Search for the Higgs boson in the inclusive WW channel at CMS

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- The Higgs search strategy in the inclusive channel
- Visibility of the H-->WW--> 2l 2nu channel
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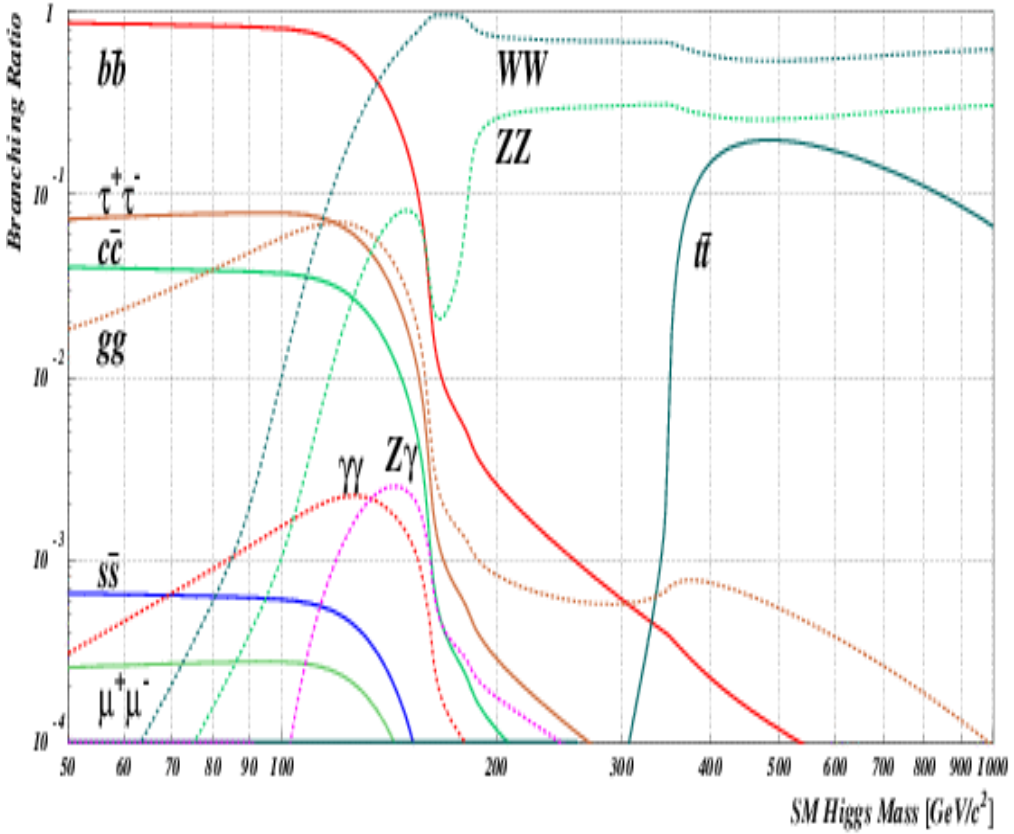
Standard Model Higgs decay

