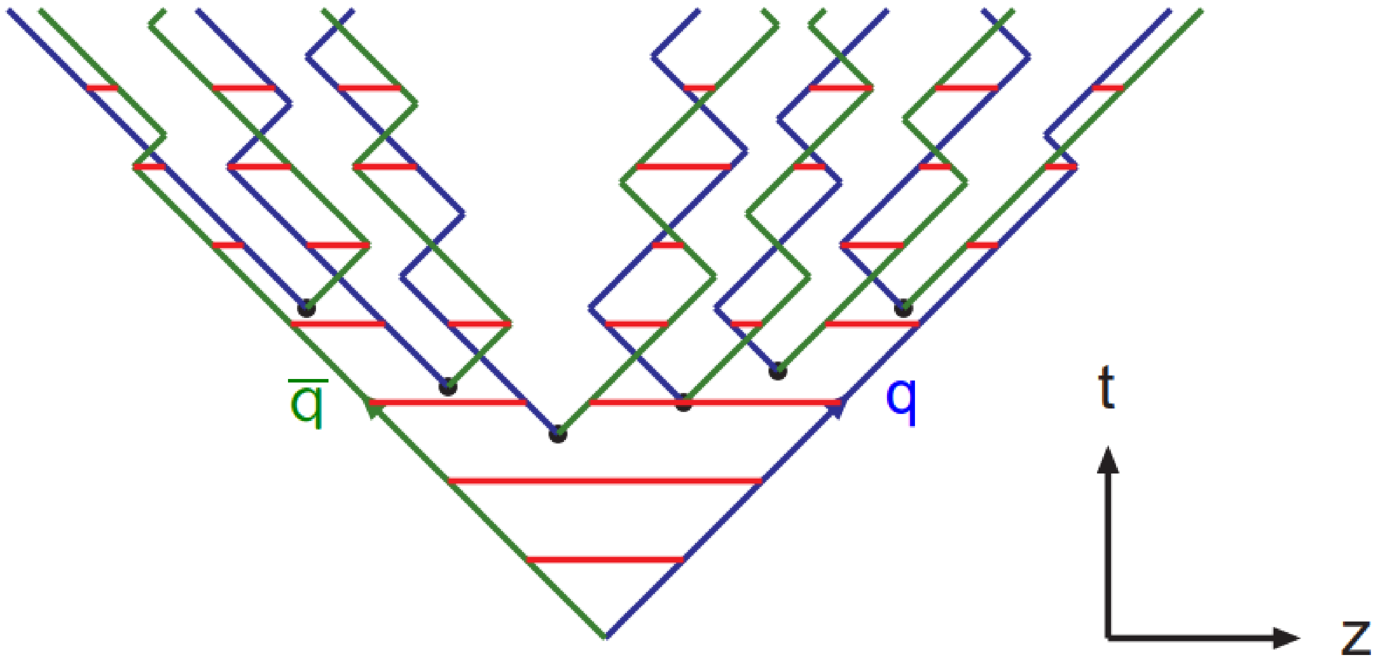
Inclusive Jet Reconstruction at EicC

Senjie Zhu

10th March, 2023

Hadronization and jet at pythia(ep collision)



- The string of the initial $q_0\overline{q_1}$ system breaks up and produced $q_2\overline{q_2}$.
- $q_0\overline{q_2}$ forms a hadron and carries out energy of q_0.
- The string of $q_2\overline{q_1}$ will break up when q_2 and $\overline{q_1}$ fly away...

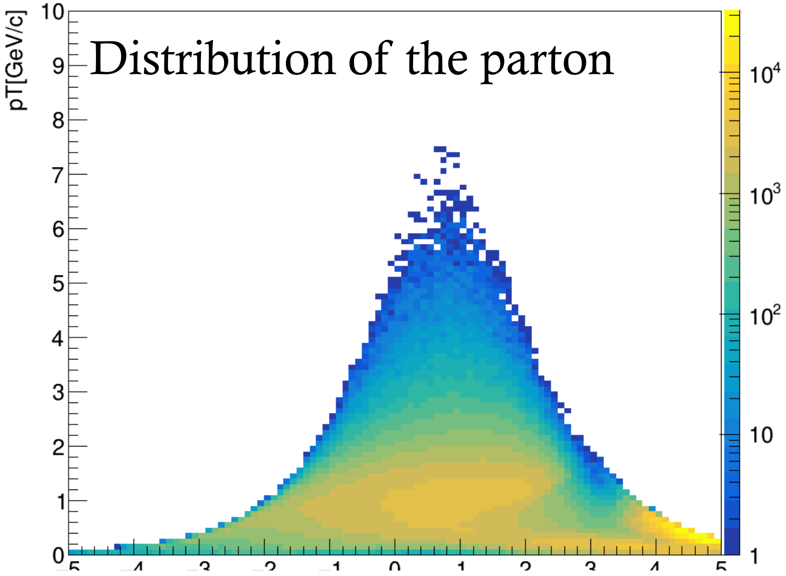
- The hadron formed by $q_0\overline{q_2}$ doesn't take away all the energy of q_0. The remaining energy of q_0 are taken by $q_2\overline{q_1}$ system which continues to fragment. In another word, fragmentation is also a process of interaction between multi partons. Here, energy of q_0 is taken by $\overline{q_1}$ when fragmenting.

