

VBS and gluon-gluon fusion to test EWSB at the LHC

E. Accomando

INFN and Università di Torino

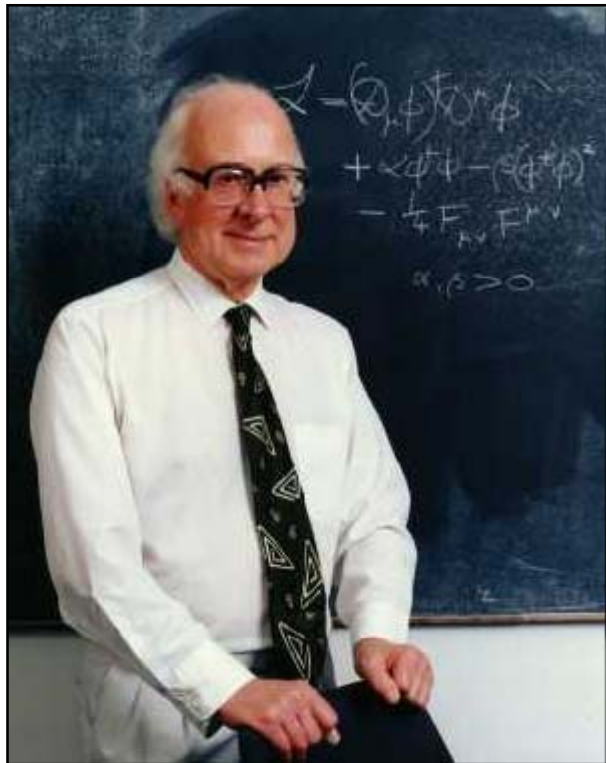
The EW symmetry breaking



the most deep mystery in QFT

2007

43th birthday of the Higgs



*Returning from the Cairngorns
scottish mountains to my lab, I had
my „one big idea“ (1964)*



11/04/2007

E. Accomando

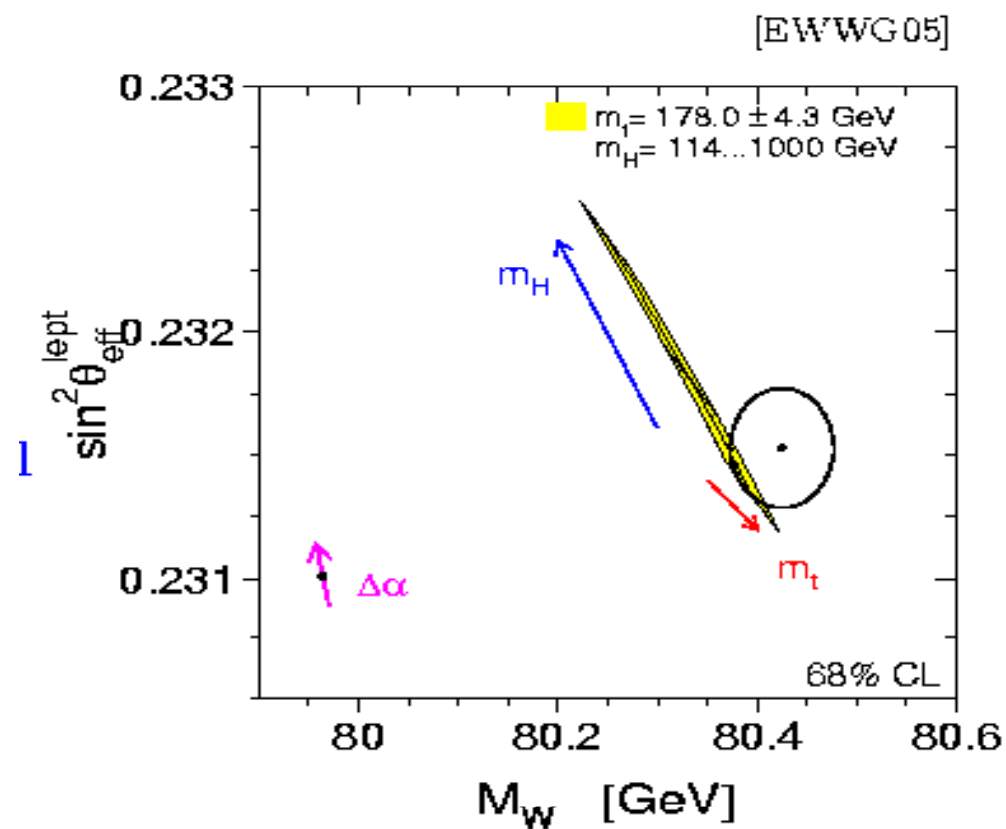
still...the Higgs

is a real particle or a way of thinking?

A possible working
hypothesis:

a Higgsless scenario

**SM is lost
SUSY as well**

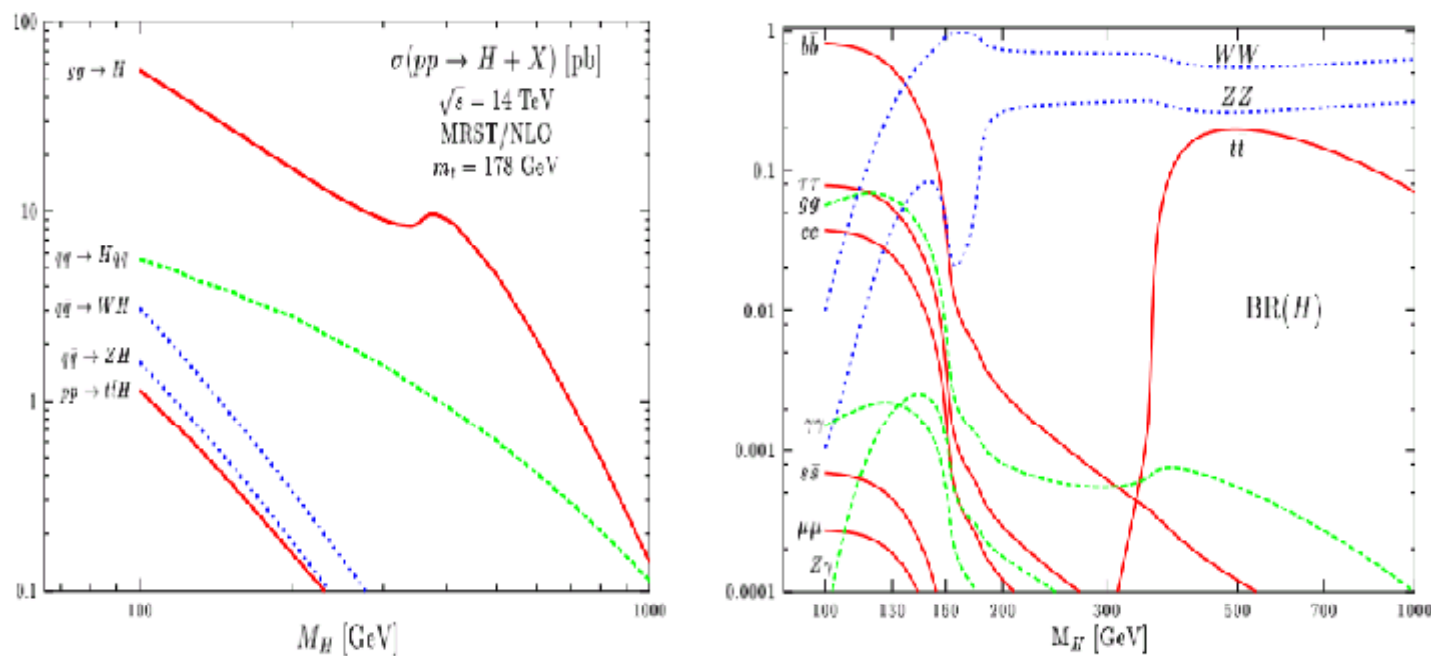


Where do we get clues on EWSB?

Looking at the same place w/wo the Higgs

Thus at the LHC

[Diouadi]

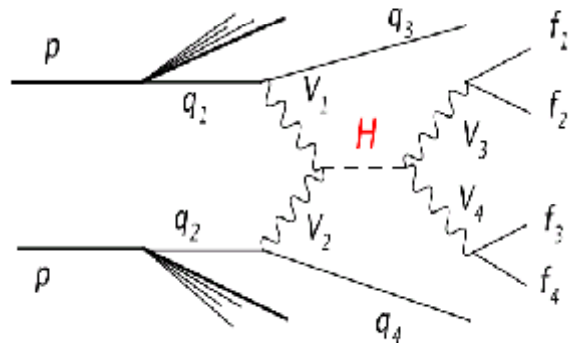


11/04/2007

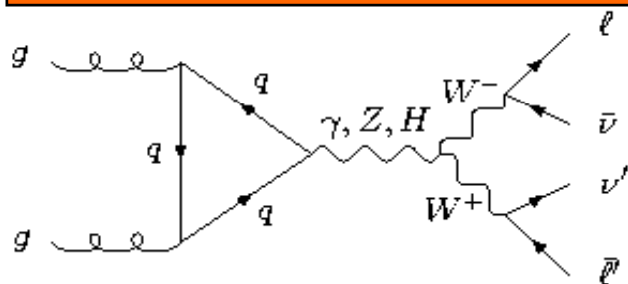
E. Accomando

Where do we get clues on EWSB?

