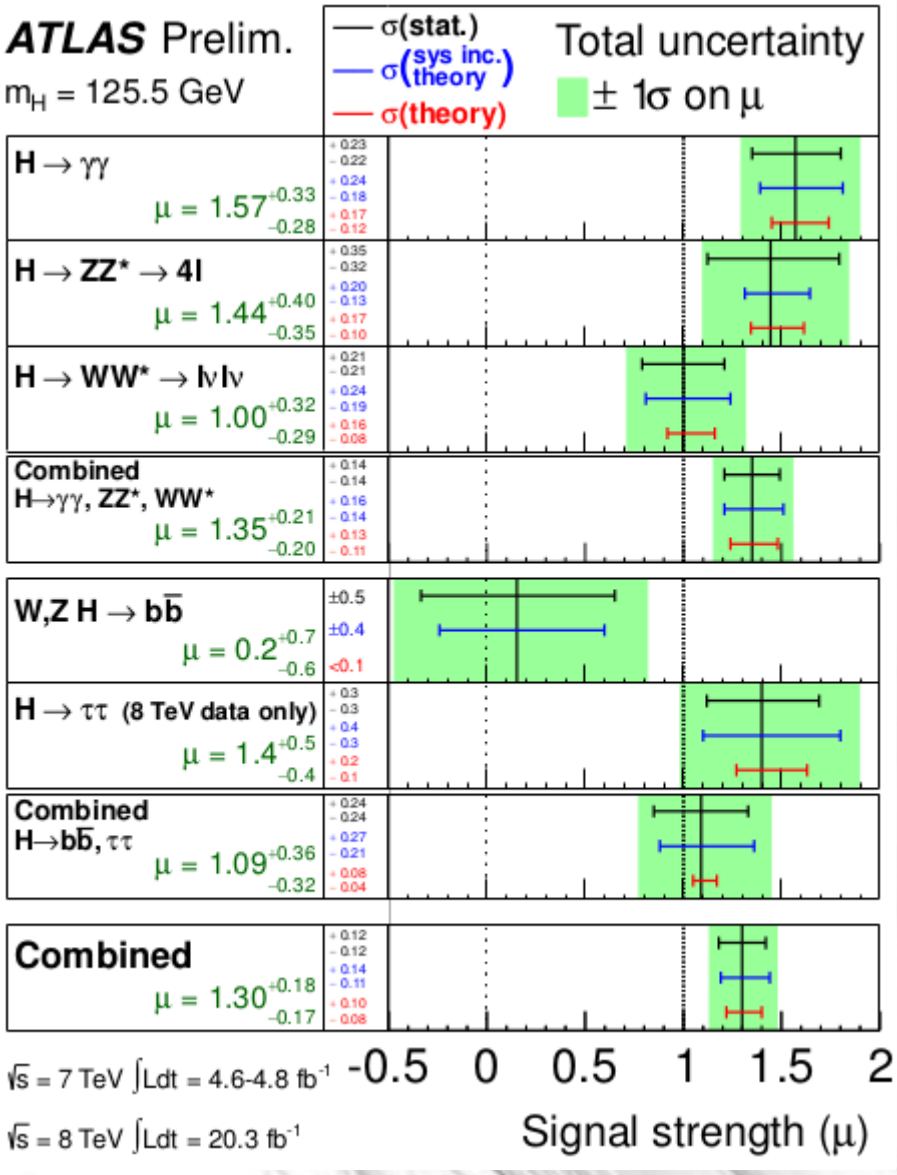
