

# PH3520 / Particle Physics

## Autumn term 2011 – week 11



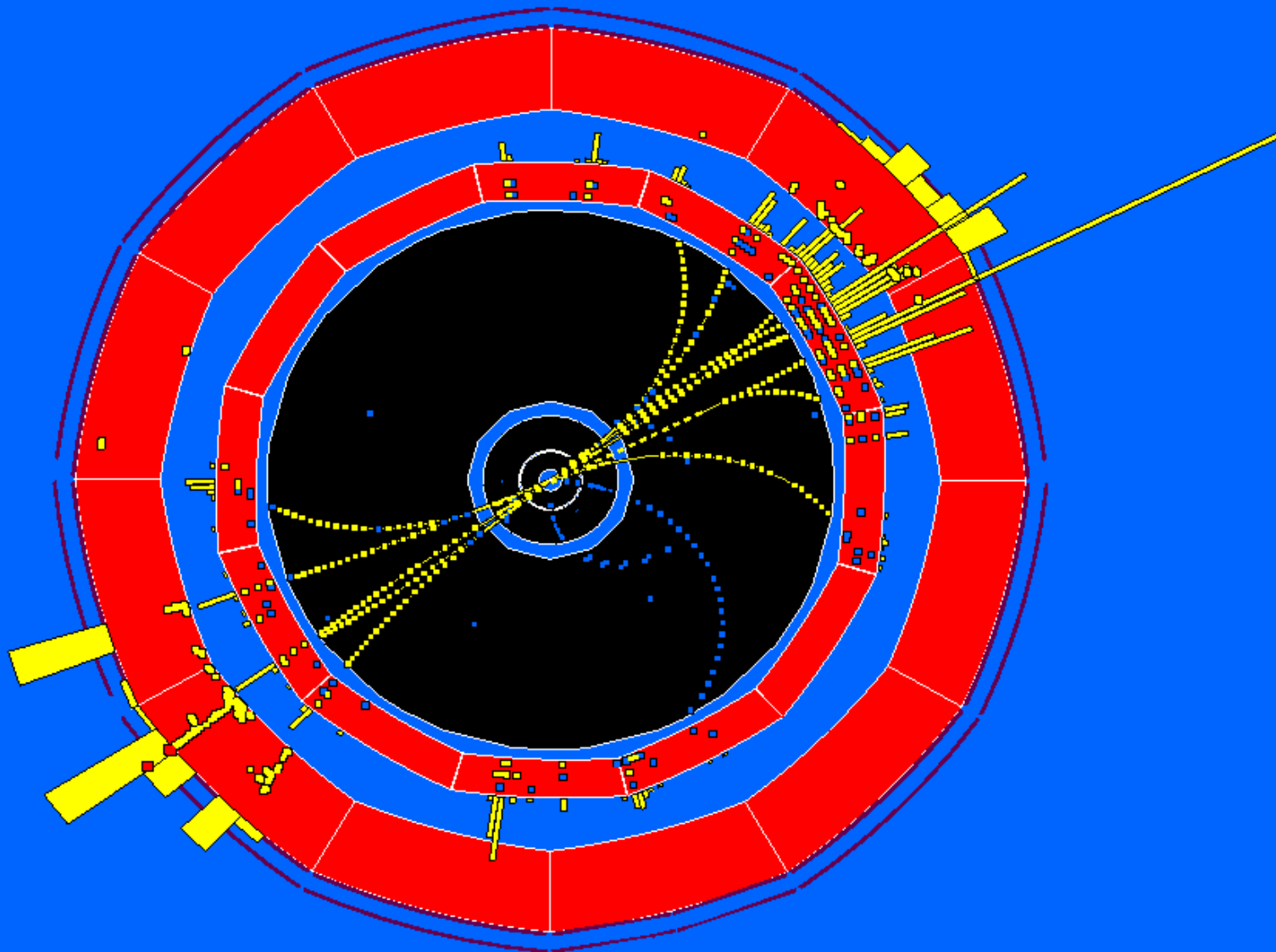
Glen Cowan  
Stewart Boogert



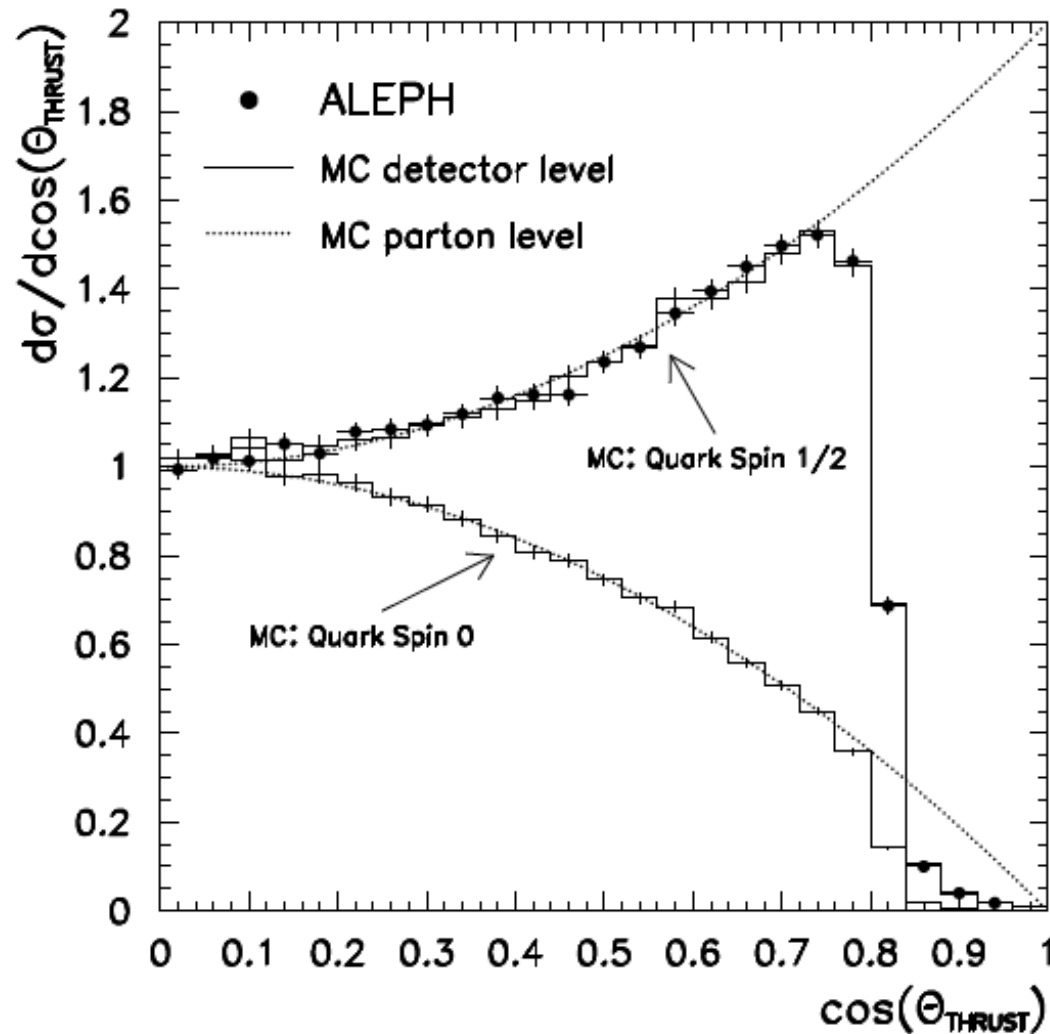
# Two-jet event at ALEPH (LEP)

