Status of jet fragmentation function moment measurement in ALICE

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FCPPL 2015
University of Science and Technology of China
April 8-10 April, 2015

10 April 2015

Outline

- Physics motivations
  - ✓ Why Jets?
  - ✓ A new variable: FFM
- FF and FFM analysis in ALICE (pp @2.76 TeV):
  - ✓ Data & MC
- Analysis status & todo
- Summary

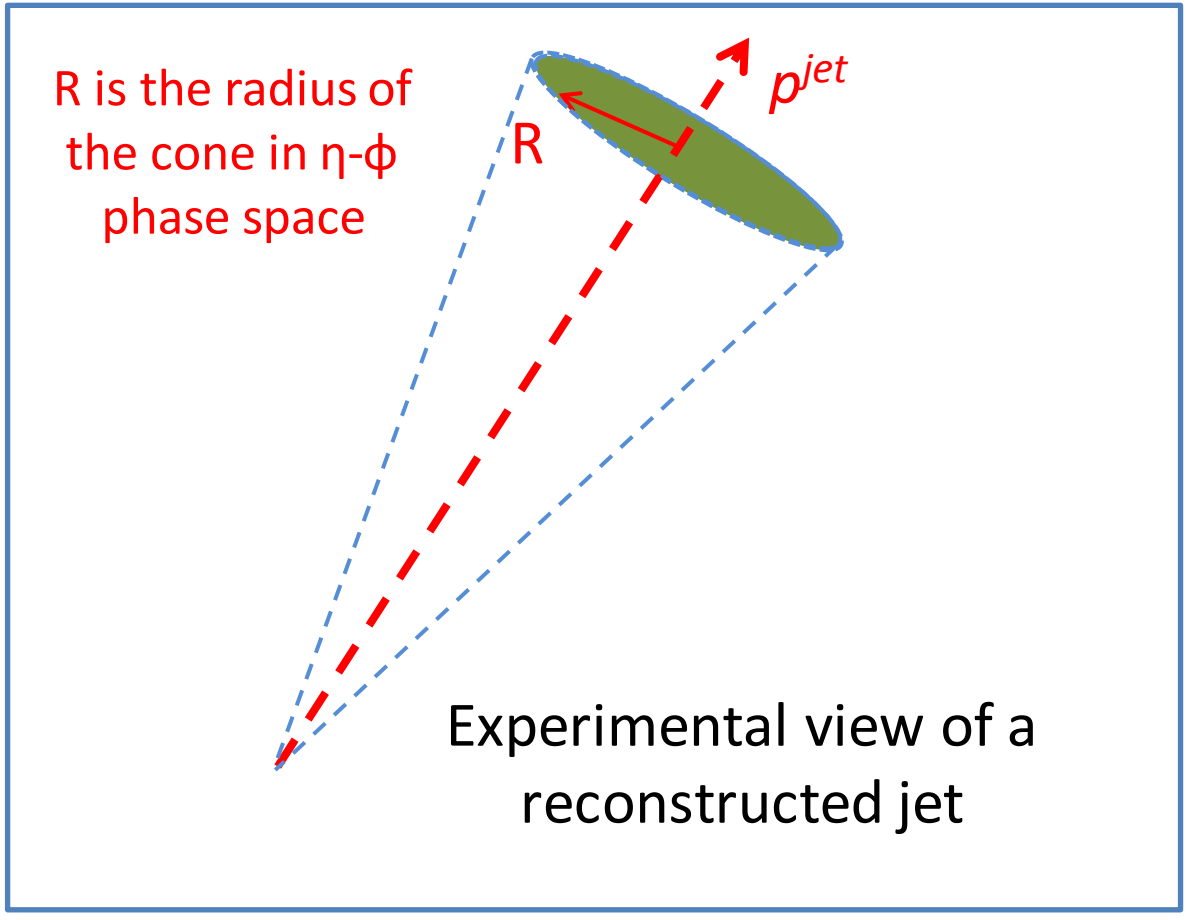
N.B. FF for fragmentation function
FFM for fragmentation function moments

Physics motivations

A Jet in the QCD "vacuum"

- **Production of a jet in elementary hadronic collision (p-p)**

A 2→2 hard process (large momentum transfer) in pp collision creates 2 outgoing partons (quarks/gluons). These hard partons firstly radiate soft gluons, creating a parton shower. They then hadronize leading to a collimated hadron shower.