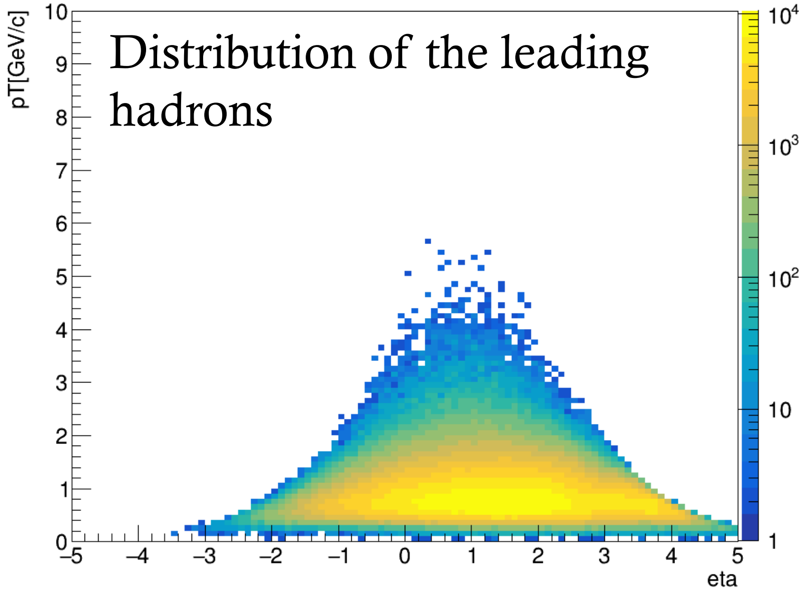
Example

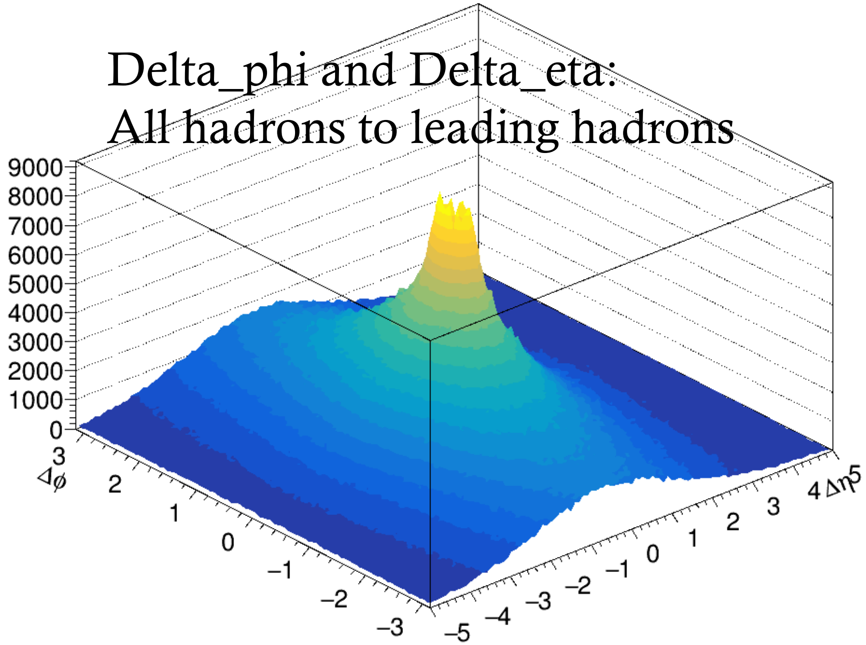
```
I        KS      id      orig     daughter        ldaughter       px      py      pz      E       m       xv      yv      zv
1        21      11      0        3       4       0       0       -3.5    3.5     0.00051 0       0       0
2        21      2212    0        5       0       -0      0       20      20.022  0.93827 0       0       0
3        21      11      1        0       0       1.8302  0.070403        -3.00101        3.51577 0.00051 0       0       0
4        21      22      1        0       0       -1.8302 -0.070403       -0.498953       -0.015735       -1.89823        0       0       0
5        21      2212    2        0       0       -0      -0      20      20.022  0.93827 0       0       0
6        21      22      4        0       0       -1.91152        -0.073531       -0.197041       0.308006        -1.89823        0       0       0
7        21      2       5        0       0       0.014501        0.000558        3.51229 3.51232 0       0       0       0
8        21      22      6        0       0       -1.91152        -0.073531       -0.197041       0.308006        -1.89823        0       0       0
9        21      2       7        0       0       0.014501        0.000558        3.51229 3.51232 0       0       0       0
10       21      2       9        0       0       -1.89702        -0.072973       3.31525 3.82033 0       0       0       0
11       1       11      3        0       0       1.8302  0.070403        -3.00101        3.51577 0.00051 0       0       0
12       12      2       10       15      17      -1.47395        0.204901        2.01559 2.50541 0       0       0       0
13       11      2101    5        15      17      -0.356247       -0.275304       17.4854 17.5008 0.57933 0       0       0
14       11      92      12       15      17      -1.8302 -0.070403       19.501  20.0062 4.07493 0       0       0
15       1       211     12       0       0       -1.29185        0.224176        1.6764  2.13282 0.13957 0       0       0
16       1       -211    13       0       0       -0.263579       -0.140269       4.65637 4.66802 0.13957 0       0       0
17       1       2212    13       0       0       -0.27477        -0.154309       13.1682 13.2054 0.93827 0       0       0
```

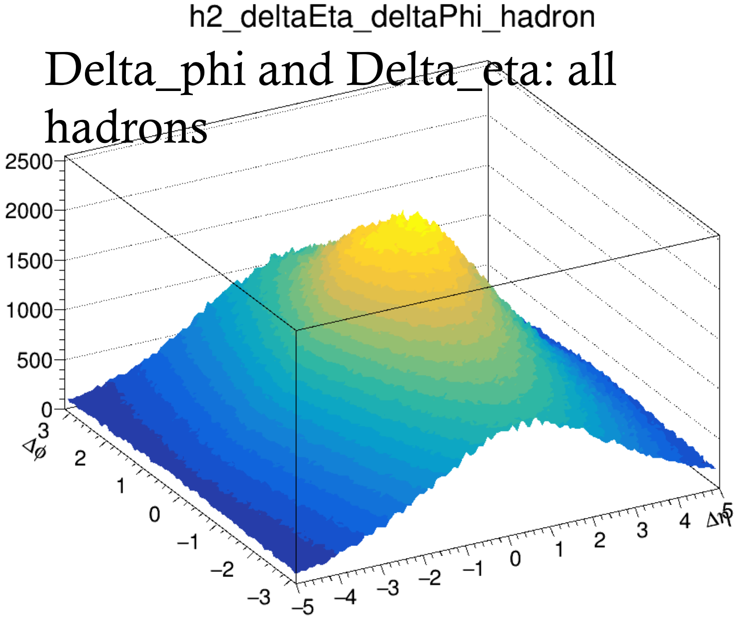
```
(x,y,z,t)=(-1.473950,0.204901,2.015586,2.505414) (P,eta,phi,E)=(2.505414,1.111217,3.003463,2.505414)
 2
(x,y,z,t)=(-0.356247,-0.275304,17.485425,17.500811) (P,eta,phi,E)=(17.491220,4.352684,-2.483665,17.500811)
 2101

(x,y,z,t)=(-1.291848,0.224176,1.676405,2.132825) (P,eta,phi,E)=(2.128253,1.065318,2.969772,2.132825)
parentID 2 id 211
(x,y,z,t)=(-0.263579,-0.140269,4.656368,4.668018) (P,eta,phi,E)=(4.665931,3.441131,-2.652541,4.668018)
parentID 2101 id -211
(x,y,z,t)=(-0.274770,-0.154309,13.168238,13.205383) (P,eta,phi,E)=(13.172008,4.425853,-2.629892,13.205383)
parentID 2101 id 2212
E_particle/E_parton 0.851286
```

