LHC-ALICE 実験におけるジェット測定のジェット抑制効果による影響

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Outline

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- Jet Finding Algorithm [FASTJET]
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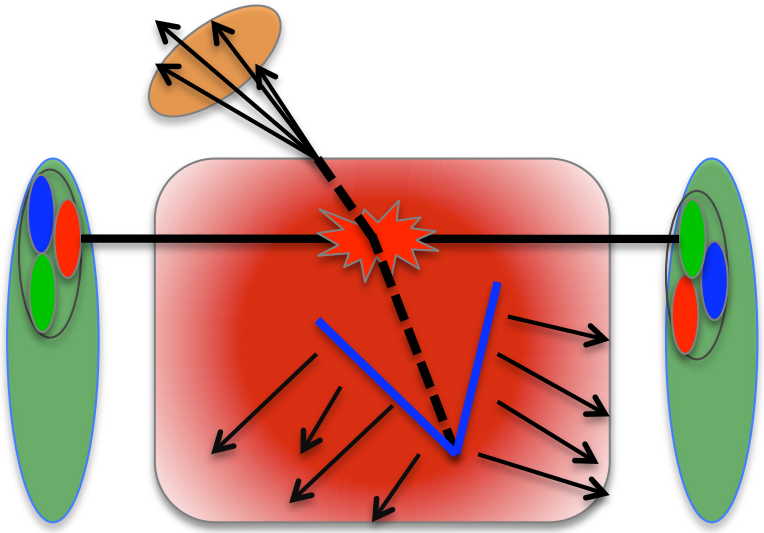
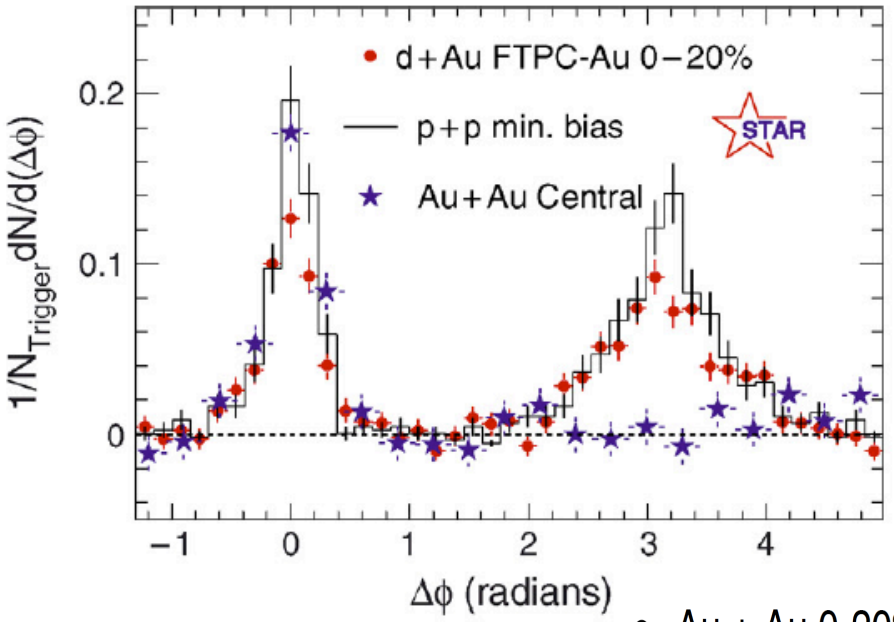
- Summary & Outlook

