Jet finding in HF in heavy ion collisions.

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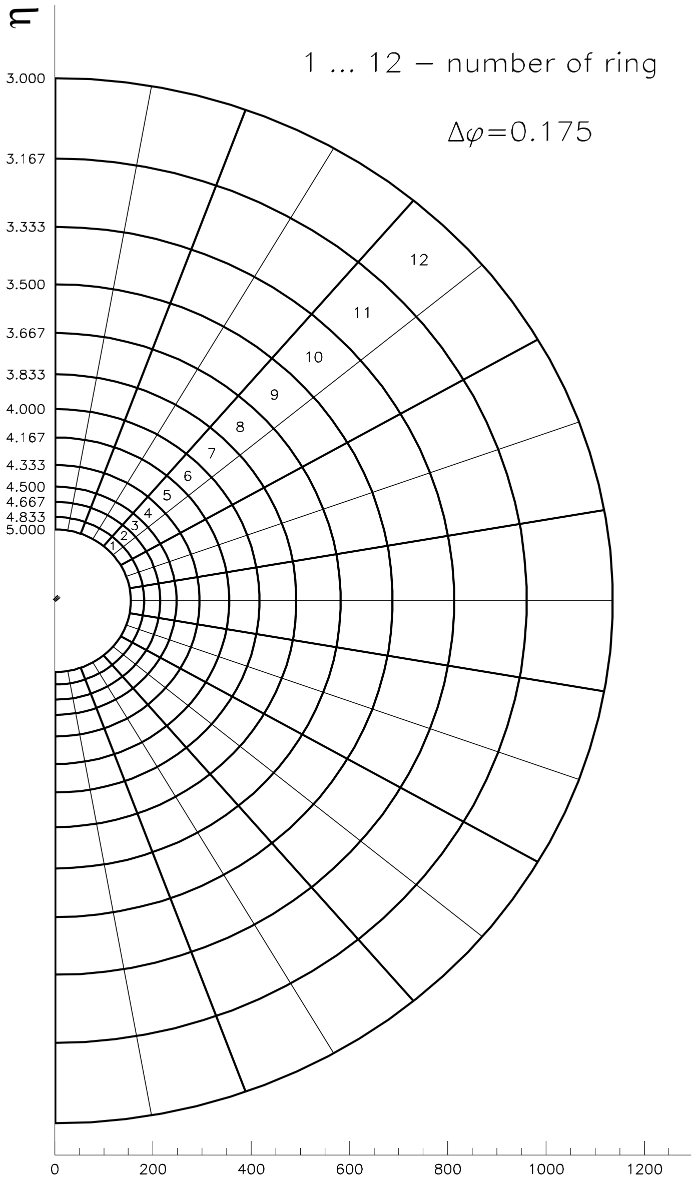
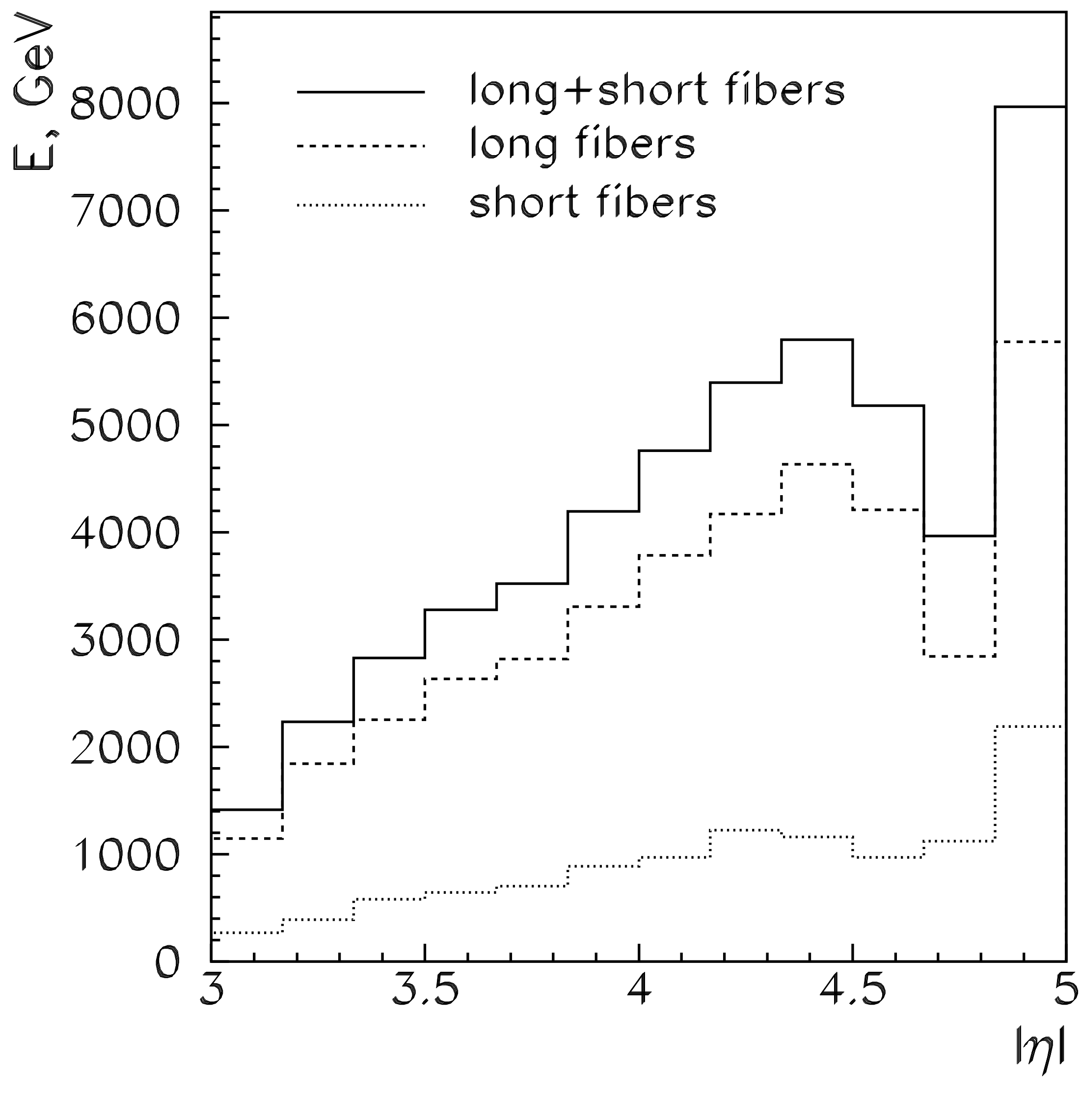
Content.