Parton MC ep3.5x20 pythiaeRHIC

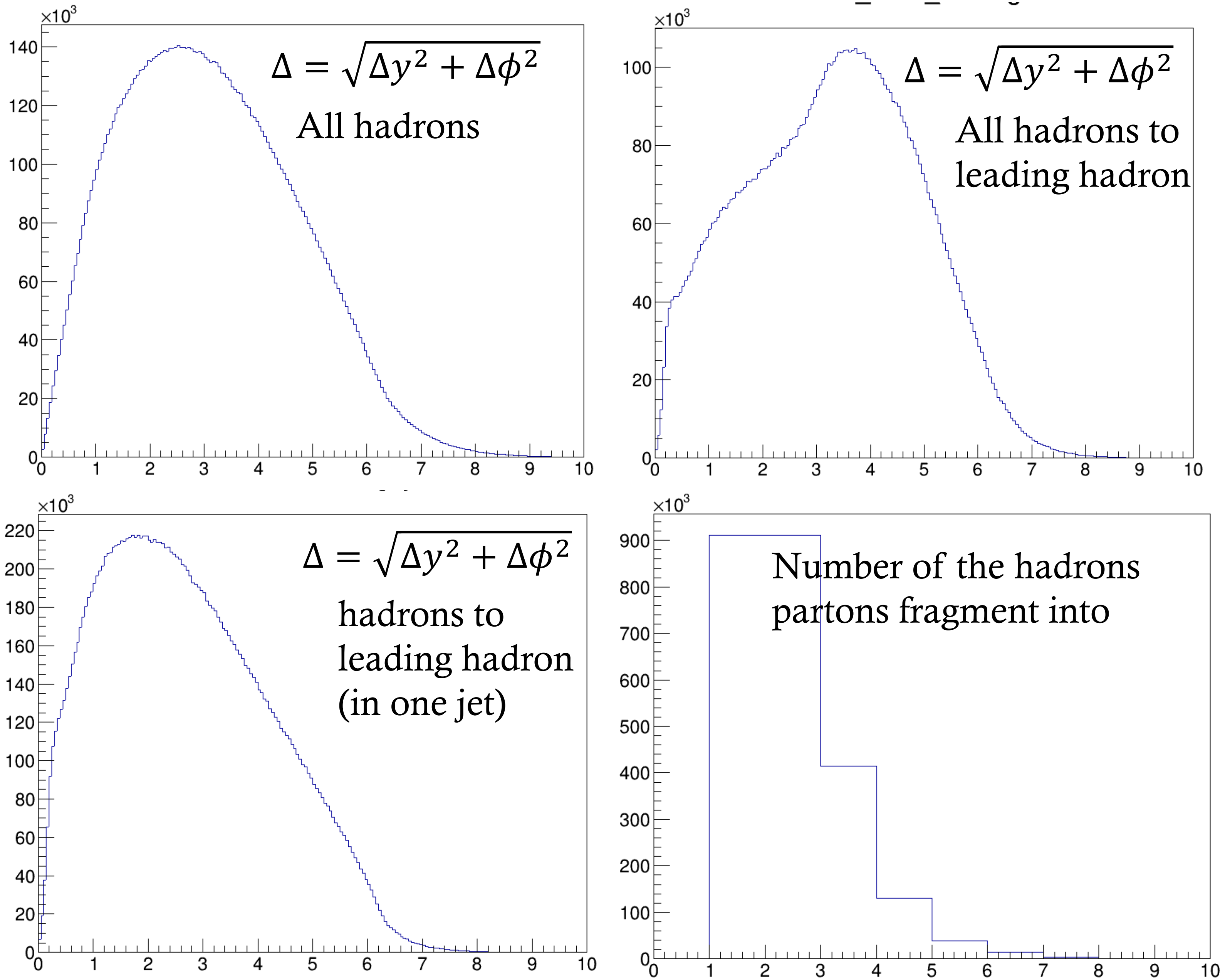








Parton MC ep3.5x20 pythiaeRHIC



Algorithm

$$d_{ij} = \min(k_{ti}^{2p}, k_{tj}^{2p}) \frac{\Delta_{ij}^2}{R^2},$$

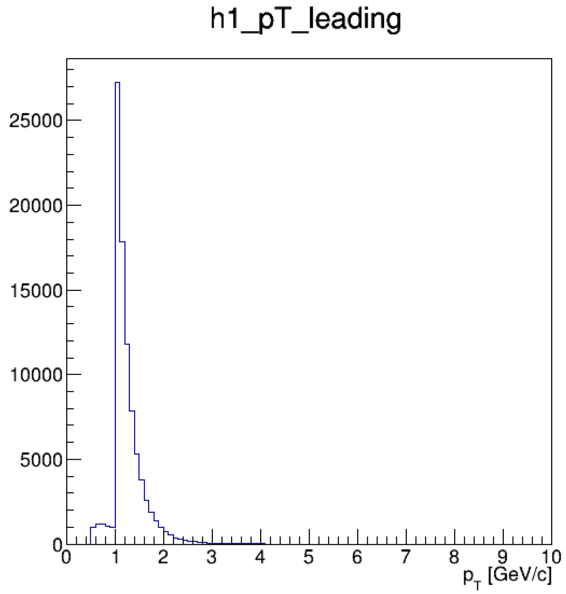
Anti-kT p=-1

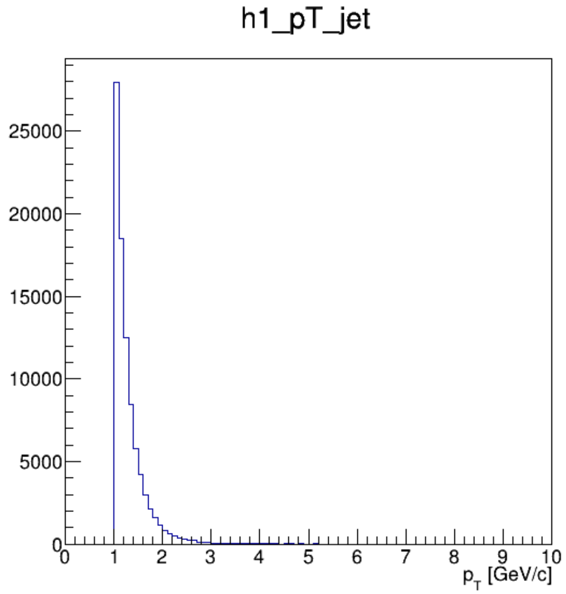
$$d_{iB} = k_{ti}^{2p},$$

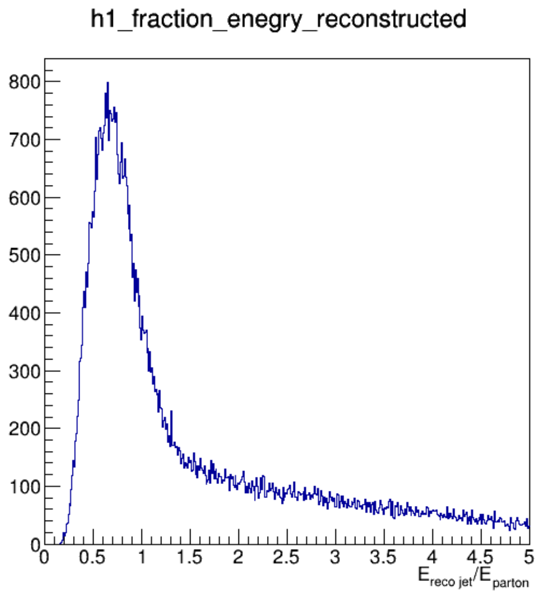
where $\Delta_{ij}^2 = (y_i - y_j)^2 + (\phi_i - \phi_j)^2$ and k_{ti}, y_i and ϕ_i are respectively the transverse momentum, rapidity and azimuth of particle i. In addition to the usual radius parameter R, we have added a parameter p to govern the relative power of the energy versus geometrical (Δ_{ij}) scales.

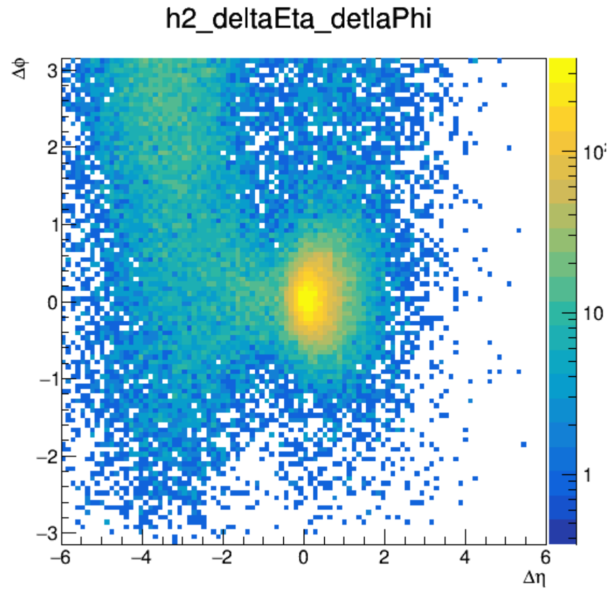
In the "inclusive" formulation of the k_t algorithm [9], the d_{ij} and d_{iB} distances are the same as above. The only difference is that when a d_{iB} is smallest, then i is removed from the list of particles/pseudojets and added to the list of final "inclusive" jets (this is instead of being incorporated into a beam jet). There is no d_{cut} threshold and the clustering continues until no particles/pseudojets remain. Of the final jets, generally only those above some transverse momentum are actually used.[3] Because the distance measures are the same in the inclusive and exclusive algorithms, the clustering sequence is common to both formulations (at least up to d_{cut}), a property that will be reflected in FastJet's common interface to both formulations.

