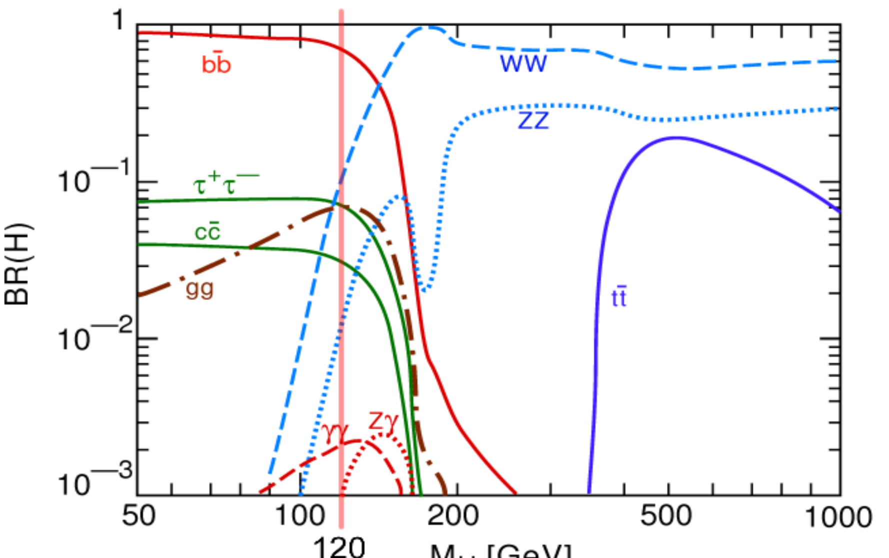
Comparison of different Particle Flow Algorithms

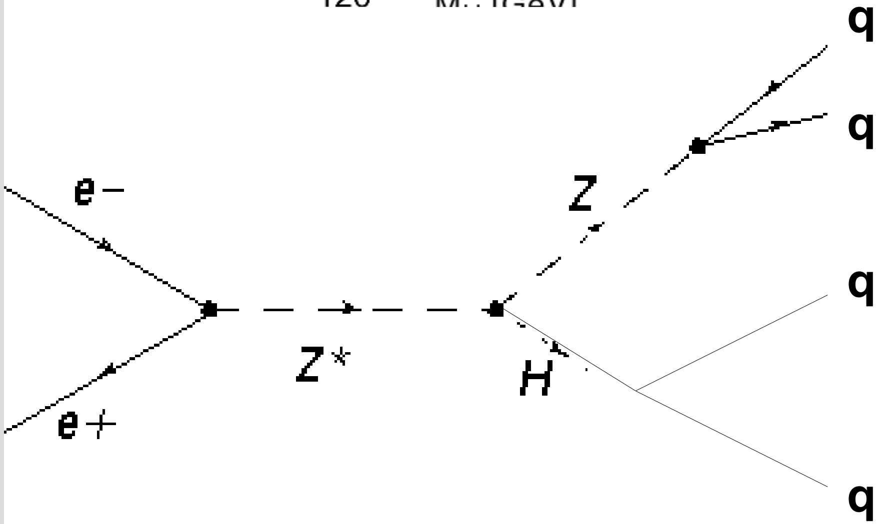
first preliminary results:

introduction
physics process & simulation
reconstruction & analysis
preliminary results

Physics Process

- Higgssthralung, higgs with mass = 120 GeV
  - Z decays mostly hadronicaly -> 2 jets (~10% into leptons excluded)
  - h decays mostly hadronicaly -> 2 jets
- final state topology: 4-jet events
  - inv. mass of 2 jets – Z mass
  - inv. mass of other 2 jets – h mass





Signal Sample

- Higgssthralung generated with PYTHIA
- detector response simulated with Mokka
- reconstruction done using Marlin
  - digitalization
  - Track Cheater
  - various PFAs
- analysis done using Marlin & ROOT
- center-of-mass energy: 500 GeV
- full detector simulation, LDC00 model
- long process, done using GRID (big thanks to Dennis :)
  - Satoru jet finder using Particle Collections from different PFAs
  - RAIDA

