

Is there a chance to
identify HHZ \rightarrow 10 jets ?

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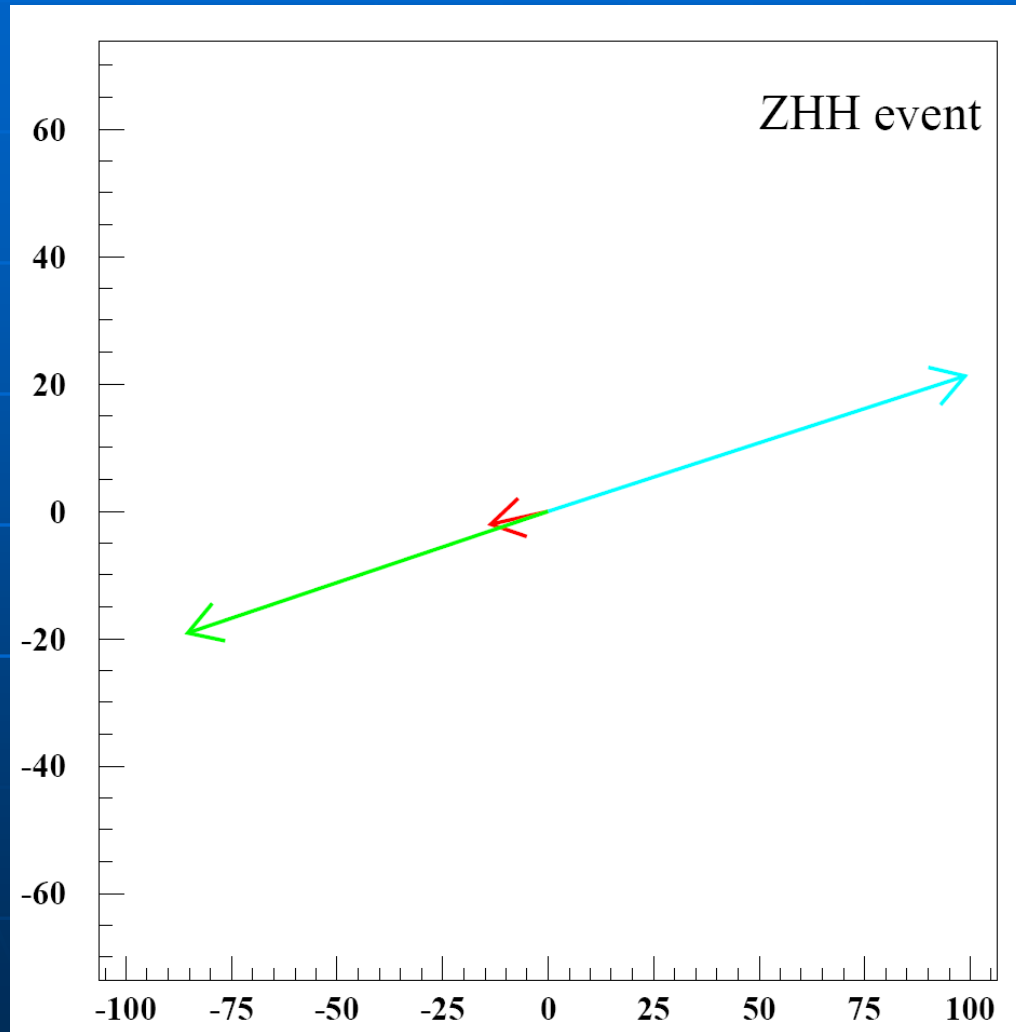
The context

- Since long, we have been asked to look for triple Higgs couplings in the case of $H \rightarrow WW$
- It means that a HHZ event is a 10 fermion event !
- My first argument against such a study was a generator concern : there is no 10 fermion generator !
- This is not a valid argument

Combinatorics

- A second argument relies on combi.
- With 10 jets, there are 4725 ways to form 5 bijets !!!
- Yes, but 10jets is only 15% of Z4W
- So, one should explore also the cases with 1 lepton and 8 jets, and also 2 leptons + 6 or 8 jets

Let's try !

