HHZ production at 3 TeV CLIC

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HHZ at 3 TeV

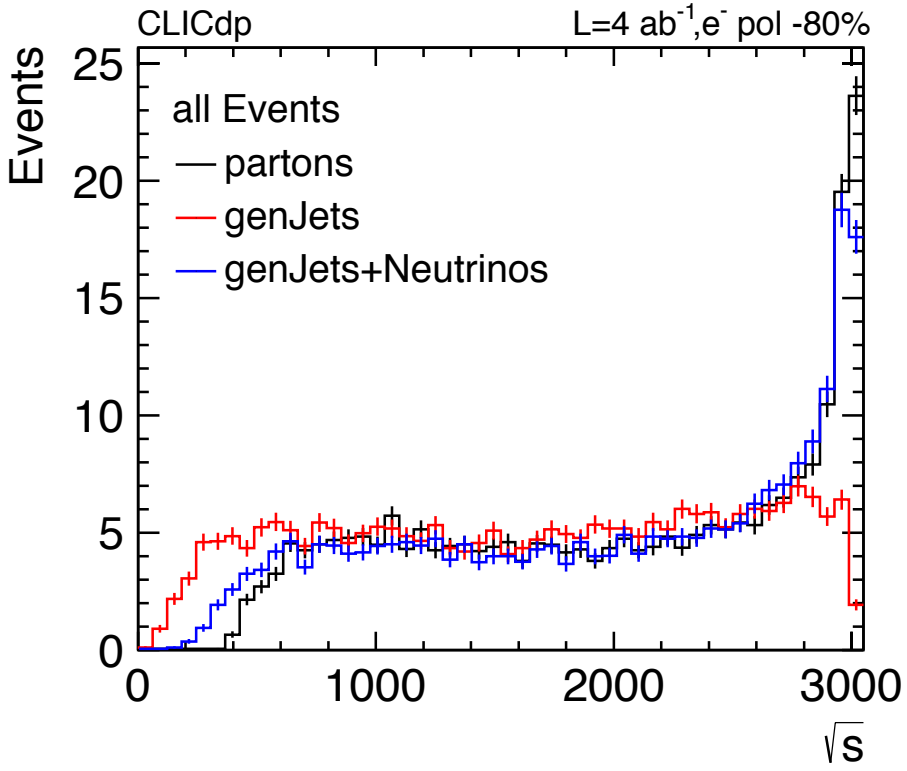
Concentrate on HH Z →bb bb qq:

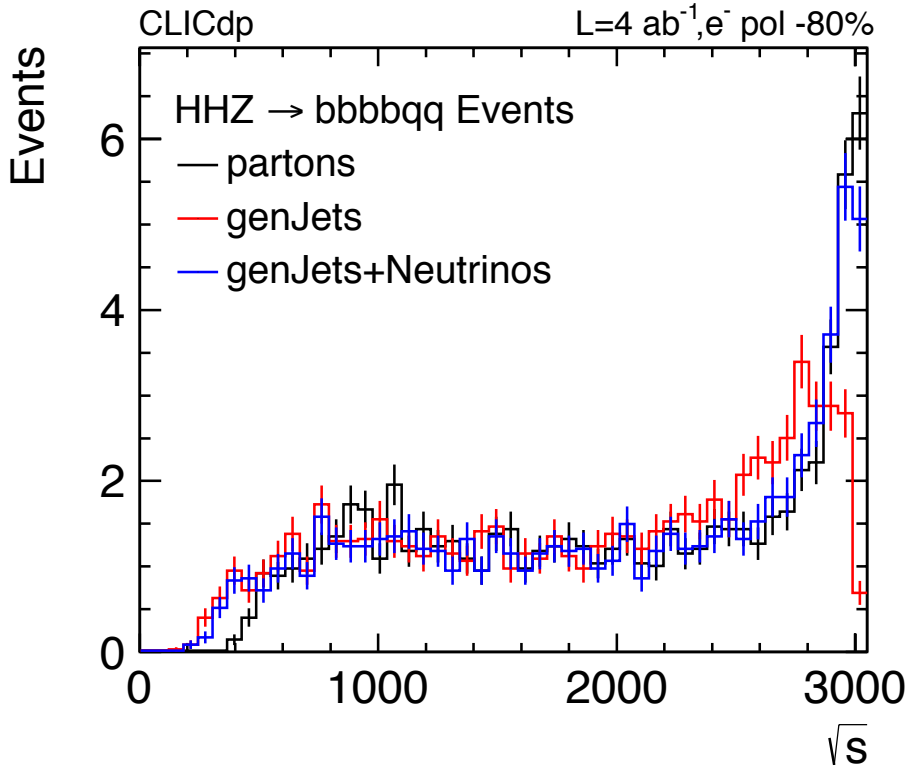
Full hadronic signature, very low statistic:
Total cross section: 6.6e-2 fb^{-1} for -80 % electron beam polarisation
→242 events in total
→ 68 in bb bb qq final state
New sample with HHqq in works, leaves out lepton and neutrino decays, and doesn't reduce width of Z

