Higgs WG - Summary (part 3)

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- Higgs coupling measurements: experiment and theory
  talk by S. Yamashita

- Photon collider physics issues
  talks by Z. Sullivan, J. Ciborowski

→ Open questions

→ Experiment/theory wish lists

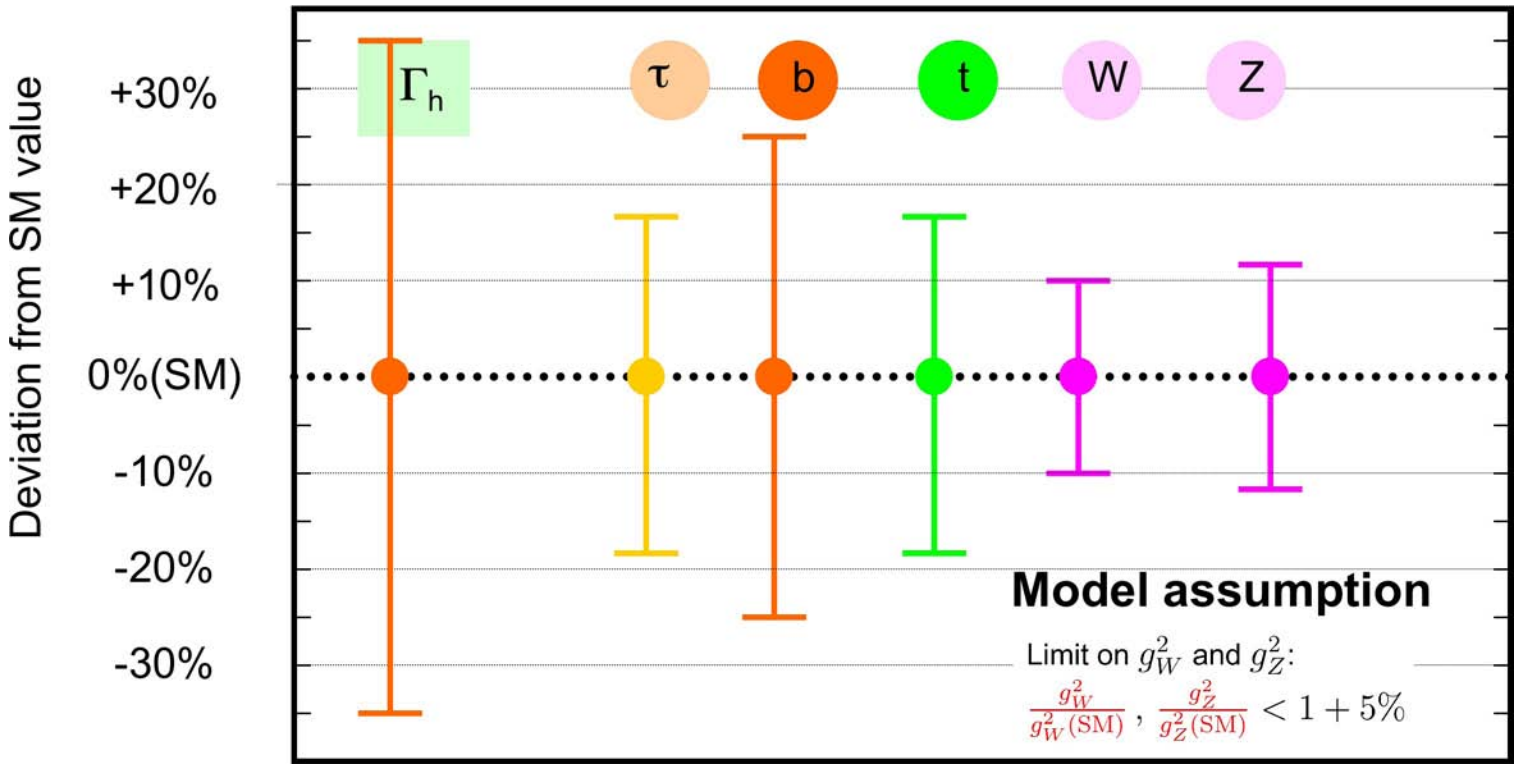
Higgs coupling measurements: experiment and theory (talk by S. Yamashita)

