ALEPH Higgs status

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LEP Higgs Meeting

For the ALEPH Higgs Task Force

Luminosities

Energy(GeV)	Luminosity (1/pb)
201.3	3.31
204.0	7.25
205.0	63.85
205.8	1.98
206.5	56.86
207.3	4.79
208.2	5.99
209.0	0.06
Total	144.06

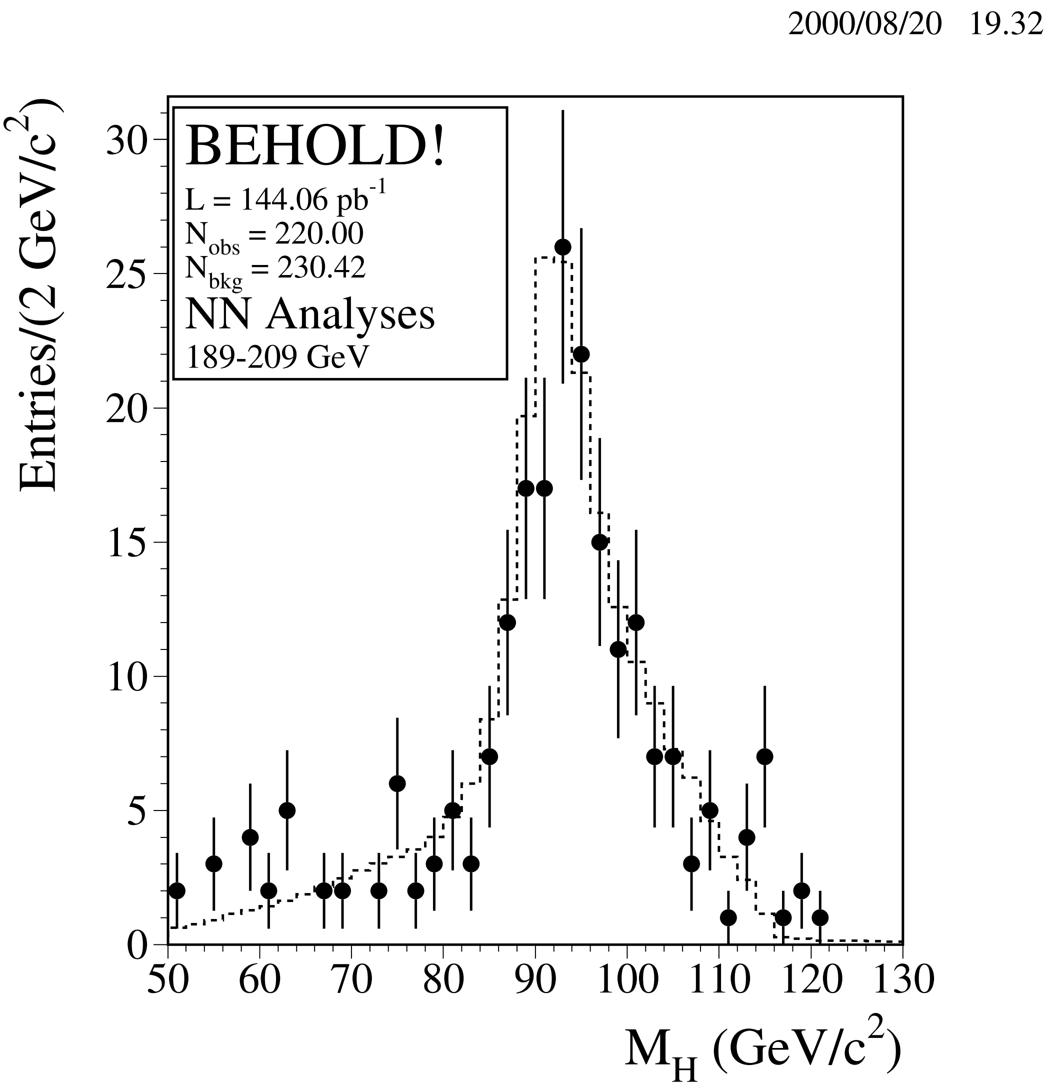
NOTE: This list currently contains some data collected after a TPC short! Things are likely to change in the near future after this short data is reprocessed

Candidates

Channel	Std. Model Background Expected	115 GeV Signal Expected	Data Events Observed
Four Jets	31.17	1.74	30
Missing Energy	25.41	0.62	26
Leptons	19.80	0.24	17
Taus	9.08	0.17	7
Total	85.46	2.77	80

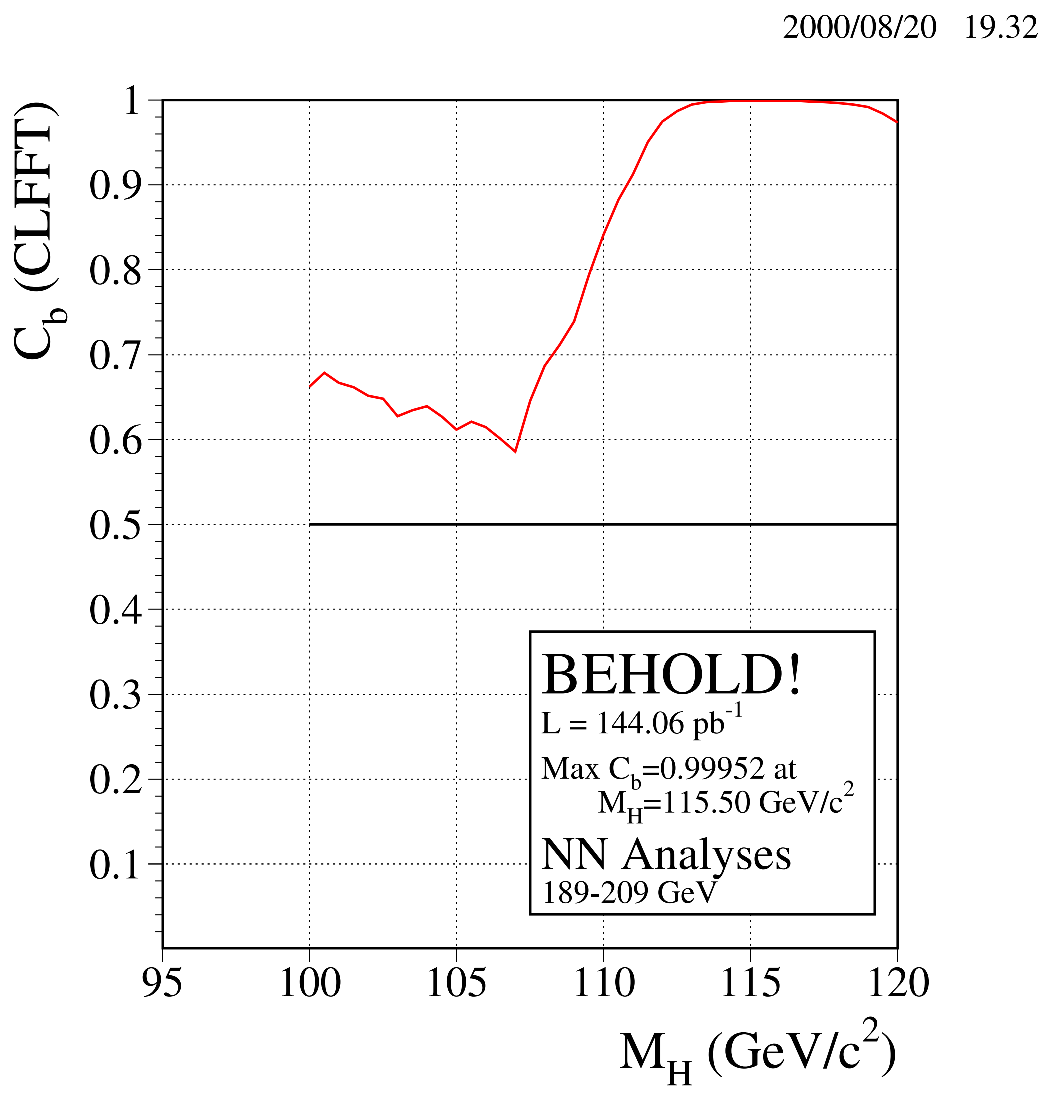
At the level of overall number of events we have quite good agreement between data and Monte Carlo.

Reconstructed Mass



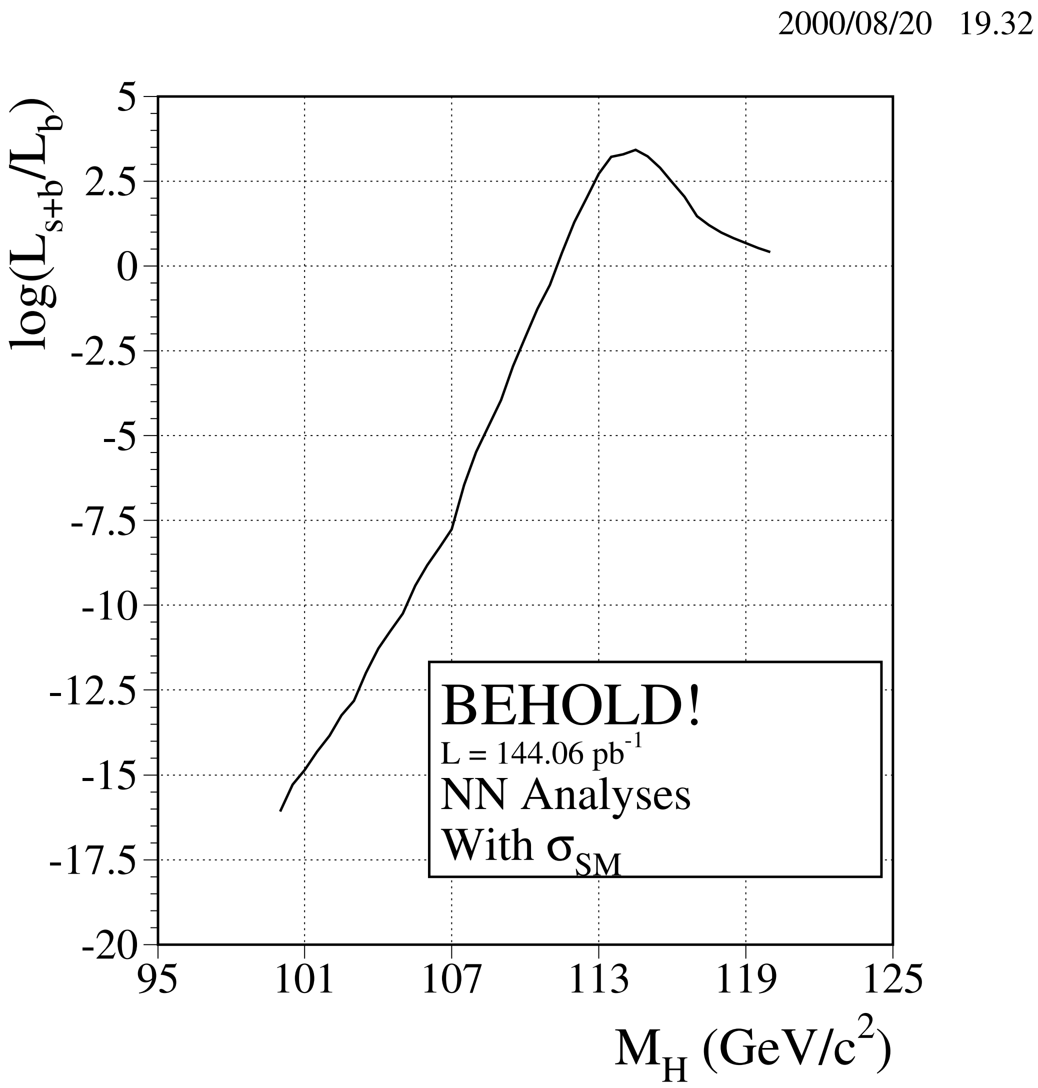
An excess of events is observed at high mass

