

Backward Hadronic Calorimeter update

Diffraction dijet study with full reconstruction

Leszek Kosarzewski

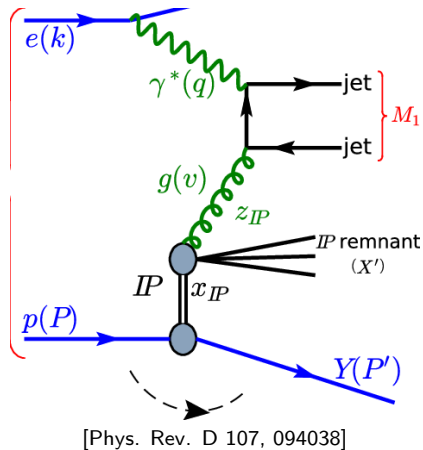
The Ohio State University

nHCal DSC meeting 4.12.2024

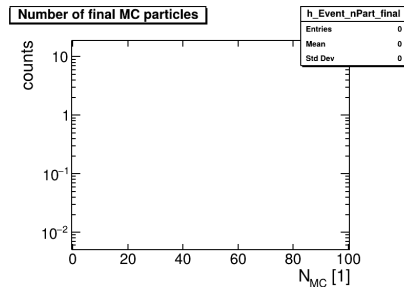
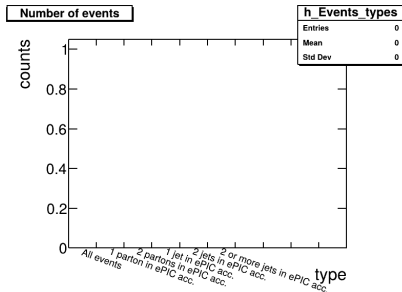
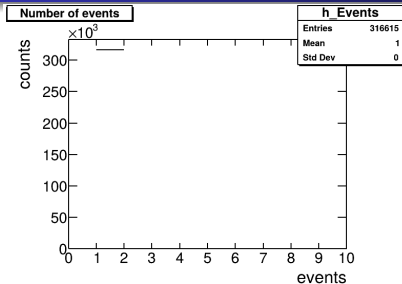


THE OHIO STATE UNIVERSITY

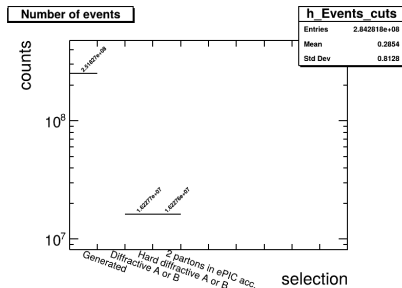
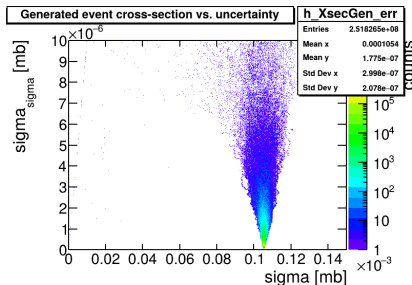
- ① Diffractive dijets with nHCal
 - Process
 - Full ePIC reconstruction
 - Events
 - Diffractive dijet cross section
- ② MC particle projections to nHCal
- ③ Cluster distances
 - Jet clustering
 - MC Jets
 - MC Jets vs. PYTHIA
 - Jets measured
- ④ Summary



- Full simulation and reconstruction
- Using the latest container now
- First look at MC and reconstructed jets
- 33k events



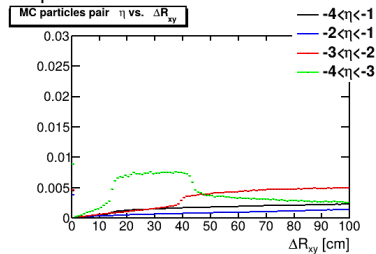
- First look at diffractive dijet events
- 33 final state particles on average



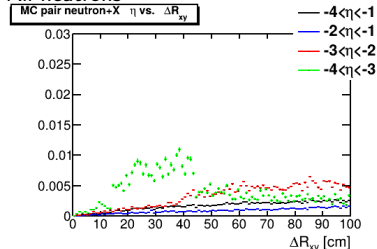
- Diffractive events cross section $\sigma \approx 10^{-4}$ mb
- Hard diffractive events fraction $\approx 6.6\%$
- With integrated luminosity per year of $10 - 100 \text{ fb}^{-1}$ this gives $10^8 - 10^9$ jets/year