1. The most fundamental issues to be clarified
   (a) Gauge coupling
   (b) Yukawa coupling
      - Up-type vs Down-type $\rightarrow$ top vs bottom (charm vs bottom)
      - Quark vs lepton $\rightarrow$ bottom vs tau
      - 2nd generation vs 3rd generation $\rightarrow$ mu vs tau, charm vs top
   (c) Self-coupling

2. Reconstruct the Higgs sector

3. Discriminate among various models;
   Translate deviations from SM into quantities in New Physics models

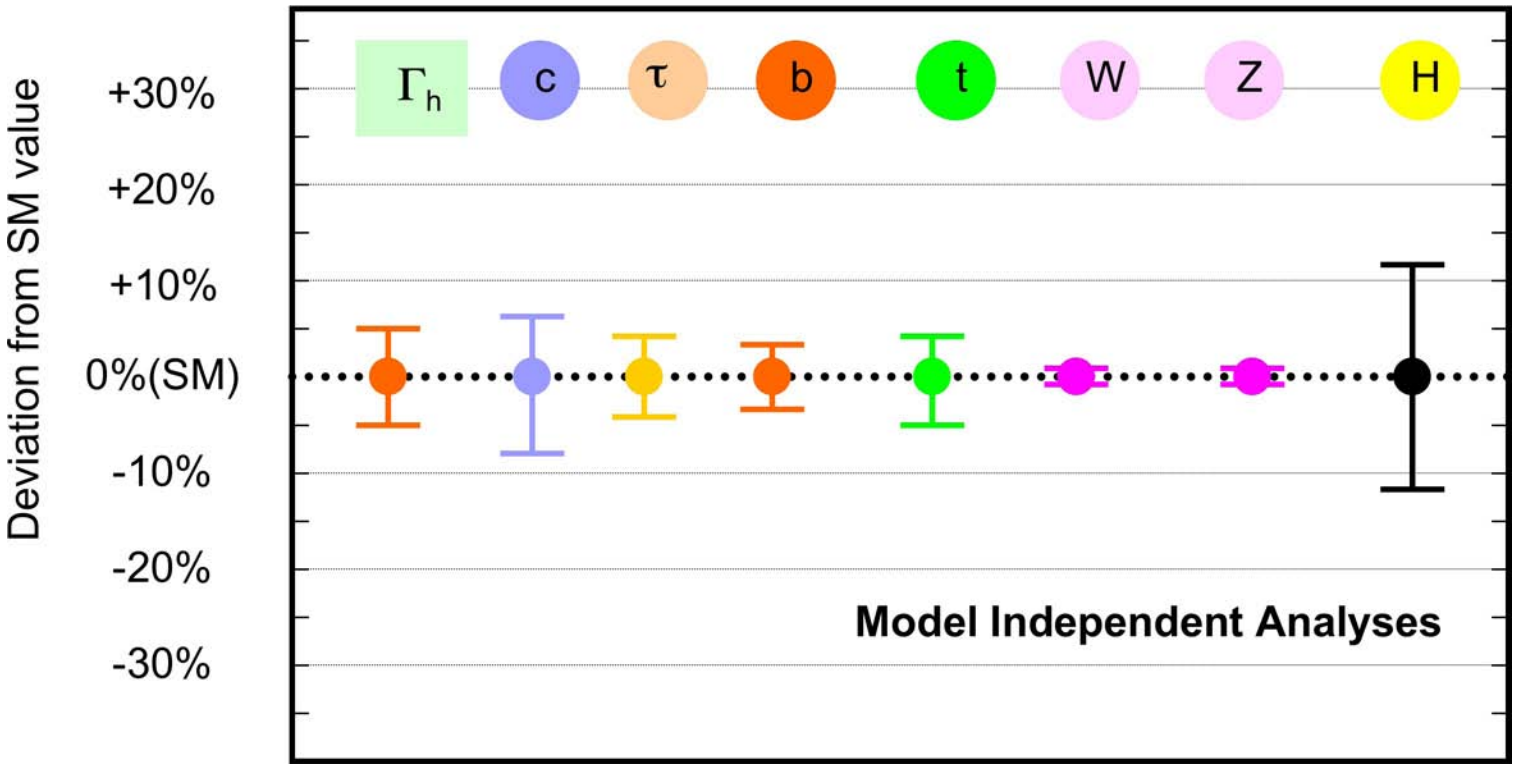
From the LHC...



