

Research Plan

Aaron Dominguez
LBNL

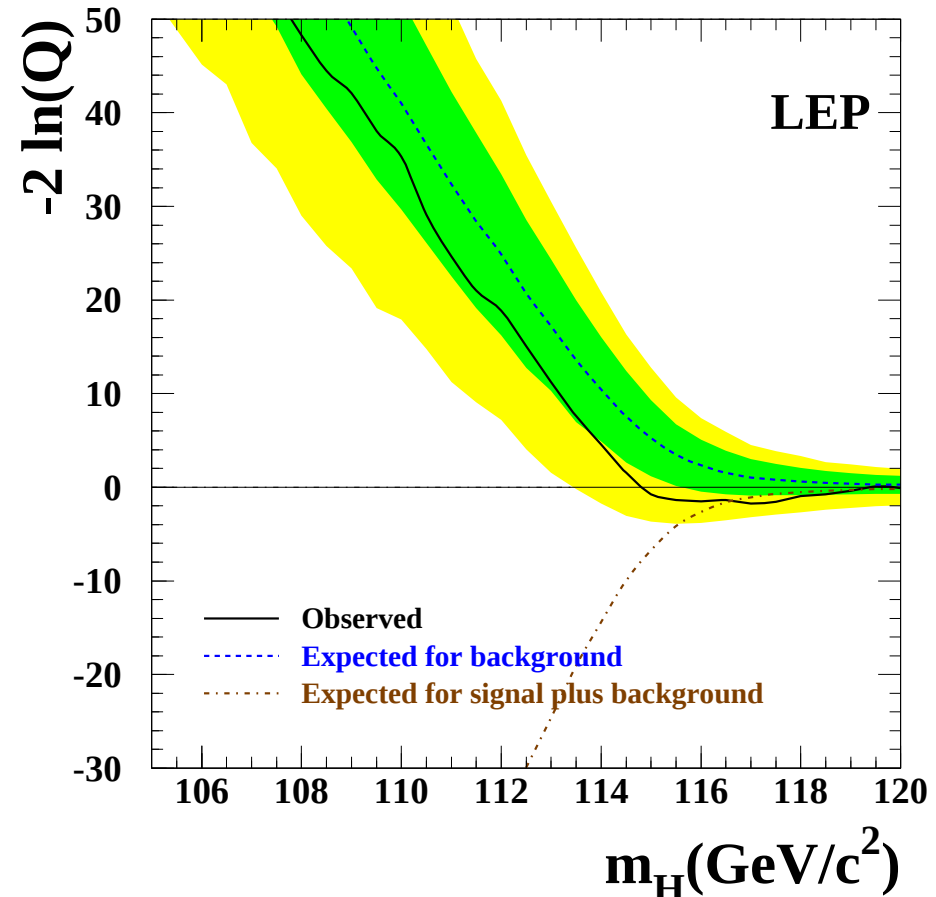