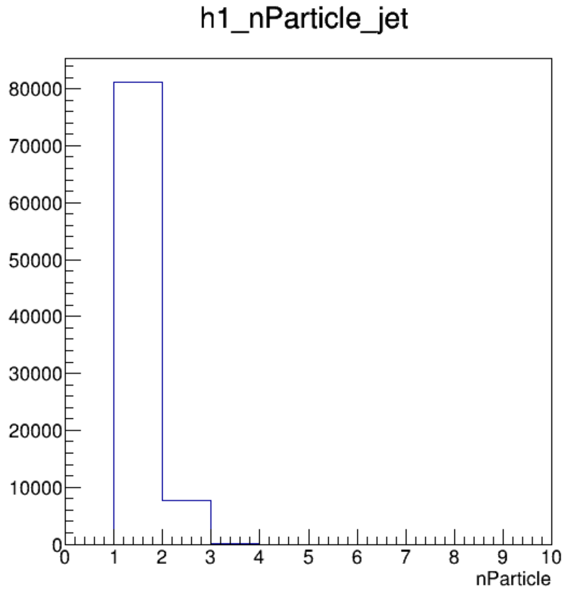
R=0.2





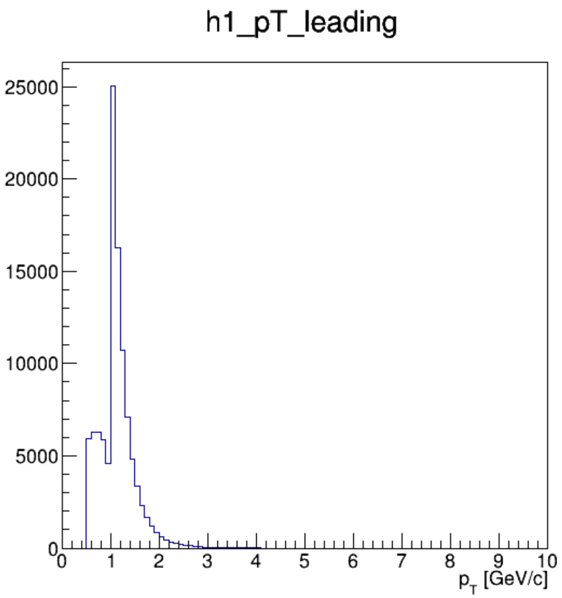


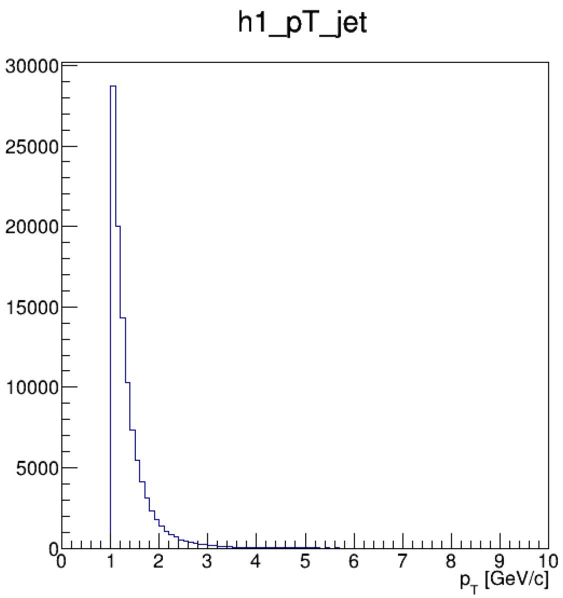


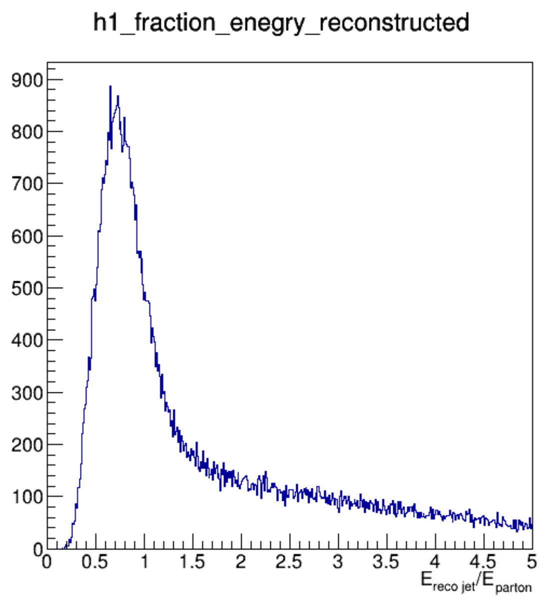


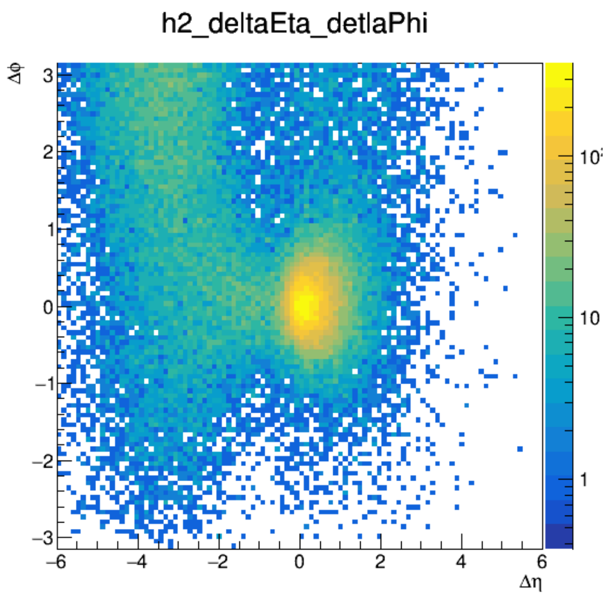
- Cut:
  - pT of leading particle > 0.5 GeV/c
  - pT of jets > 1 GeV/c

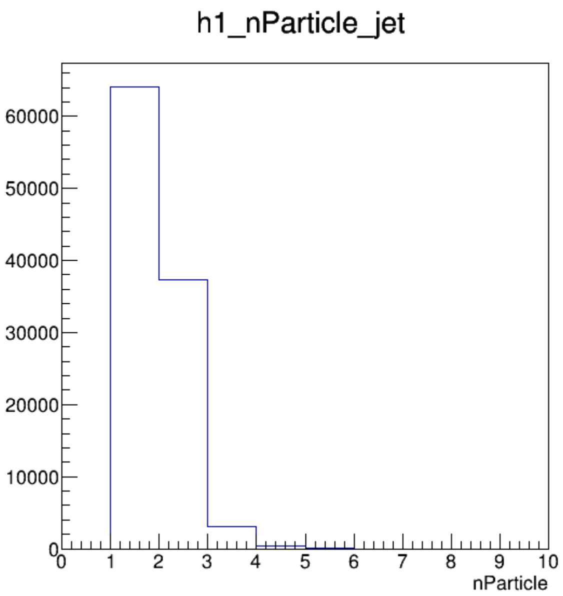
R=0.5


h1_pT_leading
p_T [GeV/c]

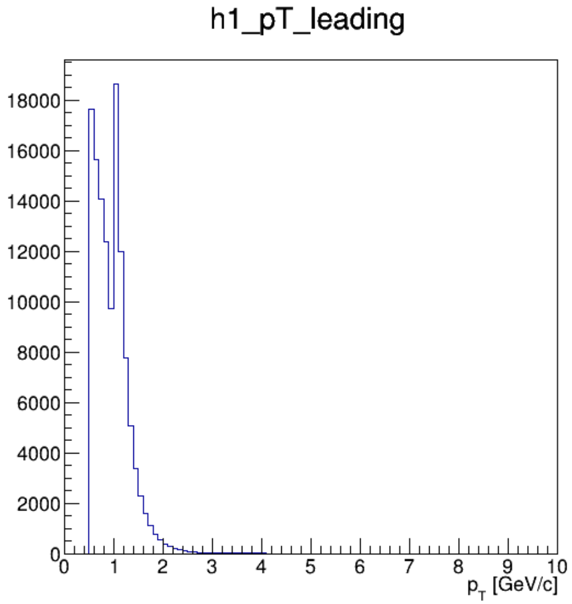

h1_pT_jet
p_T [GeV/c]