MC particle projections to nHCal

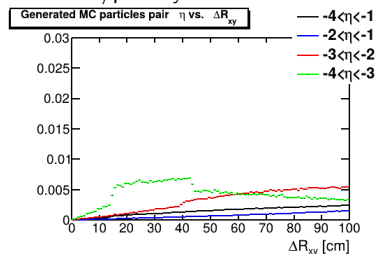
All particles



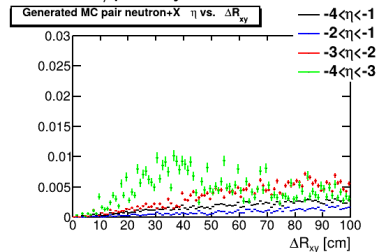
All neutrons



Generated/primary

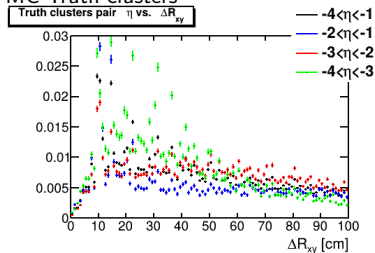


Generated/primary neutrons

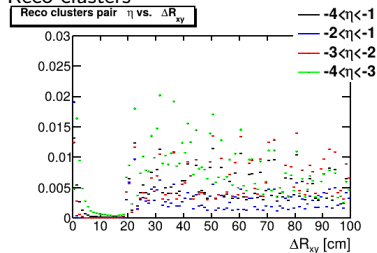


- Check particle density on nHCal surface
- Projected MC particle momentum vectors via straight line to nHCal surface
- Fraction of MC particle pairs with distance ΔR_{xy} vs. η of the first particle

MC Truth clusters



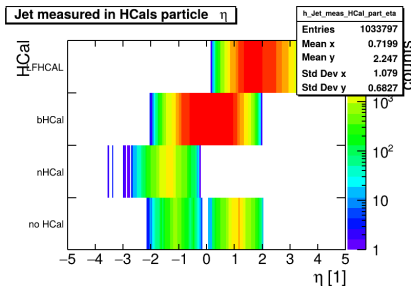
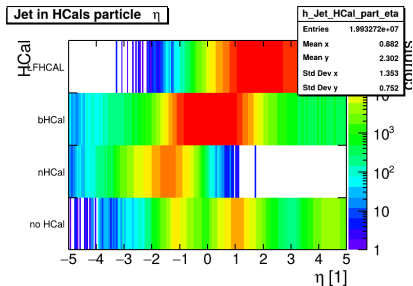
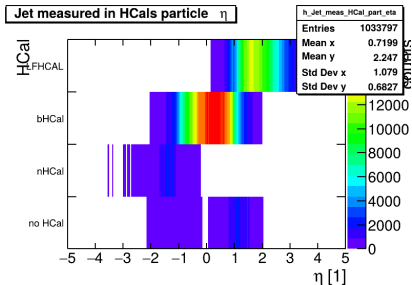
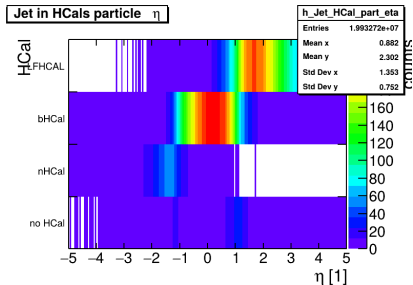
Reco clusters



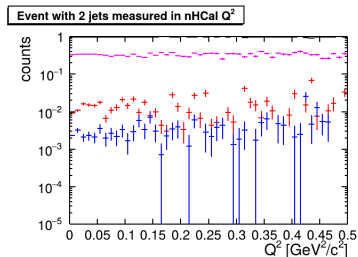
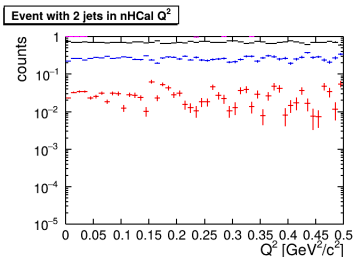
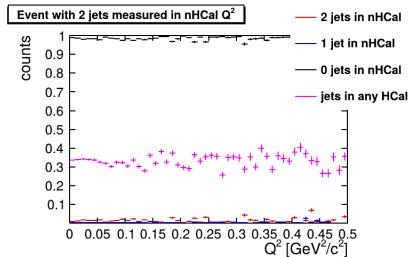
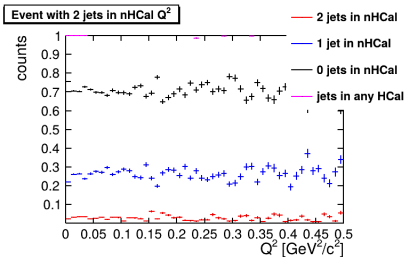
- Fraction of cluster pairs with cluster distance ΔR_{xy} vs. η of the first cluster
- Visible spikes due to tile size both for MC and Reco clusters
- $\approx 5\%$ of MC clusters within 20 cm
- Reconstructed clusters get merged when closer than 20 cm

- MC or Reconstructed particles
- Final state particles
- Anti- k_T algorithm seems to work well, IR and collinear safe
 - - $d_{ij} = \min\left(\frac{1}{p_{Ti}^2}, \frac{1}{p_{Tj}^2}\right) \frac{\Delta R_{ij}^2}{R^2}$
 - $d_{iB} = \frac{1}{p_{Ti}^2}$
- $R = 1$
- Jet $p_T > 4 \text{ GeV}$
- Sorted jets vs. p_T
- Jet types:
 - MC particle jet
 - Reconstructed particle jet
- Used Derek's code to check track-cluster matching
 - <https://github.com/eic/snippets/tree/main/Calorimetry/MatchClustersToTrackProjections>

