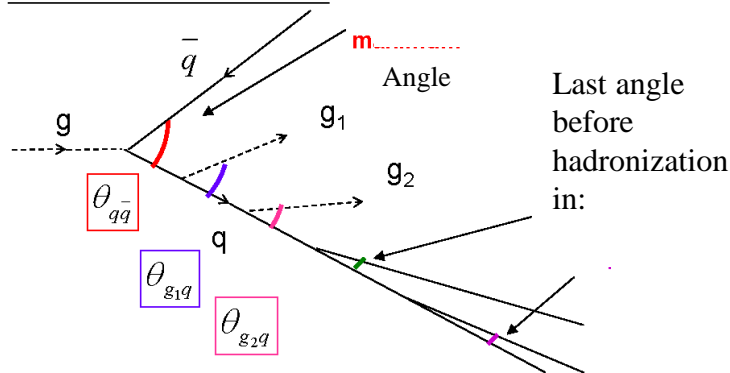
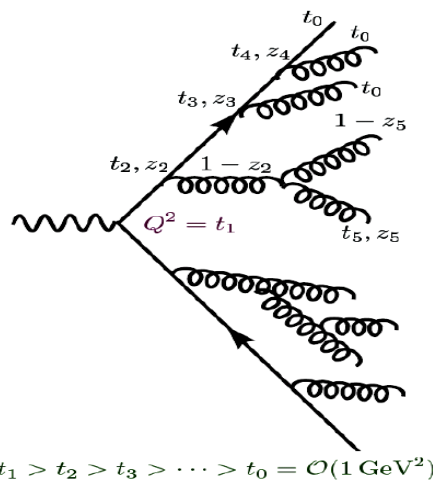
Alexandre SHABETAI  
SUBATECH CNRS/IN2P3  
Nantes France

# Jet Fragmentation: Motivations



- colored objects  $\rightarrow$  color coherence  $\rightarrow$  angular ordering
- $1/kR < \theta_{qg_2} < \theta_{qg} < \theta_{qqbar}$   
 $1/R \sim$  hadron mass at the end of the shower

Parton shower evolution:



$$\frac{d^3 \sigma_{p+p \rightarrow h+X}}{dy d^2 p_T} = \int dx_a \int dx_b G_{p \rightarrow a}(x_a, \mu_i^2) G_{p \rightarrow b}(x_b, \mu_i^2) \times \frac{d\hat{\sigma}_{a+b \rightarrow c+X}(Q^2)}{d\hat{t}} \frac{D_{c \rightarrow h}(z, \mu_f^2)}{\pi z}$$

# What about EIC from the Jet (fragmentation) point of view ?

# EIC-Smear

- **eic-smear is fast, light-weight, extensible, well-written**
- First stage unifies a host of EIC-relevant MC output
- Cannot replace a full simulation
  - but gives a good estimate of detector effects on observables in <10% of the time it takes to generate PYTHIA6.

Kolja Kauder EIC UG meeting 2019

Detector Matrix used for our FF study  
(and EIC-Smear v 1.1.1 (EIC sw. release DEV 2020b))



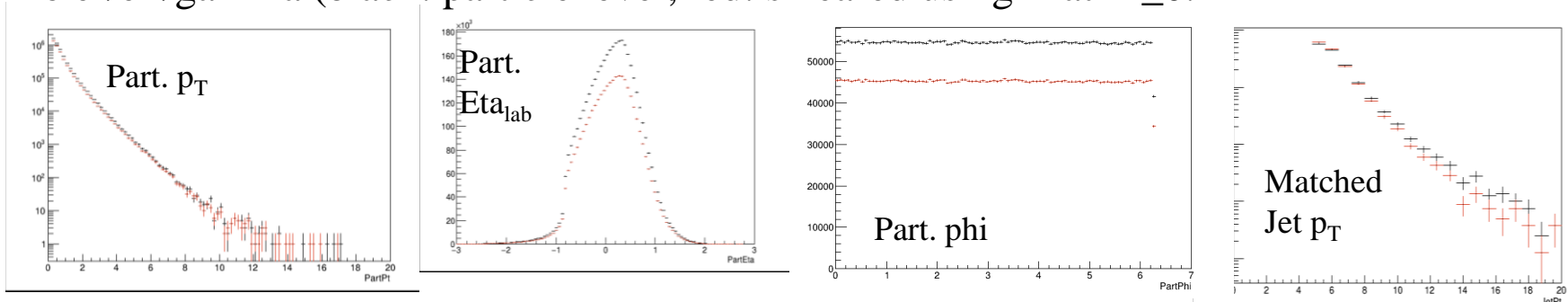
# EIC Simulation: jet FF cuts used e+p

Electron –Proton events generated at  $\sqrt{s} = 141$  GeV using PYTHIA  
(Full energy eRHIC design 20x250 GeV electron x proton)