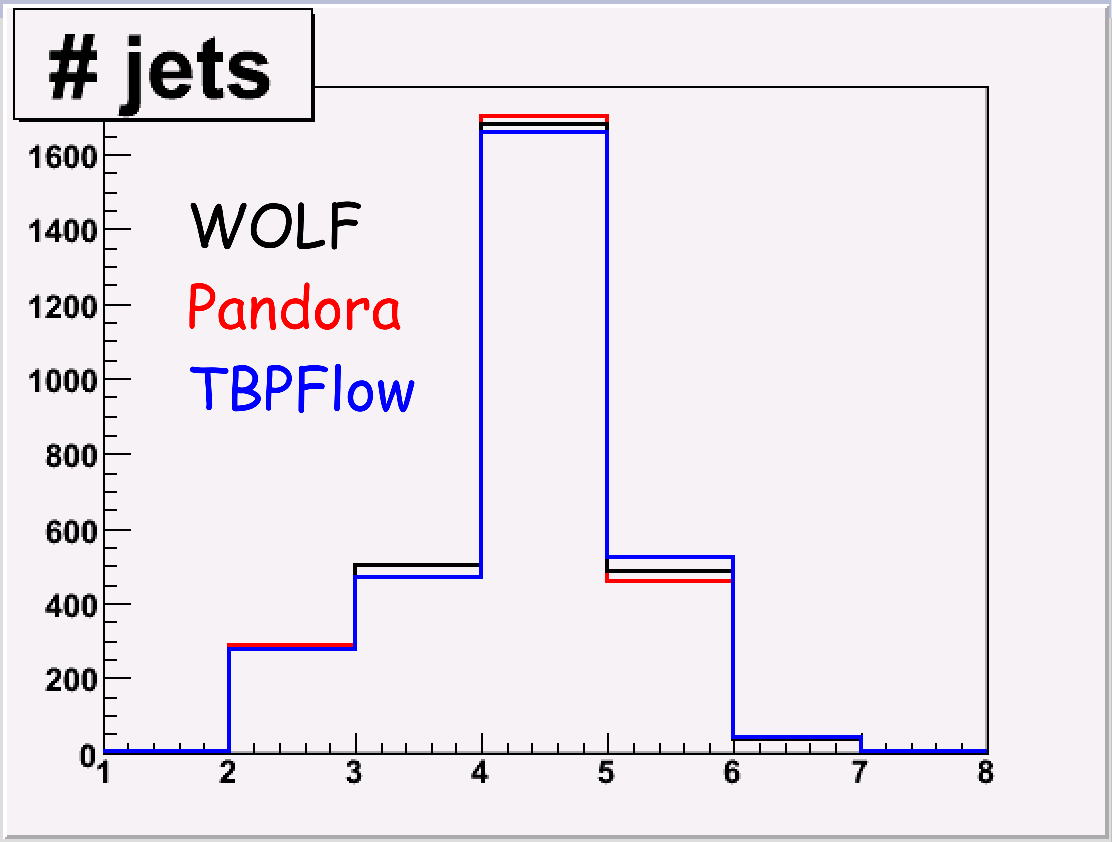
Particle Flow Algorithms

- WOLF (author A. Rasparenza)
- PANDORA (author M. Thompson)
- TrackBasedPFAlgorithm (author O. Wendt)

- cluster-based particle flow algorithm (PFA)
- cluster-based PFA but using track information as well
- track based particle flow ;)
- tuned for 250 GeV CME
- ***for details on PFAs check dedicated talks!***