 ALEPH DALI

Run=15768 Evt=5906



# Angular distribution of thrust axis



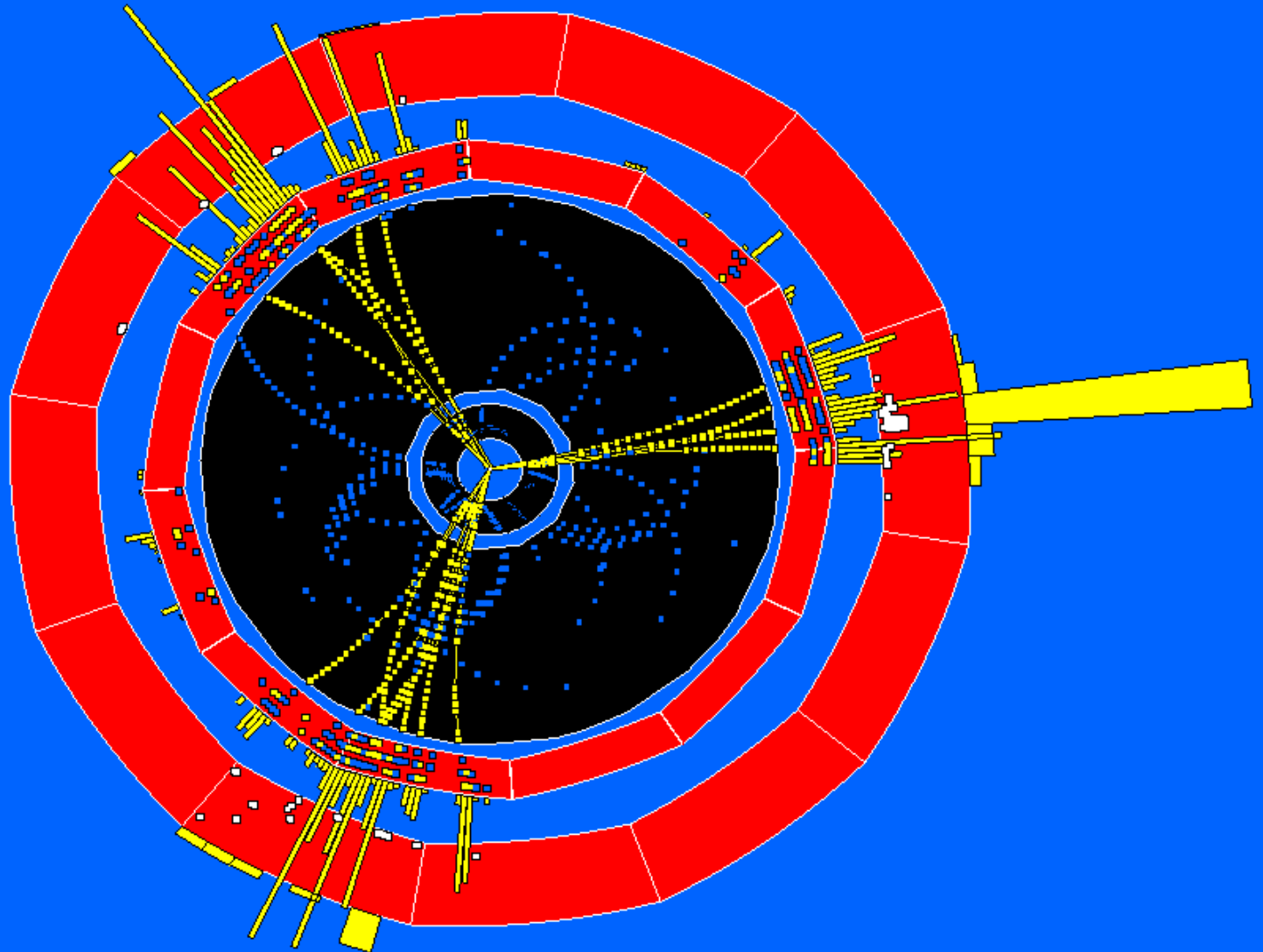
→ Quarks have spin  $\frac{1}{2}$ !

