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tth, h →bb, all hadronic decay channel

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tth h to bb , all hadronic channel

- Introduction
- trigger
- backgrounds
- preliminary results

Contributions from:
Chris Collins-Tooth, Kenny Wraight (Glasgow),
Lorenzo Feligioni (Marseille),
Fabrizio Parodi, Andrea Coccaro(Genoa)
MC samples centrally produced (Junichi & Rachid)

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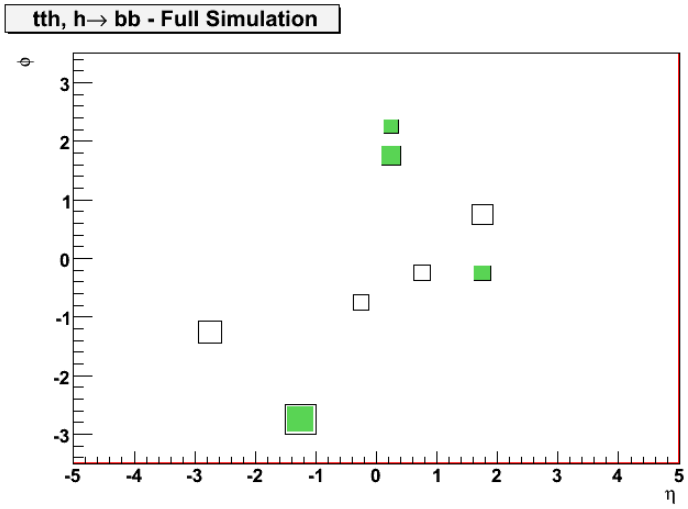
Introduction

- $h \rightarrow bb$ important for measuring Higgs Yukawa coupling
- viable only for associate production with *top*
- use *top* for triggering
- Hadronic channel 45.7% of *top* branching ratio
- Signature:
  - high jet multiplicity: 8 jets, of which
  - 4 are *b*-jets
  - high pt



Many issues in common with semileptonic top decay channel tth.
Many issues in common with hadronic top
Focus on Standard Model Higgs

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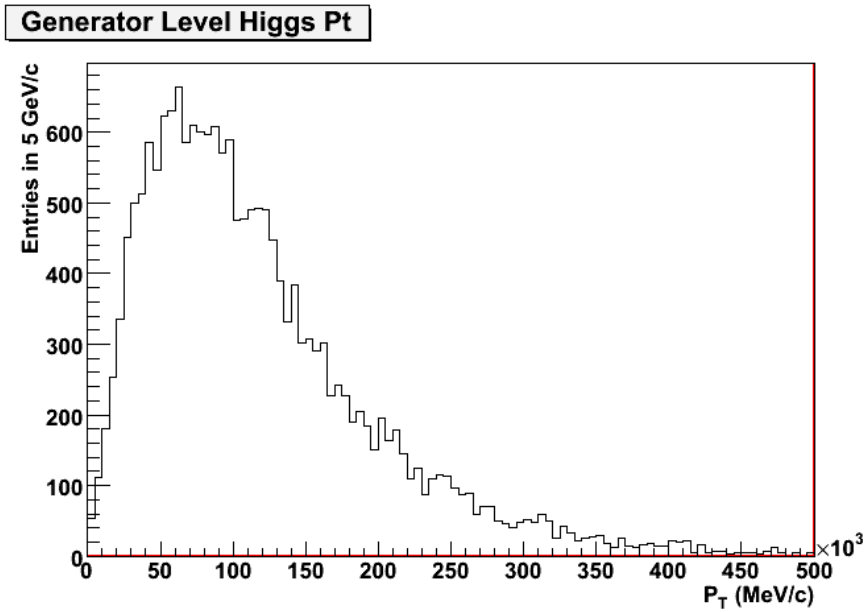
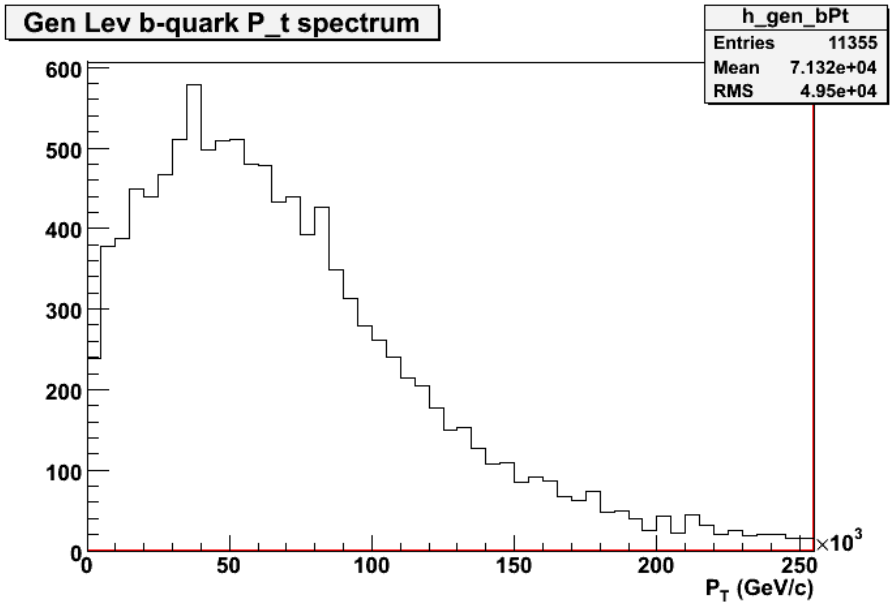
Introduction: generator-level

