

Non-standard Higgs Search at the Tevatron

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Tevatron Connection, FNAL (August 9, 2004)

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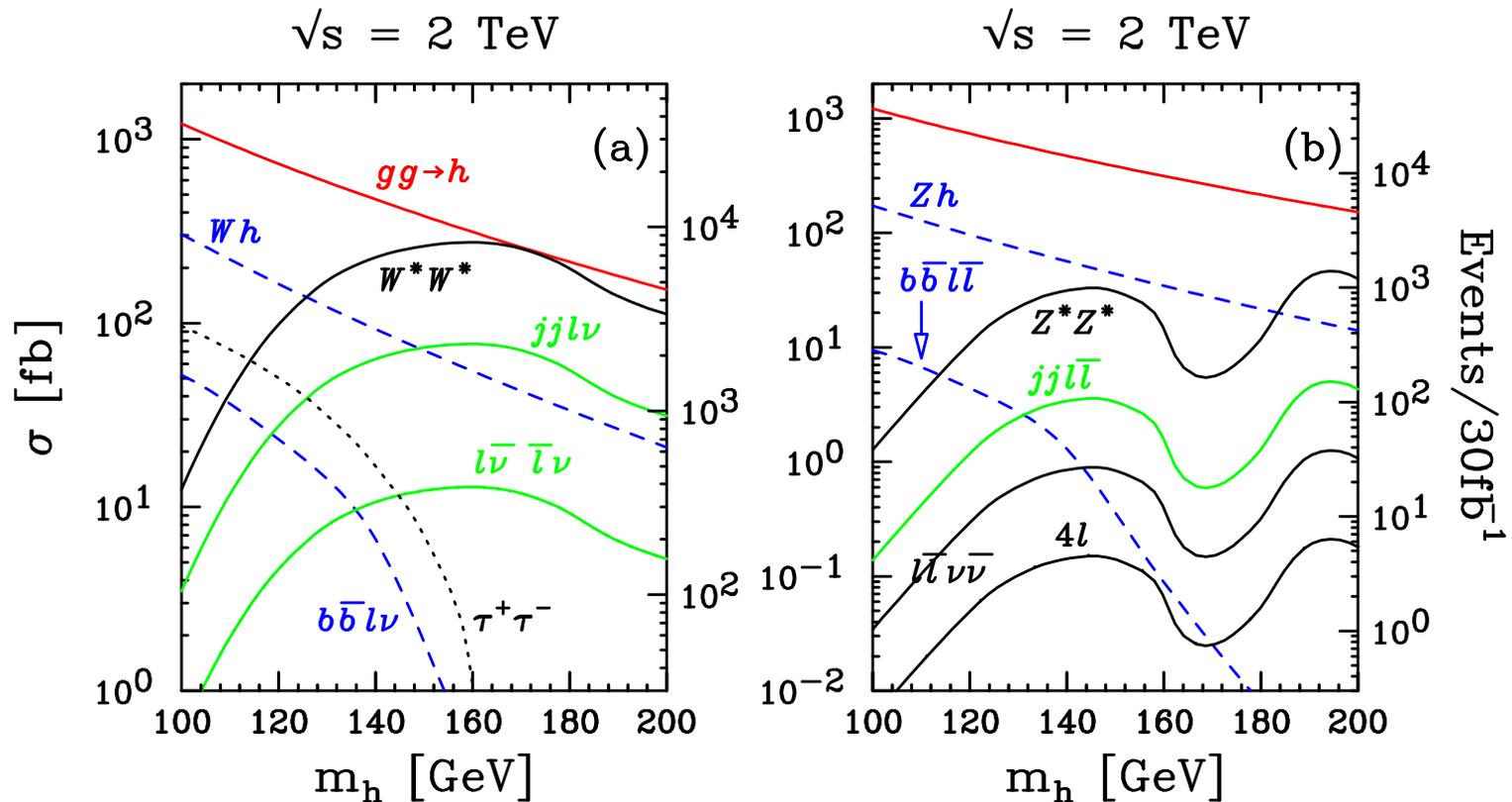
Given the readiness and the nice job done by CDF/D0 in the Higgs search, let's think ahead, and push the search to the limit.