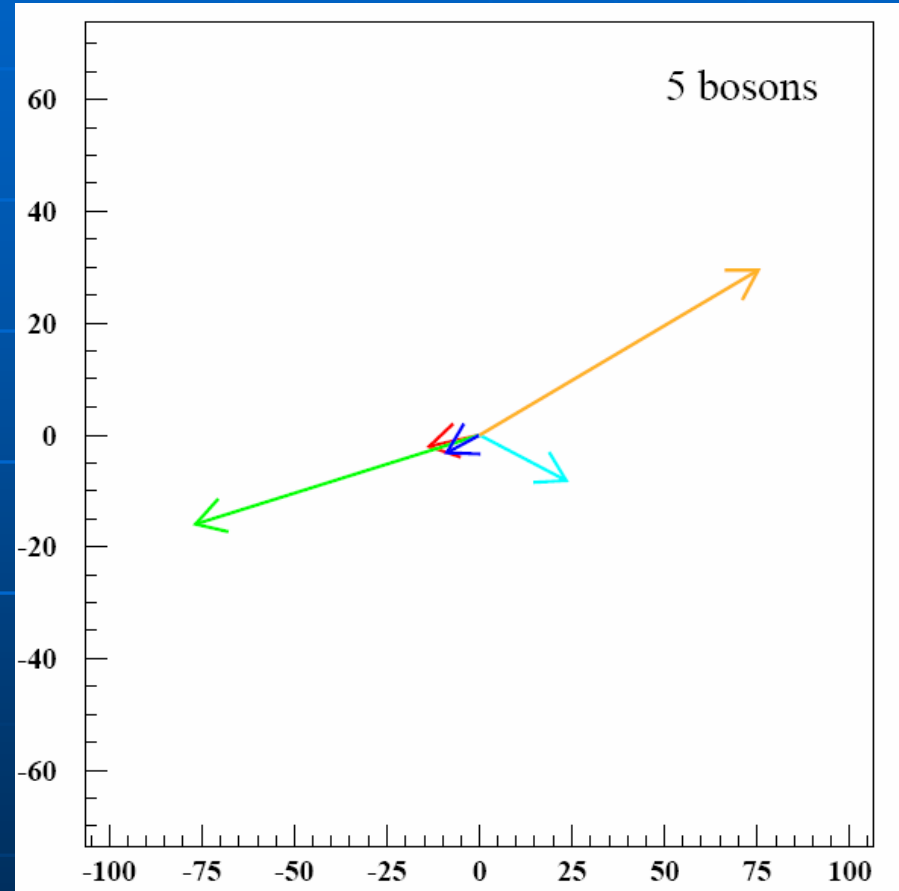
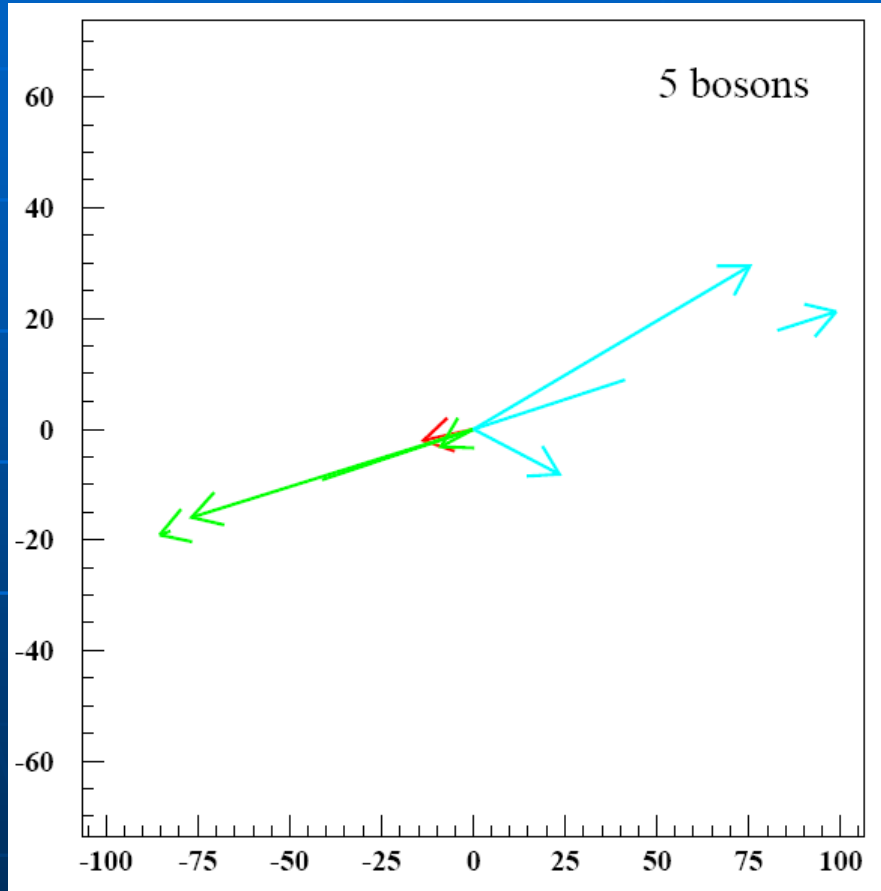