Jet Finding

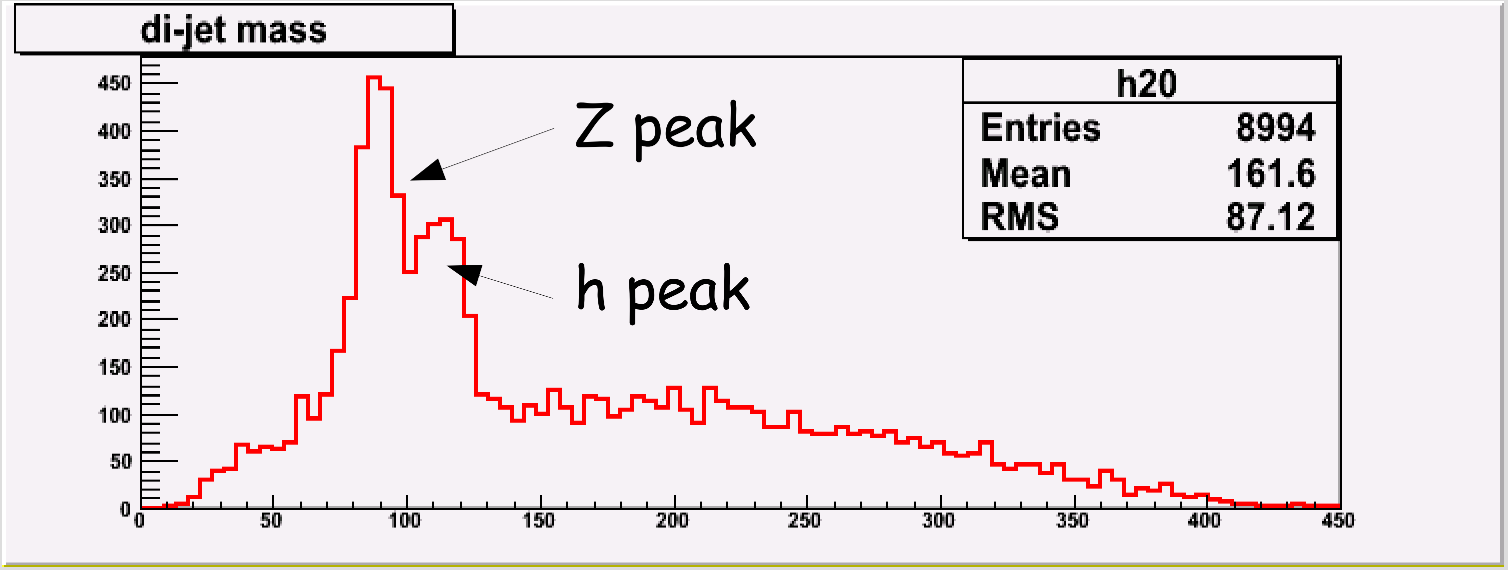
- Satoru jet finder used - Marlin processor
  - creates new *ReconstructedParticles*
  - uses Durham algorithm
  - can be used with variable y cut if forced to n-jets
  - can be used with fixed y cut
- in this analysis y cut tuned to get best ratio of 4-jet events (as expected from process topology)



