A first look at Hqq–>bbqq

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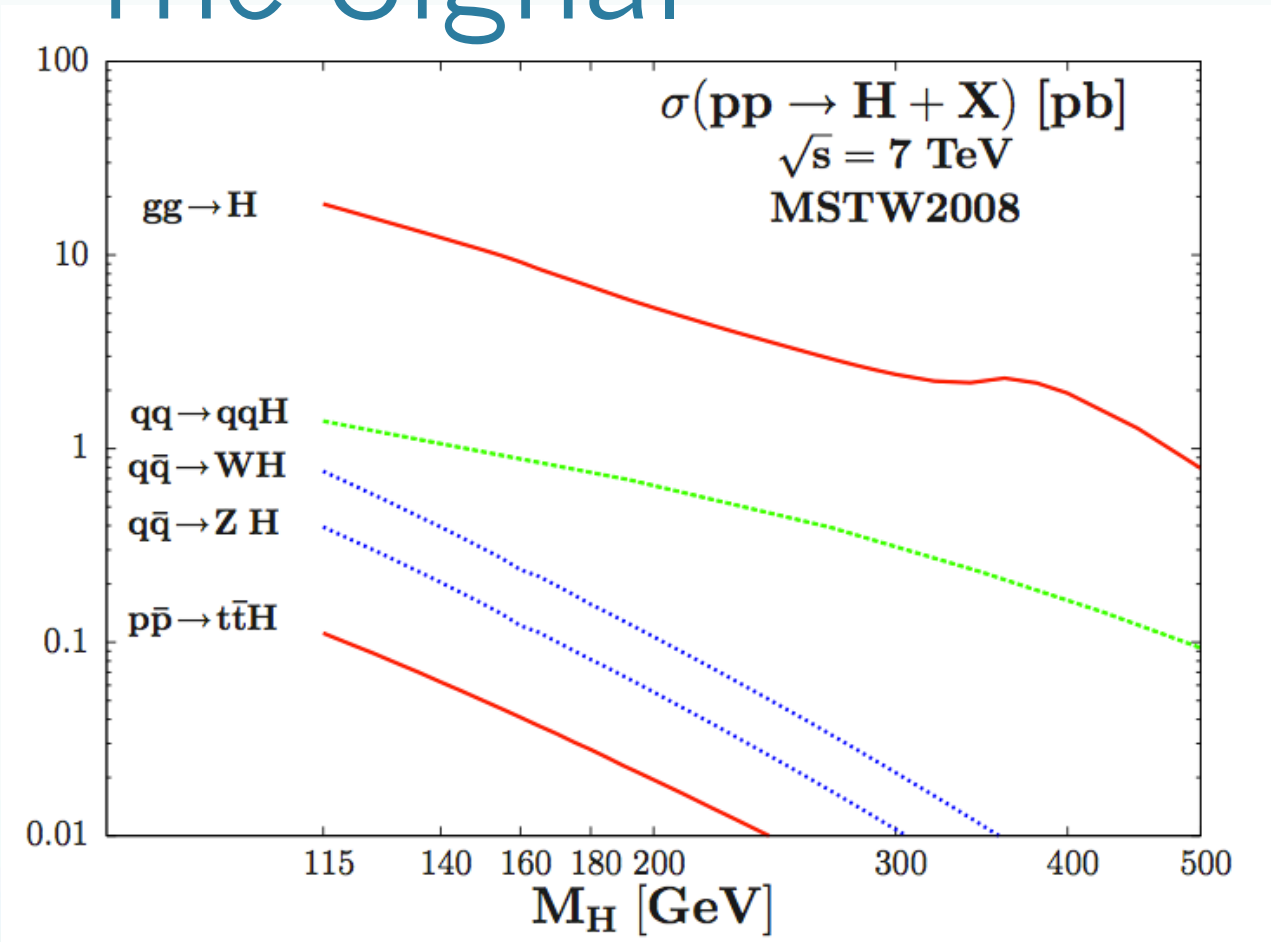
Outline

Focus on understanding signal properties

- Signal properties at parton level
- Jet reconstruction of the signal
- First Look at Trigger Efficiencies
- QCD background starting point

The Signal

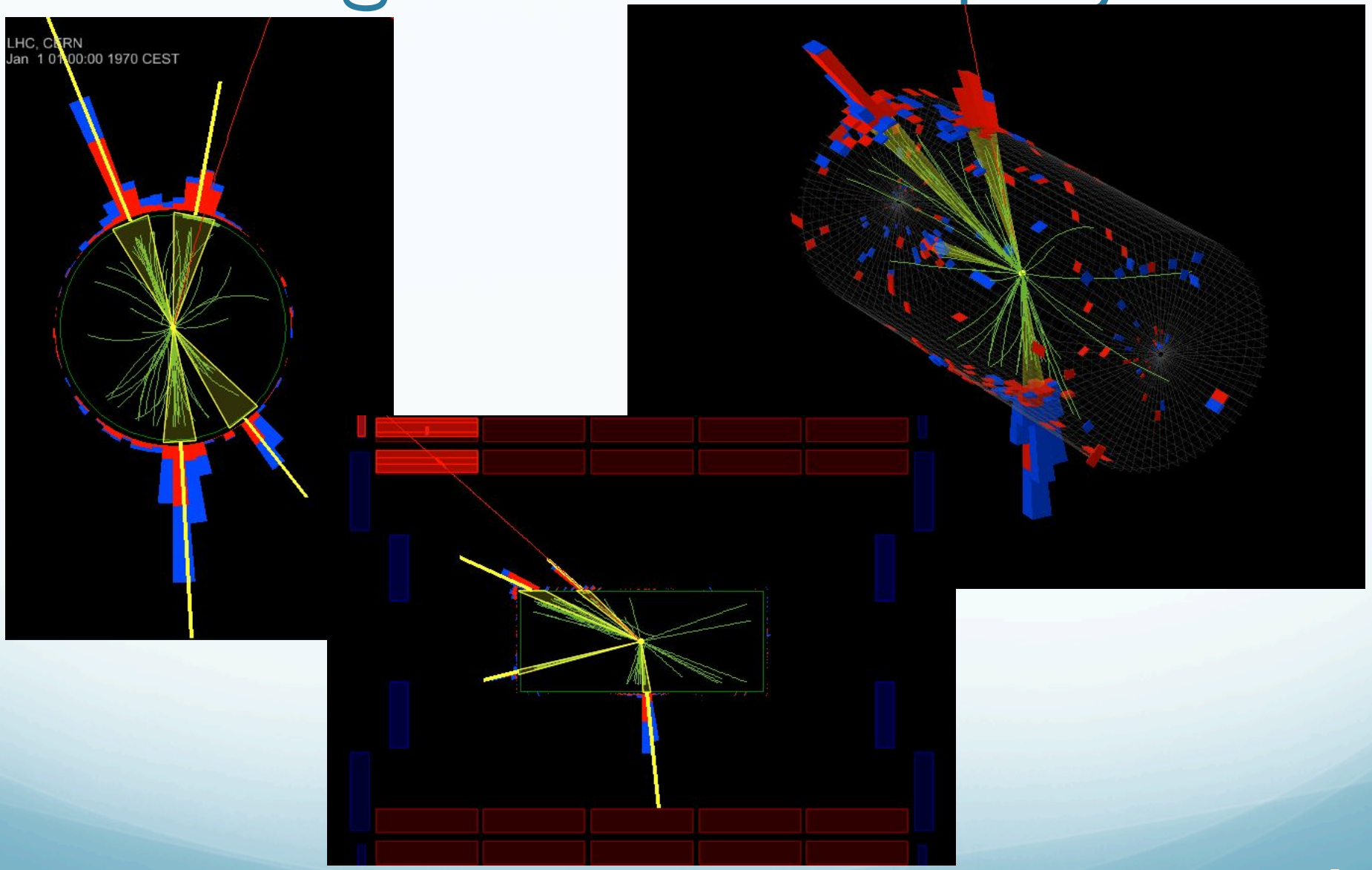
Signal Events
Generated with PYTHIA
m_H=120 GeV
BR(H–>bb)≈90%