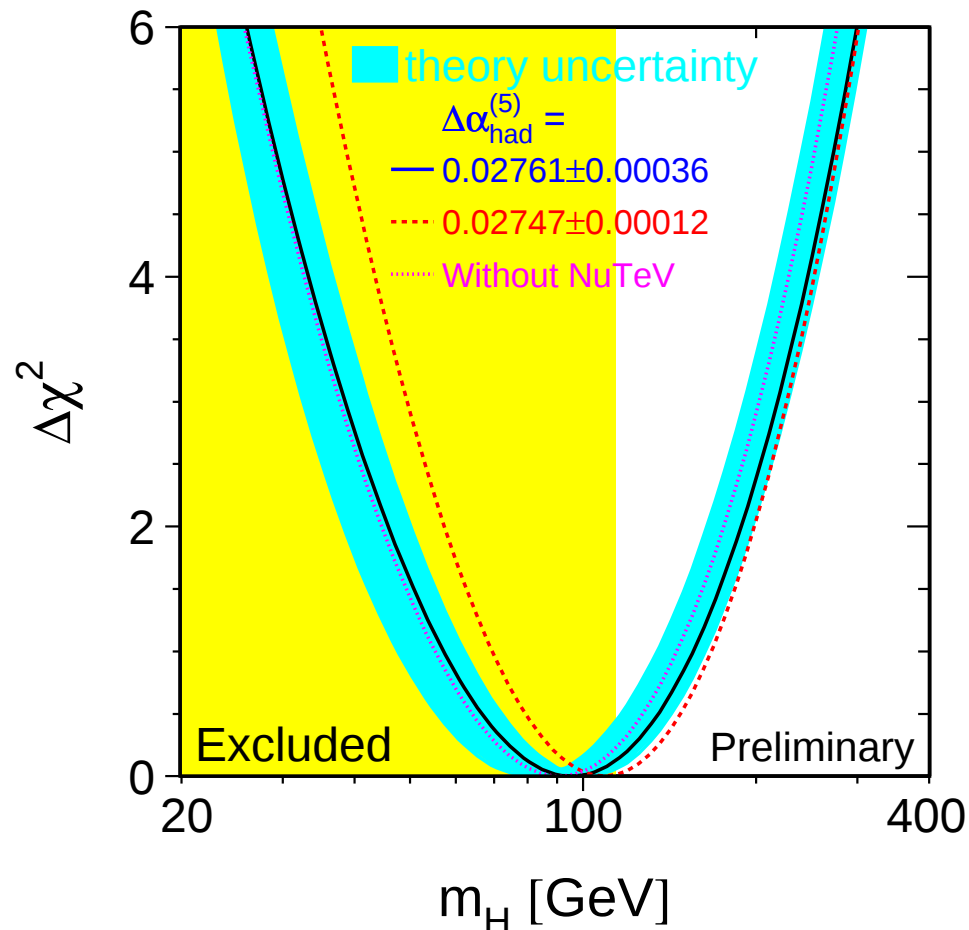
University of Toronto, April 2004