For +80 % electron beam polarisation:
Cross section: 4.23e-2 fb^{-1}
→ 42 events in total
→ 12 events in desired phase space

Scale of events: sqrt(s)

Partonic √s vs sqrt(s) based on generated jets (use all visible particles): VLC10 in exclusive mode: Njet=3





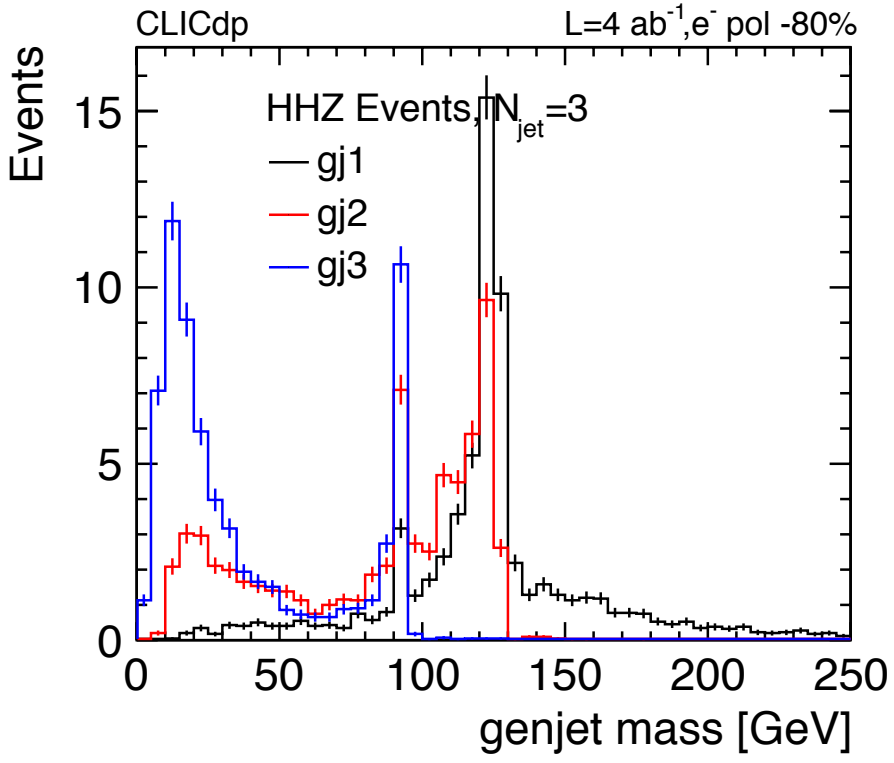
Adding Neutrino vector on genjets recovers parton sqrt(s) → all Events include decays of H→WW and H→ZZ

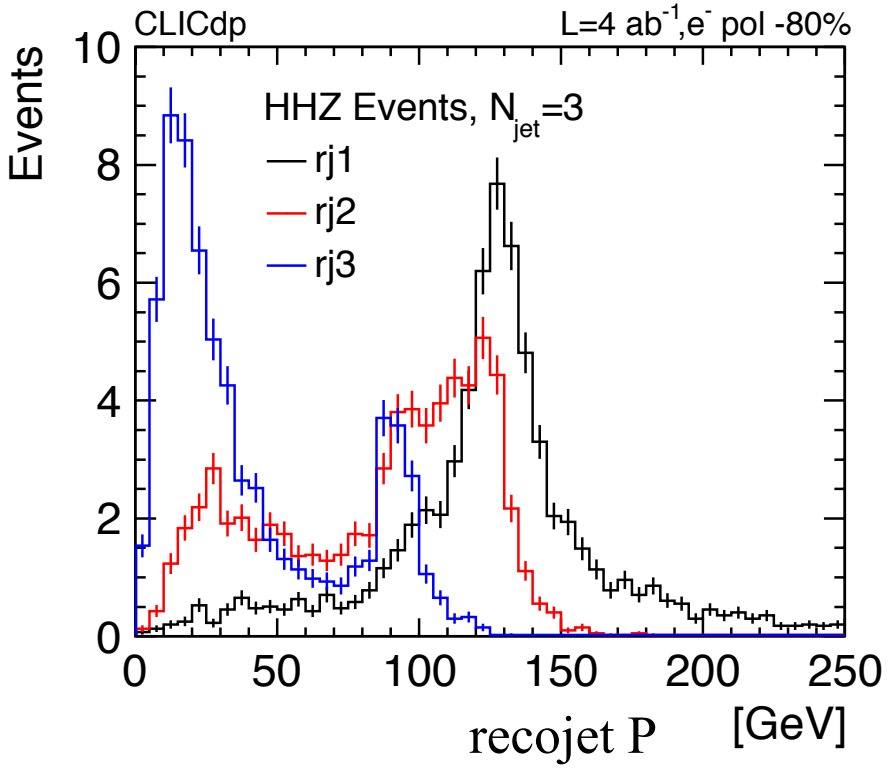
Neutrinos still play a role for total energy reconstruction in bbbbqq events, but to less extend