# Three-jet event at ALEPH (LEP)

 ALEPH DALI

Run=9063

Evt=7848

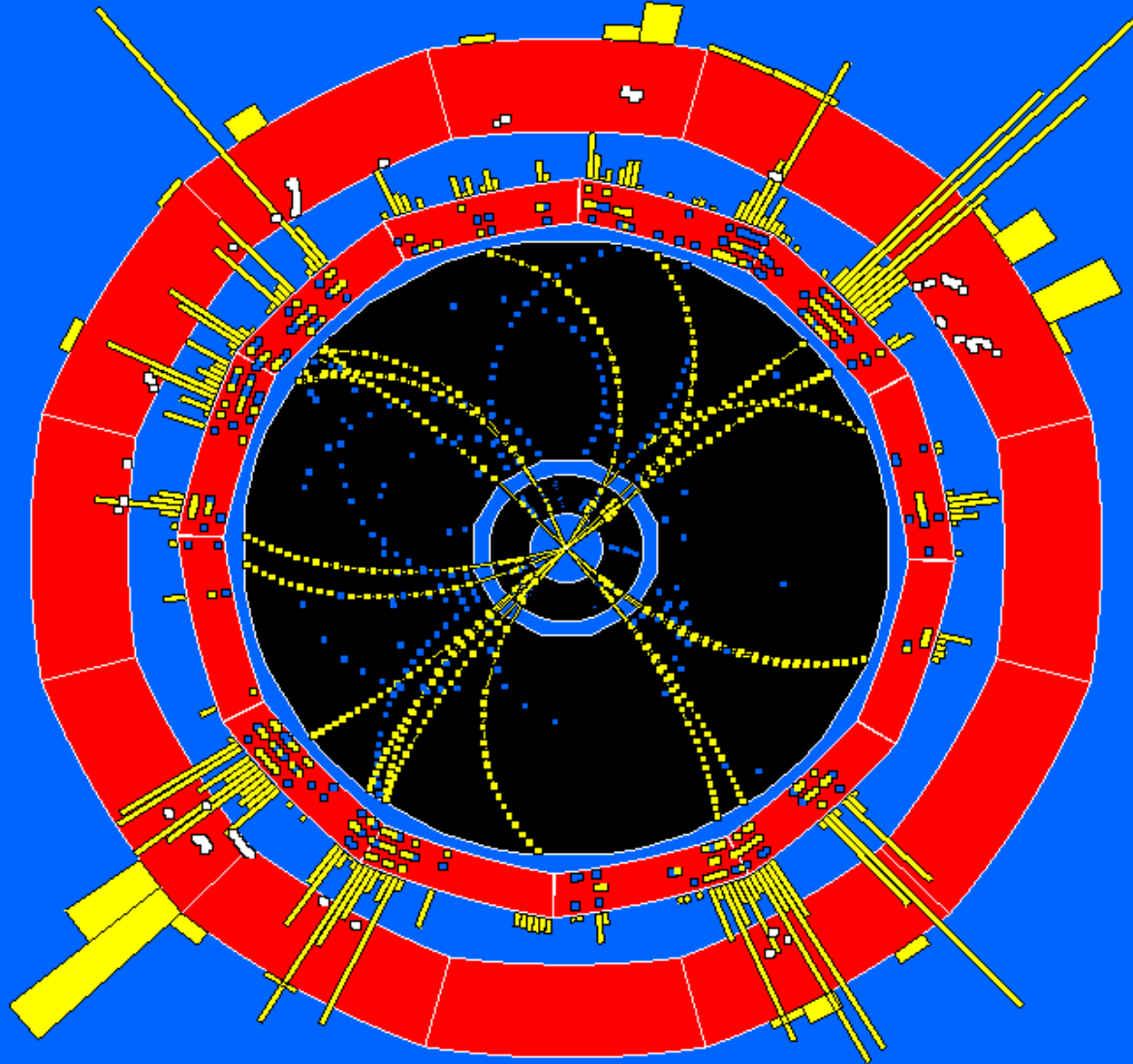


# Four-jet event at ALEPH (LEP)

ALEPH DALI

Run=9095

Evt=8852



# Measurements of $\alpha_s$

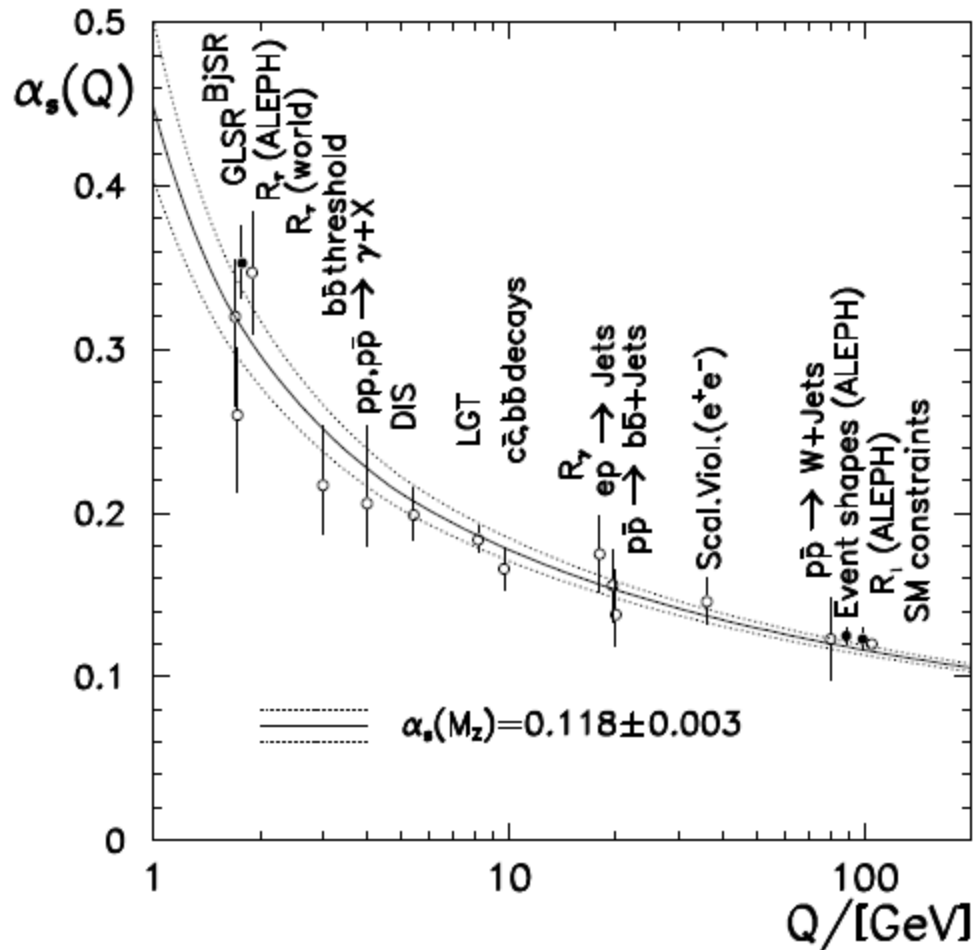


Figure 11.7: Measurements of  $\alpha_s$  from different processes shown with the QCD prediction (from [82]).

