

Searching for a Higgs Boson in the channel $t\bar{t}H^0(H^0 \rightarrow b\bar{b})$ with the ATLAS detector

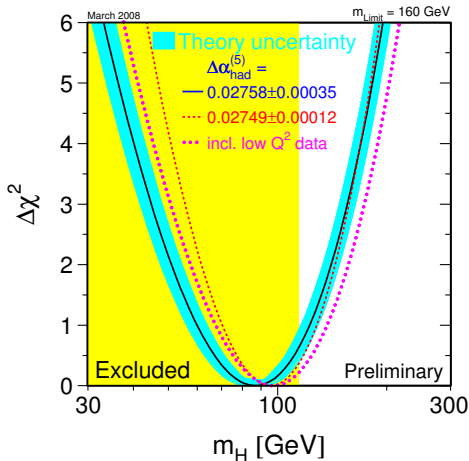
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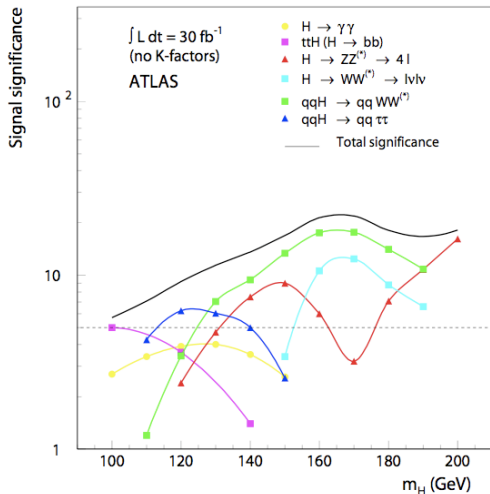
IoP HEPP Conference April 1, 2008

Standard Model Predictions for a Higgs Boson

- Scalar Higgs field is required to allow ElectroWeak symmetry breaking and give mass to the W and Z bosons.
- Standard Model predicts a Higgs boson, but does not predict its mass.
- Mass Constraints from LEP, SLD and Tevatron ElectroWeak data



Standard Model Predictions for a Higgs Boson



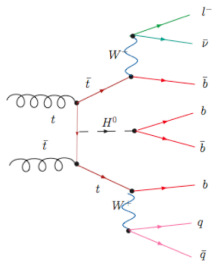
114 – 182 GeV 95% c.l.

- Combine low mass channels for discovery
- Coupling proportional to mass

$t\bar{t}H^0 (H^0 \rightarrow b\bar{b})$ signal and main backgrounds:

Signal

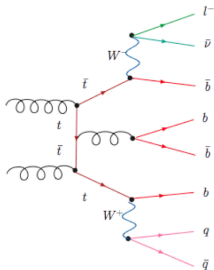
$$\sigma_{t\bar{t}H} : 0.098 pb$$



'Irreducible'
background

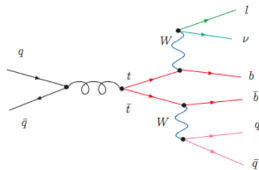
$$\sigma_{QCD} : 2.688 pb$$

$$\sigma_{EW} : 0.244 pb$$



Reducible
background

$$\sigma_{t\bar{t}X} : 114 pb$$



Pre-selection

- Require semi-leptonic decay of one top for trigger
- Exactly one $e(\mu)$ $p_T \geq 25(20)GeV$ + missing E_T
- At least 6 jets with $p_T \geq 20GeV$
- At least 4 of the jets must be tagged as **b-jets**



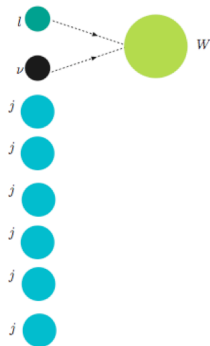
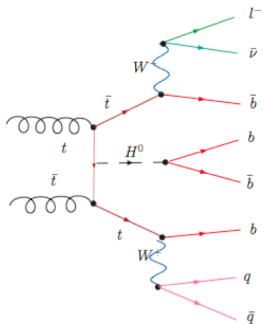
Before pre-selection