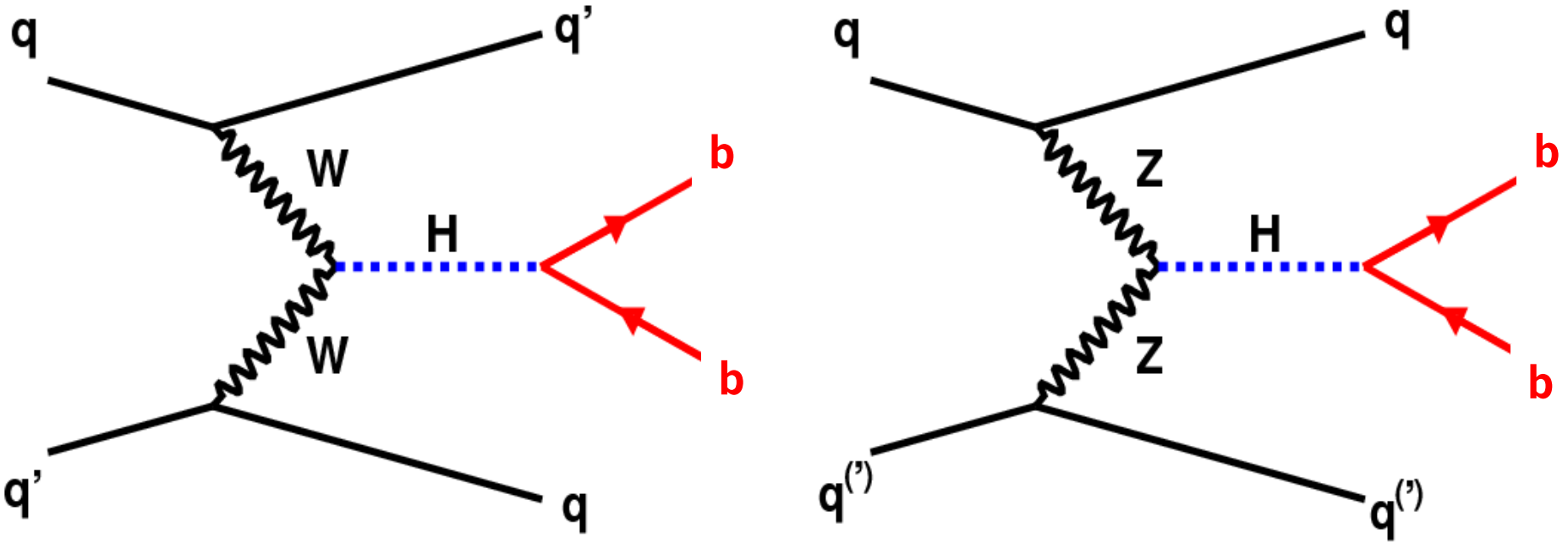
/Hbb120_VBF_GEN-SIM-RECO/fiori-Hbb120_VBF_GEN-SIM-RECO-6f87d88d4f39fafeeaa69aa8e51897fd/USER