Signal Sample: Pythia, with UL event, full simulation





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Trigger

All hadronic channel, require jet multiplicity trigger.
B-trigger essential at higher lumi.
Use case for B-trigger plus multiplicity

Preliminary phase: 4j23 unprescaled 4J23, JE240
B-triggering can include 3B45. Studies on-going, especially for 10^{33}

Preliminary cuts used in this analysis:

- ≥ 8 jets $p_T \geq 20$ GeV,
- ≥ 1bjet $p_T \geq 65$GeV,
- ≥ 3 b-tagged jets.

(not final, subj to change)

Tentative menu for 10^{33} (A. Coccaro, F. Parodi, Genoa)

L1	L2	EF
3j42(1330)	2B42_3L1jets(116 Hz)	2B42 (33 Hz)
4j23(1400)	3B23_4L1jets (43 Hz)	3B23 (1.6 Hz)

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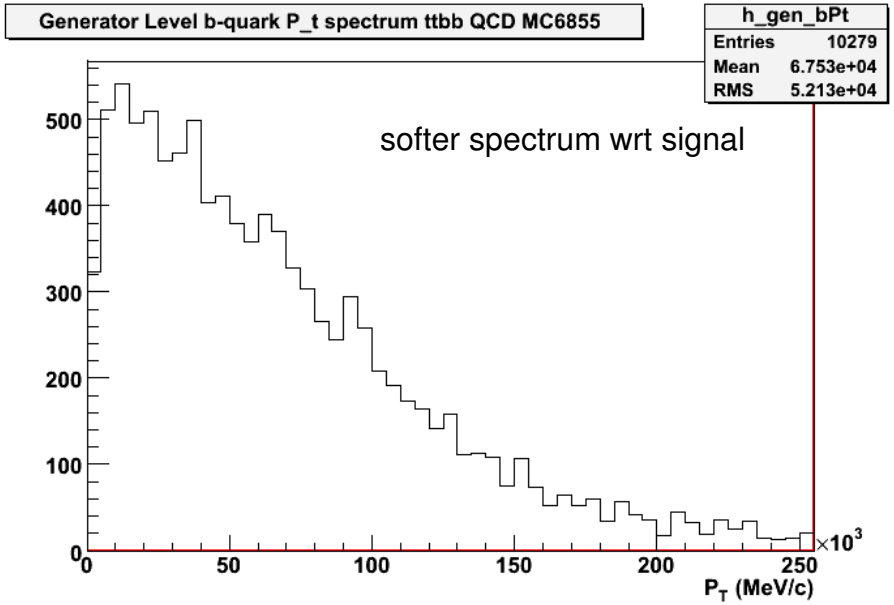
Backgrounds