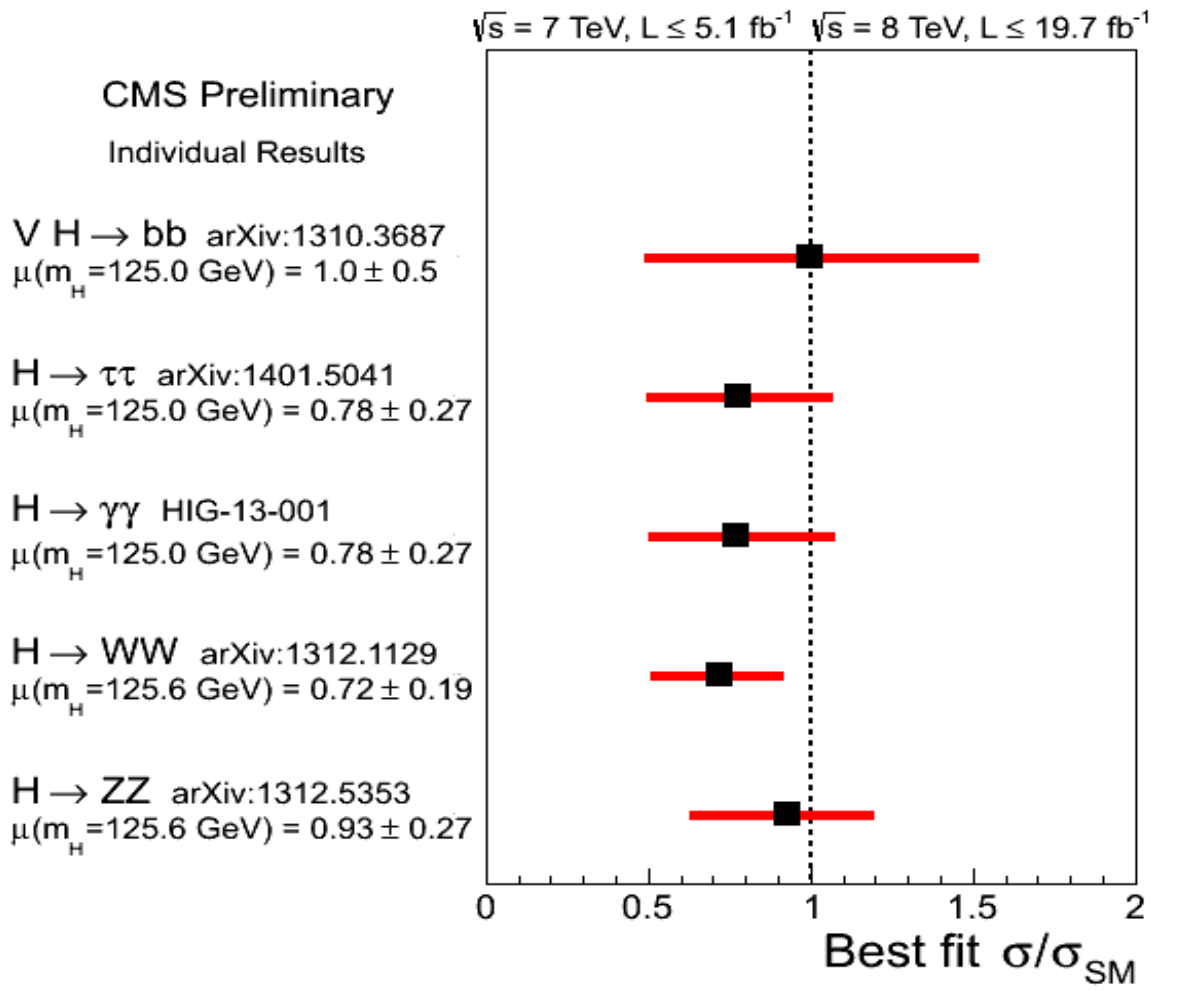
Higgs boson decay in γZ