# Constraints on Higgs and top masses from higher order electroweak corrections

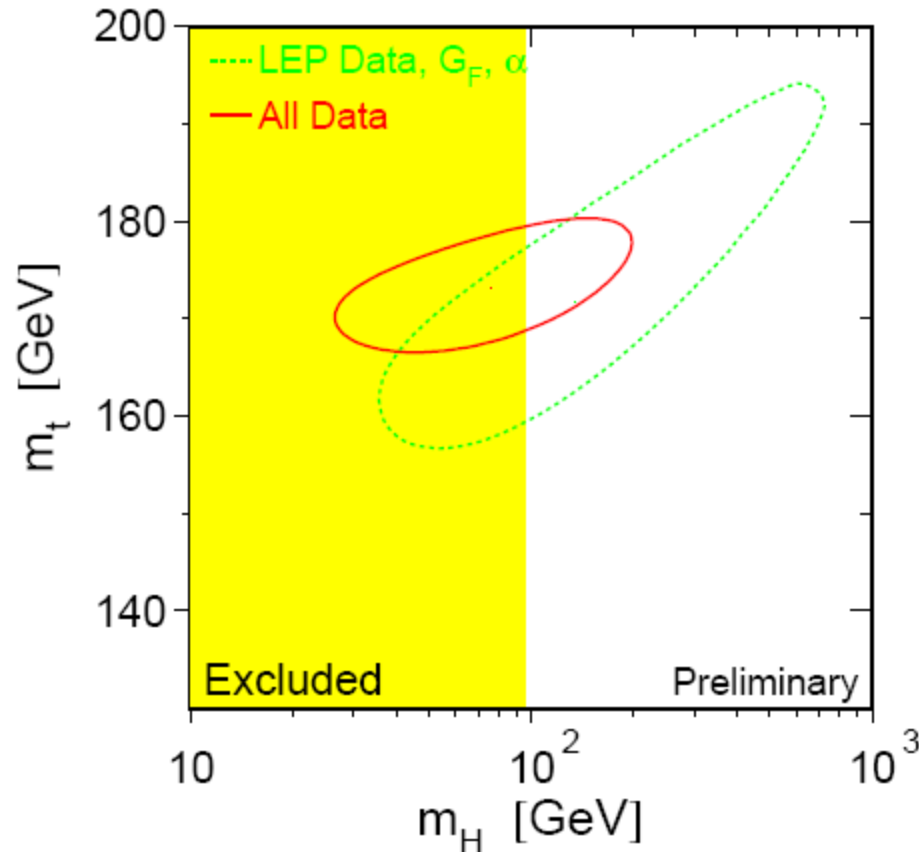
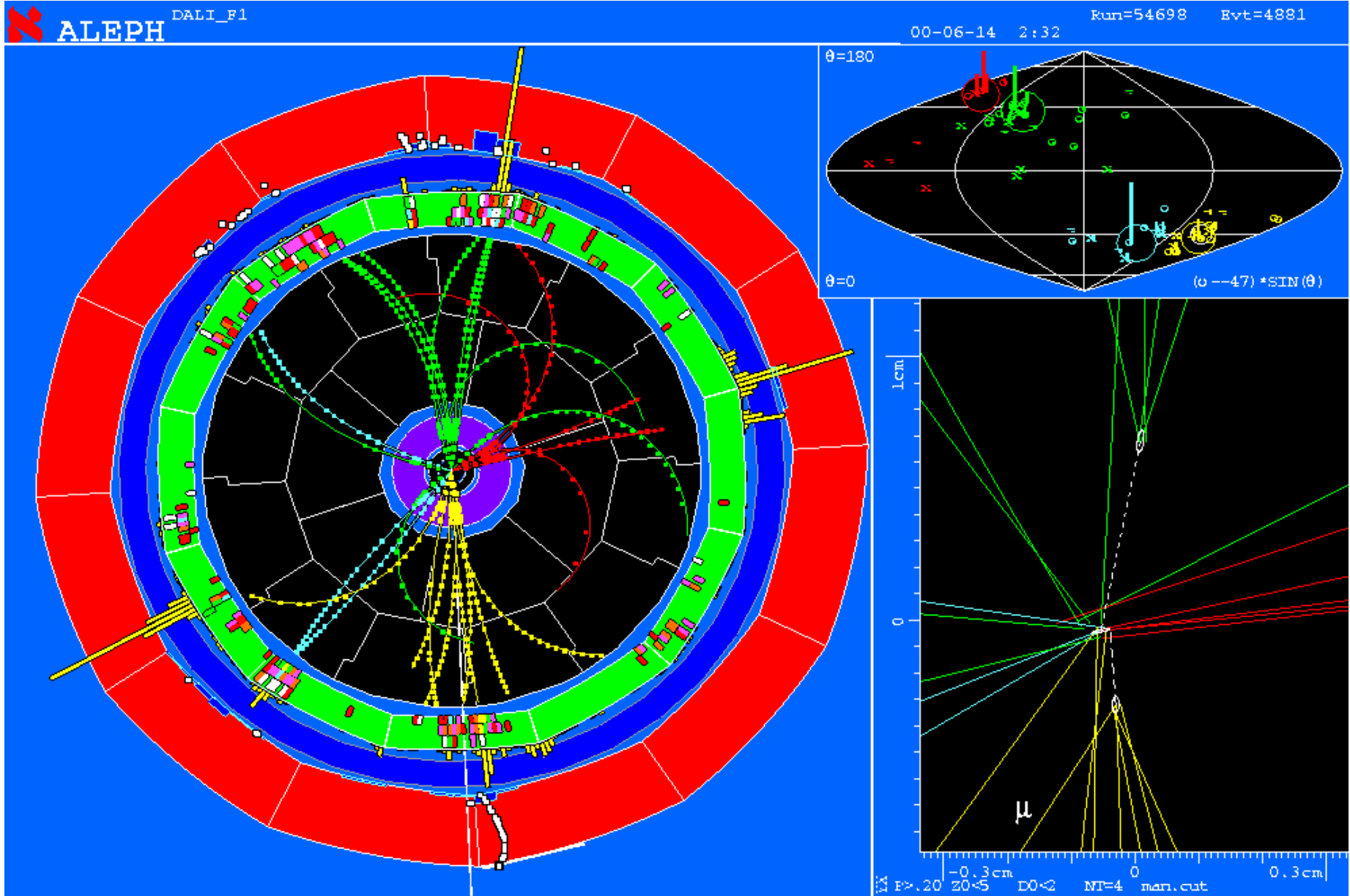


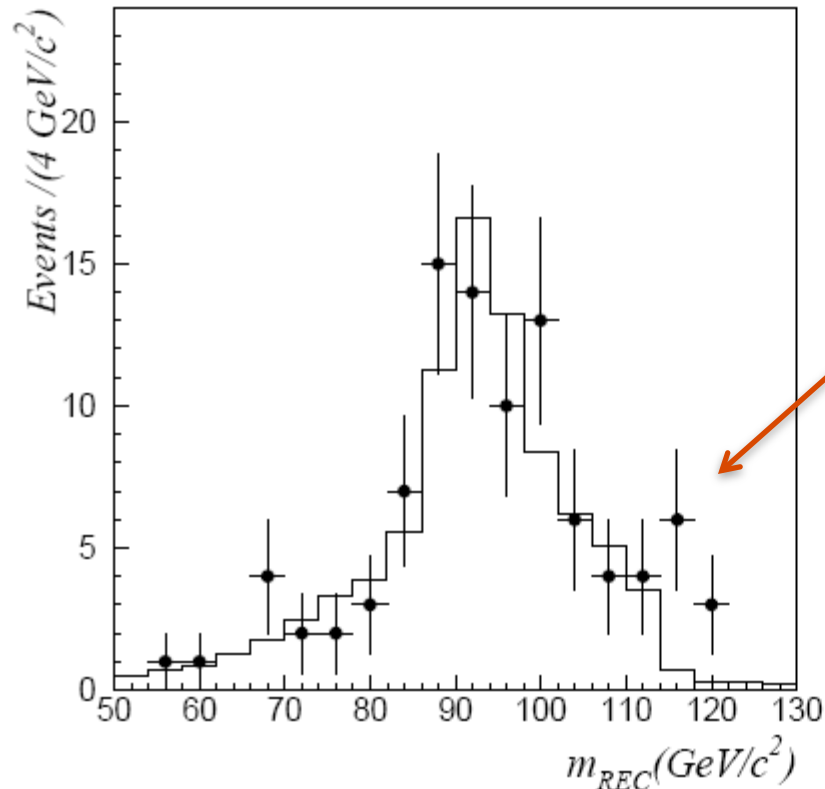
Figure 12.5: The 68% confidence region for  $m_t$  versus  $m_H$ .