QCD bkg from MADGRAPH √s=7 TeV

Signal Event Display

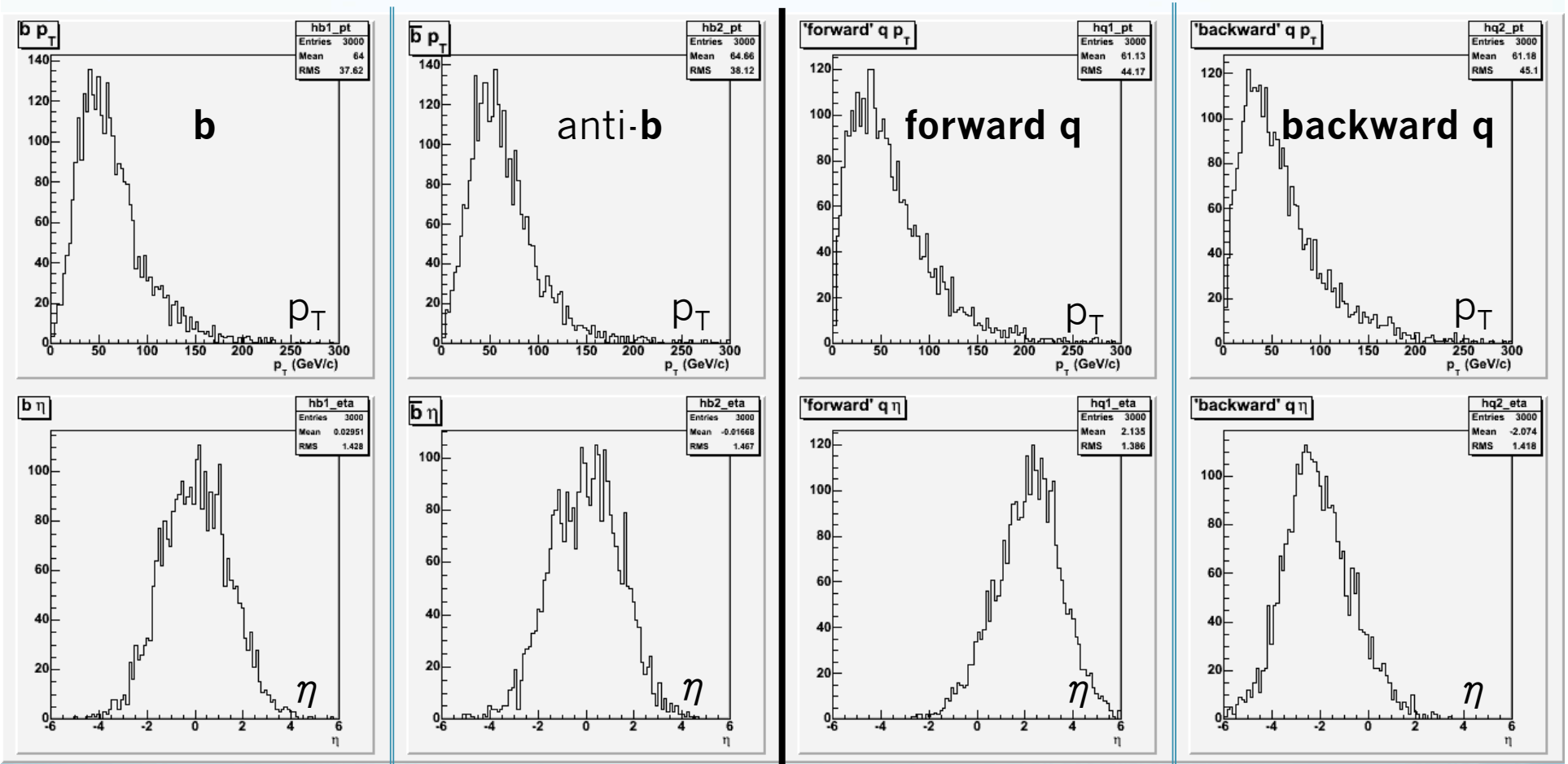


VBF Higgs diagram



Signal Four Quarks: bbqq

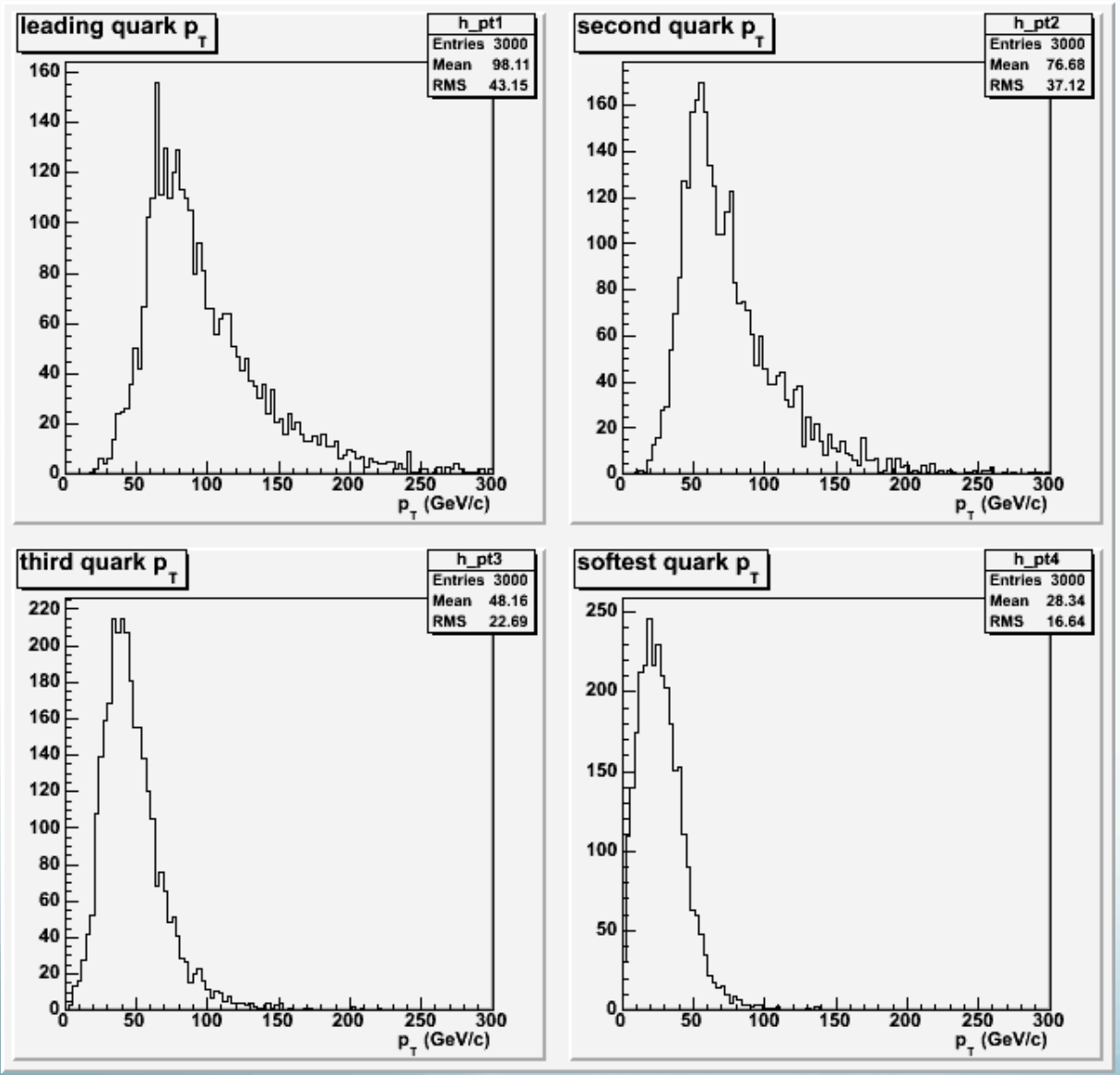
For each parton $\langle p_T \rangle \approx 62$ GeV/c



$\langle \Delta \eta_b \rangle \approx 1.4$: b-jets quite contained in the tracker acceptance