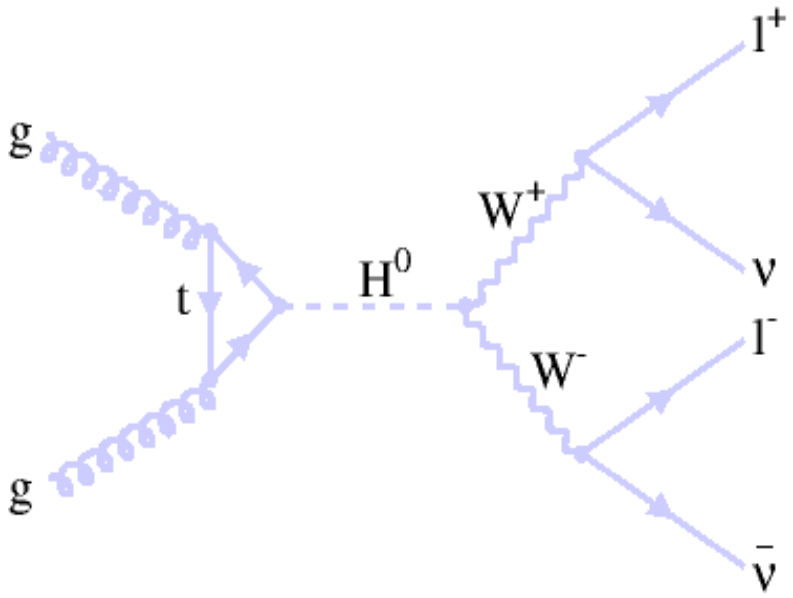


m_H (GeV/c^2)	BR(H→WW)
160	0.90
170	0.96
180	0.93

Intermediate mass range 155 GeV/c^2 < m_H < 180 GeV/c^2

almost exclusive Higgs decay in WW

H-->WW--> 2l 2nu signal



m_H (GeV/c^2)	$\sigma_{LO} \times$ BR (pb)
160	1.25
170	1.24
180	1.11

$$W \rightarrow l\,\nu, \quad l = e,\ \mu,\ \tau$$

two neutrinos in the final state: no peak reconstruction
--> good S/B ratio needed
--> optimal knowledge of all the background sources needed

at LHC large jet background -->
difficult detection of W hadronic decays

Background sources

- WW

main (irreducible) background

- Wtb
- ttbar

Smaller contributions:

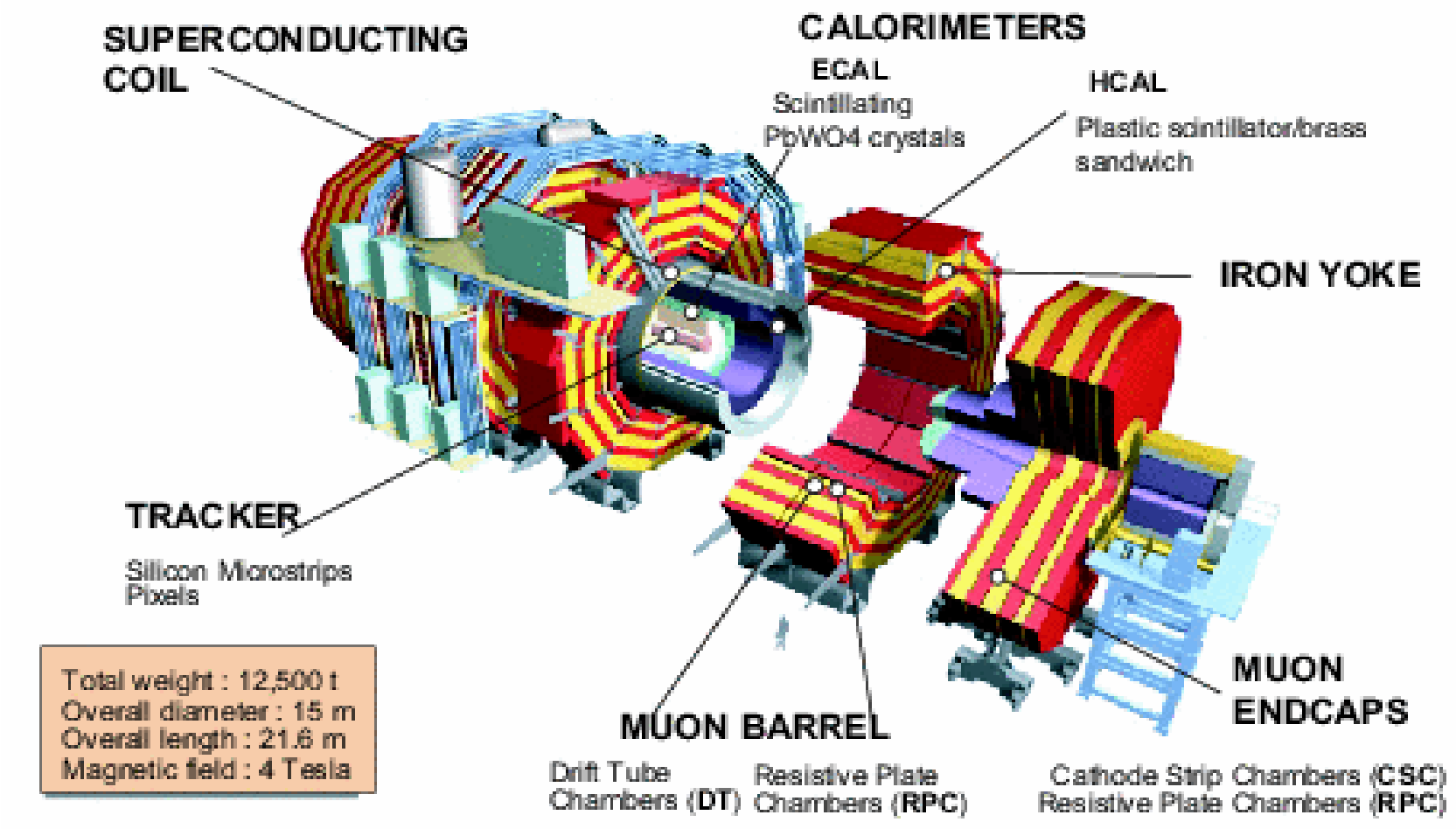
- ZZ, WZ
- W+jet, where the jet is misidentified as a lepton
- .....