# Candidate Higgs Event at LEP





# Mass distribution of Higgs candidates from ALEPH (LEP)



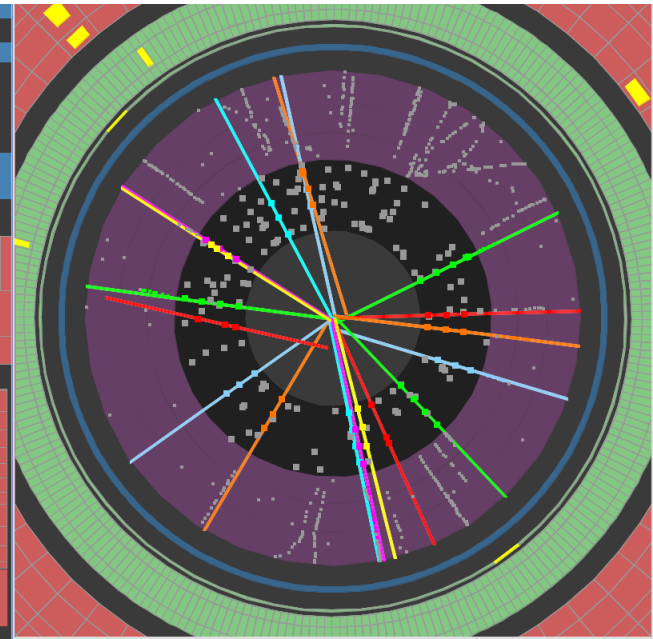
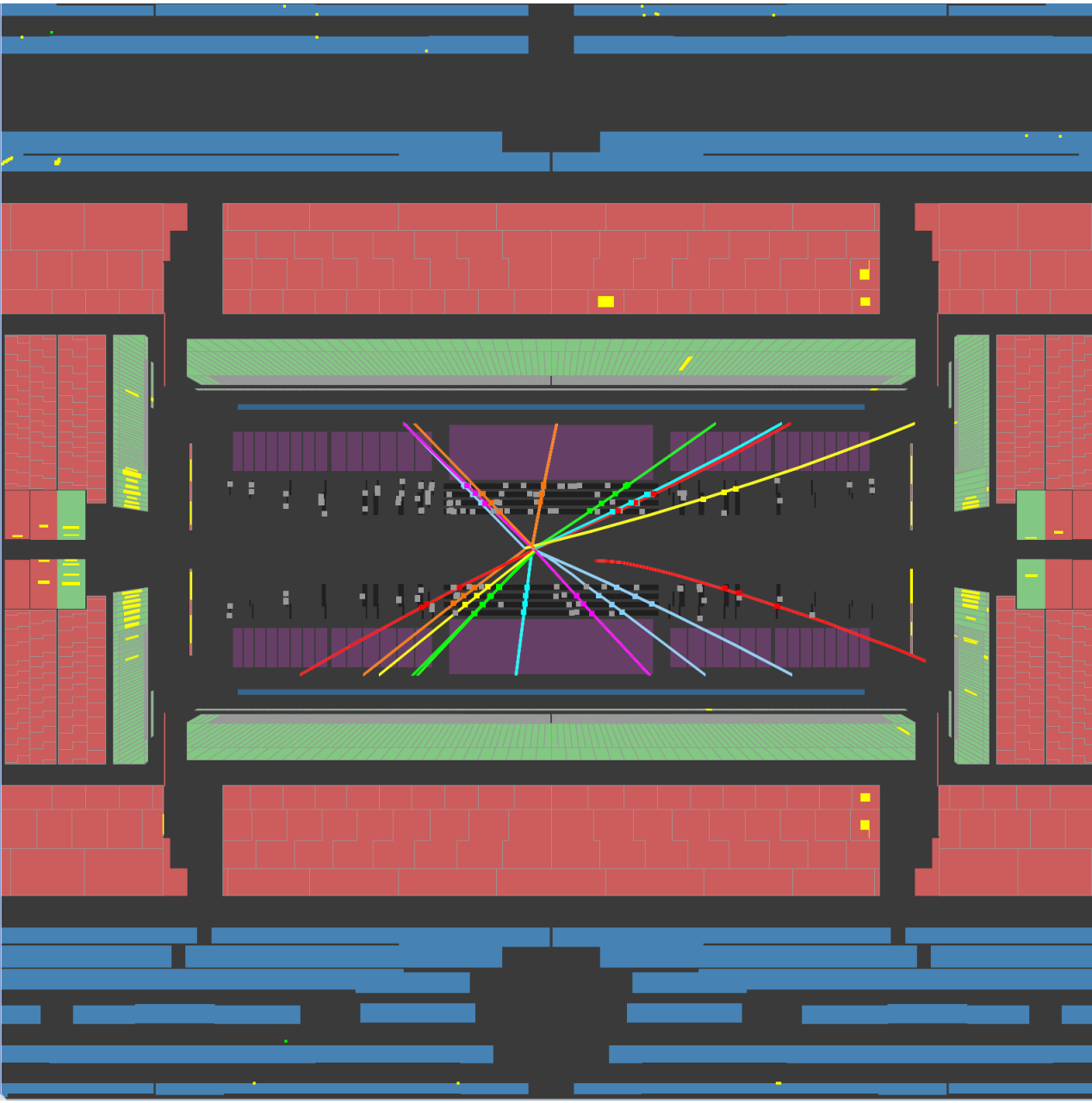
Excess?

Figure 12.7: The distribution of the reconstructed mass of Higgs boson candidates. The data are shown as points and the solid histogram indicates the expected background from processes other than Higgs boson production [88].