ECMS = 500 GeV

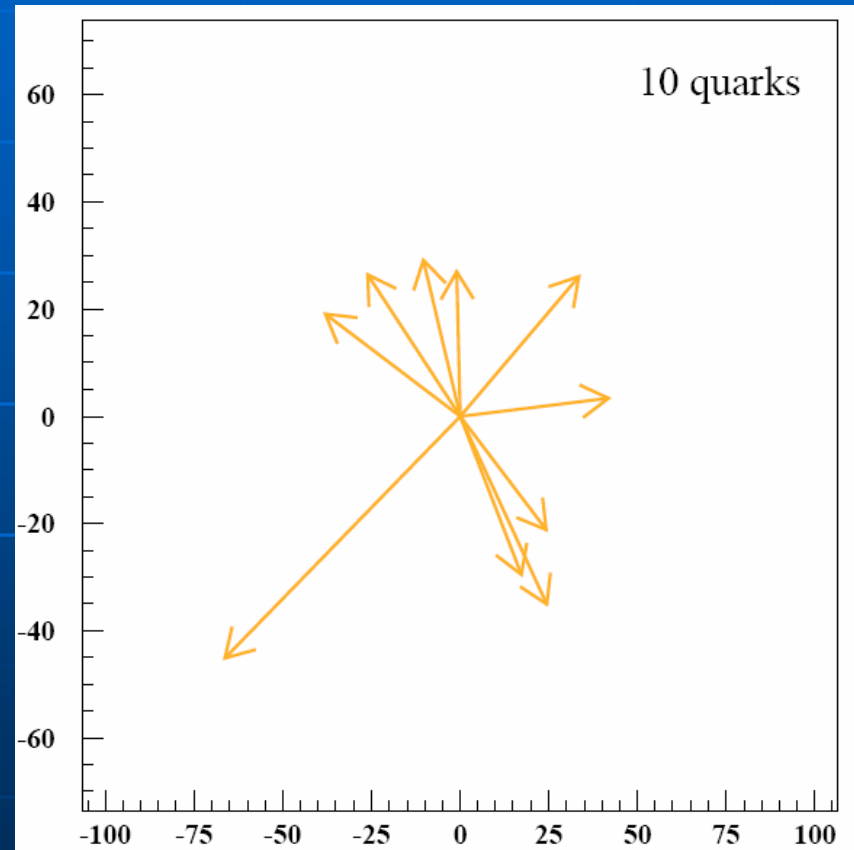
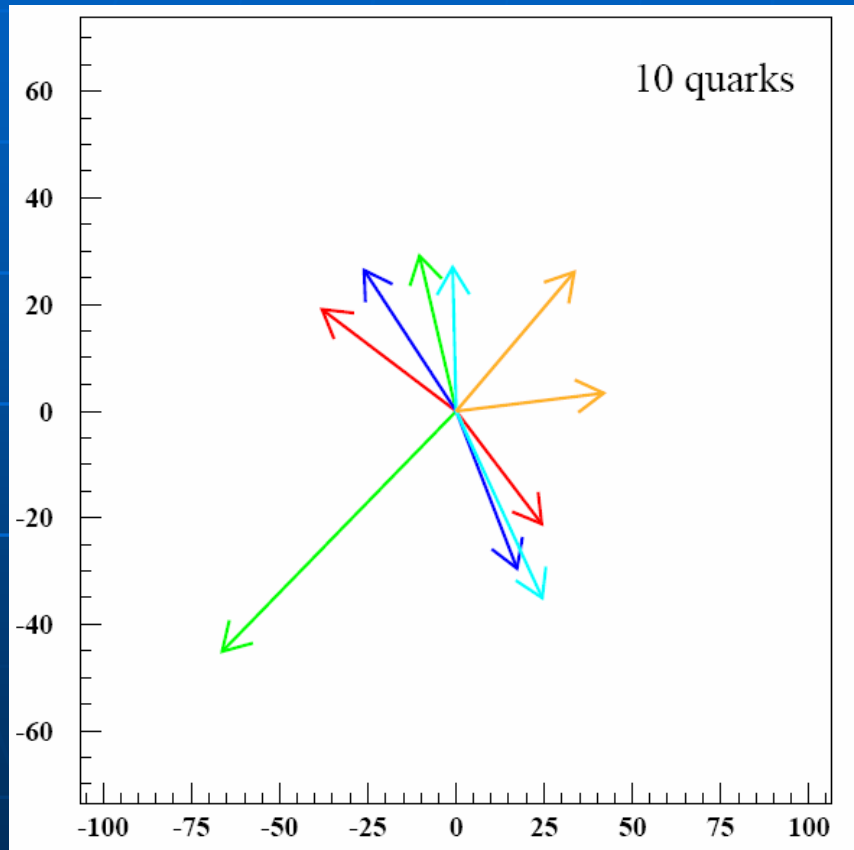
MH = 170 GeV