- **SM Higgs**: Do what we can
- **MSSM Higgs**: Possibility for discovery
- **B-Tag**: Improvements
- **Trigger**: New trigger
- **Analysis**: 4b search
- **ATLAS**: The future is now

The Broad Outline

- Finish the SM & MSSM Higgs search at CDF
- Work on relevant detectors for ATLAS Higgs search
- Find the Higgs at ATLAS

SM Higgs: Current State of Affairs

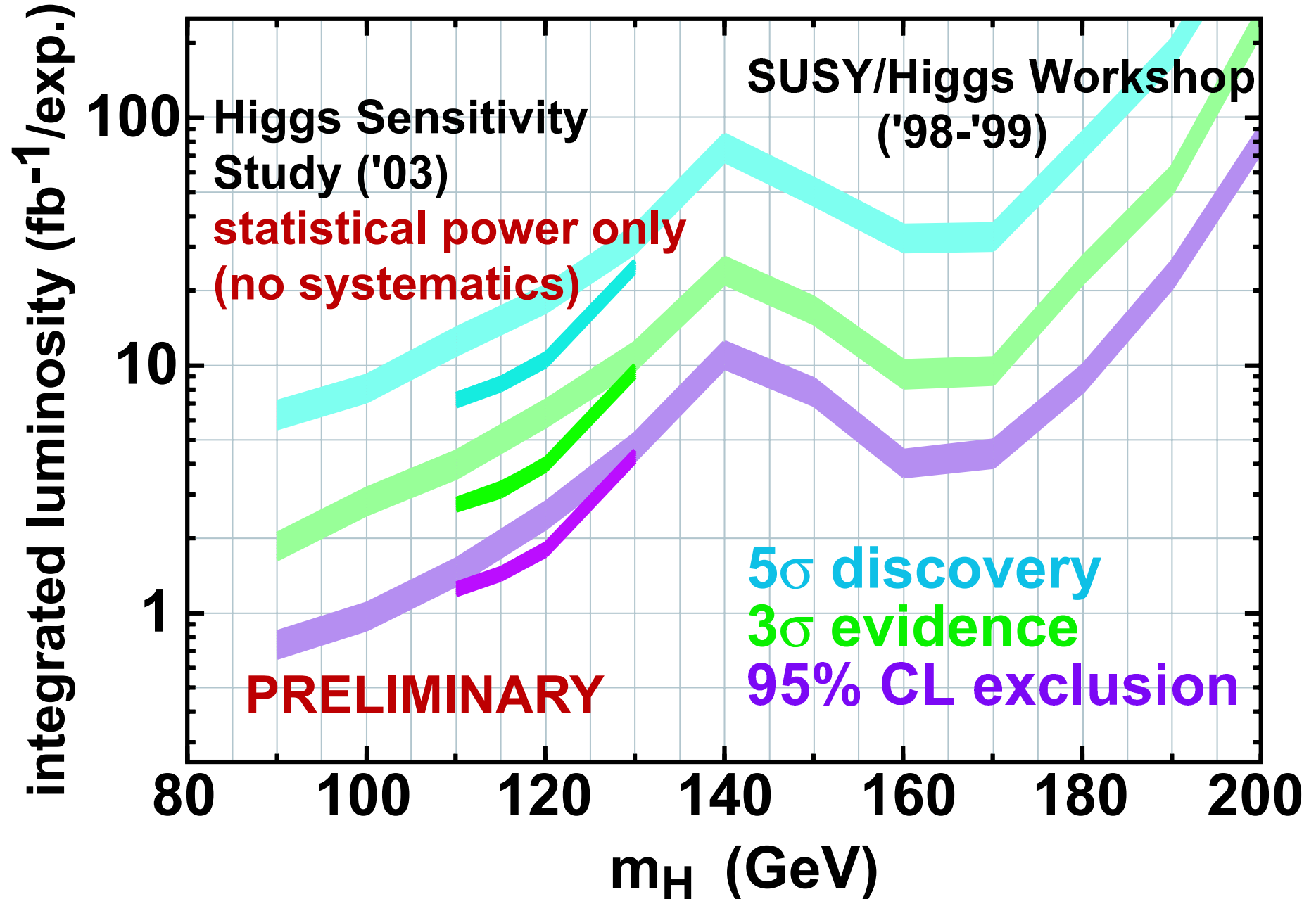


- EW Precision fits “predict” light Higgs
 $m_H < 219$ GeV, 95%CL
- One set of measurements (A_{FB}^b) differ by 3σ and pull m_h fit high. But removing them leaves

us with $m_h \approx 50$ GeV and $m_h \lesssim 110$ GeV
95%CL (Chanowitz)