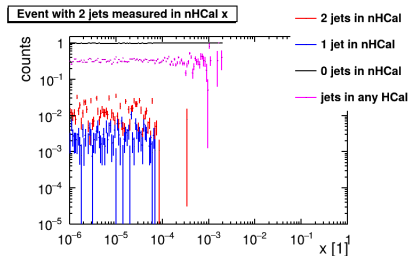
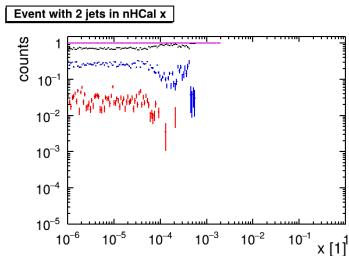
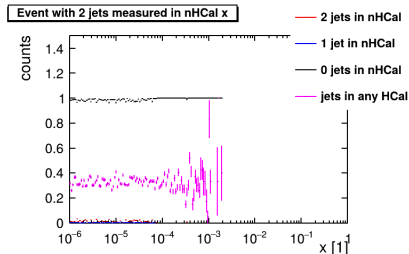
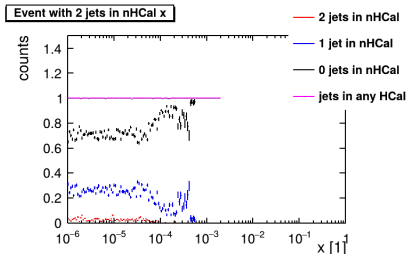
Jets in HCals vs. constituent η



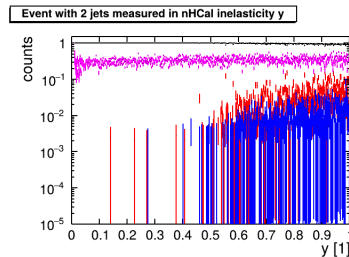
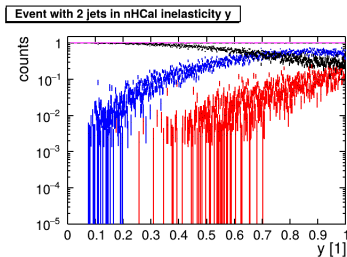
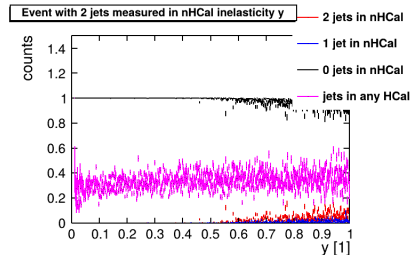
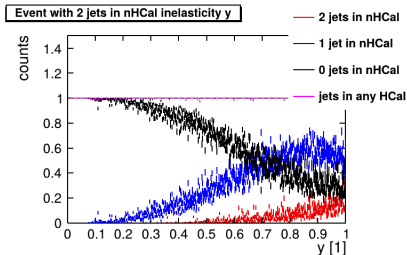
- η distributions for constituents of jets in HCals



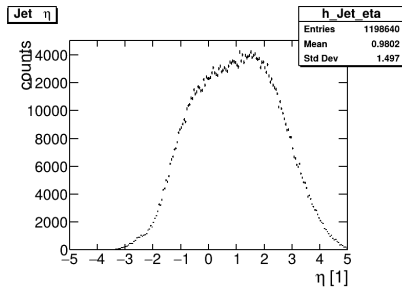
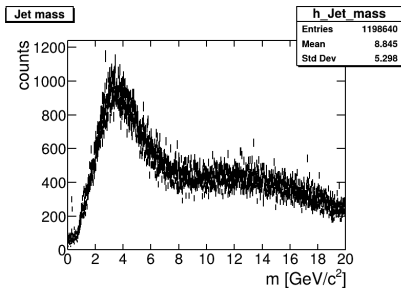
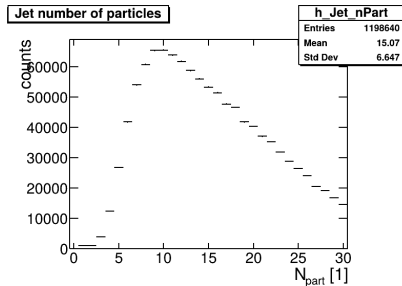
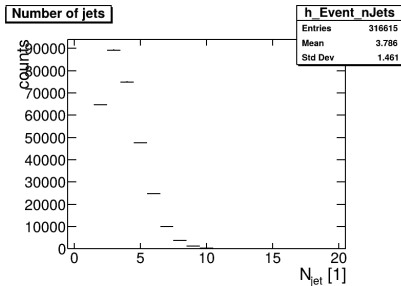
- Fractions of events with jets in HCal