process	$\sigma_{LO} \times$ BR (pb)
qq $\rightarrow$ ww	7.4
wtb	5.2
$t\bar{t}$	52

$$W \rightarrow l\,\nu, \quad l = e,\ \mu,\ \tau$$

This is a counting experiment:
all the backgrounds have to be kept separately under control

The CMS detector



The strategy

- No mass peak: search for a signal excess over background
- Signal events are selected requiring:
  - 2 high p_T isolated leptons not consistent with a Z decay
  - missing energy
  - No jet activity (to reduce top background)
  - Small opening angle between the 2 leptons in the plane transverse to the beam due to spin correlations
- For the remaining events: comparison between the leptons p_T spectra for signal and background (cuts dependent on the Higgs mass)

The WW background

Reduction exploiting spin correlations

Signal:

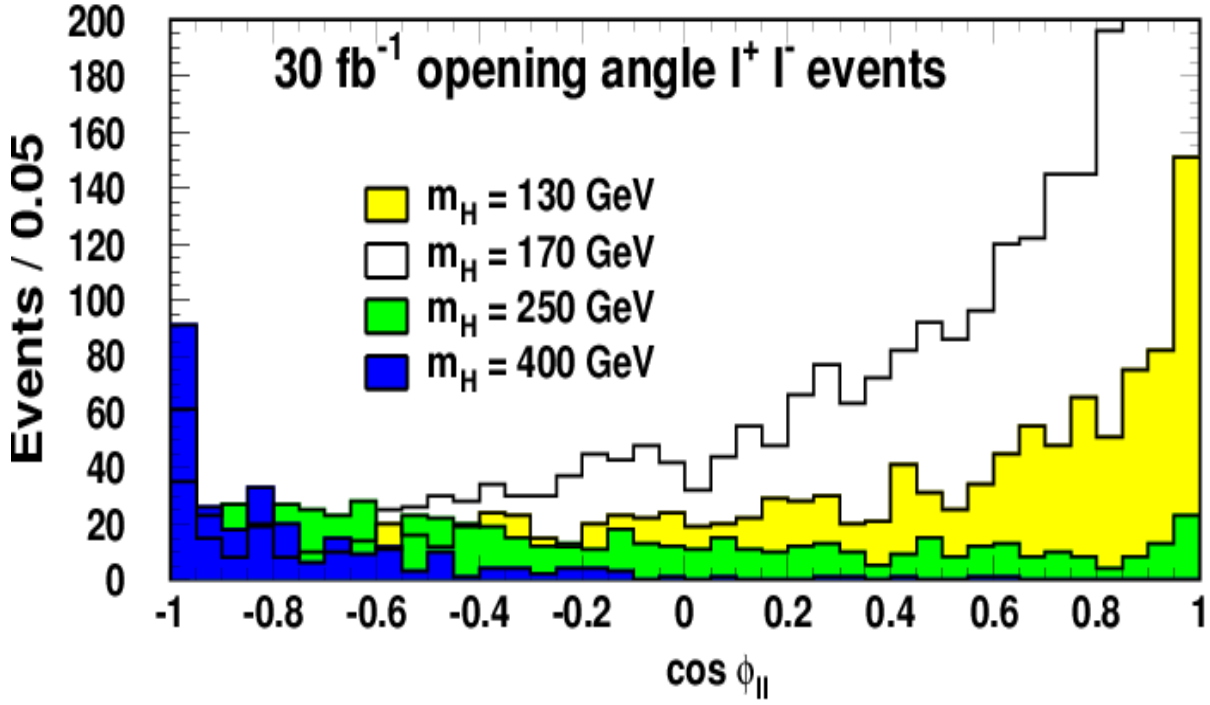
Higgs scalar, W vector

- TL couplings not allowed
- leptons emitted in almost the same direction

WW:

unpolarized initial state

- TL couplings allowed (M_{WW}=165, ~ half prod.rate)
- no correlation in the leptons directions