requires (mild) model assumptions

[talk by S. Yamashita]

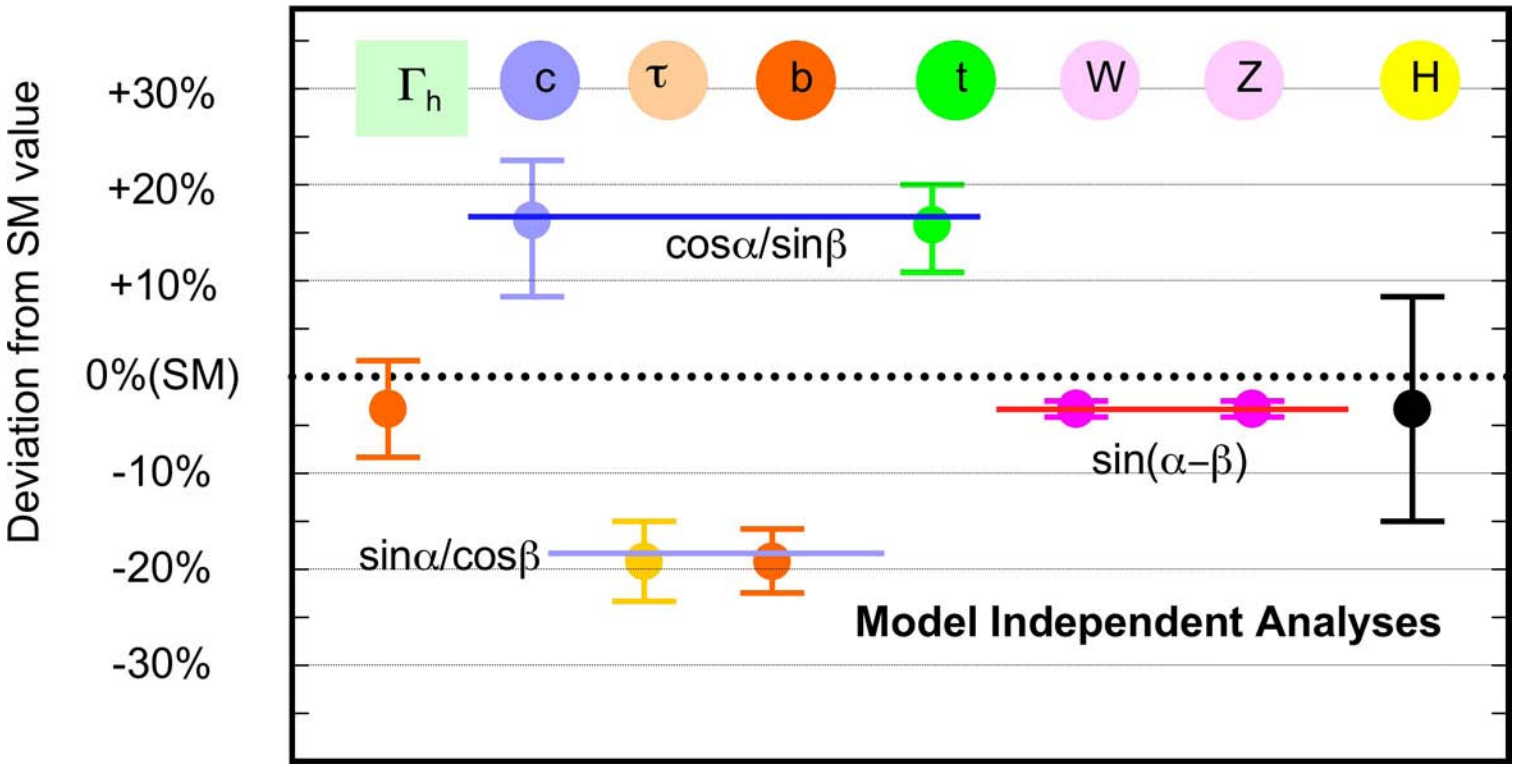