Physics motivations

Jet modification in a hot and dense medium

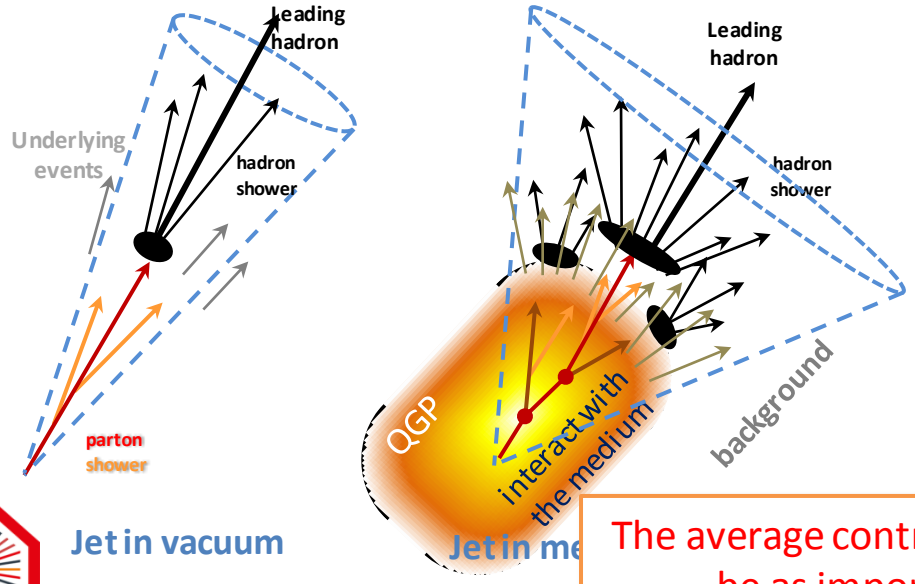
- **Jets in Pb-Pb collision**

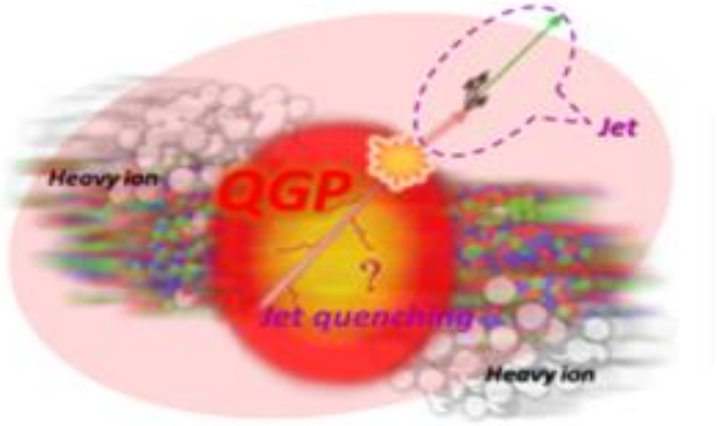
✓ Produced in the early stage of the collision before the medium creation

✓ Interact with the medium

✓ **Quenching effects**:

- Increase of track multiplicity in jets expected (modification of the jet shape)
- Potential redistribution of the p_T of the jet constituents which are overwhelmed in the event background





Sketch of collisions in p-p and A-A collisions

- **Jet as a QGP probe**

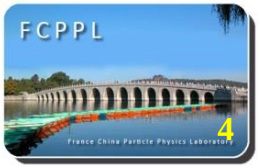
✓ pp collisions: test of pQCD and reference to the Pb-Pb case

✓ Extract medium (QGP) properties from global jet observables (e.g. R_{AA}) in Pb-Pb collisions:

- **energy loss and its path length dependence**
- **density of the medium**

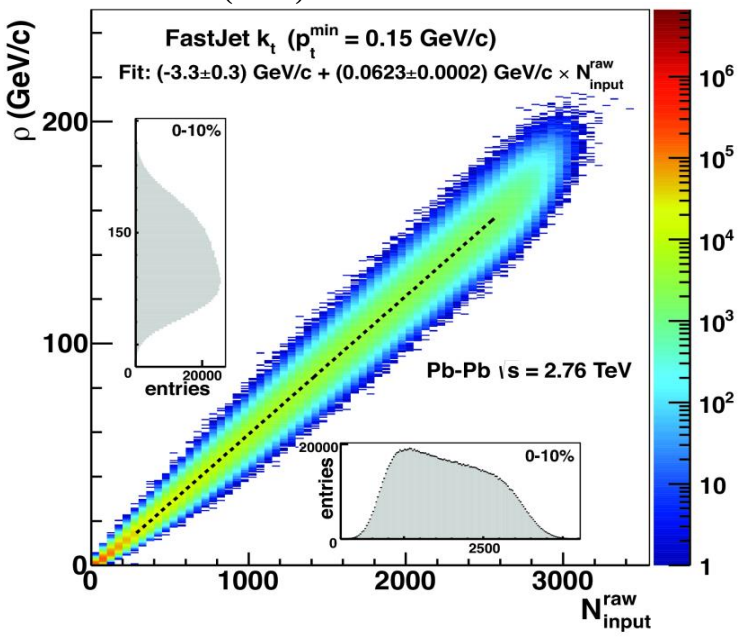
The average contribution of the **background** can be as important as the jet p_T in ALICE

+ Non-neglectable fluctuations!