CL_b

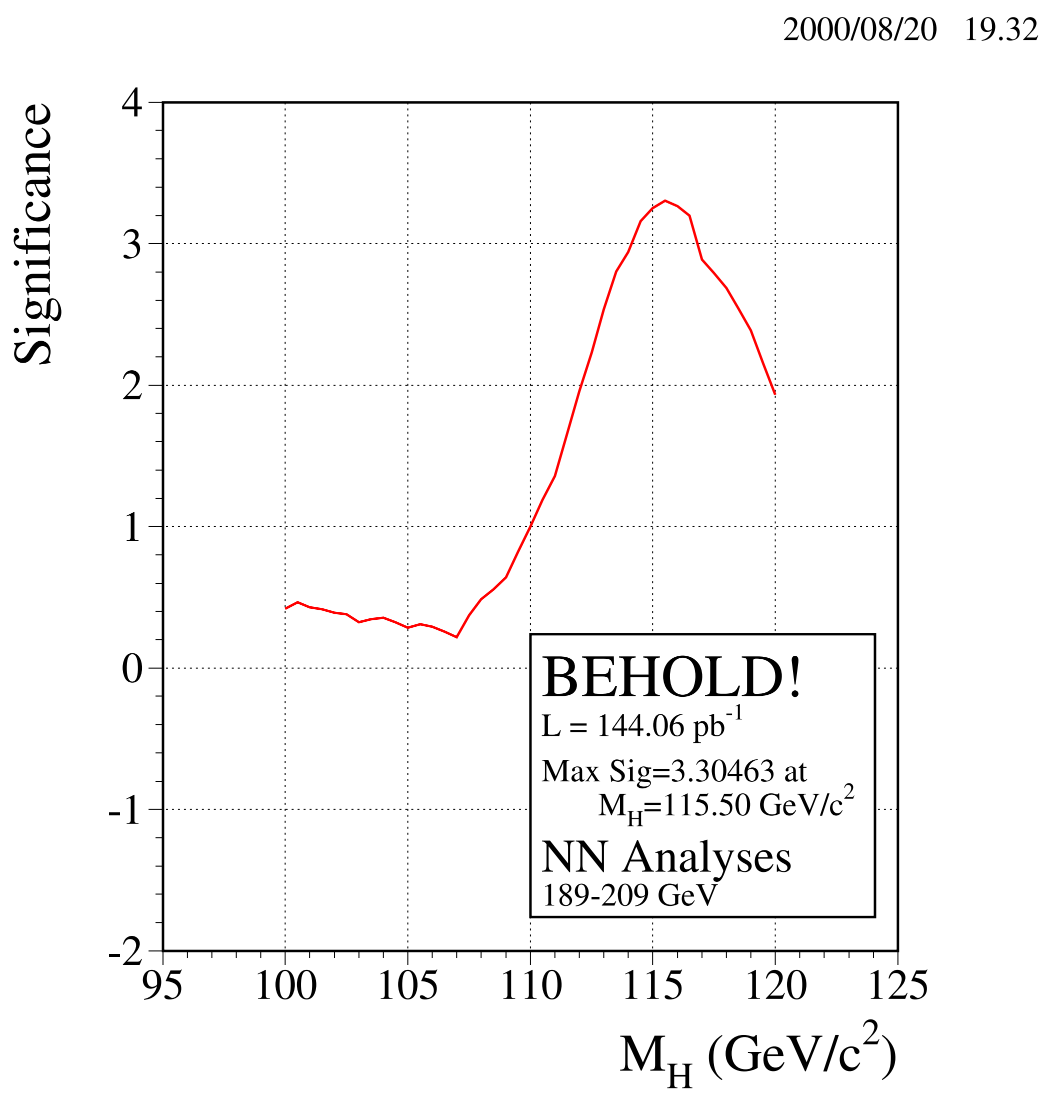


Excess results in very high background CL

Likelihood Ratio



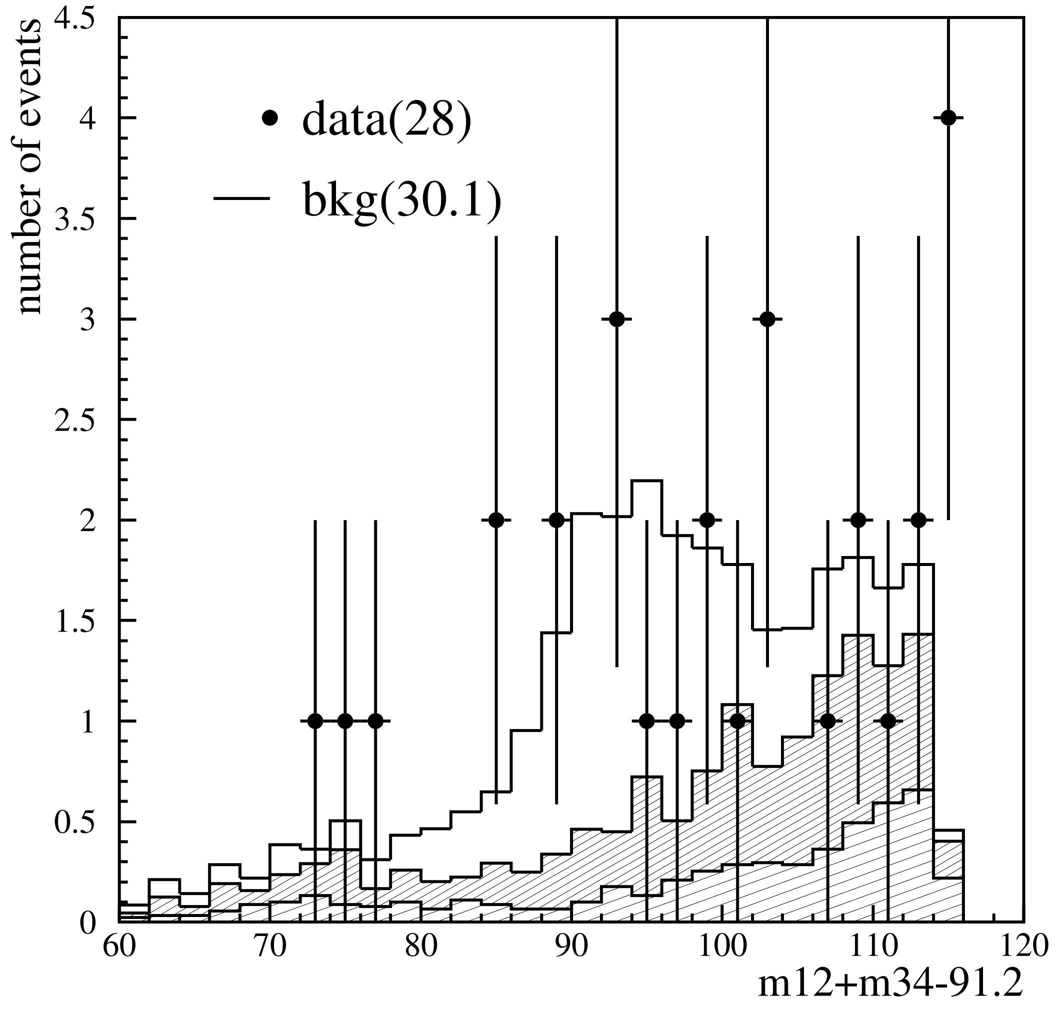
Significance



High Mass Candidates

	All masses	above 110
Four Jet		
Signal	1.74	0.96
Background	31.17	3.72
Candidates	30	7
Missing Energy		
Signal	0.62	0.26
Background	25.41	1.61
Candidates	26	1
e/μ		
Signal	0.24	0.23
Background	19.80	1.17
Candidates	17	4
$\tau\tau$		
Signal	0.17	0.11
Background	9.08	0.50
Candidates	7	3
Total		
Signal	2.77	1.56
Background	85.46	7.00
Candidates	80	15

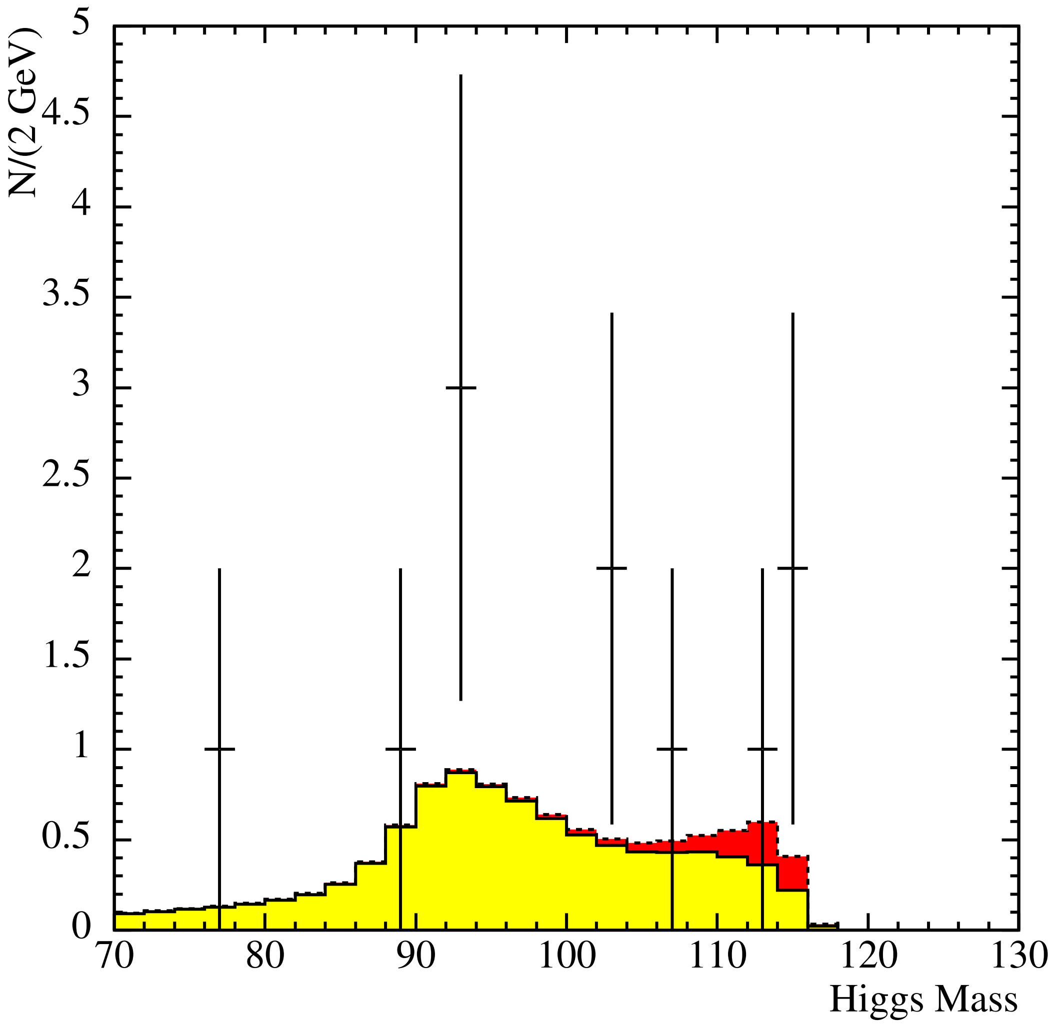
Four Jet Mass Plot



There is a concentration
of four jet events at high masses
(2.4 expected, 7 observed above 110 GeV)

s/b=0.5

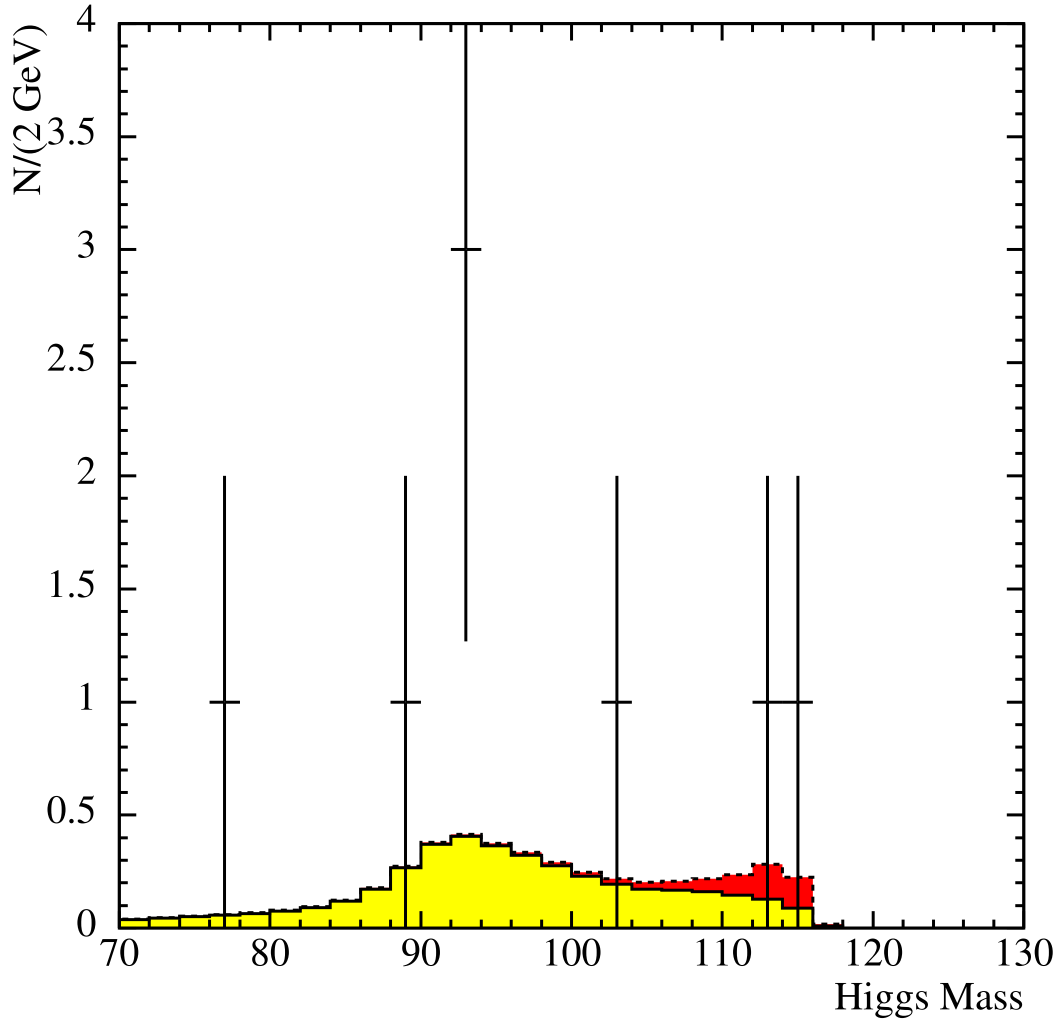
Define s/b for 115 GeV signal, above 110 GeV mass.