Jet Physics for Nuclear Collisions



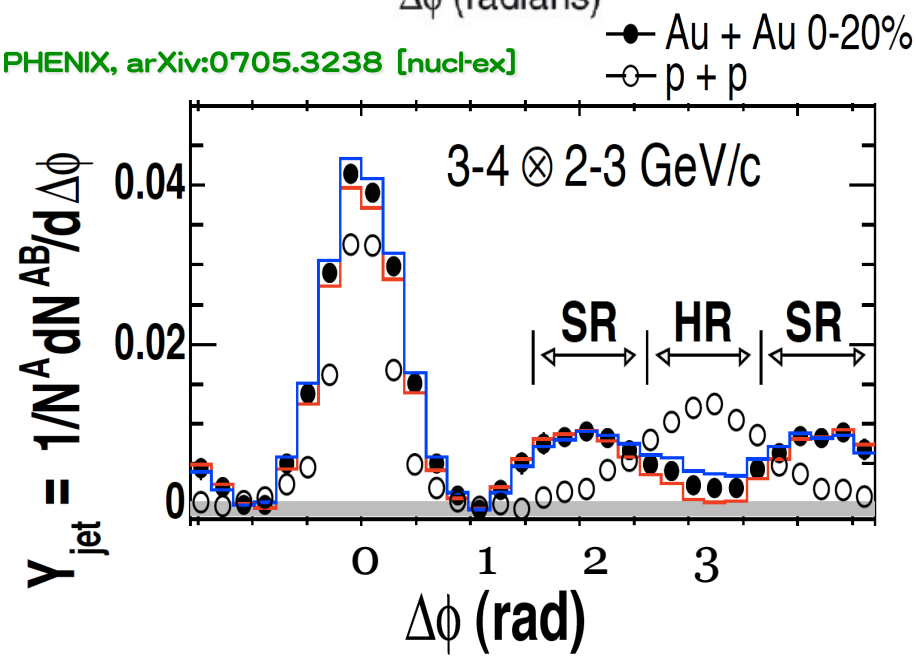
2003 Phys. Rev. Lett. 91 072304



Jet is very useful probe for investigating the hot & dense matter created by ultra relativistic heavy ion collisions.

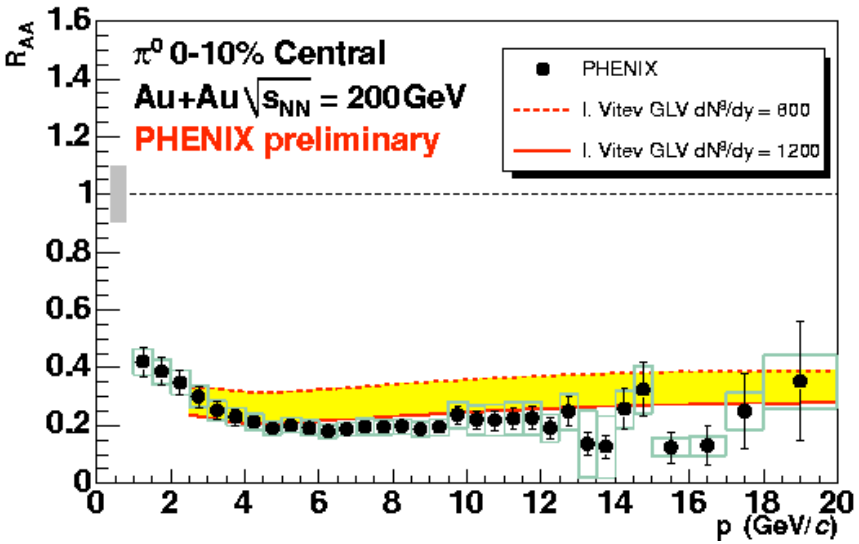
- Mach Cone
- E loss in QGP (jet quenching)
  - Collisional energy loss
  - Radiative energy loss

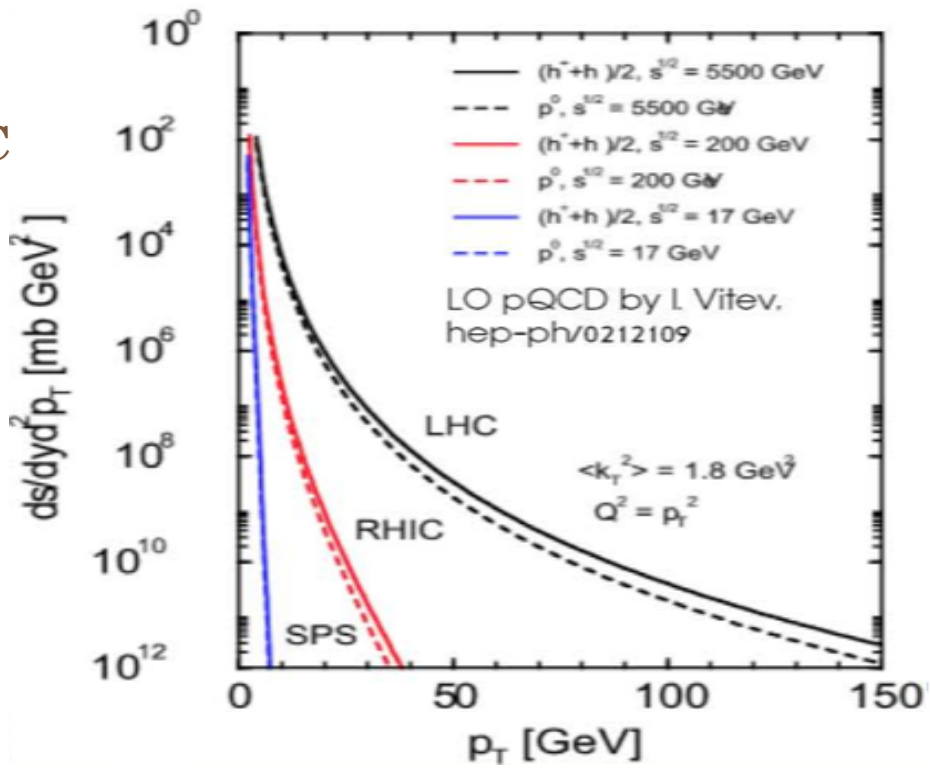
PHENIX, arXiv:0705.3238 [nucl-ex]