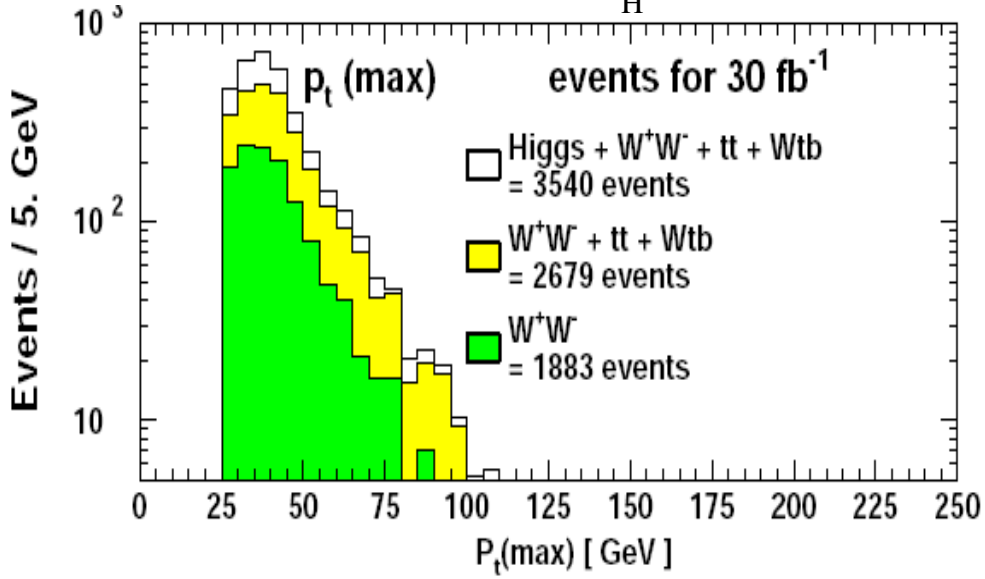


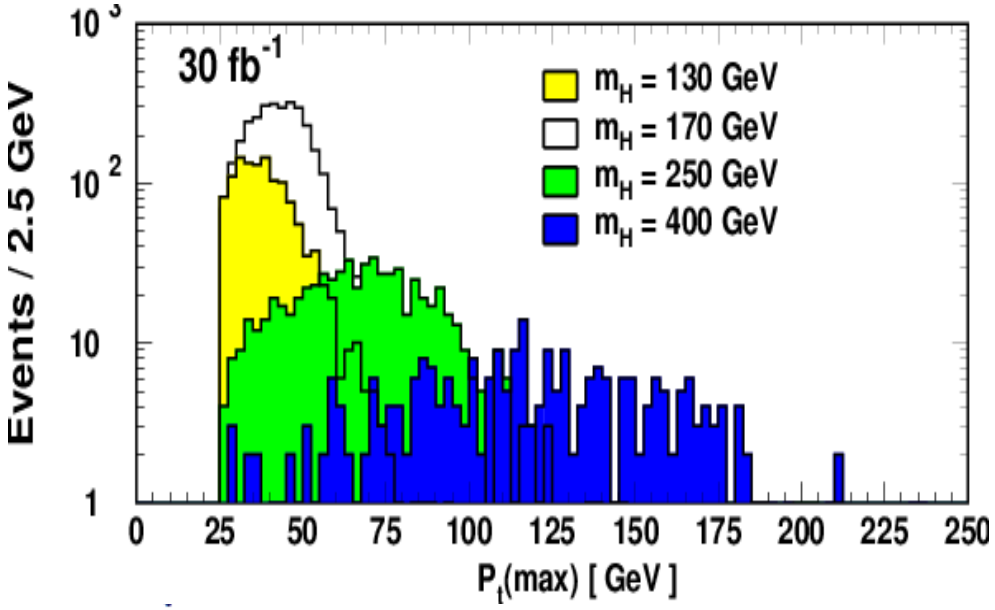
Strong effect for low masses

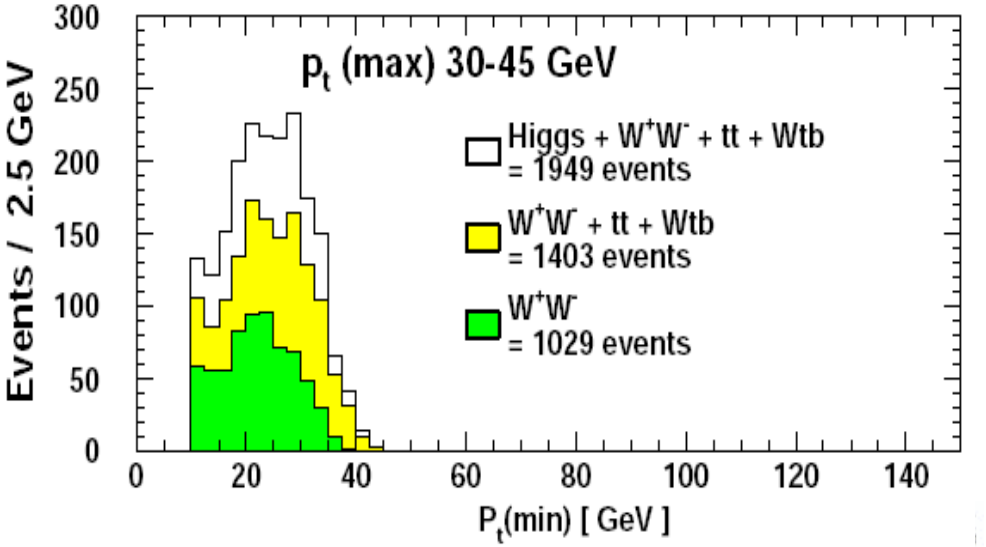
Leptons p_T spectra

- Study of the kinematics of the largest p_T lepton
- 2nd lepton analysed in the ` signal` region after selections on the 1st one