With s/b=0.5 cut, above 110 GeV:
sig=0.58, bkg=1.01, 3 candidates.

s/b=1.0

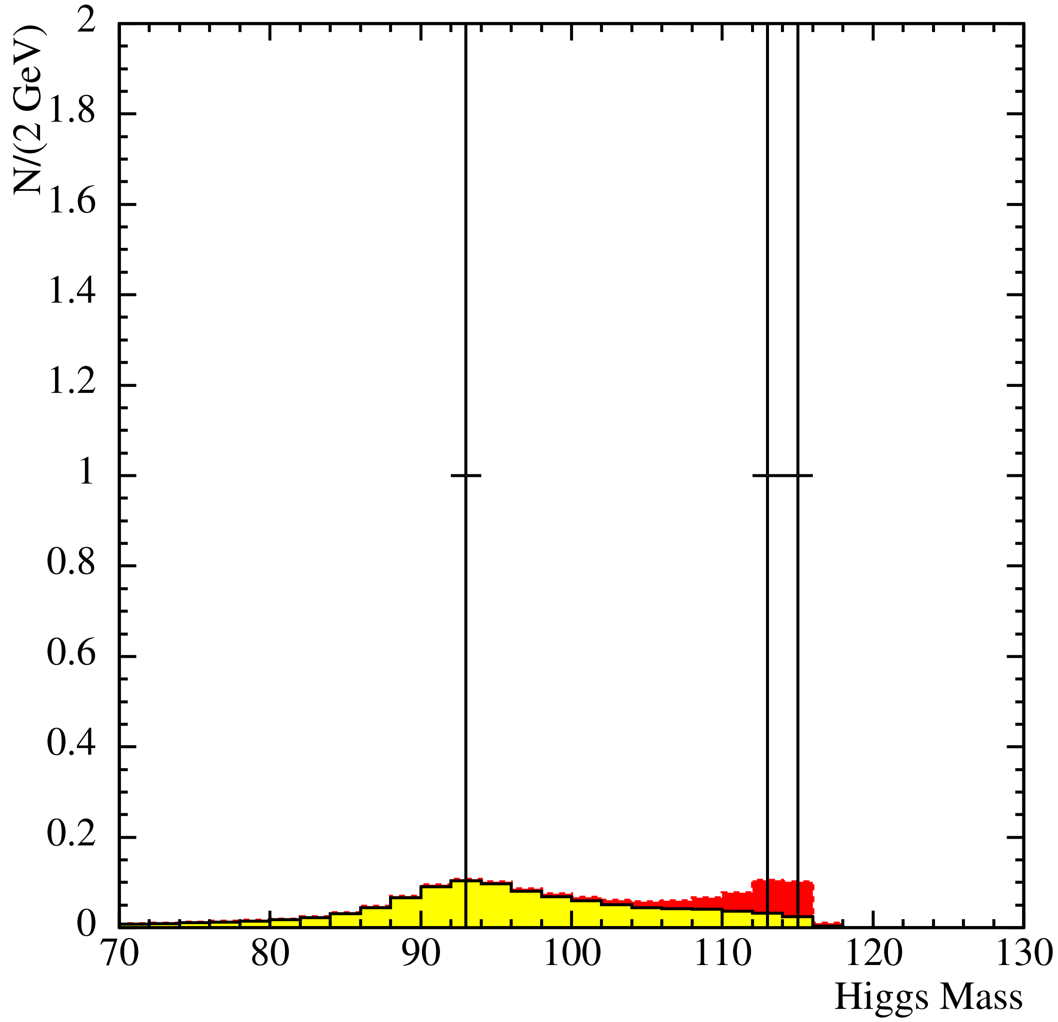
Define s/b for 115 GeV signal, above 110 GeV mass.



With s/b=1.0 cut, above 110 GeV:
sig=0.39, bkg=0.37, 2 candidates.

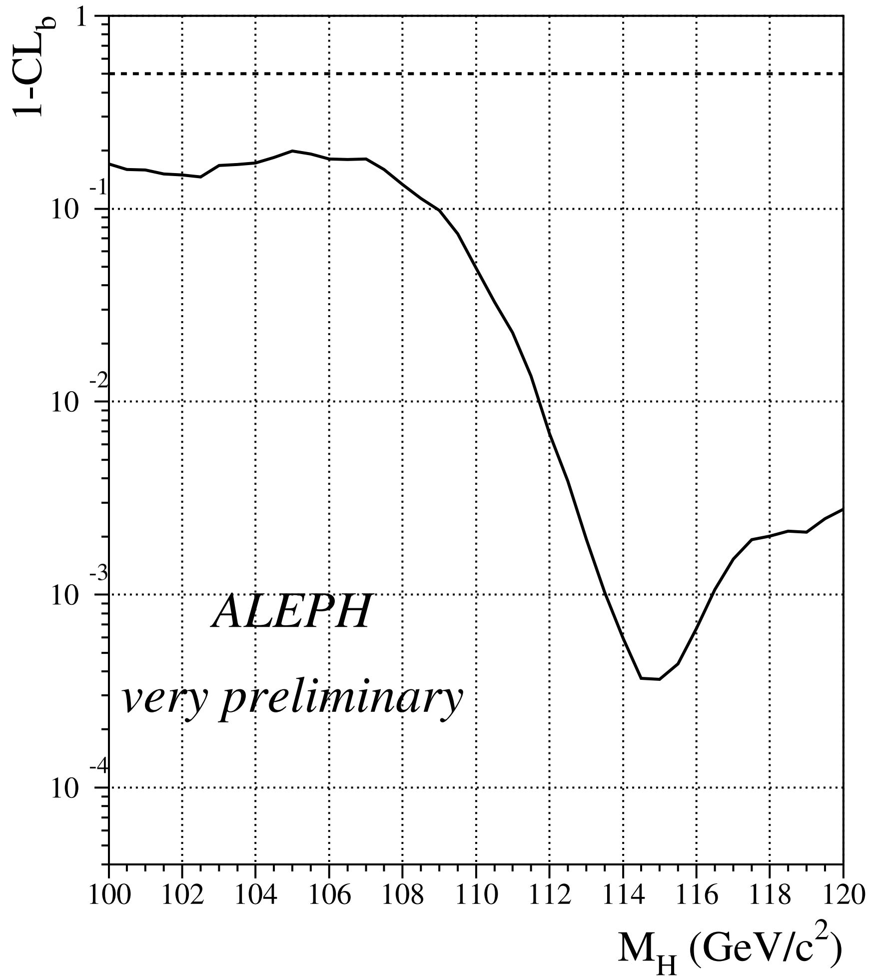
s/b=2.0

Define s/b for 115 GeV signal, above 110 GeV mass.



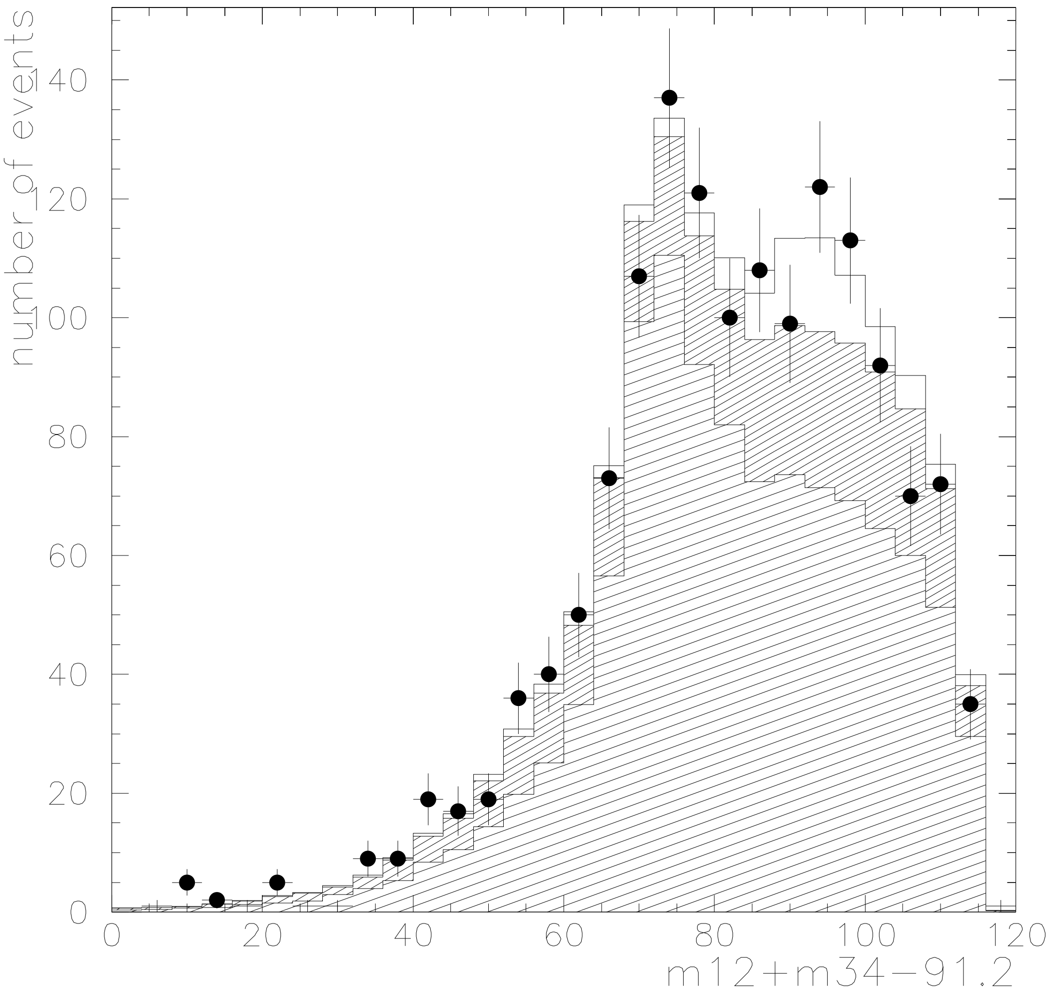
With s/b=2.0 cut, above 110 GeV:
sig=0.20, bkg=0.10, 2 candidates.

Four Jet CL_b



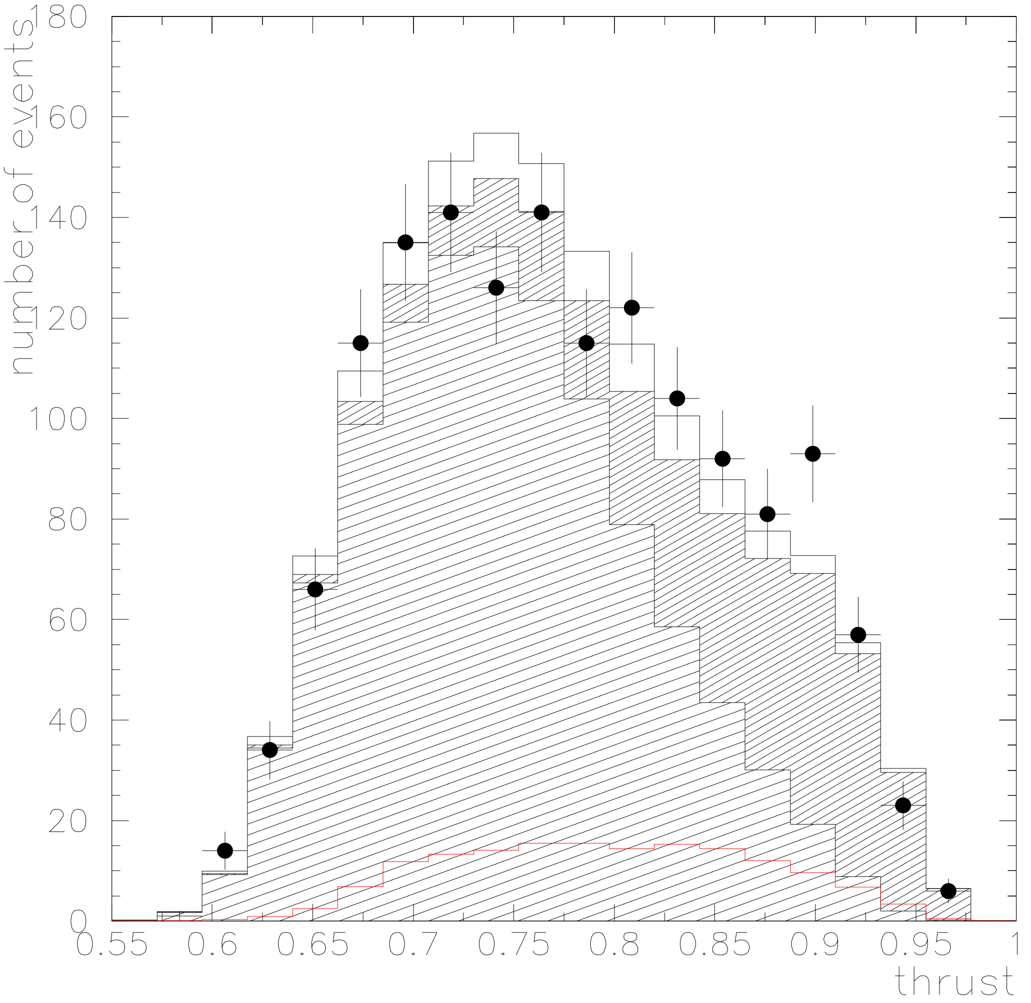
The overall excess is dominated by this excess of high mass candidates in the four jet channel

Four Jet Mass - Preselection



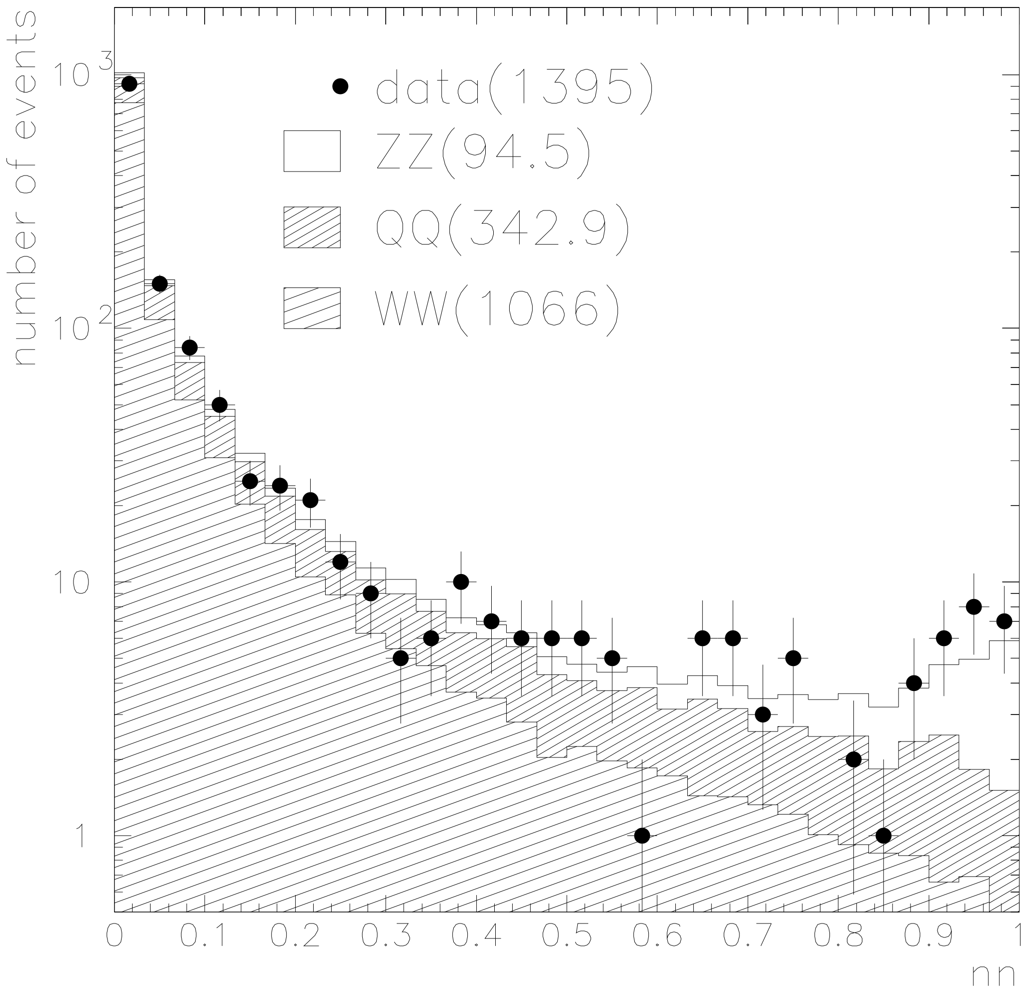
No excess of high mass candidates
is visible at the four-jet preselection.