Motivation

To know the effect of Jet quenching , varied studies of particle level has been measured at RHIC



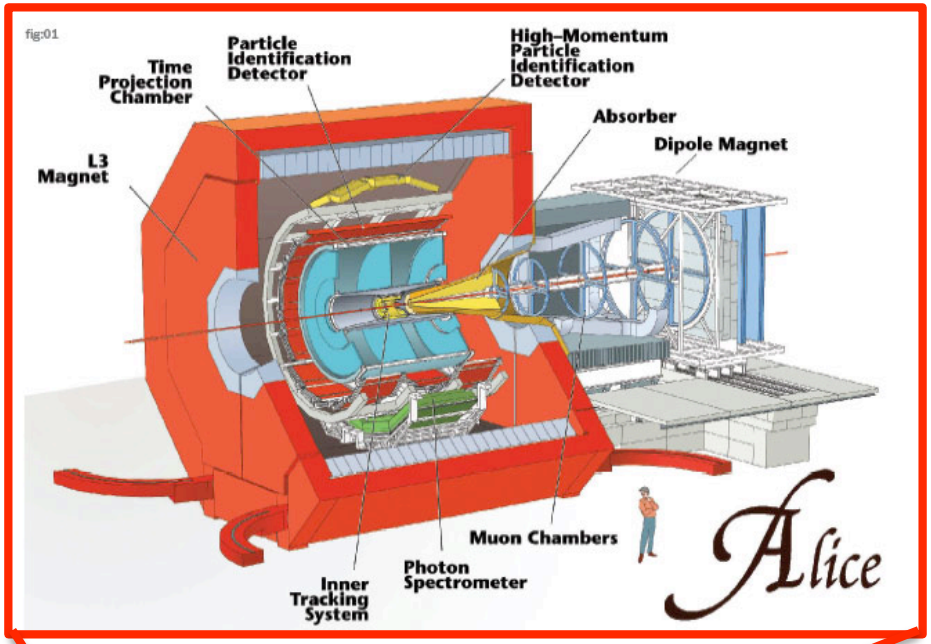


RHIC
"Particle level study"

LHC-ALICE
"Jet level study"

In order to do accurate jet level measurement for "Jet Quenching", it is necessary to evaluate the quenching effect on Jet-Finding.

A Large Ion Collider Experiment



ALICE is optimized to study heavy ion collisions.
Pb+Pb collisions will be studied at √s = 5.5TeV