Jets

Last Time: Jet Masses

Study VLC Jets, γ=β=1.0, radius R=1.0, run in exclusive mode with N=3





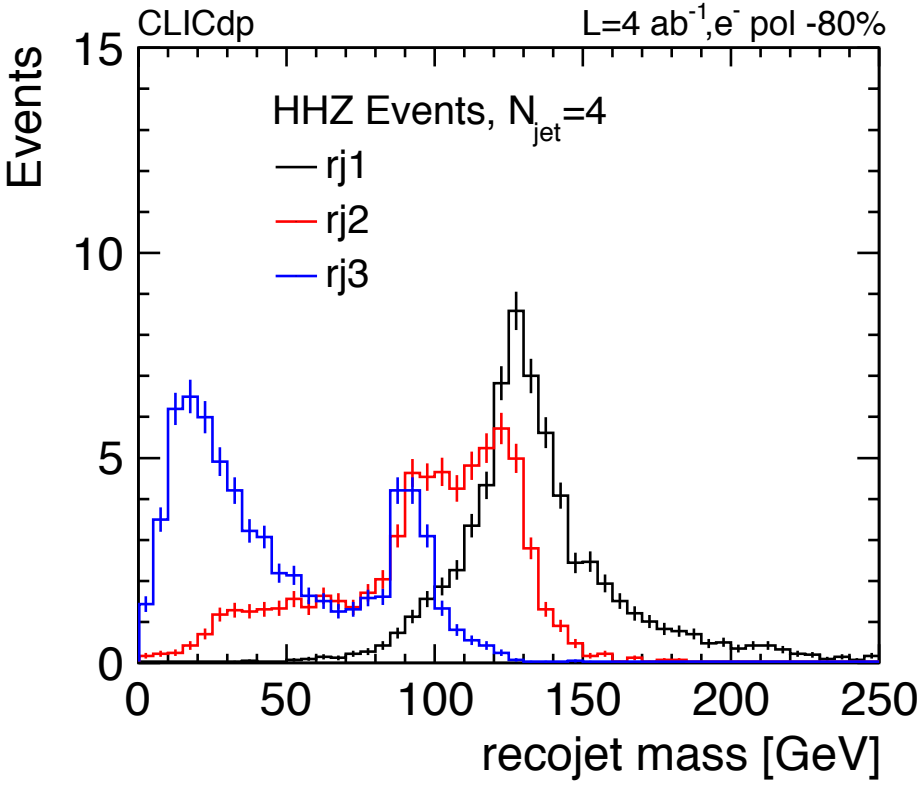
Clearly the jets are more smeared on reconstructed level, often on reconstructed level (already on particle level jets), third jet does not contain Z properly

