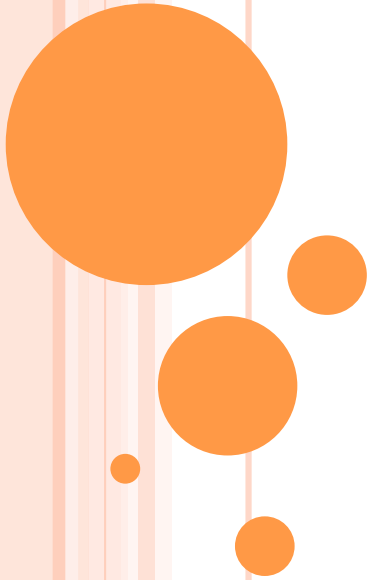

Jet and di-jet reconstruction using Hydjet++

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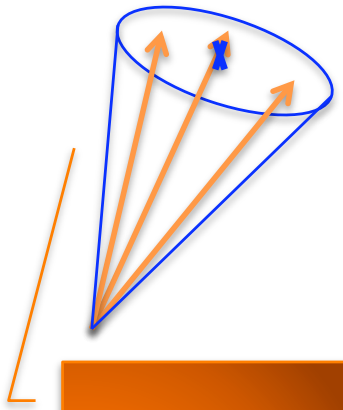
Celljet (the Jet-Finding Method)

1. divide $-1 < \eta < 1$, $-\pi < \phi < \pi$ region in [0.1, 0.1] cells
2. calculate transverse energy (eTcell) in each cell
3. subtract mean BKG defined by HYDJET HD event from eTcell (eTcell = eTcell – BKG(centrality, ϕ , η))
4. select candidates of jet-seed by eTcell > ”eTseed”
5. calculate sum of eTcell in the cone which center positioned at jet-seed (eTsum= Σ eTcell)
6. requirement1 : eTsum>”Min-eT”
7. requirement2 : eTseed/eTsum>”frac”(eT fraction of jet-seed)
8. define the survivors as found jets

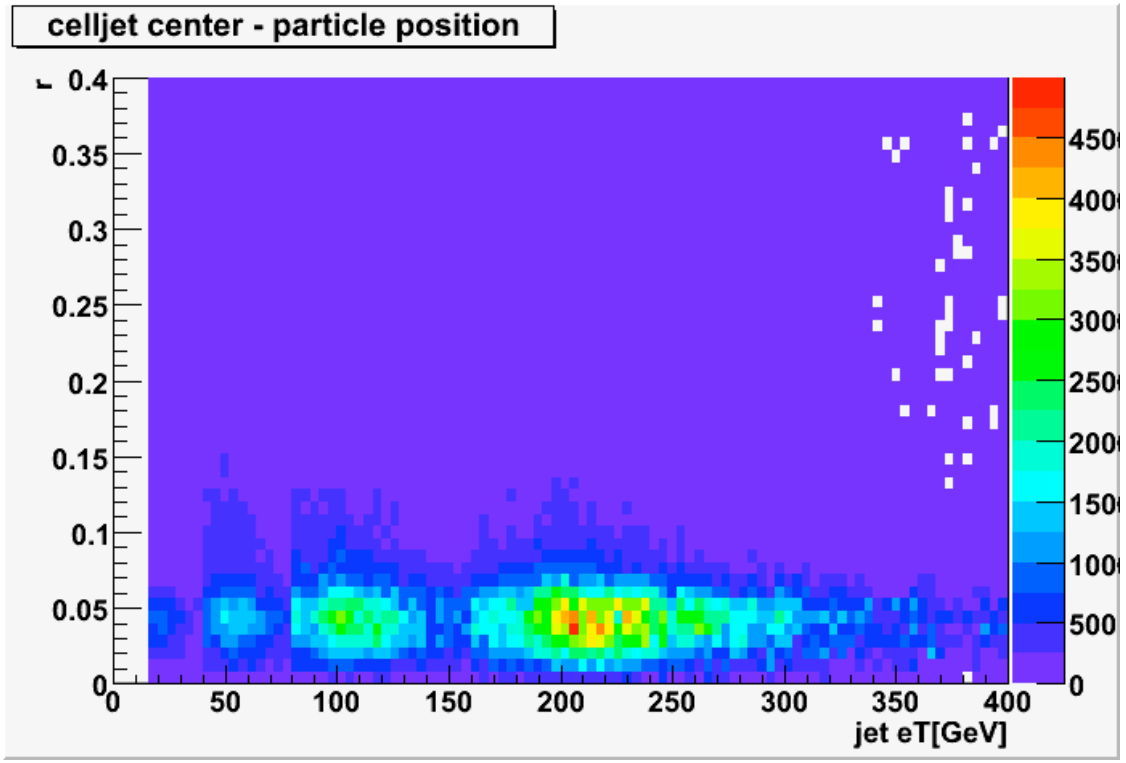
Parameters to input are
“eTseed”, “coneRadius”, “Min-eT” and “frac”

Parameter Selection ("coneRadius")