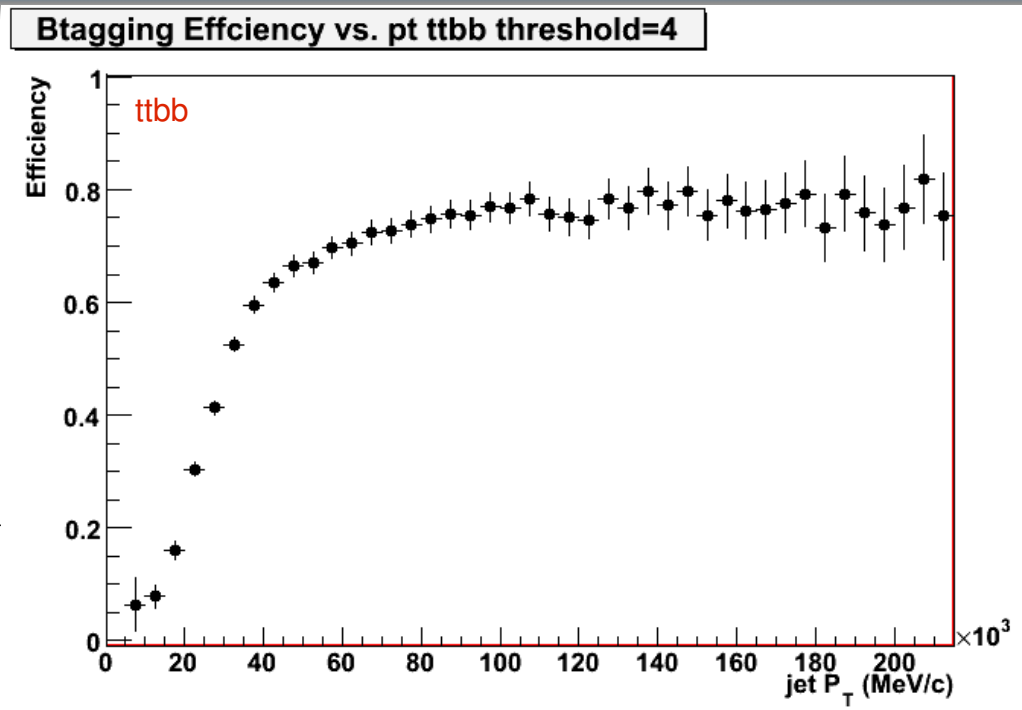
- All tt+jets backgrounds:
  - WW + 4*b*
  - WW + 2*b* + 2j
  - bb + 2jets (+2jets from hadron shower)
  - 6 jets (+2jets from hadron shower)
  - WW + 4 jets
- tt+jets
  - ttW (W to jj)
- tt *bb* "*irreducible*" QCD background
- ttZ, Z→*bb* "control channel", (low σ)

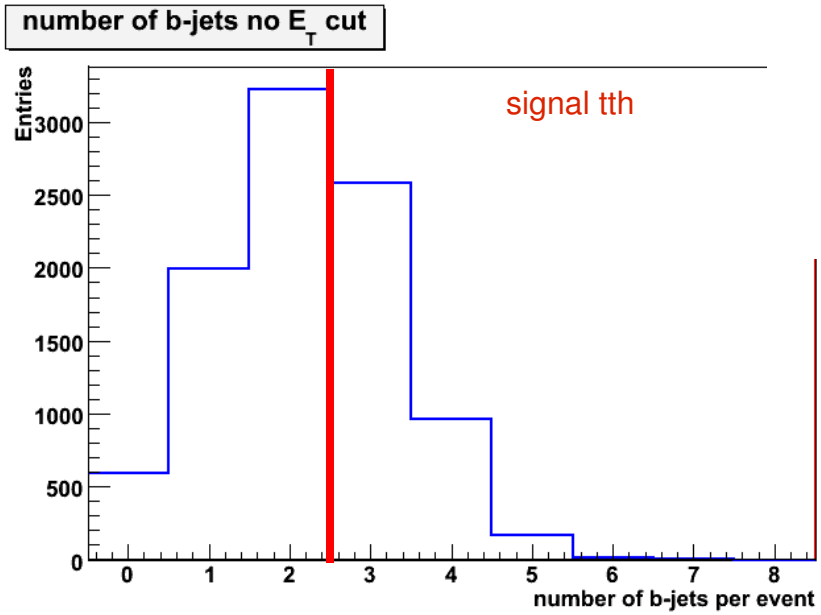
MC samples:
tt+jets: MC@NLO + Herwig
tt bb: AcerMC +Herwig 8.1 fb



Support studies: *b*-tagging

Using standard b-tagging, threshold = 4
Efficiency with respect to generator-level information





