Precise Predictions Of TTH/TTZ

Hua-Sheng Shao
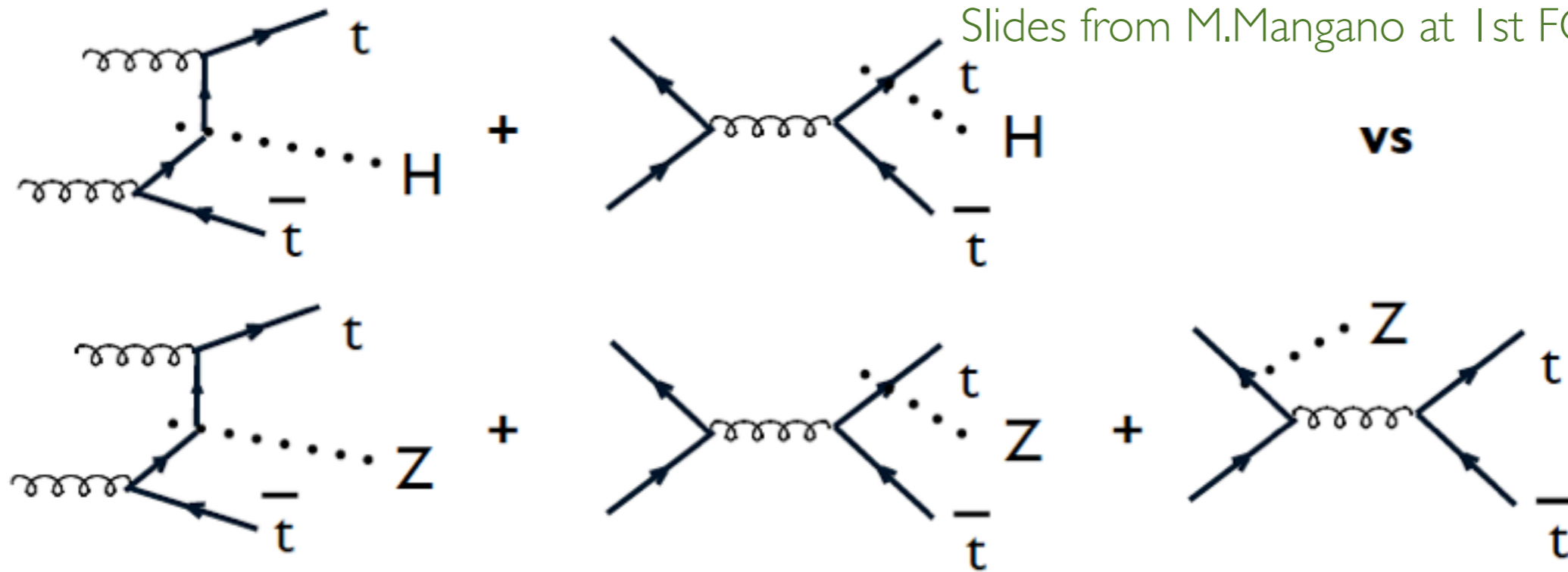
CERN, PH-TH

Based On Work In Collaboration With S. Frixione, V. Hirschi, M. Mangano, D. Pagani and M. Zaro
2014.11.24

Sunday, November 23, 14

pp→tt H vs pp→tt Z

vs

To the extent that the qqbar → tt Z/H contributions are subdominant:

- **Identical production dynamics:**

  o **correlated QCD corrections, correlated scale dependence**
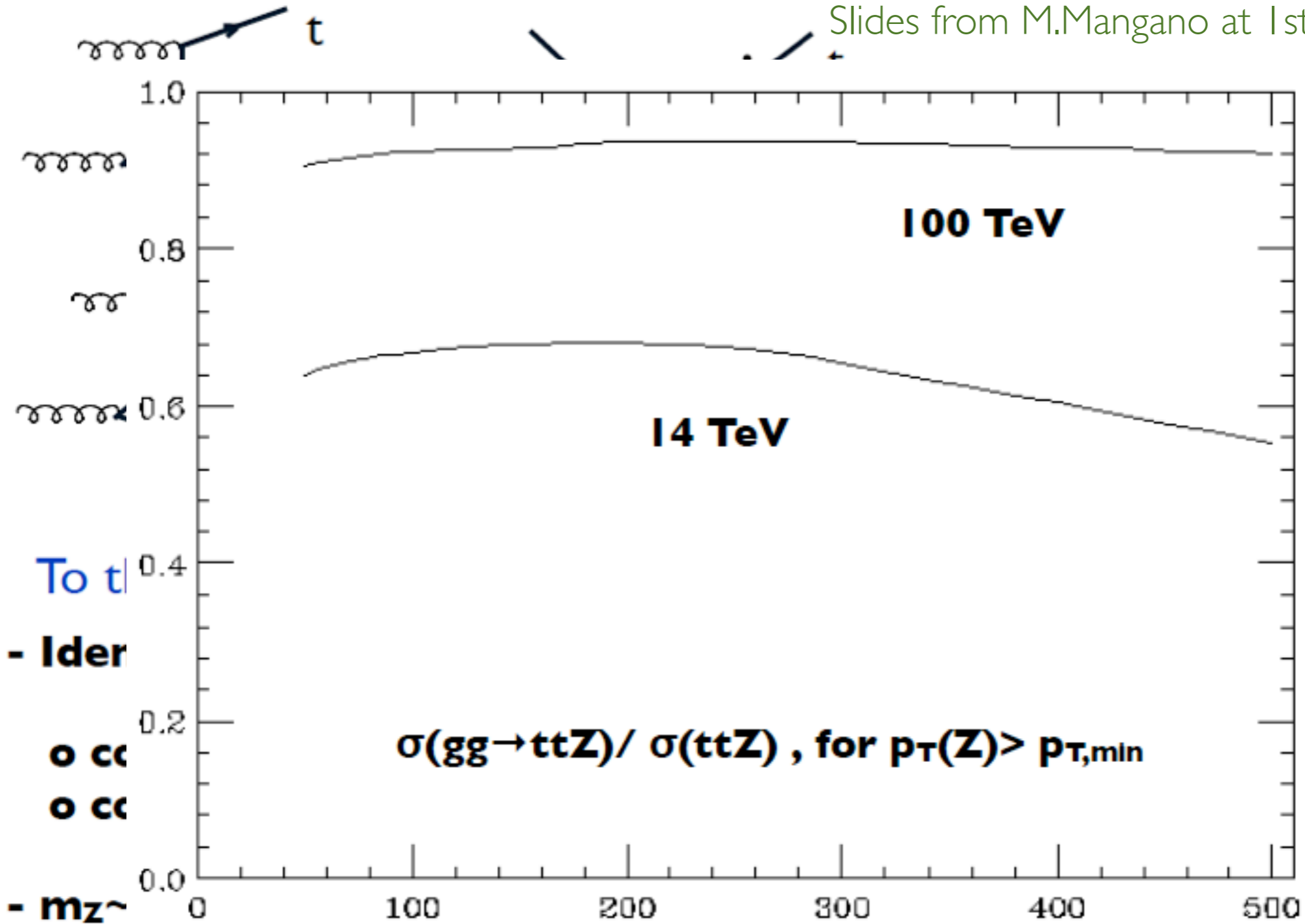 o **correlated α_S systematics**