# ATLAS Control Room, 23 November 2009



# First proton-proton collision in ATLAS

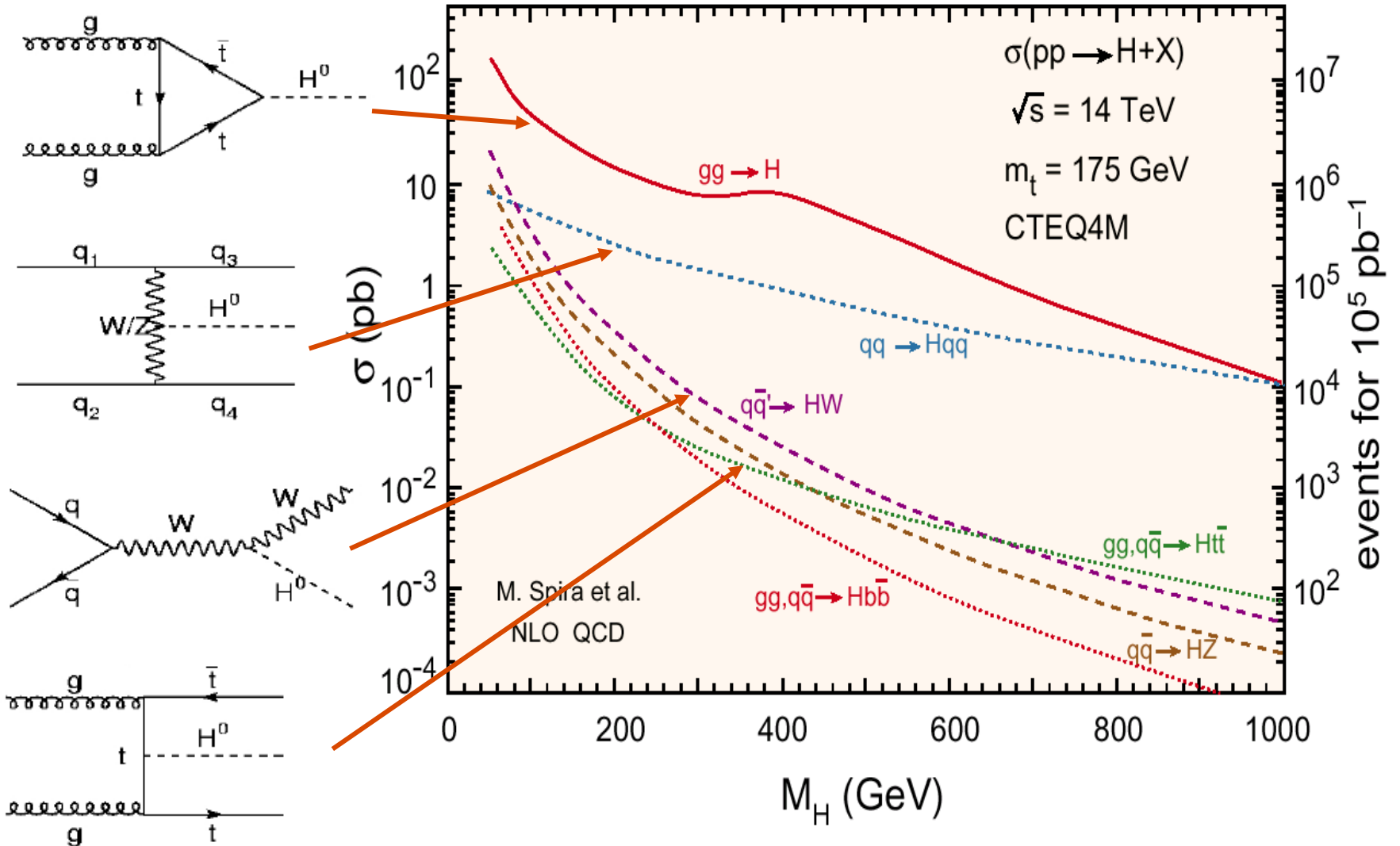


**ATLAS**  
EXPERIMENT

2009-11-23, 14:22 CET  
Run 140541, Event 171897

Candidate  
Collision Event

# Higgs production at the LHC



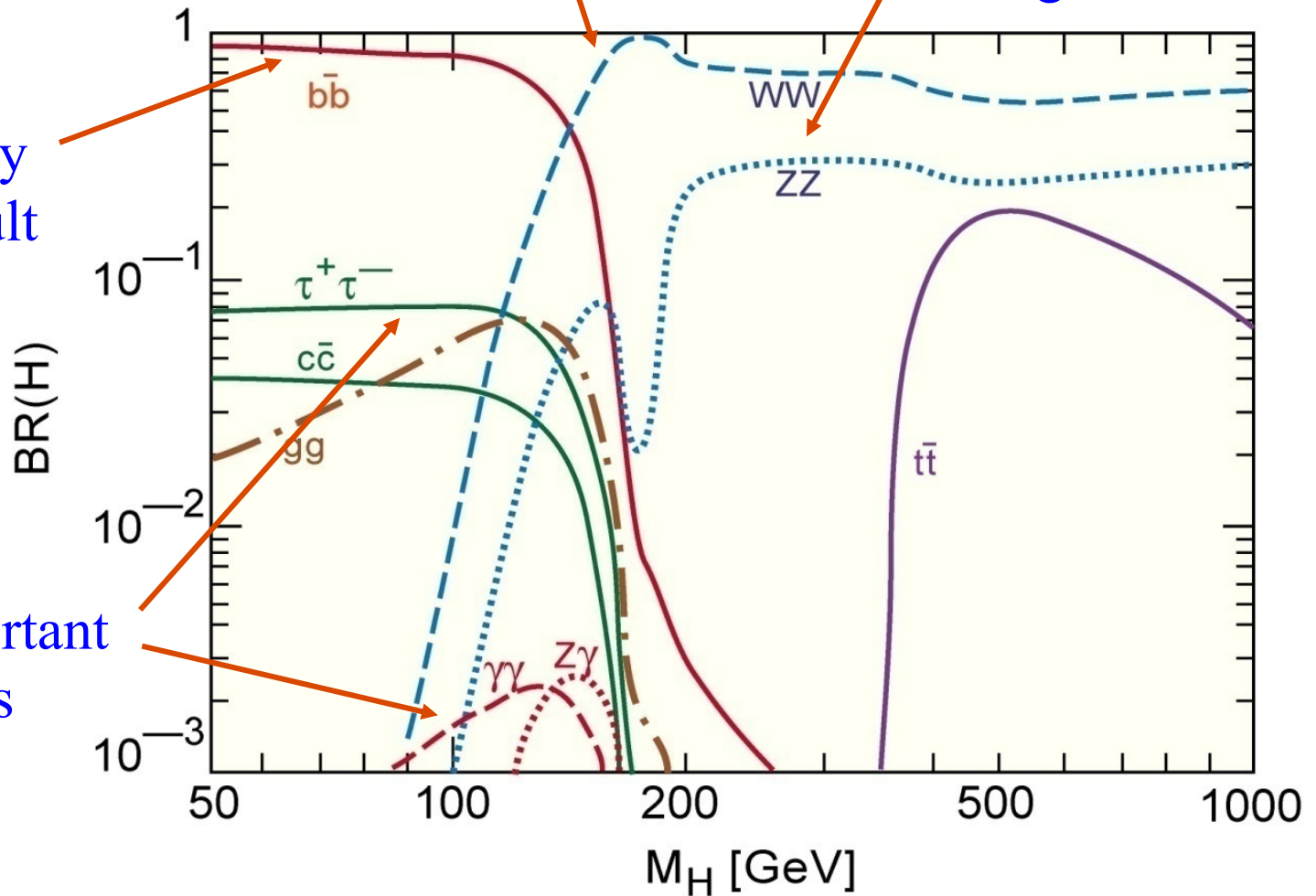
# Higgs decay modes

WW dominates for  
 $2M_W < m_H < 2M_Z$

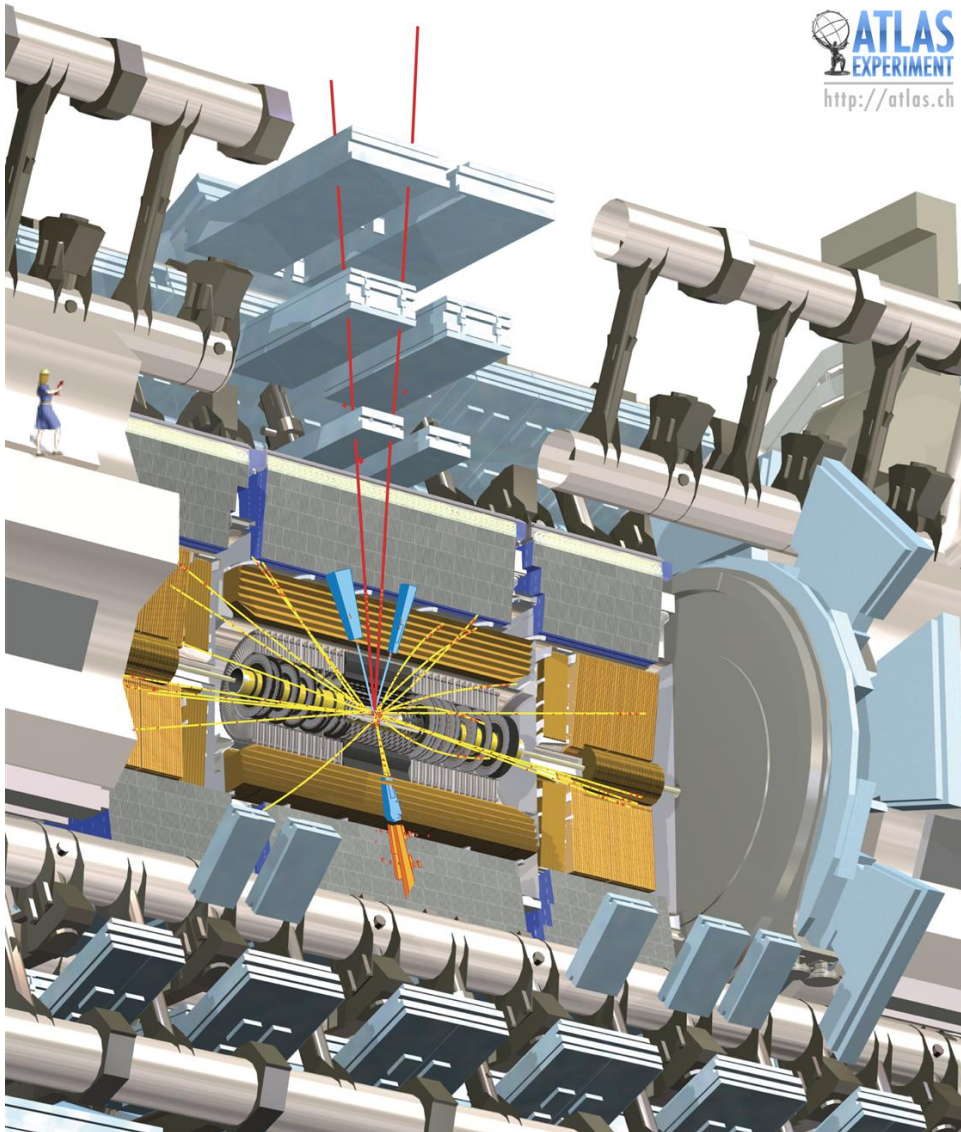
ZZ "golden mode"