$\langle \eta_q \rangle \approx \pm 2.1$

Signal Four Quarks: bbqq

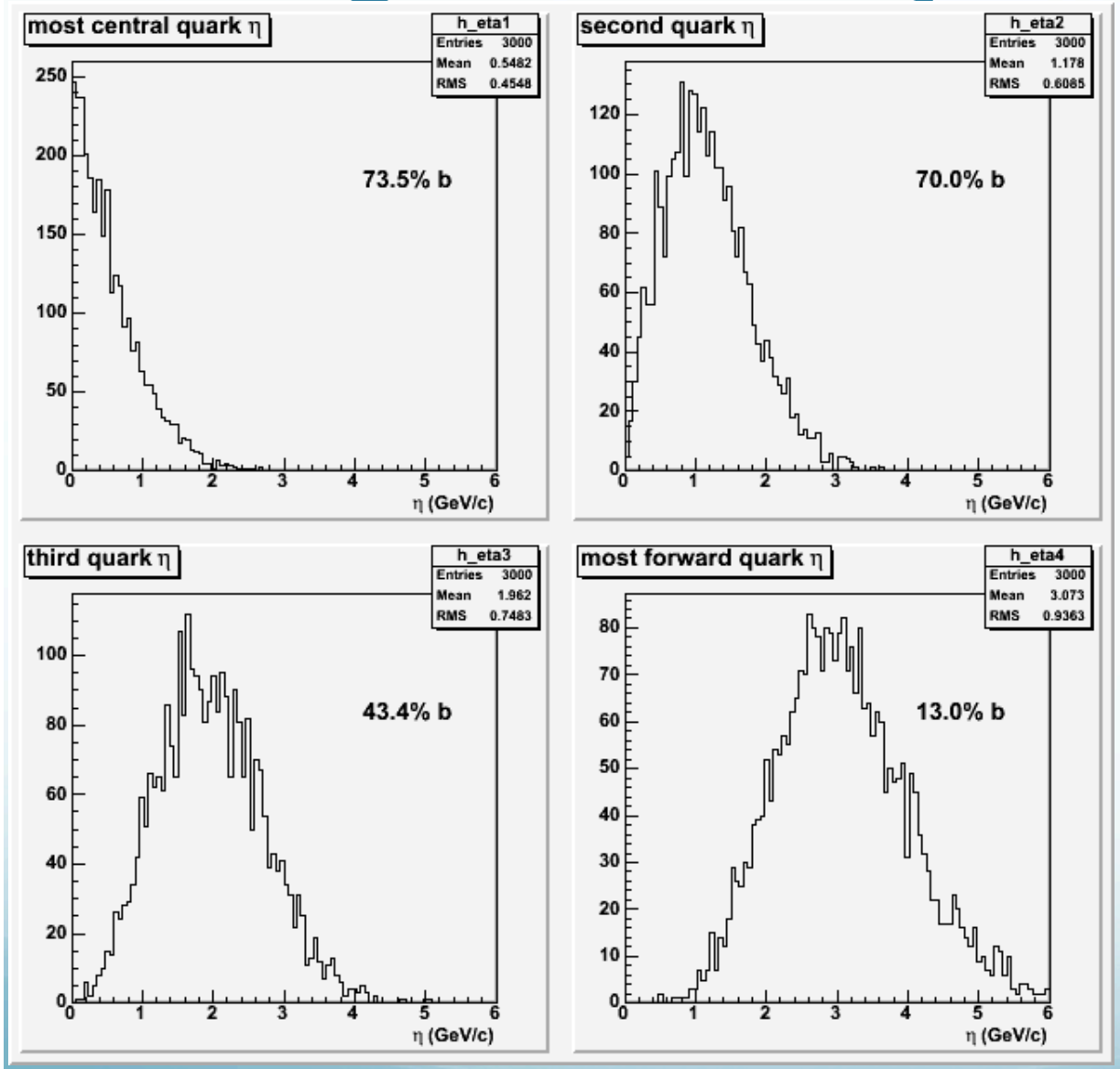


p_T-ordered parton spectra

the leading parton has $p_T \geq 50$ GeV/c

the fourth (softest) parton is soft !

Signal Four Quarks: bbqq



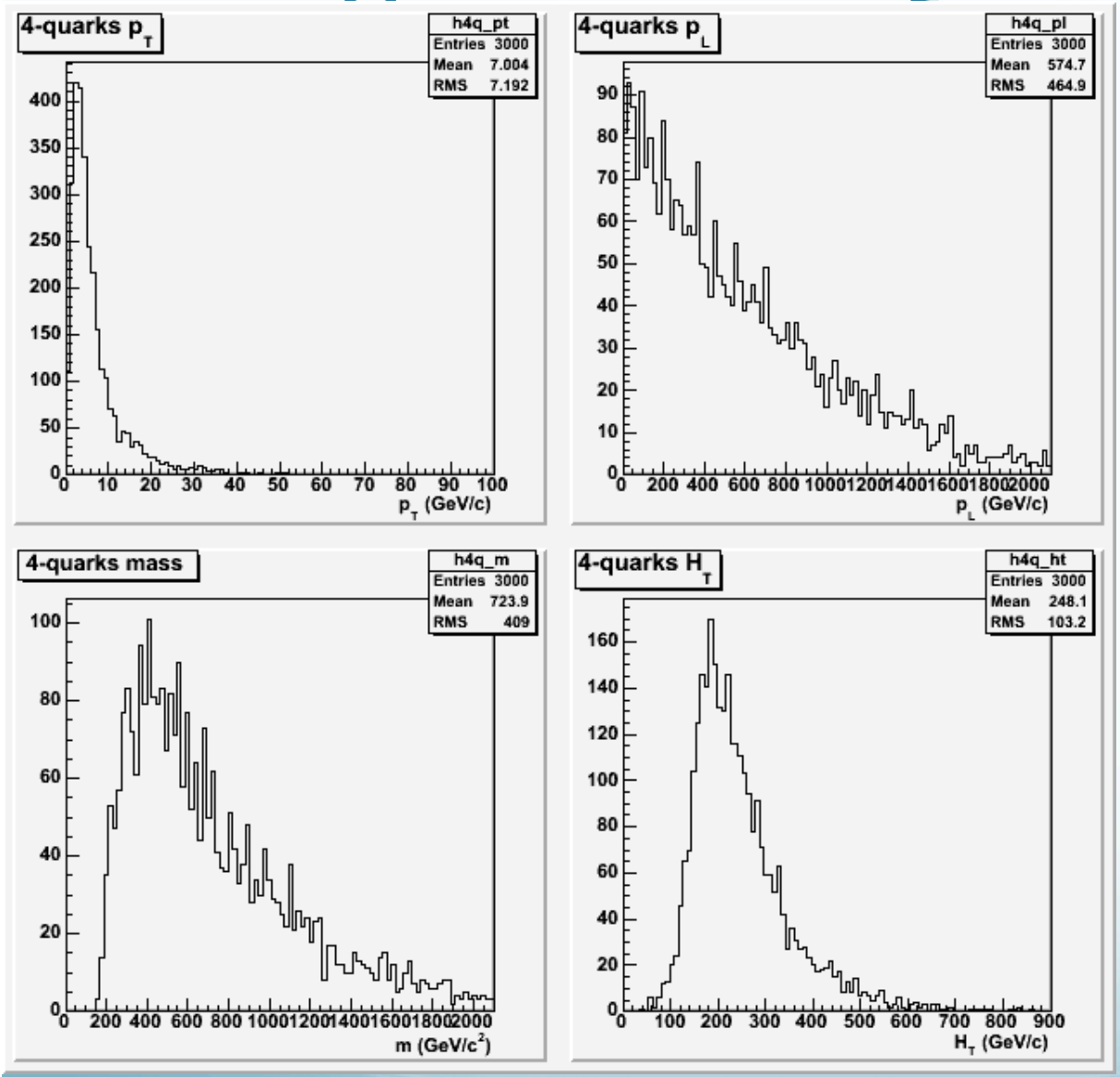
η -ordered parton distributions

The most central parton is a b (from the higgs decay) only 3/4 of the times.