- **$m_Z \sim m_H \Rightarrow$ almost identical kinematic boundaries:**

  o **correlated PDF systematics**
  o **correlated m_{top} systematics**

For a given y_{top}, we expect $\sigma(ttH)/\sigma(ttZ)$ to be predicted with great precision

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pp→tt H vs pp→tt Z

$\sigma(gg\to ttZ)/ \sigma(ttZ)$, for $p_T(Z) > p_{T,min}$

100 TeV

14 TeV

$p_{T,min}$

To th... ...dominant:

- Iden...

  o co...

  o co...

- m_Z~

  o co...

  o correlated m_{top} systematics

For a given y_{top}, we expect $\sigma(ttH)/\sigma(ttZ)$ to be predicted with great precision

	ttH (pb)	ttZ (pb)	ttH/ttZ
NLO QCD	33.9 $[^{+7.06\%}_{-8.29\%}]$Scale $[^{+0.941\%}_{-1.26\%}]$PDF	57.9 $[^{+8.93\%}_{-9.46\%}]$Scale $[^{+0.901\%}_{-1.20\%}]$PDF	0.585 $[^{+1.29\%}_{-2.02\%}]$Scale $[^{+0.0526\%}_{-0.0758\%}]$PDF

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NLO QCD , $\mu_0 = H_T/2$, LHC13

	ttH (pb)	ttZ (pb)	ttH/ttZ
MSTW	0.475 $[^{+5.79\%}_{-9.04\%}]$Scale $[^{+2.02\%}_{-2.50\%}]$PDF	0.785 $[^{+9.81\%}_{-11.2\%}]$Scale $[^{+1.93\%}_{-2.39\%}]$PDF	0.606 $[^{+2.45\%}_{-3.66\%}]$Scale $[^{+0.216\%}_{-0.249\%}]$PDF
CT10	0.450 $[^{+5.70\%}_{-8.80\%}]$Scale $[^{+6.00\%}_{-5.34\%}]$PDF	0.741 $[^{+9.50\%}_{-10.9\%}]$Scale $[^{+5.91\%}_{-5.29\%}]$PDF	0.607 $[^{+2.34\%}_{-3.47\%}]$Scale $[^{+0.672\%}_{-0.675\%}]$PDF
NNPDF	0.470 $[^{+5.26\%}_{-8.58\%}]$Scale $[^{+2.22\%}_{-2.22\%}]$PDF	0.771 $[^{+8.97\%}_{-10.6\%}]$Scale $[^{+2.16\%}_{-2.16\%}]$PDF	0.609 $[^{+2.23\%}_{-3.41\%}]$Scale $[^{+0.205\%}_{-0.205\%}]$PDF

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5%-6%

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	ttH (pb)	ttZ (pb)	ttH/ttZ
$\mu_0 = H_T/2$	33.9 $\left[^{+7.1\%}_{-8.3\%}\right]$Scale $\left[^{+0.94\%}_{-1.3\%}\right]$PDF	57.9 $\left[^{+8.9\%}_{-9.5\%}\right]$Scale $\left[^{+0.90\%}_{-1.2\%}\right]$PDF	0.585
$\mu_0 = m_t + m_{H,Z}/2$	39.0 $\left[^{+9.8\%}_{-9.6\%}\right]$Scale $\left[^{+1.0\%}_{-1.3\%}\right]$PDF	66.8 $\left[^{+10.9\%}_{-10.6\%}\right]$Scale $\left[^{+0.90\%}_{-1.2\%}\right]$PDF	0.584

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1. EW corrections are known (not shown). Their size is about 2%, and their systematic uncertainty is negligible.

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$\mu_0 = H_T/2$	33.9 $\begin{bmatrix}+7.1\% \\ -8.3\%\end{bmatrix}$Scale $\begin{bmatrix}+0.94\% \\ -1.3\%\end{bmatrix}$PDF	57.9 $\begin{bmatrix}+8.9\% \\ -9.5\%\end{bmatrix}$Scale $\begin{bmatrix}+0.90\% \\ -1.2\%\end{bmatrix}$PDF	0.585
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2. It is necessary to perform a realistic analysis to prospect how much precision can be achieved on the experimental side.