- only 4-jet events used
- v. similar #jets distribution
- 4-jet reconstruction efficiency - about 50%

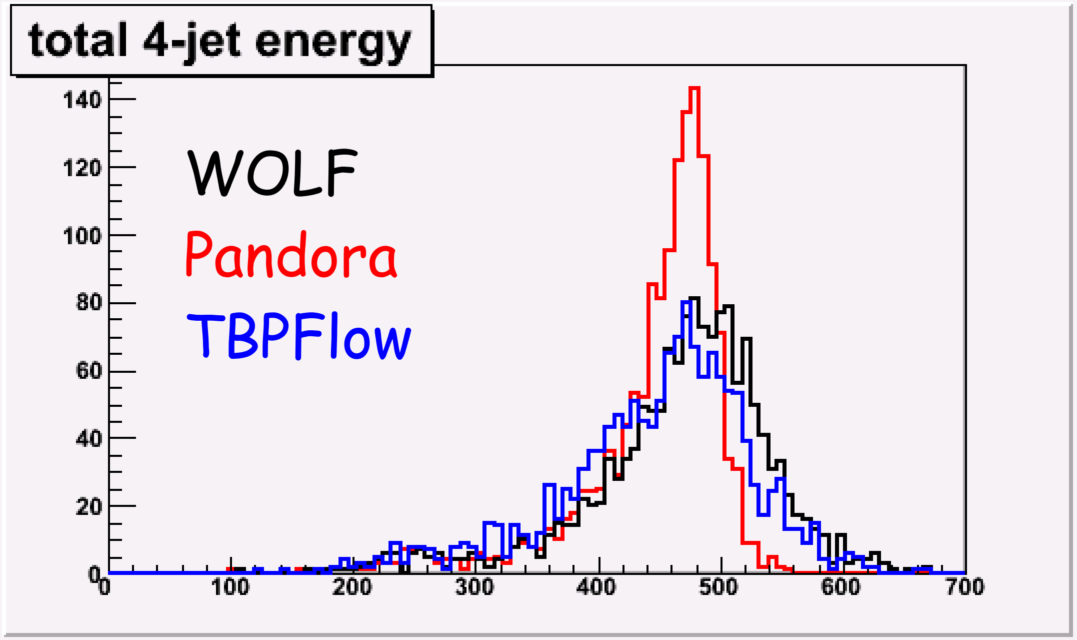
Jet Invariant Mass

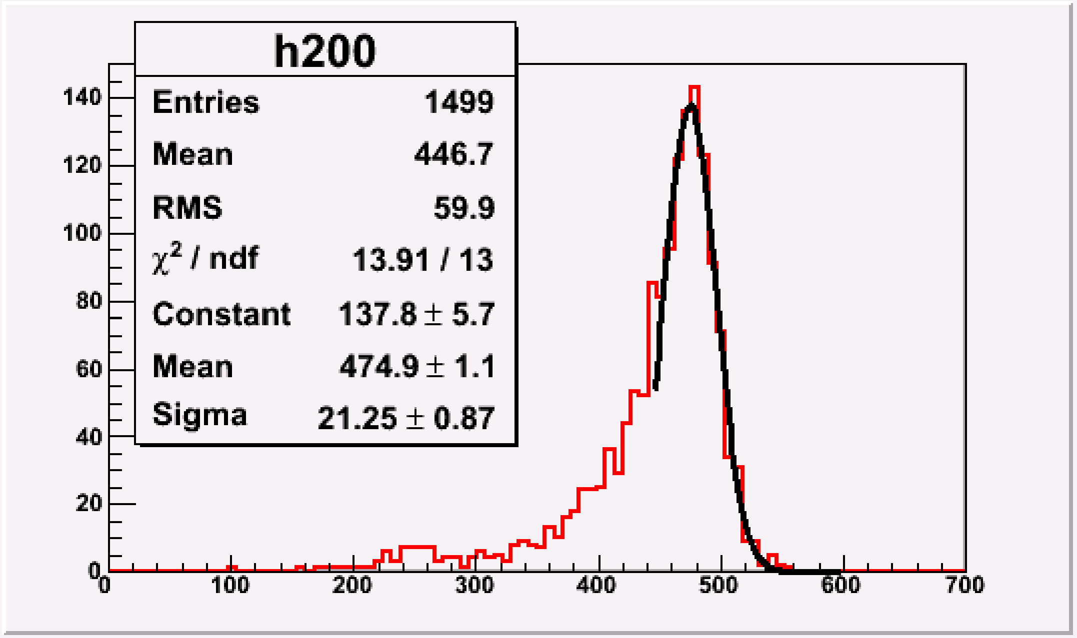
- 4 final state particles -> 4 jets -> 6 combinations of di-jets -> big, wide combinatorical background, Z and h together



- do constrained fit (energy&momentum conservation) with 1 di-jet mass constrained to Z (not done yet)
- take only 3 di-jet combinations, smaller di-jet mass assumed to be Z, bigger mass assumed to be h (this analysis)