ZHH

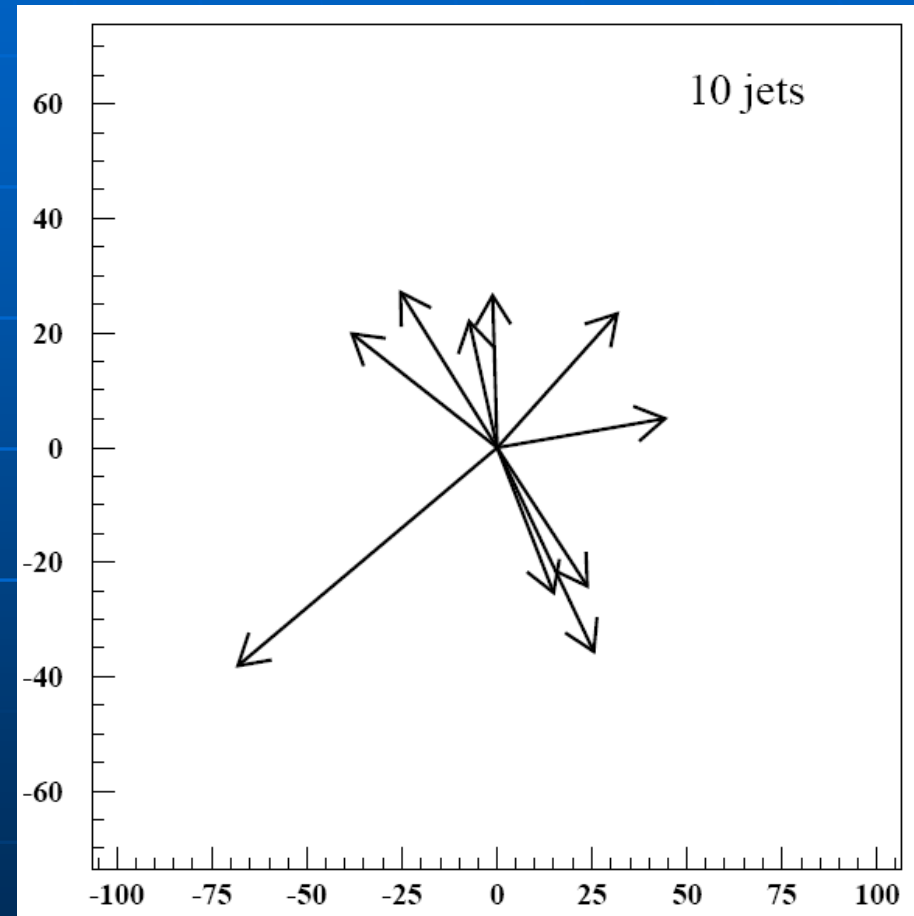
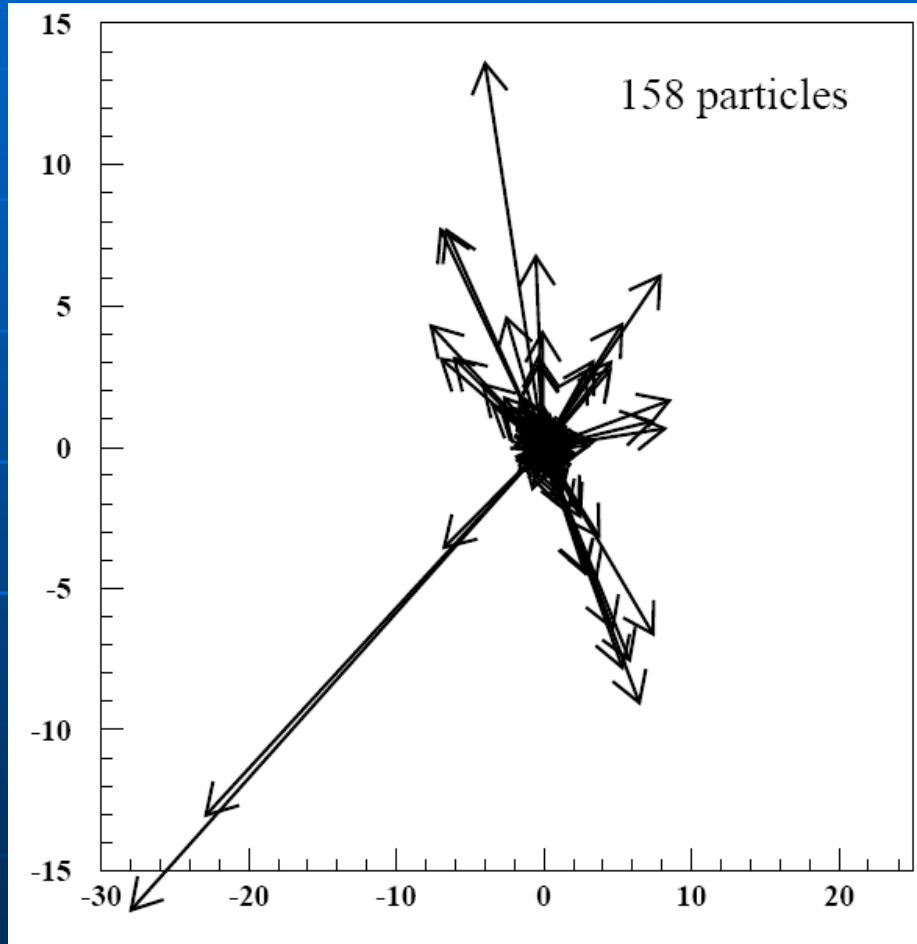
Both H into WW



