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

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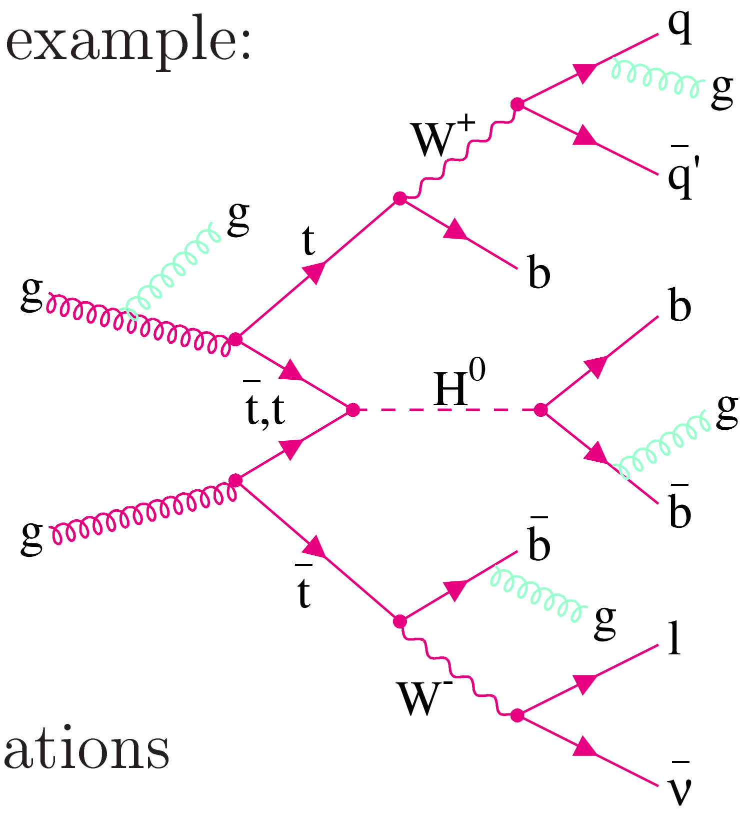
- present understanding
- combinatorial background
- possible solutions

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

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

- signal process: $t\bar{t}H^0$

example:




- 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:

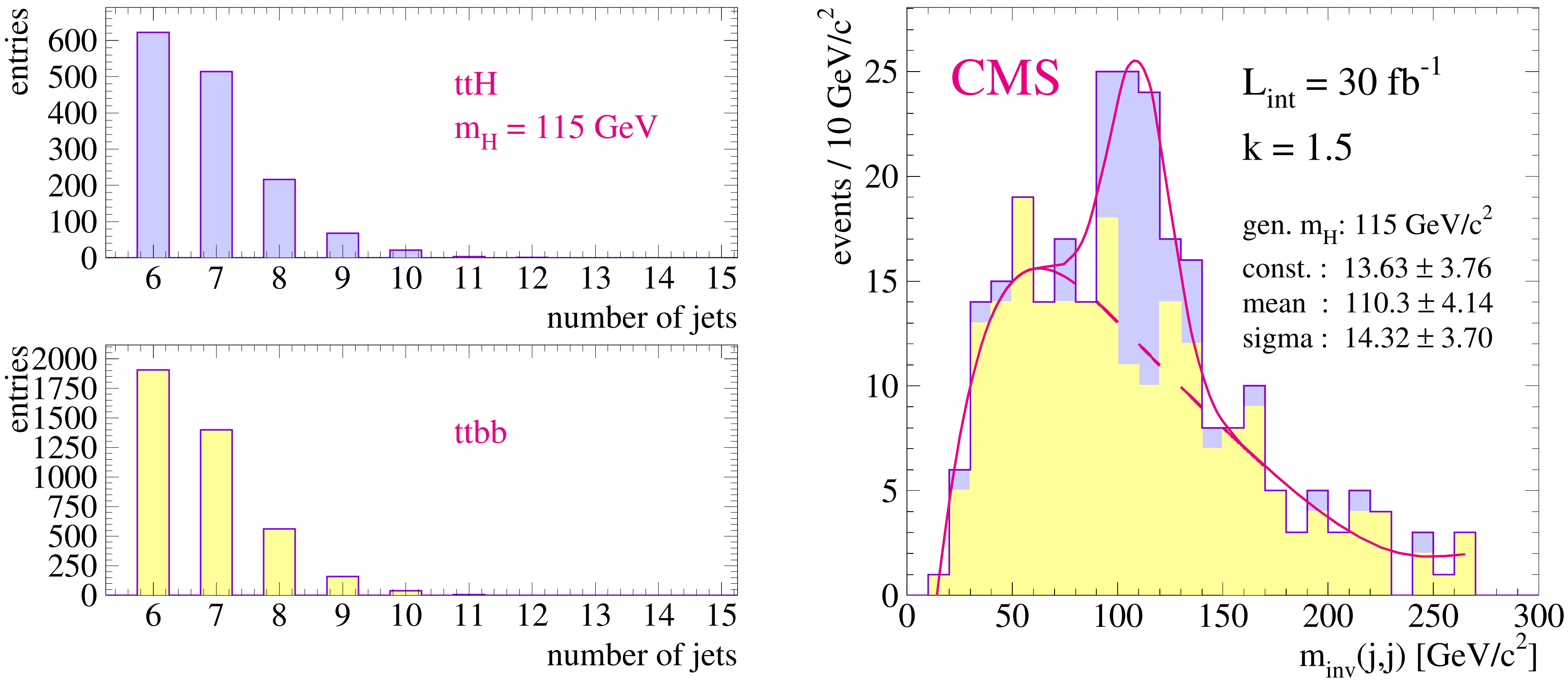
$$N = \binom{n}{6} \times 6! \times \frac{1}{2} \times \frac{1}{2} \times 2$$

$n$: jets and $N$: combinations

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $n$ | $=$ | 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



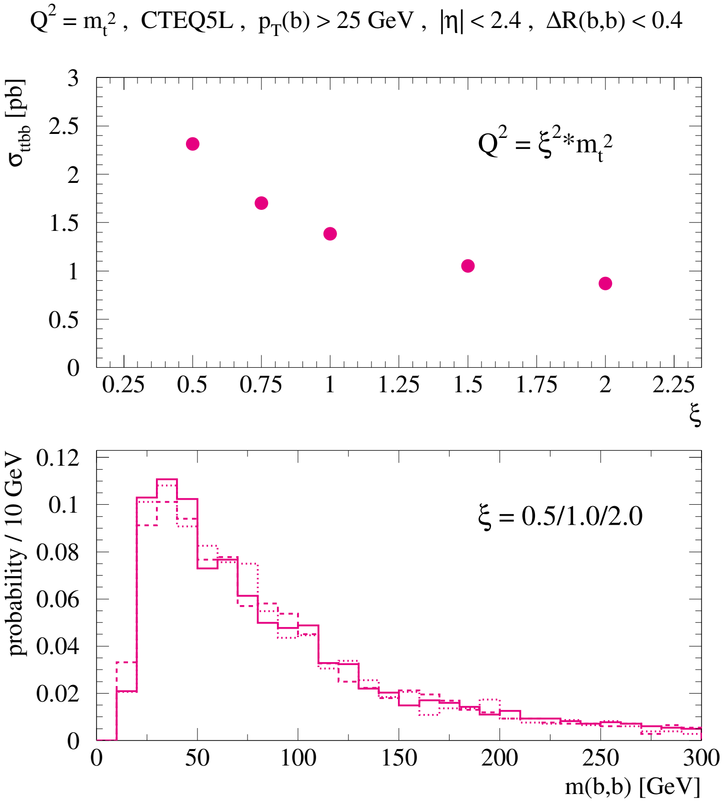

- ◇ wide mass peak ⇒ need to understand the background
- ◇ more than half of the events have additional jets (PYTHIA)