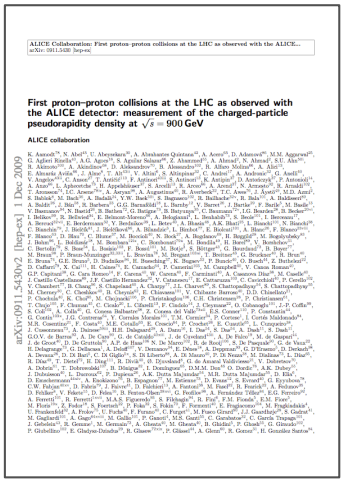
Central detectors

ITS,TPC,TRD,TOF,EMCAL,PHOS,HMPID

Forward detectors

FMD,Vo,To,ZDC,PMD,Muon

First paper was accepted
at 28 Nov. 2009!
arXiv:0911.5430



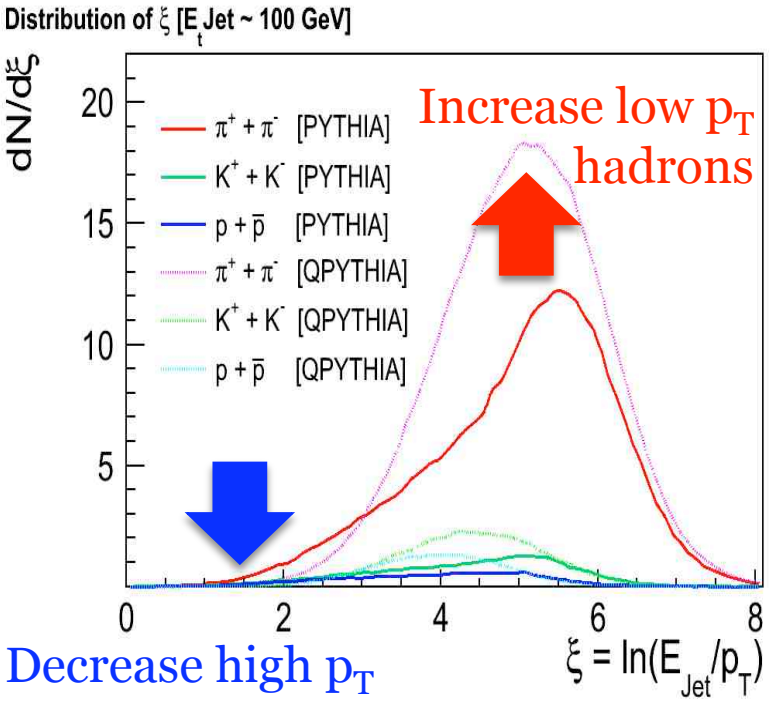
PYTHIA & QPYTHIA

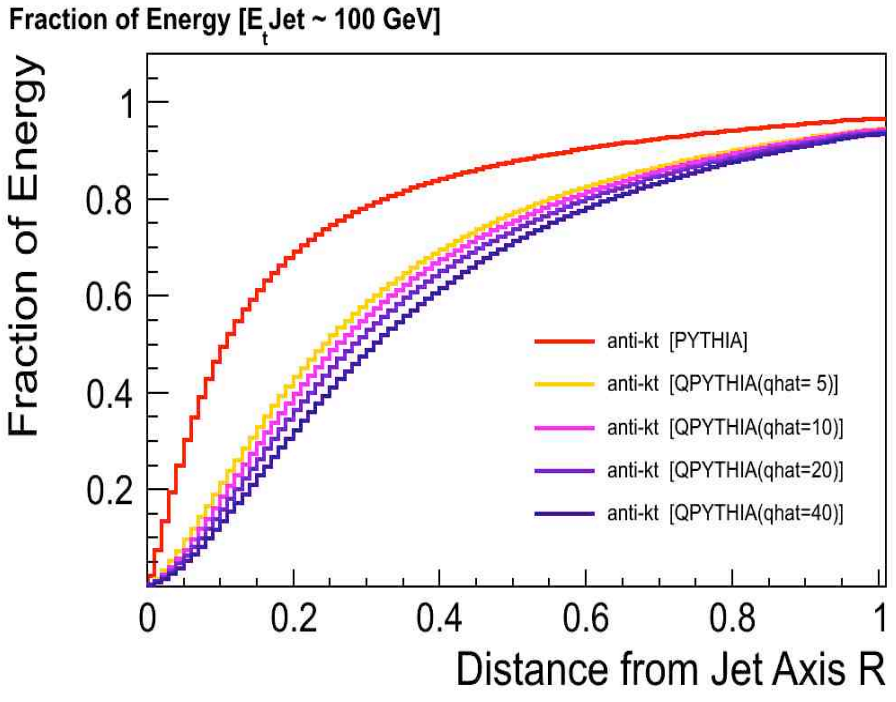
PYTHIA : event generator for pp collisions

http://home.thep.lu.se/~torbjorn/Pythia.html

QPYTHIA: event generator including quenching effect [arXiv:0906.0754]
based on BDMPS model [Phys. Rev. C58 (1998) 1706]

- ✧**Radiative energy loss : gluon radiation**
- ✧**Collsional energy loss : energy flow from parton to matter**