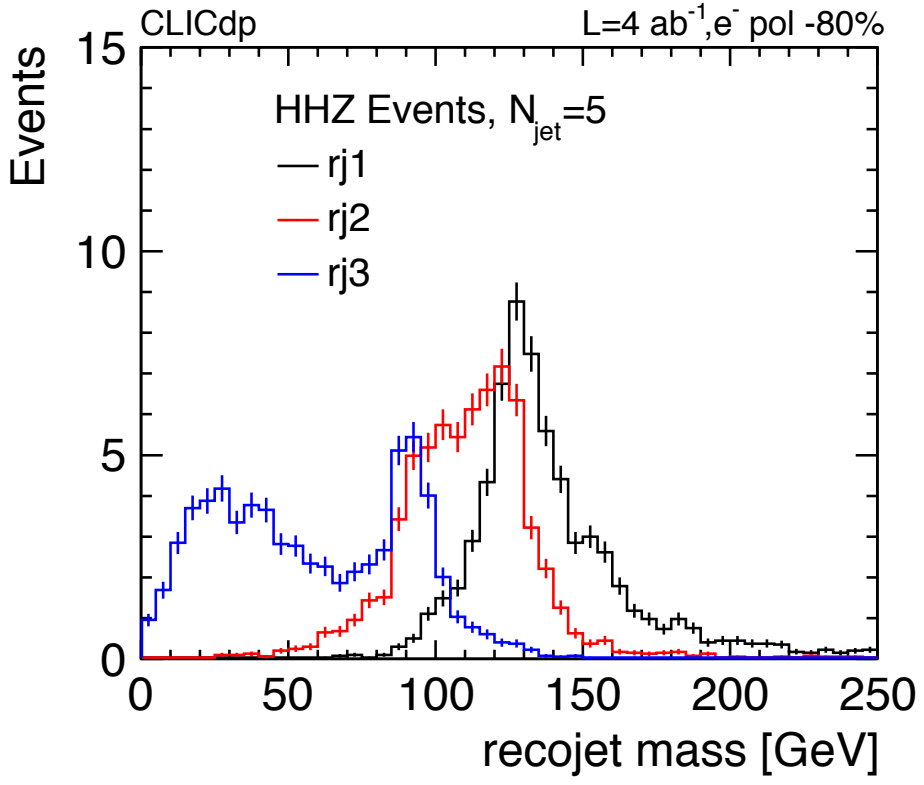
→ Second jet affected by the issue as well

Idea: increase number of jets

Start with 4, then increase number to 5, then to 6 jets: concentrate on VLC10 jets

→ Combine jets into 3, minimizing sum= $(rj(x)-m_H)^2 + (rj(y)-m_H)^2 + (rj(z)-m_Z)^2$





Reconstruct 4 and 5 jets, combine this → clear improvement, lower tail for second and largest mass jet disappears when going to 5, still sizable tail for lowest mass jet