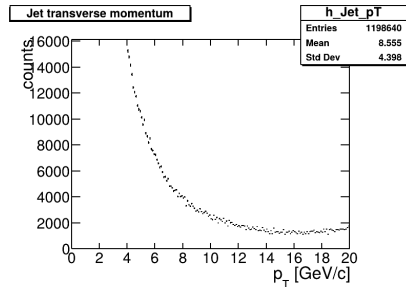
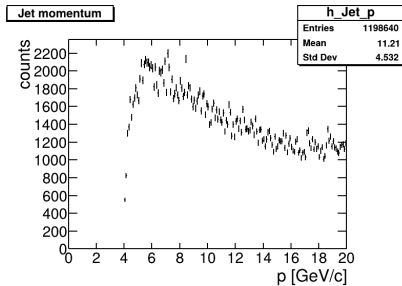
- Fractions of events with jets in HCal



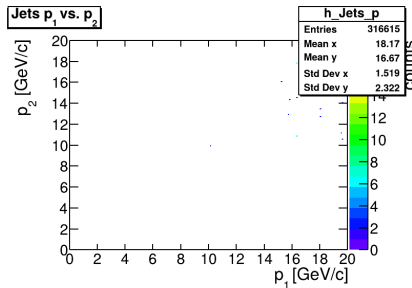
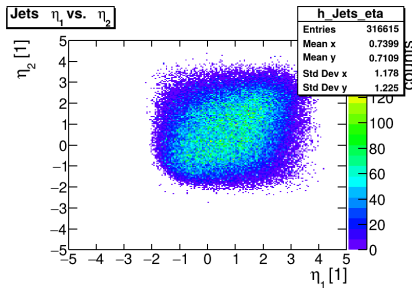
- Fractions of events with jets in HCal



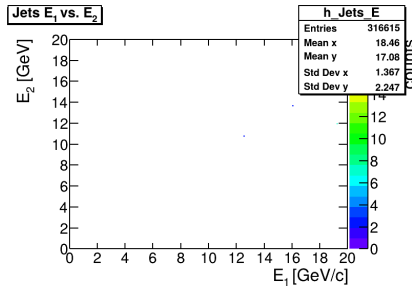
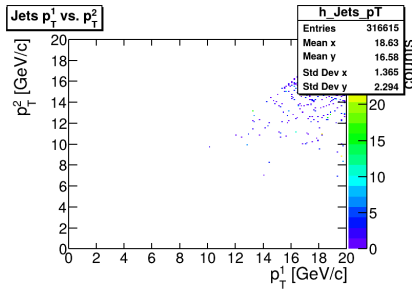
- MC jets