“Standard” Higgs Searches at the Tevatron

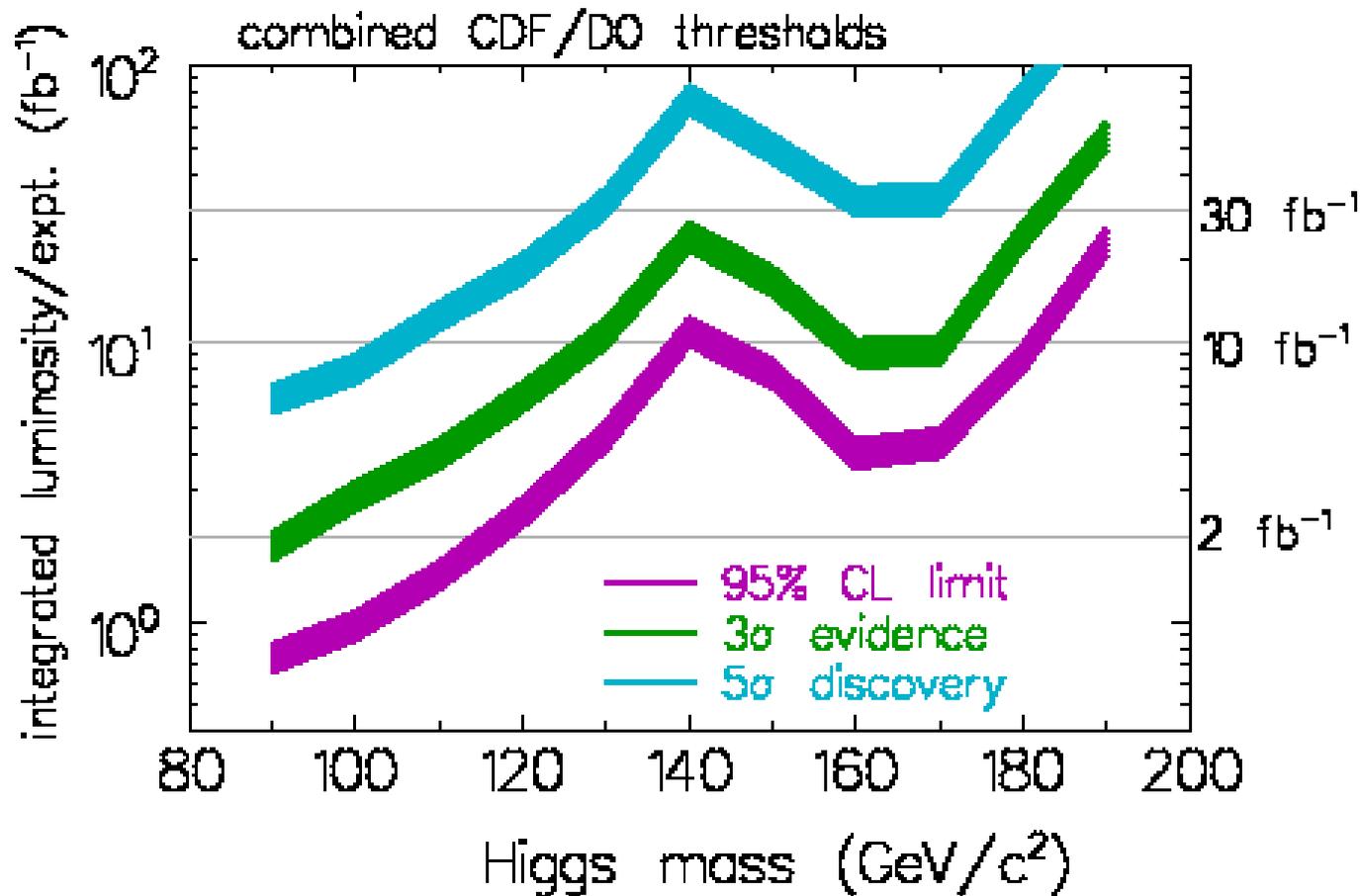
Leading production in SM:

$$gg \rightarrow h, \quad h \rightarrow WW^*, ZZ^*$$

$$q\bar{q}' \rightarrow Wh, Zh, \quad h \rightarrow b\bar{b}.$$



Run-II Higgs working group report:
(M. Carena, J. Conway et al., hep-ph/0010338.)