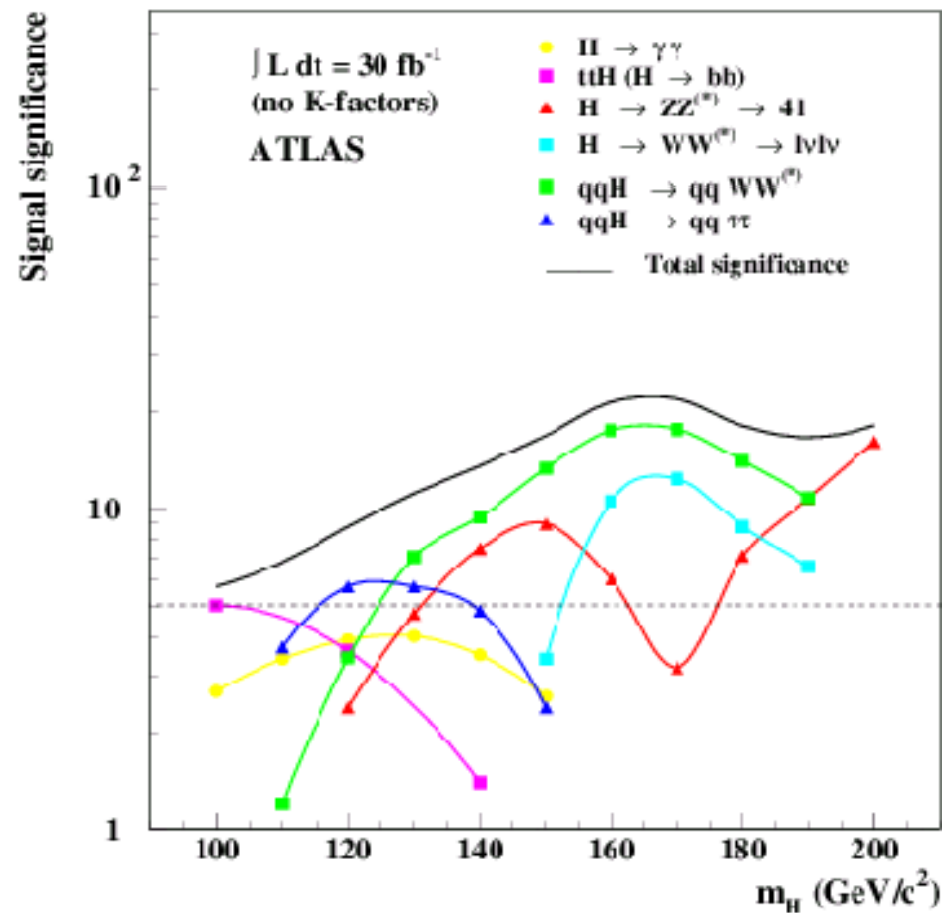
VBS



GGF

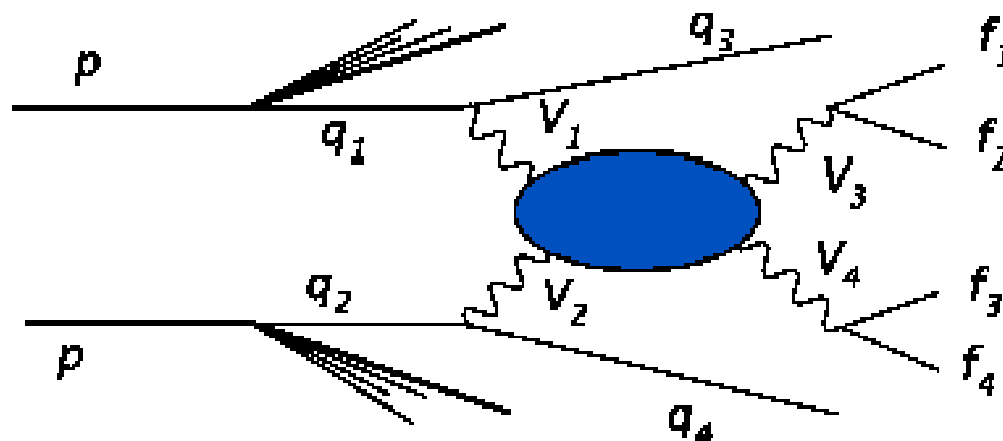


11/04/2007



E. Accomando

VBS at the LHC



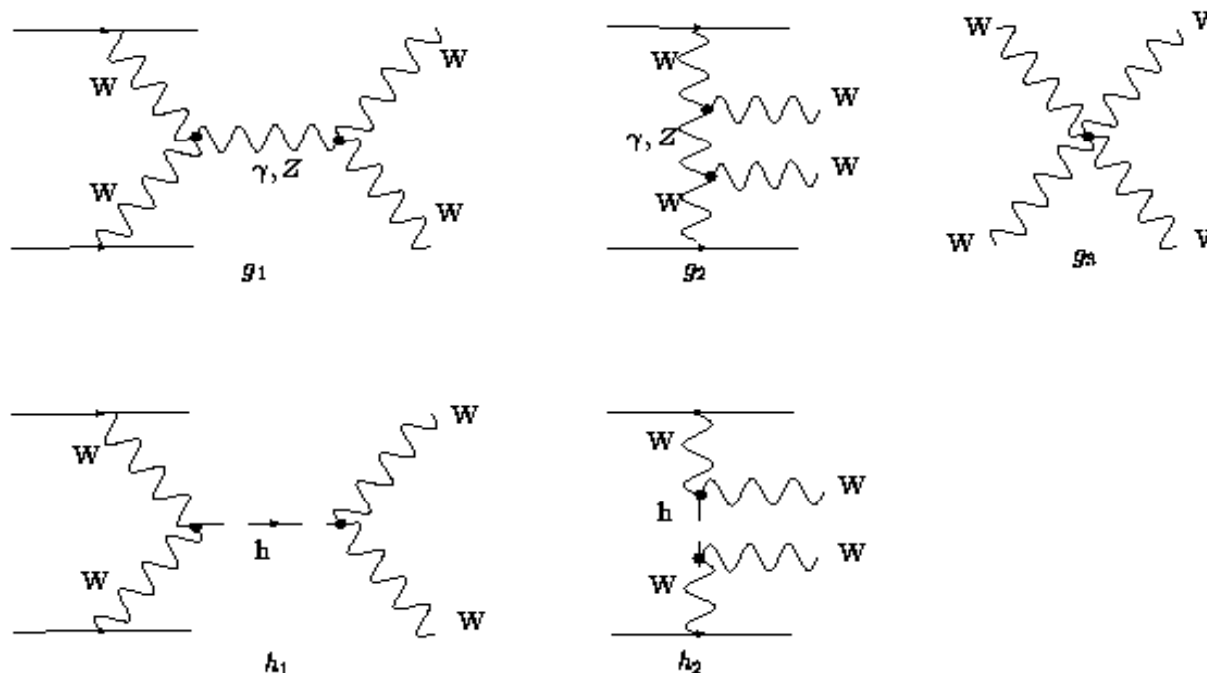
If no Higgs \rightarrow SM VBS violates unitarity

W and Z strongly interacting at the TeV scale

New Physics lies beyond the SM!

VBS at the LHC

e.g. WW scattering:



for ON-SHELL incoming W's

$$g_i \propto s^2$$

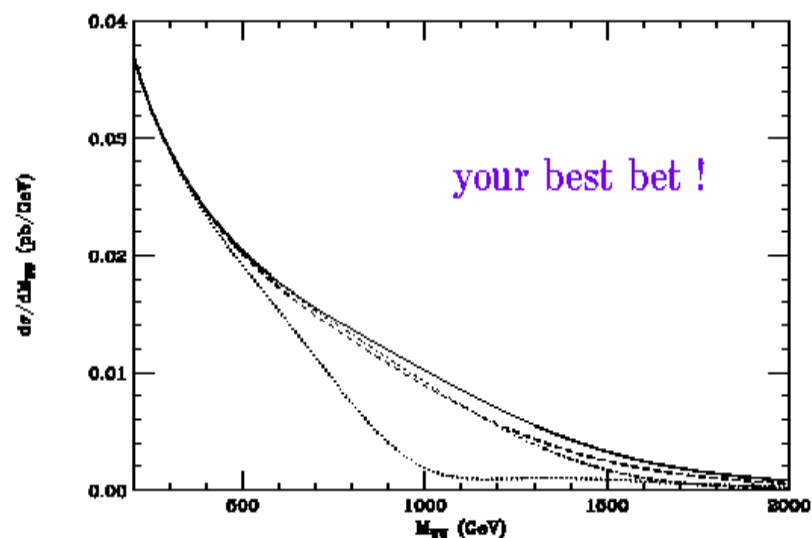
$$\Sigma g_i \propto s = M_{WW}^2$$

$$\Sigma(g_i + h_i) \rightarrow \text{Const.}$$

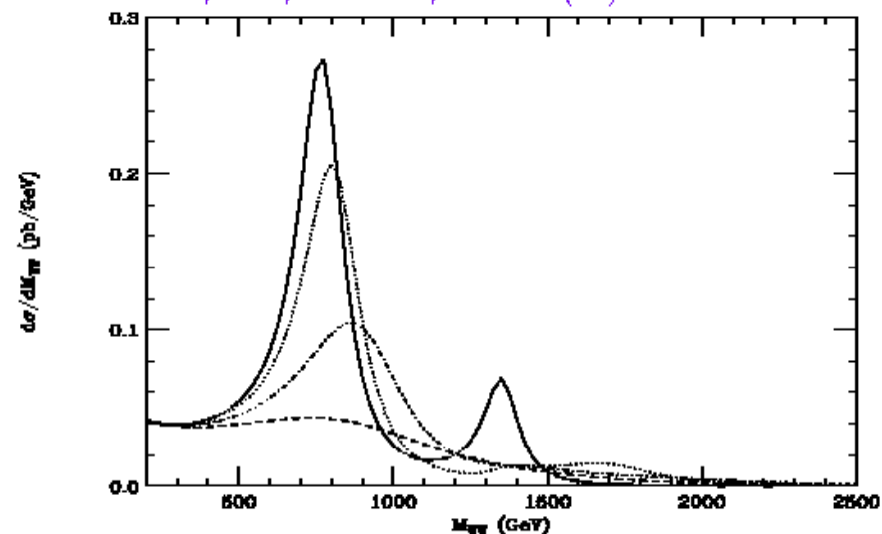
VBS at the LHC

Different ways of constructing UNITARY AMPLITUDES

Common signal: increased production of W_L and Z_L



Butterworth, Cox, Forshaw, PRD65(02)96014



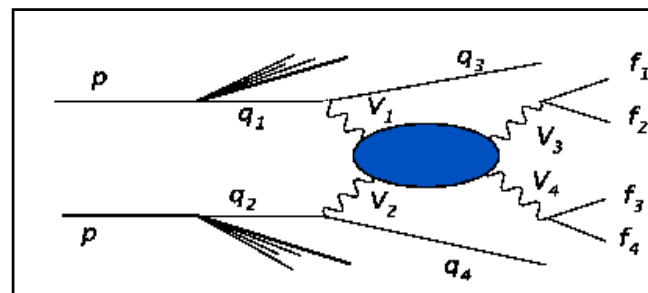
Benchmark worst VBS scenario:

The LET Model

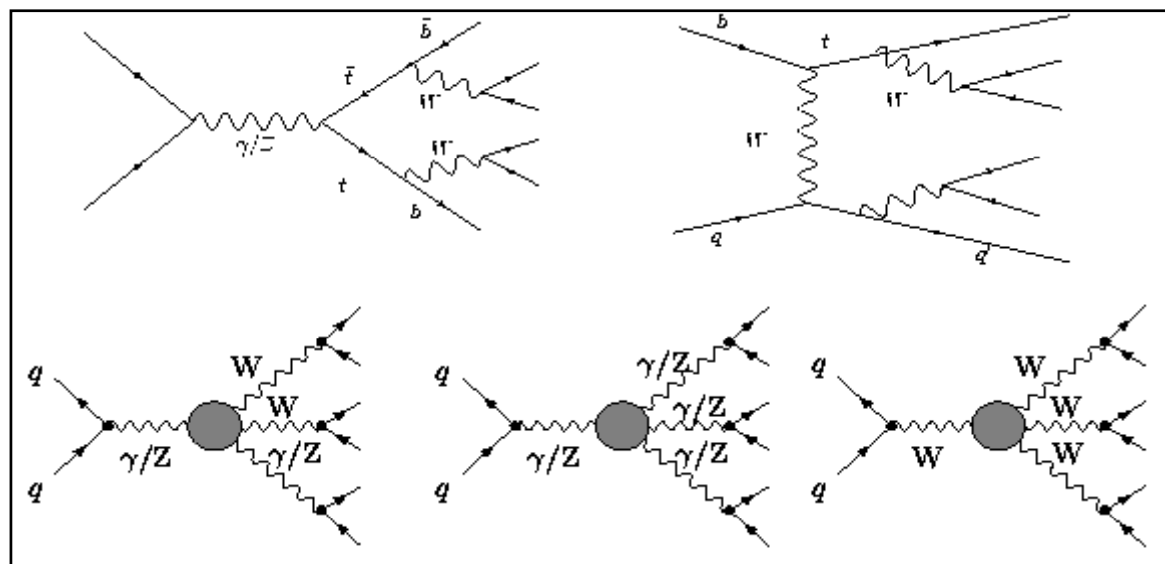
VBS at the LHC

Extracting VBS from six-fermion final states

Full Amplitude =

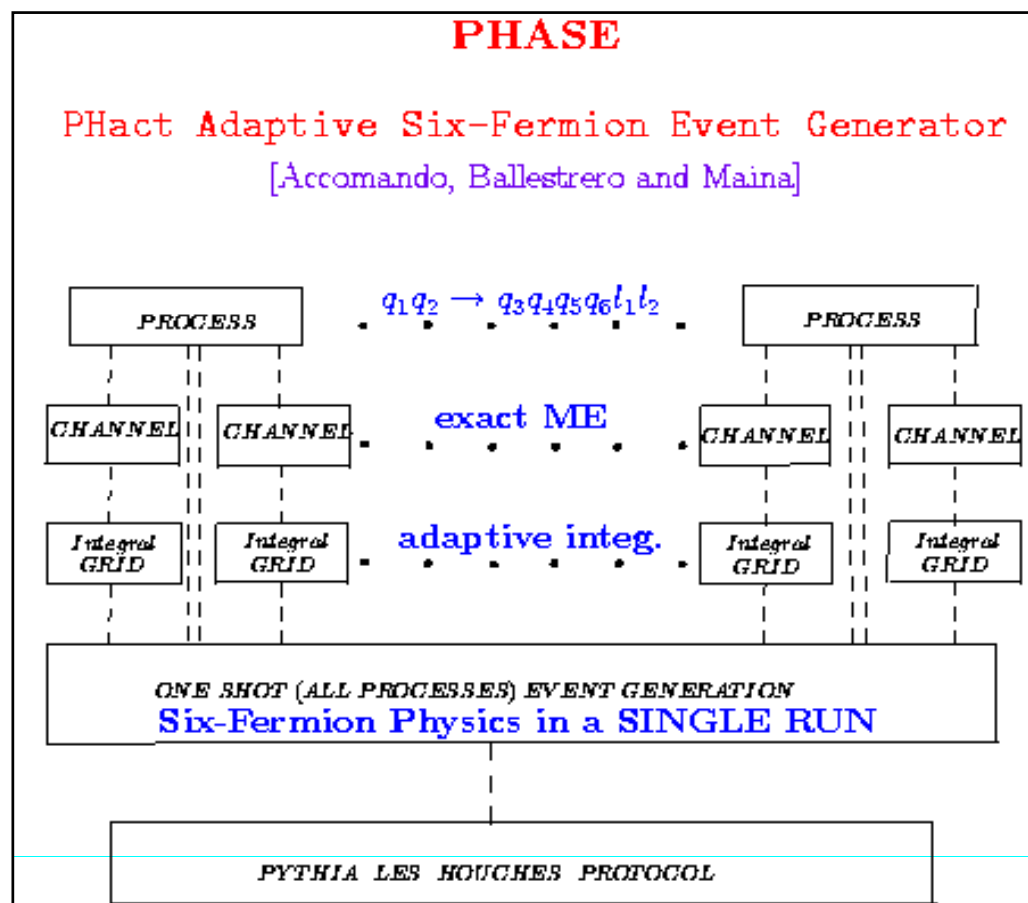


+



VBS at the LHC

Going from Exp. to Th. needs a complete Event Generator



now extended in the new
PHANTOM code

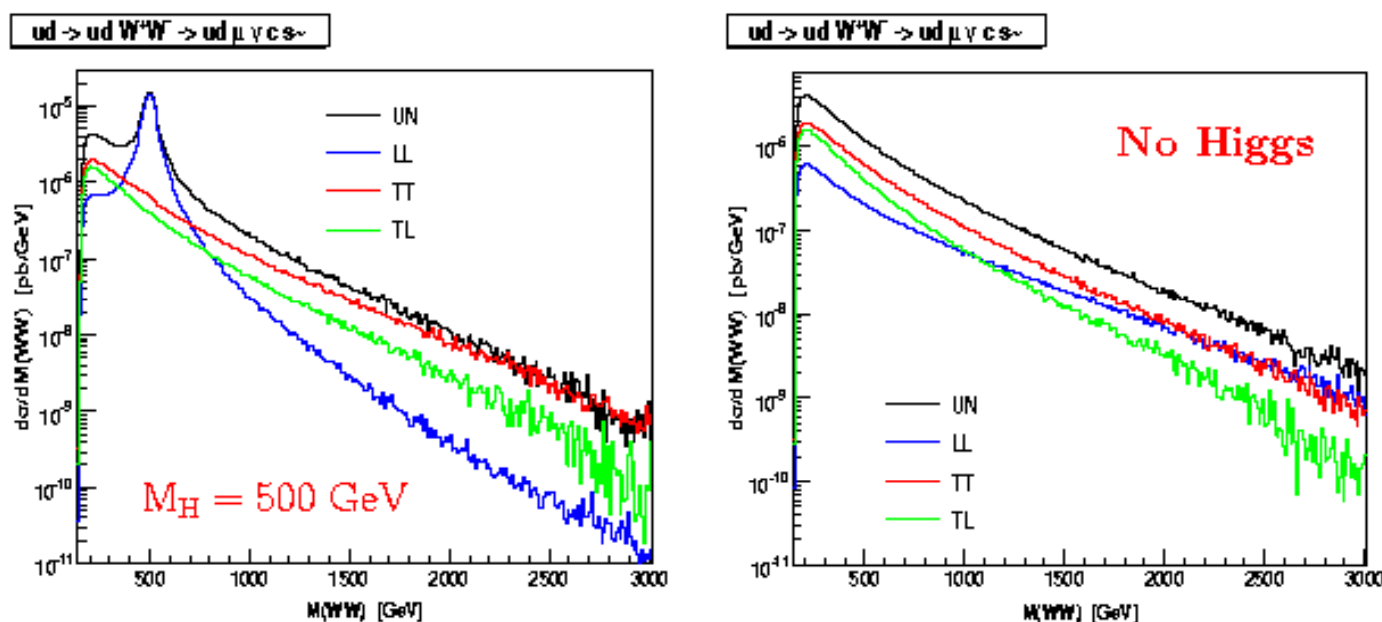
[Ballestrero, Belhouari,
Bevilacqua, Maina]

Outcome:

fully representative Event
Sample where detection
strategies can be studied

LET Model vs SM with PHASE

how to extract the VBS signal?