Soft lepton may improve tagging:
Prob at least one muon or electron in ttbb: 80%

Efficiency critically depends on b-tagging performances

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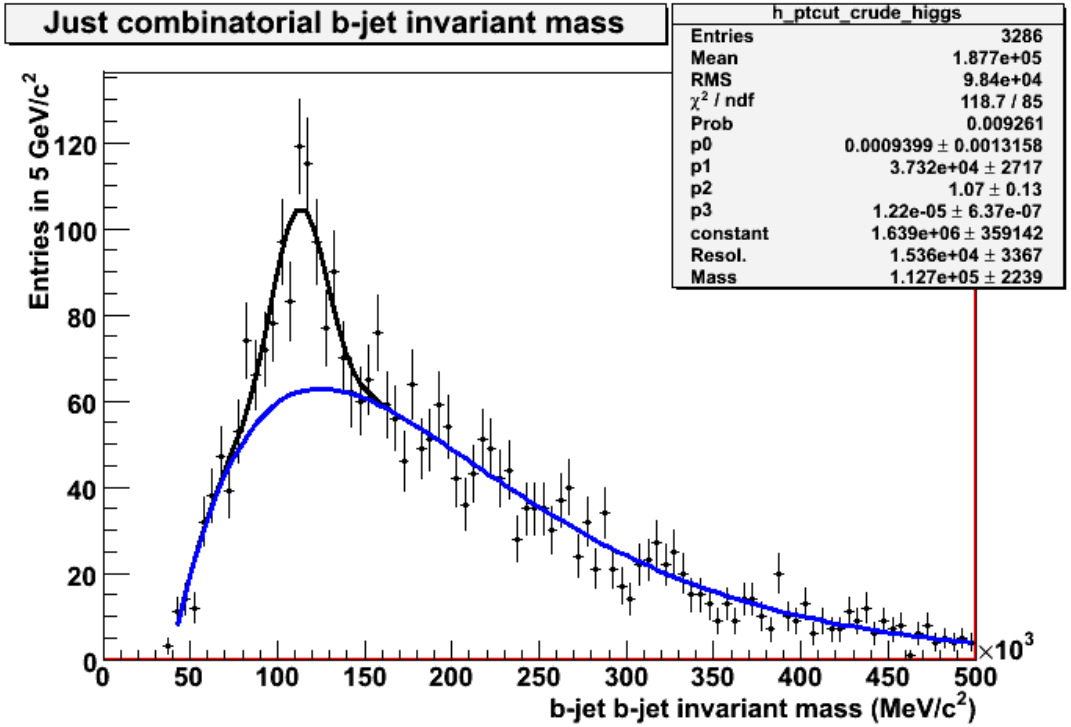
Analysis layout



Just combining 2 b-jets
ET1 > 65 GeV
ET2 > 20 GeV
Ptcand > 50 GeV

QCD background overwhelming at this stage. Look for top

No use of Generator Level information from now on

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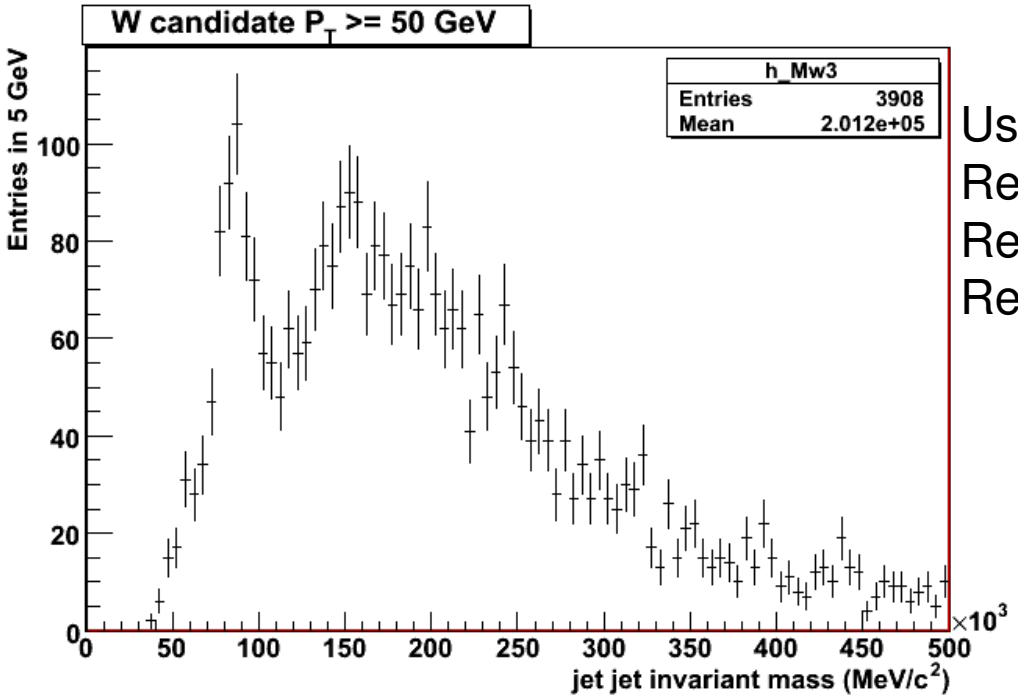
Analysis layout



Use lose b-tag veto (tag < 0) on both jets
Require 'seed' jet PT > 65 GeV/c
Require 'second' jet PT > 20 GeV/c
Require W candidate PT > 50 GeV/c