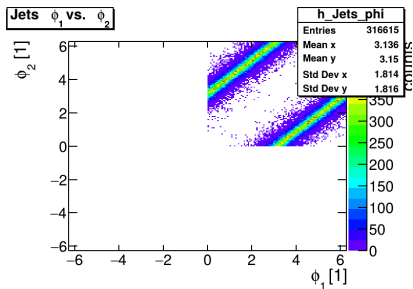
- MC jets



- All jets



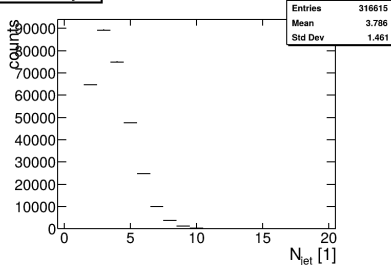
- All jets



- MC jets

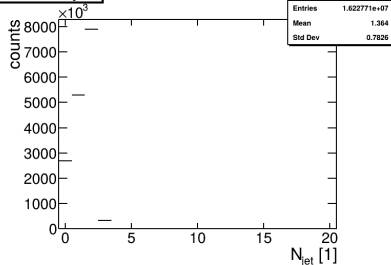
micrecon MC

Number of jets

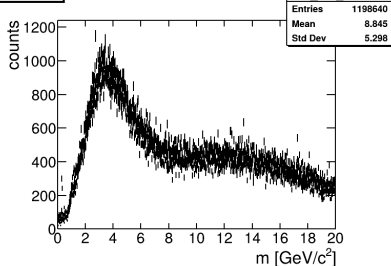


PYTHIA

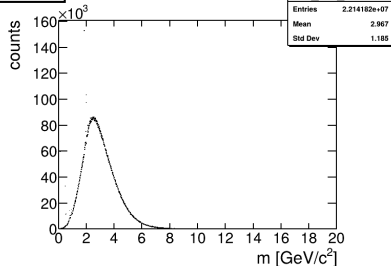
Number of jets



Jet mass



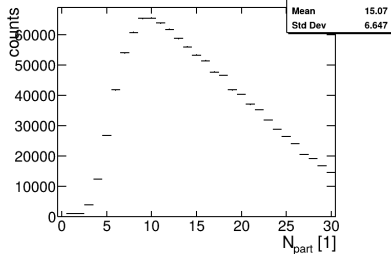
Jet mass



- MC jets

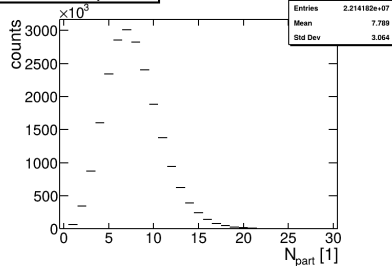
micrecon MC

Jet number of particles

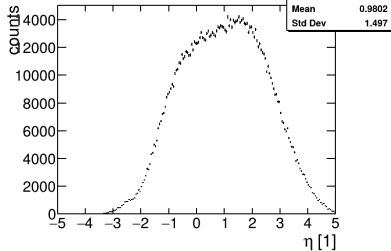


PYTHIA

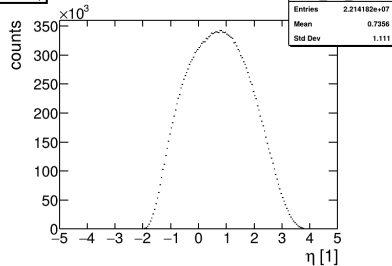
Jet number of particles



Jet η



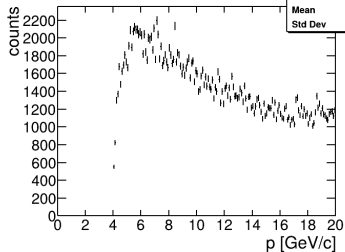
Jet η



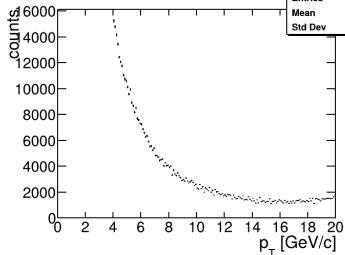
- MC jets

eicrecon MC

Jet momentum

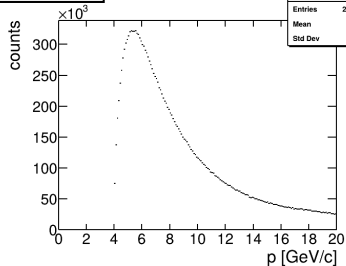


Jet transverse momentum

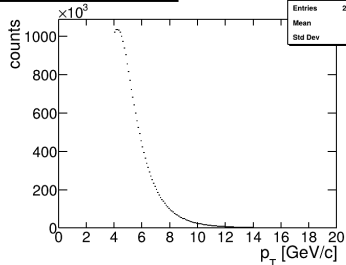


PYTHIA

Jet momentum

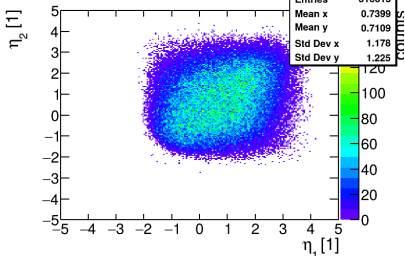
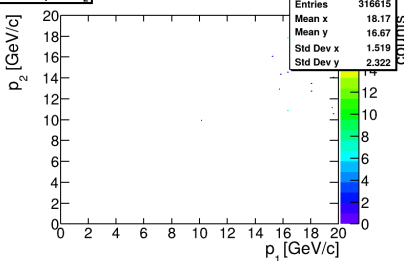


Jet transverse momentum

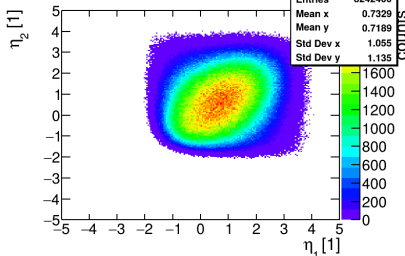
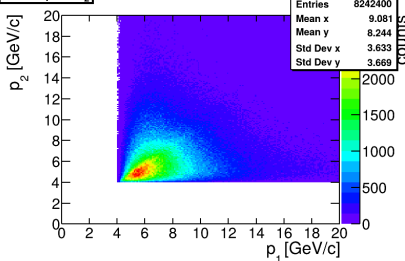


- MC jets

eicrecon MC

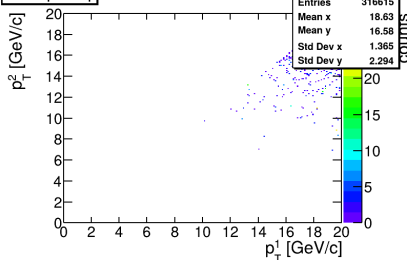
Jets η_1 vs. η_2 Jets p_1 vs. p_2 

PYTHIA

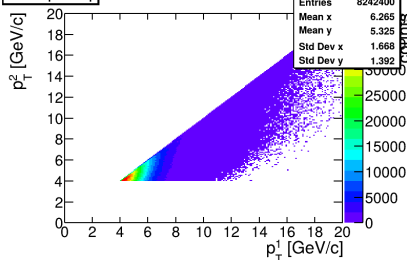
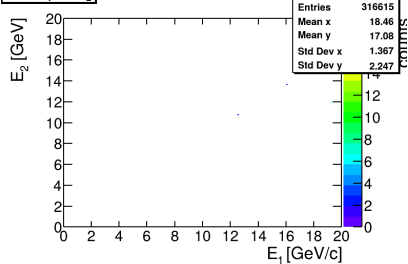
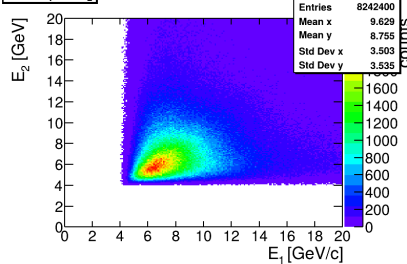
Jets η_1 vs. η_2 Jets p_1 vs. p_2 