- PYTHIA simulation (pp 5500GeV quark-jet)
- distance btw Celljet center and each track (eT weighted)



calculate distance

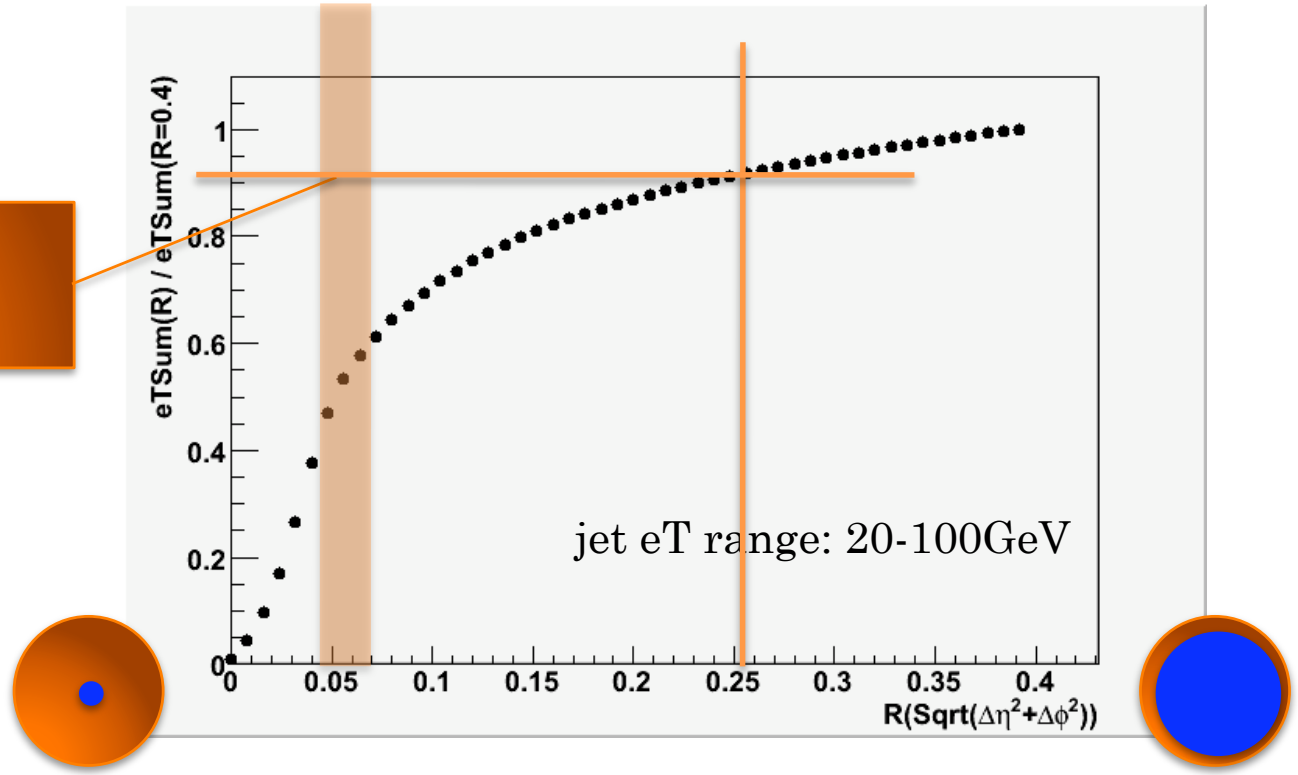


"coneRadius" = 0.25 is sufficient

Parameter Selection (“frac”)

- distance btw Celljet center and each track (eT weighted)->ProjectionY
- eT fraction against jet-eT(R=0.4) as a function of length from Celljet center