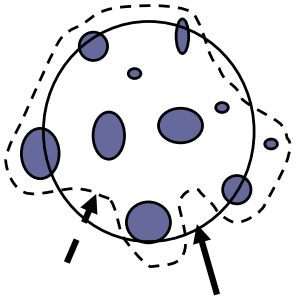


FastJet

FastJet: sequential clustering algorithms

http://www.lpthe.jussieu.fr/~salam/fastjet/

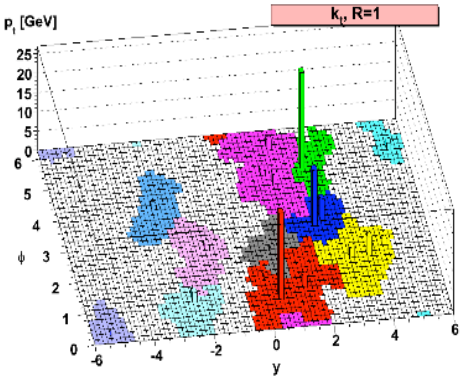
$$d_{ij} = \min(k_{ti}^{2p}, k_{tj}^{2p}) \frac{\Delta R^2}{R^2} \begin{cases} p = 1 & k_T \text{ algorithm} \\ p = 0 & \text{Cambridge/Aachen algorithm} \\ p = -1 & \text{anti-}k_T \text{ algorithm} \end{cases}$$

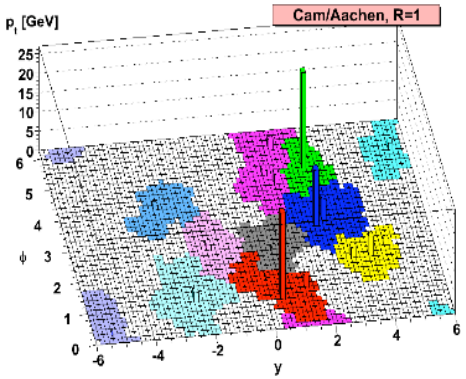


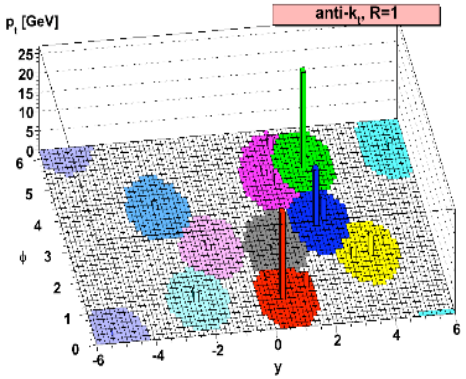
K_T jet Cone jet

Procedure of Jet Finding

Calculate particle distance : d_{ij}
Calculate Beam distance : $d_{iB}=k_{ti}^{2p}$
Find smallest distance (d_{ij} or d_{iB})
If d_{ij} is smallest combine particles
If d_{iB} is smallest
and the cluster momentum
larger than threshold
call the cluster a Jet.