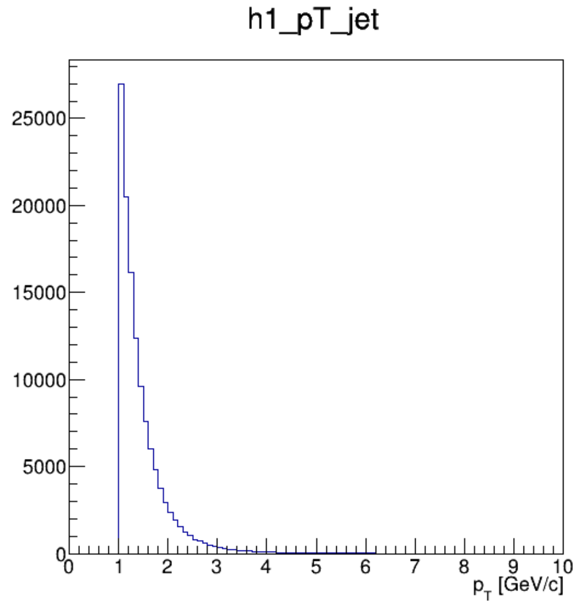

h1_fraction_enegry_reconstructed
E_reco jet/E_parton

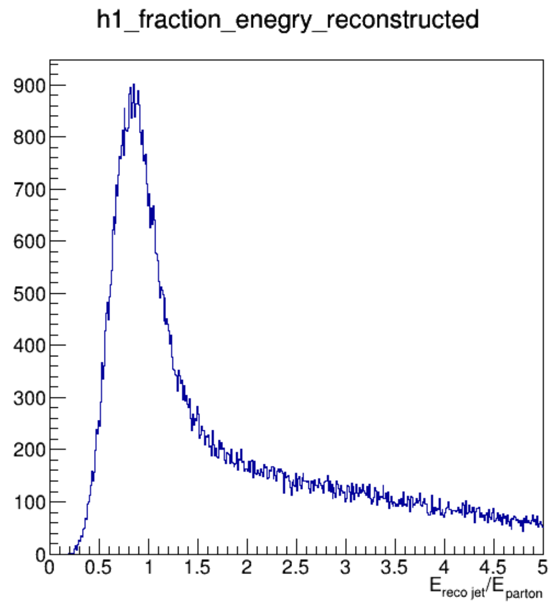

h2_deltaEta_detlaPhi
Δφ
Δη

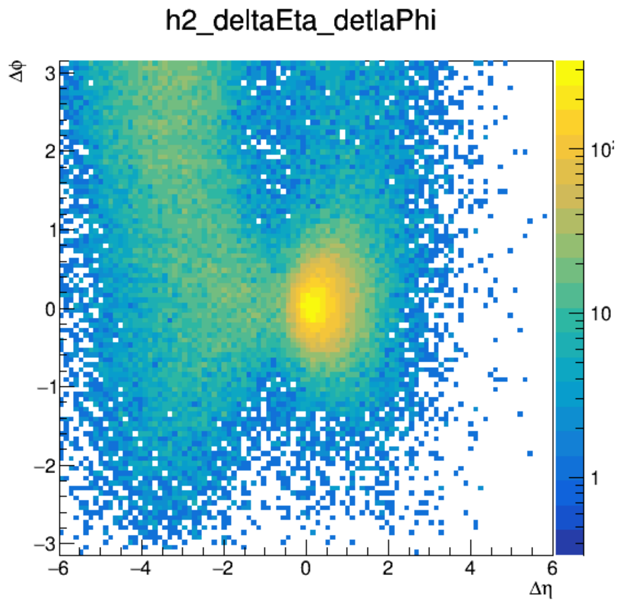

h1_nParticle_jet
nParticle

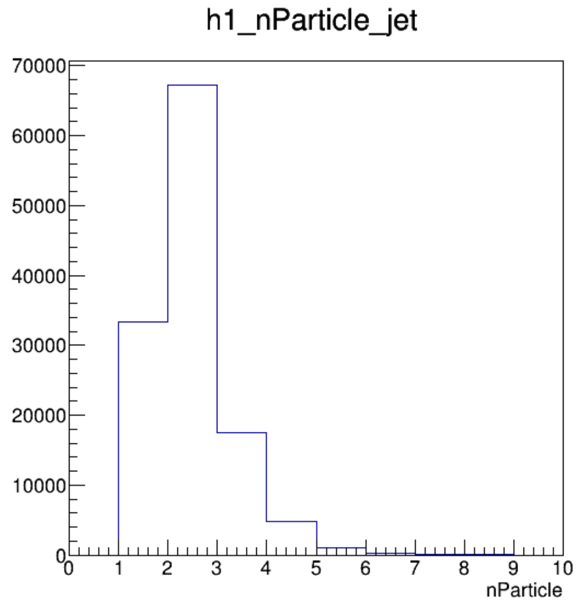
R=1


h1_pT_leading
p_T [GeV/c]

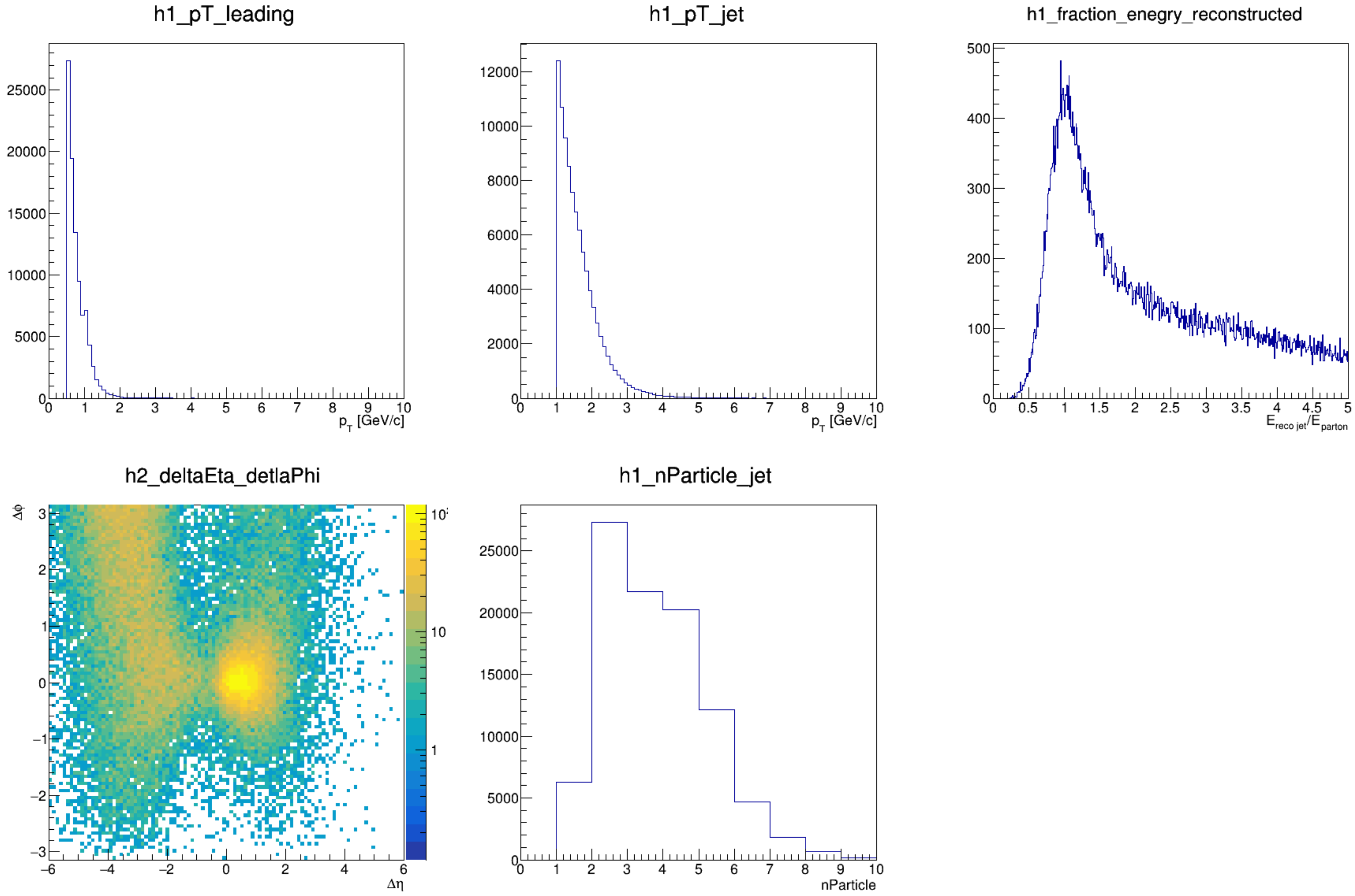

h1_pT_jet
p_T [GeV/c]