In pairs, the two most central partons can be:

- the two b-quarks (45%)
- one b-quark and one associated-quark (54%)
- the two associated-quarks (1%)

Signal Four Quarks: bbqq



total four-quark system

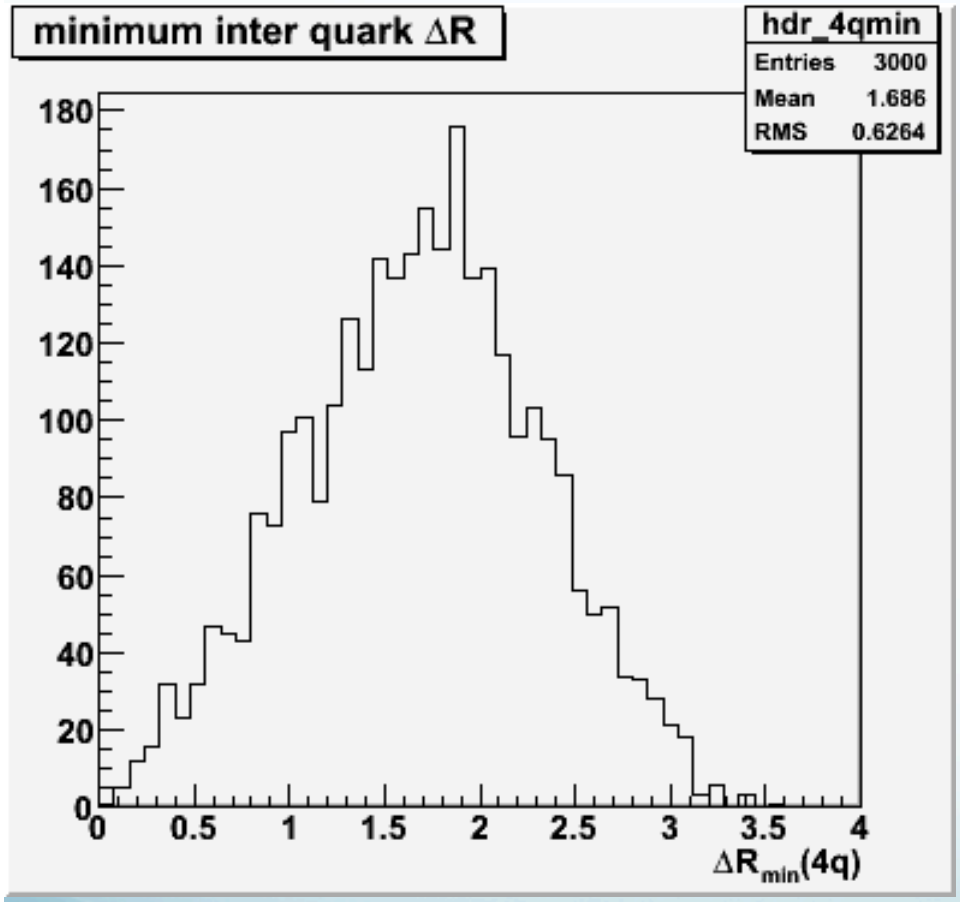
Total p_T ~ 7 GeV/c
Total p_L ~ 600 GeV/c.

No (p_T,p_L) correlation.