Four Jet Thrust - Preselection



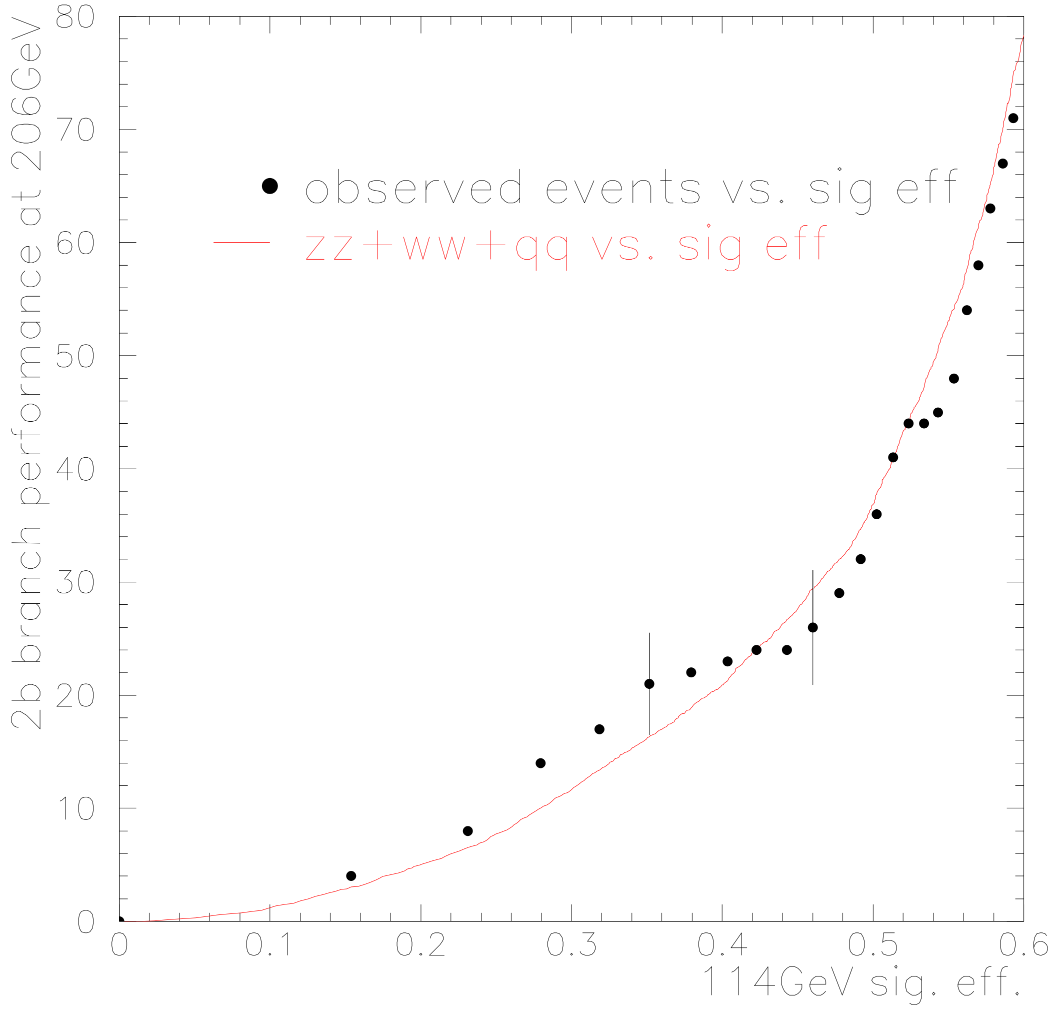
Thrust shows reasonably good agreement at preselection level.

Four Jet NN - Preselection



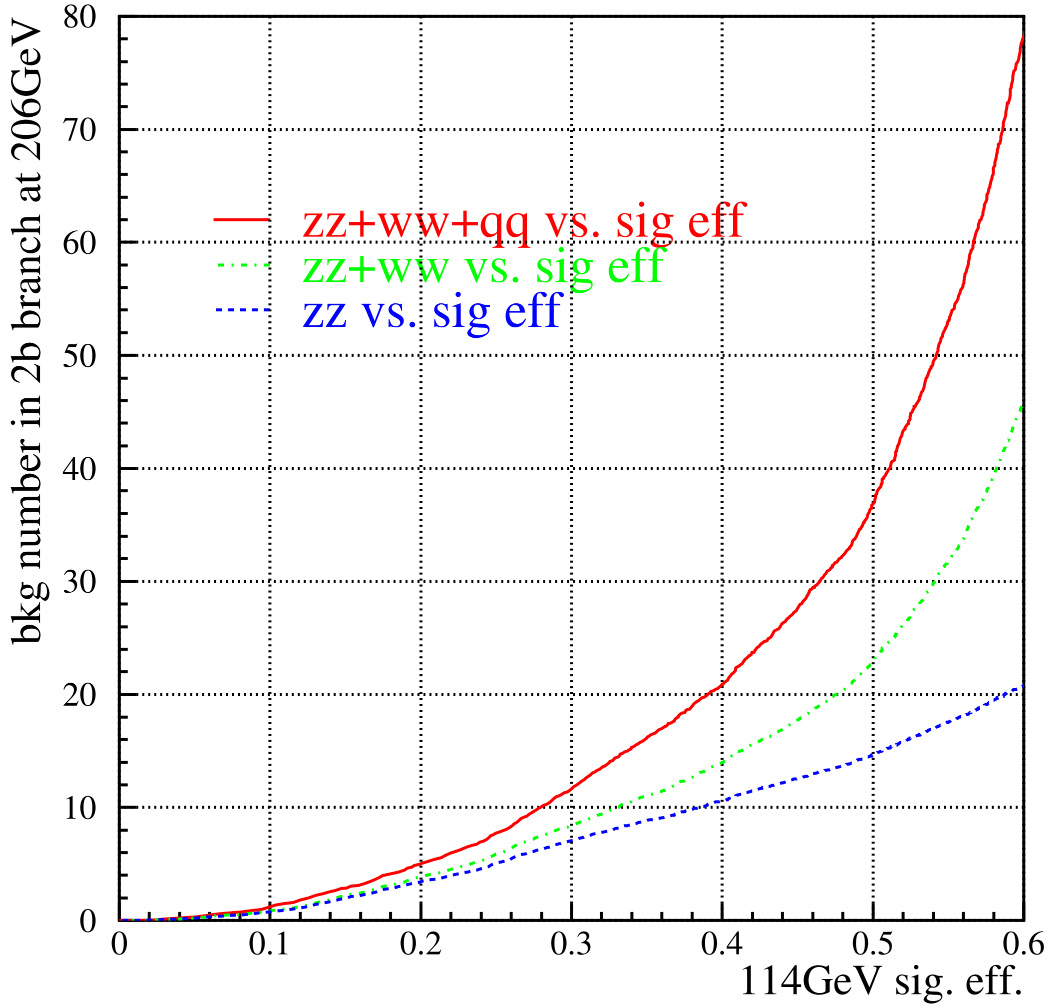
Analysis Neural Network distribution shows good overall agreement.

Four Jet Bkg-Eff curve



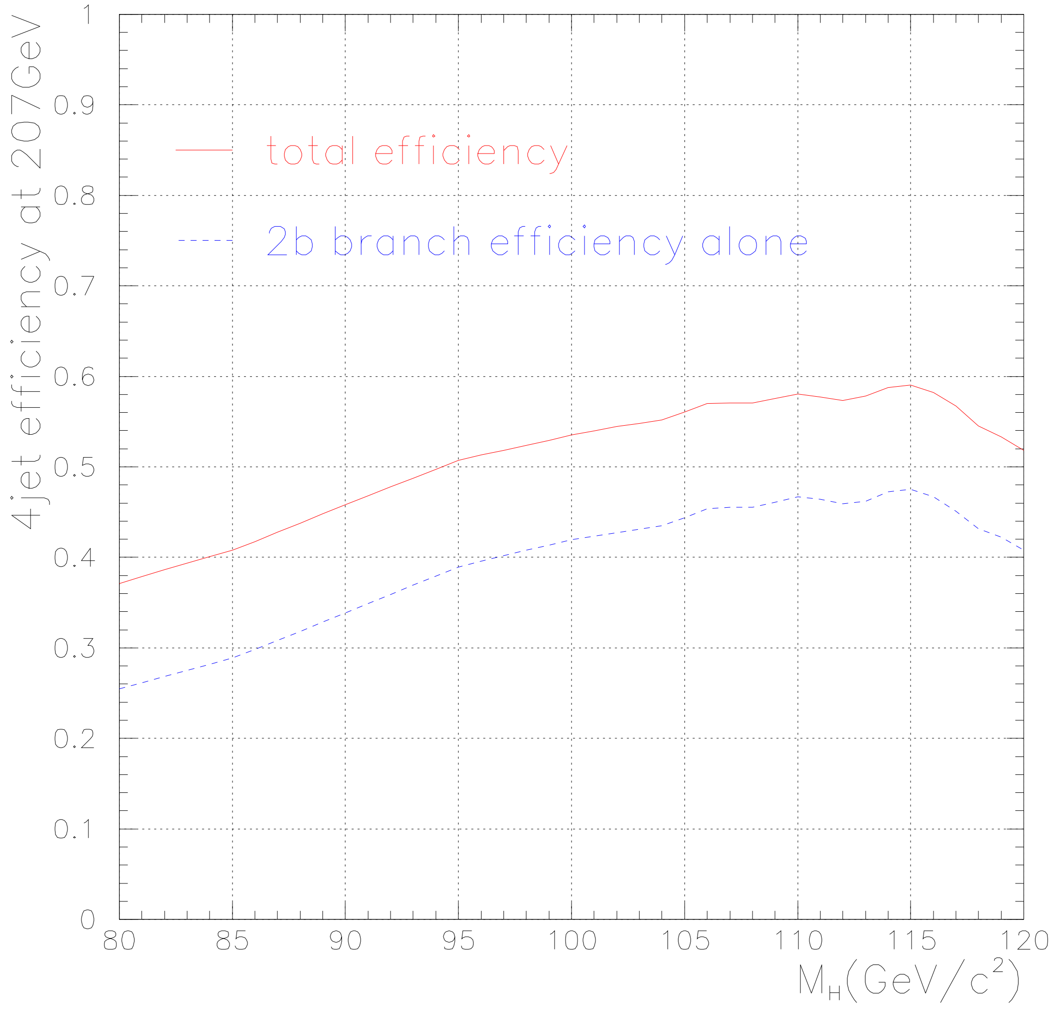
Looking at NN distribution closely,
see (slight) excess of high purity candidates.

Four Jet Bkg composition



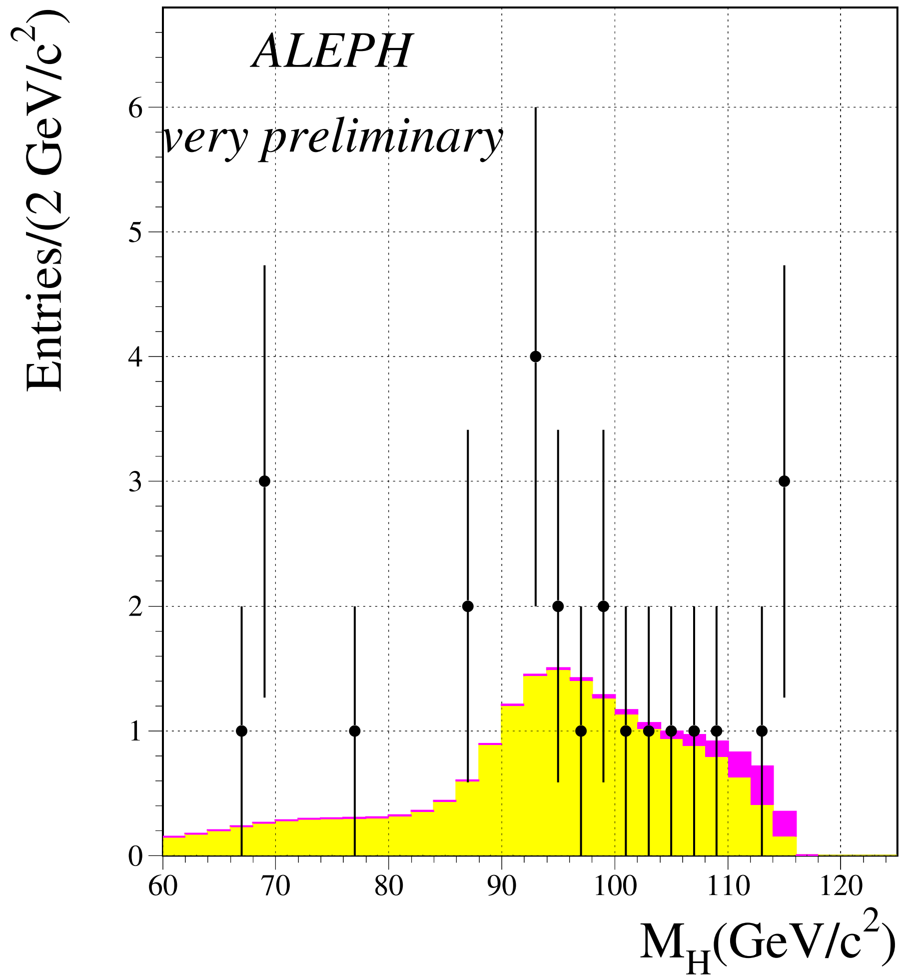
At 40% efficiency,
about 50% of background is ZZ.