- LEP Combined search limits
 $m_H > 114$ GeV, 95%CL

SM Higgs: Sensitivity vs Luminosity



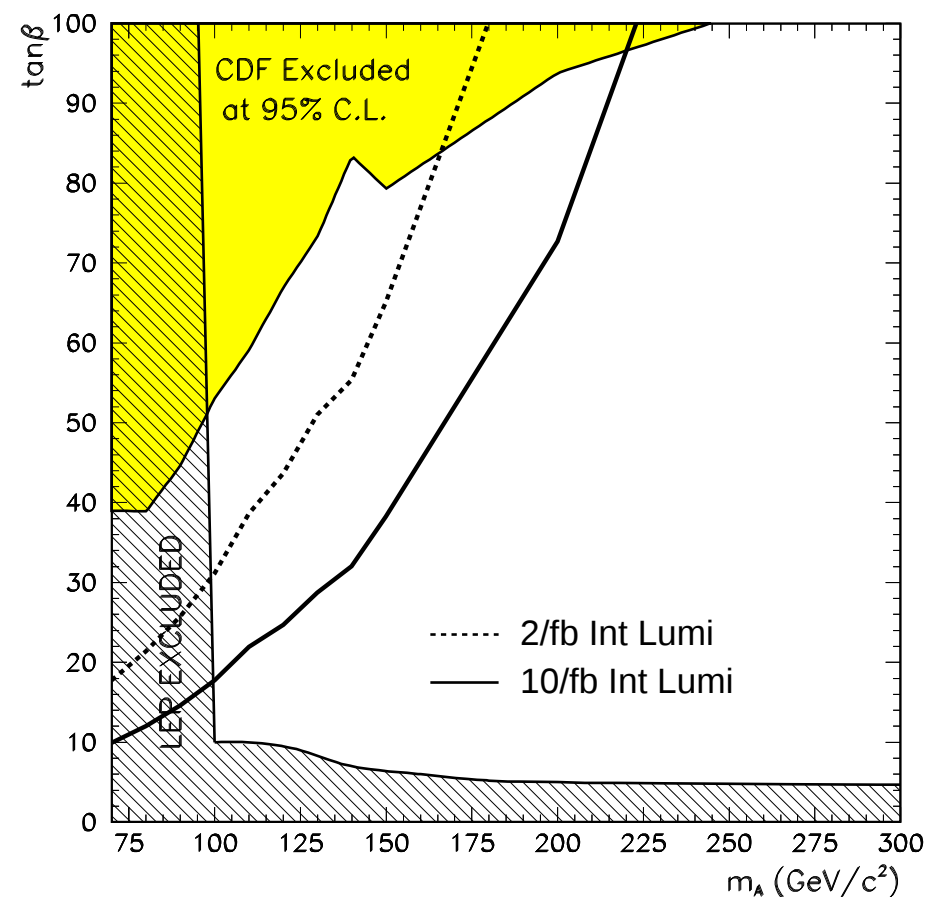
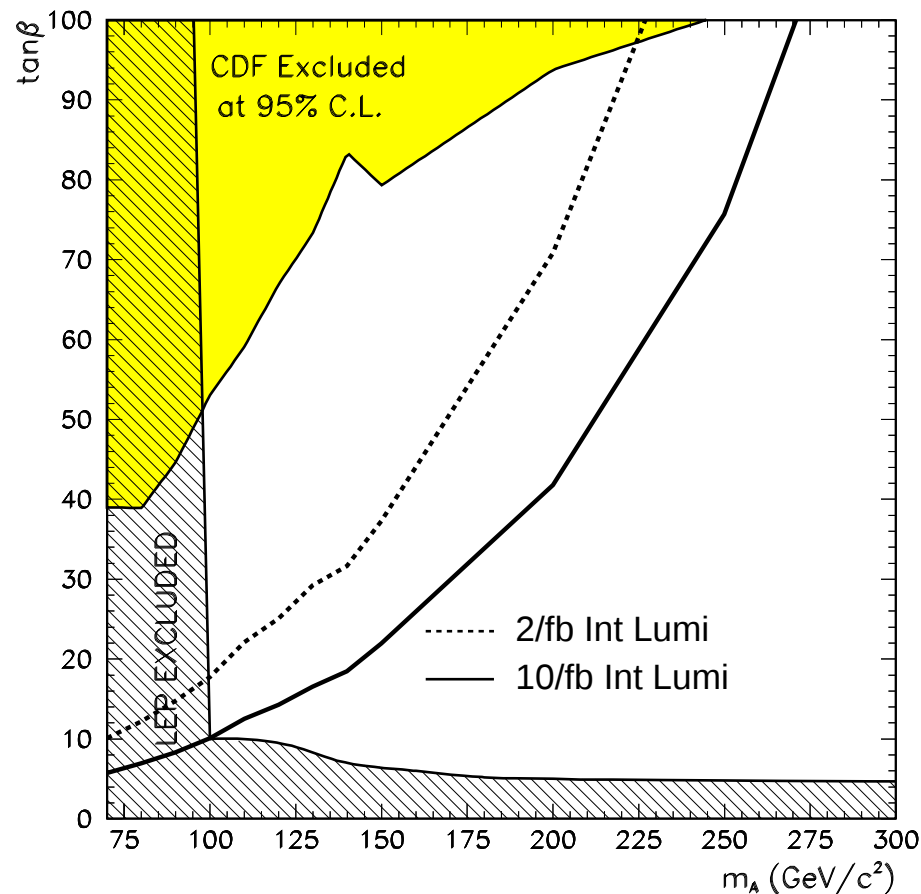
SM Higgs: Let's Finish It