CMS HF-calorimeter (transverse view)



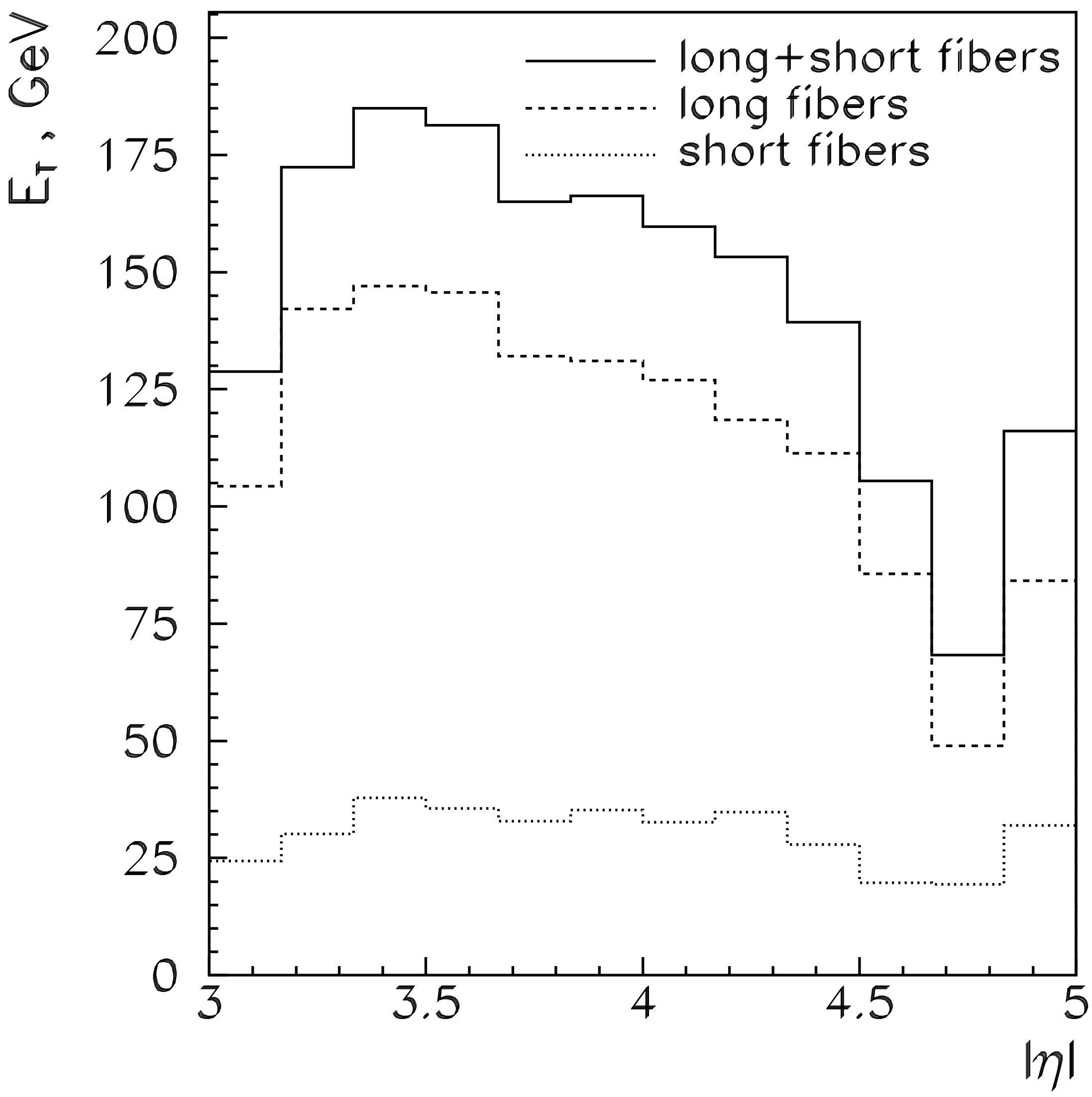
Energy flow in HF-calorimeter for central Ar-Ar collision