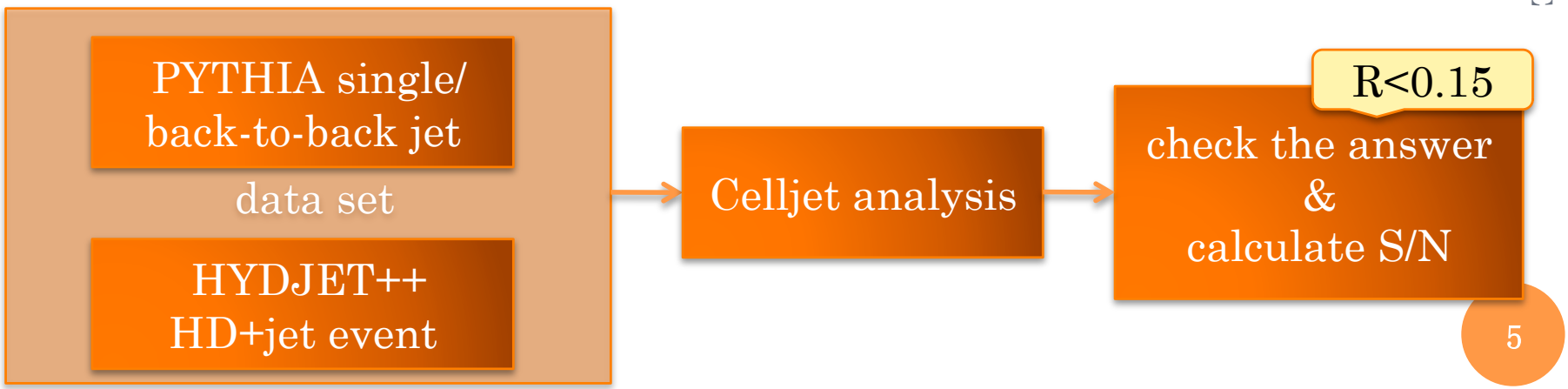
region of jet-seed



seed-eT fraction “frac” = 0.3 is selected

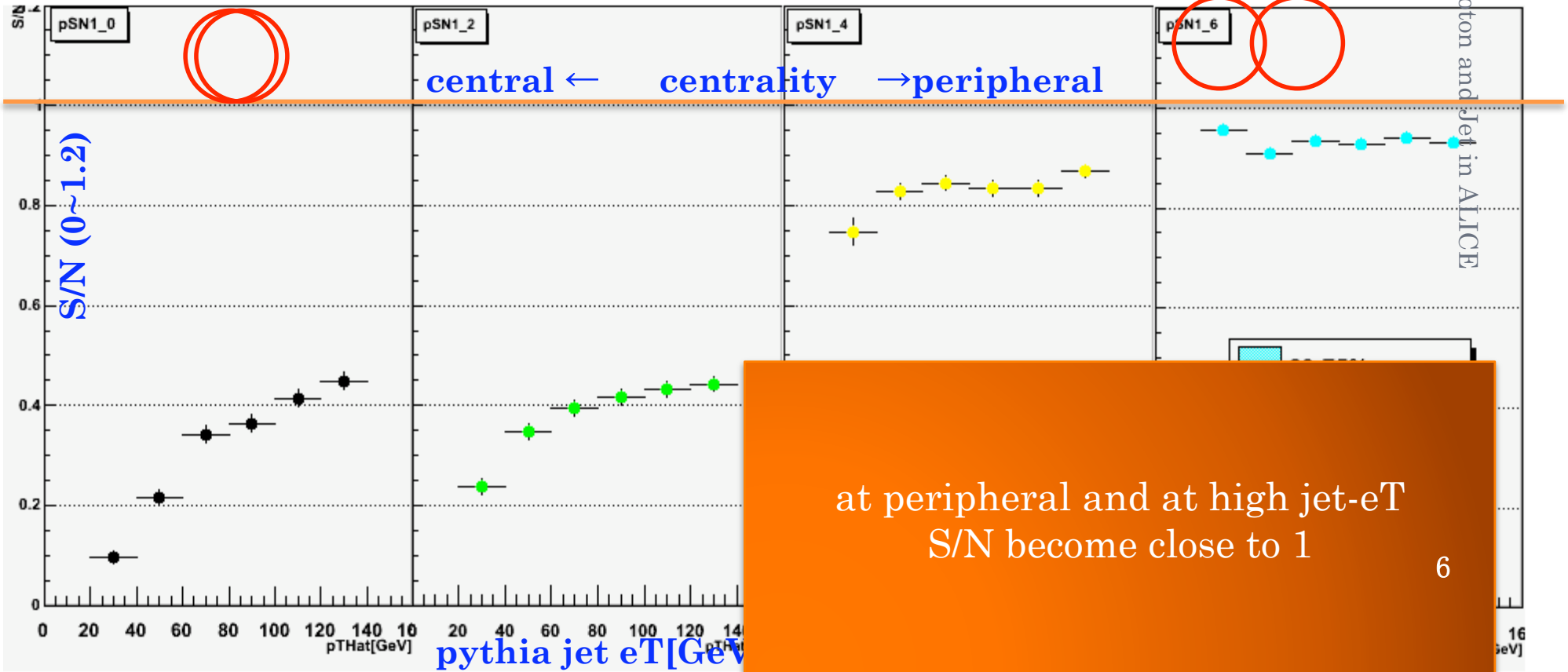
Analysis Flow

1. prepare data of single/back-to back jet by PYTHIA 5500GeV pp collision at each jet-eT region
2. prepare data of HD+Jet event using HYDJET++ √s=5500GeV PbPb collision
3. embed a PYTHIA jet into a HD+Jet event
4. analyze using Celljet method, then find single/back-to back jets
5. compare the direction of embedded jet with those of found jets
6. calculate S/N



Quality of Single-jet Finding

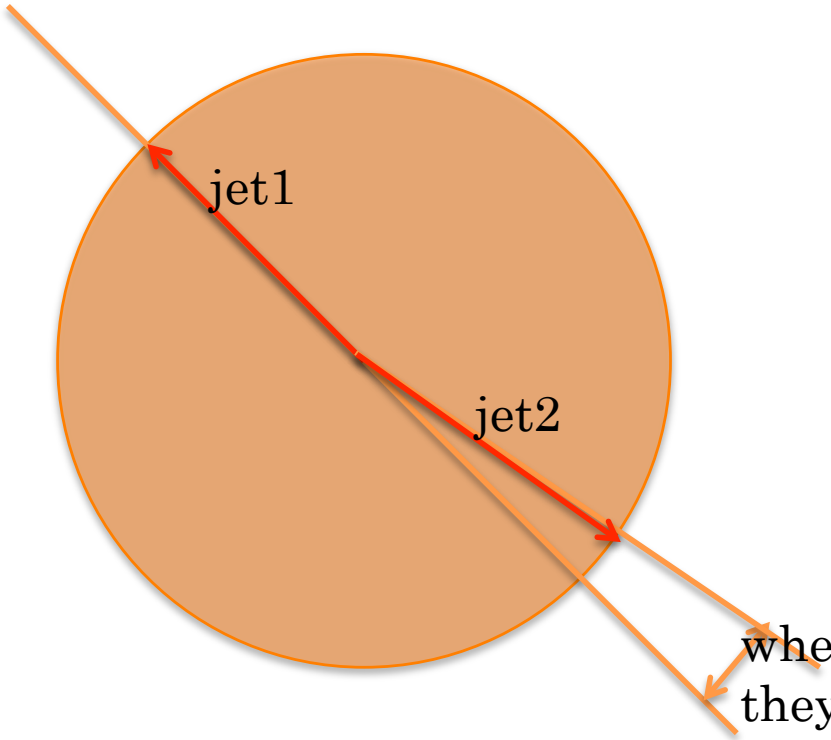
- HYDJET "HD+Jet" event + PYTHIA single-jet
- charged pion, proton and photon tracks are used
- "Min-eT" = 20[GeV], "eTseed" = "Min-eT"*0.3 is selected
- **S/N≡ (# of found PYTHIA jets)/(# of found jets)**