Total invariant mass ~ 700 GeV/c

Total H_T ~ 250 GeV

Signal Four Quarks: bbqq

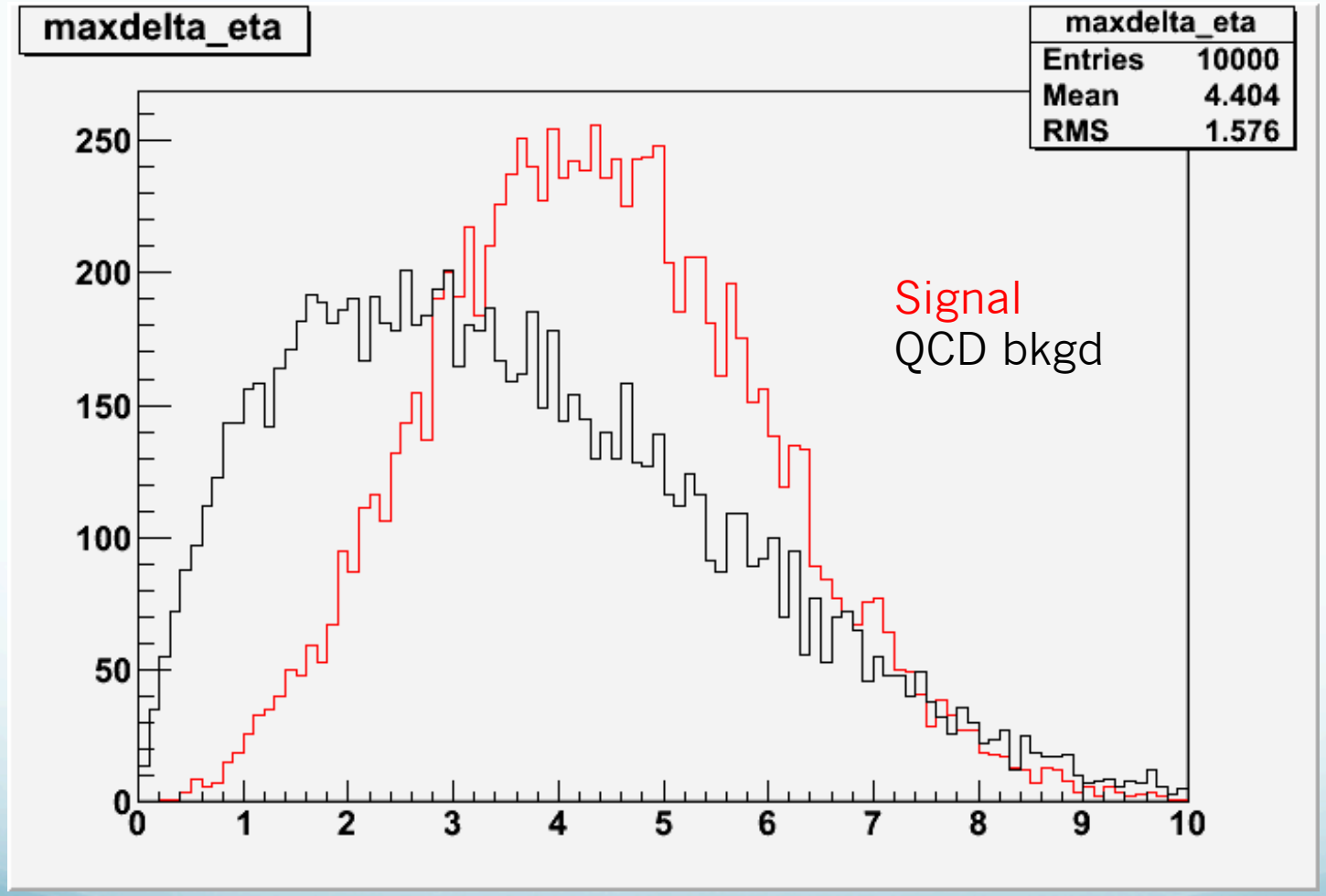


smallest ΔR between parton pairs

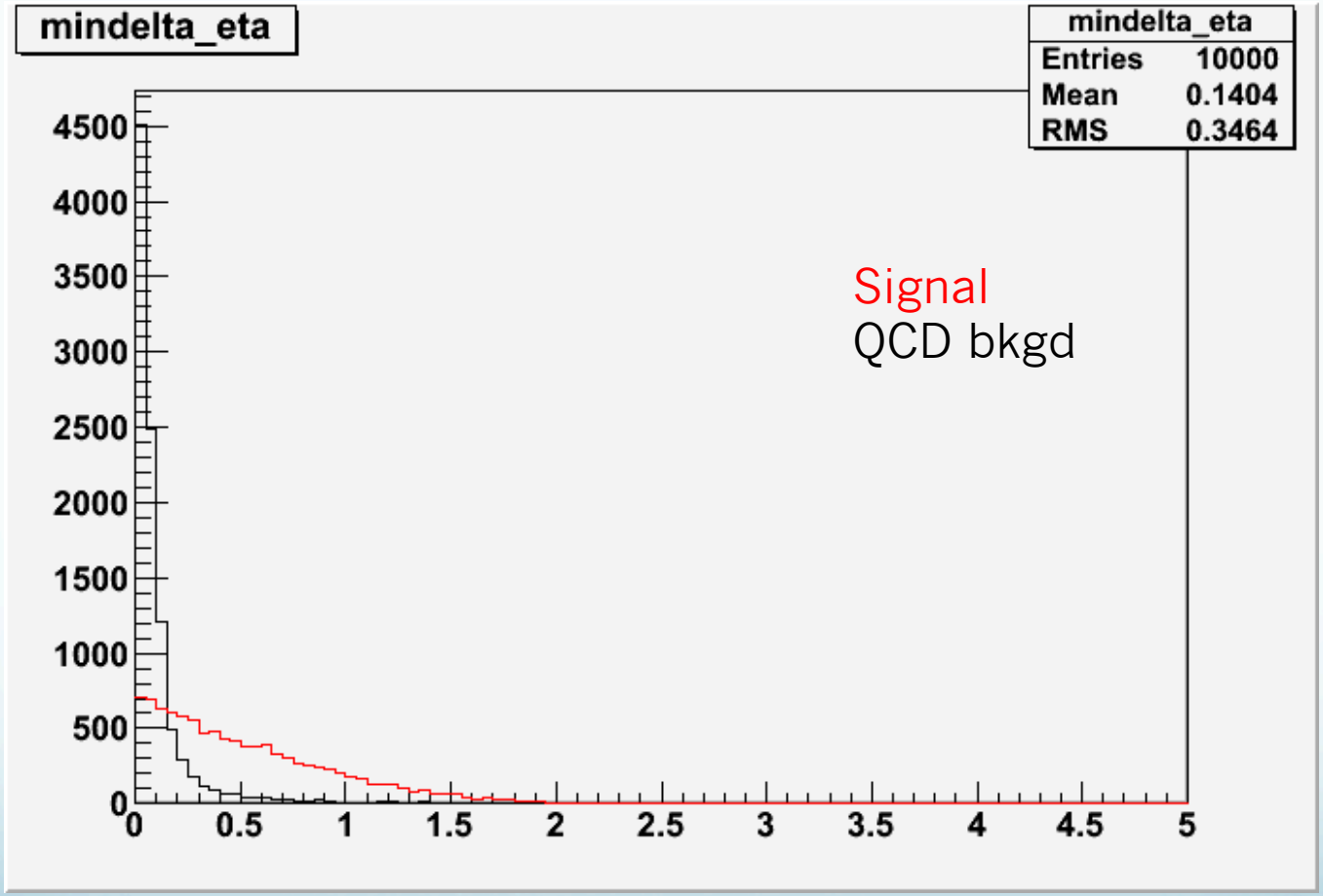
the four partons are angularly quite well separated.

In 83%(97%) of signal events all six quark-pairs have ΔR>1(0.5).

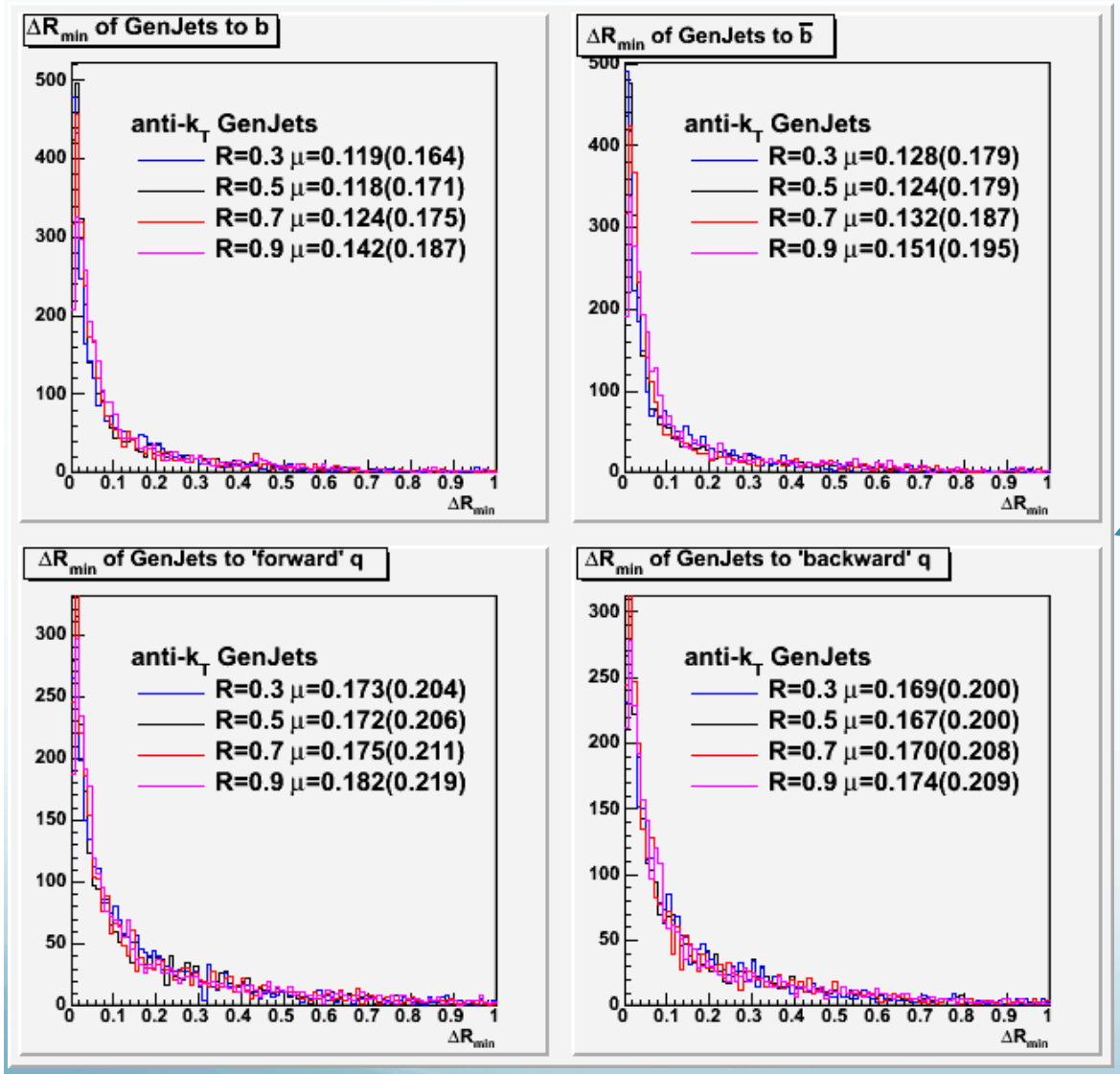
Max Δη


maxdelta_eta
maxdelta_eta
Entries 10000
Mean 4.404
RMS 1.576
Signal
QCD bkgd
250
200
150
100
50
0
0
1
2
3
4
5
6
7
8
9
10