Ar-Ar, 1 event, $\sqrt{s} = 6.3A\ TeV$, $b = 0\ fm$



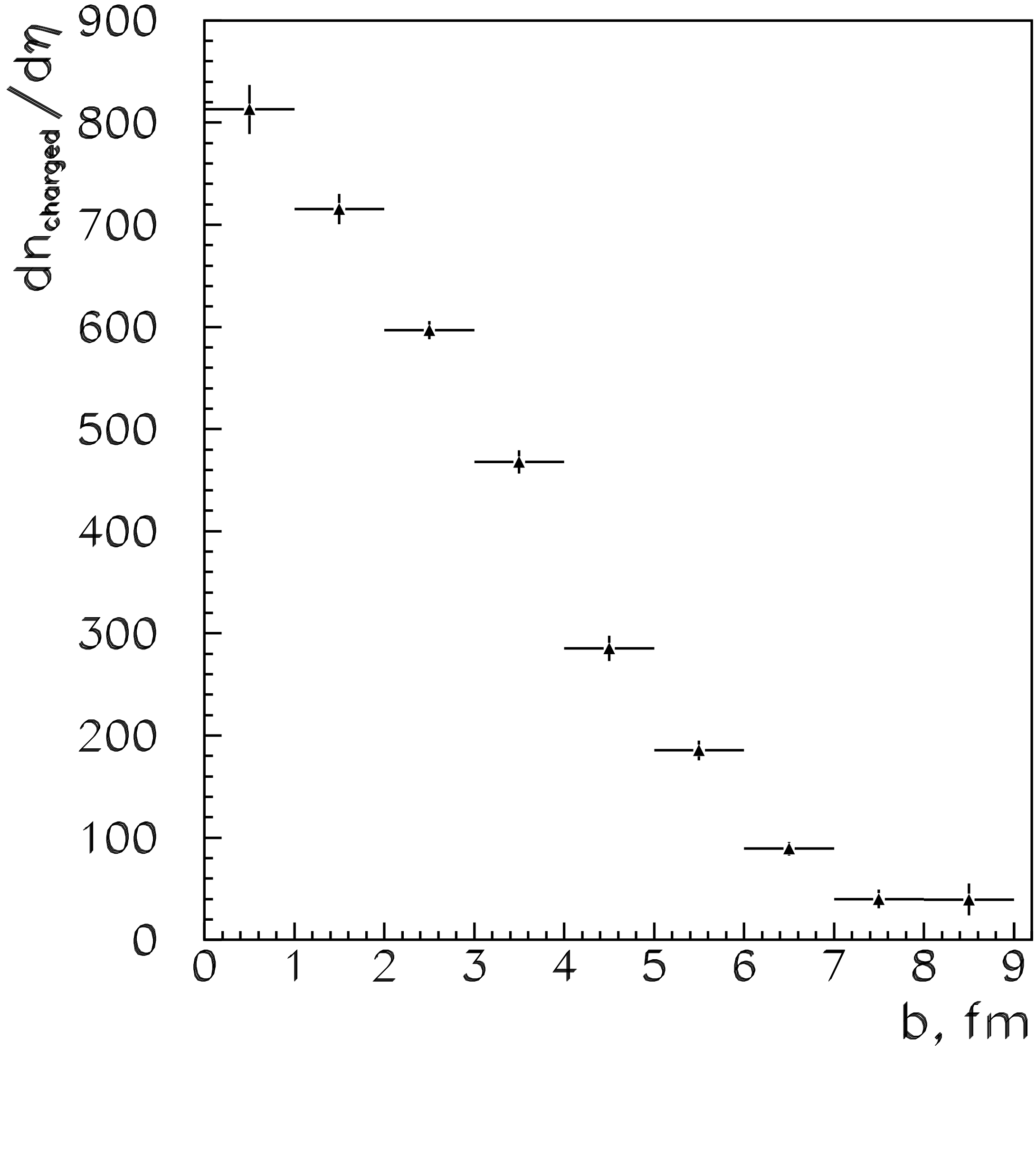
Transverse energy flow in HF for central Ar-Ar collision

Ar-Ar, 1 event, $\sqrt{s} = 6.3A\ TeV$, $b = 0\ fm$



Charge particle multiplicity $dn_{ch}/d\eta$ v.s. impact parameter

Ar-Ar, 750 events, $\sqrt{s} = 6.3A\ TeV$, $0 \le b \le 9\ fm$, $0 \le \eta \le 1$