bb very  
difficult

$\tau\tau$ ,  $\gamma\gamma$  important  
at low mass



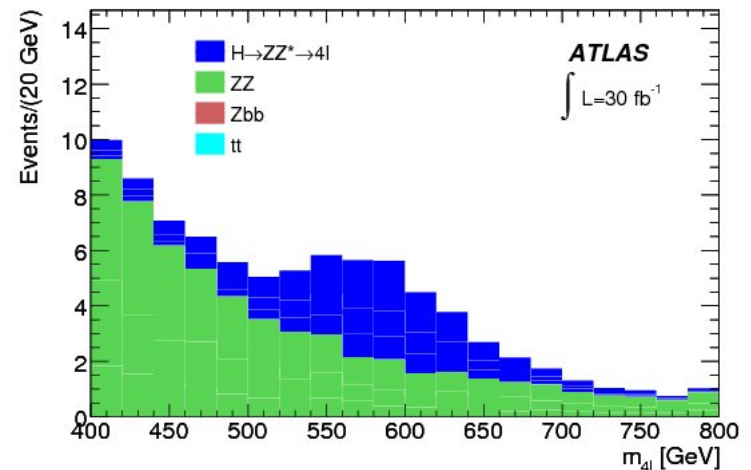
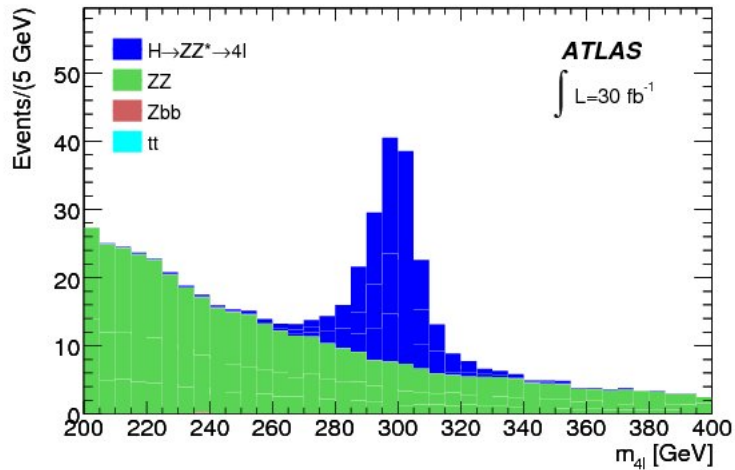
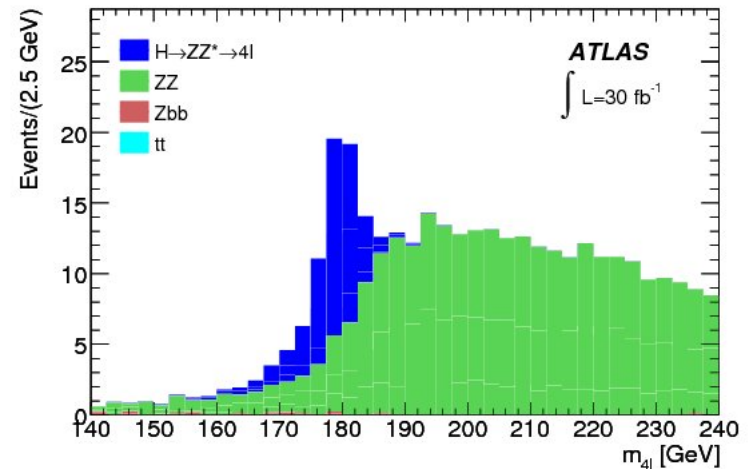
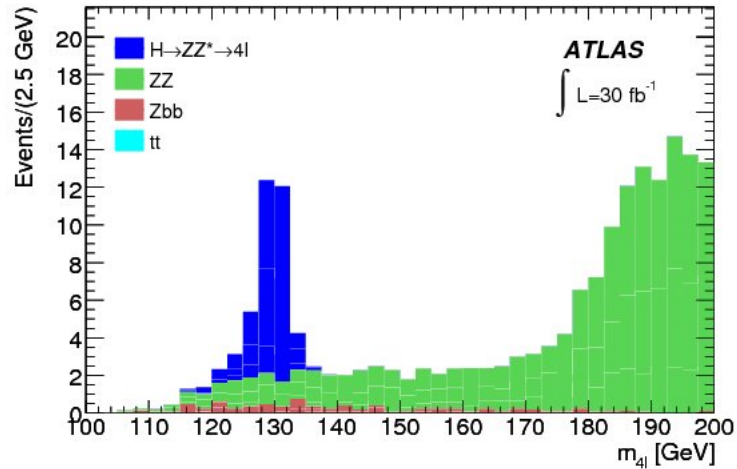
# Simulated Higgs event at ATLAS



ATLAS  
EXPERIMENT  
<http://atlas.ch>

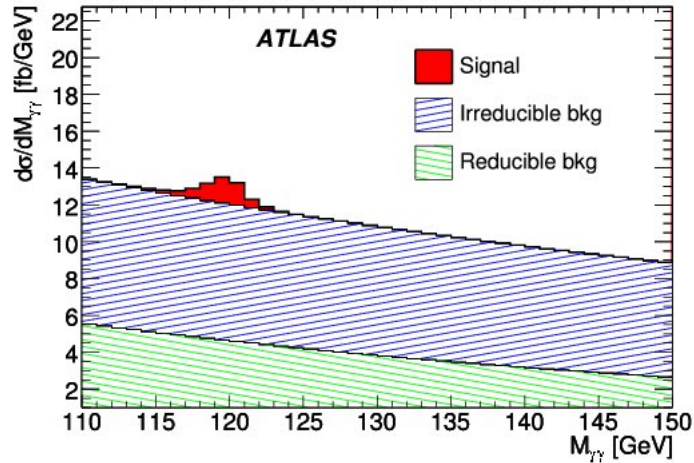
$$H \rightarrow ZZ \rightarrow ee\mu\mu$$