- SM search difficult at Tevatron
- There are no golden channels
- Will be necessary to combine all search channels and two experiments
- As current co-convenor of CDF Higgs group, I'm well placed to get first round of SM searches published and combined.
 - Pipeline: $WH \rightarrow \ell \nu b \bar{b}$, $ZH \rightarrow \nu \bar{\nu} b \bar{b}$, $H \rightarrow WW^*$,
 $W/ZH \rightarrow q \bar{q} b \bar{b}$

MSSM Higgs: Sensitivity

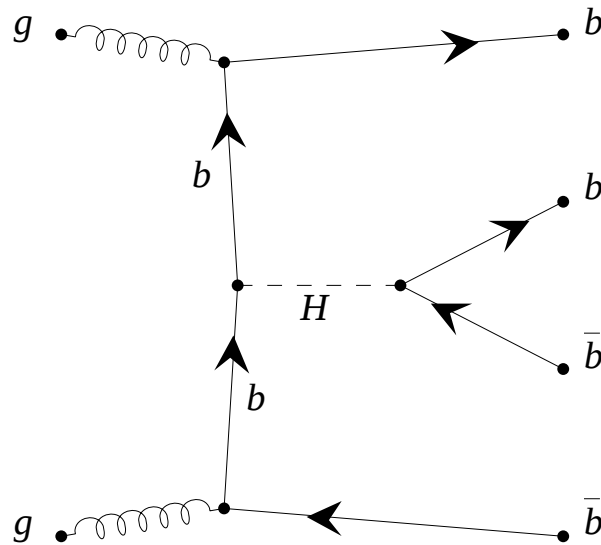
95% CL Exclusion

5σ Discovery

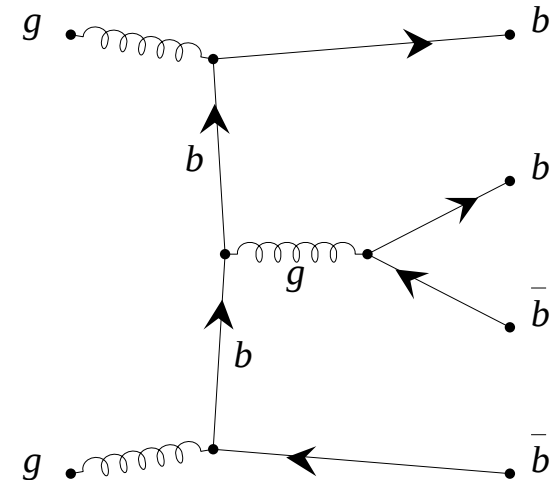


MSSM Higgs: 4b Channel

Signal



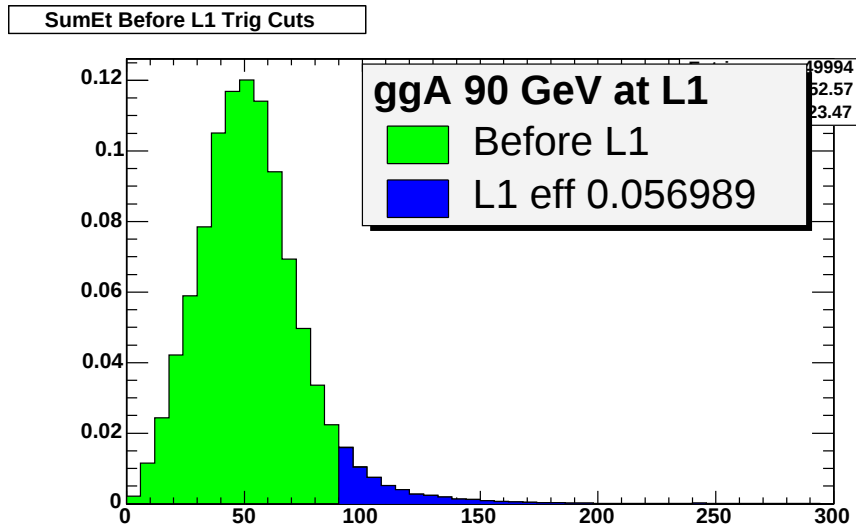
QCD 4b Background



- Signature: 4 b-jets in final state with lots of visible energy
- Dominant background: QCD processes giving 4 real b-jets in final state
- Trigger:
 - 3 jets with $E_T > 10$ GeV
 - $\sum E_T > 100$ GeV
 - Heavy flavor present (use SVT)