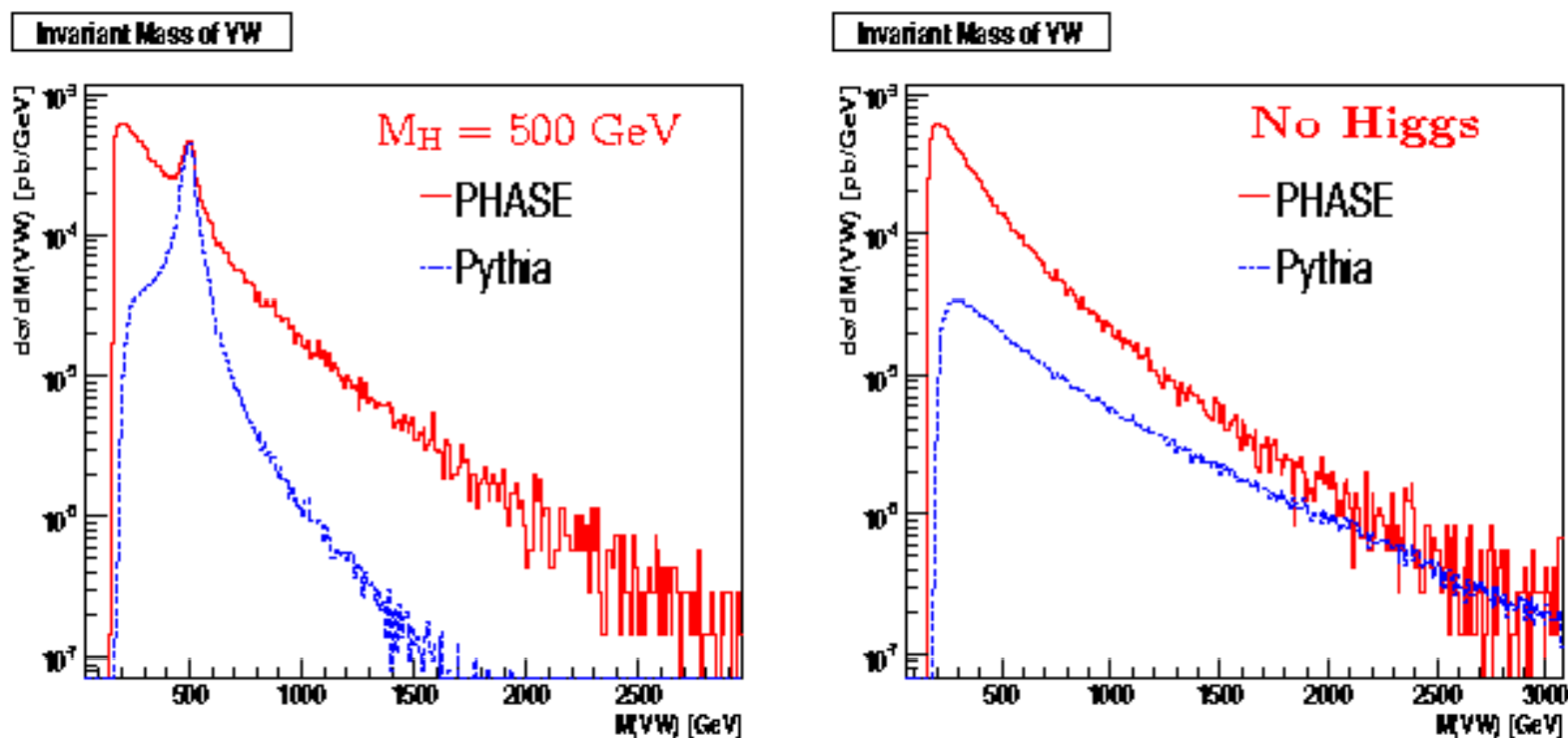


Barger suggestion [94]

$$\sigma(\text{VBS}) = \sigma(\text{no Higgs}) - \sigma(\text{light Higgs})$$

PHASE vs PYTHIA

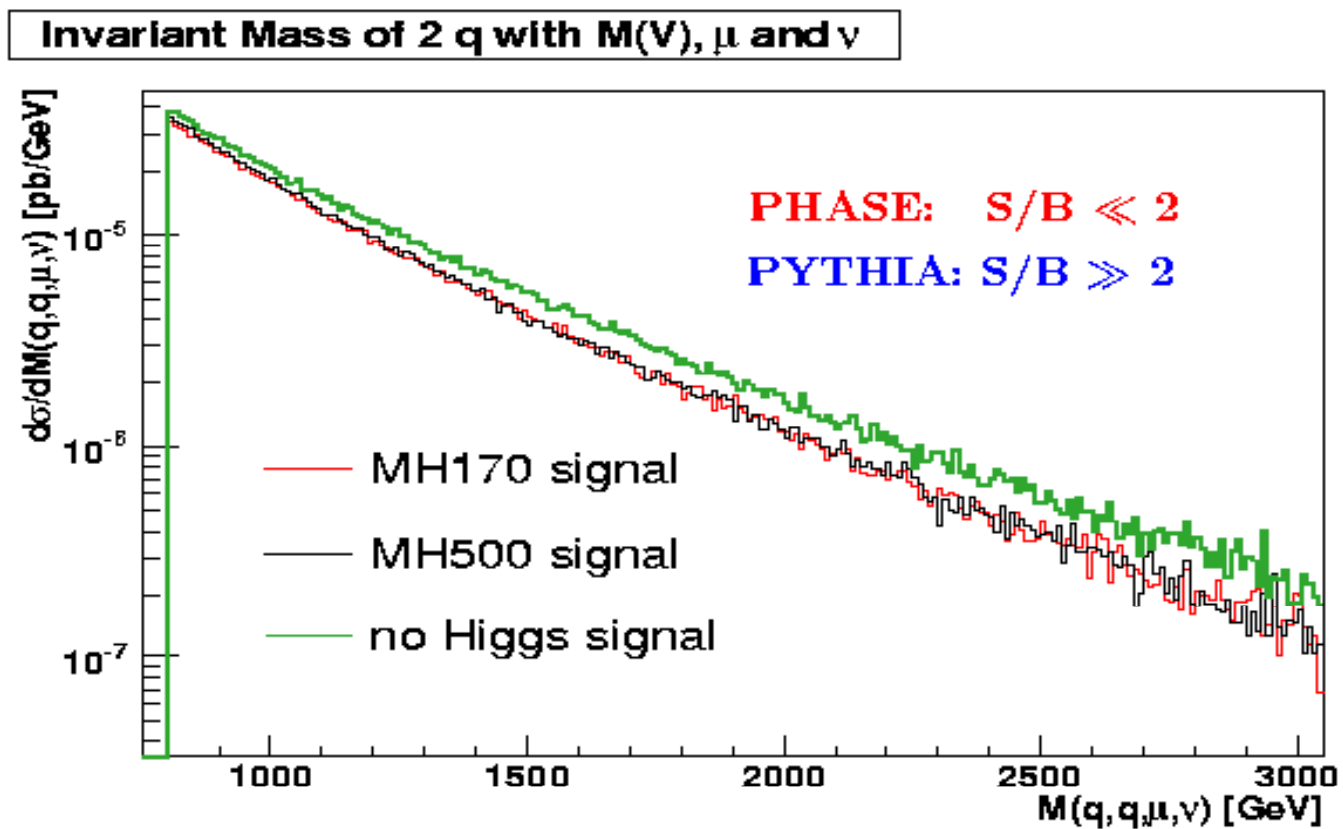
All $O(1000)$ processes: $q_1 q_2 \rightarrow q_3 q_4 q_5 q_6 \mu \nu$



