SM Higgs Searches at LEP

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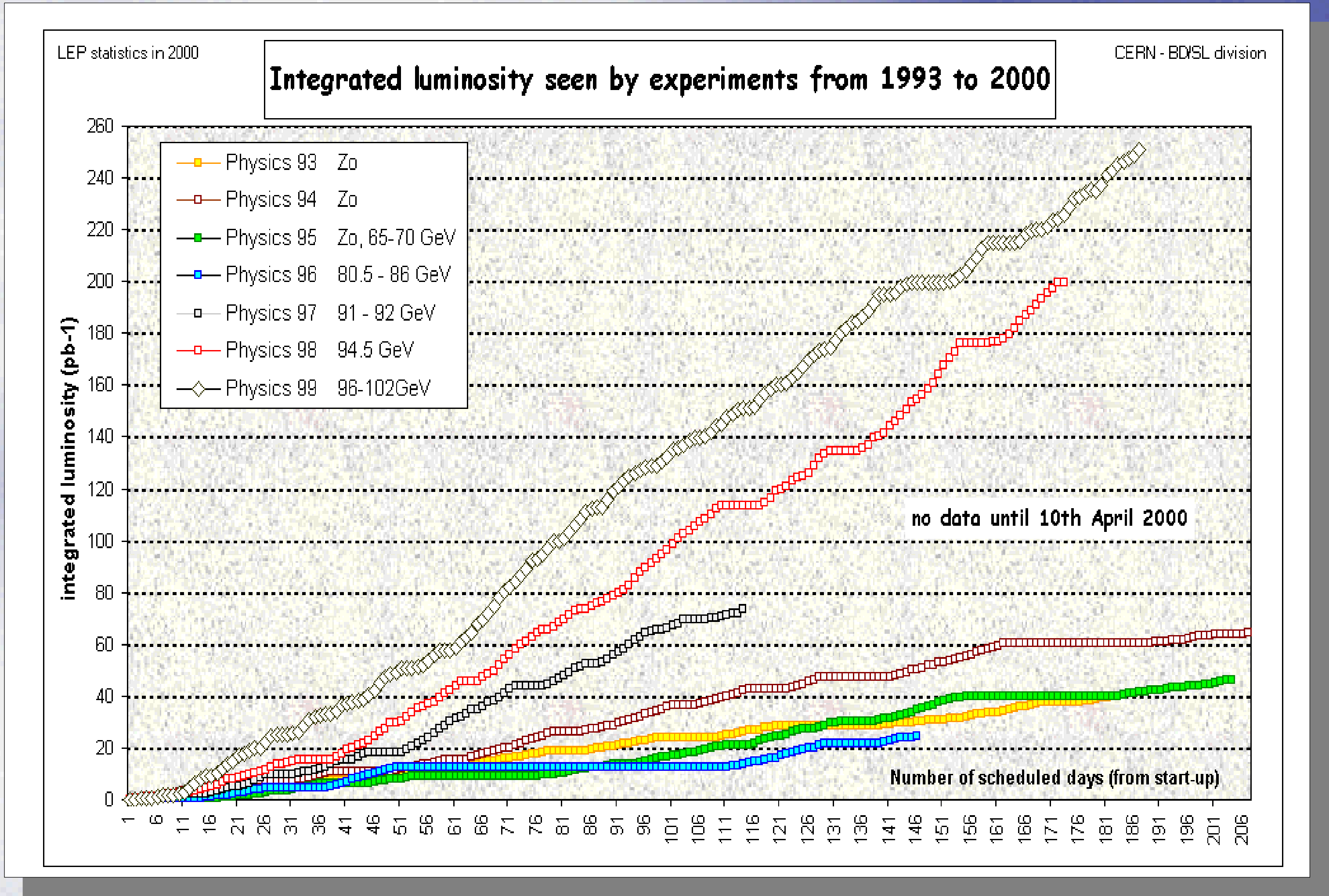
All results are still preliminary !