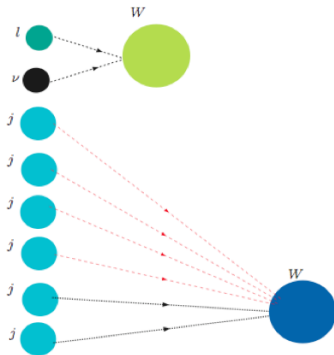
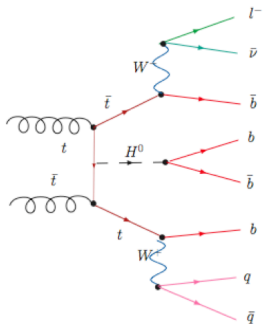
After pre-selection

$\frac{\text{signal}}{\text{background}}$ \uparrow by factor 40

Reconstruction of the event

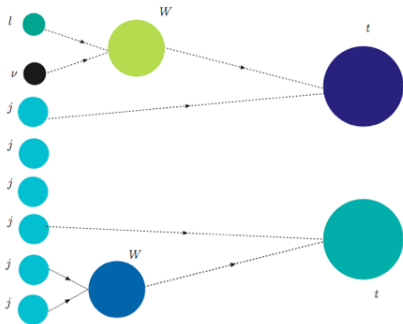
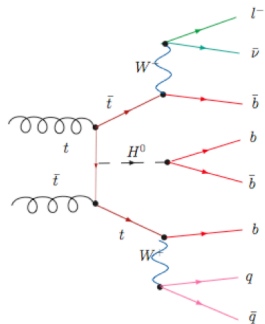


Reconstruction of the event



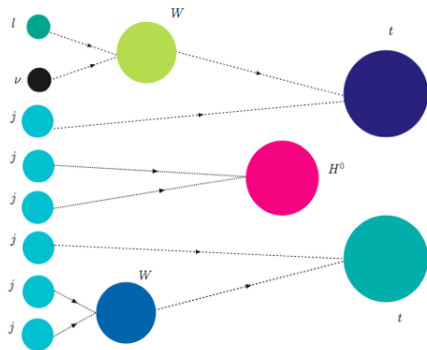
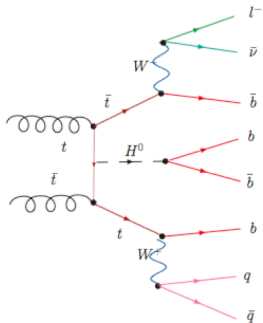
- Use b-tagging information on jets in optimal way

Reconstruction of the event



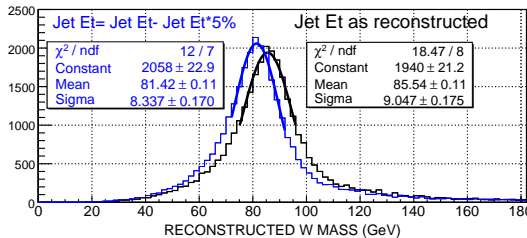
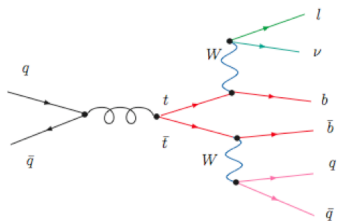
- Minimize $\chi^2 = \frac{(m_{l\nu b} - m_t)^2}{\sigma_{l\nu b}^2} + \frac{(m_{jjb} - m_t)^2}{\sigma_{jjb}^2} + \frac{(m_{jj} - m_W)^2}{\sigma_{jj}^2}$

Reconstruction of the event



During the first year of data taking...

Reconstruct hadronic W and $t\bar{t}$ system:



- Calibrate jet E_T to m_W
- Apply calibration coefficients as $f(E_T, \eta)$ to light jets

- A difficult but an **essential** channel for observation of a low mass Higgs
- $\frac{\text{signal}}{\sqrt{\text{background}}} \simeq 1.8$
- **combine significance** with $H^0 \rightarrow \tau\bar{\tau}$, $H^0 \rightarrow \gamma\gamma$, $ZH^0/WH^0 (H^0 \rightarrow b\bar{b})$
- High Energy and serious luminosity by the end of this year. Exciting times!

Comments & Questions ?