Higgs boson decays



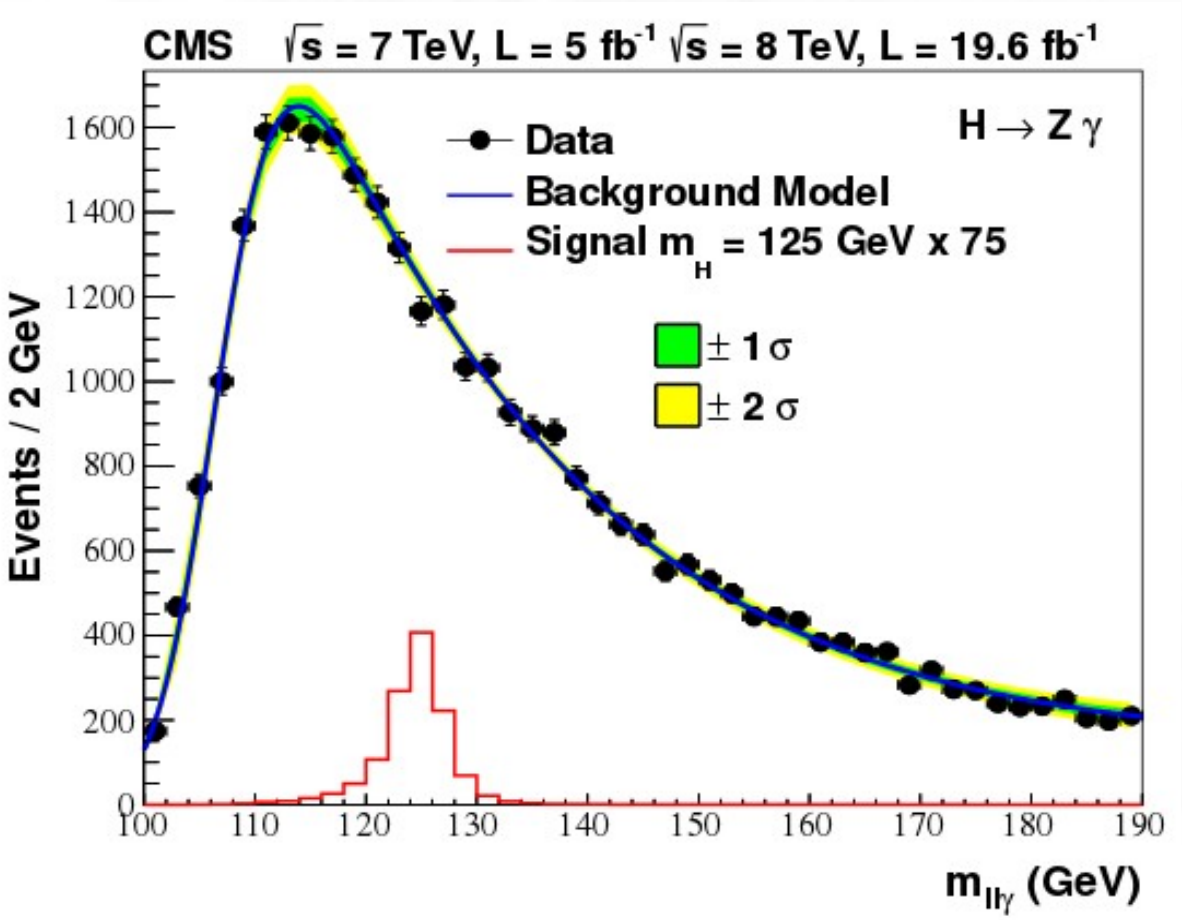
$$\mu = \frac{\sigma}{\sigma_{SM}}$$

Higgs boson decays



Higgs boson decays

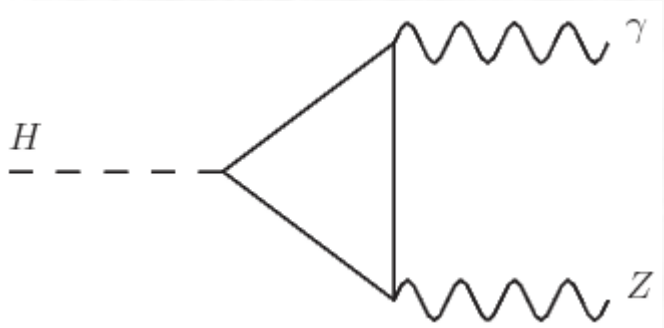
- Future channel : $H \to \gamma Z$



One needs precise theoretical calculation of this partial width

$H \rightarrow \gamma Z$

- One loop Feynman diagrams with all charged particles in the loop :



⇒ If new charged particles are present, there will be a deviation from Standard Model expectation

NMSSM

- MSSM + a new gauge singlet chiral superfield
- Solves the μ-problem by generating this parameter dynamically

$$\mu \hat{H}_u.\hat{H}_d \longrightarrow \lambda \hat{S} \hat{H}_u.\hat{H}_d$$

- Higgs potential :

$$\begin{aligned} V_{Higgs} =& |\lambda(H_u^+ H_d^- - H_u^0 H_d^0 + \kappa S^2)|^2 + (m_{H_u}^2 + |\lambda s|^2)\left(|H_u^0|^2 + |H_u^+|^2\right) \\ & (m_{H_d}^2 + |\lambda s|^2)\left(|H_d^0|^2 + |H_d^+|^2\right) + \frac{g_1^2 + g_2^2}{8}\left(|H_u^0|^2 + |H_u^+|^2 - |H_d^0|^2 - |H_d^-|^2\right)^2 \\ & + \frac{g_2^2}{2}|H_u^+ H_d^{0*} + H_u^0 H_d^{-*}|^2 + m_S^2|S|^2 + (\lambda A_\lambda (H_u^+ H_d^- - H_u^0 H_d^0) S + \frac{1}{3}\kappa A_\kappa S^3) \end{aligned}$$