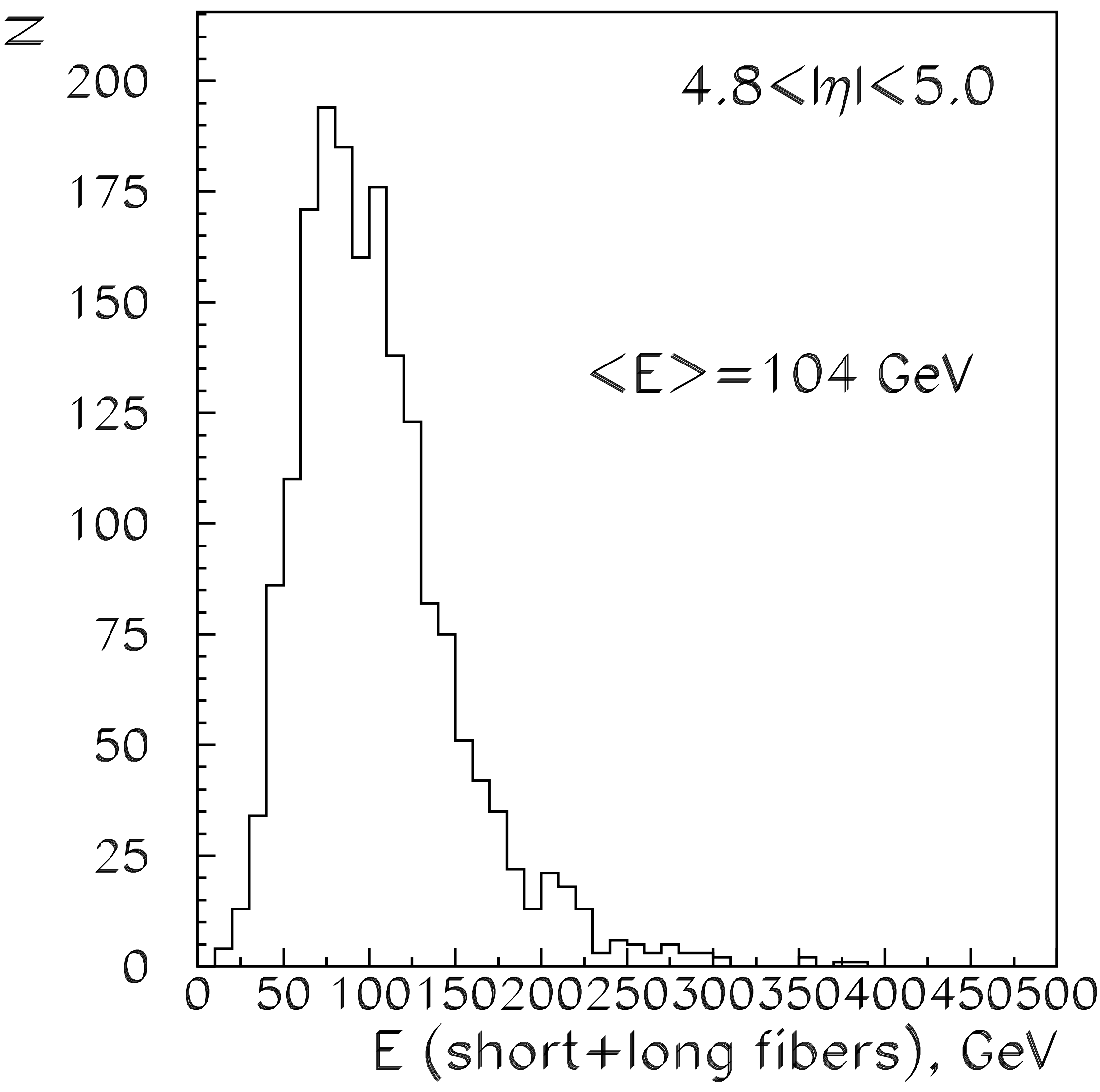


Fast simulation procedure

1. **We generate Ar-Ar events with different impact parameters in heavy ion generator HIJING**
2. **For getting responses of HF-calorimeter on real Ar-Ar events we use program CMSIM 120**
3. **Using HF responses on real Ar-Ar events we plot energy distributions in towers for all η-rings**
4. **With help of these energy distributions we simulate HF responses for all towers for each η-ring**
5. **Using HF responses on real Ar-Ar with different impact parameters we can get simulated responses on different Ar-Ar events**

Energy distribution in towers of one HF calorimeter η-ring

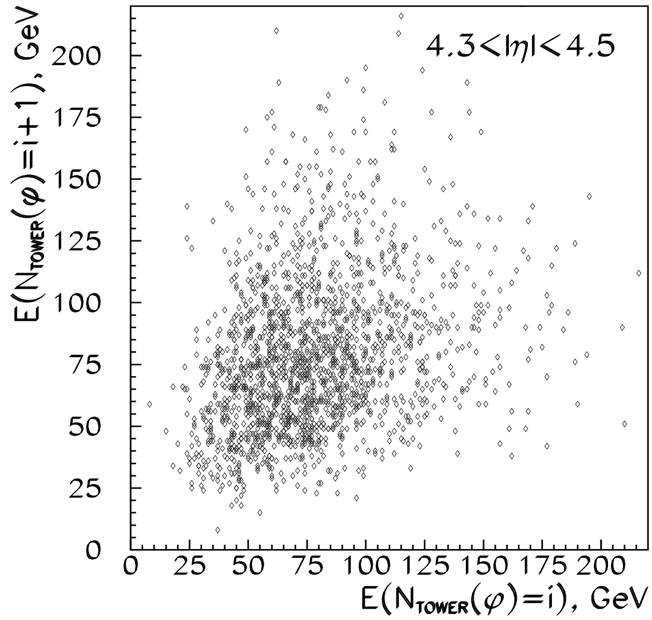
Ar-Ar, 25 events, $\sqrt{s} = 6.3A\ TeV$, $0 \leq b \leq 1\ fm$



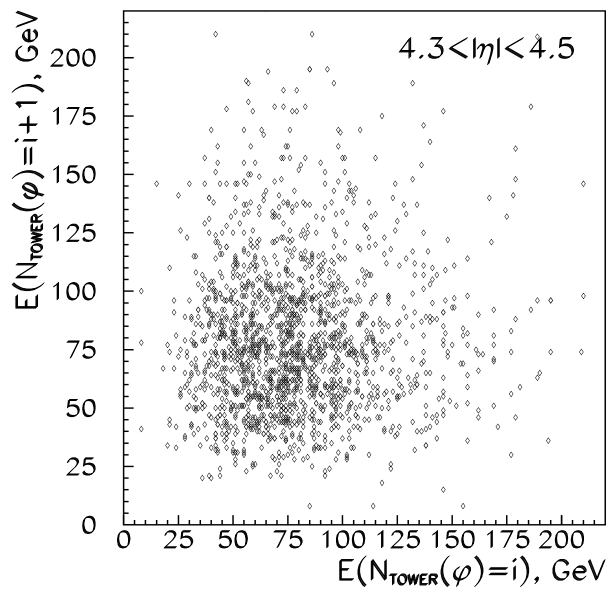
Correlation between neighboring towers

Ar-Ar, 25 events, $\sqrt{s} = 6.3A\ TeV$, $0 \le b \le 1\ fm$, 1800 pairs of towers