Consider W candidates if
74 < M < 96 GeV

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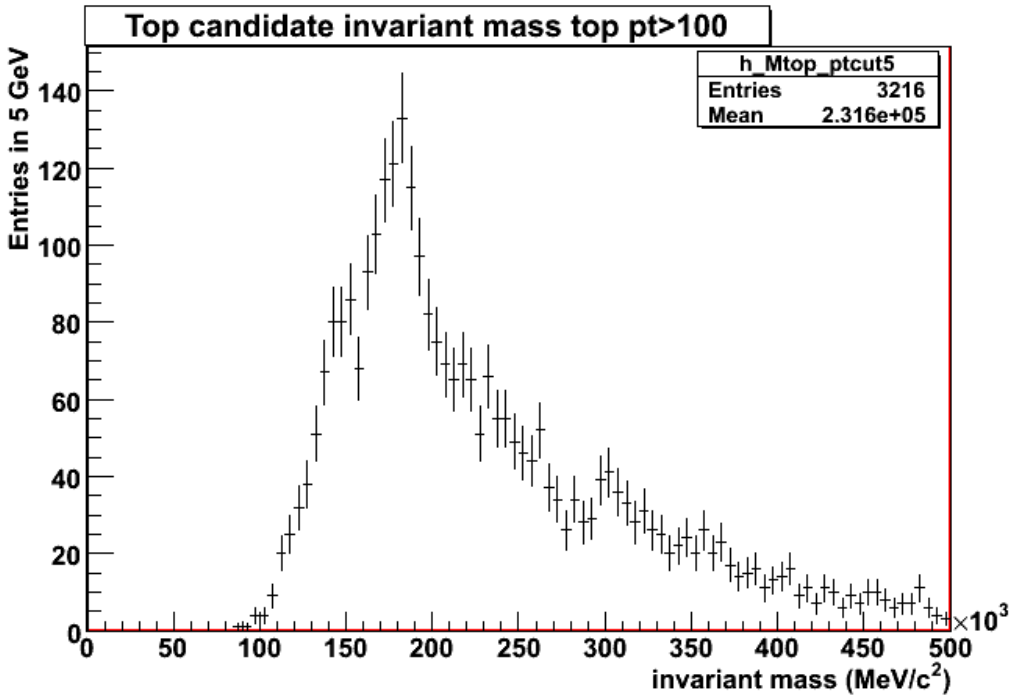
Analysis layout



Require b-tagging on third jet but no pt cut

Require $pt_{cand} > 100$ GeV

Select candidates with

$155 < M_{cand} < 192$ GeV

All cut values need to be optimized.

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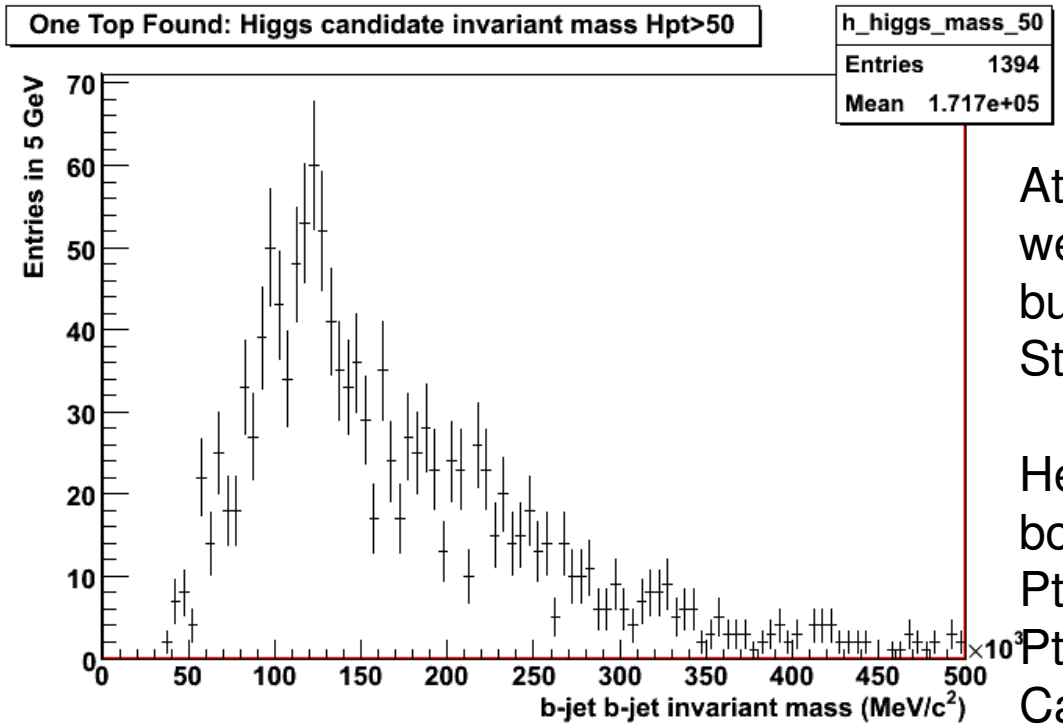
Analysis layout