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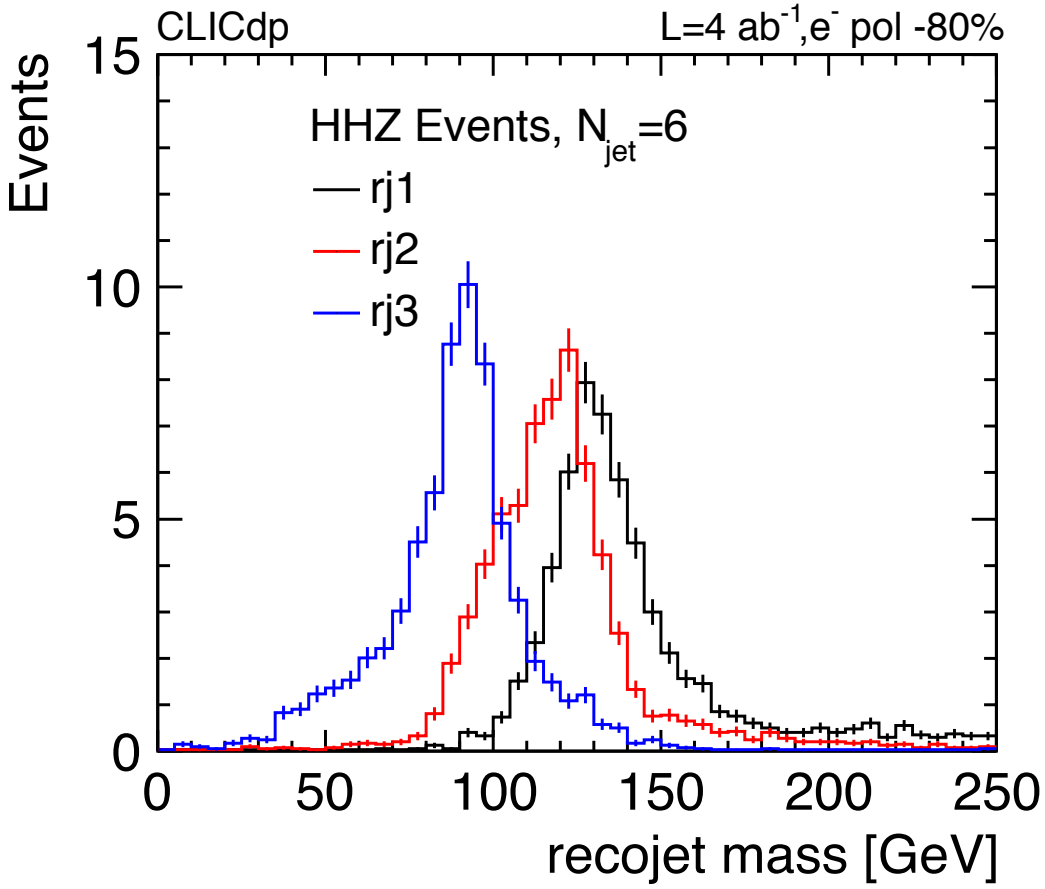
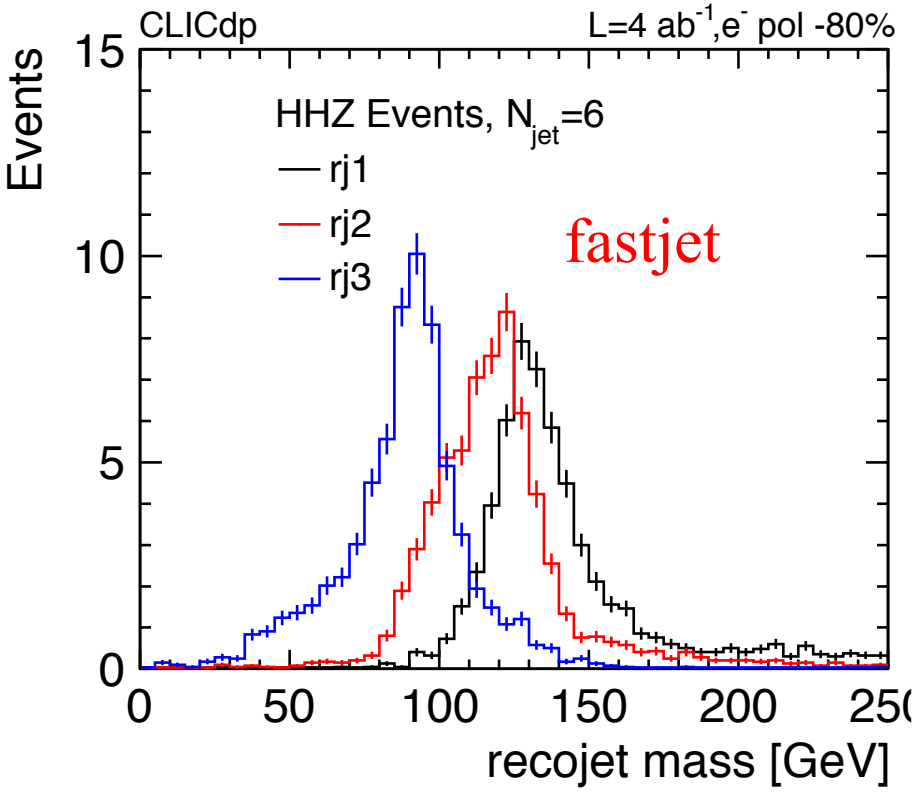
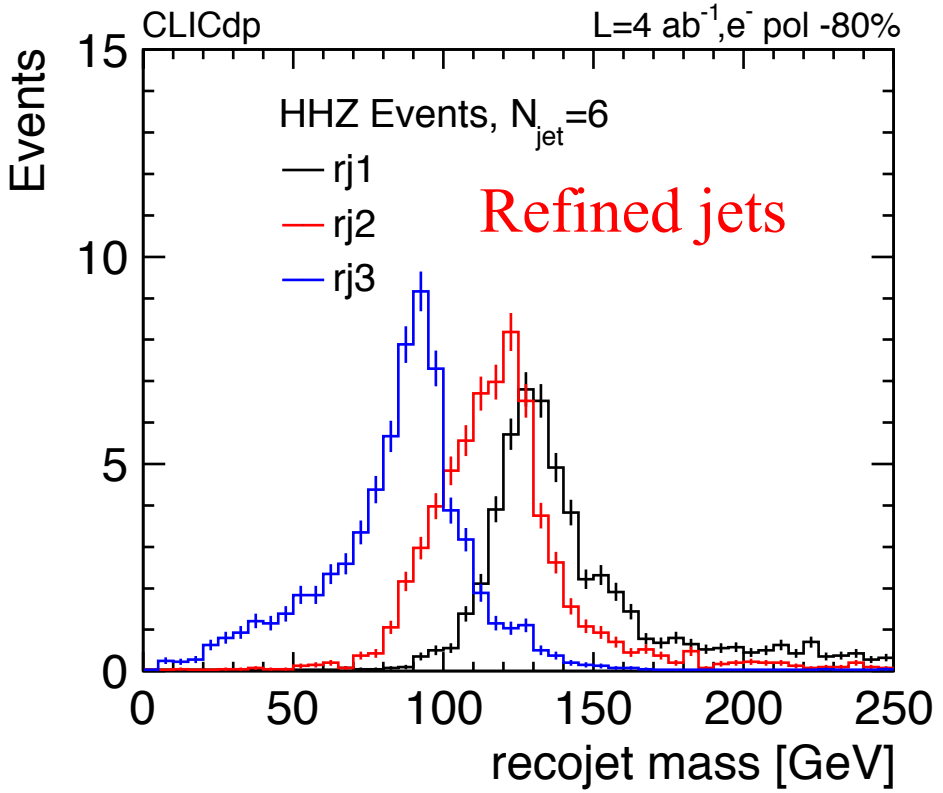