Full simulation



Fast pileup, full jet simulation

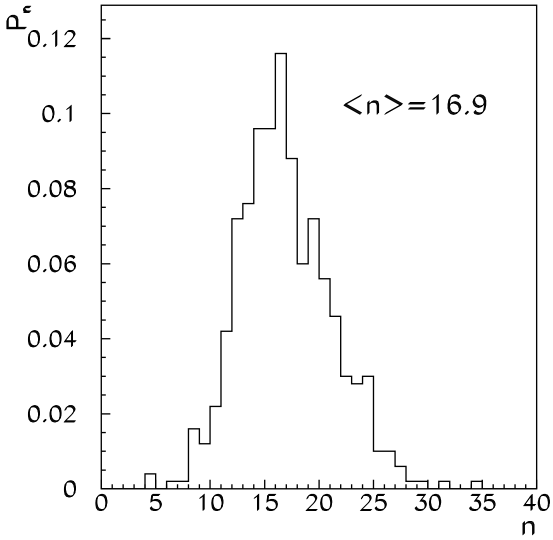


Jet finding and jet energy reconstruction procedure

1. We generate hard events in program PYTHIA.
2. After that we find jets with different transverse energy (from 30 to 150 GeV) and $4.9 < \eta < 5.1$.
3. Using program CMSIM 120 we get HF responses on jets.
4. Using fast simulation procedure we simulate background for jets.
5. Add jets and background.
6. For all η-rings we count mean and dispersion and substruct their from towers of its rings.
7. Search in HF tower with highest energy and compare it with real jet center. If tower get in cone 0.5 we assume it's a real jet.
8. Try to reconstruct jet energy. Count mean and dispersion (jets + background) for all η-rings without cone 0.5 around the center of jet. Substruct their from all towers of its rings. Collect energy in towers in cone 0.5 around the center of jet.

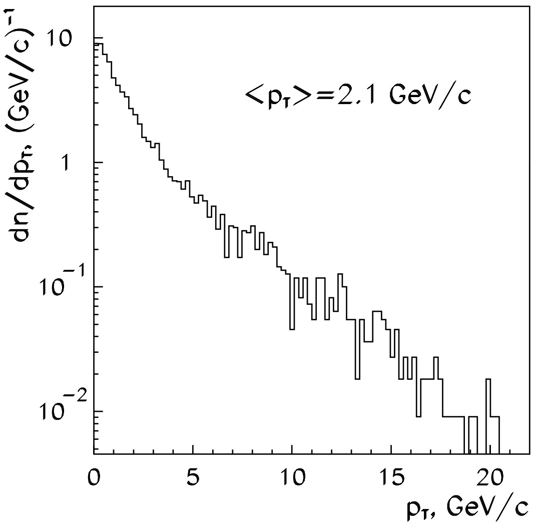
Particles multiplicity distribution of jets.

500 jets, $30 \leq E_T^{JET} \leq 50\ GeV$



The transverse momentum distribution of particles in jets.

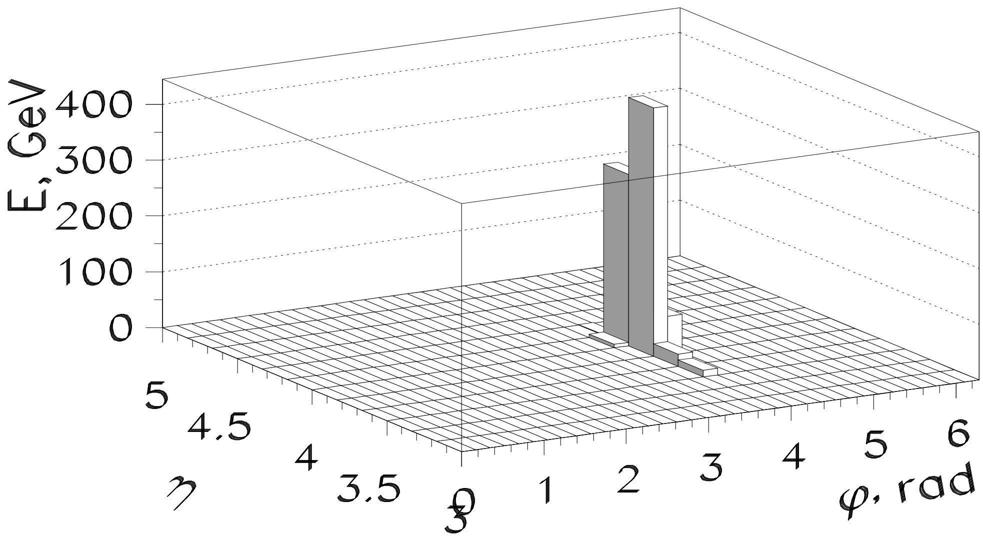
500 jets, $30 \leq E_T^{JET} \leq 50\ GeV$



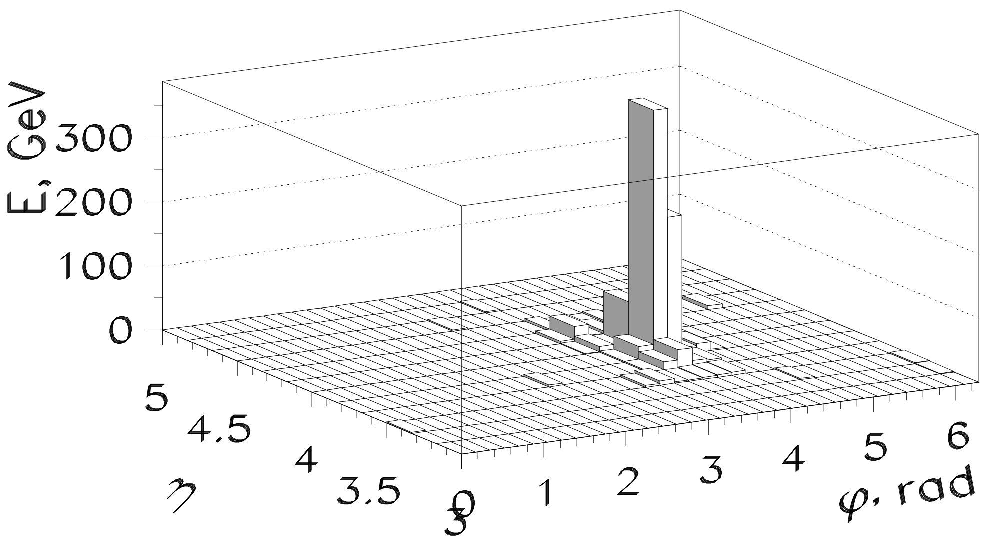
Jet in PYTHIA model and HF responses on this jet