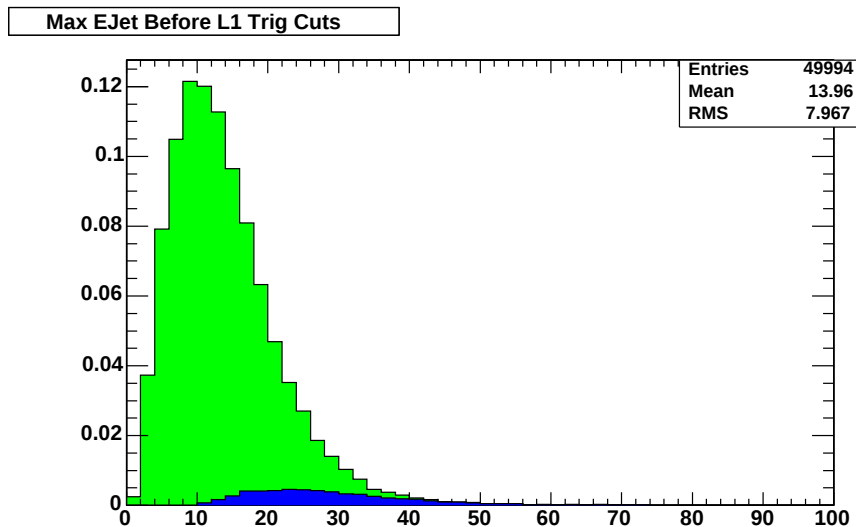
4b Channel: To-Do

Improve trigger eff



Improve b-tag eff

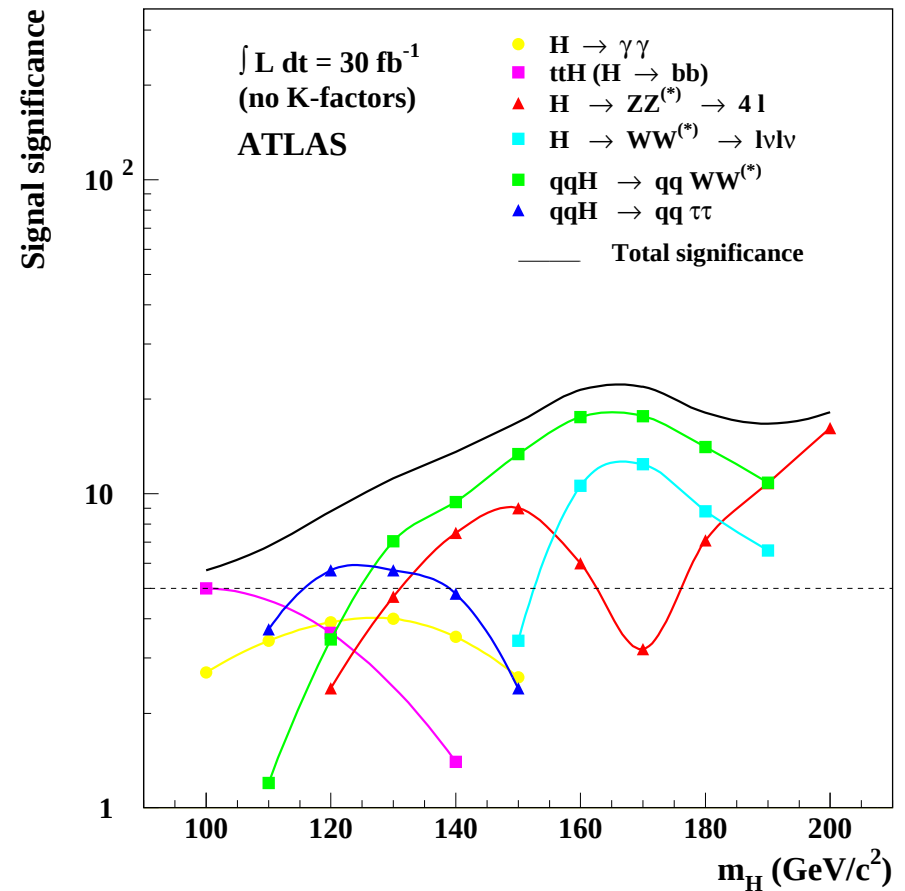
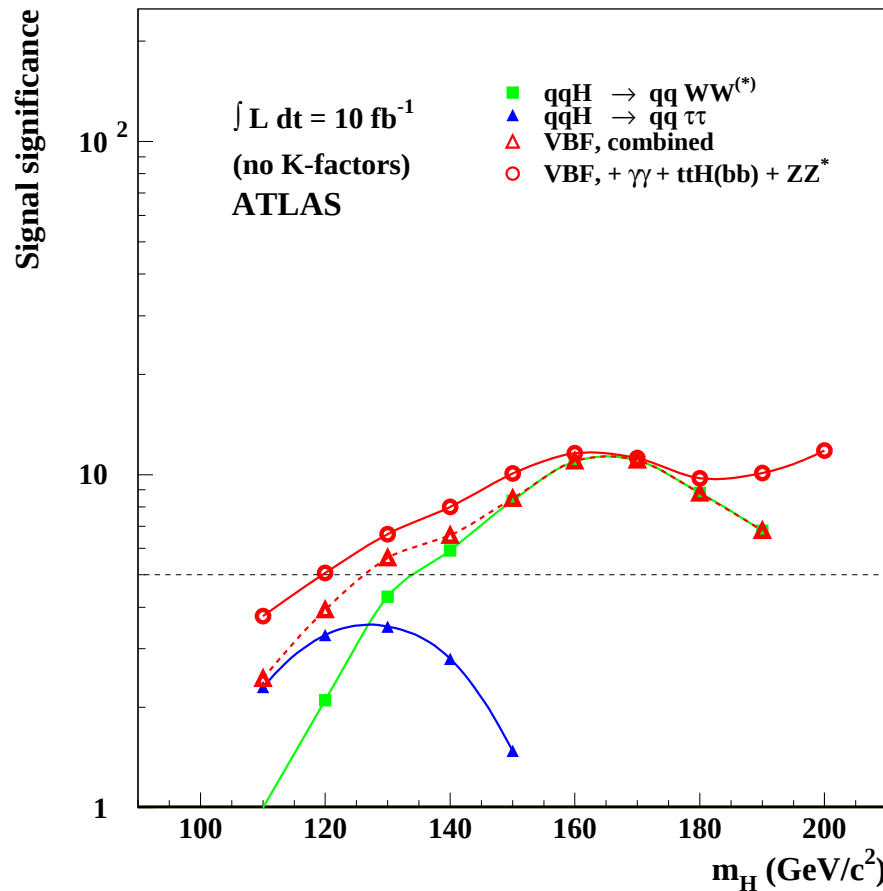
- Need 3 b-tags to beat down bkg
- 25% improvement per jet gives us $\times 2$ signal eff
- Improvements from:
 - Forward tracking
 - L00
 - Neural net & improved algorithm (a'la S. Lai)



CDF Higgs Search

- Finish first round of search for $gg \rightarrow b\bar{b}A/h \rightarrow b\bar{b}b\bar{b}$
- Implement more efficient trigger
- Combined search
 - Willinbrock predicts $gg \rightarrow bA \rightarrow b\bar{b}\bar{b}$ is ~ 10 times bigger than $4b$ final state. Measure similar process $p\bar{p} \rightarrow Zb$ first.
 - $b\bar{b}\tau\tau$ channel is 10 times smaller, but still helpful at high $\tan\beta$.
 - Also combine $gg \rightarrow A \rightarrow \tau^+\tau^-$
 - Confirmation in τ -channel would be key!
 - Can combine results with D0 a'la LEPHWG for more sensitivity
- Combine with other SUSY searches, esp $B_s \rightarrow \mu^+\mu^-$ for *global MSSM search*
- MSSM Higgs search seems most promising for CDF