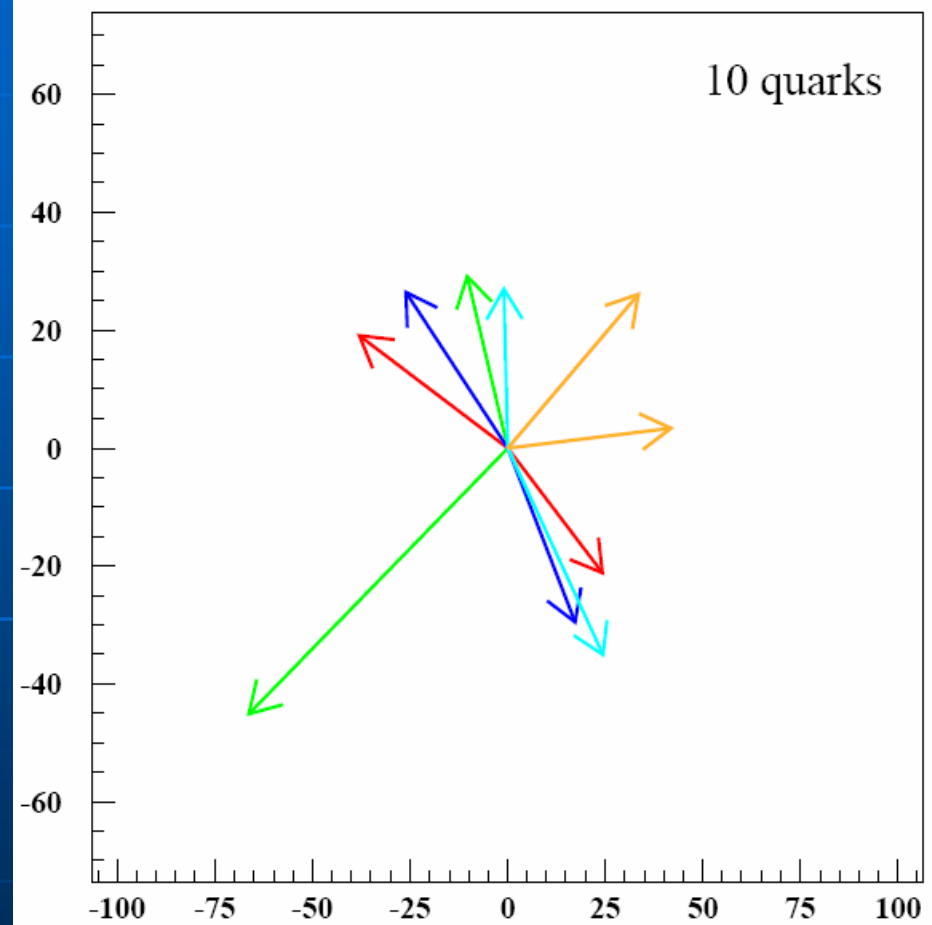