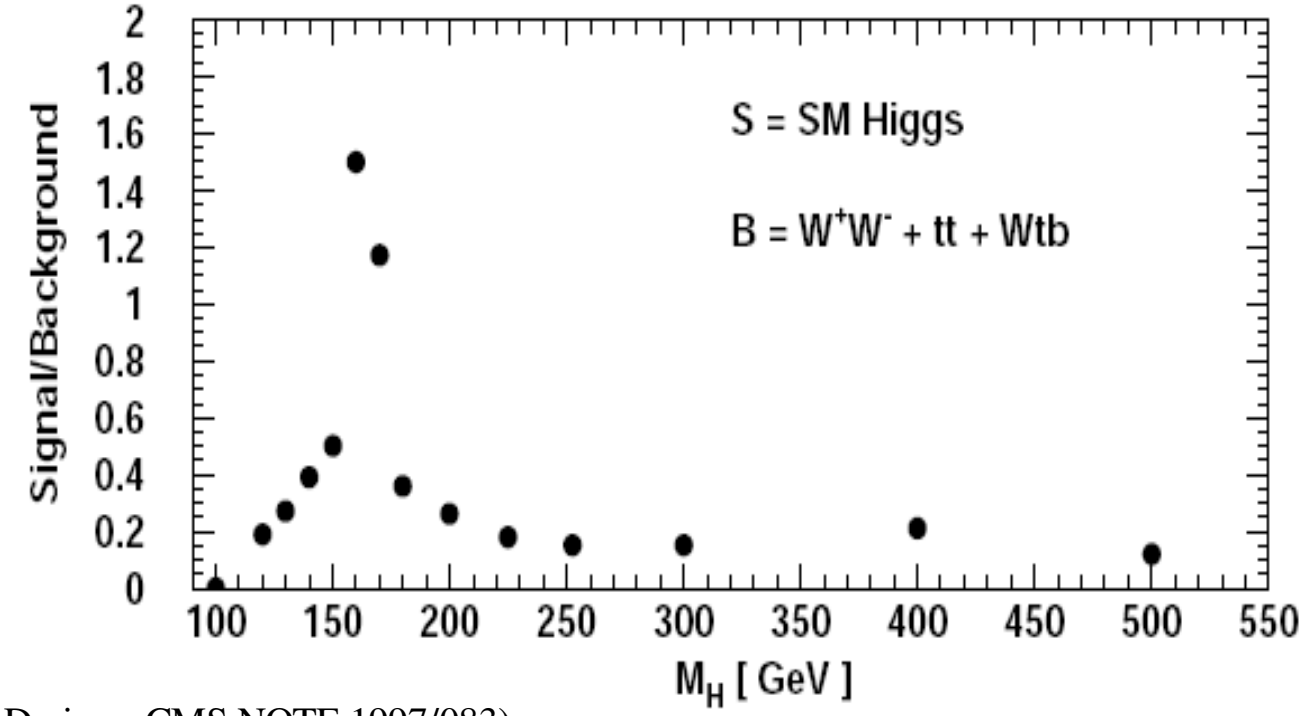
M_H=140 GeV/c^2







The first results



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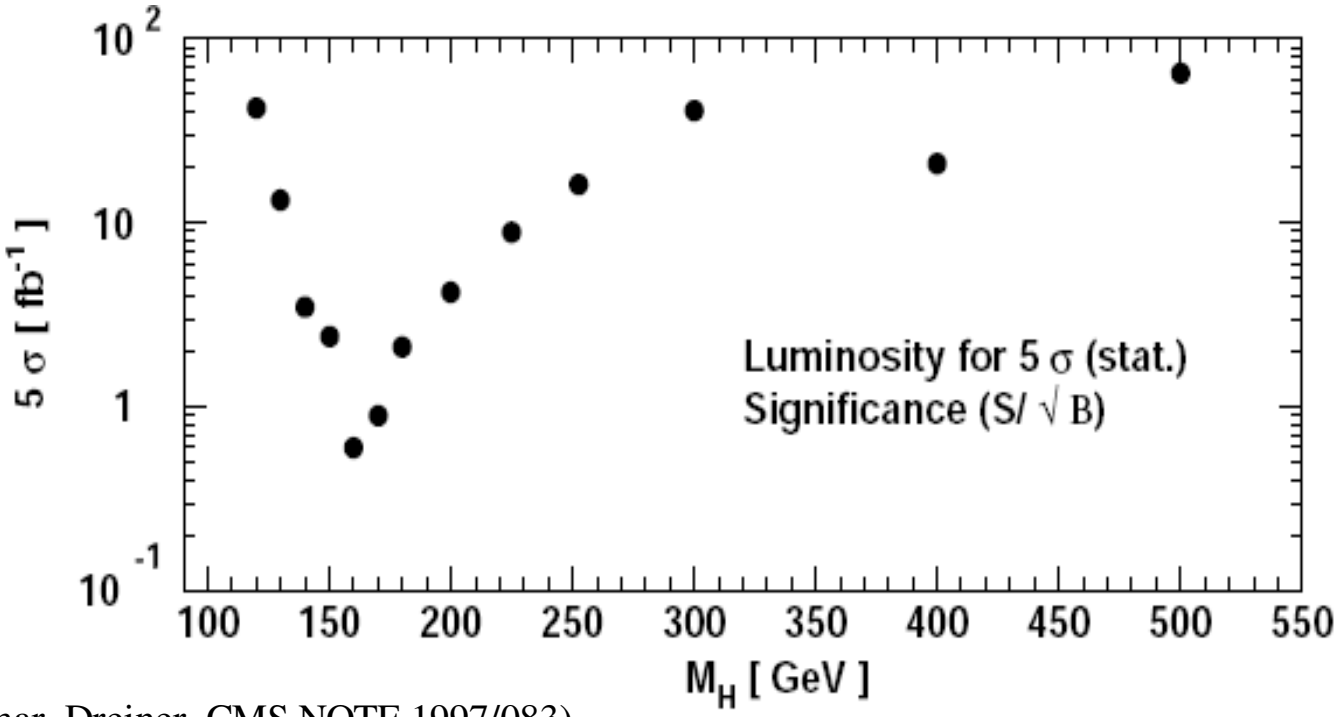
(Dittmar, Dreiner, CMS NOTE 1997/083)

- only statistical errors included
- NLO k factors for signal, ww and ttbar backgrounds included
- no k factor for wtb background
- Higgs mass dependent cuts

