HO Effects in $t\bar{t}H^0 \rightarrow l^{\pm}\nu q\bar{q}b\bar{b}b\bar{b}$ Searches at LHC

MC Workshop, CERN, 8. July 2003

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- introduction
- present understanding
- combinatorial background
- possible solutions

$t\bar{t}H^0 \to l^{\pm}\nu q\bar{q}b\bar{b}b\bar{b}$ Events

- LO events generated with CompHEP (hard process) + PYTHIA (fragmentation, underl. ev. $\to$ HO effects)

- signal process: $t\bar{t}H^0$
- BG processes: $t\bar{t}b\bar{b}$, $t\bar{t}jj$, $t\bar{t}Z^0$

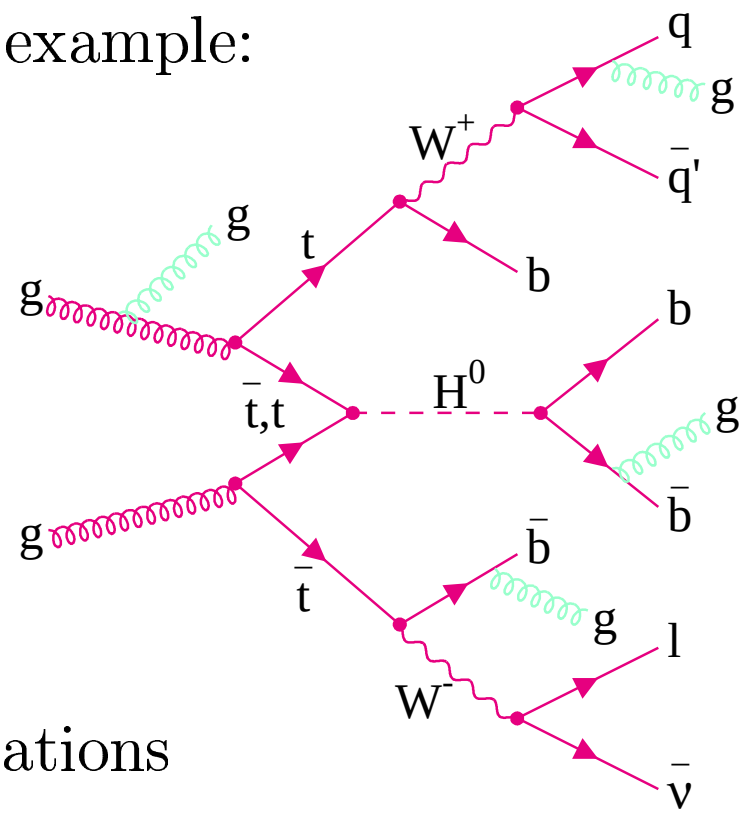
- 1 $l^{\pm}$, E_T^{miss}, min. 6 j.

- jet combinatorics:

$$N = \binom{n}{6} \times 6! \times \frac{1}{2} \times \frac{1}{2} \times 2$$

n: jets and N: combinations

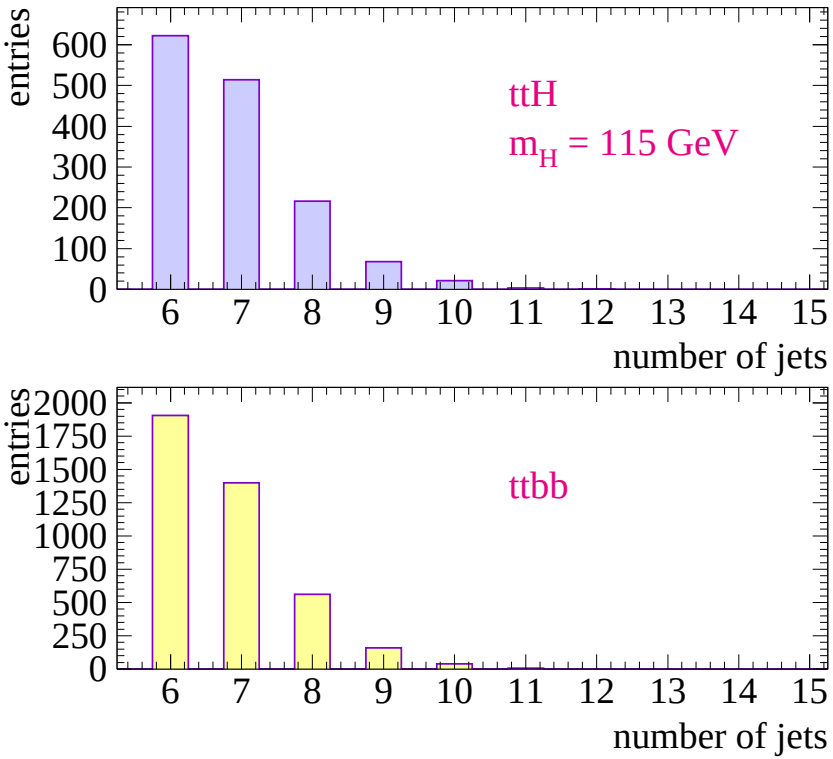
example:

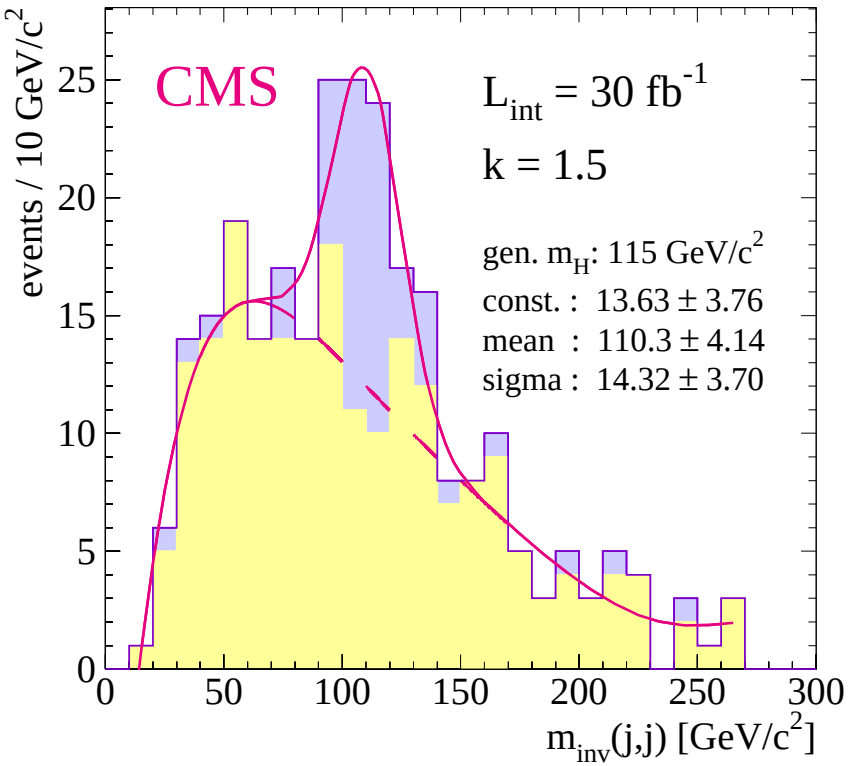


n	=	6	7	8	9	10	11	12
N	=	360	2520	10080	30240	75600	166320	332640

$t\bar{t}H^0 \to l^{\pm}\nu q\bar{q}b\bar{b}b\bar{b}$ Reconstruction

Example from hep-ph/0111312





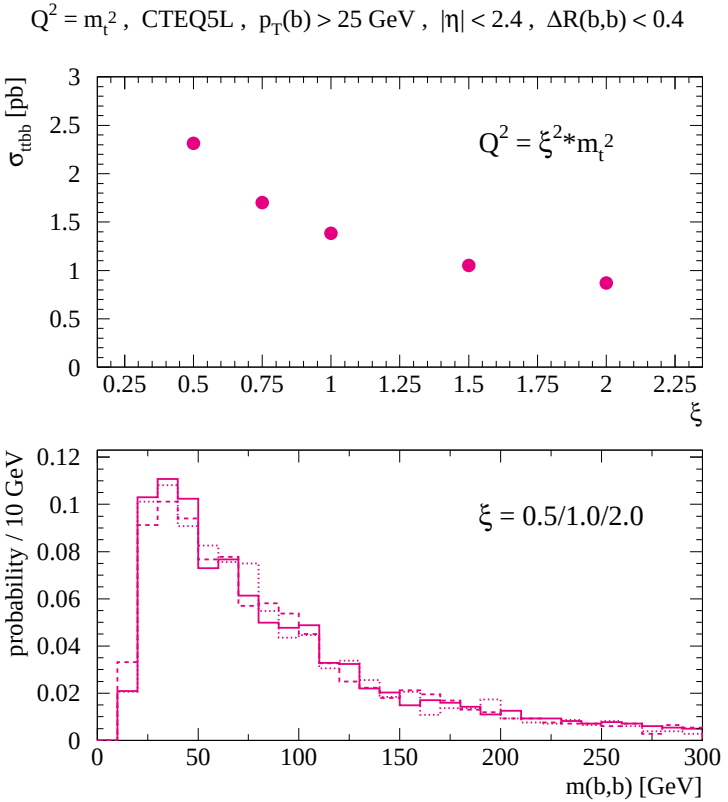
◇ wide mass peak ⇒ need to understand the background

◇ more than half of the events have additional jets (PYTHIA)