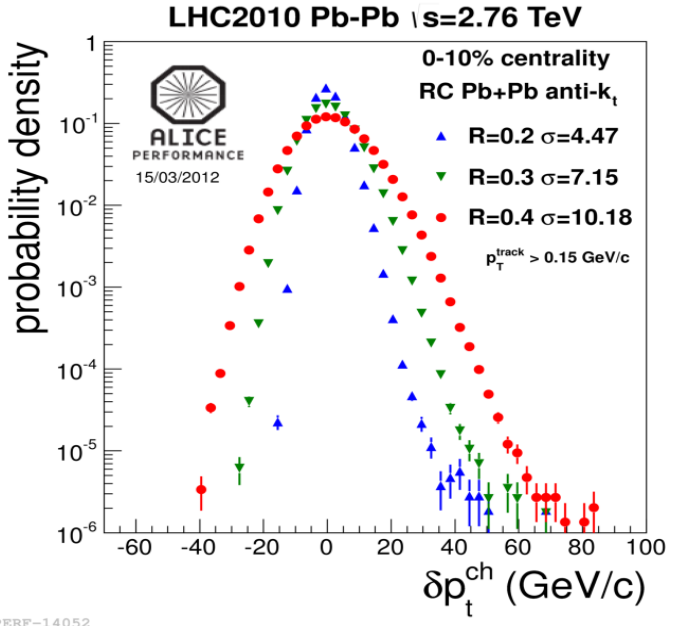
Pb-Pb background estimation and fluctuations for "charged" jets

JHEP 03 (2012) 053



$$\rho = median\left(\frac{p_T^{jet,i}}{A_i^{jet}}\right)$$

- Background density ρ_{ch} increases for more central collision



2010 data charged jets:

σ_{ch} ≈ 4.5 GeV/c for R=0.2

σ_{ch} ≈ 7.0 GeV/c for R=0.3

σ_{ch} ≈ 10.0 GeV/c for R=0.4

- Larger background fluctuations for larger R, while larger R should be preferred to recover as much information as possible (jet properties).

$$\delta_{p_T} = p_T^{rec} - \rho A - p_T^{probe}$$

Select observables as insensitive as possible to the heavy ion background fluctuations

FFM as a new observable

- **The fragmentation function moments (FFM) should be less sensitive to the background fluctuations.***

* Reference: Cacciari et al., Eur.Phys.J. C73 (2013) 2319, "Jet fragmentation function moments in heavy ion collisions"

$$\mathbf{M}_N = \frac{1}{N_{jet}} \int_0^1 z^N \frac{dN_{hadron}}{dz} dz\,,$$

$$where\ z = \frac{p_T^{hadron}}{p_T^{jet}}$$

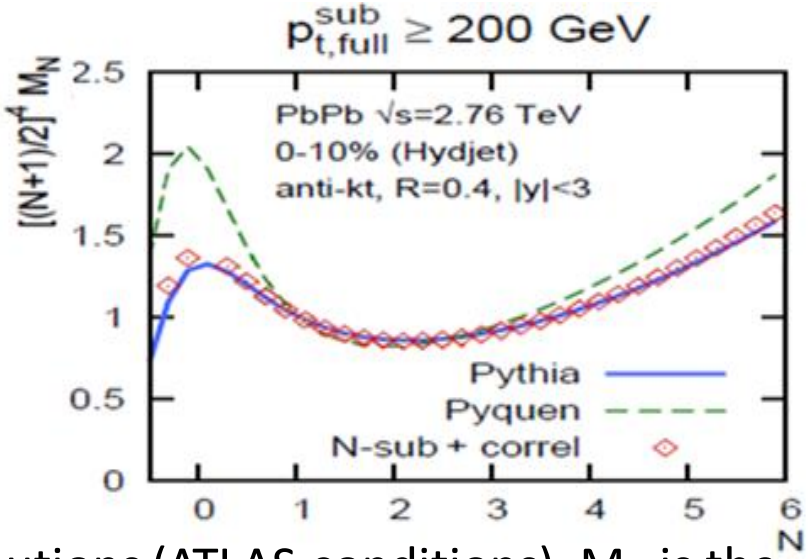


Figure: model calculations of FFM distributions (ATLAS conditions), M_N is the N^{th} fragmentation function moments.

In practice, M_N for each jet is defined as:

$M_N = \sum_i z_i^N$, $i\ is\ the\ i^{th}\ constituent\ track$

Y-axis: $[\frac{N+1}{2}]^\alpha M_N$ (α = 2, 3, 4)

Summary

- The study of the jet fragmentation is interesting to get some insights into the QGP properties
- Background contribution and its fluctuations are large in heavy ion collisions and affect the jet reconstruction
- FFM should be less sensitive to background than FF
- My PhD topic: FFM analysis in ALICE (pp)
- The corrections and systematic studies for FF and FFM are ongoing

Thank you !

BACKUP