At this point, one top is found,
we can use remaining b-jets to
build invariant mass spectrum.
Still dominated by 'self-combinatorics'

Here require
both b-jets (thr =4)
Pt(1) > 65GeV
Pt(2) > 25 GeV
Candidate Pt > 50 GeV

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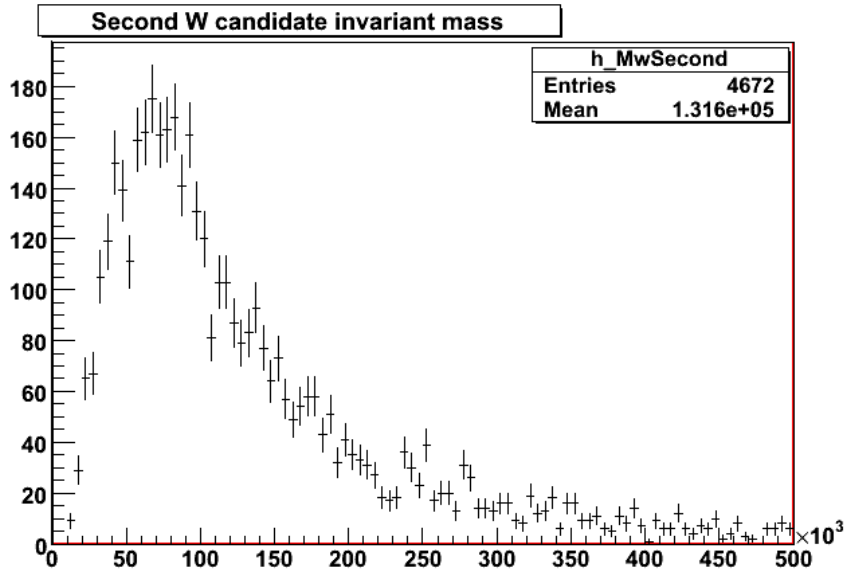
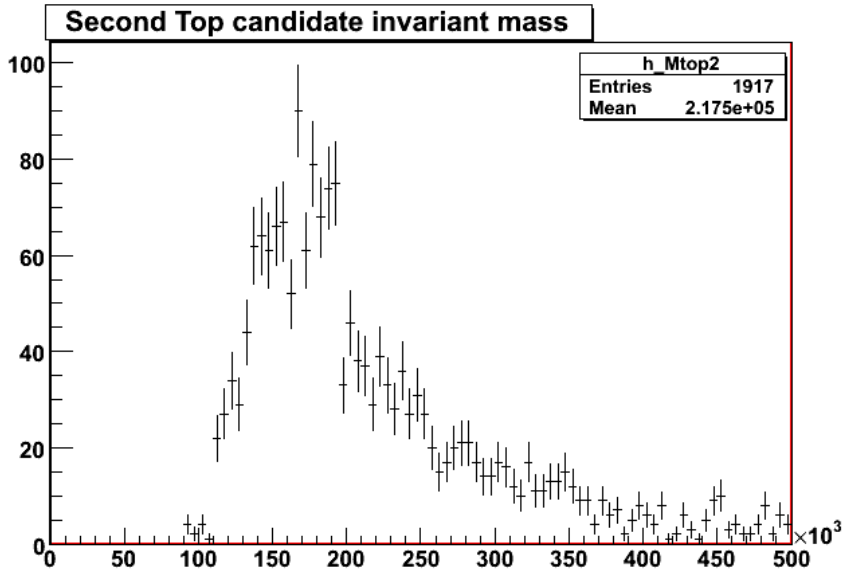
Analysis layout



Repeat for second W,
avoid using the same jets,
b-jet veto, no pt cut this time

Apply the same invariant mass cuts
Add b-jet, no pt cut

At this point we have used 6 jets.



