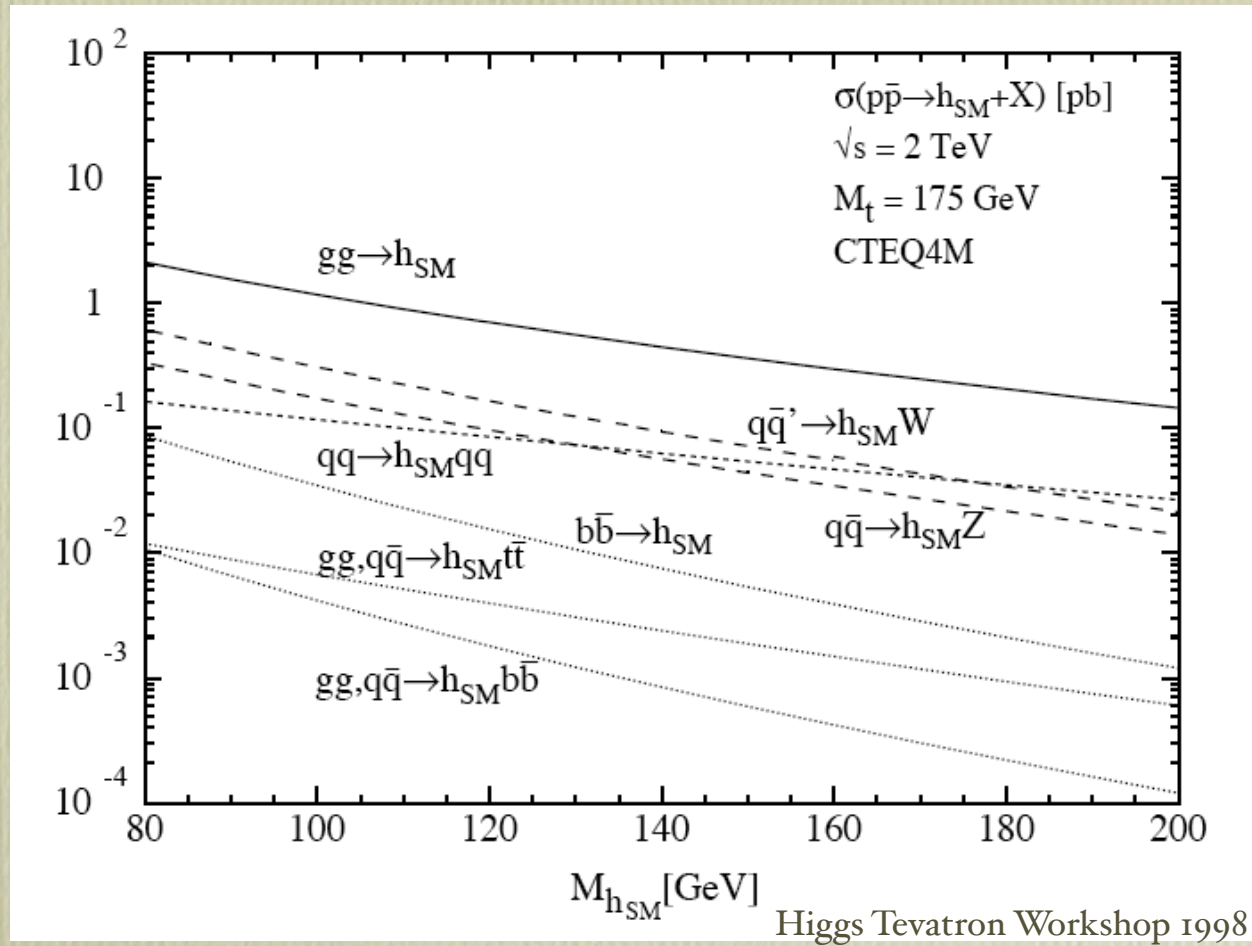


A Kaizen approach to $b\bar{b} \rightarrow h$



Fabio Maltoni
Centro Enrico Fermi, Rome

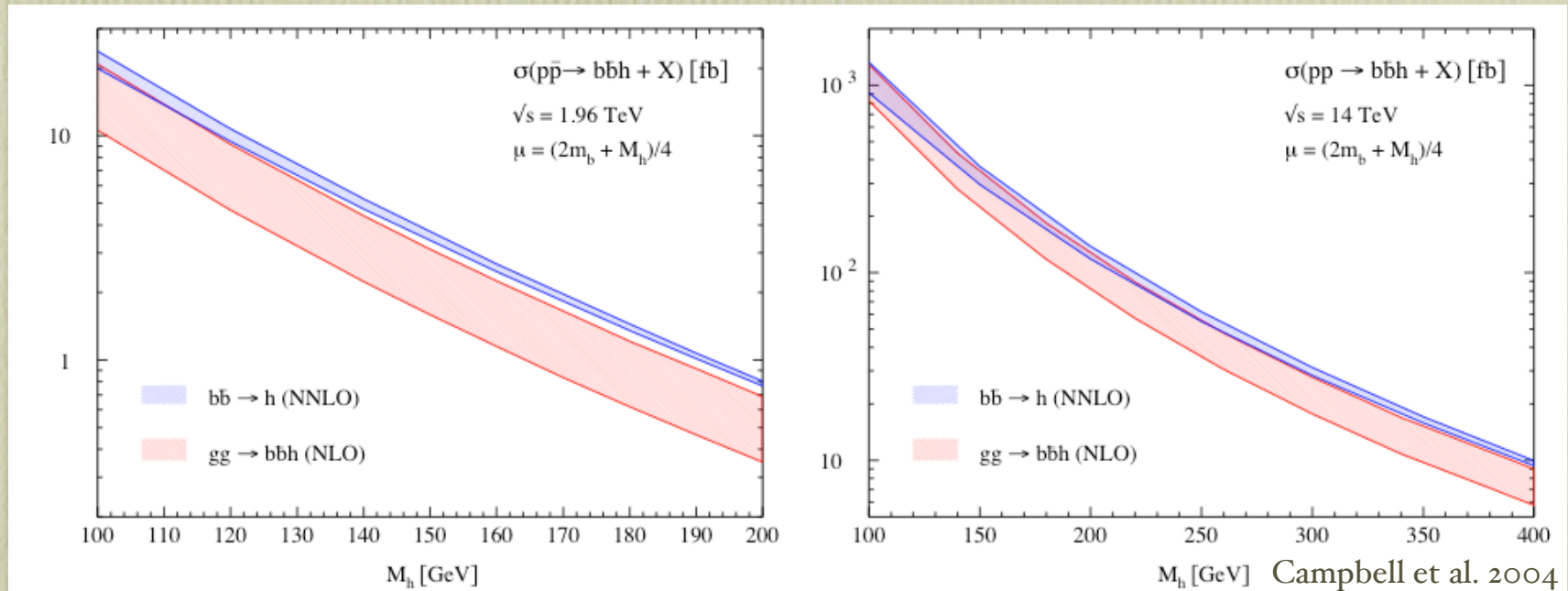
Continuous improvement in $bb \rightarrow h$



Continuous improvement in $bb \rightarrow h$

- 1989 Dicus, Willenbrock (LO)
 - 1999 Dicus, Stelzer Sullivan Willenbrock (NLO)
 - 1999 Balazs, He , Yuan (NLO)
 - 2003 FM., Sullivan, Willenbrock (NLO)
 - 2003 Kilgore, Harlander (NNLO)
 - 2003 Dittmaier, Kraemer, Spira
 - 2003 Dawson, Jackson, Reina, Wackerroth
- } $pp \rightarrow bbh$ at NLO

Continuous improvement in $bb \rightarrow h$



We think we now understand how to calculate the cross section for this process

Higgs Working Group @ TEV₄LHC, September 2004

Are we done?