Min $\Delta\eta$



Signal Jet Reconstruction

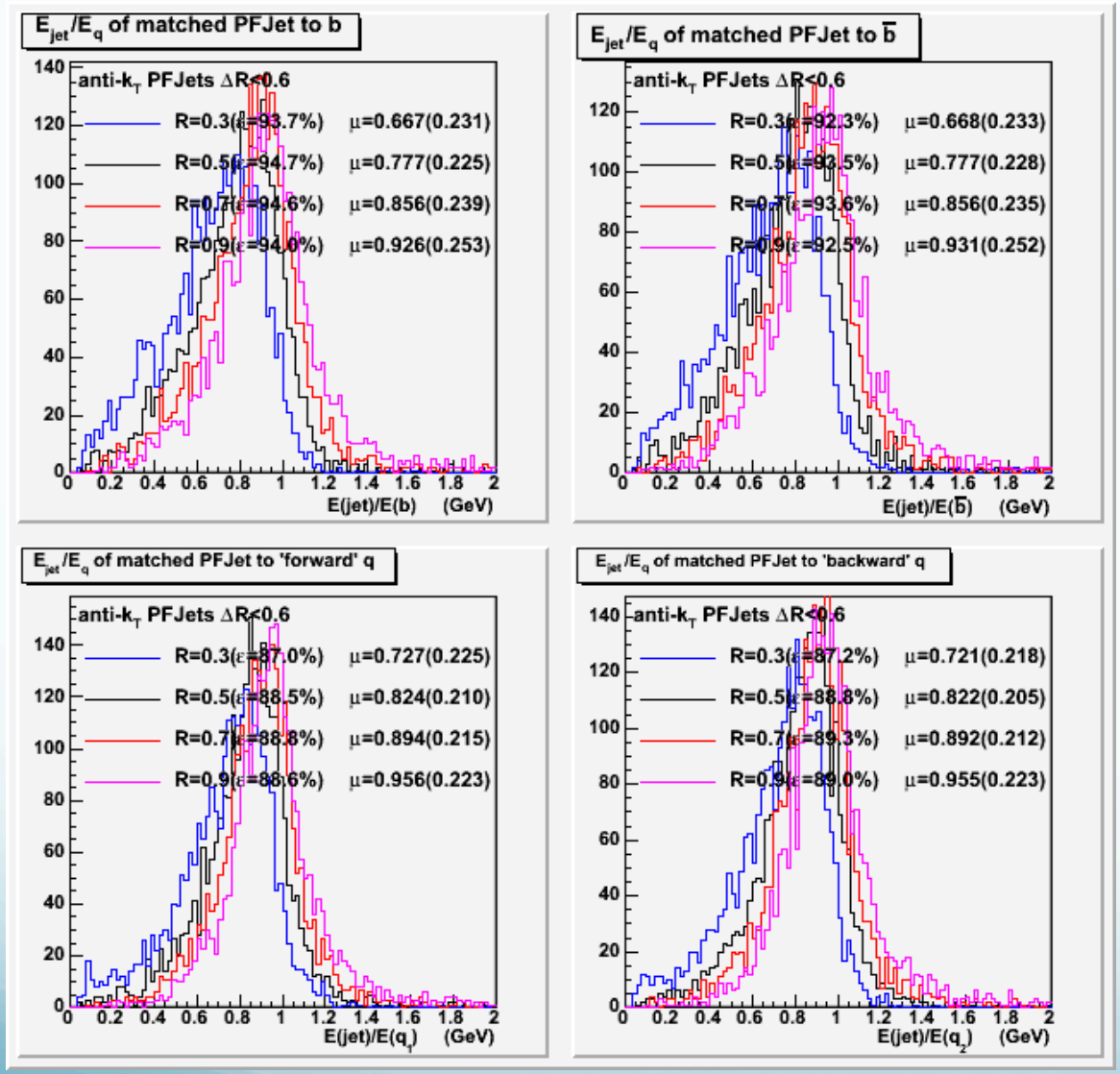


anti-k_T
R=0.3-0.5-0.7-0.9
GenJets, CaloJets, PFJets

quark – GenJet matching

loose inclusive matching with $\Delta R<0.6$

Signal Jet Reconstruction



signal PF Jets energy resolution

matched to signal partons with $\Delta R<0.6$

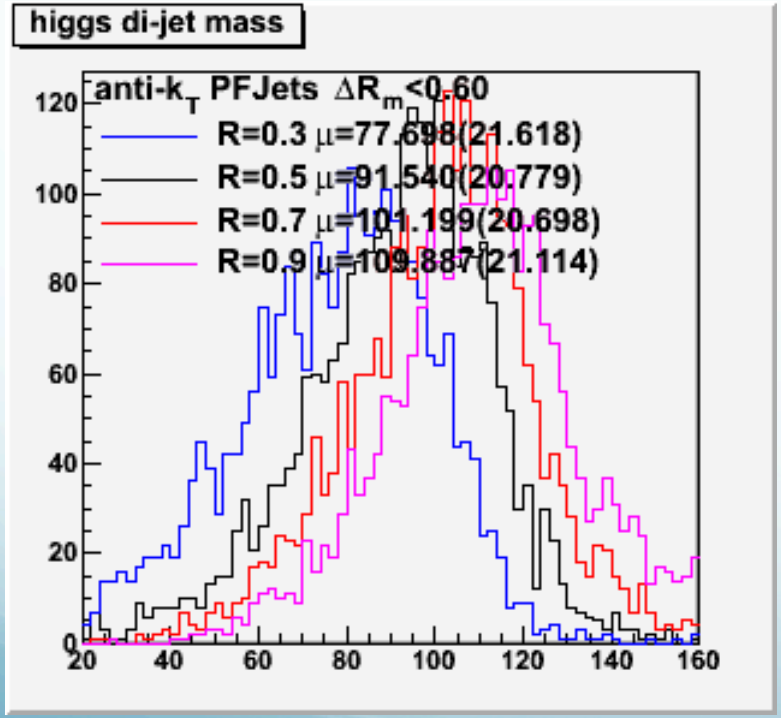
(uncorrected energies)