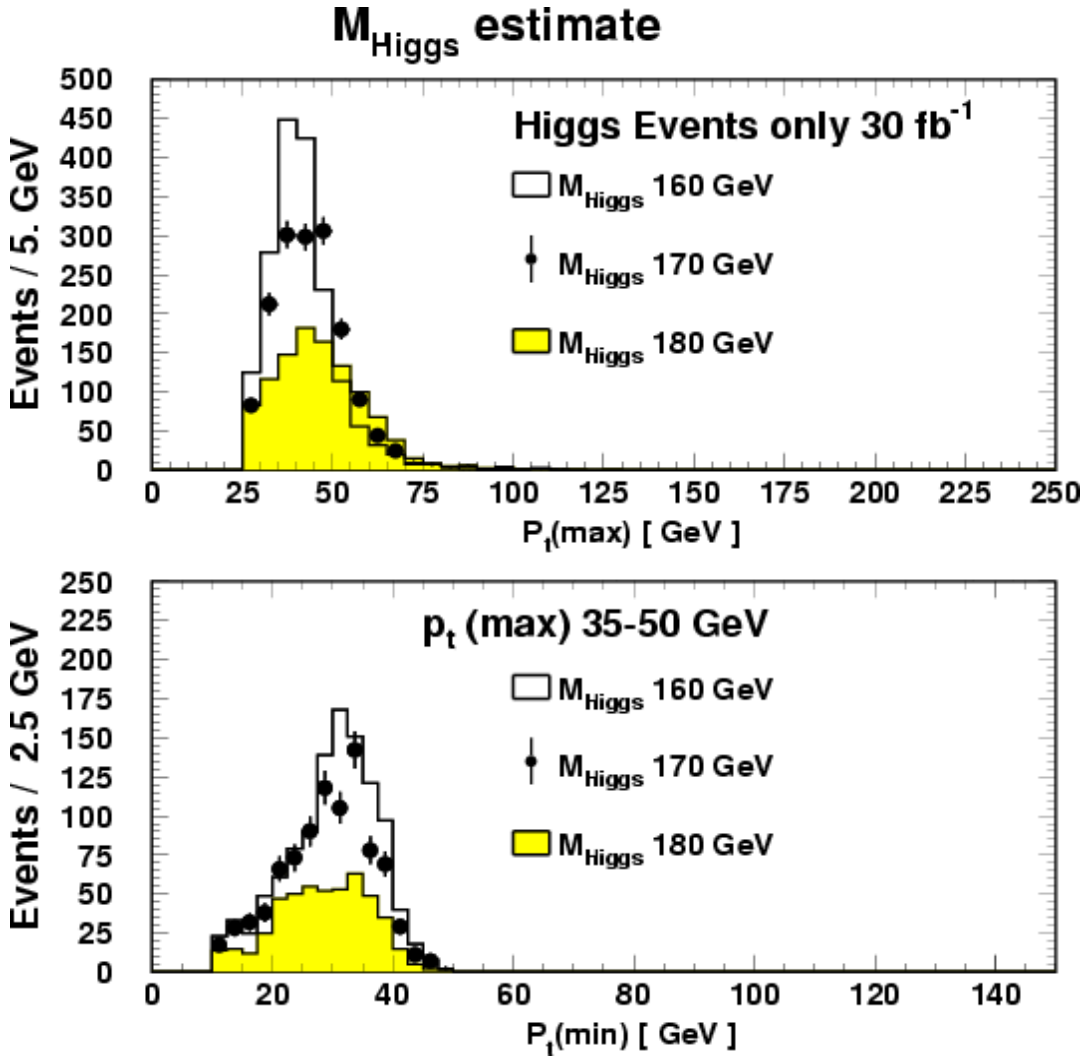
The first results



(Dittmar, Dreiner, CMS NOTE 1997/083)

- discovery channel for the range 155 GeV/c^2 < m_H < 180 GeV/c^2
- few months at the LHC low luminosity enough for the discovery
- high significance for masses between 140 – 200 GeV/c^2
- low mass: vector boson fusion much better

Higgs mass estimate



No peak:
looking for variables which are sensitive to the Higgs mass

- leptons p_T spectra
- ww transverse mass
- others ?

What is going on

A detailed analysis is currently ongoing in CMS
with a full and realistic simulation of the detector

Main experimental issues:
-- lepton reconstruction --->
efficiency, momentum resolution, isolation...
-- jet reconstruction and calibration --->
different algorithms, jet energy corrections...

Main theoretical issues:
-- background theoretical estimation
-- different generators comparison
-- NLO cross sections. Constant k factors or p_T dependent k factors

Goal: good understanding of all the backgrounds and systematics

Conclusions

- The channel H-->WW-->2l 2 nu is very promising for the Higgs search at the LHC
- It is THE discovery channel in the mass range 155 – 180 GeV/c^2 : only few months at the LHC low luminosity are enough for the discovery, provided all the backgrounds and systematics are well understood
- Promising results have been obtained over the entire considered mass range