... to the ILC



model independent!

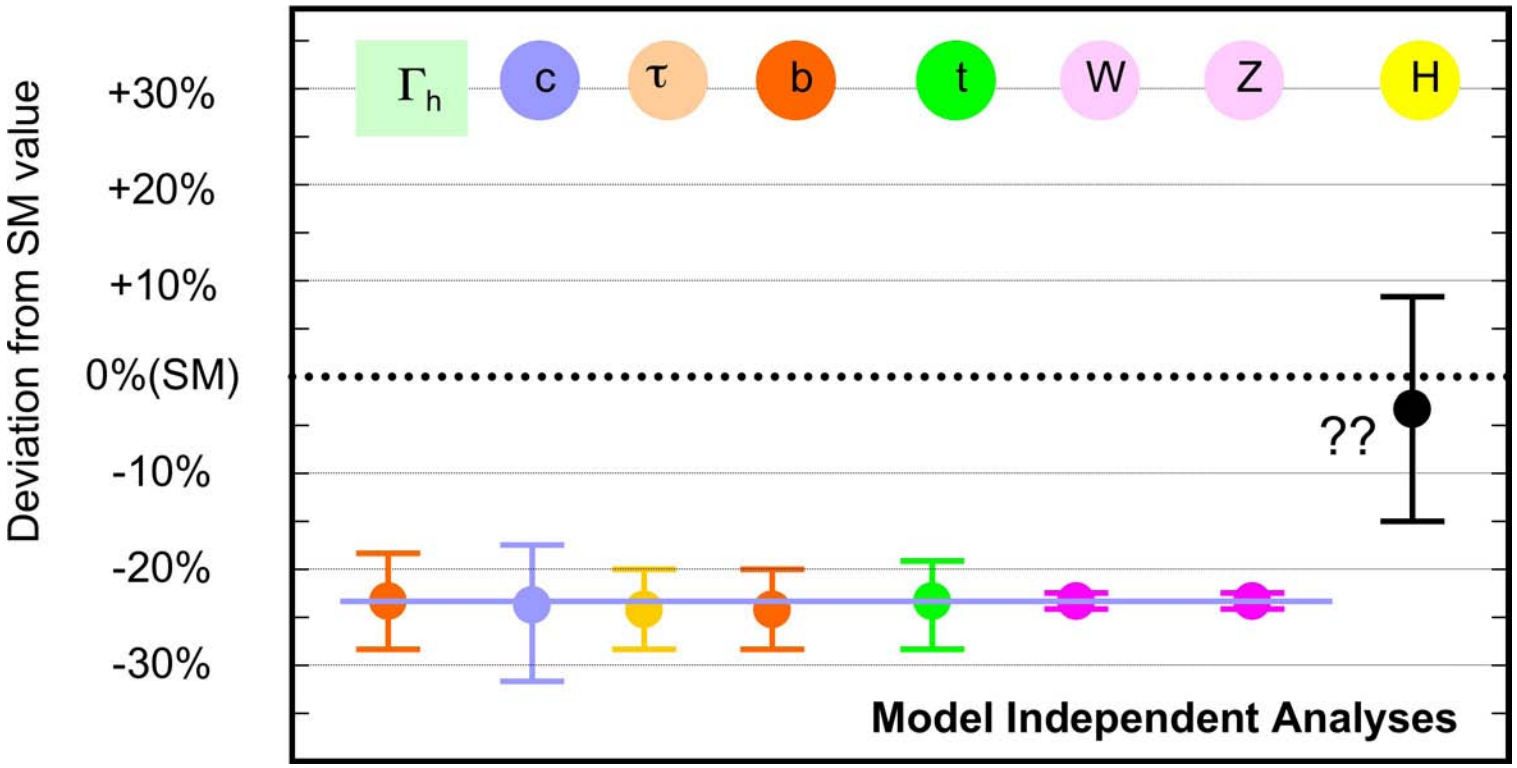
[talk by S. Yamashita]