Four Jet Efficiency



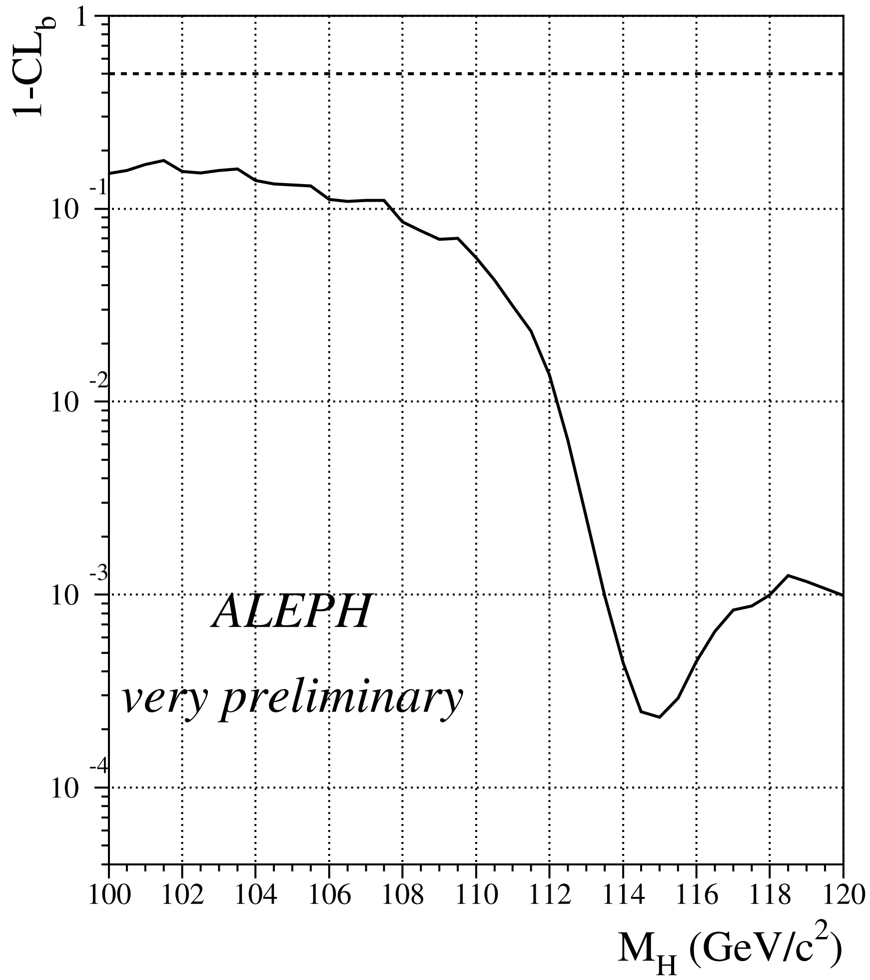
The efficiency of the four jet analysis is fairly flat across a wide mass range.

Four Jet Cuts



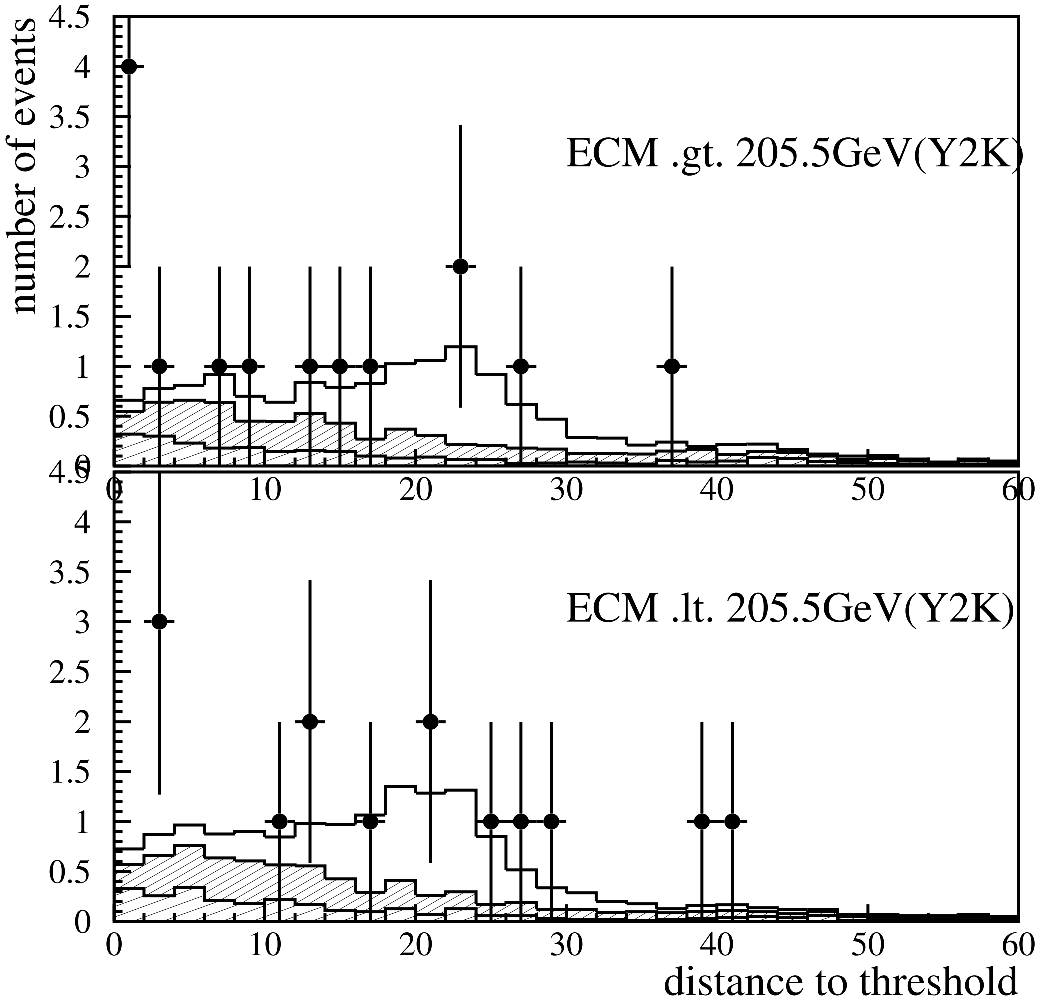
The cut analysis has similar performance to NN. Comparison allows us to check that excess is not the result of a malfunctioning Neural Network.

Four Jet Cuts - CL_b



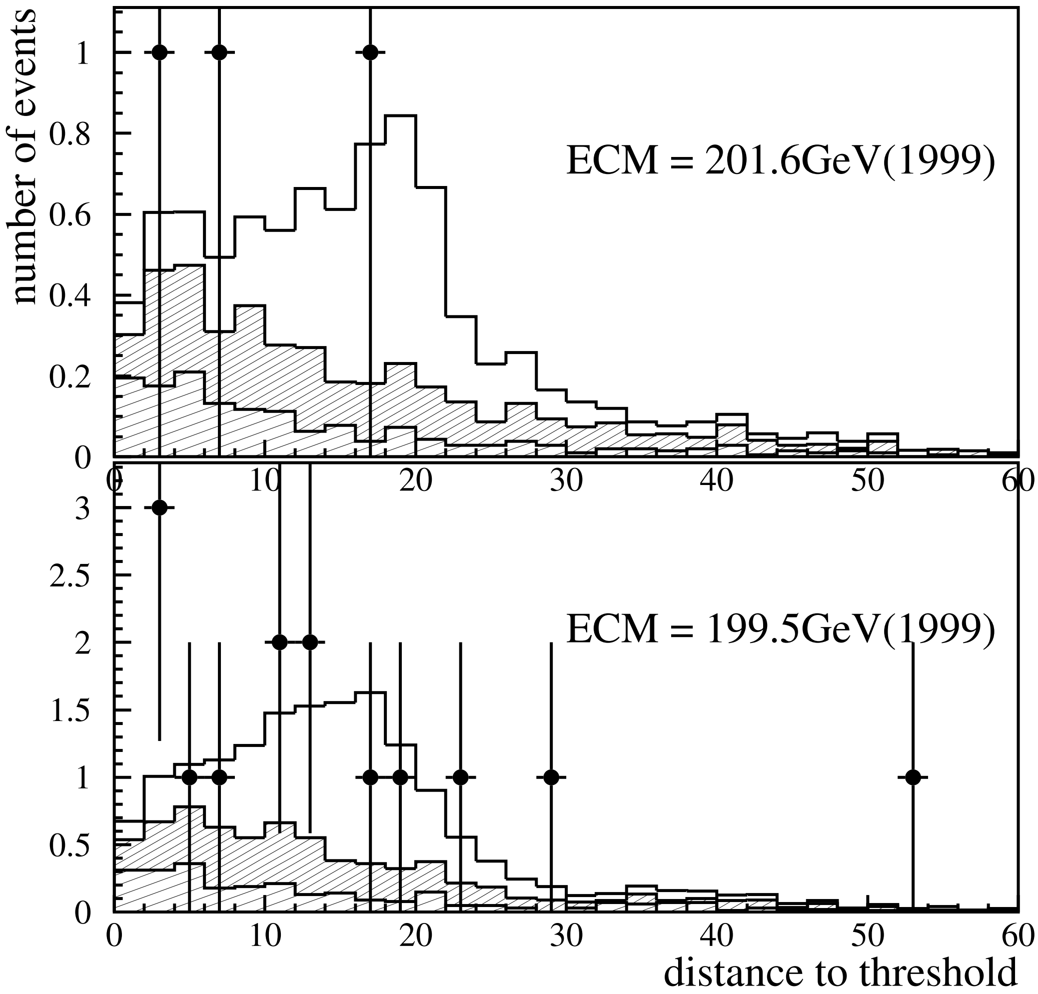
We can also see that the excess is not caused only by the second discriminating variable (4 jet cut analysis uses only mass)

Threshold Bias



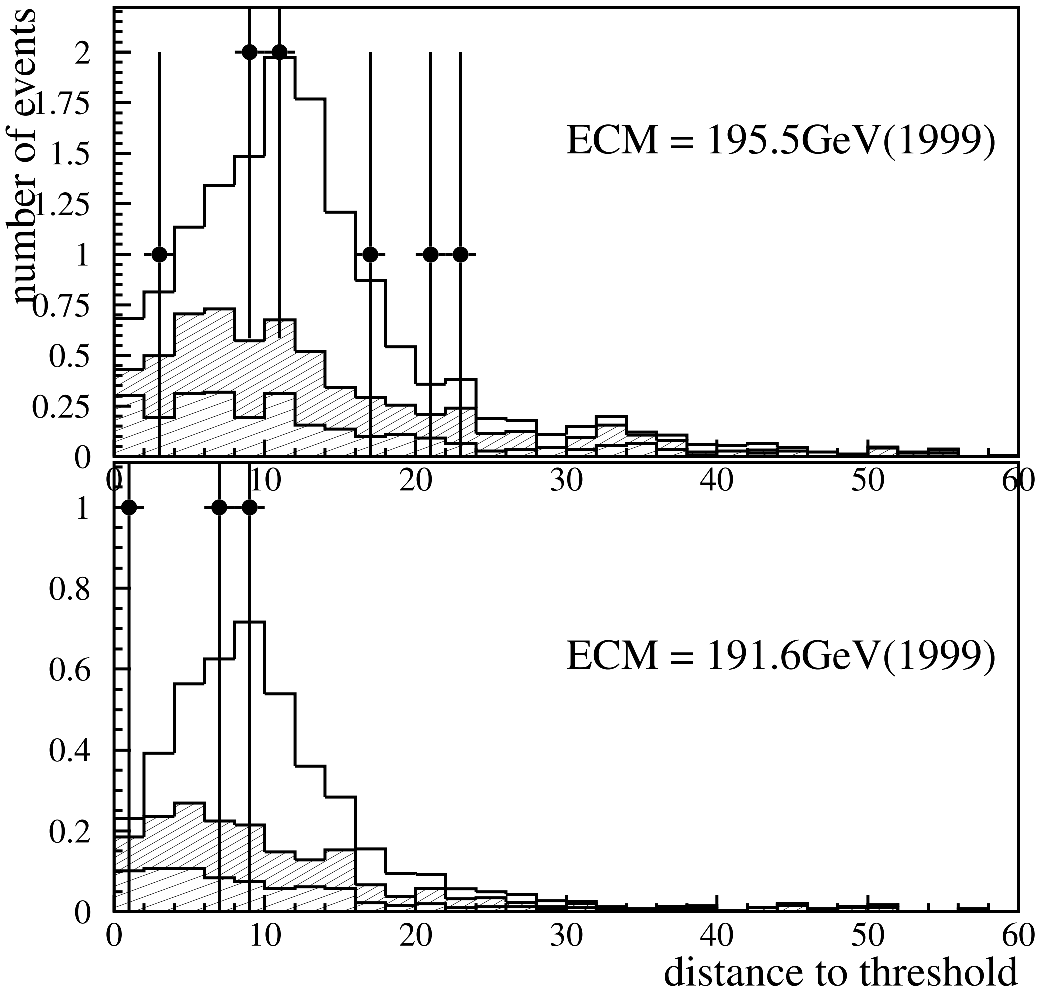
We have several events near threshold–
do we have a bias which is
not reflected in the Monte Carlo?