at peripheral and at high jet-eT
S/N become close to 1

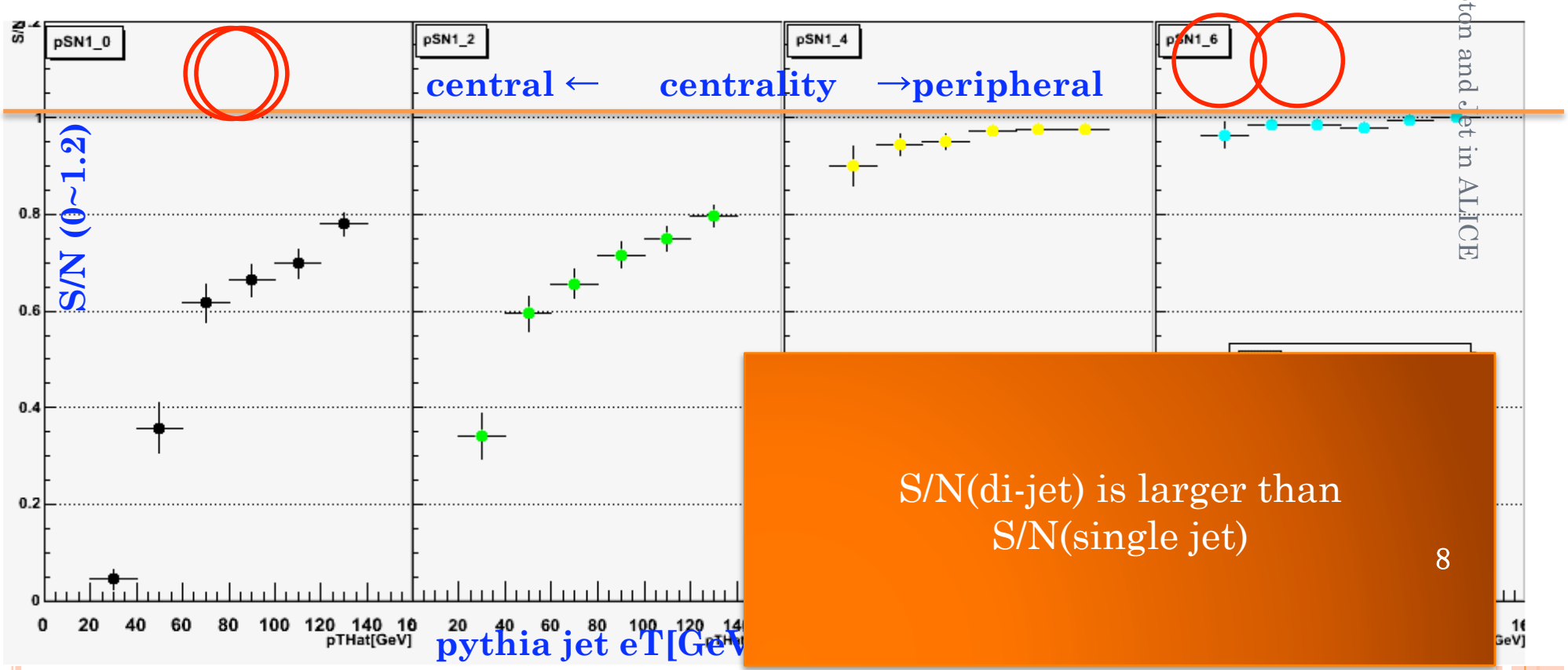
CELLJET – BACK-TO-BACK JET FINDING

- difference btw ϕ directions of found jets ($\Delta \phi$)
- $| \Delta \phi | > 17/18 * \pi$ [rad]



Quality of Di-jet Finding

- HYDJET "HD+Jet" events + PYTHIA di-jet(back-to back)
- charged pion, proton and photon tracks are used
- "Min-eT"=20[GeV], "eTseed"="Min-eT"*0.3 is selected
- **S/N≡(# of found PYTHIA back-to back jets)/(# of found back-to back jets)**