2HDM or MSSM



[talk by S. Yamashita]

Extra dimensions (radion-Higgs mixing)

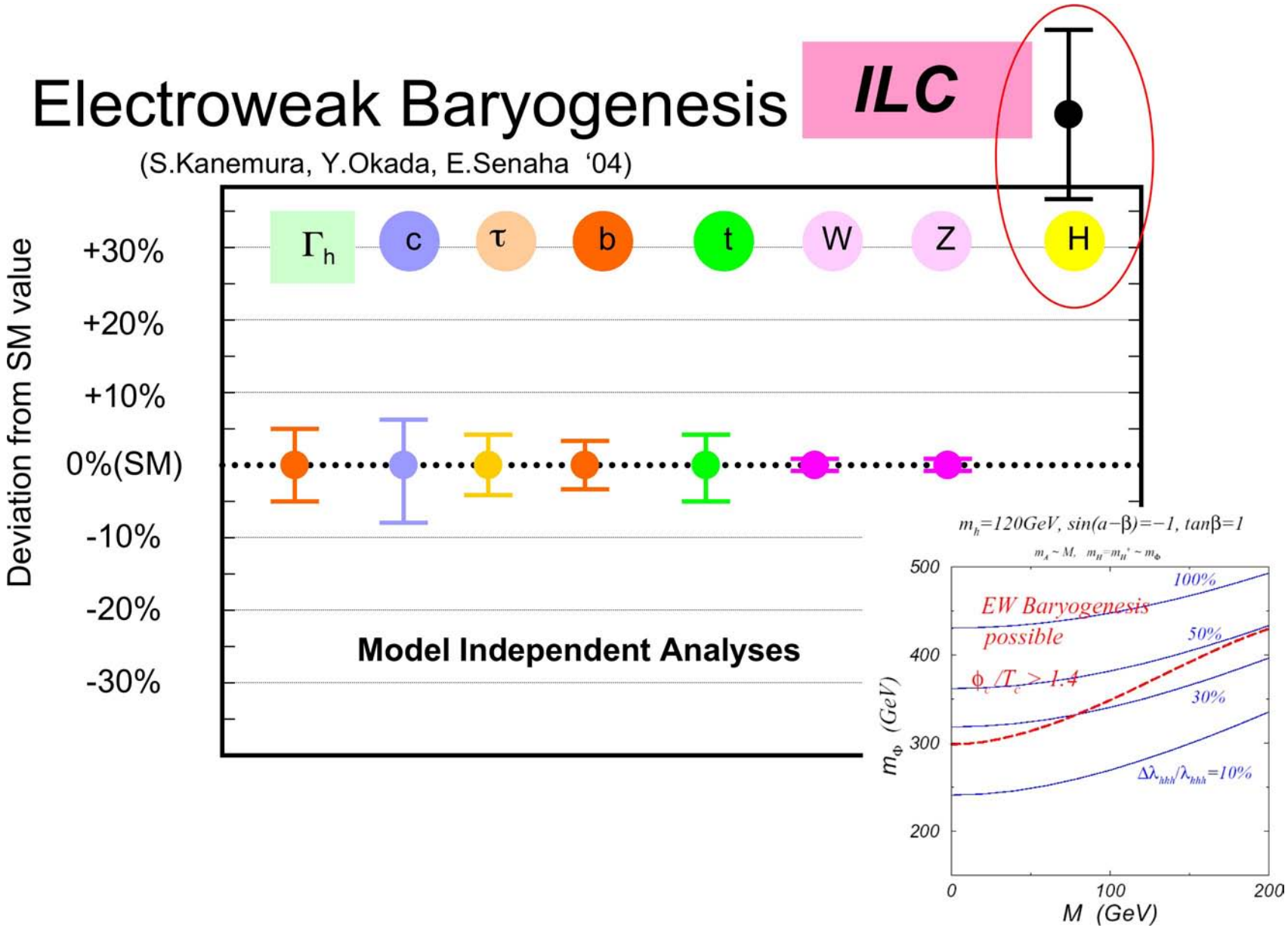


[talk by S. Yamashita]

Electroweak Baryogenesis

ILC

(S.Kanemura, Y.Okada, E.Senaha '04)



[talk by S. Yamashita]

Experimental wish list

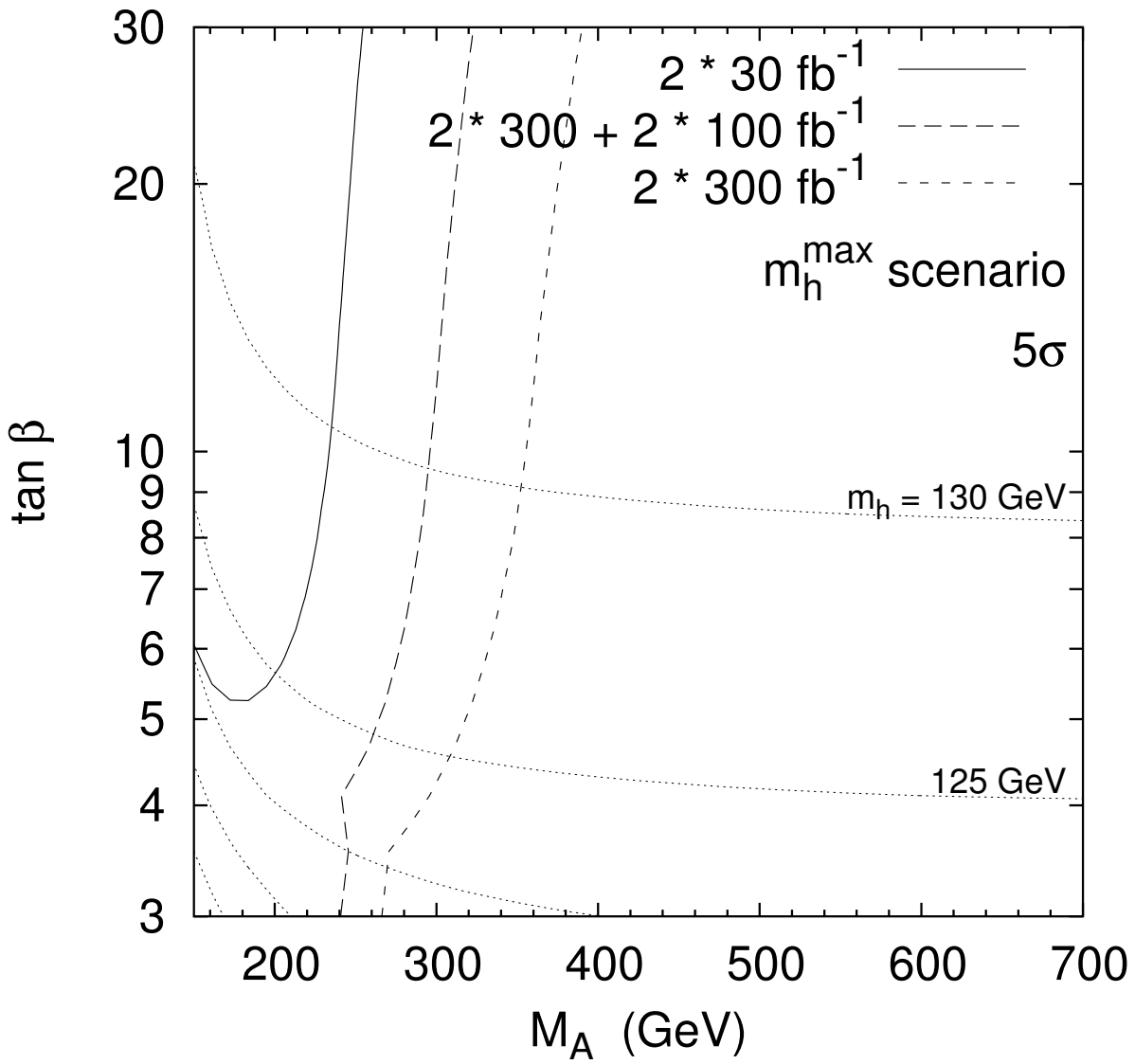
- Mapping between "physics space" and "detector space"
  How do experimental precisions depend on detector performance?
  $\longrightarrow$ Going from fast simulation to full simulation
  $\longrightarrow$ Update experimental techniques for cold design ILC
  This mapping needed to evolve an intelligent detector design
  ($\longrightarrow$ Alexei's talk)