Pythia heavily underestimates the background

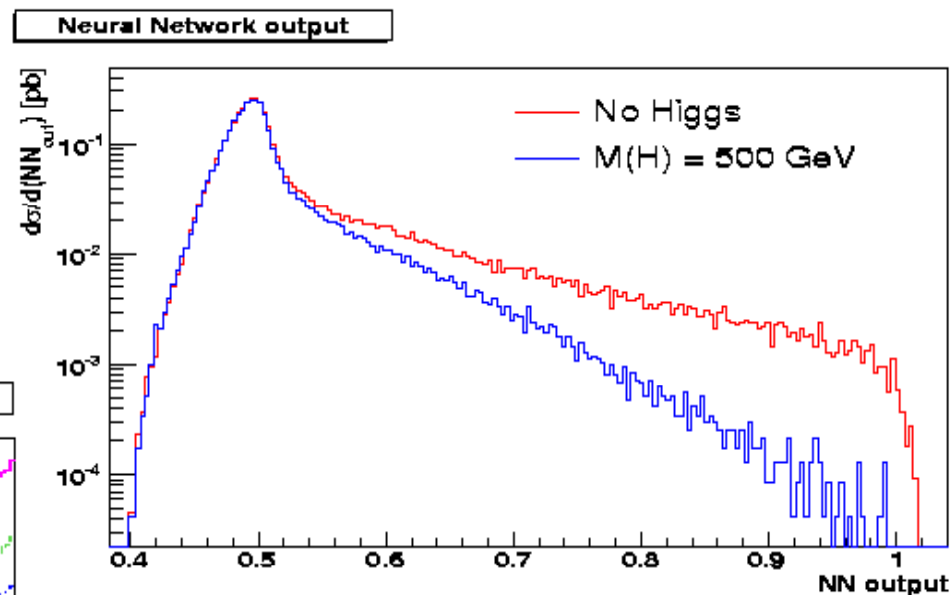
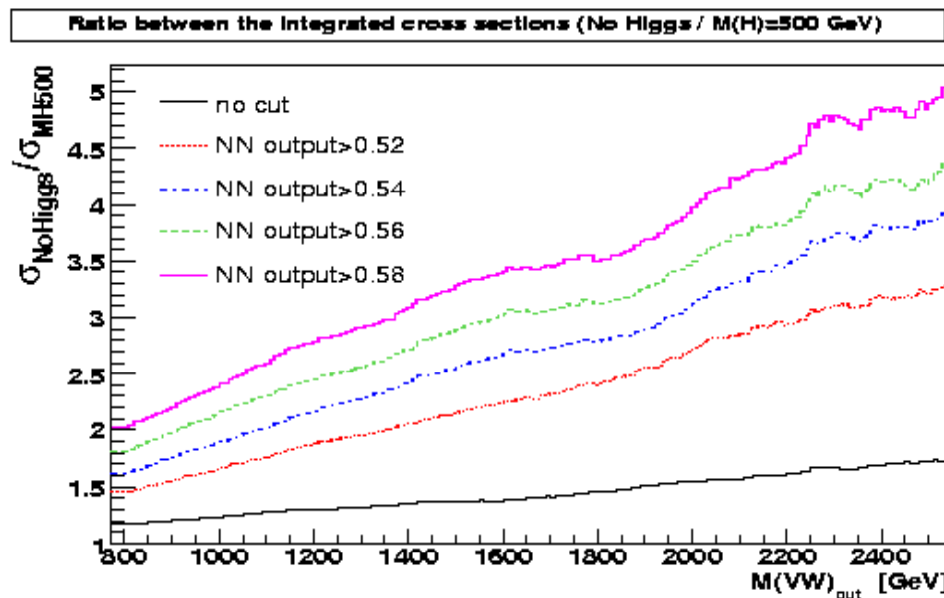
LET Model vs SM with PHASE

With CMS Torino [Mariotti and Bolognesi]



Neural Network

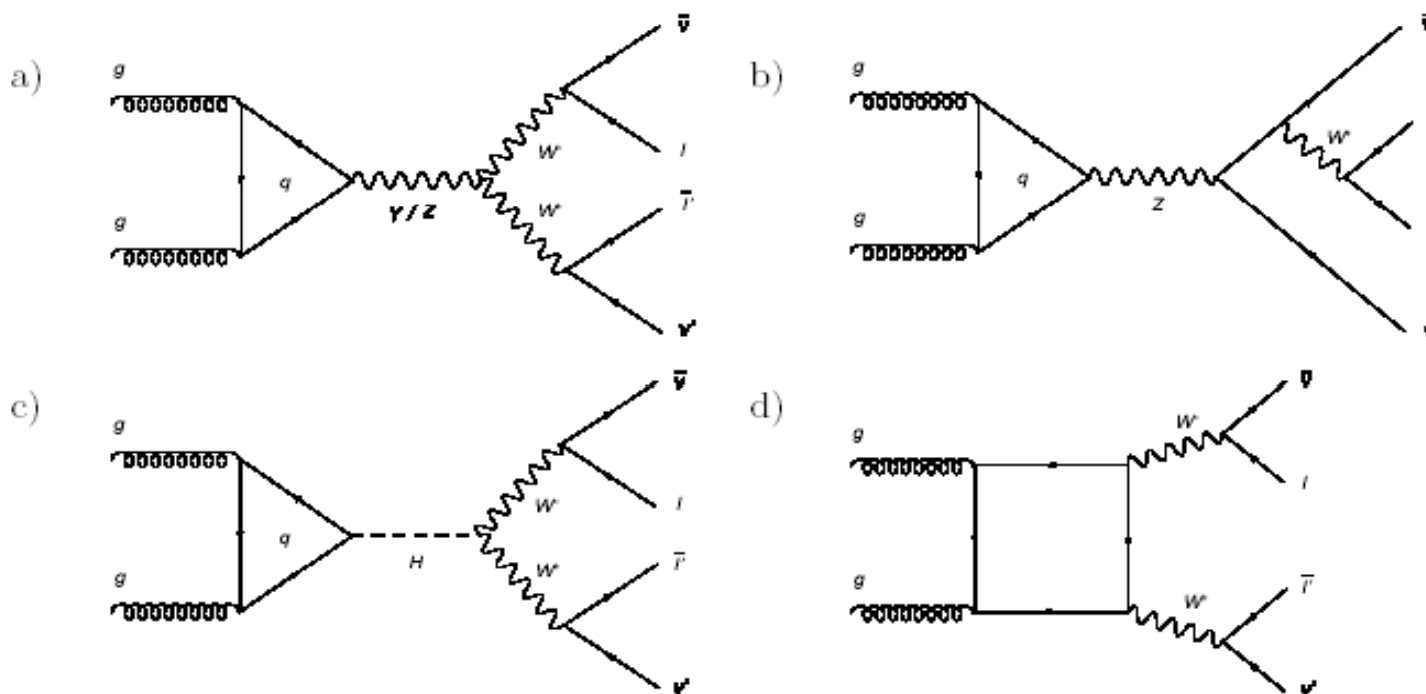
Winning strategy to



Strongly Interacting VBS

in the benchmark worst scenario

GGF: a new channel to probe EWSB



$$g_i \sim s \quad \Sigma g_i \sim \sqrt{s} \quad \Sigma g_i + g_h \sim \text{const.}$$