# 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

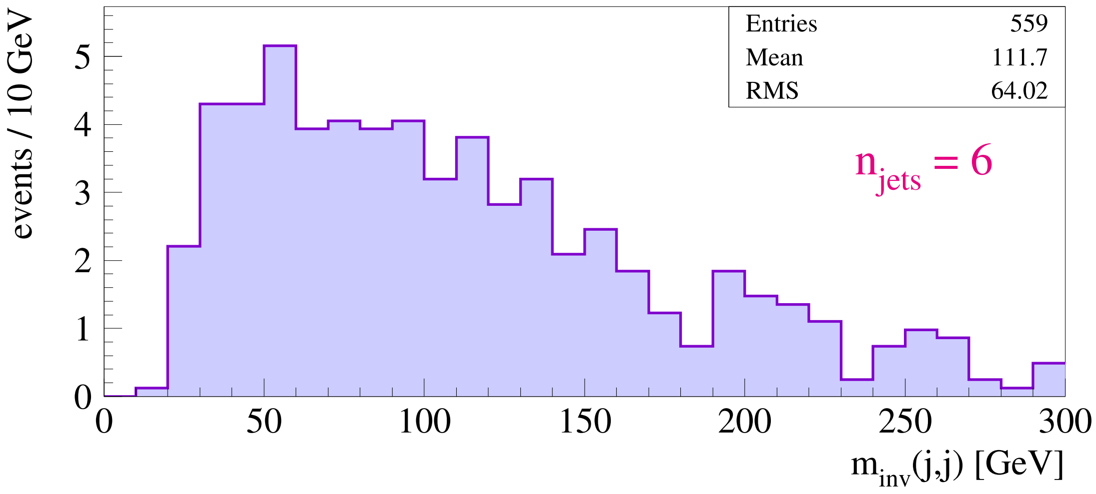
◇ $t\bar{t}b\bar{b}$ is main BG
only known at LO

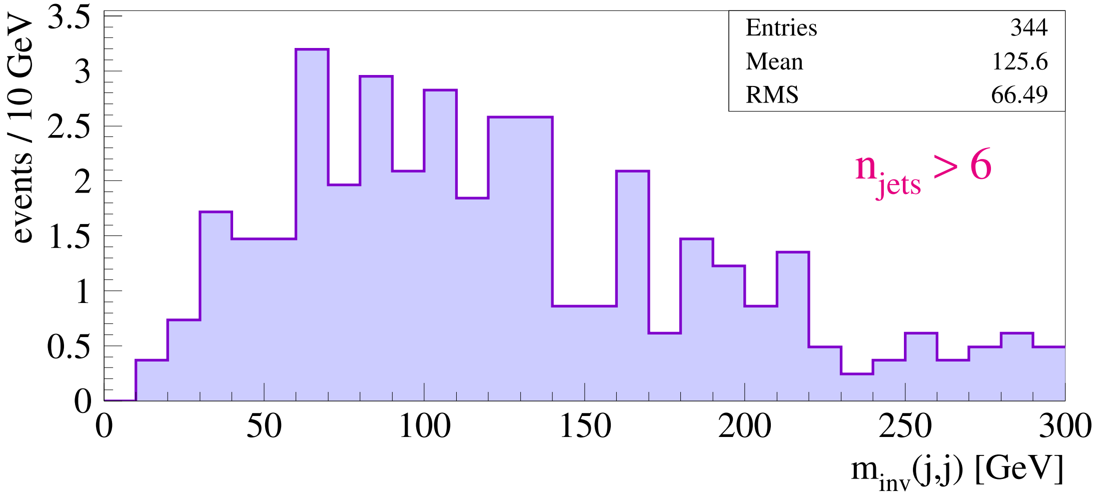



◇ strong scale variation of cross section, but
mass shape stays similar
Les Houches 2003

$\Rightarrow$ 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?