# $H \rightarrow 4l$ at different $m_H$

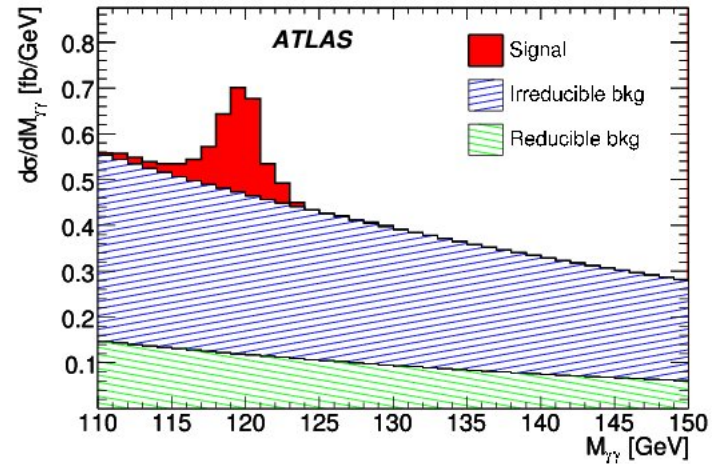


# $H \rightarrow \gamma\gamma$ for exclusive channels

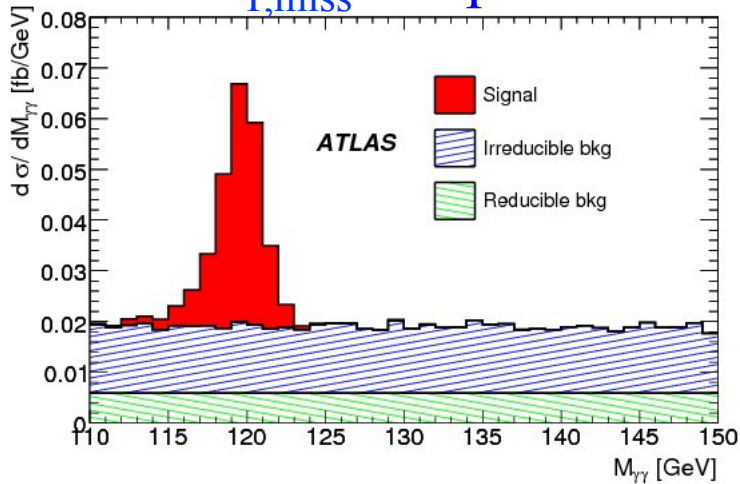
$H + 1 \text{ jet}$



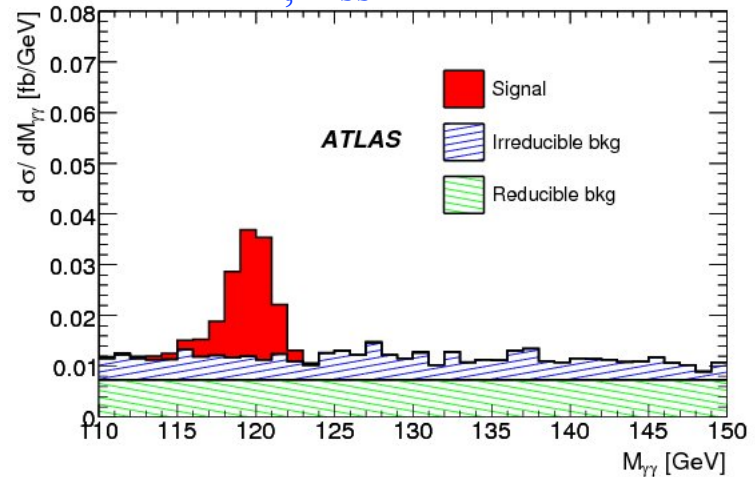
$H + 2 \text{ jets}$



$H + E_{T,\text{miss}} + \text{lepton}$



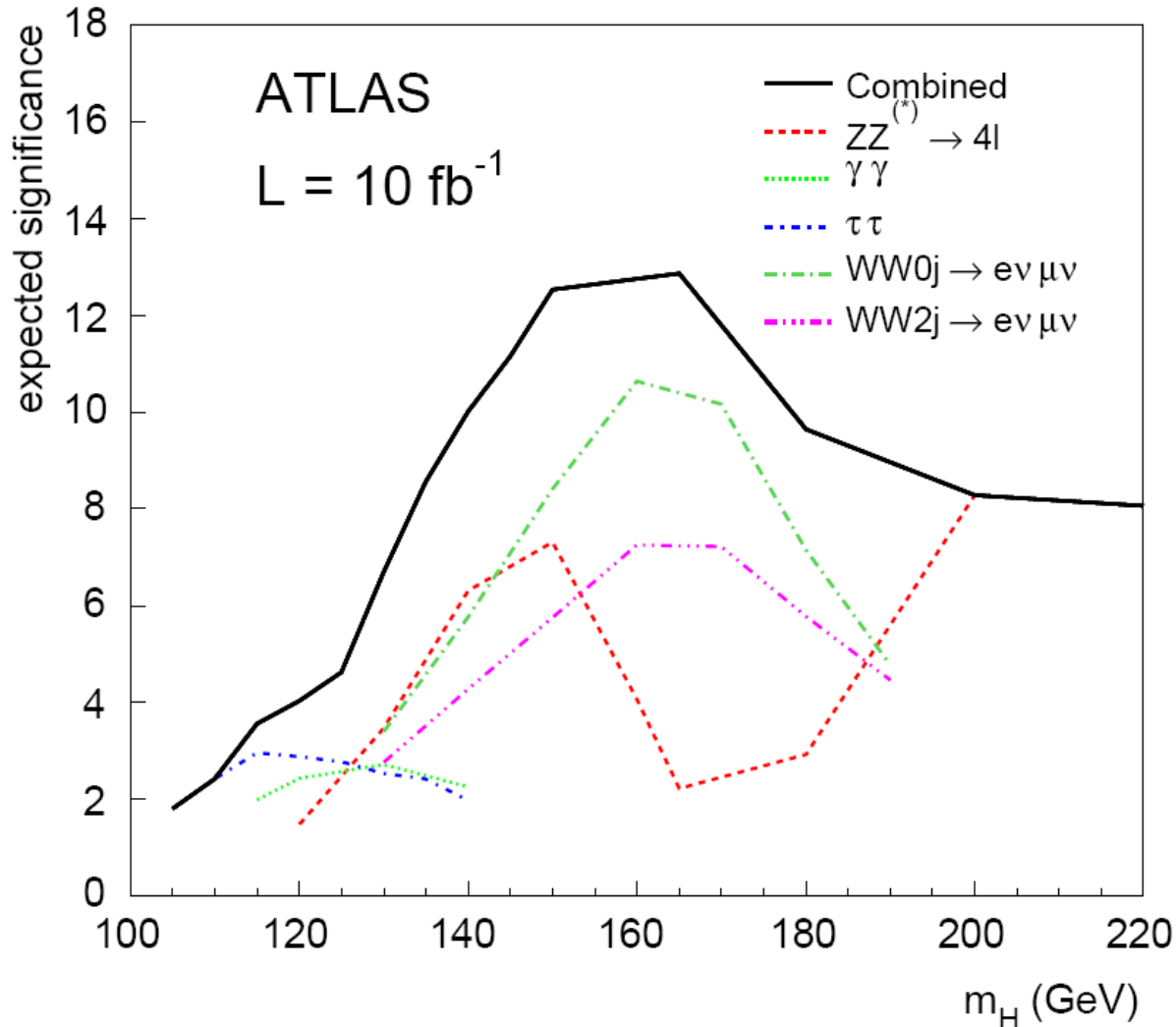
$H + E_{T,\text{miss}}$





# ATLAS combined discovery significance

*Expected Performance of the ATLAS Experiment: Detector, Trigger and Physics, arXiv:0901.0512, CERN-OPEN-2008-20.*



# ATLAS limits on SM Higgs