Threshold Bias–200-202 GeV



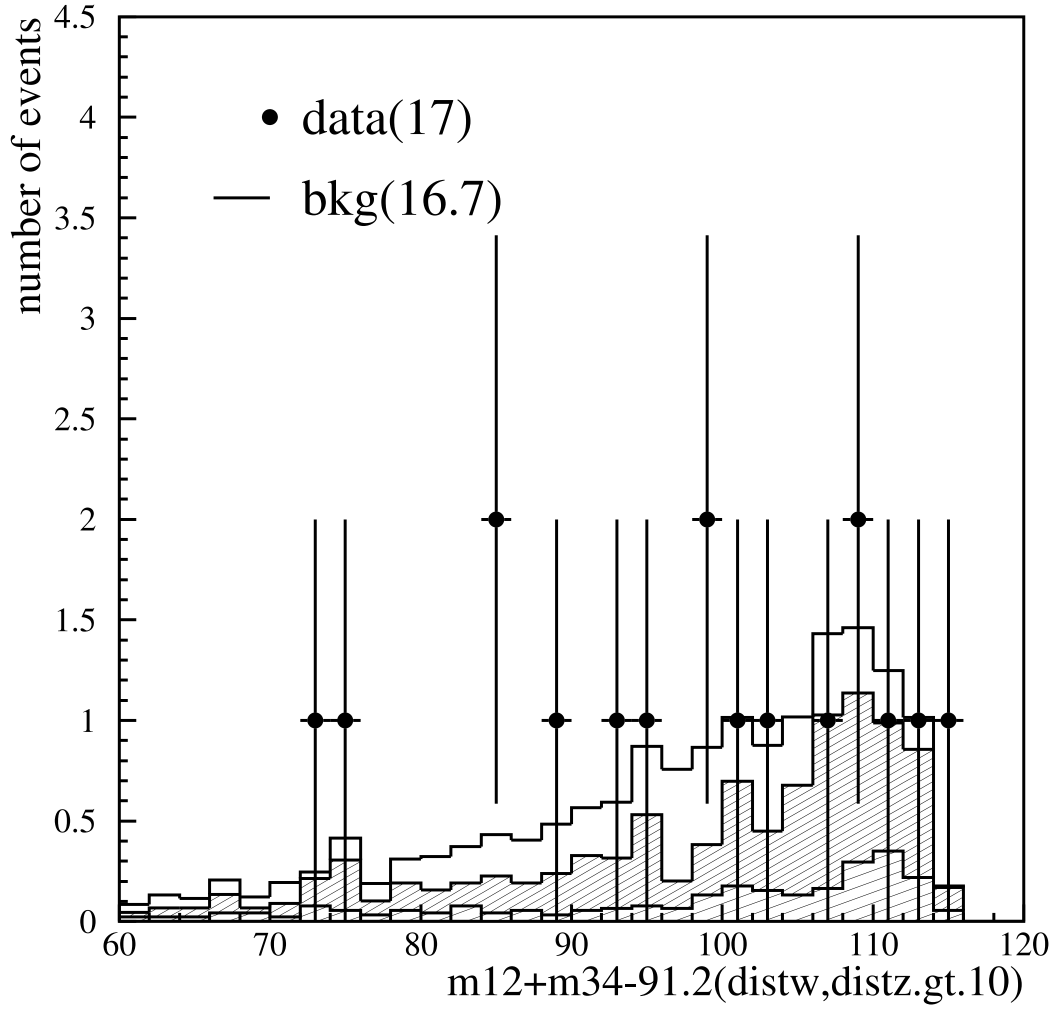
Slight excess in 200 GeV sample
(3 observed, 1.5 expected)

Threshold Bias–192-196 GeV



Slight deficit in 196 GeV data.
There is no sign of systematic bias towards threshold.

Pairing Choice



Rejecting candidates with a pairing in 10 GeV ZZ or WW ellipse–
High mass excess is gone?

Analysis of Pairing Choice

Across the entire mass spectrum the cuts
Reject 45% of the background $(30.1 \rightarrow 16.7)$,
and 34% of the signal $(1 \rightarrow 0.66)$.
Observed events are reduced from $28 \rightarrow 16$

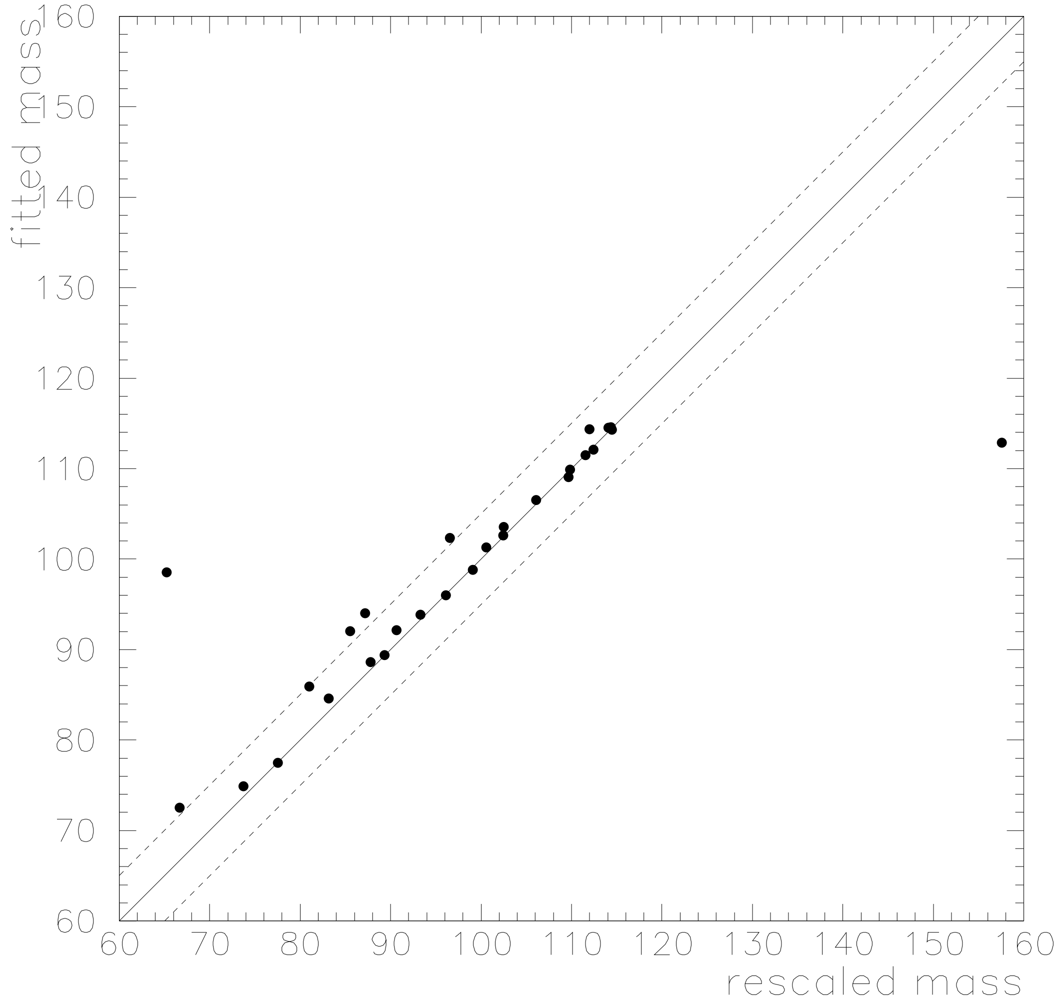
If all events are from background,
probability 16 or fewer remain is 79%
If all events are from signal,
probability 16 or fewer remain is 34%

Above 110 GeV, the cuts
Reject 37% of the background $(3.9 \rightarrow 2.44)$,
and 42% of the signal $(1 \rightarrow 0.58)$. Observed events
are reduced from $7 \rightarrow 3$

If all events are from background,
probability 3 or fewer remain is 23%
If all events are from signal,
probability 3 or fewer remain is 33%

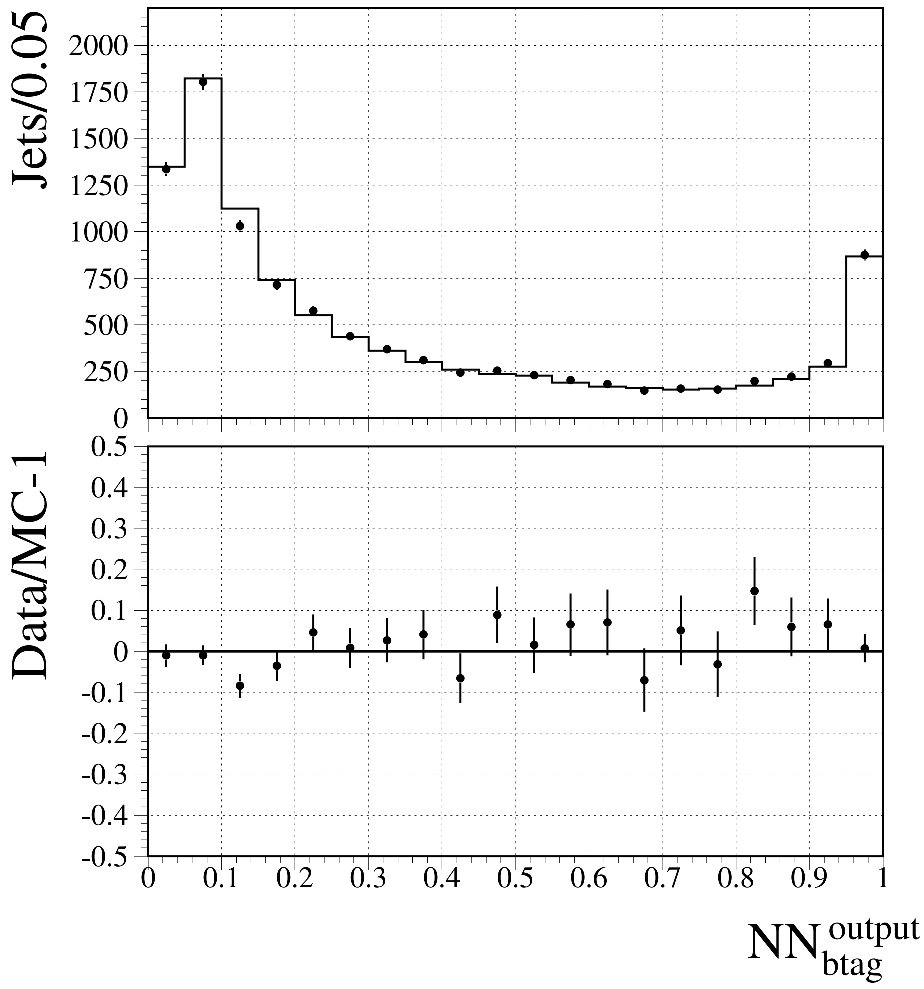
Although this seems like a good test,
it behaves counter-intuitively,
and has almost no discriminating power.

Fit vs Rescaling



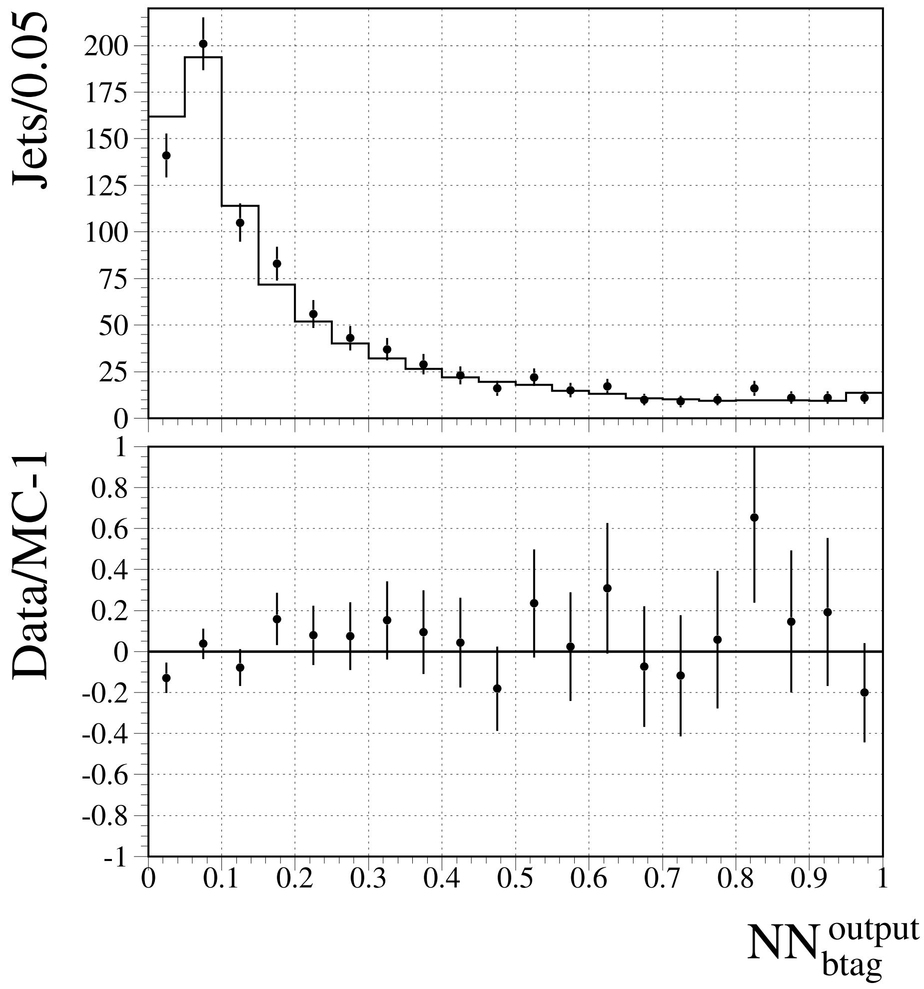
Most high mass candidates obtain the same mass with either method. One candidate fails rescaling.

btag– Z return events



The b-tag neural network agrees quite well in Z return events

btag– WW semileptonic



The b-tag neural network also agrees well in WW events

Further b-tagging studies are ongoing.