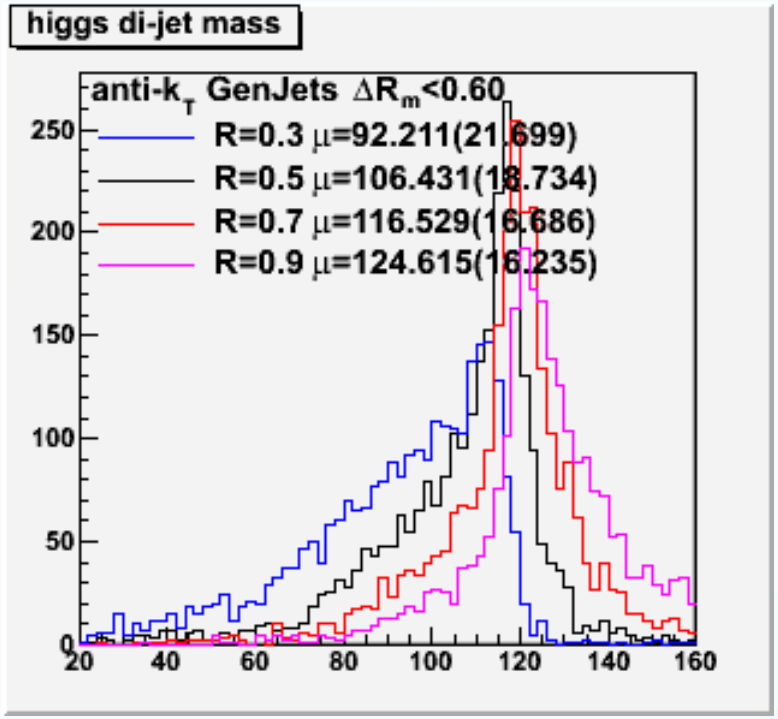
Best matching efficiency **and** energy resolution (σ / μ) for R=0.7 Jets !

Signal Jet Reconstruction

Higgs di-jet mass

Best resolution (σ / μ)
for R=0.7 Jets



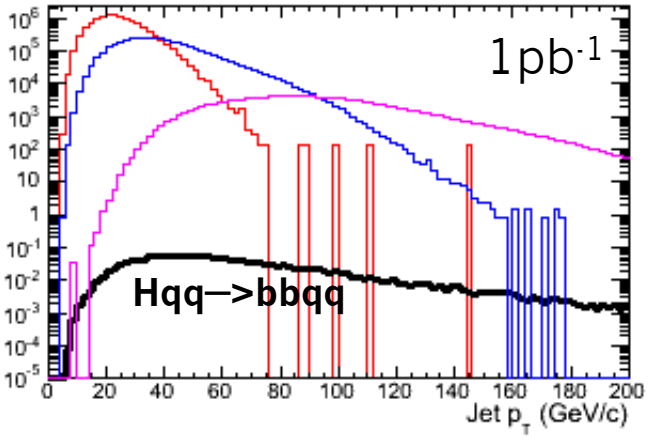


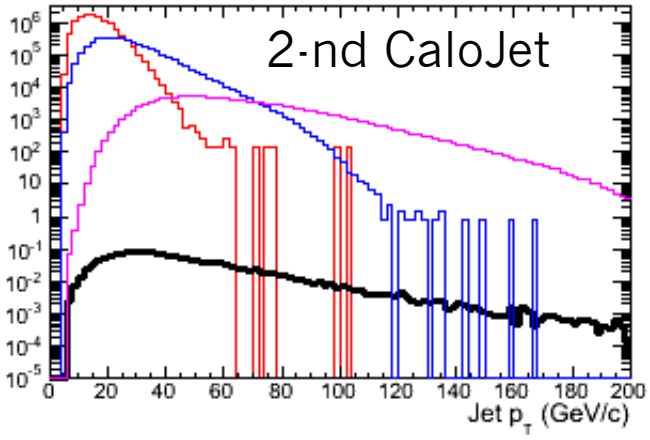
Signal vs QCD

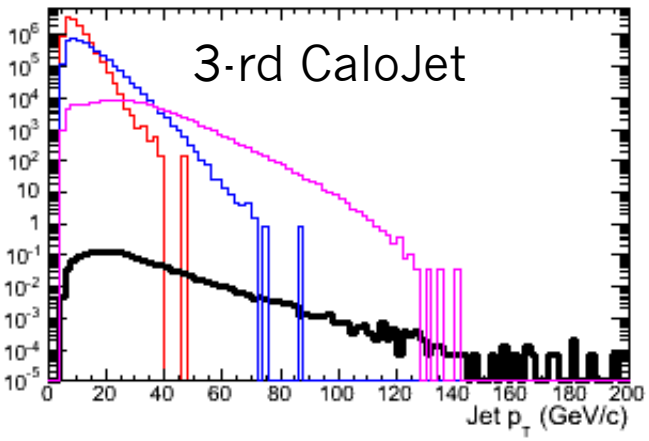
The Starting Point :

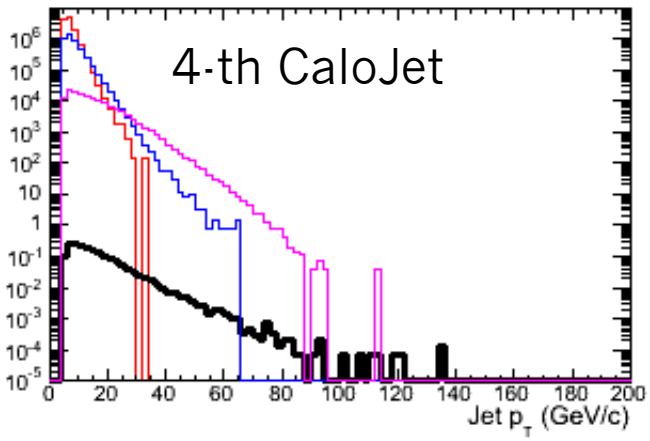
4 CaloJets p_T>5GeV

leading CaloJet









MadGraph QCD:
HT50To100
HT100To250
HT250To500

10 μb vs 2 pb

Trigger efficiencies

a possible plan for Hqq->bbqq

- L1_TripleJet14 ε_S=75.70 +- 0.15% (m_H=120GeV)

- HLT: p_T(jet1)>36 p_T(jet2)>28 p_T(jet3)>18 p_T(jet4)>7

(uncorrected CaloJets) ε_S≈51%

rate≈60Hz @1.7*10^32 (openHLT) ➔ <400Hz@10^33 (?)

then use HLT PFJets cutting on 4-jets p_Ts, invariant masses, …

reach ~5Hz

Trigger efficiencies

Adding a muon (from b/c decays H→ bb → μ X ~ 40%)

Pt (μ)> 3 GeV

signal	HT50_100	HT100_250	HT250_500	~28 Hz
14%	0.003%	0.27%	5.2%	

Pt (μ)> 5 GeV

signal	HT50_100	HT100_250	HT250_500	~16 Hz
10.9%	0.003%	0.14%	3.4%	

Pt (μ)> 9 GeV

signal	HT50_100	HT100_250	HT250_500	~8 Hz
6.6%	0.0015%	0.06%	1.8%	

Plans

- Study a possible dedicated HLT selection for high lumi data taking using the full CaloJets kinematics information

- After the HLT selection plan to use a MVA signal/background discrimination approach with 4-jet kinematics, b-tagging and gluon tagging observables.