- All jets

eicrecon MC

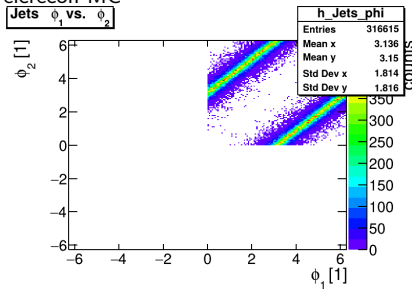
Jets p_T^1 vs. p_T^2 

PYTHIA

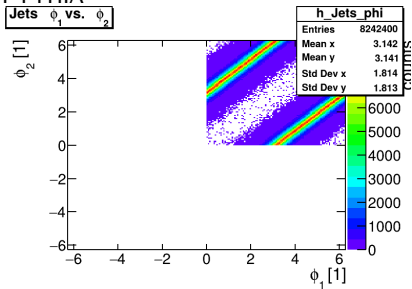
Jets p_T^1 vs. p_T^2 Jets E_1 vs. E_2 Jets E_1 vs. E_2 

- All jets

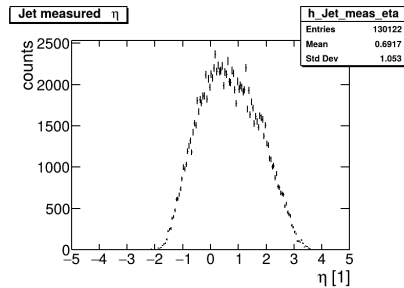
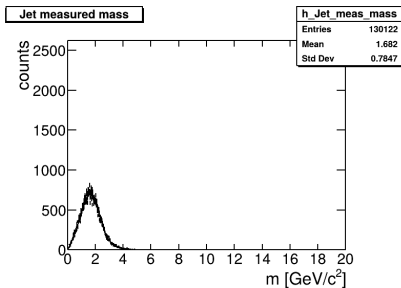
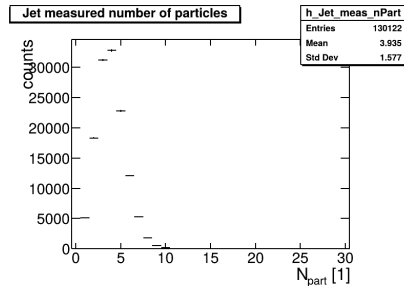
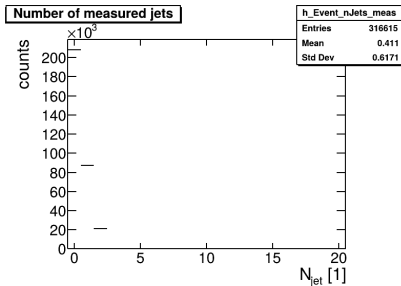
eicrecon MC



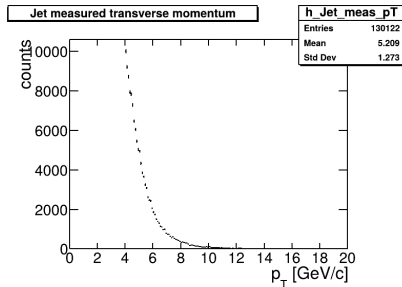
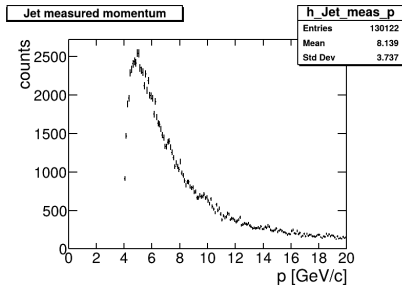
PYTHIA



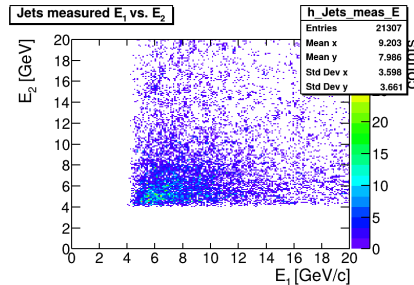
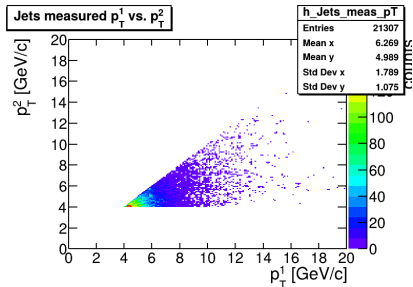
- MC jets