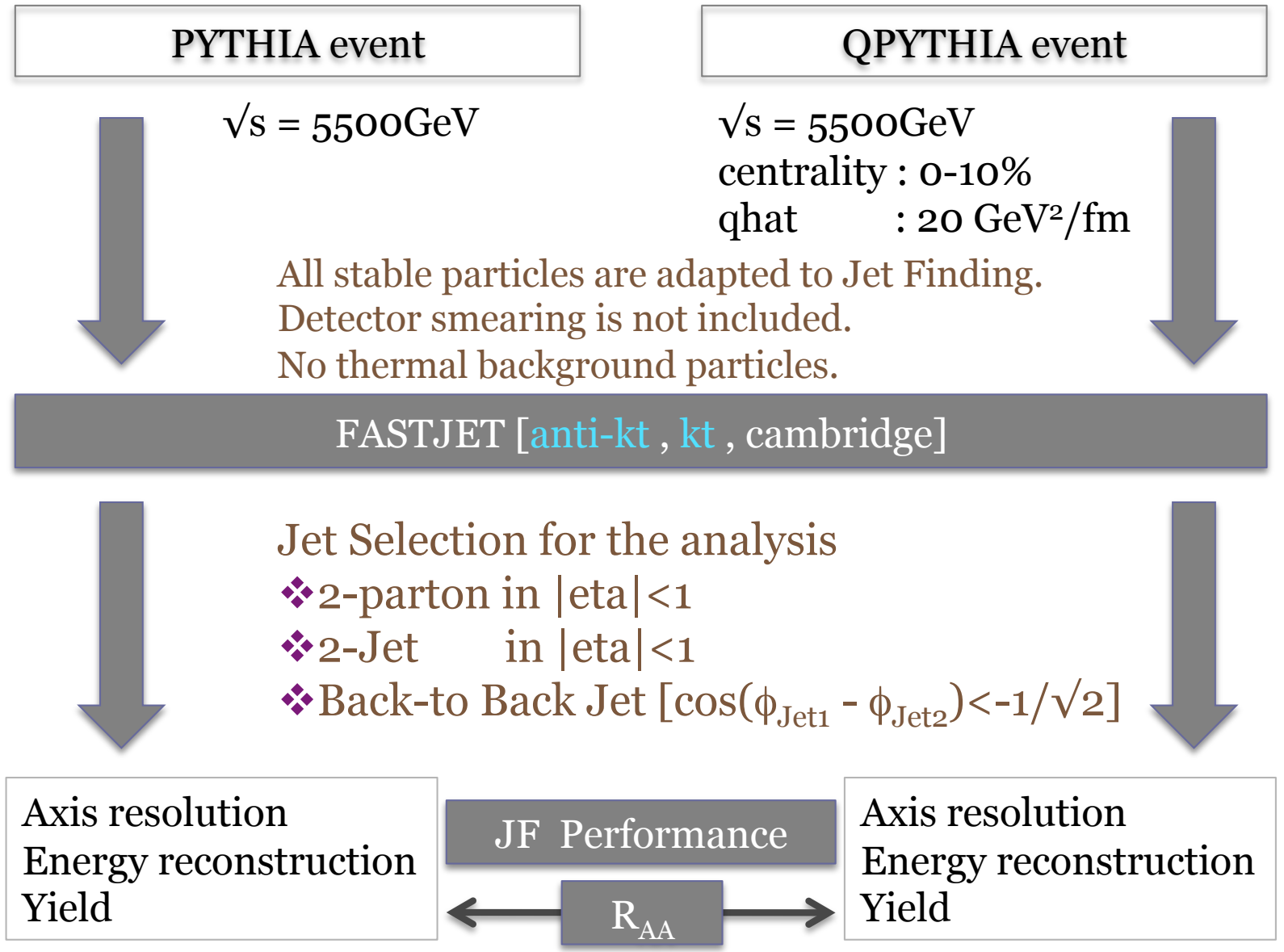


arXiv:0802.1189v2 [hep-ph] (2008)

Parameters

- R size (= $\sqrt{d\phi^2 + d\eta^2}$)
- p_T cut of single particle
- Jet momentum threshold

Analysis Flow



Jet Finding Performance

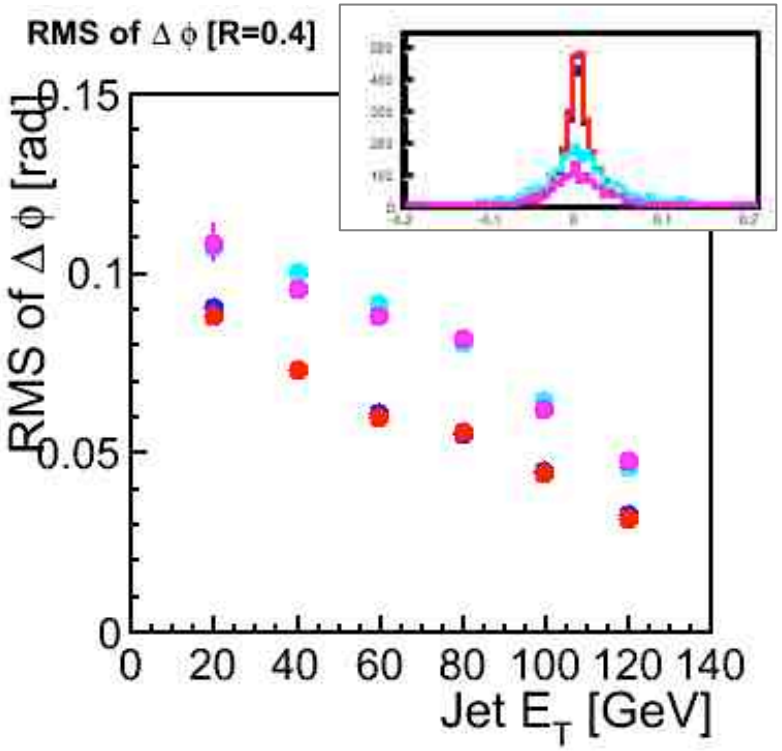
threshold : 20 [GeV/c]