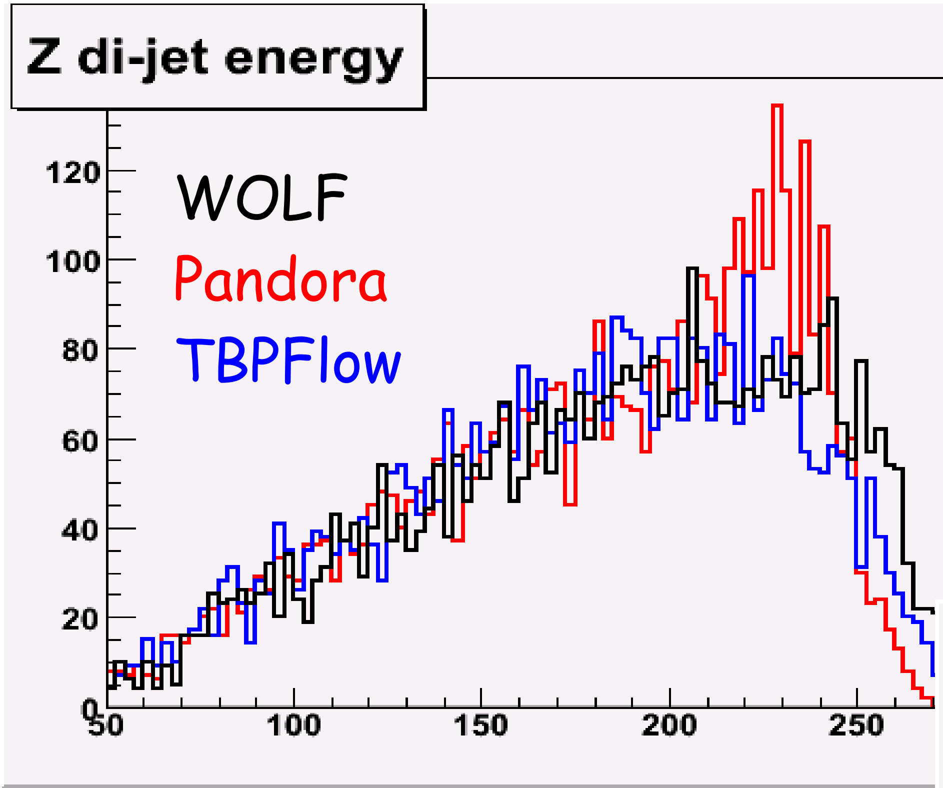
Total 4-Jet Energy



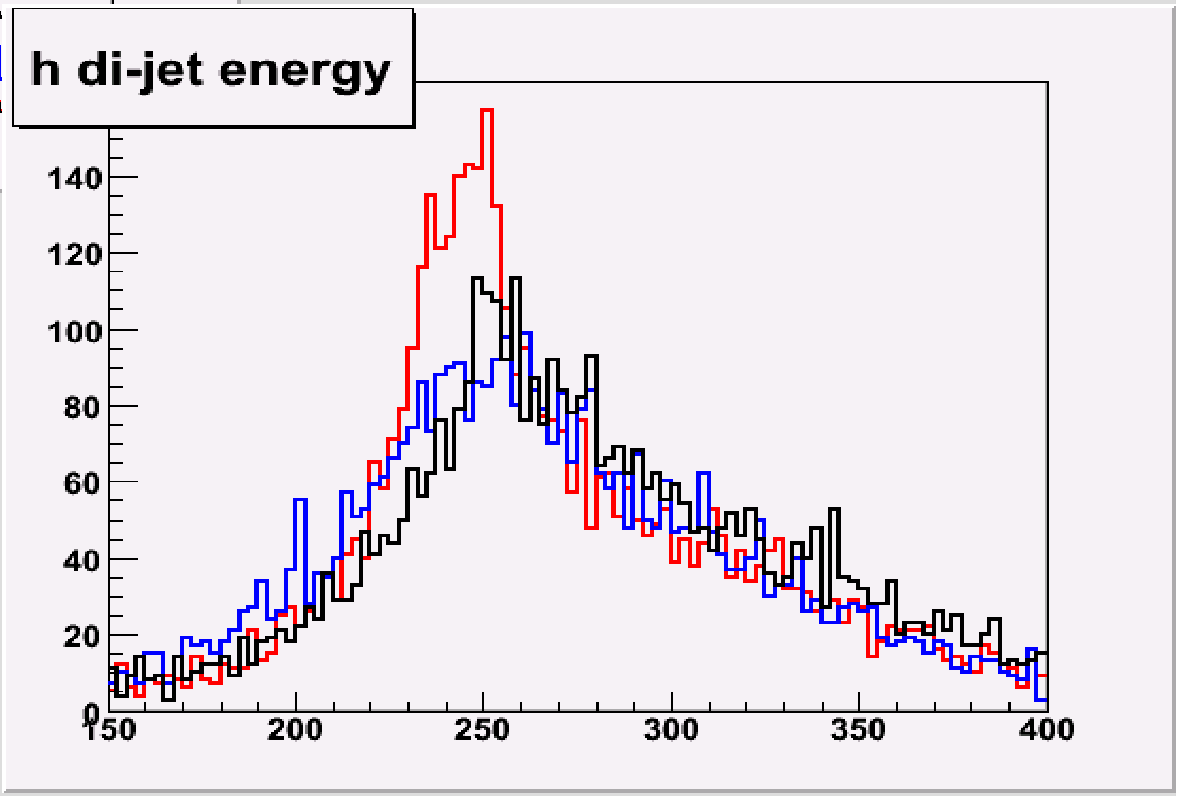


- Pandora total 4-jet energy narrowest
- WOLF and TBPFlow comparable
- energies a bit shifted
- ISR & beamsthralug losses visible