Ar-Ar, 1 event, $\sqrt{s} = 6.3A\ TeV$, $0 \leq b \leq 1\ fm$,
$E_T^{JET} = 40\ GeV$

Jet in PYTHIA



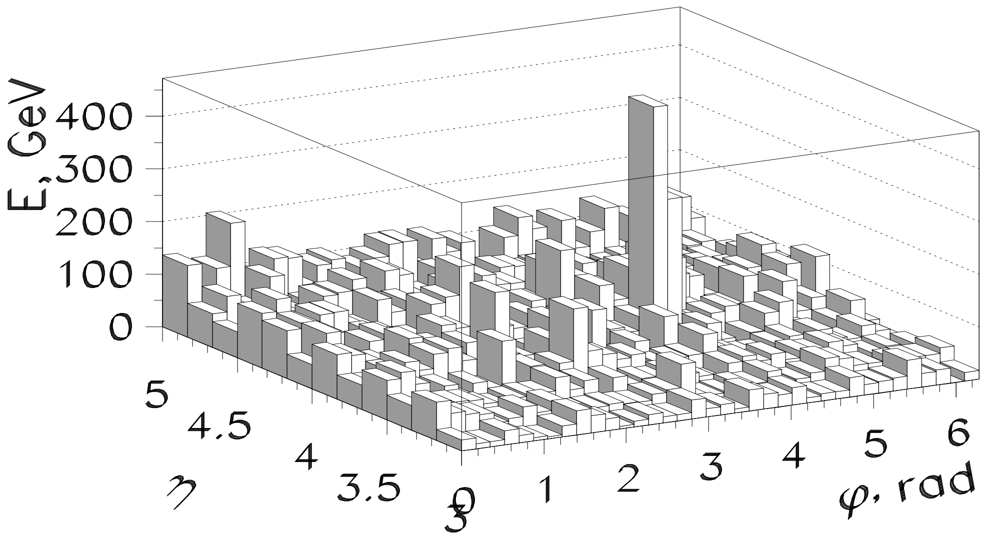
Jet in HF (CMSIM 120)



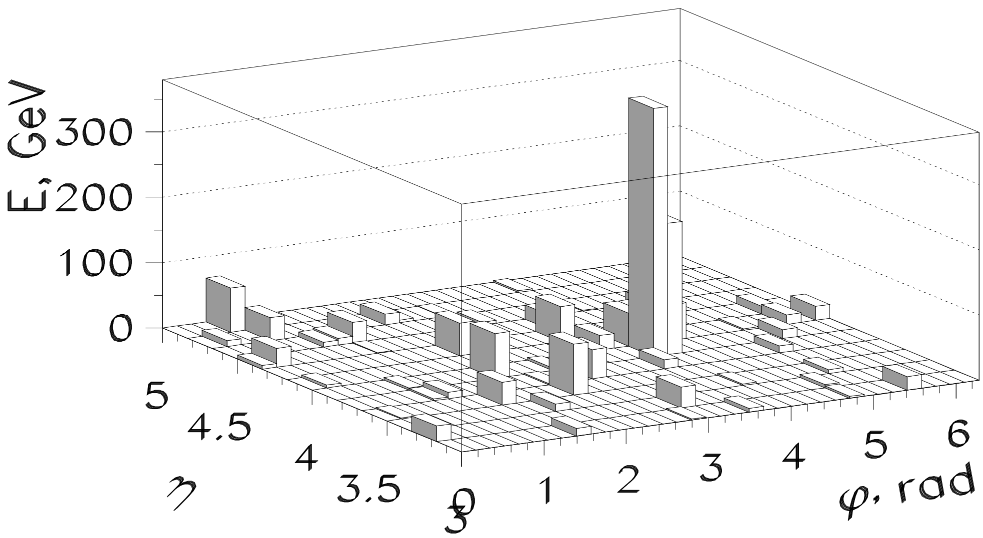
The same jet and background in HF and reconstructed jet in HF

Ar-Ar, 1 event, $\sqrt{s} = 6.3A\ TeV$, $0 \leq b \leq 1\ fm$,
$E_T^{JET} = 40\ GeV$