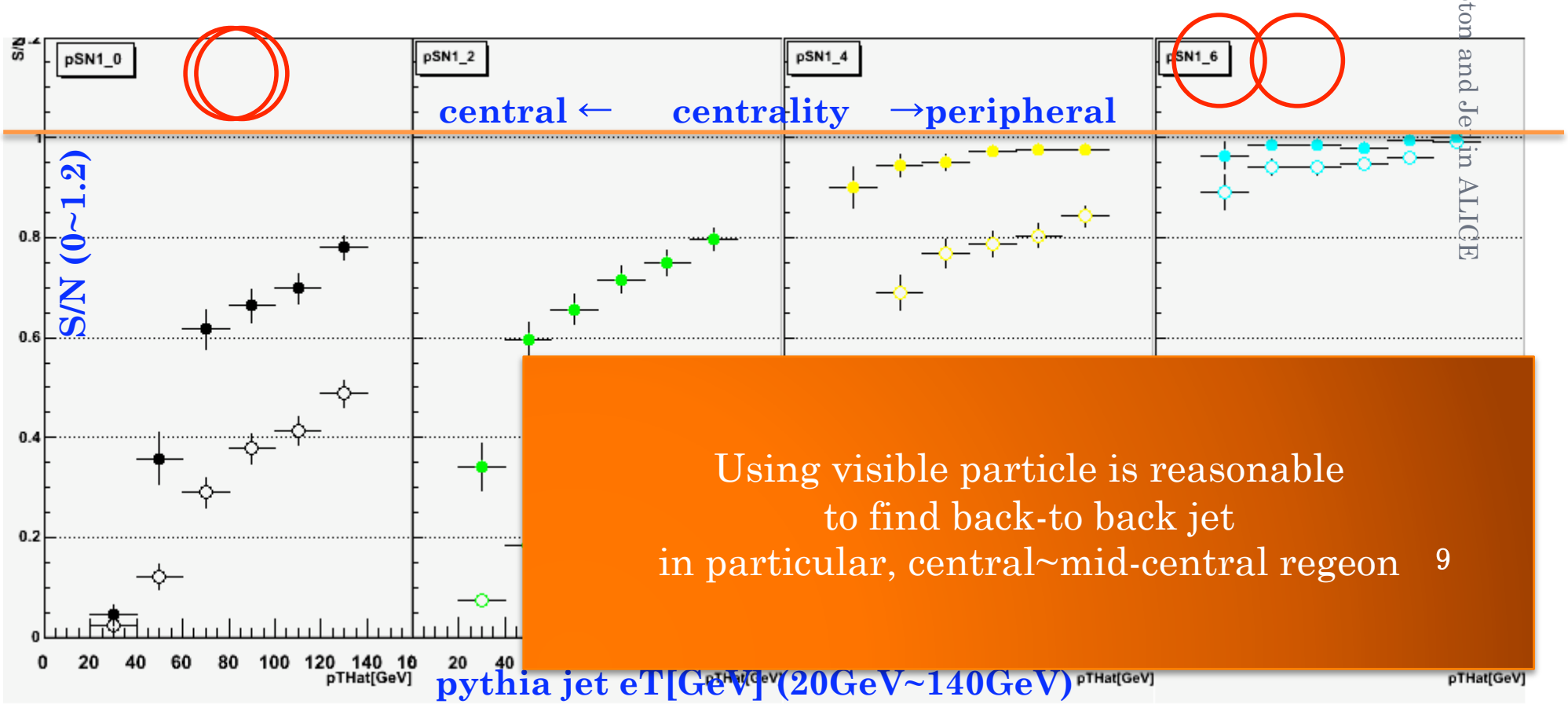


S/N(di-jet) is larger than S/N(single jet)

For J-Cal Project

- back-to back jet finding quality using visible particle
  - (in case using EMCal and TPC → catch proton, pion and photon)
- back-to back jet finding quality using only charged particle
  - (in case using only TPC → catch proton and charged pion)
  - jet finding parameter : eT-Min$_{charged}$ = eT-Min$_{visible}$ * 2/3 (assume pion is dominant)

Detector resolution is not included



Using visible particle is reasonable
to find back-to back jet
in particular, central~mid-central regeon

Summary

- Estimate the quality of jet finding using “Celljet” method
  - parameter setting : “coneRadius”=0.25, “frac”=0.3
  - jet finding (jet-eT = 20GeV) in PbPb √s=5.5TeV “HD+Jet” +PYTHIA jet
  - jets of low-eT in central are difficult to be identified.
    → parameter tuning is necessary.

- J-Cal
  - EMCal is very useful to find back-to-back jets in central ~ mid-central collisions.
  - → calorimeter at opposite side of EMCal is necessary in ALICE environment.