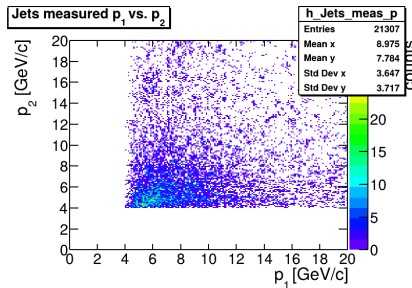
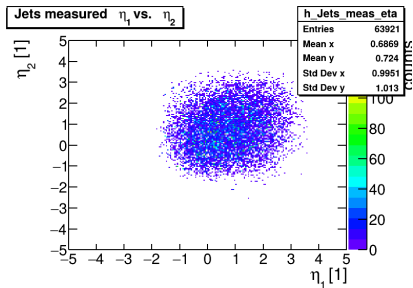
- Measured jets



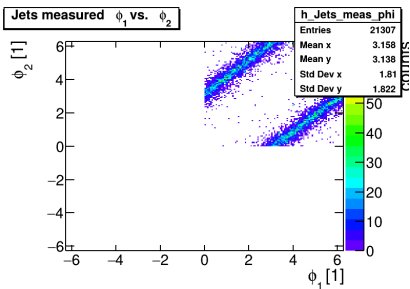
- Measured jets



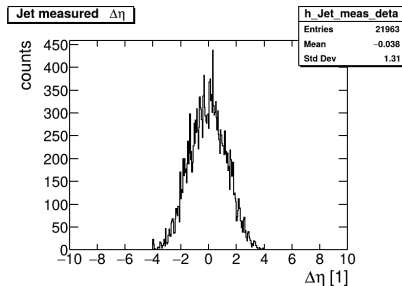
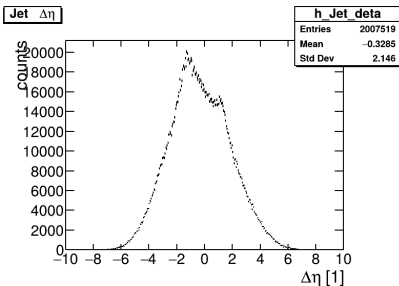
- Measured jets



- Measured jets



- Measured jets



- All jets vs. measured

Conclusions

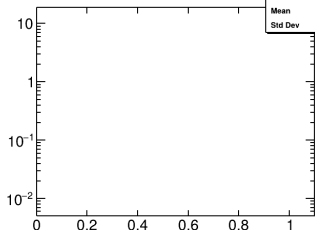
- Implemented FastJet
- First look at jets

BACKUP

Event kinematics - Q^2

Event with jets in any HCal Q^2

counts

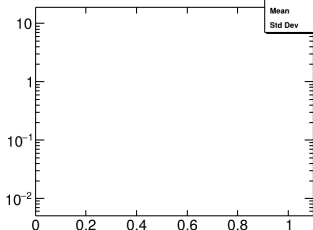


h_Event_AllHCal_Q2	
Entries	0
Mean	0
Std Dev	0

Q^2 [GeV^2/c^2]

Event with 1 jet in nHCal Q^2

counts

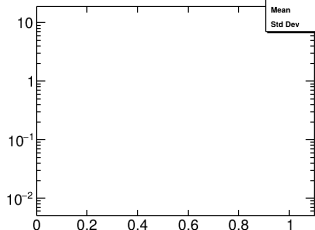


h_Event_nHCal_1_Q2	
Entries	0
Mean	0
Std Dev	0

Q^2 [GeV^2/c^2]

Event with 2 jets in nHCal Q^2

counts

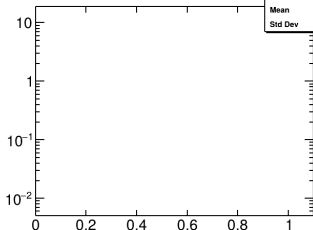


h_Event_nHCal_2_Q2	
Entries	0
Mean	0
Std Dev	0

Q^2 [GeV^2/c^2]

Event with 0 jets in nHCal Q^2

counts

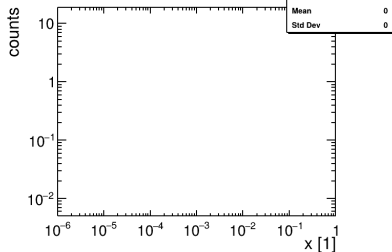


h_Event_nHCal_0_Q2	
Entries	0
Mean	0
Std Dev	0

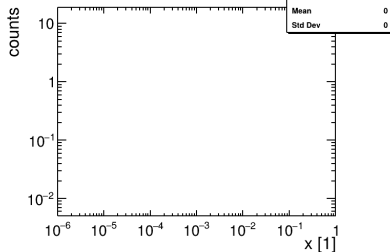
Q^2 [GeV^2/c^2]