$d\phi = \phi^{parton} - \phi^{Jet}$

$dE_T = dE_T^{parton} - dE_T^{Jet}$

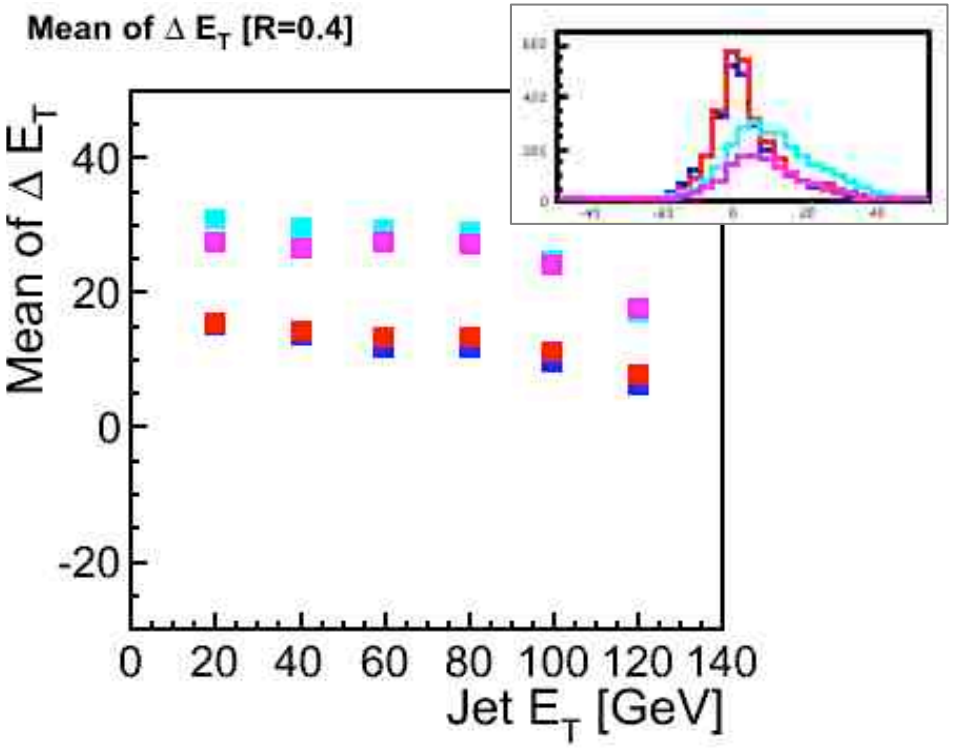
	PYTHIA	QPYTHIA
anti-k_T algorithm	■ ●	■ ●
k_T algorithm	■ ●	■ ●