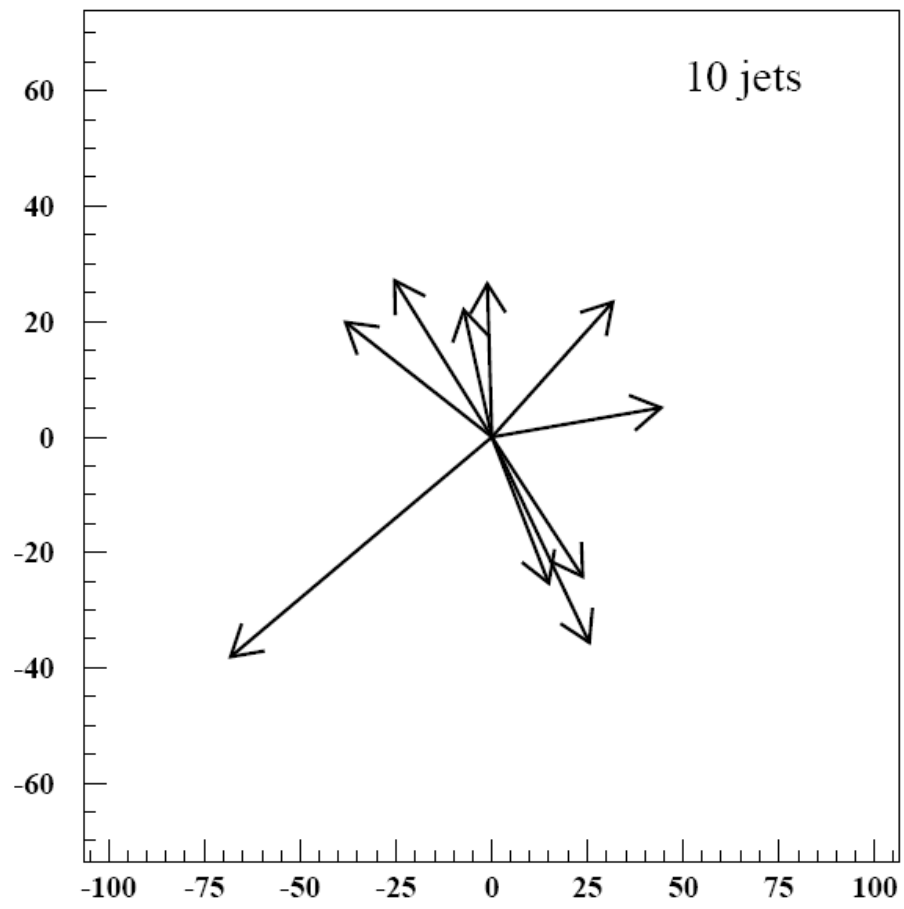
All hadronic !