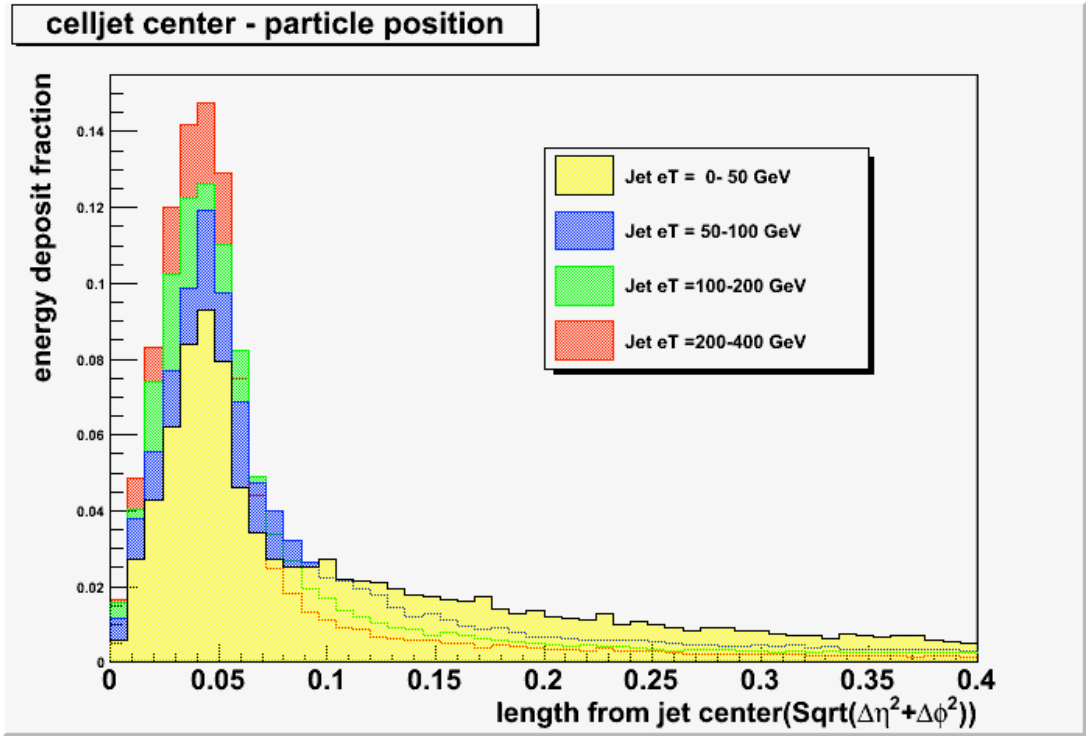
BACK UP

PARAMETER SELECTION(CONERADIUS)

- pythia celljet settings
  - pythia.readString("HardQCD:gg2gg = off");
  - pythia.readString("HardQCD:qqbar2gg = off");
  - pythia.readString("HardQCD:qg2qg = off");
  - pythia.readString("HardQCD:gg2qqbar = on");
  - pythia.readString("HardQCD:qq2qq = on");
  - pythia.readString("HardQCD:qqbar2qqbarNew = on");
  - pythia.readString("HardQCD:gg2ccbar = on");
  - pythia.readString("HardQCD:gg2bbbar = on");
  - pythia.readString("HardQCD:qqbar2bbbar = on");
  - pythia.readString("HardQCD:qqbar2ccbar = on");
  - **quark jet is selected for make jets have sharp shape**
  - CellJet cellJet(1., 20, 64, 2, 0, 0.5, 2, 0);
  - cellJet.analyze(pythia.event , 0.8*pTHatMin, 0.4, 0.15*pTHatMin);

PARAMETER SELECTION(FRAC)

- distance btw celljet center and each track (eT weighted) ->ProjectionY



frac = 0.3 is selected from integral

PARAMETER SELECTION(FRAC)

- integral in circle(R=0.056) / integral in circle(R=0.25)
  - space of [0.1,0.1] square equal with that of circle(R=0.056)

jet eT	0-50GeV	50-100GeV	100-200GeV	200-400GeV
ratio	0.45	0.54	0.62	0.71

parameter “frac” must be less than all ratio
then I selected “frac = 0.3”

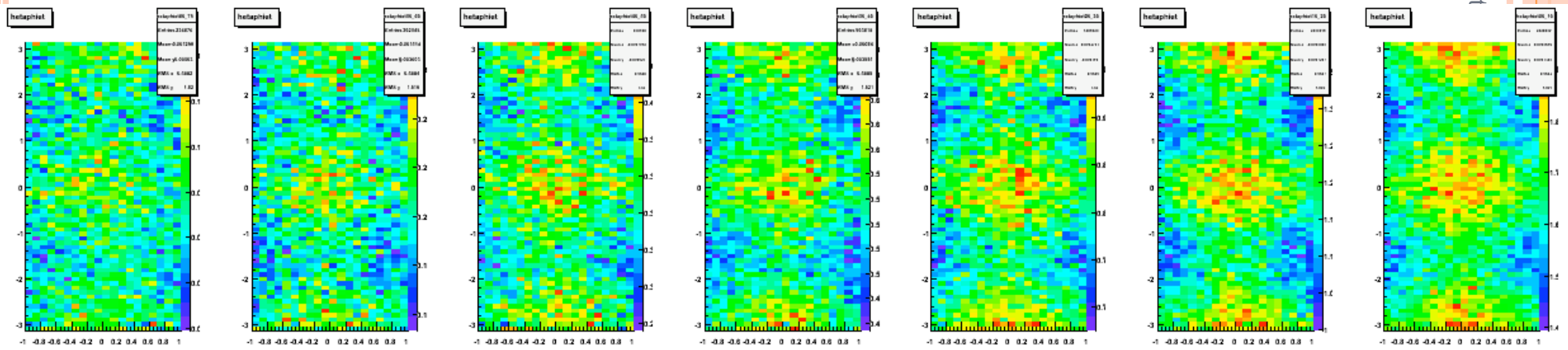
PYTHIA JET GENERATION SETTING FOR JET ENBEDDING TO HYDJET

- pythia celljet settings
  - pythia.readString("HardQCD:gg2gg = off");
  - pythia.readString("HardQCD:qqbar2gg = off");
  - pythia.readString("HardQCD:qg2qg = off");
  - pythia.readString("HardQCD:gg2qqbar = on");
  - pythia.readString("HardQCD:qq2qq = on");
  - pythia.readString("HardQCD:qqbar2qqbarNew = on");
  - pythia.readString("HardQCD:gg2ccbar = on");
  - pythia.readString("HardQCD:gg2bbbar = on");
  - pythia.readString("HardQCD:qqbar2bbbar = on");
  - pythia.readString("HardQCD:qqbar2ccbar = on");
  - **quark jet is selected for make jets have sharp shape**
  - CellJet cellJet(1., 20, 64, 2, 0, 0.5, 2, 0);
  - cellJet.analyze(pythia.event , 0.8*pTHatMin, 0.25, 0.2*pTHatMin);