Jet and background in HF

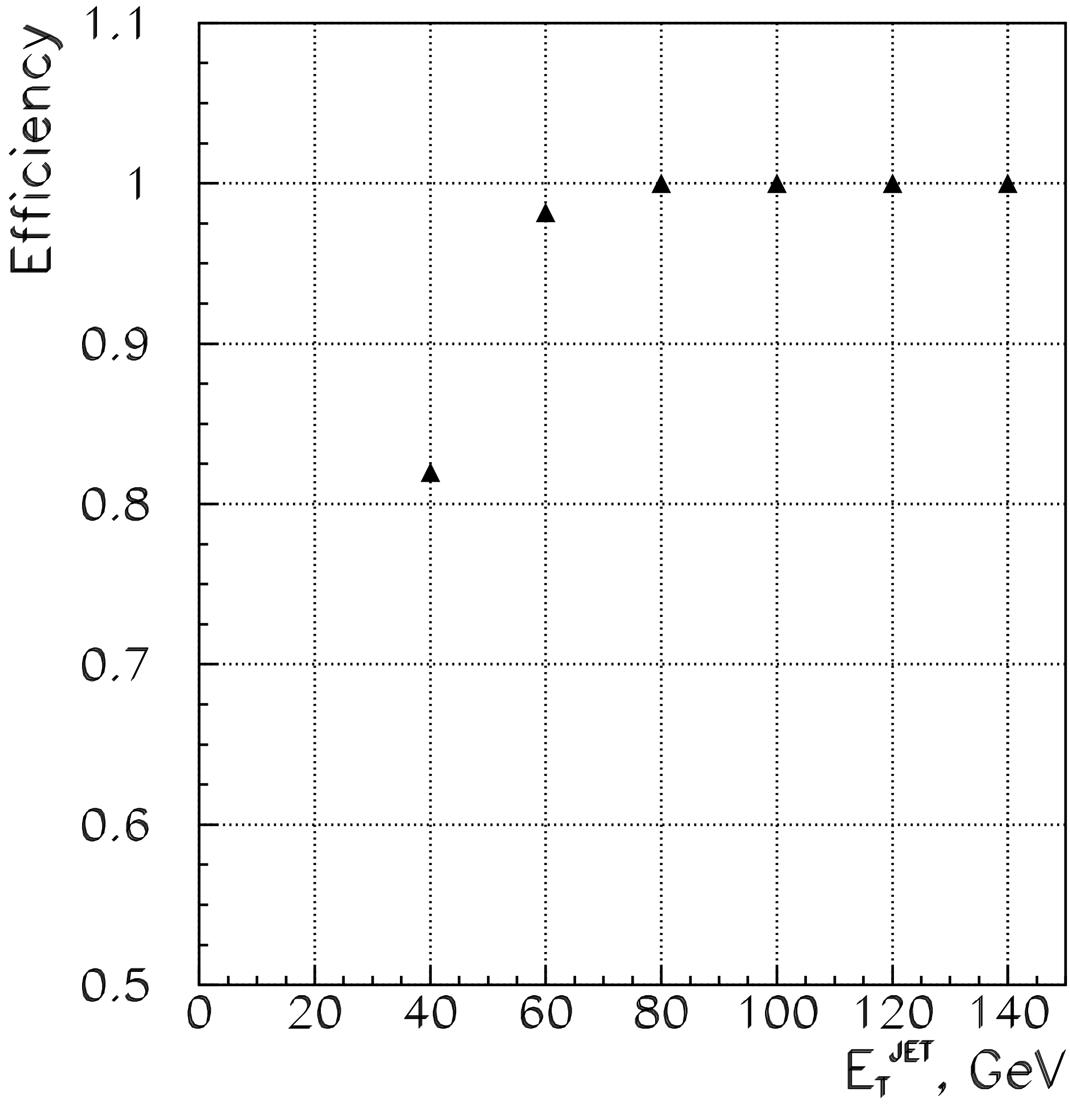


Reconstructed jet in HF



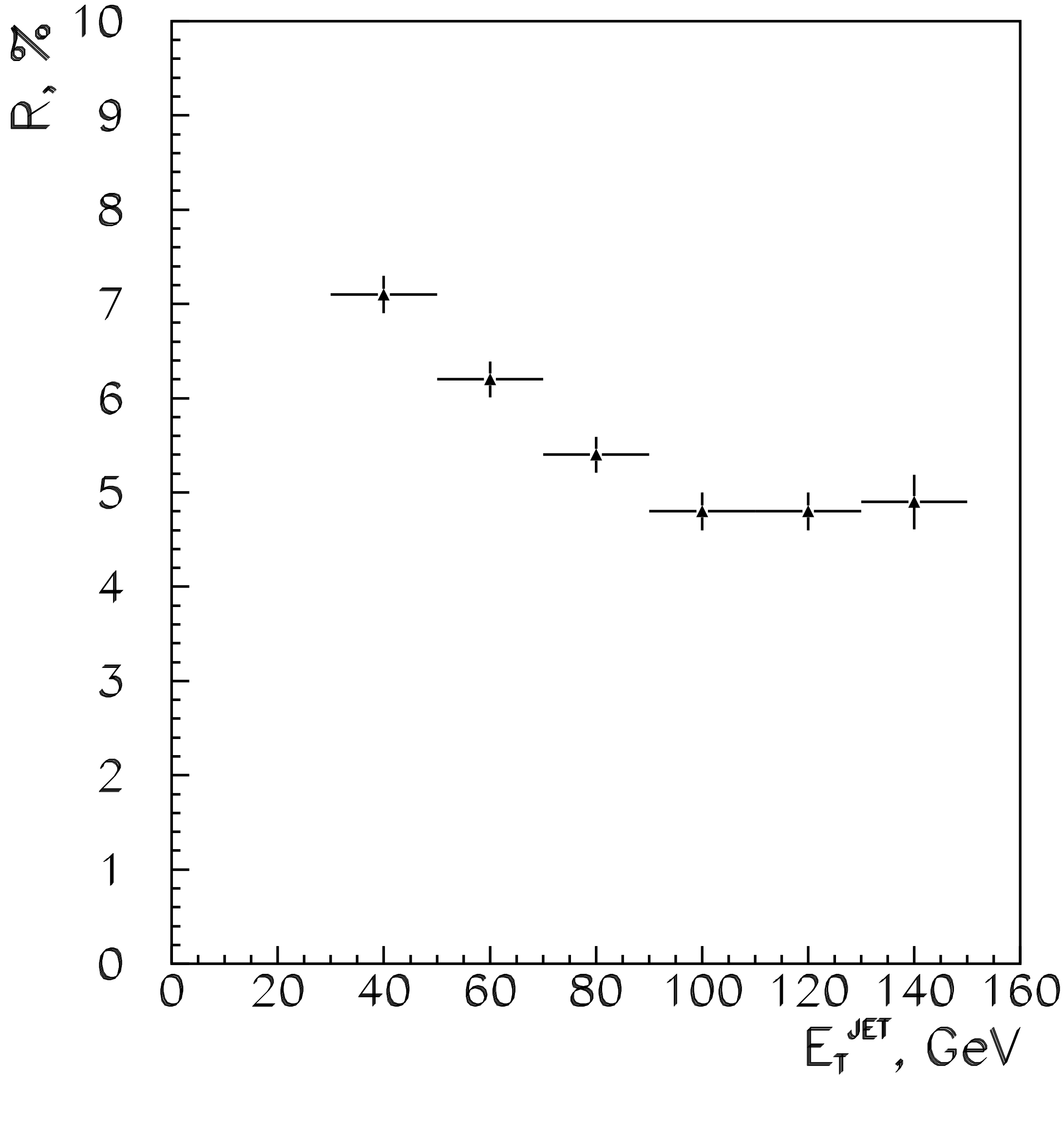
Efficiency of jet finding in HF
v. s. jet transverse energy

