Twin Higgs from Left-Right Symmetry

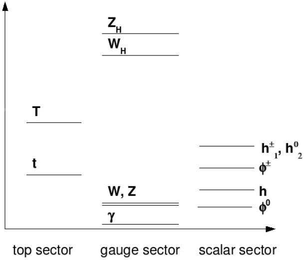
- The Higgs mass is bounded to be between 114 and 185 GeV.
- The cutoff can be estimated from measurements to be at least of order 5-10 TeV ("best fit to LEP data"). This suggests the scale of new physics should be over 5 TeV.

  Problem Quantum corrections of order 5 TeV generate a Higgs with a mass much bigger than 200 GeV

$$V(h) = \frac{1}{2} m_H h^2 + \lambda h^4 + \ldots + O(\Lambda^2) h^2 + Counterterms$$

- Counterterms must be precisely adjusted to keep the Higgs mass small (*Fine Tuning*)

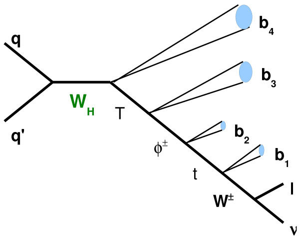
- The *Left-Right Twin Symmetry* when broken adds new terms to the Lagrangian.
- This eliminates cuadratic divergences (at NLO) from Higgs boson's mass.



Mass is the only free parameter of the Twin Higgs model. Amongst its predictions, there are $SU(2)_R$ gauge bosons, vector-like quarks and a natural candidate to dark matter (h_2^0)

Study of channel $W_H(1\,TeV/c^2) \rightarrow Tb$

$4b + l + E_T^{Miss}$ does not appear in *Little Higgs*



Particle	Mass (GeV)	Decay	BR
W_H	1000	$T_H b$	20%
T_H	500	$\phi^\pm b$	80%
$\phi^\pm$	200	tb	100%
t	175	$W^\pm b$	100%
$W^\pm$	80	$l\nu$	21%

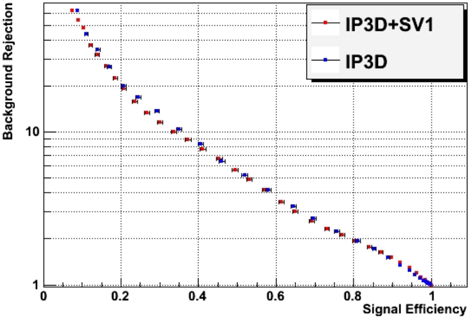
"New Physics at the LHC: A Les Houches Report. Physics at Tev Colliders 2007" – New Physics Working Group. Gustaaf H. Brooijmans et al. Feb 2008 arXiv:0802.3715 [hep-ph]

- $l + \nu \rightarrow W^\pm$
  - $p_Z^\nu // p_Z^l$ to reconstruct $W^\pm$.
  - $p_T^l > 25GeV/c$
  - $E_T^{miss} > 25GeV/c$.
  - $p_T^{W^\pm} > 25GeV/c$.
- $W^\pm + b \rightarrow t$
  - $25GeV/c < p_T^{jet} < 200GeV/c$.
  - $M_t < 300GeV/c$.
- $t + b \rightarrow \phi^\pm$
  - $25GeV/c < p_T^{jet} < 100Gev/c$
  - $M_{\phi^\pm} < 300GeV/c$.
- $\phi^\pm + b \rightarrow T_H$
  - $p_T^{jet} > 100GeV/c$.
  - $p_T^{T_H} > 120GeV/c$
- $T_H + b \rightarrow W_H$
  - $p_T^{jet} > 150GeV/c$.
- Always $|\eta| < 2.5$

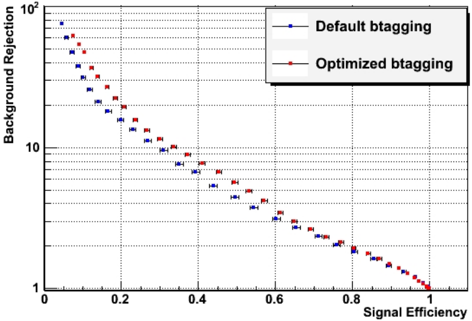
B-tagging

- A sample of 20000 events of $W_H(1\,TeV/c^2) \rightarrow Tb$ was made with Athena v.12.0.6.1
  - Generation with Pythia v.6.4
  - Simulation with GEANT4
  - Reconstruction made including IPatRec info.
- Also 20000 events of background $t\bar{t}$ No Hadronic (Semileptonic + Dileptonic)
  - $\sqrt{s} > 500 GeV$
  - $p_T > 100 GeV$