BKG HD EVENT DISTRIBUTION

- centrality is defined by HYDJET parameter "Bgen" that mean the impact parameter

peripheral ← centrality → central

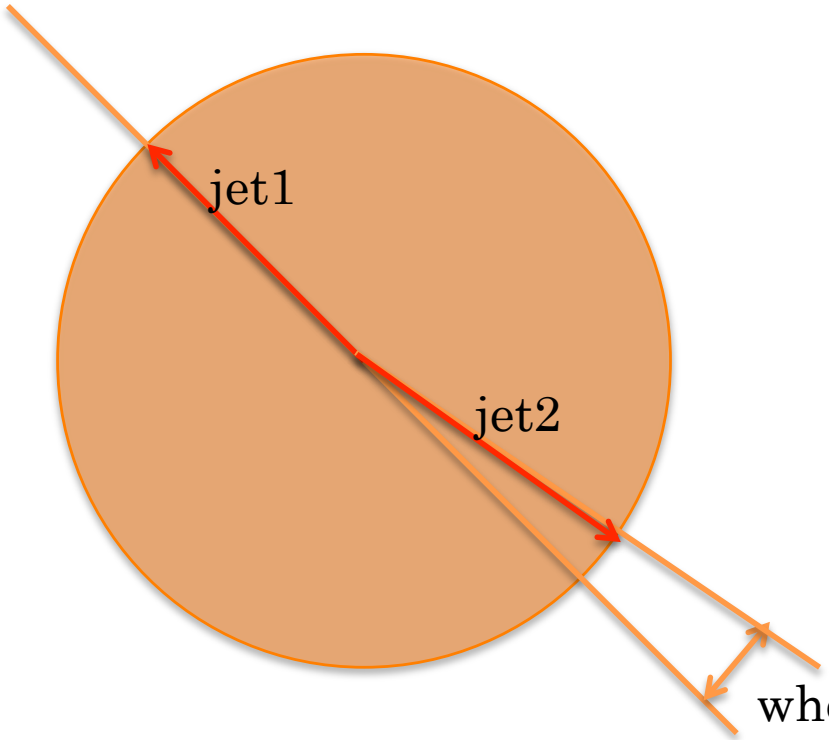


<-phi->

<-eta->

CELLJET – BACK-TO-BACK JET FINDING

- difference btw ϕ directions of found jets ($\Delta \phi$)
- $| \Delta \phi | > 17/18 * \pi$ [rad]

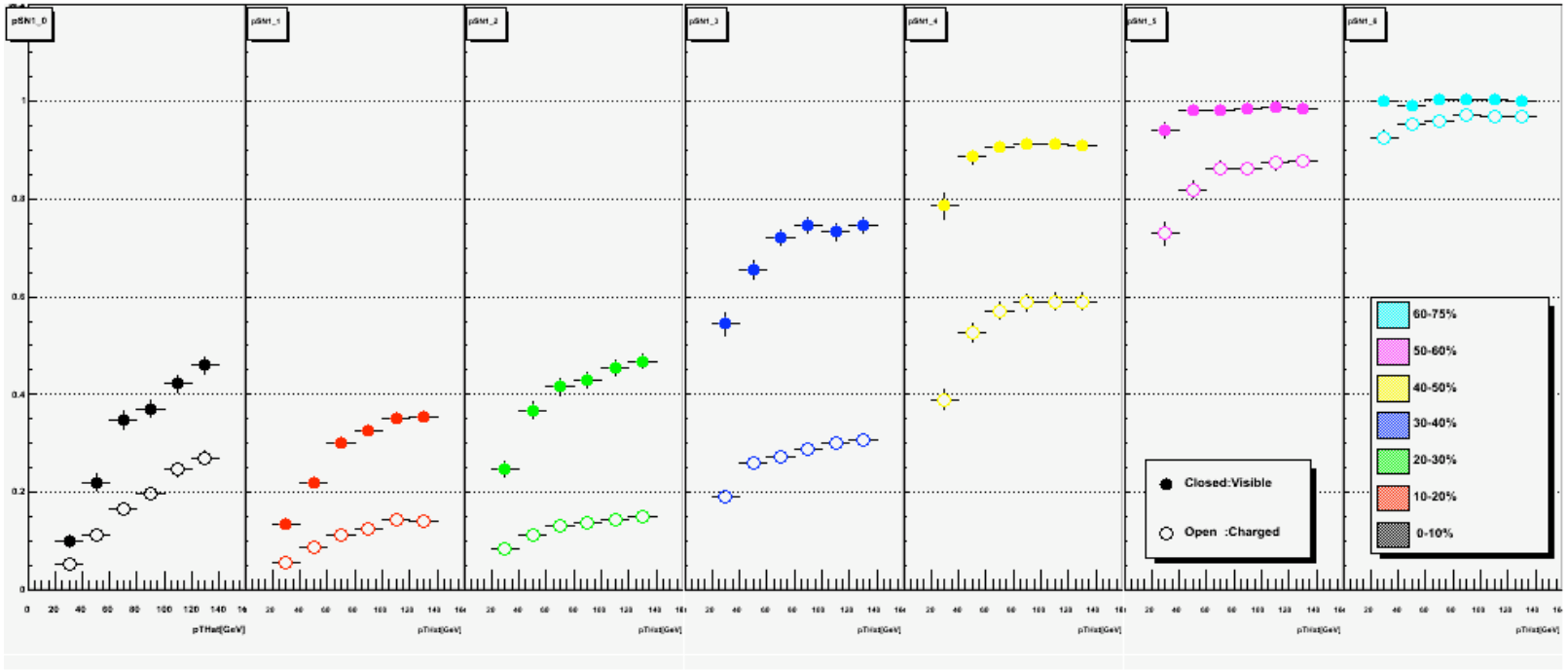


when this angle is less than π/18, define them “Di-jet”.