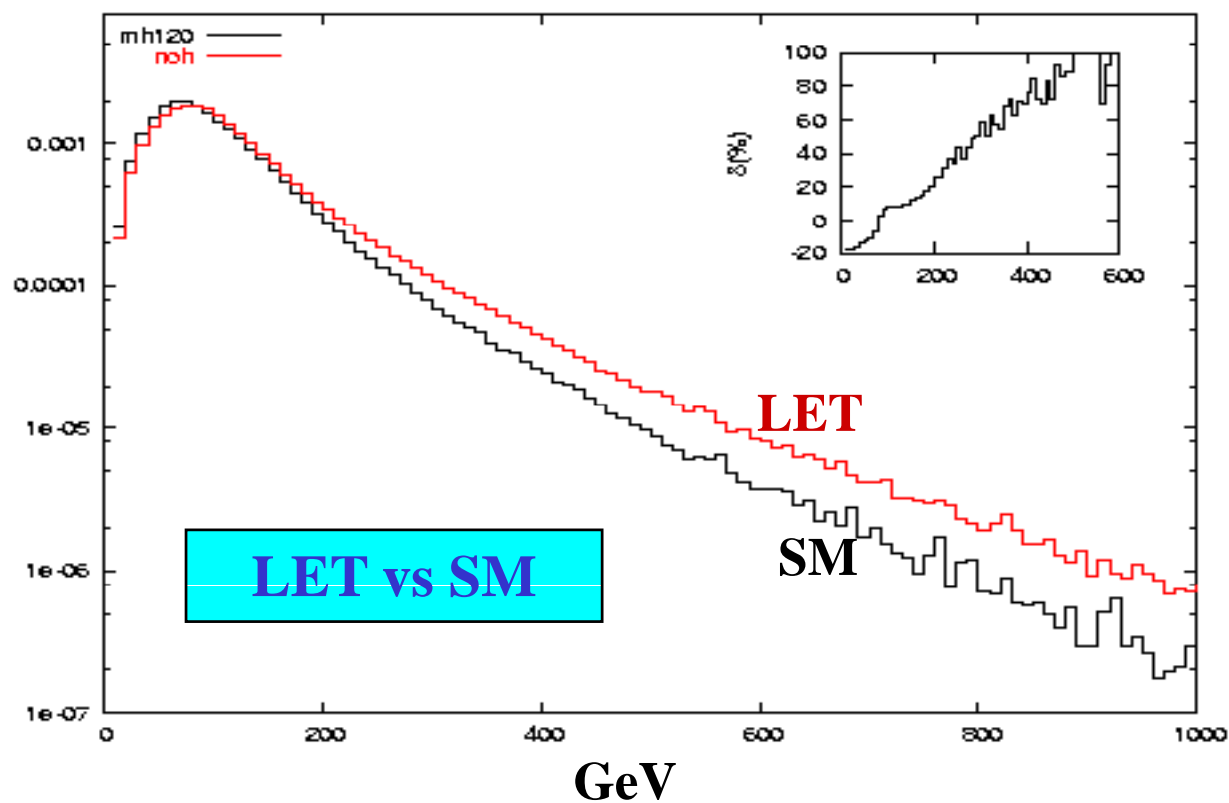
Unitarity violation in absence of Higgs

GGF: a new channel to probe EWSB

Very preliminary

$$pp \rightarrow \nu_e e^+ \mu^- \nu_\mu$$

$$M_{\text{inv}}(e\mu)$$



11/04/2007

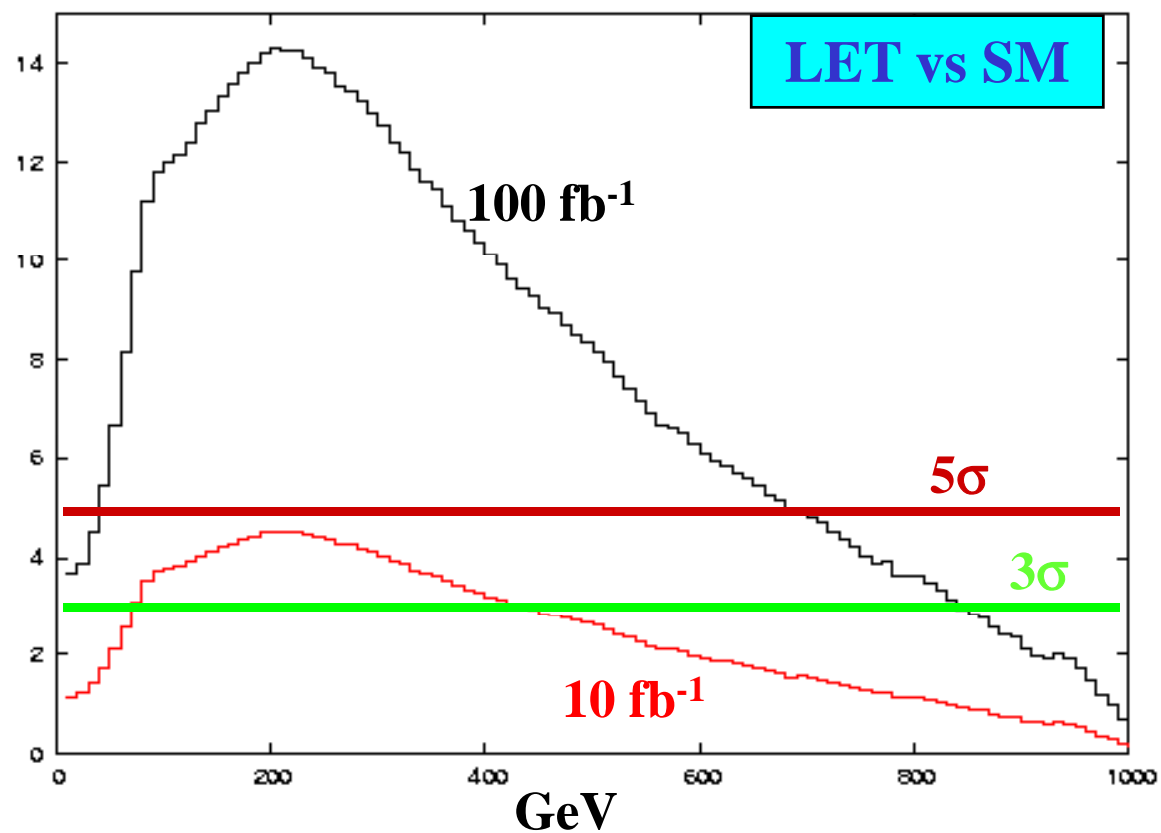
E. Accomando

GGF: a new channel to probe EWSB

Very preliminary

Significance

Evidence already
in the first year of
running



11/04/2007

E. Accomando

Conclusions

TeV-scale physics will be probed at the LHC

- a window to understand the EWSB dynamics
- and reveal the underlying theory

Testing ground

VBS: the gold-plated channel

GGF: a new silver-plated channel

Great improvement from simultaneous analyses