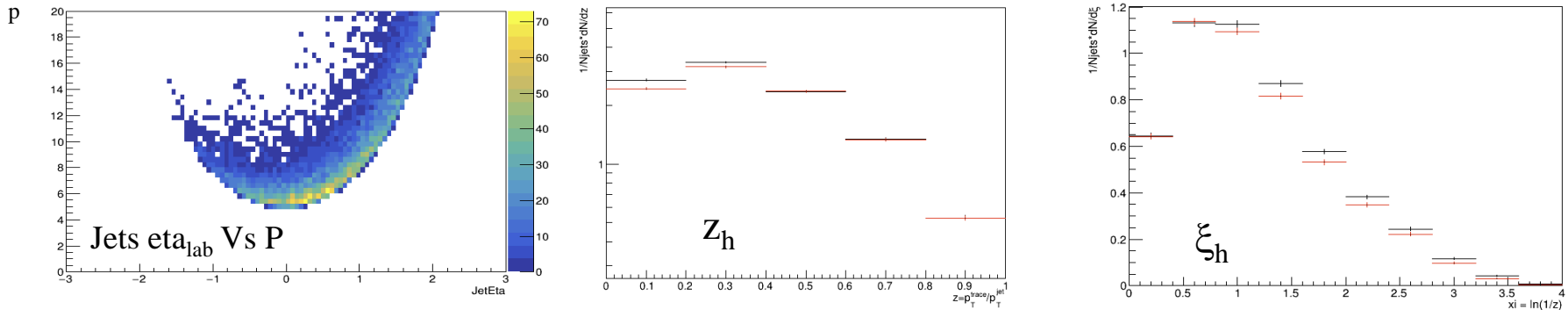
- Cut on inelasticity:  $0.01 < y < 0.95$
- Jet Algorithm: Anti\_kT
- Jets found in Lab frame
- Particles used in jet finding:
  - Stable
  - $p_T \geq 200$  MeV
  - $\eta \leq 3.0$
- Parent cannot originate from scattered electron

# FF simulation in e+p (for EIC)

ep switch to 18x275 no RadCor kT=1.0\_1 Uncorrected  $p_{Tjet} > 5$  GeV/c  
 Charged jets Antik<sub>T</sub> R=0.3  $|\eta_{jets}| < 3 - R$ ; UE not subtracted  
 no e-/e+/gamma (black: particle level, red: smeared using Matrix\_0.1)



PythiaRHIC Q2=10-100 GeV<sup>2</sup> 1 M events (Yellow Report Events) Lab Frame

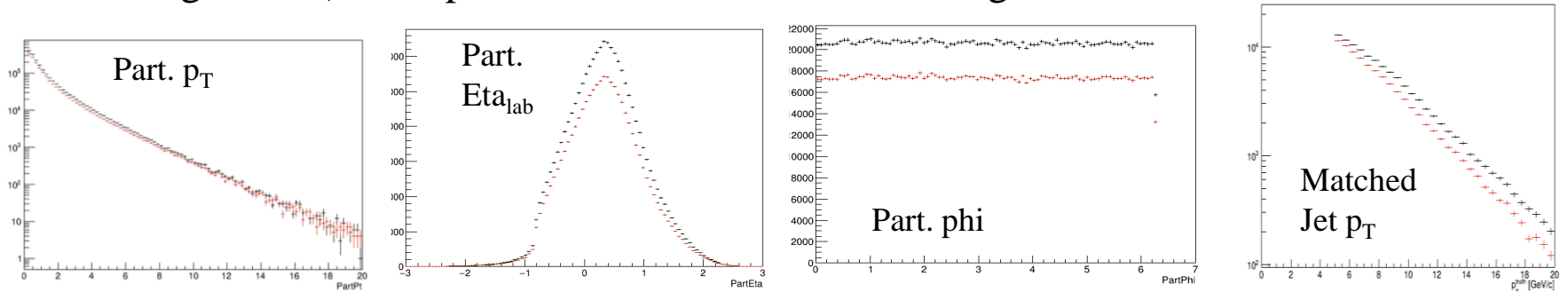


Next: to be optimized ( $p_{Tjet}$  min, use larger R ref.) and studied as function of sqrt(s), jet resolution parameter R