Only when going to 6 jets the low tail of reconstructed jet masses disappears for lowest energy jet, at cost for tail of highest jet

Btagging Issue: use refined instead of FastJet jets

How to best merge information from BTag jets: LCFIPlus saves info in refined jets, but then merging to FastJet VLC jets →possibly using refined jets instead

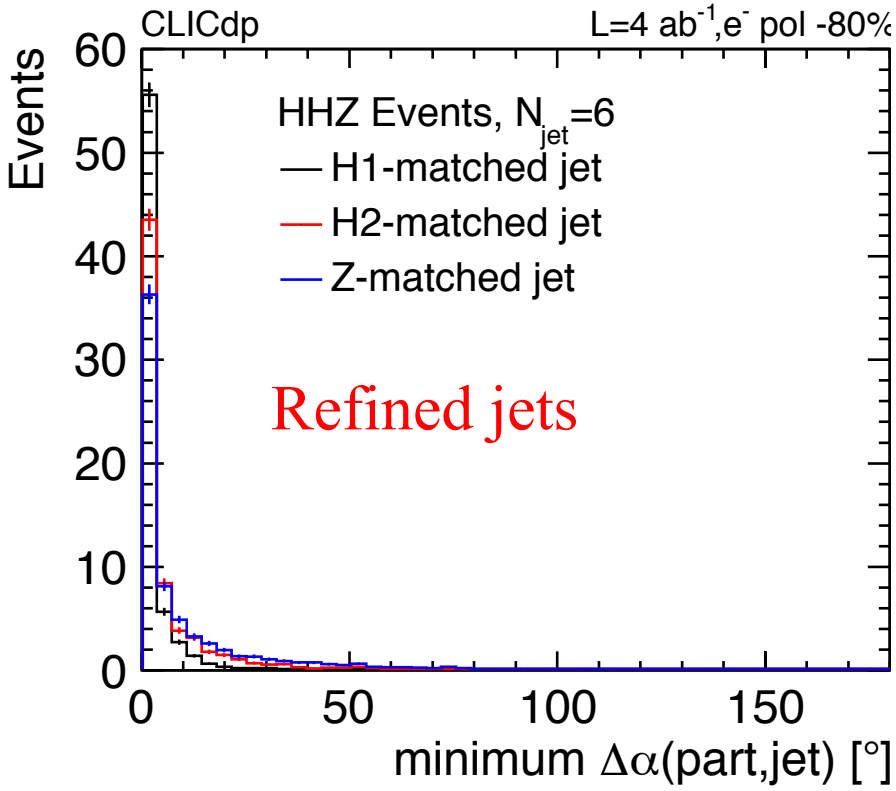


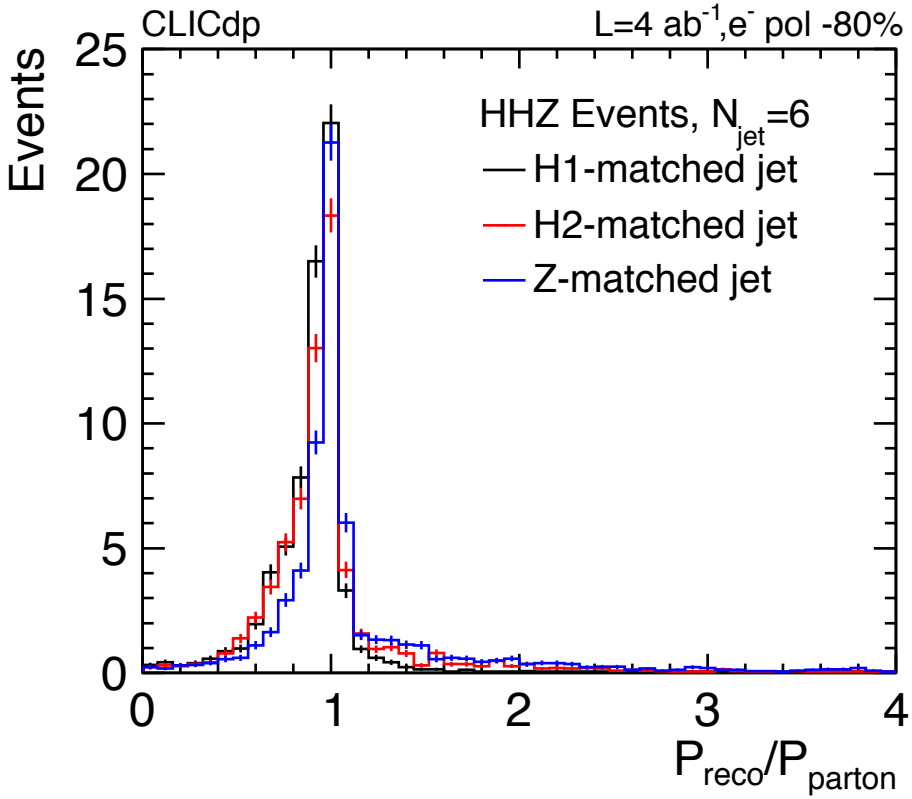