- Combination of IP3D and SV1 used.
- Paremeters of both algorithms have been optimized for a wider energy range jets.
- Although SV1 was found to have negligible efect.



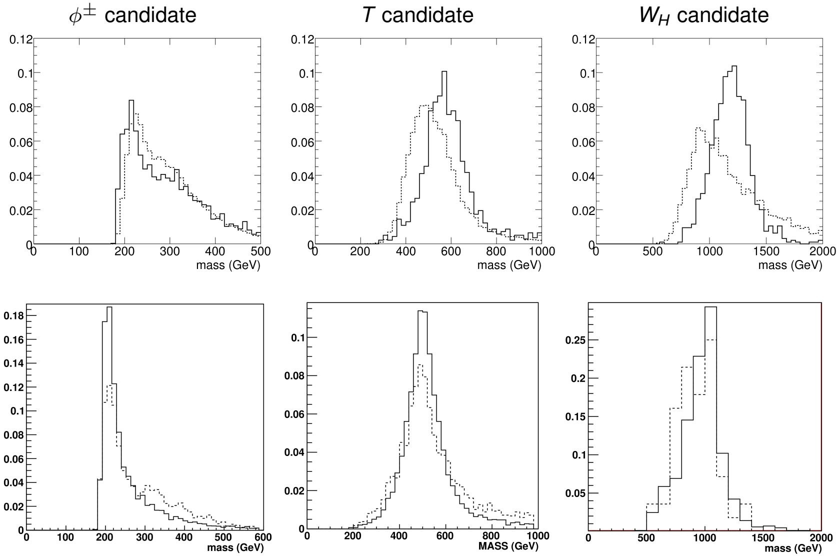
B-tagging



- Sum weights of the four jets used on W_H reconstruction.
- Use events with sum > 34 (20% signal efficiency and 95% background rejection)

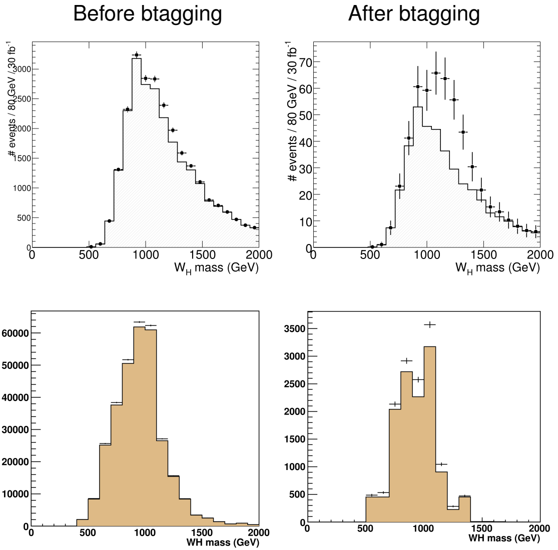
In the plot we call "defalut" to the parameters set for high p_T jets, the algorithms had before our optimization.

W_H invariant mass reconstruction.



Mass distributions for different steps of the reconstruction of the decay chain for signal events (full line) and the dominant $t\bar{t}$ background (dashed histogram) both for Atlfast (up) and Full simulation (down)

Btagging effect on W_H invariant mass reconstruction.



Reconstructed mass distribution of W_H candidates (data points). The contribution of the $t\bar{t}$ and $W + jets$ backgrounds is indicated by the colored region.

Conclusions.

	Atlfast		Full	
selection	no b-tag	b-tag	no b-tag	b-tag
signal	1058	138	4414	917
$t\bar{t}$	23500	392	193537	7251
$S/\sqrt{B}$	6.9	7.0	10.0	10.8
S/B	0.05	0.4	0.02	0.13