Higgs cross sections at $\sqrt{s} = 100$ TeV

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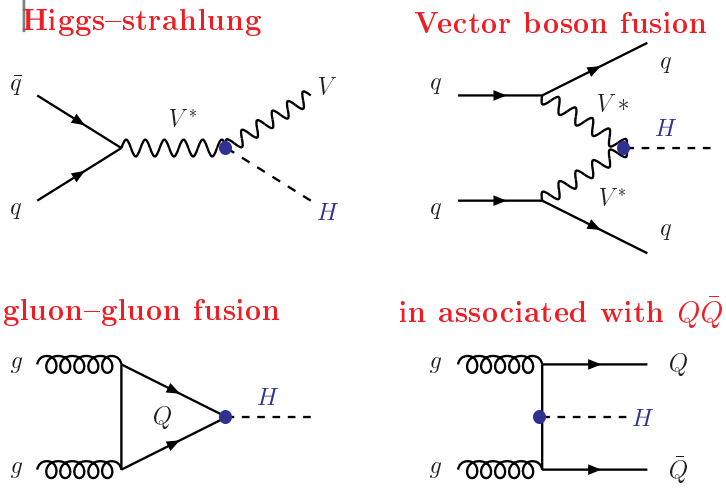
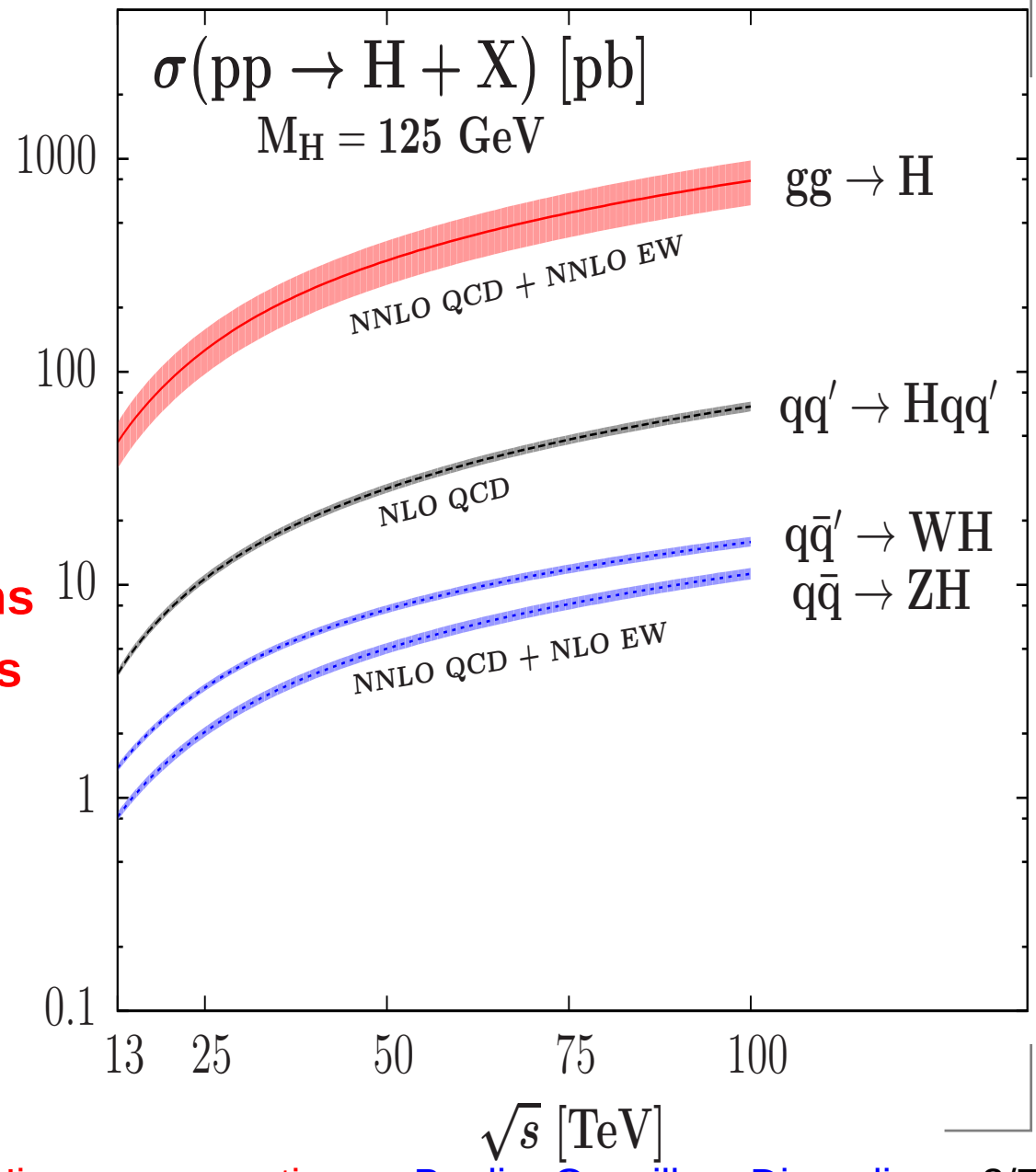
- SM Higgs in main channels
- SM Double Higgs in main channels
- SM Higgs in higher order processes
- The MSSM Higgs bosons