Z and h Di-Jet Energy

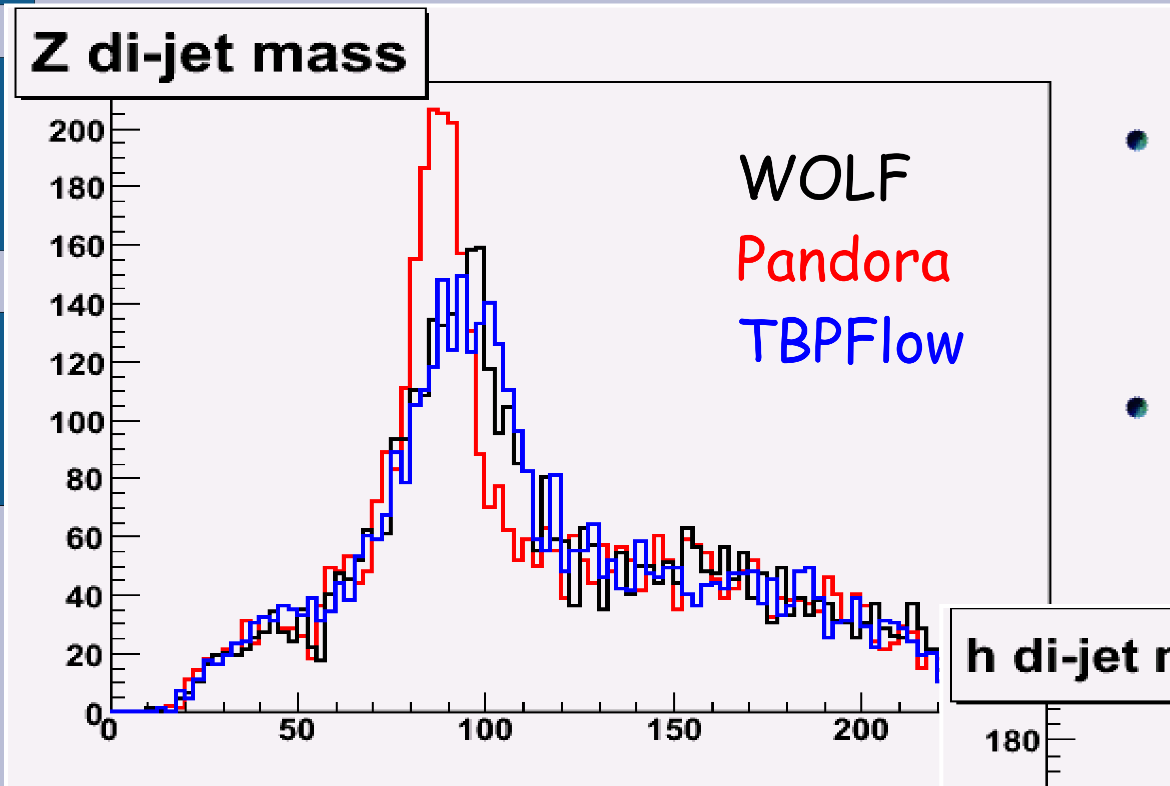


- Pandora and TBPFlow – no visible Z-energy peak
- Pandora – also wide but peak visible
- combinatorical background

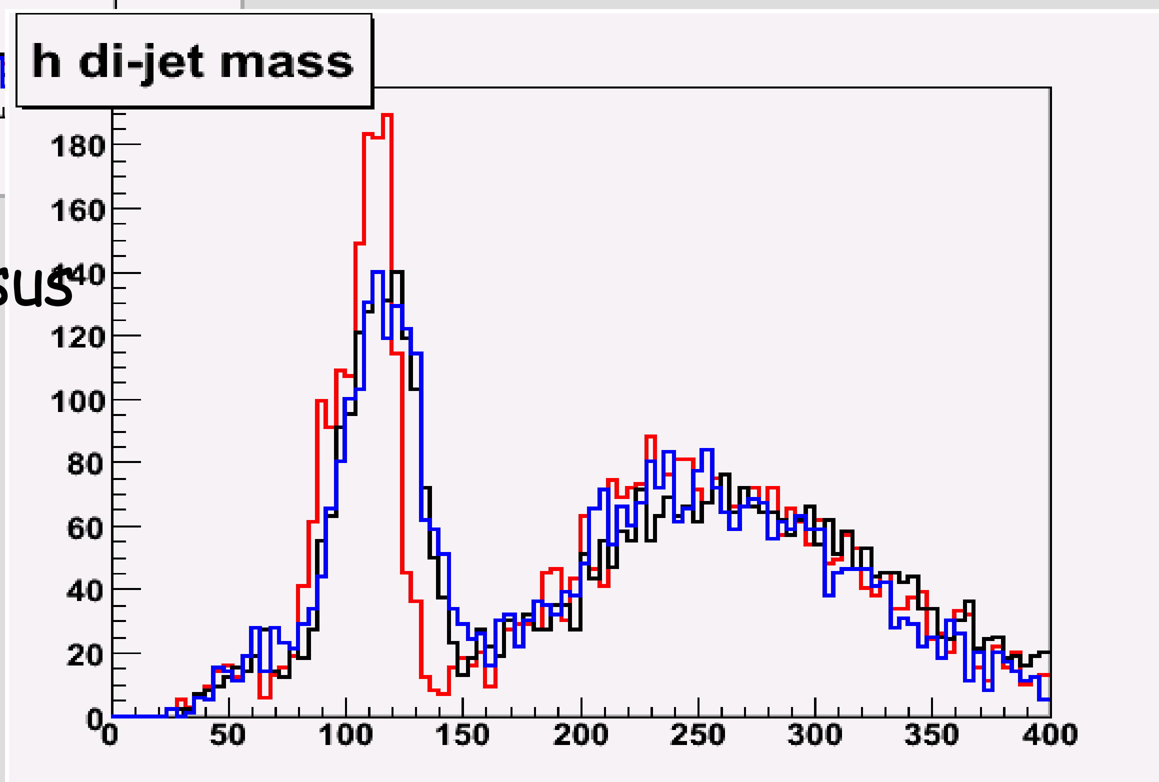


- Pandora h-energy shifted versus WOLF & TBPFlow Z-energy
- Pandora "slimmest", TBPFlow widest