SM Higgs Searches at LEP

Overview:

- LEP II data taking
- Production mechanisms at LEP, decay modes
- SM Higgs Signatures
- Four jets channel
- Jets + Missing Energy channel
- Jets + Leptons channel
- Results from the experiments
- Conclusions and Outlook

Lep II data taking

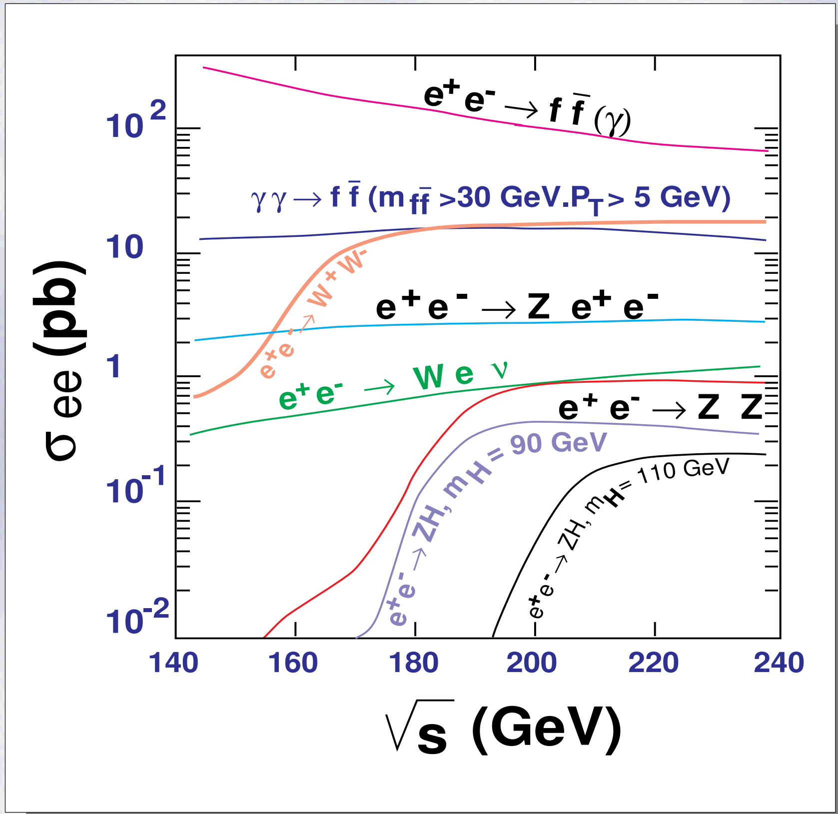


Lep II data taking

Year	CM energy	Avg. Lumi deli–vered per exp.
1997	183 GeV	55/pb
1998	189 GeV	170/pb
1999	192 GeV	30/pb
	196 GeV	90/pb
	200 GeV	90/pb
	202 GeV	40/pb

Lep is performing better than ever !