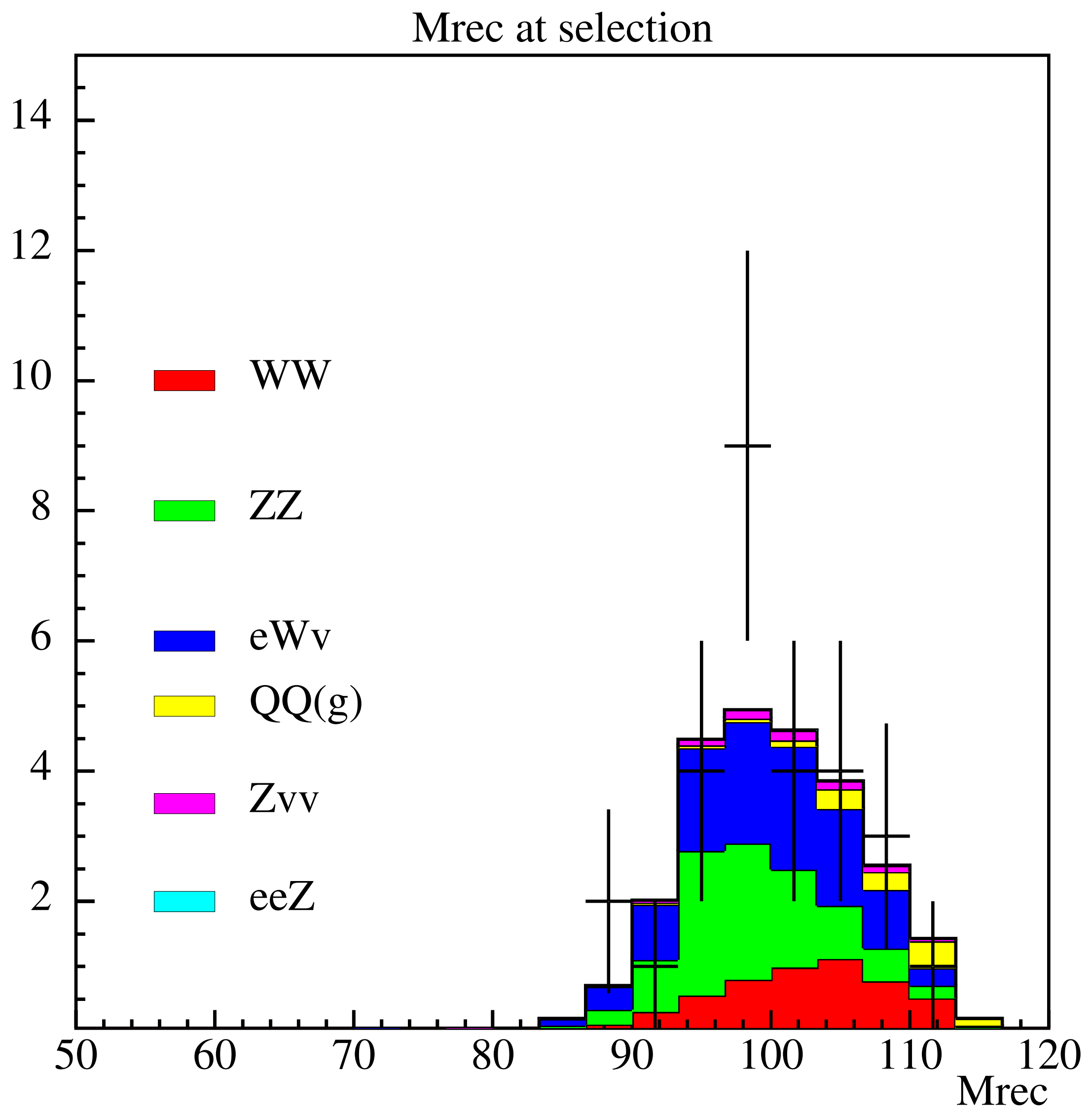
Missing Energy

What do we expect from a signal in the missing energy channel?

Branching ratio is 30% of four jet (68% vs 20%),
Efficiency is 66% of four jet (46% vs 30%)
Expect only 1 Missing Energy event
for each 5 Four Jet events.

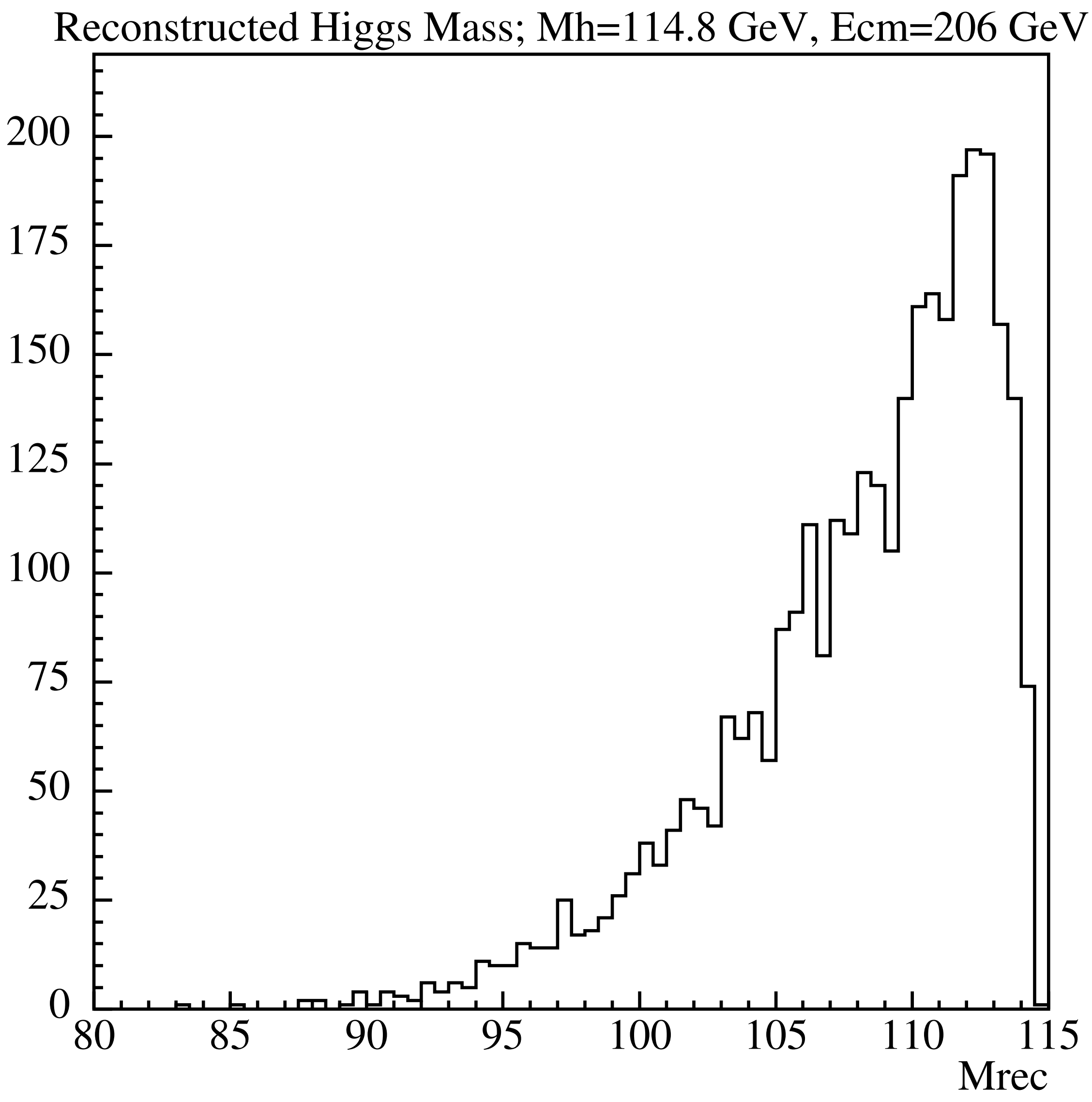
Specifically, expect only XXX Missing Energy events from XXX GeV signal.

Missing Energy Mass Plot

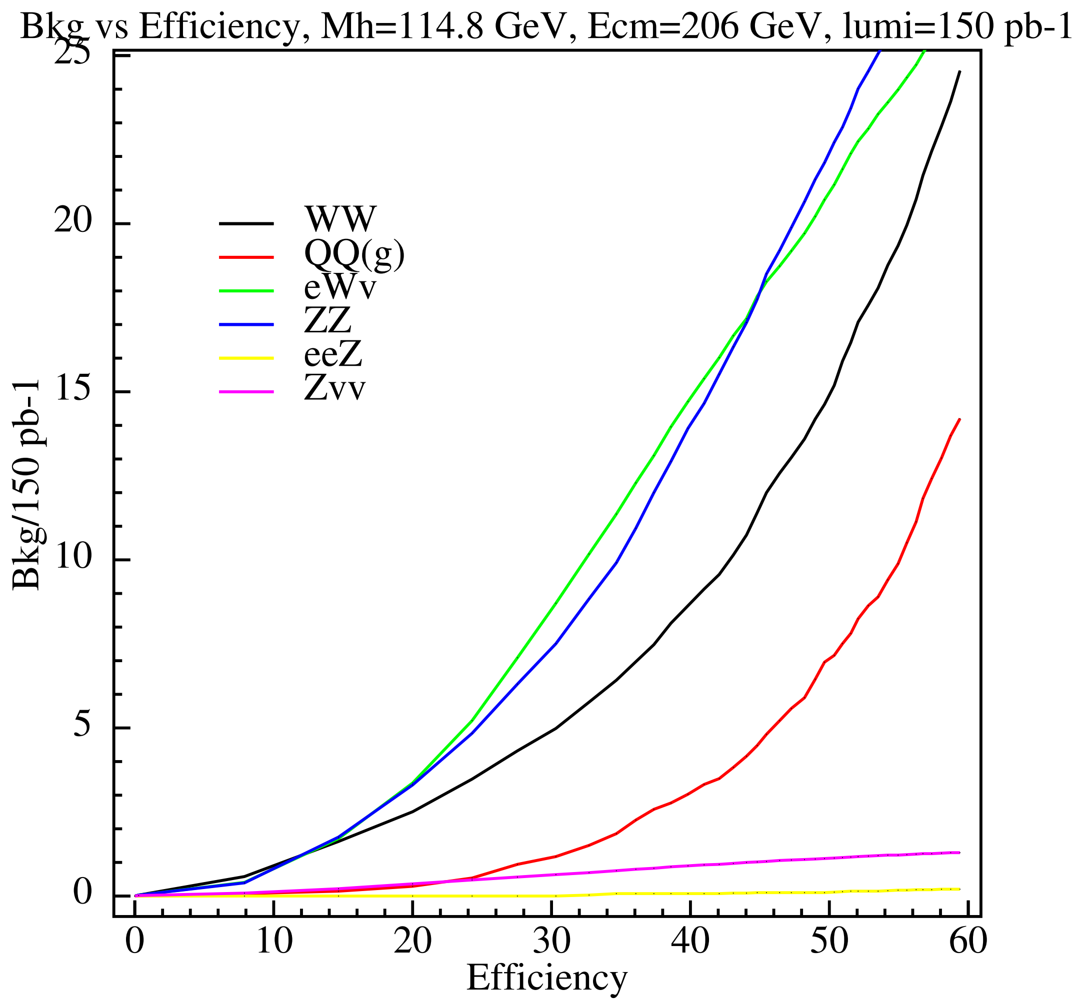


Missing Energy sees no excess of high mass events.