- Need ILC studies for $m_H > 160$ GeV
  $\longrightarrow$ Proposal: $m_H = 130, 150, 160, 180, 200$ GeV
  ...Ready to pull out our "ILC physics case" slides whatever M_H LHC finds...

Theory wish list

- Mapping between "physics space" and "detector space"
  What physics gain do we get from a given coupling precision?
  Request from experimenters: more concrete examples of models
  $\longrightarrow$ Map between coupling precision and model discriminating power
  $\longrightarrow$ Collect results/predictions for various models – mostly only MSSM has been studied in this way
  Summary of many models $\longrightarrow$ power of Higgs measurements

E.g.: MSSM at LHC:



Theory wish list, continued

- More modern BSM/SUSY models allow a heavier SM-like Higgs
  $\longrightarrow$ Predictions in these models need to be worked out
  ($\longrightarrow$ Tim's talk)
  $\longrightarrow$ Mapping between coupling precision and physics reach for models with higher M_H values
  $\longrightarrow$ Stronger motivation for experimental work on higher M_H

- Accounting of theoretical uncertainties in SM Higgs production/decay
  $\longrightarrow$ Parametric: m_b, m_c, α_s: how will they improve?
  $\longrightarrow$ QCD scale dependence; correlation

- Techniques to identify model structure given pattern of coupling deviations

Photon collider physics issues
(talks by Z. Sullivan, J. Ciborowski)

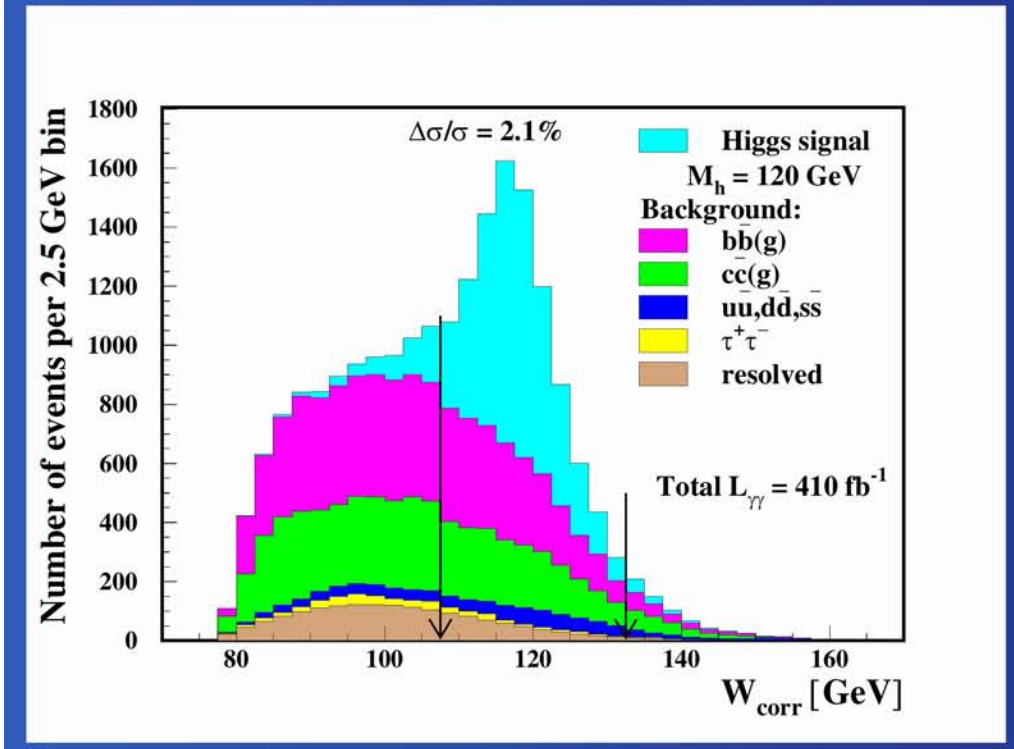
- $\gamma\gamma \to H \to b\bar{b}$ in SM – good measurement of $H\gamma\gamma$ coupling