h1_fraction_enegry_reconstructed
$E_{reco\ jet}/E_{parton}$


h2_deltaEta_detlaPhi
$\Delta\phi$
$\Delta\eta$

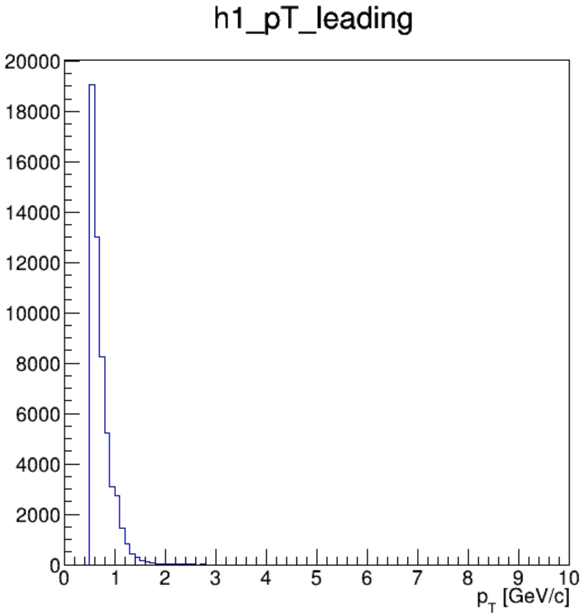

h1_nParticle_jet
nParticle

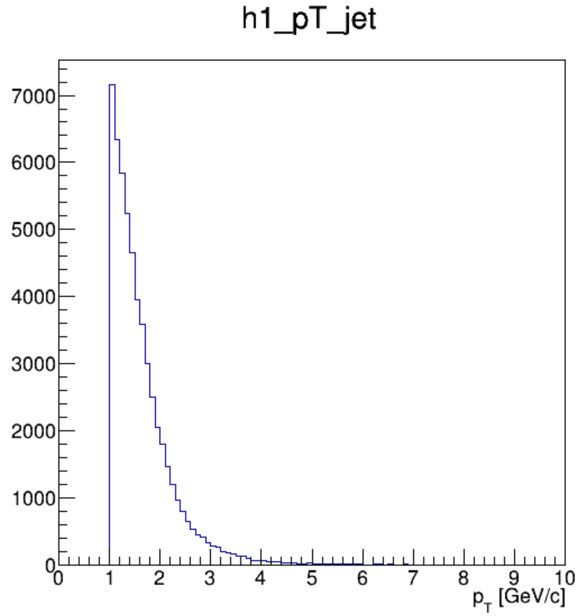
R=2

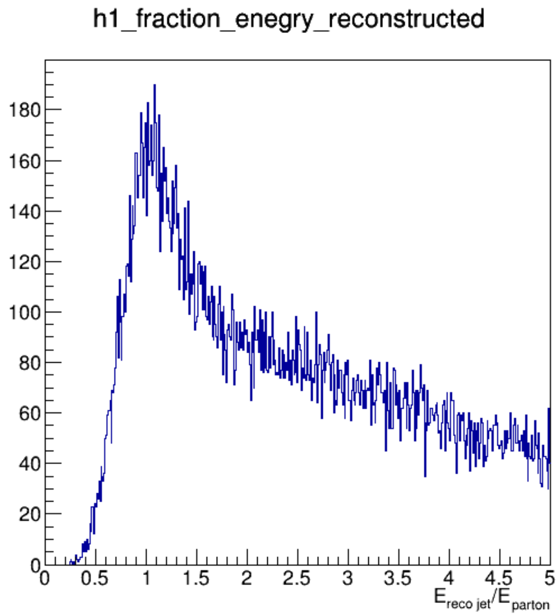


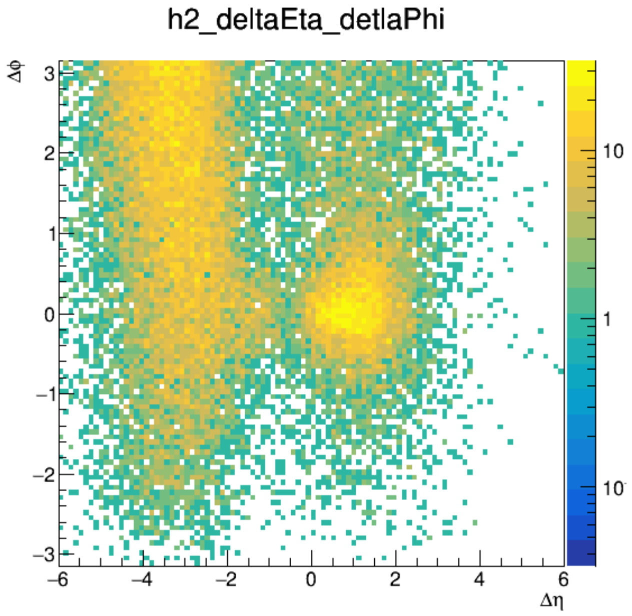
h1_pT_leading
p_T [GeV/c]
h1_pT_jet
p_T [GeV/c]
h1_fraction_enegry_reconstructed
$E_{reco\ jet}/E_{parton}$
h2_deltaEta_detlaPhi
Δφ
Δη
h1_nParticle_jet
nParticle

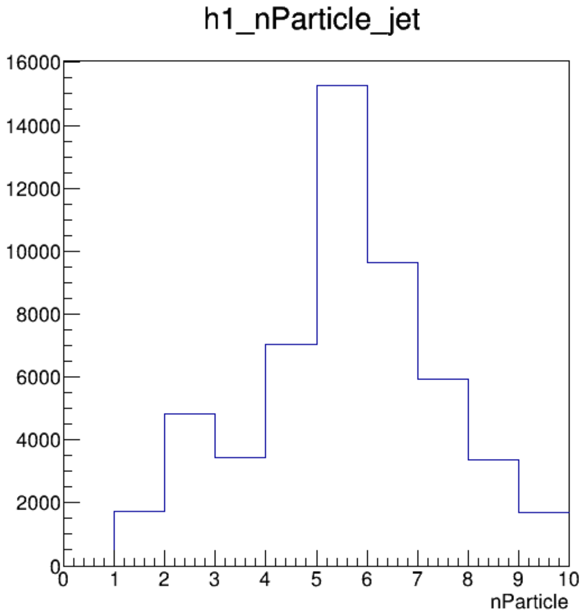
R=3


h1_pT_leading
p_T [GeV/c]