Signal Resolution



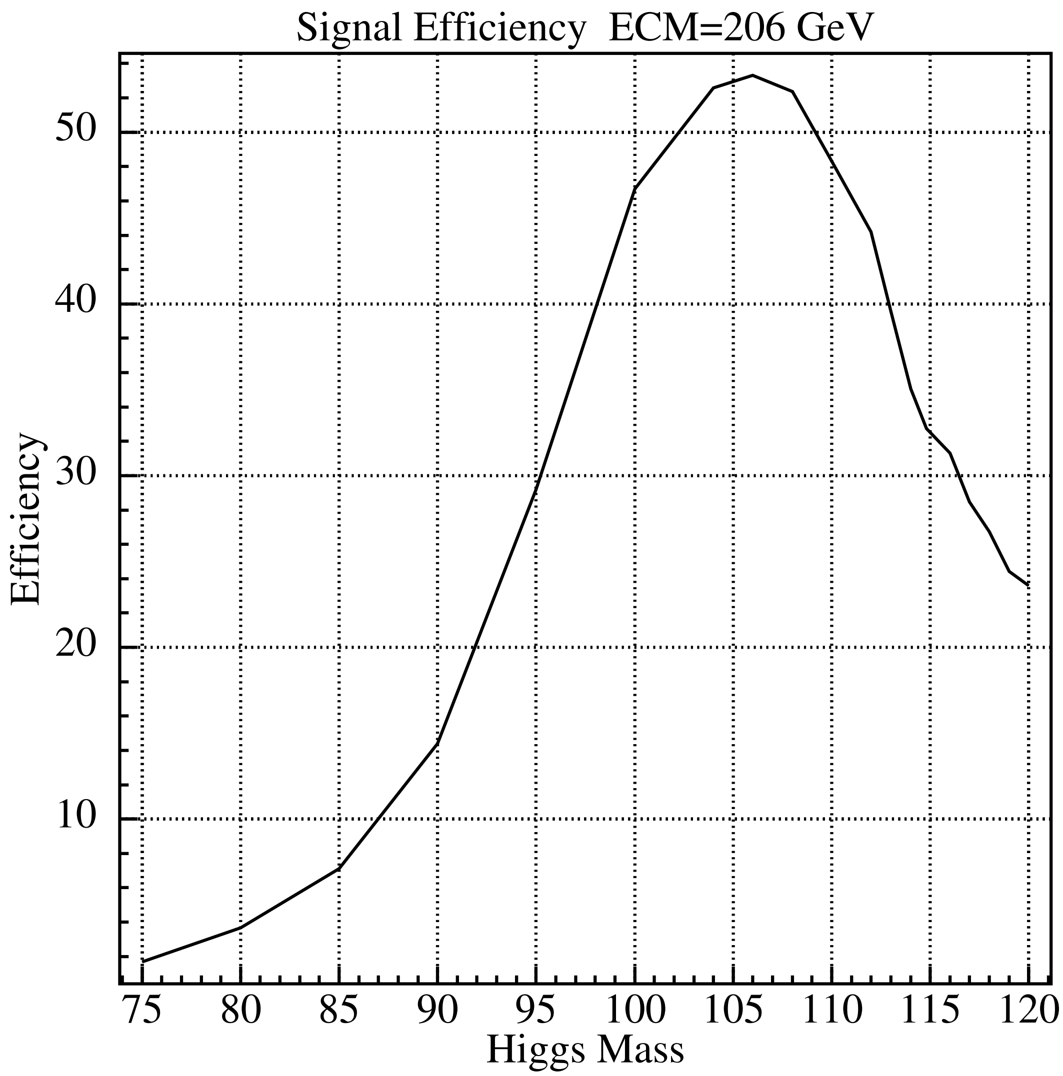
Background Composition



Dominant backgrounds at selection level are ZZ and $We\nu$.

Note: b-tag is used only as a second discriminant variable.

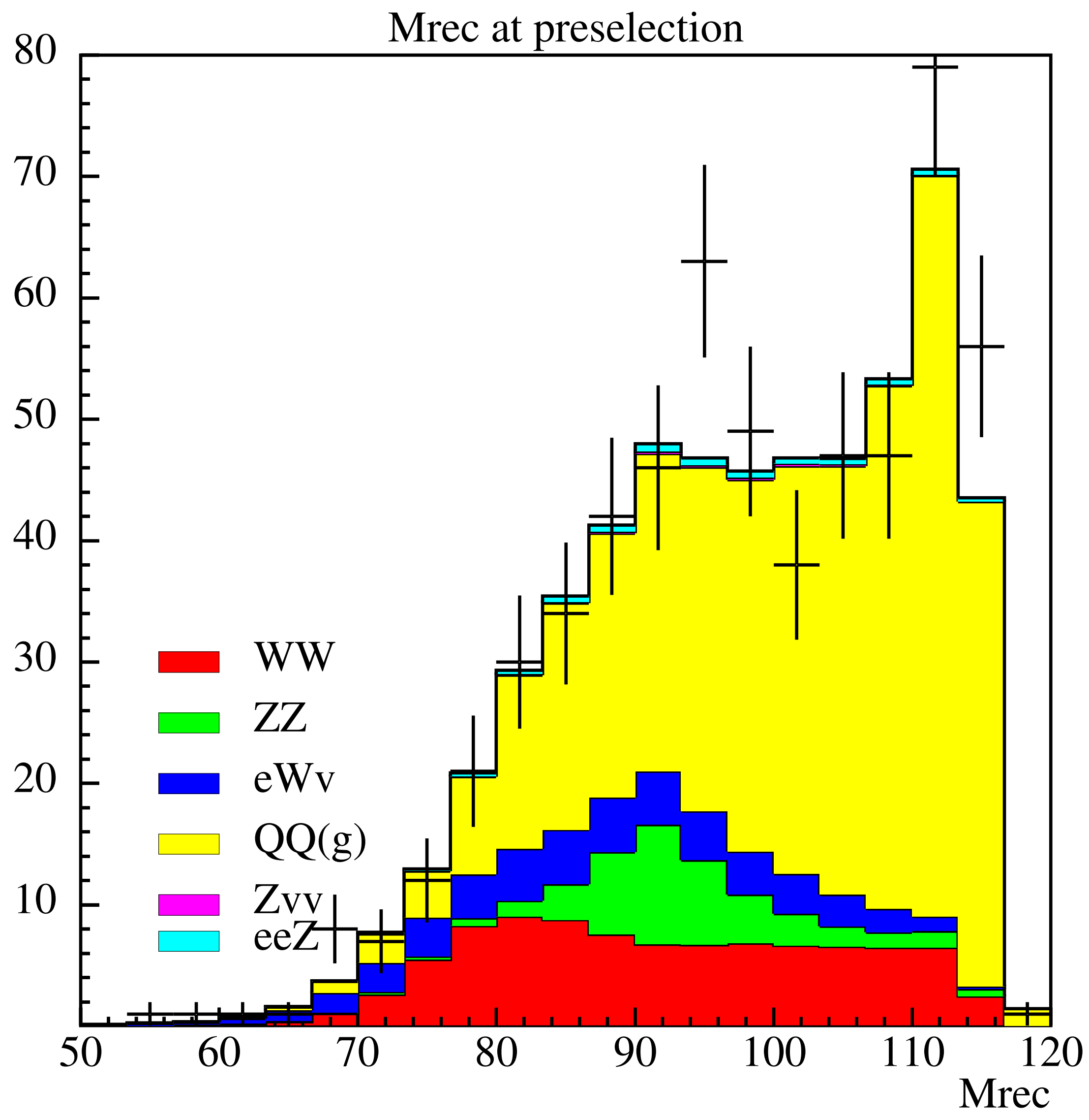
Efficiency curve



Efficiency is highly mass dependent
to optimize performance near threshold.

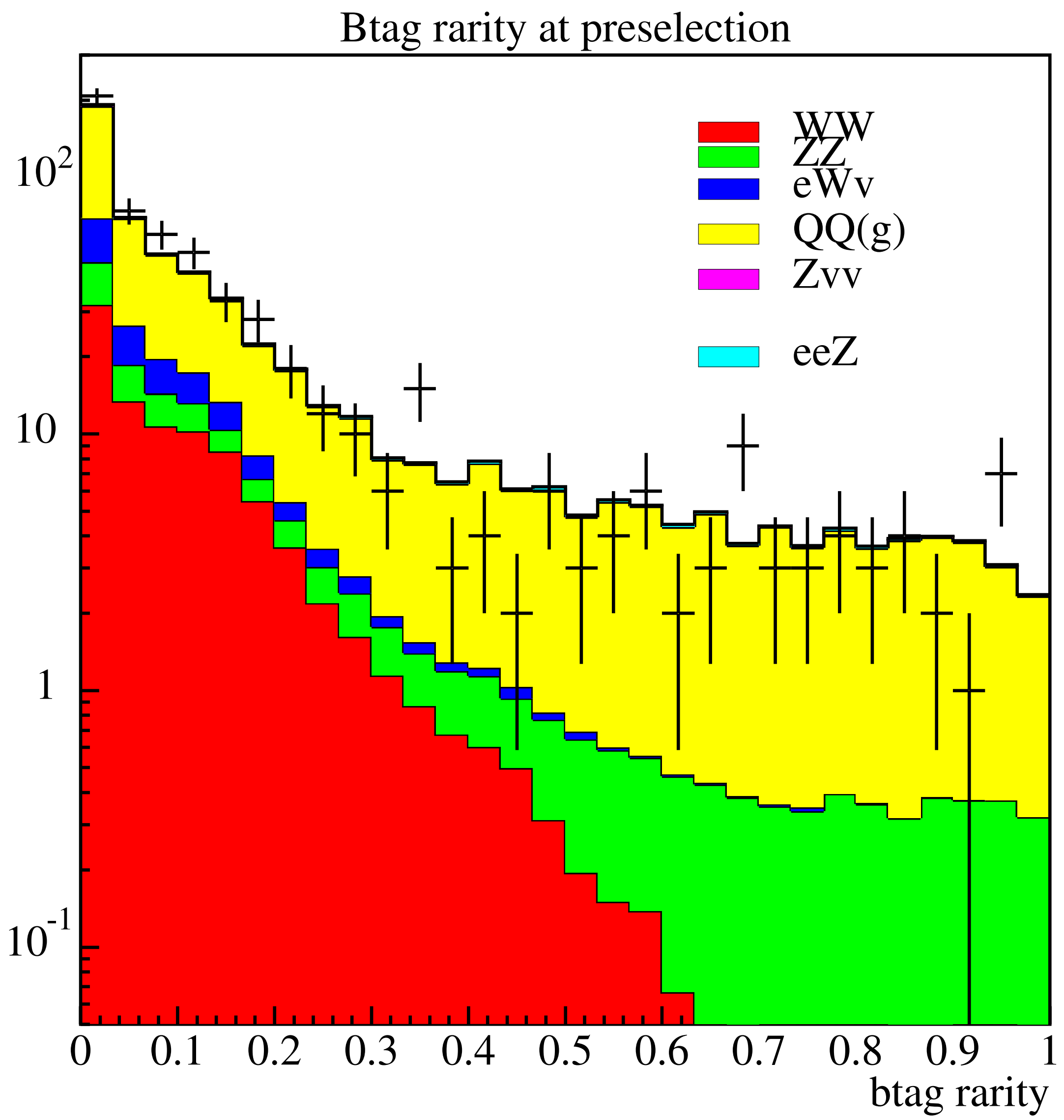
It peaks about 10 GeV below threshold.

Missing Energy Preselection



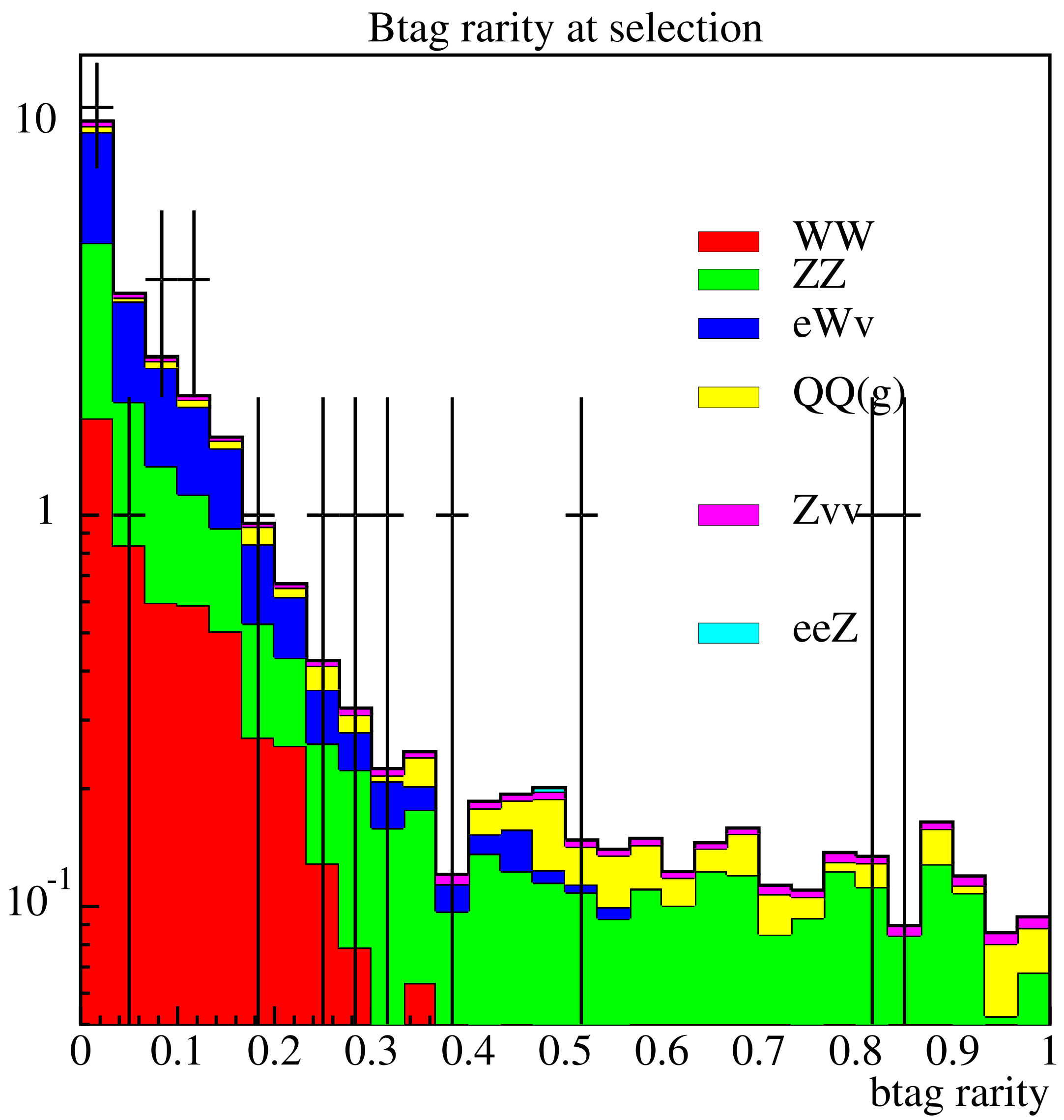
At preselection, data mass distribution agrees with Monte Carlo distribution.

Missing Energy B-tag



At preselection, data and Monte Carlo b-tag rarities agree well.

Missing Energy B-tag



There is also good agreement at the selection level between data and Monte Carlo.

Conclusion

These are results from the ALEPH online analysis

Although there is good agreement in overall number of events, there is a significant excess in the high mass region.

We currently see an excess equivalent to a 3.3 standard deviation fluctuation near 115 GeV

These results are preliminary –

Further studies are ongoing