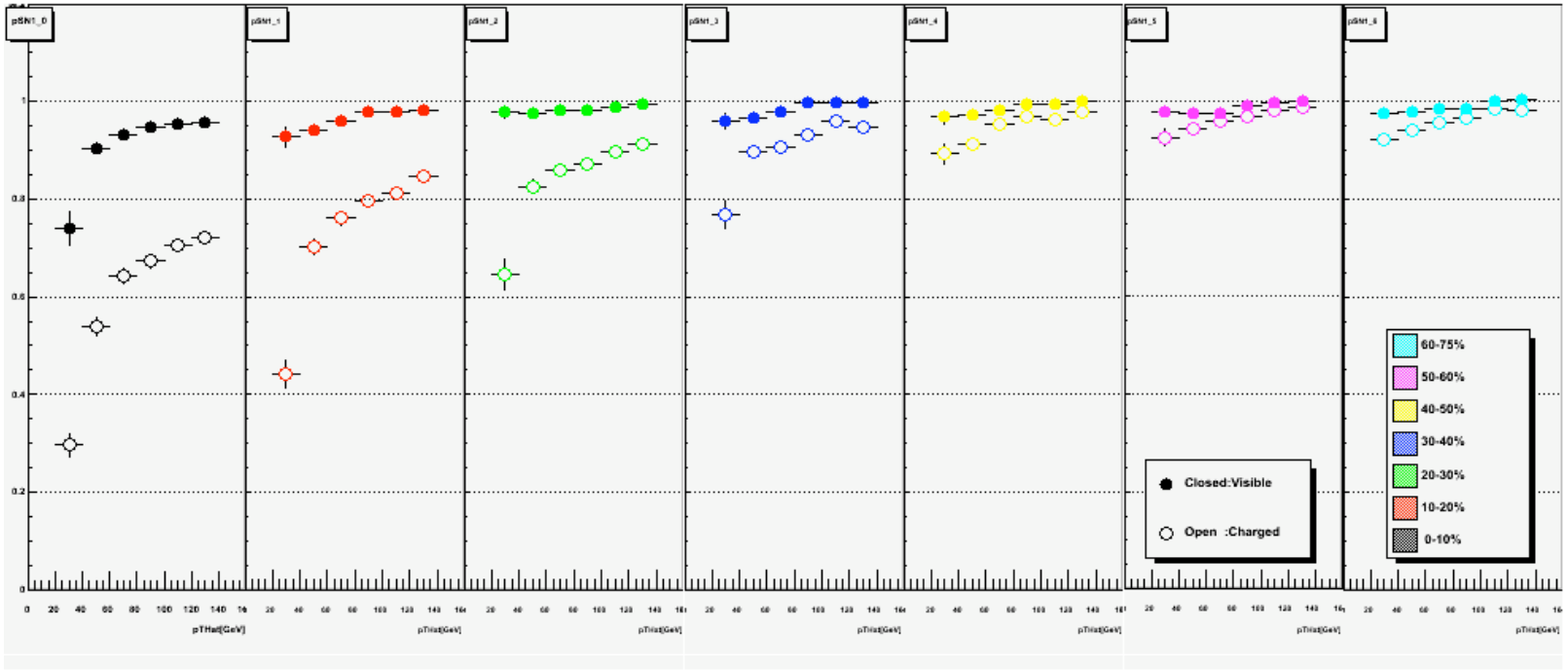
CHECKING ANSWER

- single jet
  - center of PYTHIA jet : $(\phi_{\text{PYTHIAjet}}, \eta_{\text{PYTHIAjet}})$
  - center of found jet : (ϕ, η)
  - $R = \sqrt{(\phi - \phi_{\text{PYTHIAjet}})^2+(\eta - \eta_{\text{PYTHIAjet}})^2}<0.15$
- back-to-back jet
  - center of PYTHIA back-to-back jets : $(\phi_{\text{PYTHIAjet1}}, \eta_{\text{PYTHIAjet1}}),(\phi_{\text{PYTHIAjet2}}, \eta_{\text{PYTHIAjet2}})$
  - center of found jets : (ϕ_i, η_i)
  - $R1 = \sqrt{(\phi_1 - \phi_{\text{PYTHIAjet1}})^2+(\eta_1 - \eta_{\text{PYTHIAjet1}})^2}<0.15$
  - and $R2 = \sqrt{(\phi_2 - \phi_{\text{PYTHIAjet2}})^2+(\eta_2 - \eta_{\text{PYTHIAjet2}})^2}<0.15$

S/N : HYDJET-"HD+JET" + PYTHIA "SINGLE JET"



S/N : HYDJET-"HD" + PYTHIA "DI-JET"



S/N : HYDJET-"HD+JET" + PYTHIA "DI-JET"