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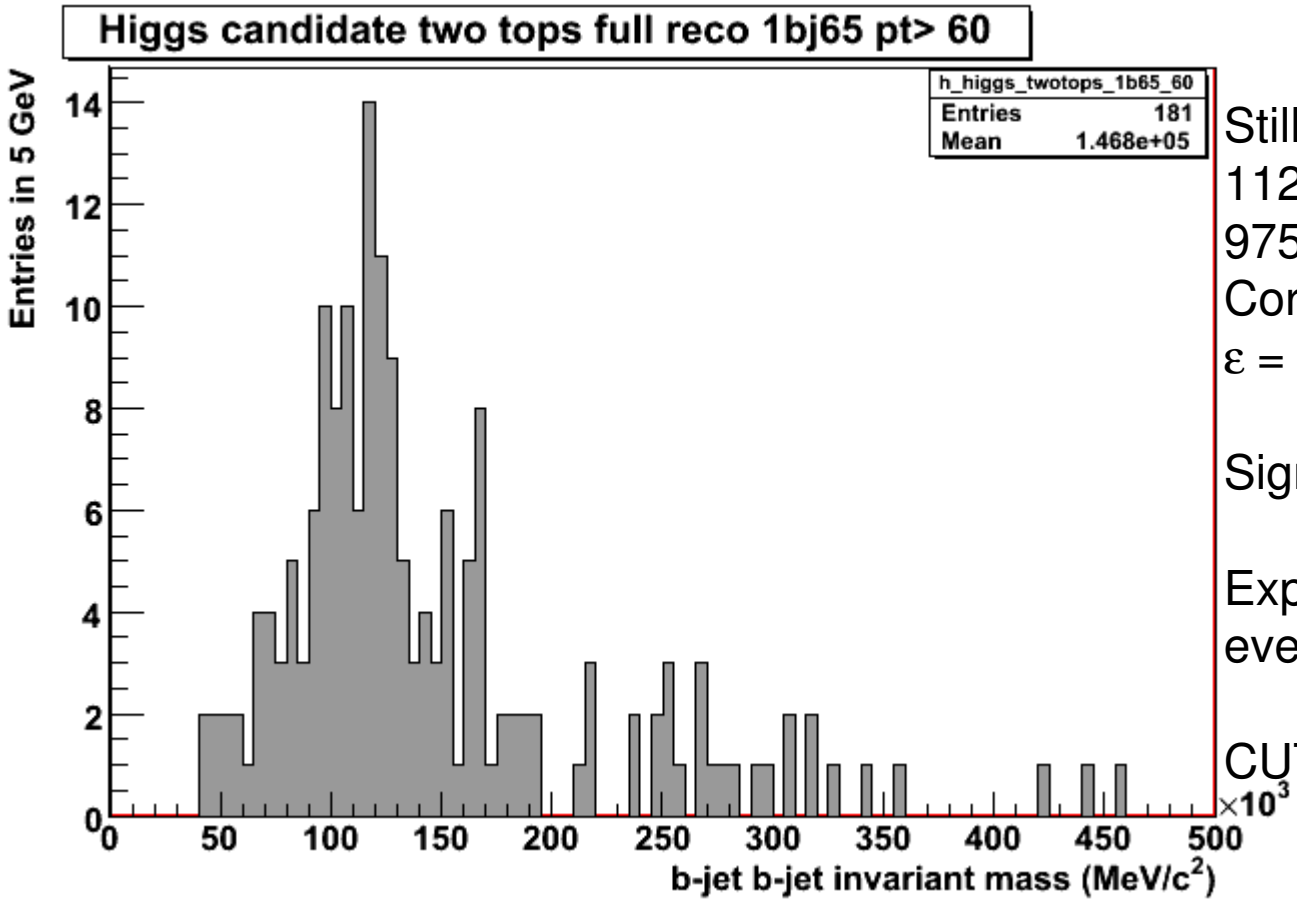
Preliminary Results



Still visible signal !
112 candidates from
9750 MC signal events
Corresponding to 63.8 fb-1
ε = 1.1 %

Signal Width ≈ 22 GeV

Expect 18 candidate events in 10 fb-1

CUTS not optimized !!

