# Next steps towards coupling measurements

# Coupling parameter models

1) One parameter model with one scale $\mu$ : available from 2011 results
2) Two parameter model with Xg related to the gauge couplings and Xf related to the Yukawa coupling. Ratios within the gauge and fermion couplings as in the SM. Interference terms, if they can't be factorized by a clever choice of X, as in the SM.
3) Four parameter model with Xg, Xf and X$\gamma$ for the photon decay and Xgluon for the gluon decay/production. Ratios within the gauge and fermion couplings as in the SM. Interference terms, if they can't be factorized by a clever choice of X, as in the SM.
4) A model with XW, XZ, X$\tau$, Xb, X$\gamma$, Xgluon, (+ Xtop if ttH production gets available). Interference terms, if they can't be factorized by a clever choice of X, as in the SM.
5) A model with XW, XZ, X$\tau$, Xb, Xtop (assuming no new particles in the gamma and gluon loop). Interference terms, if they can't be factorized by a clever choice of X, as in the SM.

- **X still to be exactly defined (next slide)**
- **functional expressions for X$\gamma$, Xgluon for 2) and 5) are needed**

# What is X

**Options for X:**

1) some coupling strength scale factor $g_i$ that would appear directly at the Higgs vertex (e.g. $\sigma(WH) \sim g_W^2$ for i=W)

2) the partial decay width $\Gamma_i$ (e.g. $\sigma(WH) \sim \Gamma_W$ for i=W)

3) Separate by observable initial/final states (e.g. 4$\mu$ instead of ZZ)
   → postpone for now because of limited available data

**Needed for all**

- Uncertainty calculations or estimations
- Full list of assumptions that underly each choice

**What about the mass?**

- Is it a parameter of the fit?
- Is it determined independently from the $\gamma\gamma$ and ZZ mass peak and then used as a fixed input parameter (with uncertainty) to the fit?

# Jet related systematic uncertainties

**Most analysis are performed in exclusive jet bins**

- Do we need special uncertainties for jet bins when doing coupling measurements?
- How do soft physics effect play into this?
- Is it possible to get a jet bin related uncertainty matrix for all coupling parameter models? Is this a trivial extension of existing knowledge or are some new calculations needed? Does not mean this group needs to get a number – a clear procedure for all analysis and coupling choices is sufficient

# Higher order corrections and interference terms

- We know of several places where interference terms between different final states appear and even within only the Higgs sector these interference terms have some model dependence. If SM background interference terms are included, the situation is even harder
  1) find a new pseudo-observable X that is not or less sensitive to these interference effects
  2) somehow give a limit on the size of the theory uncertainties induced by possible interference terms
- Given that there are so far no suggestions (is that really true?) in the literature for 1), this is most likely not a trivial task.
- However, discussions indicate that 2) is not too relevant today, as experimental uncertainties would still be large.
- Is there a way of quantifying the uncertainties and state under which conditions these quantifications are correct?
- Proposal for 2012: mention all this, but ignore it as experimental uncertainties are still too large to make this relevant

# Relative and absolute measurements

- Without further assumptions one can finally fit for
  a) ratios X_i/X_j and one global scale mu=X_j2/Gamma_H
  b) X_i/sqrt(Gamma_H)
- If all correlations are kept in the fit, a) and b) are strictly identical. Are there other options that are preferable because of their separation power between models without evaluating all correlations?

- Assumptions for an absolute coupling measurement:
  1) no invisible/undetectable decays
  2) only the undetectable SM decays from H→cc, H→gg, ... and these are calculated by assuming that X_c==X_b or something similar.
  3) Gamma_W<Gamma_W(SM)
  4) Anything else?
- Can combine “no assumption” and 1)-3) with every coupling parameter model (slide 2-3)