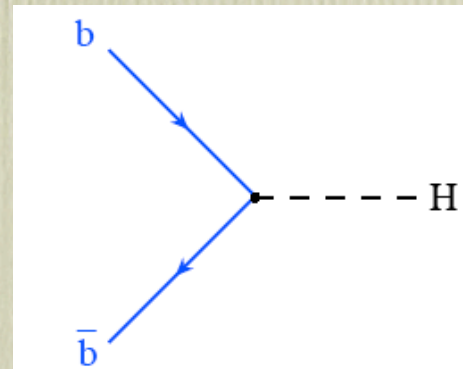
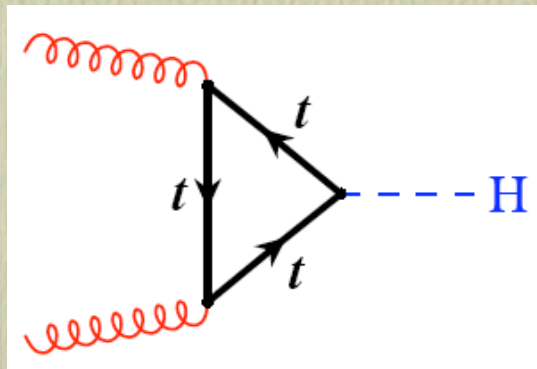
Are **we** done?

Actually, **we** have just started!

$gg \rightarrow H$ vs $bb \rightarrow H$?

Suppose we see $pp \rightarrow H \rightarrow \mu^+ \mu^-$ but we have not enough events to look at $pp \rightarrow H j$ with b- tagged jets

How can we distinguish between



Idea: look at the “b-content” of the events!

“Inclusive” b tagging

- b's are produced mainly at low pt in $bb \rightarrow h$
- asking for a b-tagged jet has a dramatic effect on the cross section
- experimental efficiencies on jet reconstruction give a further suppression

Inclusive approach: look only at the track displacements in the vertex detector and give to the event a probability of containing a b quark.

Status: Experiment

- Tevatron: are there attempts to measure “inclusive b” cross sections? In DO and CDF?
- LHC: CMS has on-going studies on this. What about ATLAS?
- What is a reasonable number to expect for the efficiency/purity ratio? How important is the charm?

The Higgs+1 b-jet example:

- $pp \rightarrow H + 1 \text{ b-jet}$ is known at NLO in both 4FS and 5FS (interesting comparison in Doreen's talk)
- $pp \rightarrow Z + 1 \text{ b-jet}$ is known at NLO in the 5FS

Use the Z to test our theory predictions and tools for the Higgs!

Spin-off: Can we measure the b-distribution function?

Status: Theory

- For the Higgs we have all the results in the 4FS and 5FS at least at NLO accuracy.
- $gg \rightarrow Zbb$ and $qq \rightarrow Zbb$ (massive) only known at LO ! The same for $gg, qq \rightarrow Wbb$!
- $bb \rightarrow Z$ known at NLO and “feasible” at NNLO !

Room for improvement!

Cross sections (pb) for Z + “inclusive b” production

Process LO	TeV		LHC	
scale	$m_Z/4$	m_Z	$m_Z/4$	m_Z
gg > Zbb	14.7	6.6	1230	754
qq > Zbb	25.3	14.4	170	122
bb>Z	14.7	32.3	735	1910

Very similar to bb>H

Proposal for the TEV₄LHC

Study “inclusive” bottom measurements in W/Z production

Why?

theory: we can predict cross sections extremely well

experiment: new approach, maybe better sensitivity

How?

theory : perform the new NLO (and NNLO) calculations for Z and W that are needed

experiment: look at what CMS has done, use CDF and DO data for Wbb and Zbb to test feasibility, find efficiencies, etc...