Z and h Di-Jet Mass

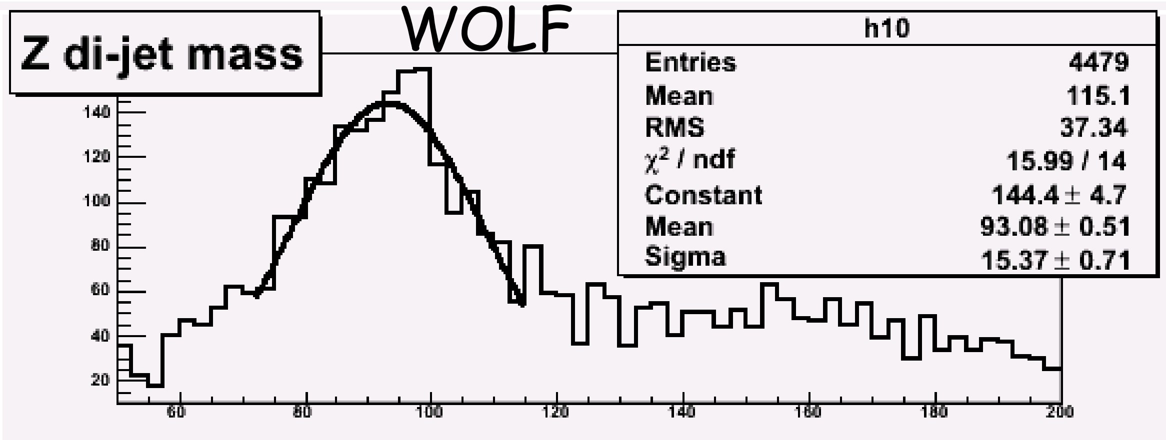


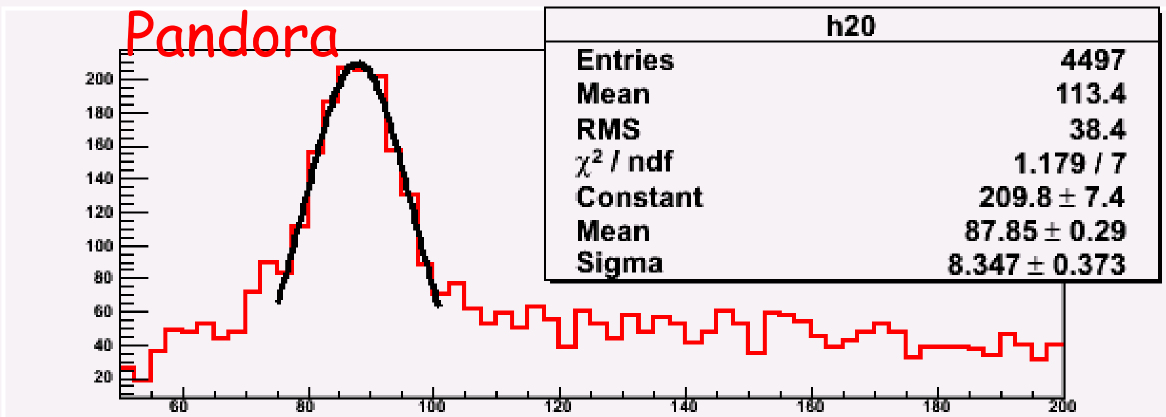
- Pandora Z-mass shifted versus WOLF & TBPFlow Z-mass
- Pandora narrowest, clear difference

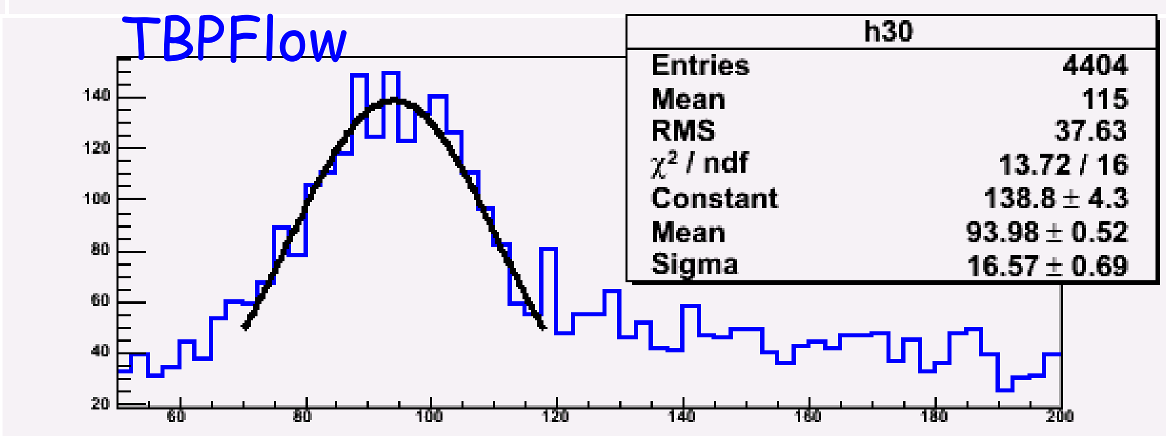


- Pandora h-mass shifted versus WOLF & TBPFlow h-mass
- Pandora “slimmest” but differences not so big