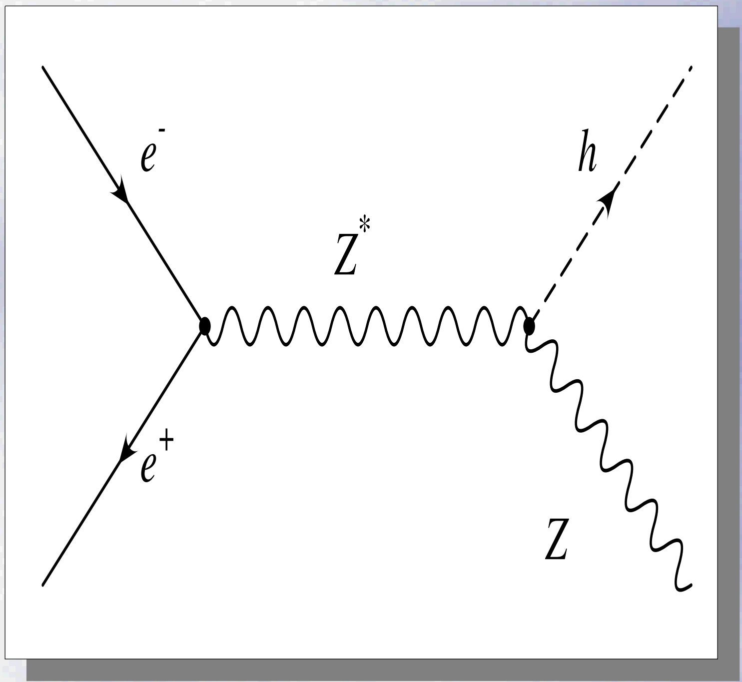
Signal and Background cross sections



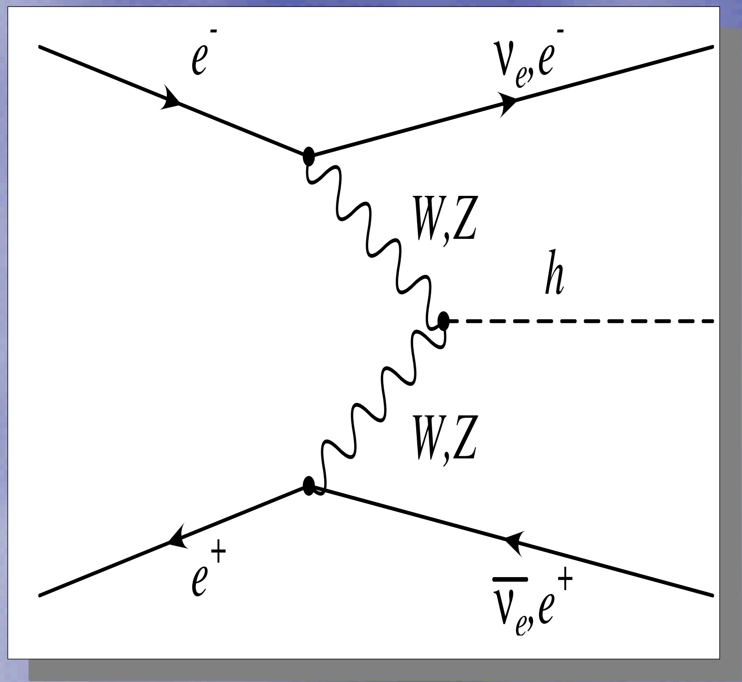
- We are looking for a small signal
- Background cross sections are up to 150 times higher

SM Higgs Production at LEP

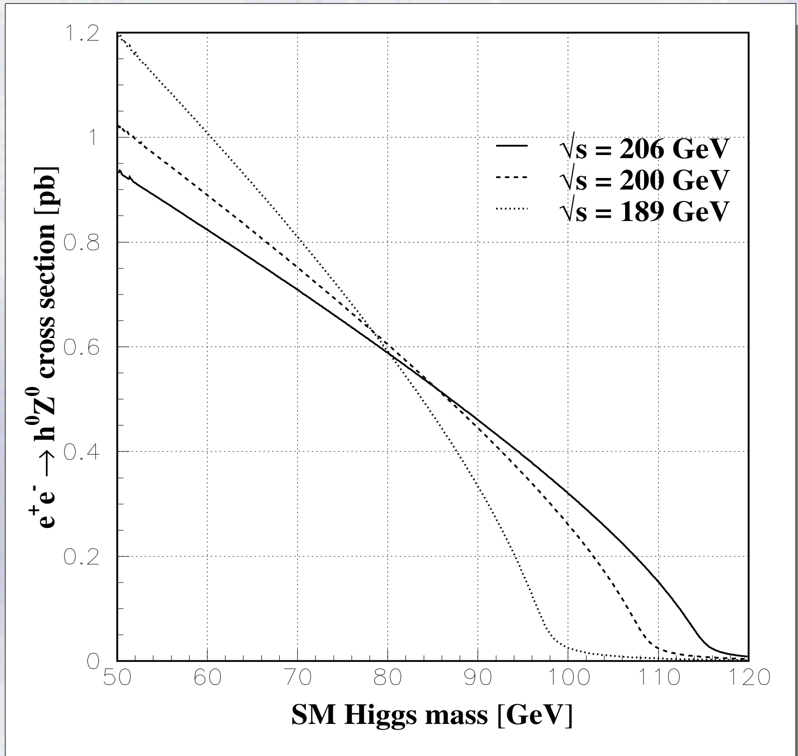
Via Higgs Strahlung:



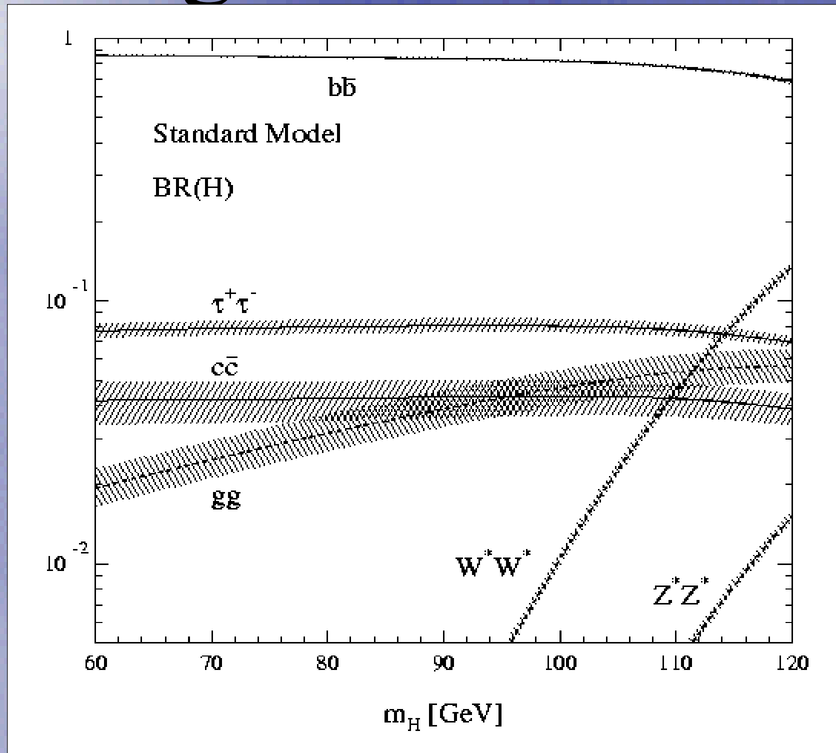
Via W/Z fusion



$e^+e^- \rightarrow hZ$ Production cross sections and H branching ratios



Production cross sections as function of m_h for different CM energies



Higgs branching ratios as function of thie Higgs mass

SM Higgs signatures

$HZ \to bbqq$

Highest relative rate ($BR(Z \to qq) = 70\%$)
but also highest background:
$WW \to qqqq$, $ZZ \to qqqq$, $e^+e^- \to qq(gg)$

$HZ \to bb\nu\nu$

Second highest statistics channel
($BR(Z \to \nu\nu) = 20\%$)
most important backgrounds:
$ZZ \to qq\nu\nu$, $e^+e^- \to qqe\nu$

$HZ \to bbll$

Small statistics channel ($BR(Z \to l\,l) = 10\%$)
most important backgrounds:
$ZZ \to l\,l\,qq$, very clean ! Higgs Mass
reconstruction possible from leptons