Ar-Ar, $\sqrt{s} = 6.3A\ TeV$, $0 \leq b \leq 1\ fm$, 2600 jets



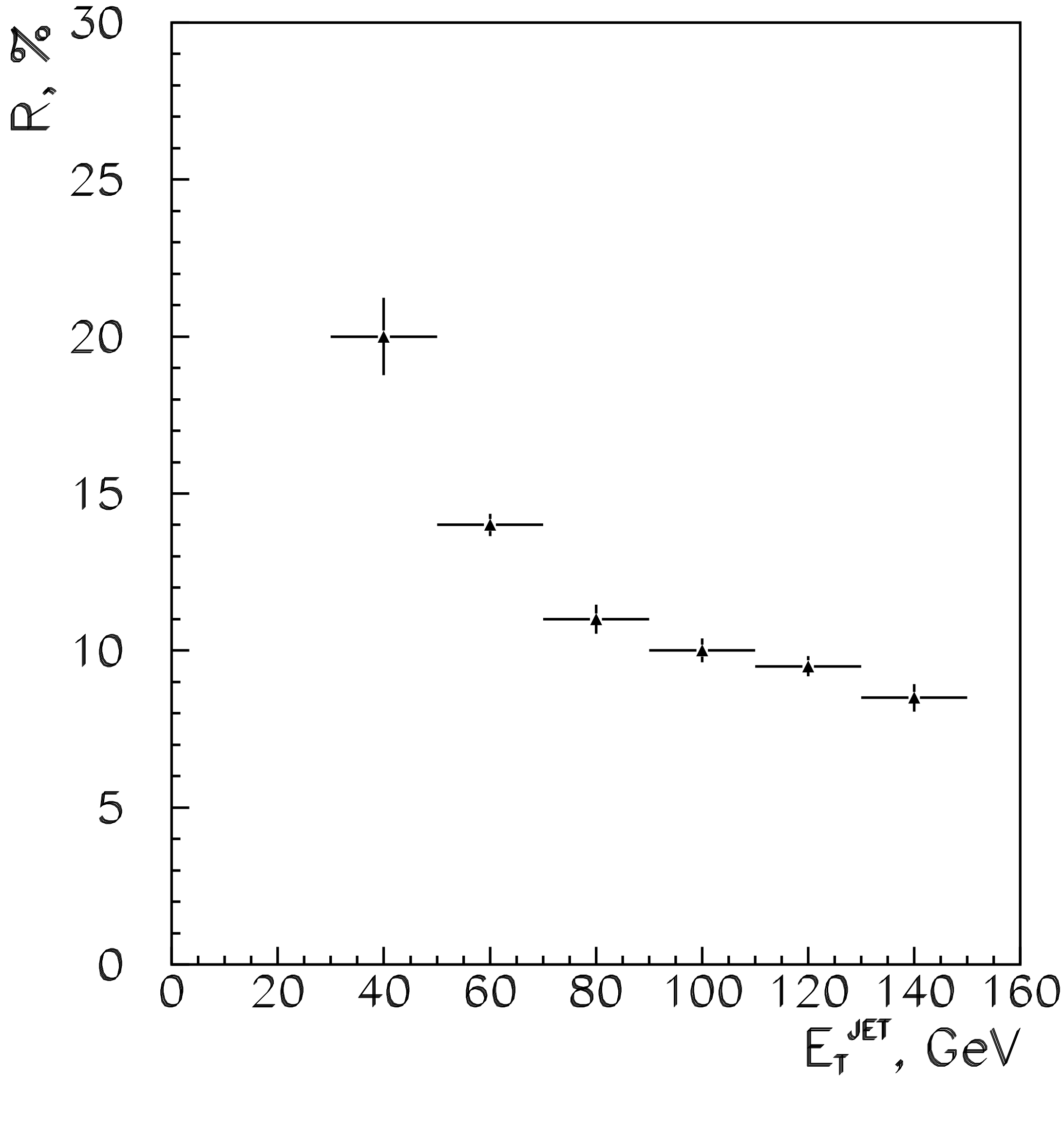
Jet energy resolution of HF without heavy ions

Ar-Ar, $\sqrt{s} = 6.3A\ TeV$, $0 \leq b \leq 1\ fm$, 2600 jets



Jet energy resolution of HF with heavy ions and pileup substruction

Ar-Ar, $\sqrt{s} = 6.3A\ TeV$, $0 \leq b \leq 1\ fm$, 2600 jets



Summary

1. **HF calorimeter lets registrate jets.**
2. **Fast simulation procedure lets get background from heavy ion collisions for studing jet finding efficiency and jet energy resolution of HF.**
3. **Efficiency is determined for hard jets with different transverse energy.**
4. **Jet energy resolution is calculated for jets without heavy ions and jets with heavy ions and pileup substruction.**