1. SM Higgs in the main channels

Main Higgs production channels





Update production cross sections and evaluate theory uncertainties

- **gg→H at NNLO QCD+NLO EW**
- **VBF at NNLO QCD + NLO EW**
- **VH at NNLO QCD + NLO EW**
- **ttH at NLO: MC@NLO**

... still to come: distributions?

1. SM Higgs in the main channels

Process	$\sigma^{\rm NNLO}$[pb]	Scale[%]	PDF+α_s[%]	EFT[%]	Total [%]
$gg \to H$	788.6	$+7.1\ -6.1$	$+8.3\ -8.0$	± 5	$+20\ -19$
$qq' \to Hqq$	68.74	$+2.2\ -2.1$	$+3.1\ -3.2$	0	$+5.3\ -5.2$
$q\bar{q}' \to WH$	15.88	$+0.7\ -0.1$	$+5.0\ -4.7$	0	$+5.7\ -4.8$
$q\bar{q} \to ZH$	11.28	$+1.8\ -1.7$	$+4.5\ -4.3$	0	$+6.3\ -6.0$

Table 1: Total Higg production cross section at NNLO QCD+NLO EW in the ggF VBF, HW and HZ processes (in pb) at $\sqrt{s} = 100$ TeV at the central scales for $M_H = 125$ GeV and the theoretical uncertainties.

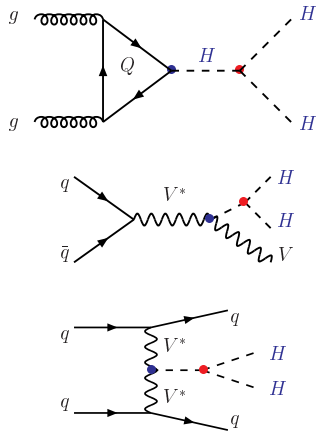
2. Double Higgs production

Big challenge: measure Higgs self-couplings and access to V_H

- g_{H^3} **from** $pp \to HH + X$
- g_{H^4} **from pp→3H+X, maybe?**

Various processes for HH prod:

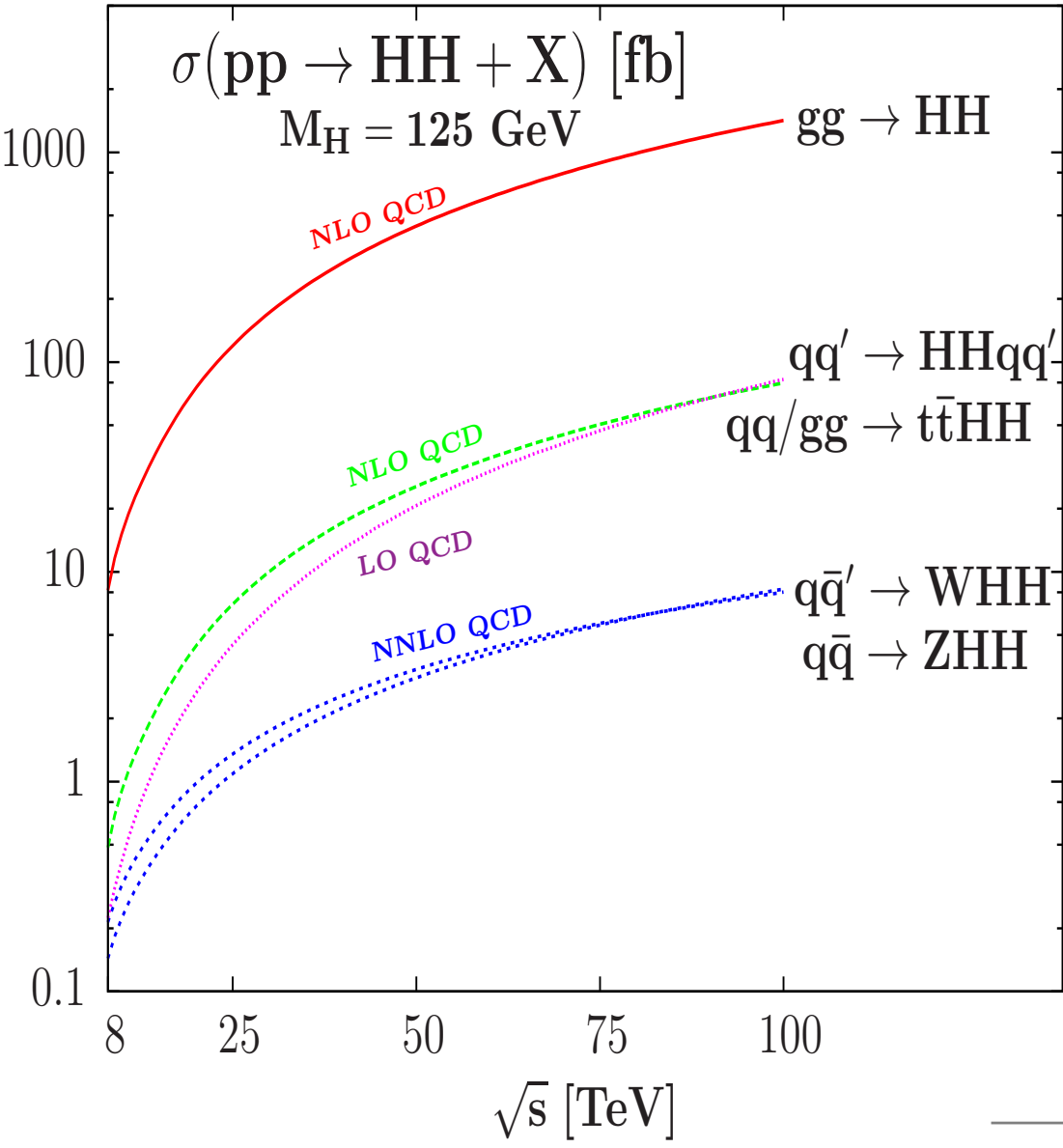
$gg \to HHX$ **by far dominant**



Baglio et al., arXiv:1212.5581

– distributions: $\frac{d\sigma}{dM_{HH}}, \theta_{HH}$**?**

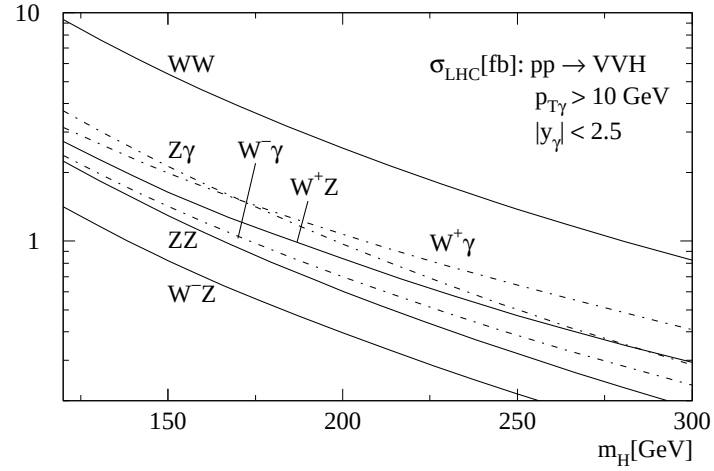
– test sensitivity to λ_{HHH}**?**

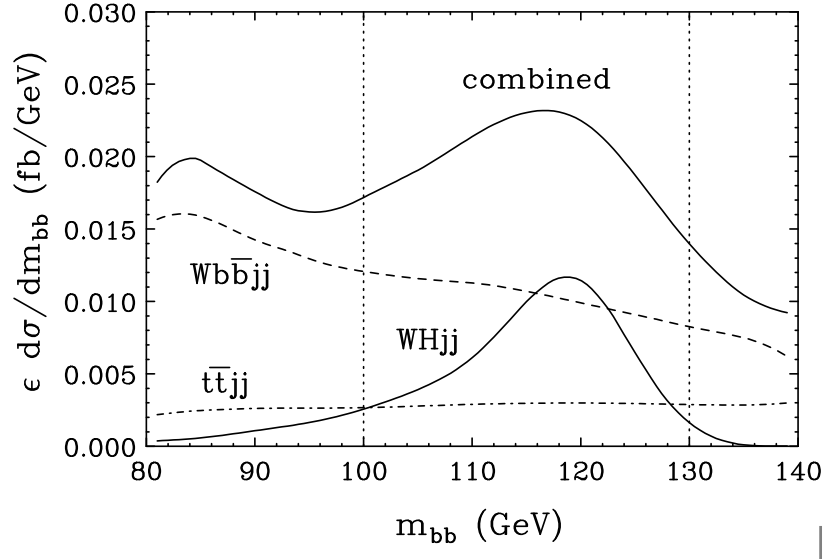


3. SM Higgs at higher orders

Higher order channels to consider:

- **asso. bbH:** $gg/q\bar{q} \to Hb\bar{b}$
- **single top:** $pp \to tH + X$
- **VVH:** $q\bar{q}, qq \to VVH$
- **VBF HV:** $qq \to HVqq$
- **Hγ loop:** $qq, gg \to H\gamma$
- **Top decays:** $t \to Hc, ...?$
- **Diffractive H:** $pp \to Hpp?$
- **anything else??**





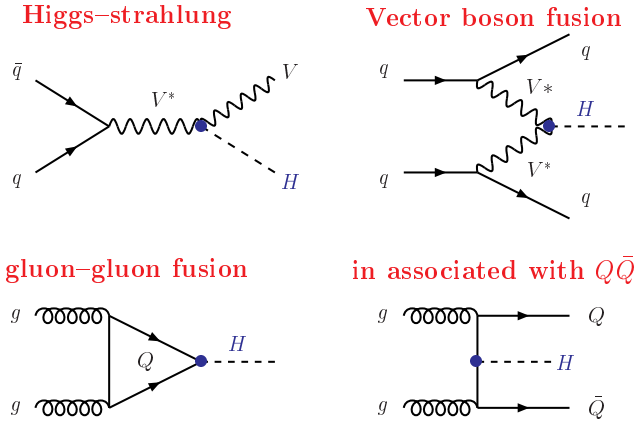
Very small cross sections at LHC

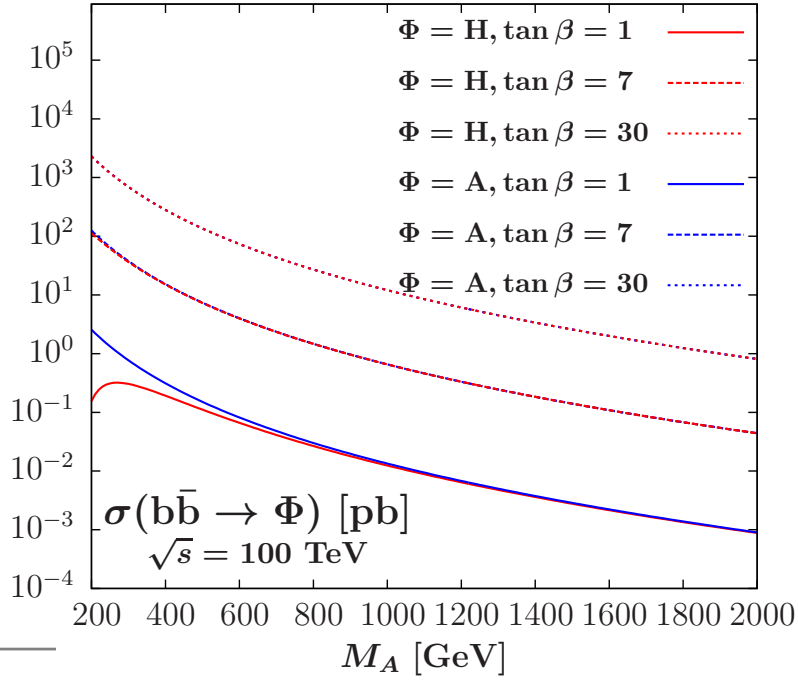
Any interesting additional test?

4. The MSSM Higgs bosons

MSSM Higgs production: besides SM–like h, heavier H/A and $H^{\pm}$ states.

SM production mechanisms





What is different in MSSM

- **All work for CP–even h,H bosons.**
  - **in ΦV, $qq\Phi$ h/H complementary**
  - **additional mechanism: qq $\to$ A+h/H**
- **For $gg \to \Phi$ and $pp \to QQ\Phi$**
  - **include contribution of t,b–quarks**
  - **dominant contr. at high tanβ!**
- **For pseudoscalar A boson:**
  - **CP: no ΦA and qqA processes**
  - **$gg \to A$ and $pp \to bbA$ dominant.**
- **For charged Higgs boson:**
  - **$M_H \gtrsim m_t$: continuum $pp \to t\bar{b}H^-$**
  - **non-leading: $q\bar{q}, gg \to H^+H^-, A/H+$**

Evaluate all production processes

- **focus on very heavy Higgs states**
- **how far can we go in $[\tan\beta, M_A]$ space**

4. The MSSM Higgs bosons

Probing the MSSM $[M_A, \tan\beta]$ plane: extrapolations from now:

- $pp \to H/A \to \tau\tau$
- $t \to H^+ b \to b\tau\nu$

(also at low tanβ values)

- **H$\to$WW and ZZ**

(but width as in SM).

- **CMS A$\to$hZ analysis**
- **CMS H$\to$hh analysis**

(both MSSM interpreted).

- $pp \to H/A \to t\bar{t}$

with complete analysis:

– effect of total width

– S and B interference

– boosted top jets

the action is at low tanβ!

..... in progress