Refined jets slightly less good, but not that far different

Is the combination correct: parton matched to jet

Compare angle between partons and closest reconstructed jet (after combining 6 jets into 3)

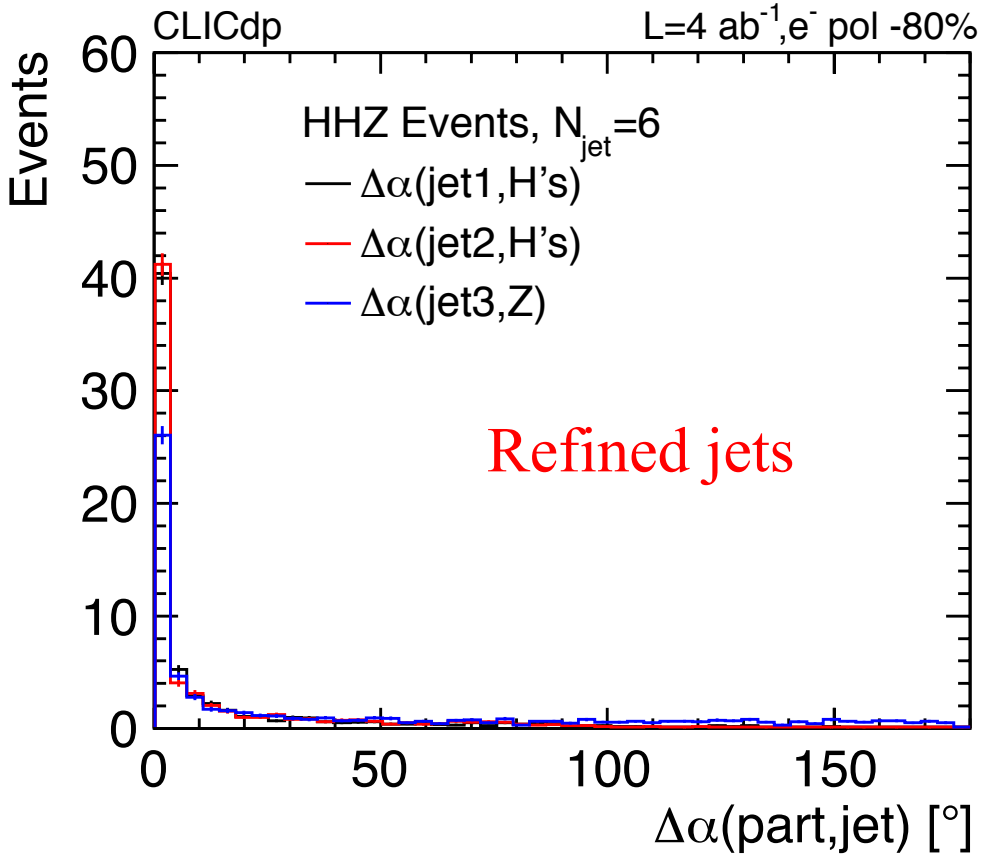




Energy not totally off, Z-jet includes less B hadrons → response peaked slightly more
→ Get often correct jet, and energy pretty decently reconstructed