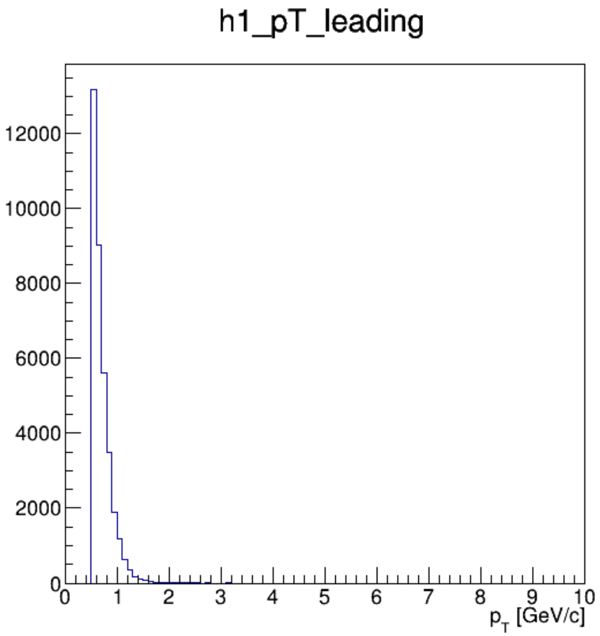

h1_pT_jet
p_T [GeV/c]

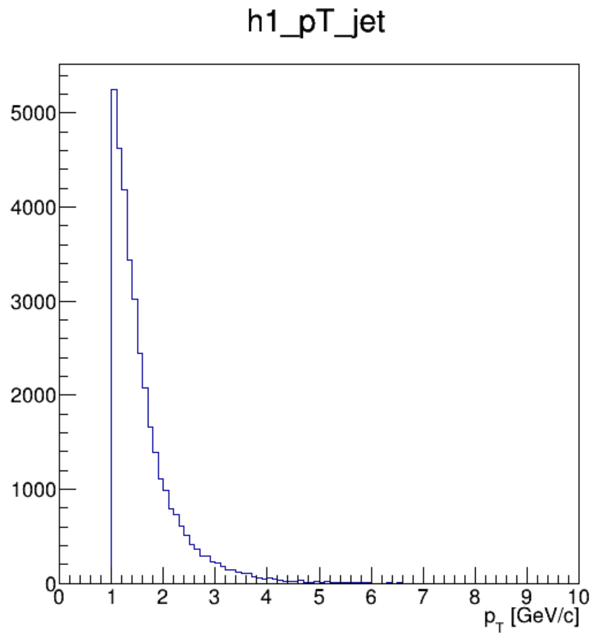

h1_fraction_enegry_reconstructed
$E_{reco\ jet}/E_{parton}$

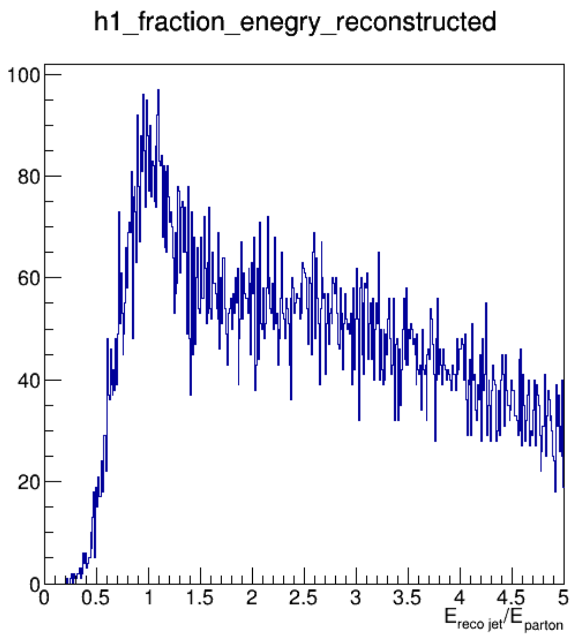

h2_deltaEta_detlaPhi
Δφ
Δη

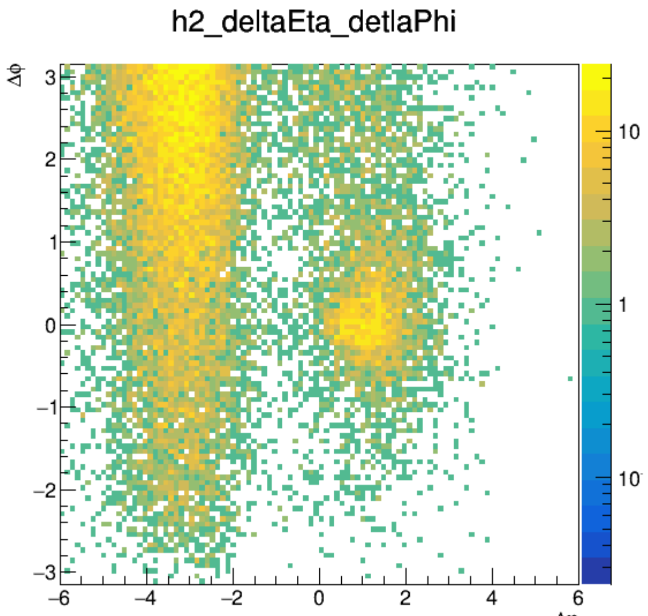

h1_nParticle_jet
nParticle

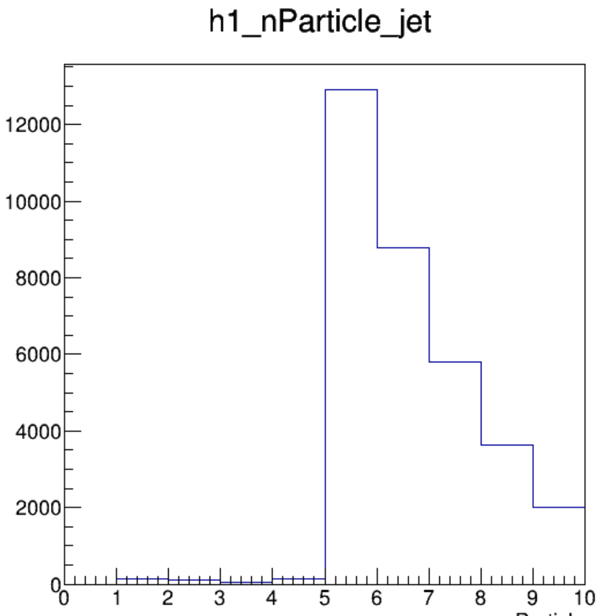
R=4


h1_pT_leading
p_T [GeV/c]


h1_pT_jet
p_T [GeV/c]


h1_fraction_enegry_reconstructed
$E_{reco\ jet}/E_{parton}$


h2_deltaEta_detlaPhi
Δφ


h1_nParticle_jet