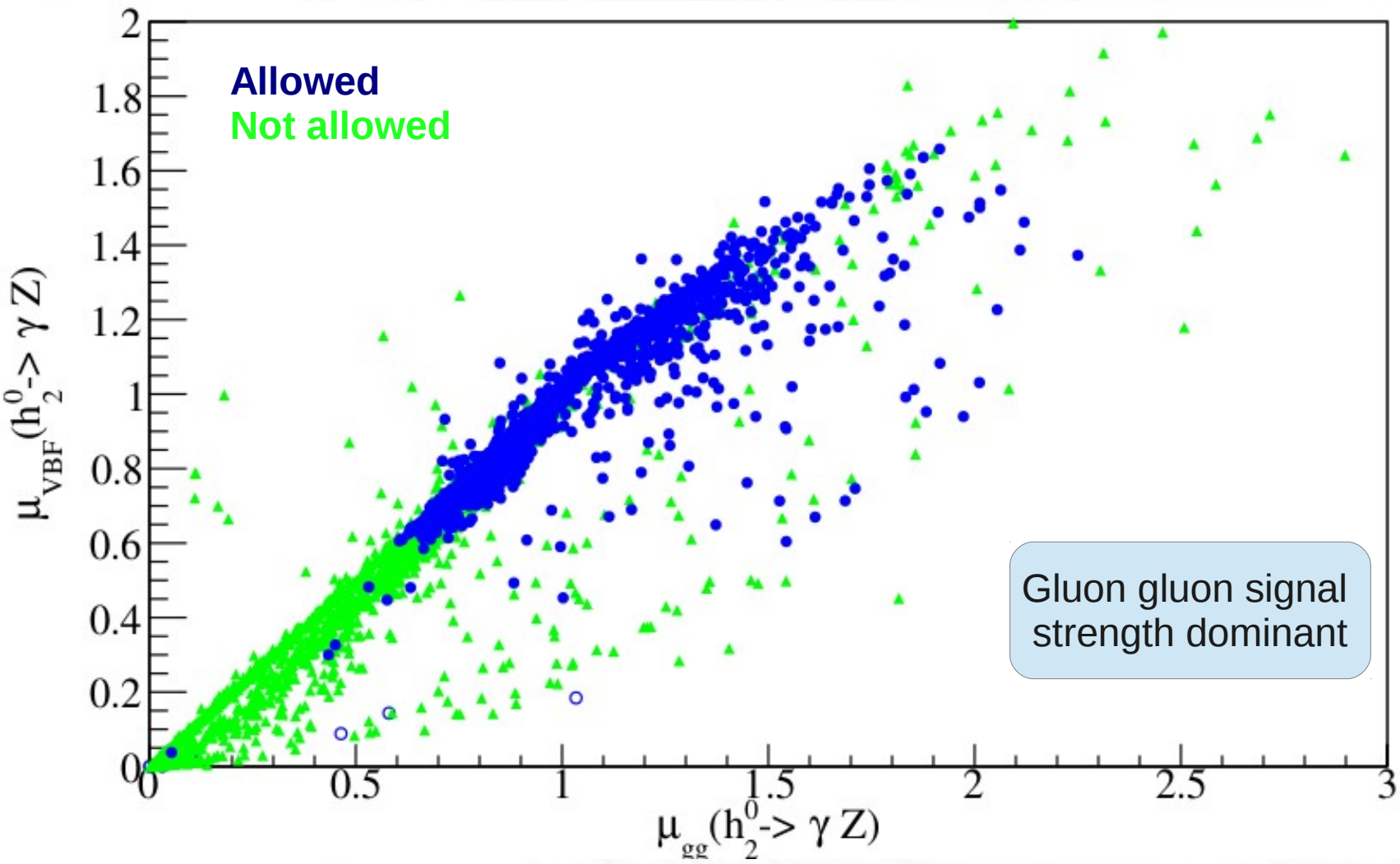
$H \to \gamma Z$ in NMSSM

- Advantages of the NMSSM :
  - 3 CP-even Higgs bosons : the two lightest of them could be the one observed at LHC
  - Easier to get a 125 Higgs boson scalar

$$\text{MSSM} \quad : \quad m_h^2 = m_Z^2 \cos(2\beta) + \frac{3}{(4\pi)^2}\frac{m_t^4}{v^2}\left[\ln\frac{m_{\tilde{t}}^2}{m_t^2} + \frac{X_t^2}{m_{\tilde{t}^2}}\left(1 - \frac{X_t^2}{12m_Z^2}\right)\right]$$

$$\text{NMSSM} \quad : \quad m_h^2 = m_{h,MSSM}^2 + \lambda^2 v^2 \sin^2(2\beta)$$

$H \rightarrow \gamma Z$: signal strength



Gluon gluon signal strength dominant

ArXiv : 1402.3522

Conclusion

- $h_1 \longrightarrow \gamma Z$ similar to SM expectations
- Larger deviations for h_2 (possible enhancement of the signal). Such large deviation would indicate a need for a lighter Higgs boson
- Better measurement of this channel during the next LHC run will put additionnal constraints on the NMSSM