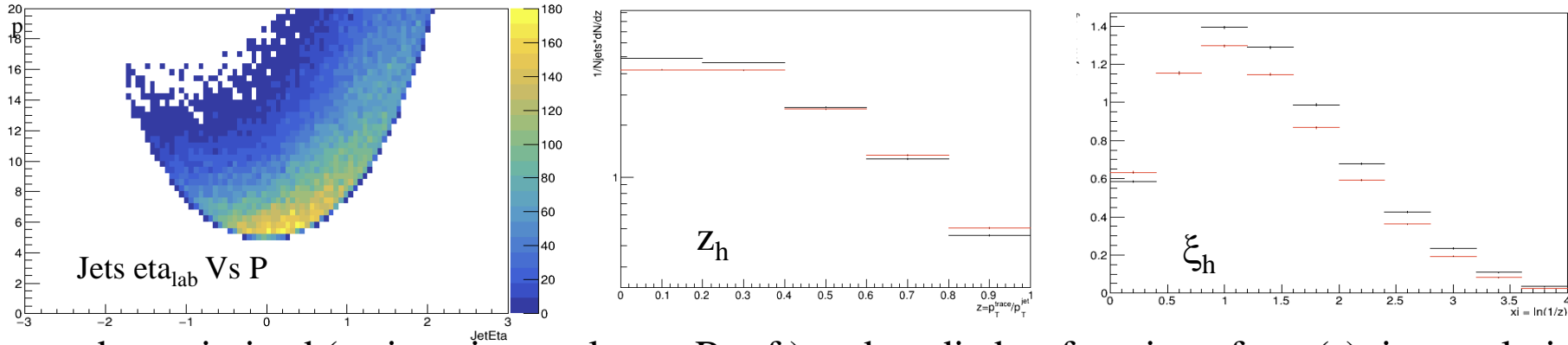
More statistics can be used

# FF simulation in e+p (for EIC)

ep 18x275 no RadCor kT=1.0\_1 Uncorrected  $p_{Tjet} > 5$  GeV/c  
 Charged jets Antik<sub>T</sub> R=0.3  $|\eta_{jets}| < 3 - R$ ; UE not subtracted  
 no e-/e+/gamma (black: particle level, red: smeared using Matrix\_0.1)



PythiaRHIC Q2=100-1000 GeV<sup>2</sup> 250000 Evts (Yello Report Events) Lab Frame



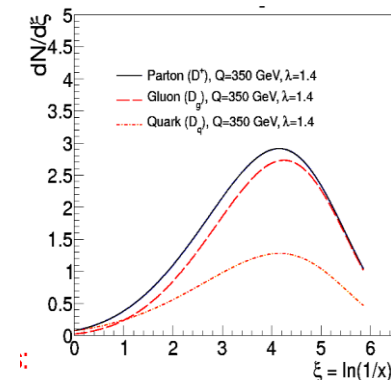
Next: to be optimized ( $p_T$  jet min, use larger R ref.) and studied as function of sqrt(s), jet resolution parameter R,

More stat to be added

# Fragmentation functions @ EIC next steps

- Analysis code still very simple → to be enhanced
- Started looking at  $z$  and JES/JER in e-p using PHYTHIAerhic hiQ2 events (stat limited) smeared using EIC-Smear
- ⇒ In order to add statistics could use AGILE (<https://agile.hepforge.org>) to get HepMC output from the fortran driver.
- ⇒ That will allow to run it on the fly and on the grid
- Switch to full simulation (several framework exists ATM tracking is implemented).
- **Mass and flavor dependence** of (identified) jet Fragmentation functions
- **q/g separation**

Easy access to the **gluon** sector at the EIC





# JetScape for EIC : Status

JETSCAPE: candidate for general e+A MC with unique strengths

\* e+P baseline:

- Hard process generation done
- Hadronization done à further improvements out of scope
- Infrastructure mostly done à Streamline DIS observable output
- Next: Include into official distribution, fine-tune & validate

\* e+A

- Switch to E-loss modules in principle trivial, works
- Next: tuning (e.g., HERMES) and attract users!

Kolja Kauder – BRBC EIC virtual Workshop on jet Observable

Starting to generate events using eJETSCAPE (thanks Kolja)

# Outlook

As a reference (slides from last week)

[https://indico.bnl.gov/event/9394/contributions/41389/attachments/30374/47553/EIC\\_YRMeeting\\_shabetai.pdf](https://indico.bnl.gov/event/9394/contributions/41389/attachments/30374/47553/EIC_YRMeeting_shabetai.pdf)

# Backup

# ALICE Pb-Pb Full Jets $R_{AA}$ vs Models

Answer to question asked last week