Z Di-Jet Mass

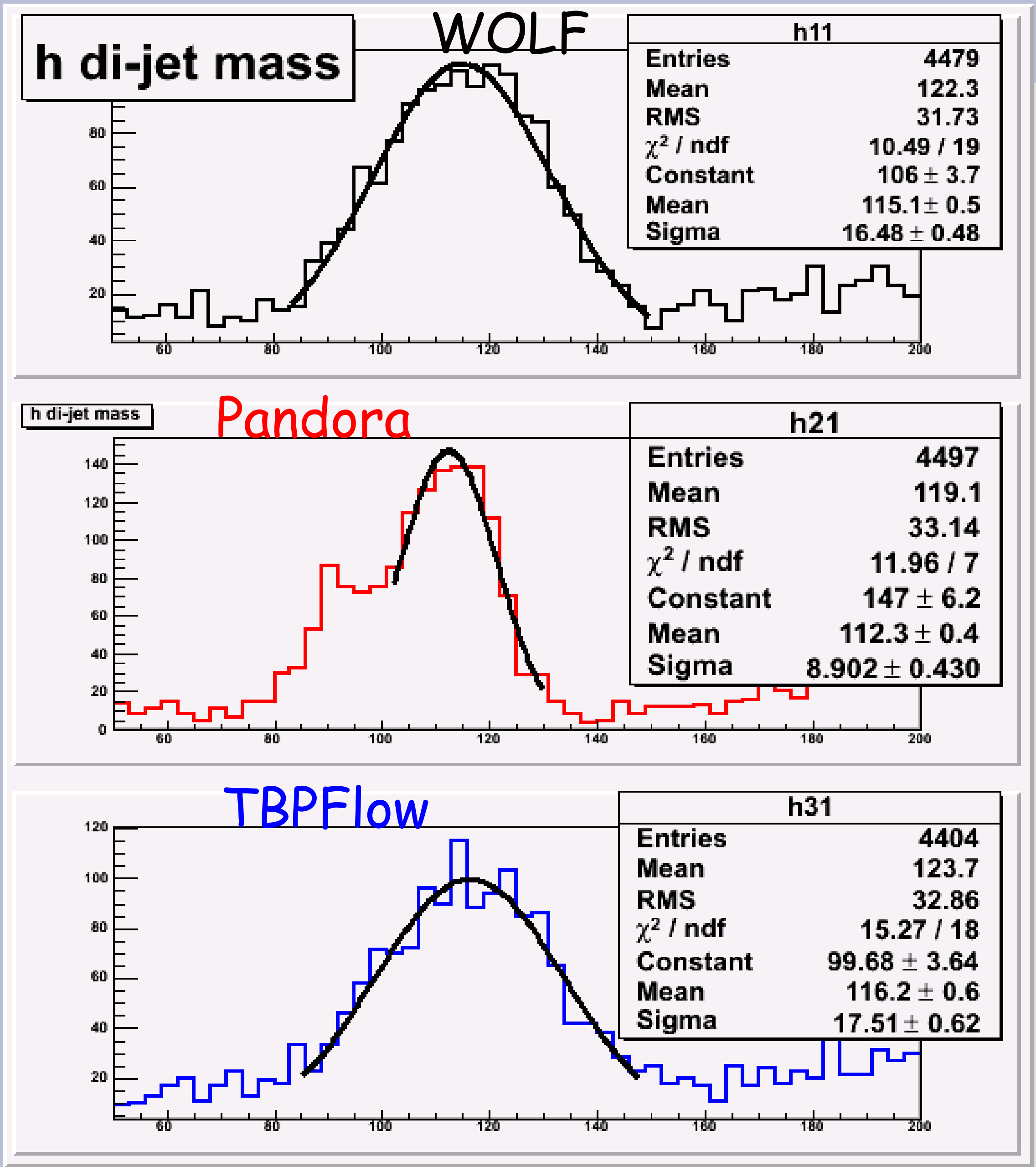






- WOLF & TBPFlow overestimate Z mass, Pandora underestimates
- Pandora norrower by a factor of 2
- flat (wide)combinatorical background
  - can be reduced by using constrained fit (energy, momentum, Z-mass constrains)

H Di-Jet Mass



- second small peak for Pandora (from Z? too close?)
- h mass too small for all PFAs
- Pandora narrowest(but with extra peak), WOLF & TBPFlow comparable
- Pandora behavior needs more studies

Summary & Conclusions

- 3 different PFAs were studied using jets from ZH @ 500 GeV
  - cluster based (WOLF)
  - track based (TBPFlow)
  - mixed (Pandora)
- Pandora shows best behavior, others can be tuned (probably)
- need more studies (ex. proper constrained fit for invariant mass distributions)