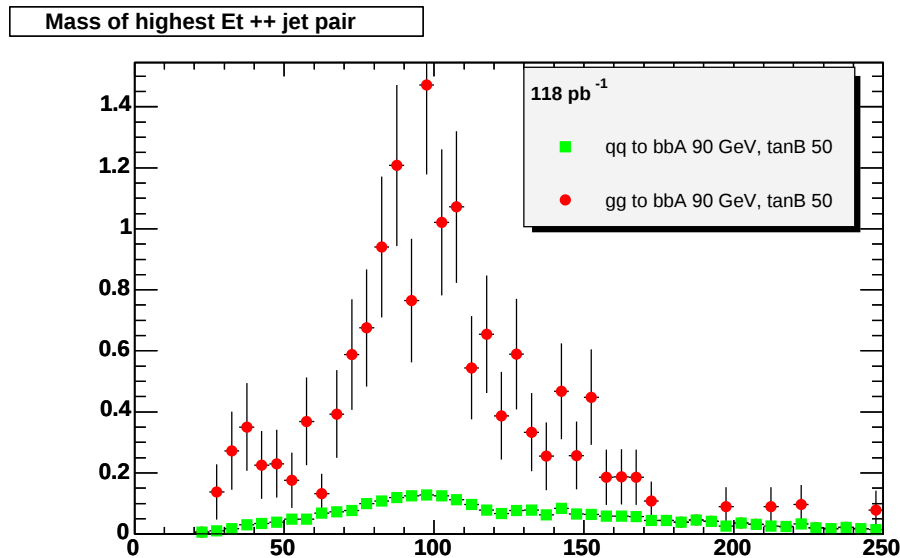
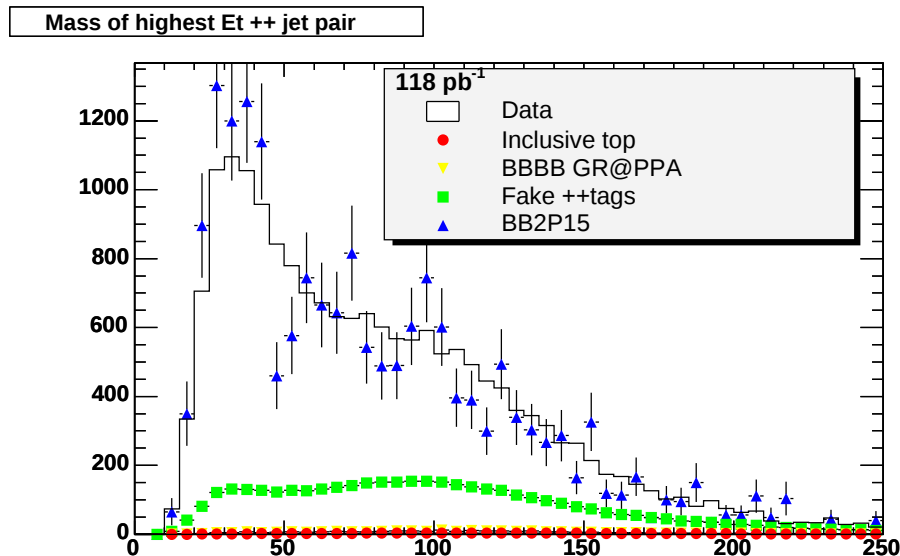
ATLAS Higgs Search (from TDR)



- Low mass region needs b-tagging
- Will be hard work, but unless we've closed it at FNAL...

- We should go after this region due to LEP limit and EWK fit
- Calorimetry and tracking will be key

ATLAS Higgs Search: Need to Understand QCD BKG



- Any hadronic final-states dominated by QCD bkg, like at CDF
- Use same tricks we've learned at Tevatron
- LO ME generators (ALPGEN, GR@PPA) for QCD b events, measure absolute cross section from background dominated data

ATLAS Higgs Search: Need Strong Canadian Team!

- Physics in ATLAS will be a battle
- If we're serious about a topic, we need to build a strong team
- Toronto has expertise in two of the most important aspects for Higgs physics: calorimetry & tracking

ATLAS Higgs Search: Need Strong Canadian Team!

- Propose that we work out a strategy with Toronto expertise and other Canadian groups to get more involved with tracking/silicon for ATLAS and go after Higgs & new physics!