Assign combined jets to correct parton

Hypothesis: Leadings combined jets (larger reconstructed masses) originate from H bosons, third jet (after combination) originates from Z

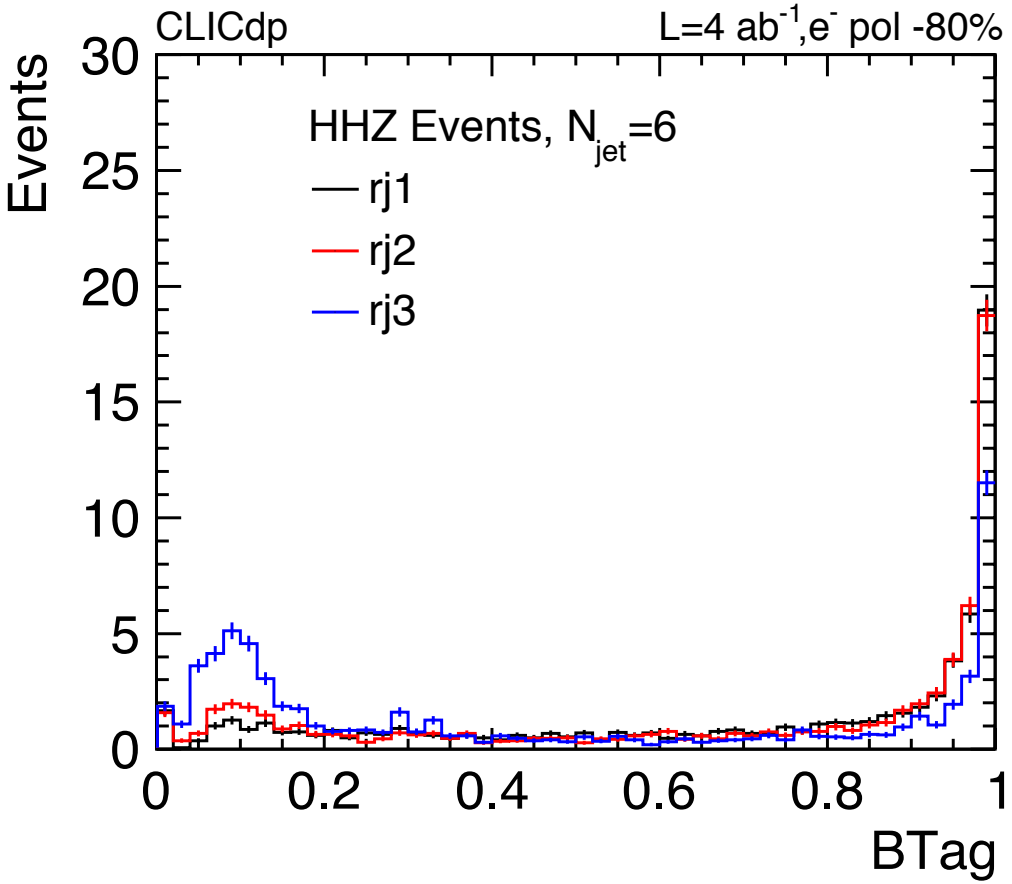


Decent assignment for H boson hypothesis, similar for both jets

Z jet direction more off, but still decent enough

BTag information from refined jets

BTag information for reconstructed jets: consider maximum BTag from the two jets used in combination



Very similar BTagging distributions for leading jets (in mass), assigned as H-jets, third leading jet far more values with low BTag values (consistent with Z hypothesis)

Different use of B-tagging information

At times issues assigning refined VLC jets (BTag info) and FastJet VLC Jets
→ it can happen that a refined jet is a combination of two original VLC jets, since vertex jets are first combined and then used as seed in refiner step

Known effect of B-decays: Sizable tail to lower values in momentum and mass of reconstructed jet → mass ordering might be flipped
→Use BTag information in combination instead
It can happen that only one of two jets from H has a high BTag value

Result of check: worse performance
→angular matching between jets and partons less good, mass distribution and energy distribution has larger tails

Summary

Not really a boosted analysis anymore

- Combining 6 jets into 3 jets gives far superior performance compared to using 3, 4 or 5 jets

Using refined VLC jets instead of FastJet VLC leads to slight degrading of mass reconstruction and energy reconstruction, but with the benefit of correctly assigned Btag information

Using B-tag information for jet combination: worse performance in every respect → use 6 refined jets, but combine them into 3 objects, using only mass information as default