Axis resolution



Axis resolution is about 40% broad due to quenching

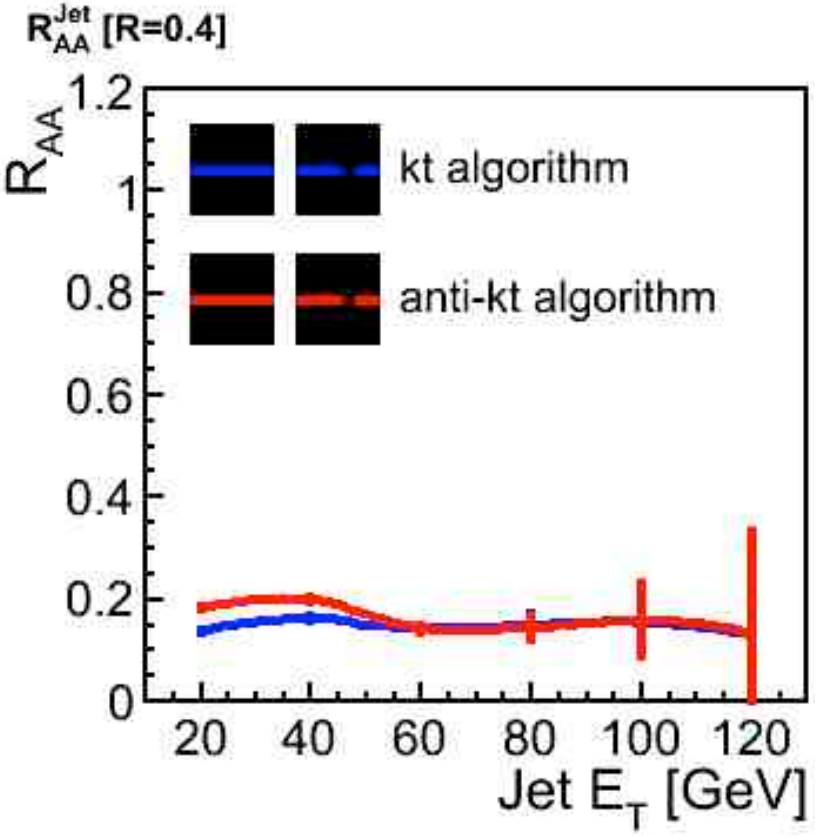
Energy reconstruction

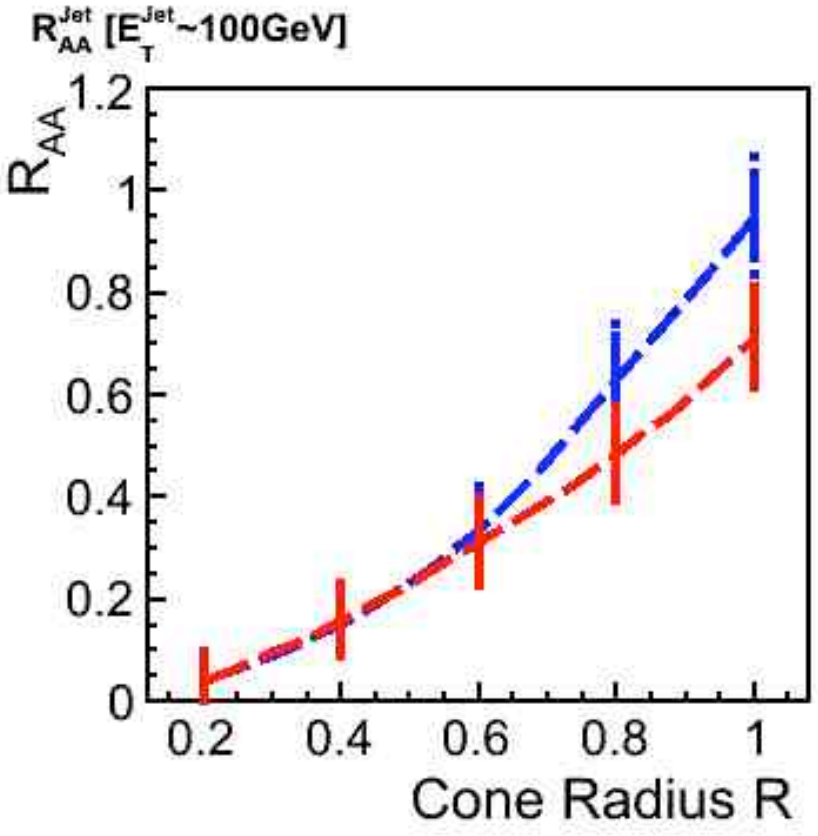


dEt is shifted about 20GeV by quenching effect

R_{AA} of Di-Jet

threshold : 20 [GeV/c]





Di-Jet yield of quenched Jet is
15% of the yield of unquenched Jet at R=0.4

R_{AA} is getting larger with increasing R.

Summary & Outlook

- **Tested several Jet Finding algorithms w/wo quenching effect.**
  - Axis resolution is about 40% broad due to quenching effect.
  - dE_T is shifted about 20GeV by quenching effect.
  - R_{AA} of Di-Jet is about 0.15 at R=0.4

- **Evaluate Jet Finding performance with background.**
- **Evaluate possibility of reconstruction of Energy loss.**

Thank you very much

Backup

Event Generation & Selection

PYTHIA
p+p 5500GeV

QPYTHIA
Pb+Pb 5500GeV
Centrality : 0-10%
qhat : 20 GeV²/fm

All stable particles are adapted to Jet Finding.
Detector smearing is not included.
No background particles.

Status of PYTHIA & QPYTHIA (tuned for ALICE)

AliRoot	v4-17-01
# of event	10000
Process	All QCDon
ϕ	0 ~ 2π
η	-1 ~ 1

Jet Selection for the analysis

- 2-parton in |eta|<1
- 2-Jet in |eta|<1
- Back-to Back Jet [$\cos(\phi_{Jet1} - \phi_{Jet2}) < -1/\sqrt{2}$]

To evaluate "Quenching effect" with Jet Finding, it is necessary to minimize the other higher order effects.