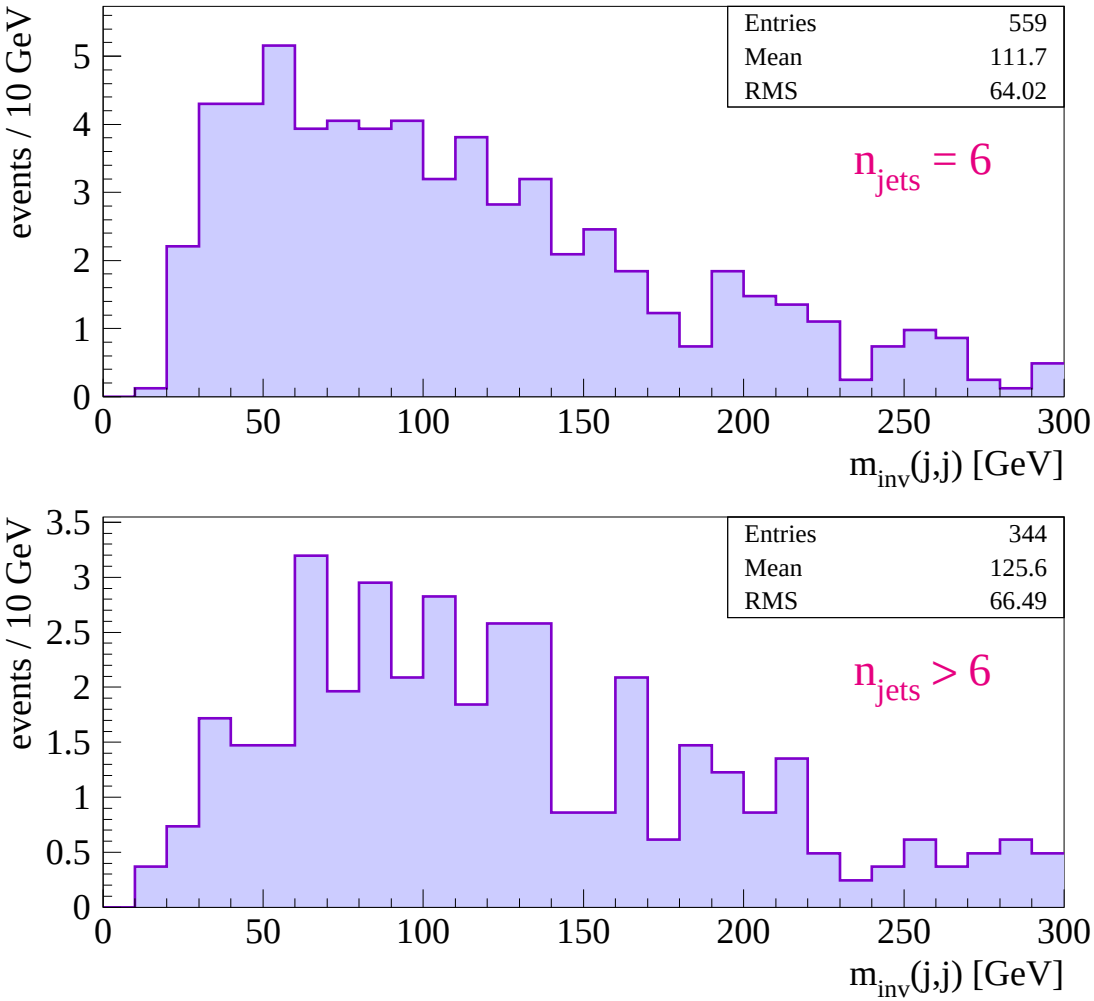
Present Understanding

- $t\bar{t}H^0$ production calculated at NLO Nucl.Phys.B653:151-203 and Phys.Rev.D67:071503
- Michael Spira: $t\bar{t}H^0$ MC at NLO on the way
- $t\bar{t}b\bar{b}$ is main BG only known at LO
- strong scale variation of cross section, but mass shape stays similar Les Houches 2003

$\Rightarrow$ really?



$t\bar{t}b\bar{b} \rightarrow l^{\pm}\nu q\bar{q}b\bar{b}b\bar{b}$



- reconstr. efficiency: is lower for events with additional jets
- mass shape: is different (higher mean for events with additional jets)

$\Rightarrow$ What happens, if real NLO gives more energetic jets?

Problems

- background is not calculated at NLO (big scale dependence of the cross section, not of the mass shape)
- mass shapes and selection efficiencies are different for events with additional jets

Possible Solutions

- get NLO generators for all processes involved
- try to study combinatorial effects with $x + j$ at LO
- give up

Question

- how would a NLO calculation of the hard interaction lead to the $l^{\pm}\nu q\bar{q}b\bar{b}b\bar{b} + X$ final state at NLO?