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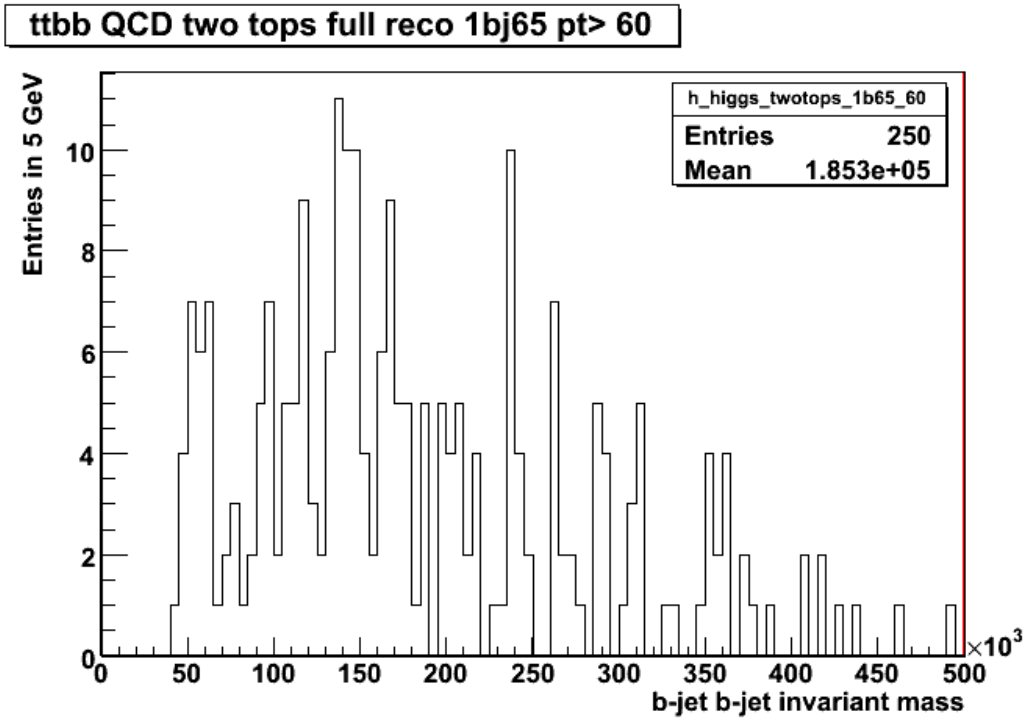
Preliminary results



Background:
dominated by ttbb QCD production
Consider only this for the moment
Apply exactly same procedure
Statistics not sufficient for shape analysis.
Require more MC with fast sim.
114 background events in 10 fb-1
Un-optimized significance:
$S/\sqrt{B} \approx 1.7\ \sigma$ in 10 fb^{-1}
$S/\sqrt{B} \approx 2.9\ \sigma$ in 30 fb^{-1}
Significance dilution for the "Look elsewhere effect" not so large if restricted search range < 150 GeV.
Probably not "discovery channel", ...not "disney channel" either, results can improve.

Optimization:
Calculate ε and B (from fit) for various cuts, maximize $\varepsilon / (1.5 + \sqrt{B})$ for stat coverage

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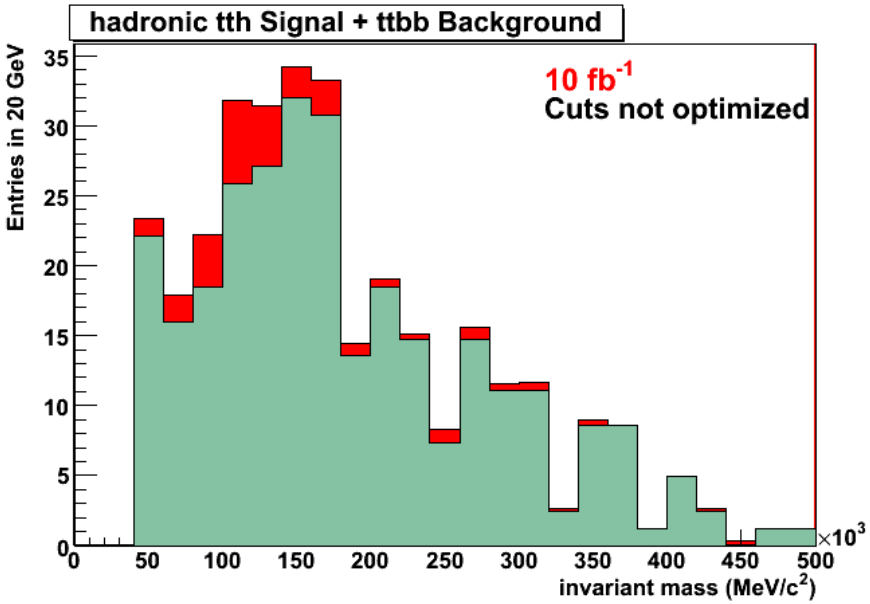
Conclusions and plan



On-going work

- Plan to use larger fast MC statistics for background: present limitation
- Intend to use shape analysis and fit for signal significance. Stat forum
- Precise experimental measurement of tt + jets needed to pin down the background.
- Precise measurement of *b*-tagging efficiency. Systematics.
- Trigger optimization, and preliminary cuts.

Short term plan:

Optimization to be performed.

Run on other background MC samples tt+jets, remove double counting of b-jets (MC@NLO). Preliminary version almost ready for CSC note.

Double semi leptonic top decay: had just a quick look, most samples exist, Help very welcome

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Backup