Particles, and jets (Durham)



Differences, but not so big !



Go to simul. & algo.

- HHqq (in order to get the Z width)
- With Whizard, at $E_{cms} = 500$
- $M_H = 170$ Gev ($Br(H \rightarrow WW)$ max)
- No ISR, no beamstrahlung
- Thus, this is mainly a test of the jet algorithm

Usable topologies and their Br.

Topologies	Z into	Br (any Z)	Br (had. Z)
10 jets	qqbar	15 %	21.4 %
8 jets	$\nu\nu$	4.3 %	0
8 jets 1 lept.	qqbar	28 %	40.2 %
8 jets 2 lept.	llbar	2 %	0
6 jets 2 lept.	qqbar	20 %	28.4 %

Sum

69 %

90 %

Algorithm (1)

- Count the number of leptons, and make a partition according to that. (Should be improved) (taus difficult)
- Clusterize in 10, 8 or 6 jets accord.
- Replace the lepton by a W
- Make all bijets (45 if $n_{\text{jet}} = 10$)
- Keep only bijets with mass between 70 and 100 GeV (to be tuned)
- Do the combinatorial study

Results (1)

- Lepton number OK in
 - 95% for pure hadronic events
 - 68% when 1 lepton
 - (83% if taus are ignored)
 - 62% for events with 2 leptons
 - (85% if taus are ignored)
- Taus have to be studied carefully

Results (2)

- One find 1 (or more) possible comb. of 5 bijets making 5 bosons in 48% of the cases, ind. of lepton number.
- Overall, we find the correct assign. in
 - 47% of hadronic events
 - 29% of 1-lepton events
 - 25% of 2-lepton events
- Thus, an overall efficiency of 29%.

TO DO list

- Algorithm optimisation
- Use other jet algorithms (Cambridge)
- Check that at same level of simul,
the background is harmless
(already done for HZ events)
- Add ISR and beamstrahlung
- Go to real simulations