- All events

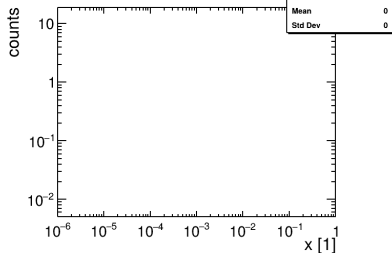
Event with jets in any HCal x



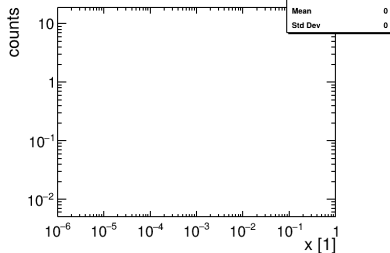
Event with 1 jet in nHCal x



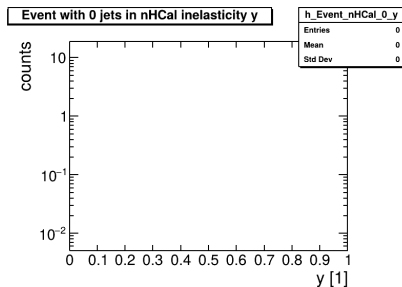
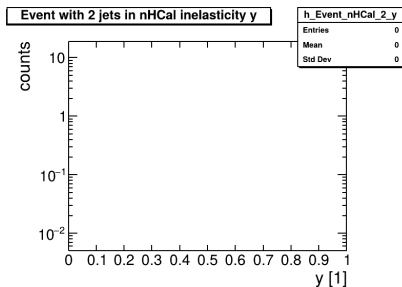
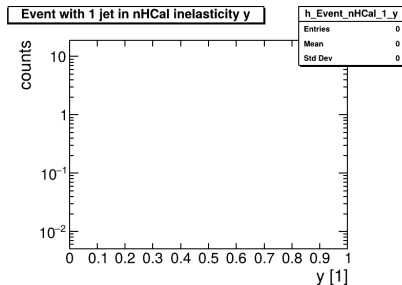
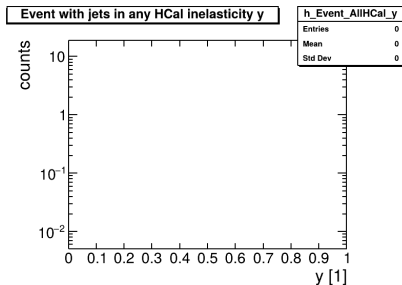
Event with 2 jets in nHCal x



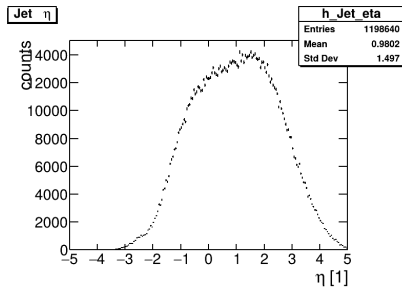
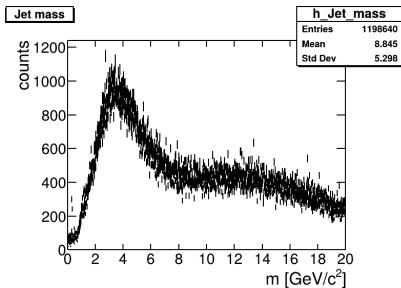
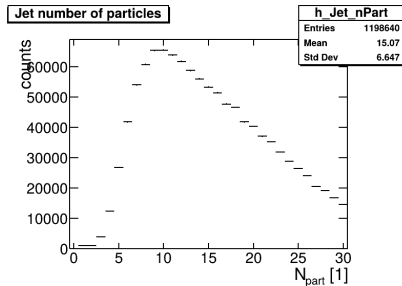
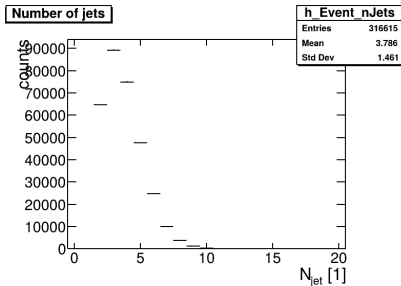
Event with 0 jets in nHCal x



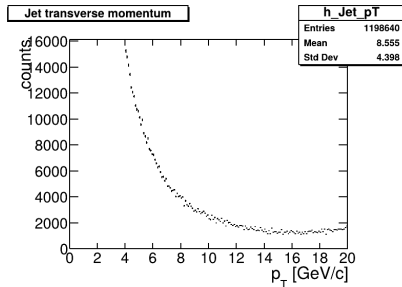
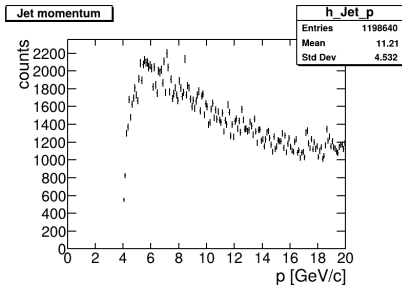
- All events



- All events



- All jets



- All jets