SM Higgs signatures

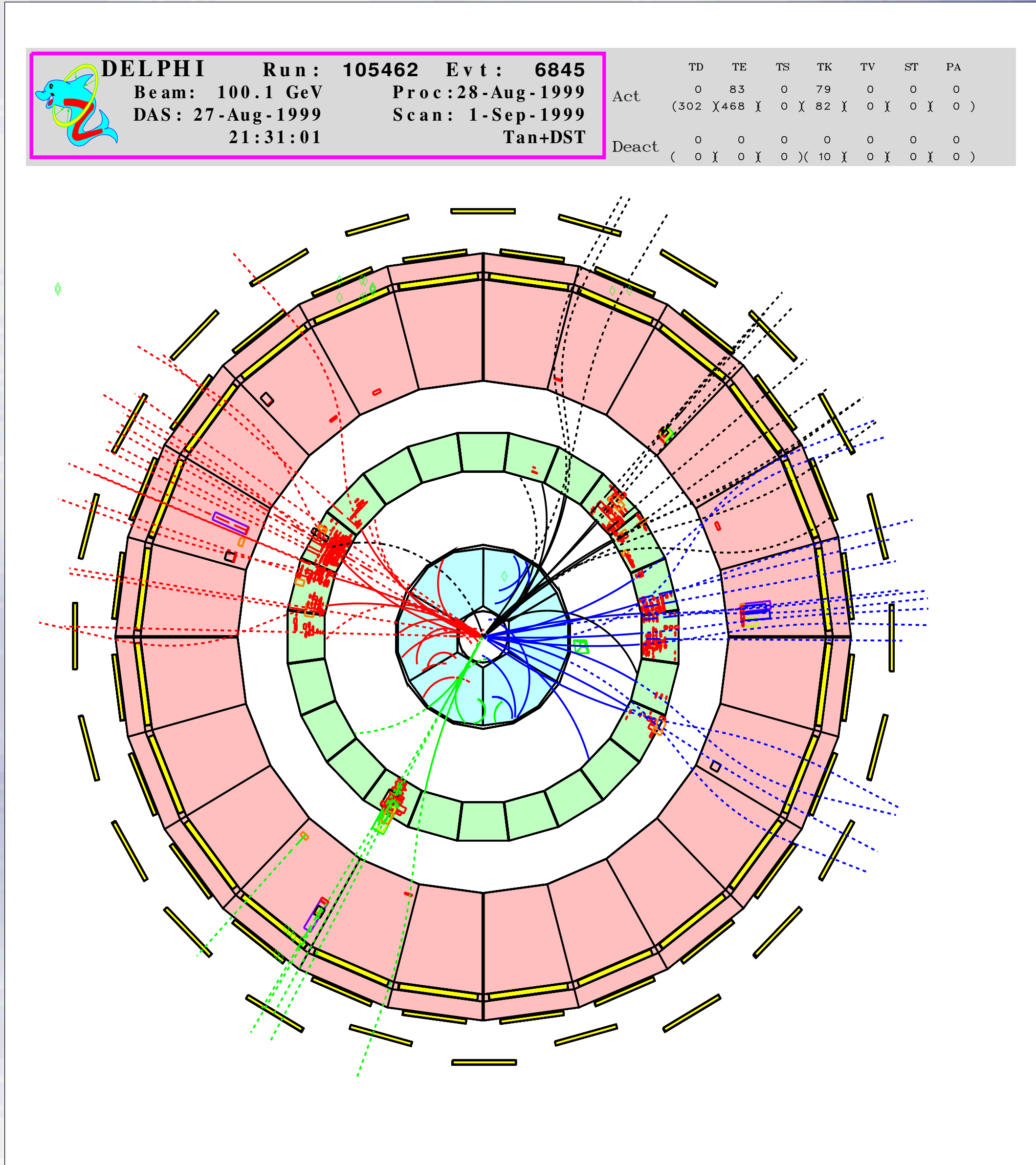
$HZ \to \tau\tau qq$

Small statistics channel (~6% of hZ decays)
overlap with bb$\tau\tau$ channel, lower B tag

Total coverage: 98% of hZ decays

Analysis procedure

- The Analyses are split into
  - a Preselection, to check the quality of the data
  - a construction of a final variable
- Examples of final variables:
  - Mass distribution
  - Combination of probability of observing a higher B tag value and probability of observing a worse mass matching (for the current mass hypothesis)
  - Neural Network Output, based on event shape, multiplicity and B tag variables; combined with mass information



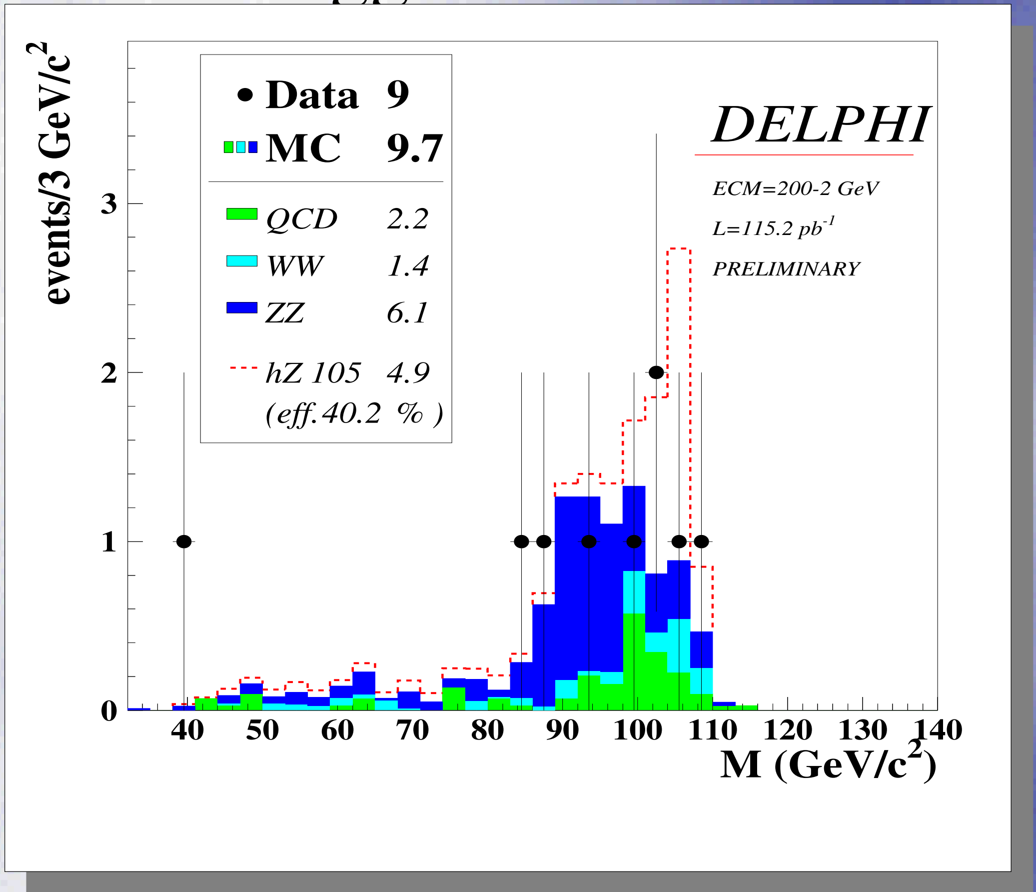
Delphi HZ $\rightarrow$ Four jets candidate

Reconstructed Higgs mass:

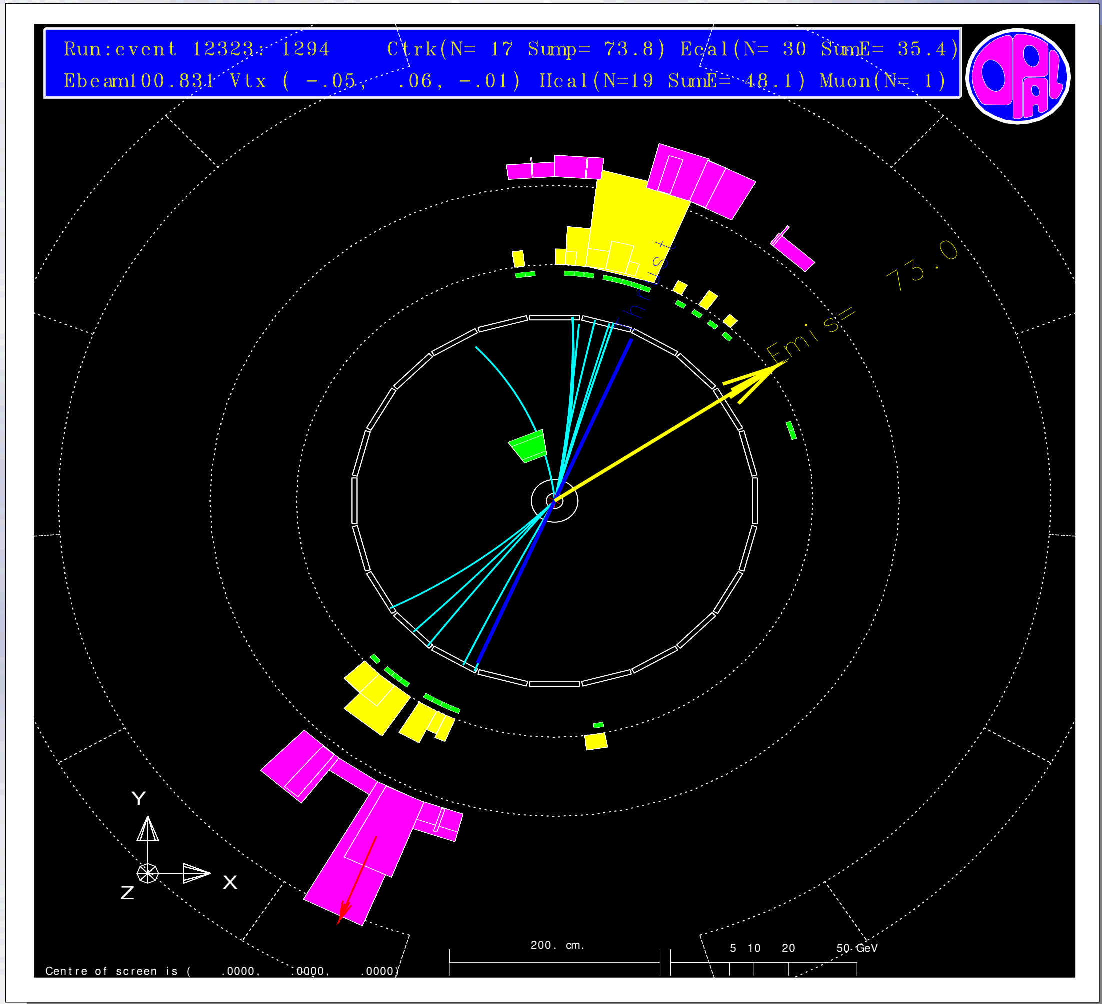
97.5 GeV

Delphi HZ → Four jets channel

- Reconstructed Higgs mass



HZ → qqνν candidate



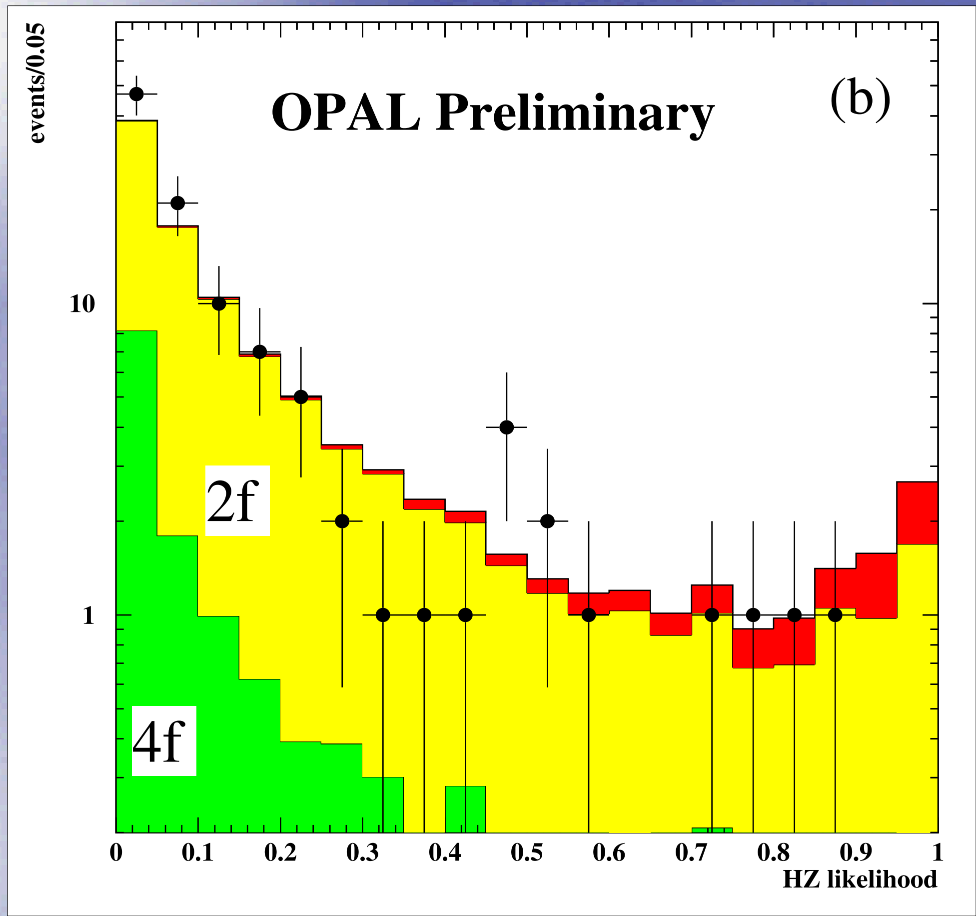
Reconstructed Higgs mass:

106.9 GeV

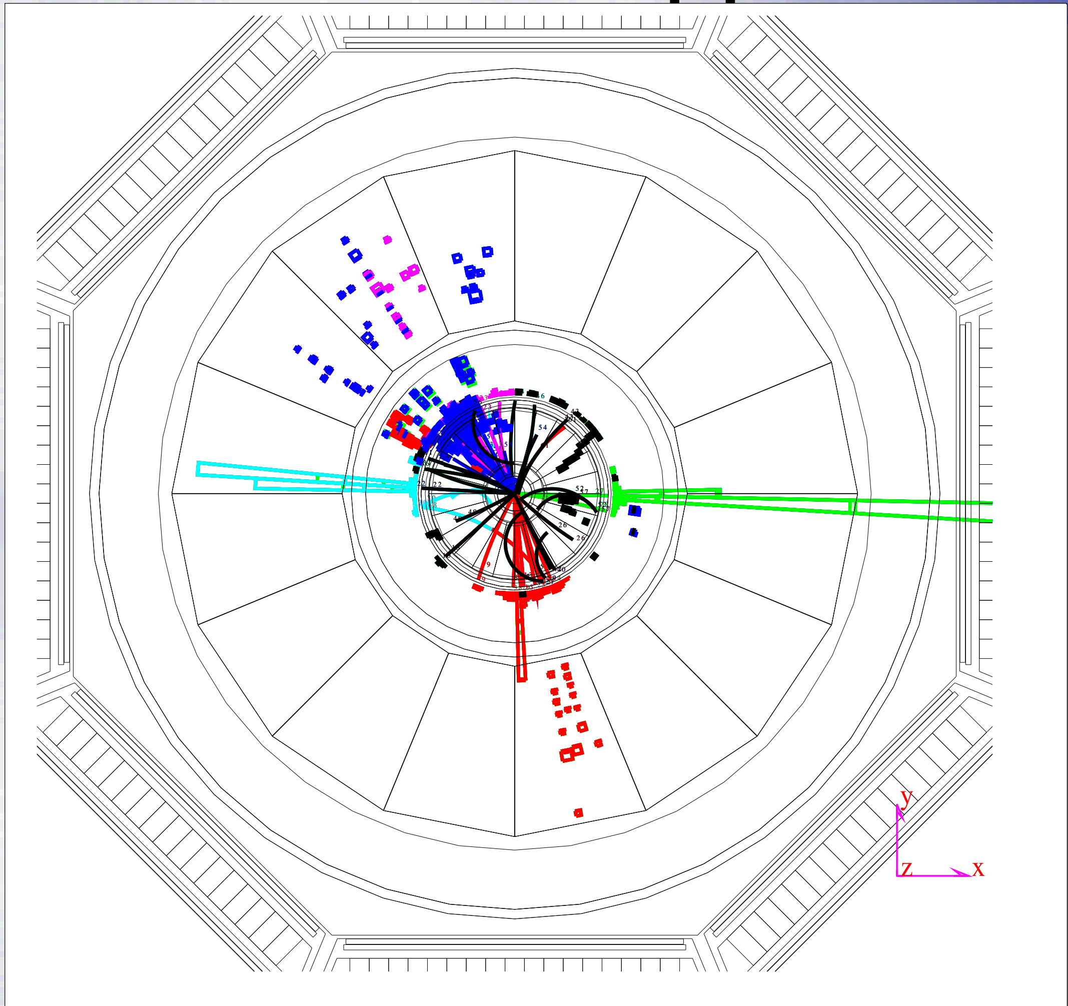
Opal HZ → qqνν channel

- Example of a final variable distribution:
- number of events after cut:

Signal (mh=100 GeV)	Background	Observed Data
3.4	8.7	5



L3 HZ → qq l l candidate

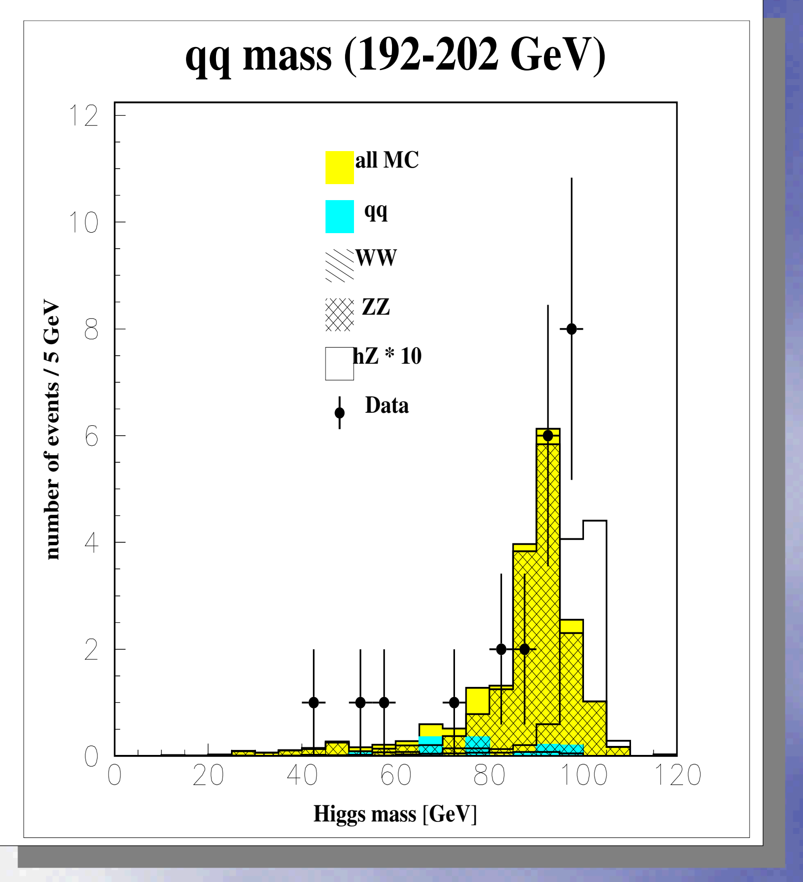


Reconstructed Higgs mass:

100.1 GeV

L3 HZ → qq l l channel

- Reconstructed mass distribution (L3 preliminary):



Combining the individual channels

- No indication of a signal
  → we set lower limits on the Higgs mass
  at 95% CL:

	Aleph	Delphi	L3	Opal
Expected (med.) Limit [GeV]	106.6	105.9	105	102.0
Observed Limit [GeV]	105.6	106.2	103	102.0

(note that different experiments analyzed different luminosities)

Conclusions and outlook

- No indication for a SM Higgs observed so far

  M(h) > 102.0 GeV at 95% CL

  (preliminary – all four Experiments combined with all luminosity not yet available)
- LEP is foreseen to run up to a center of mass energy of 206 GeV (or higher) in the year 2000 $\rightarrow$ sensitivity in the mass range will be extended
- Discovery potential of the four experiments combined: ~110 GeV if >200 pb^{-1} in 2000 at 206 GeV per experiment