Scott Willenbrock's comment I

- The channels $p\bar{p} \rightarrow Wh, Zh, h \rightarrow b\bar{b}$
unique to Tevatron: signal swamped at the LHC.
- Understanding the backgrounds crucial: *
accuracy of PYTHIA/HERWIG?

*Zack Sullivan: [hep-ph/0408049](https://arxiv.org/abs/hep-ph/0408049).

“Non-standard” Searches

“Less standard” decays

(1). $h \rightarrow \tau^+ \tau^-$ (via $gg \rightarrow hj$)

Very important to

- help in the region $m_h \approx 140$ GeV;
- improve the coverage in $M_A - \tan \beta$. *

*Belyaev, TH, Rosenfeld, hep-ph/0204201; Conway, Anastassov: SUSY04.

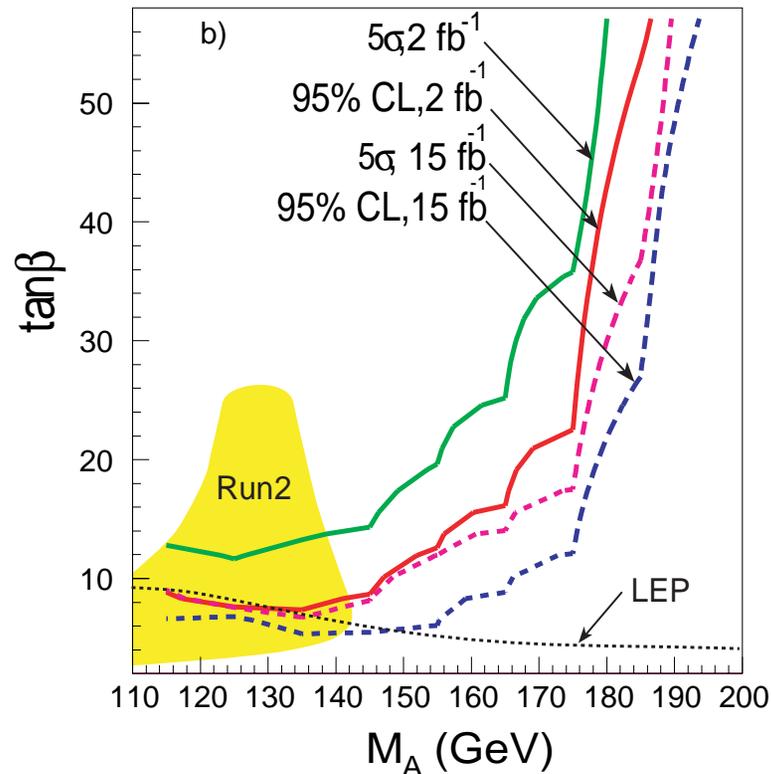
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Very interesting since

- good experimental signatures to search for;
- motivated by $\nu_\mu - \nu_\tau$ oscillations: nearly-maximal mixing!

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Must be also enhanced $BR(h \rightarrow WW^*, ZZ^*)$.

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(4). Higgs FCNC coupling at hadron colliders: $t \rightarrow ch$.

Coupling $\sim \kappa \sqrt{\frac{m_c m_t}{v}}$?

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“Less standard” production

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Well known to you. A lot of progress made lately both in experiments and in theory. *

*For a recent account, see J. Campbell et al., [hep-ph/0204093](https://arxiv.org/abs/hep-ph/0204093).

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Scott Willenbrock's comment II

- The channels $b\bar{b} \rightarrow h, gb \rightarrow hb, gg \rightarrow hb\bar{b}$.
INclusive or EXclusive?
- Claim: $gb \rightarrow hb$ best treatment.

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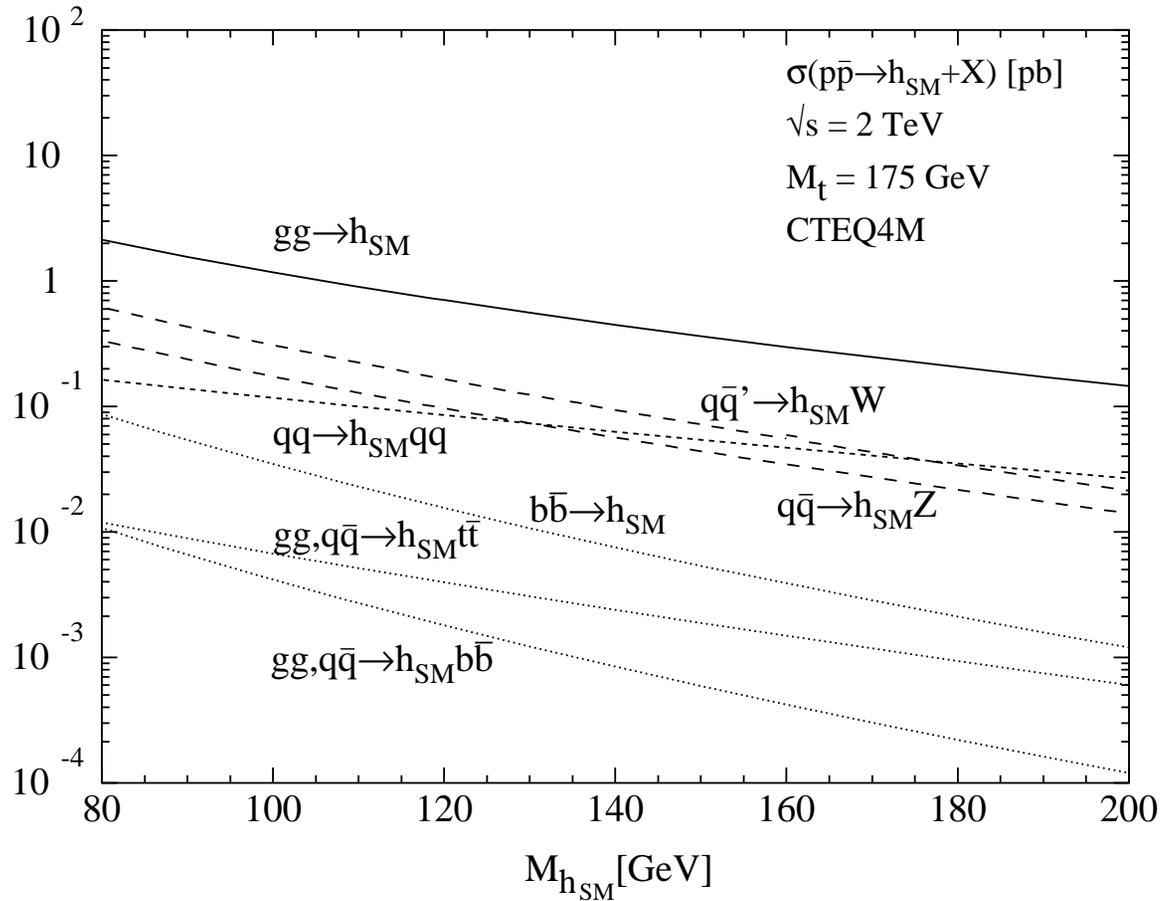
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May consider both $t \rightarrow bH^\pm$ (easy) and $H^\pm \rightarrow t\bar{b}$ (hard). †

†Belyaev et al., hep-ph/0203031; E. Berger et al., hep-ph/0312286.

(4). gauge-boson fusion $qq \rightarrow qqh$



If $h \rightarrow \gamma\gamma$, $\tilde{\chi}_0\tilde{\chi}_0$ (invisible), etc. become dominant, exploit $qq \rightarrow qqh$.

Recap

- Build upon the “Standard Search”:

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- Search for the “Non-standard” decays:

$$h \rightarrow \tau^+\tau^-, \quad \mu^\pm\tau^\mp$$
$$h \rightarrow \gamma\gamma, WW^*, ZZ^*$$
$$t \rightarrow ch\dots$$