- MSSM Heavy Higgses H, A – discovery in LHC Wedge region s-channel production: higher reach than e^+e^-

- Resolved photon background – photon PDF not well constrained

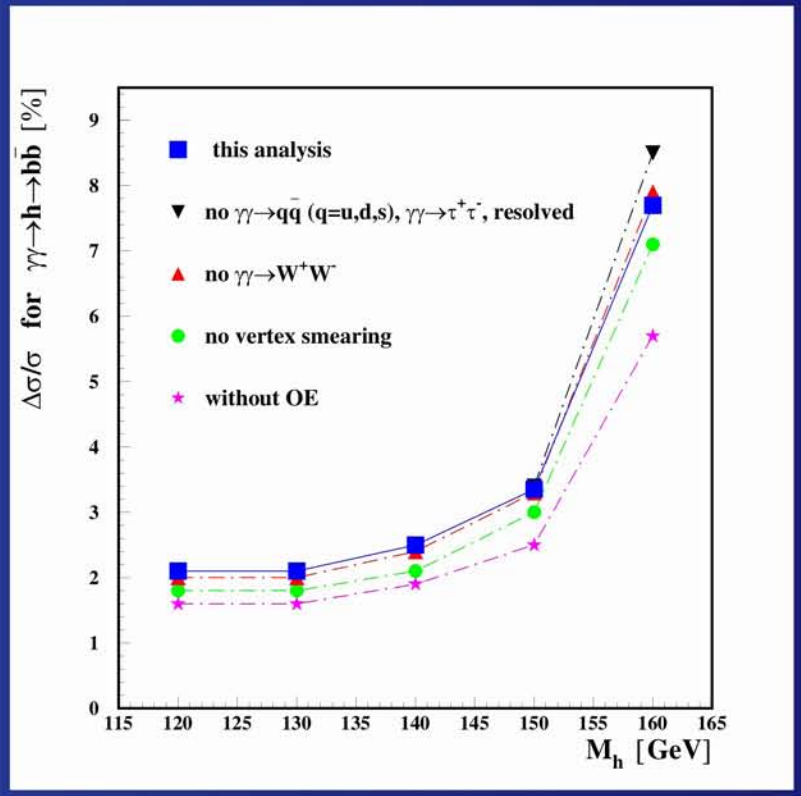
Standard Model Higgs:
Most complete $\gamma\gamma \to H \to b\bar{b}$ study to date

Results for $M_h = 120$ GeV



Corrected invariant mass distributions for signal and background events

Results for $M_h = 120$-160 GeV



For $M_h = 150$, 160 GeV additional cuts reduce $\gamma\gamma \to W^+W^-$

[talk by J. Ciborowski]

Resolved photon contribution:
$g\gamma \to b\bar{b}$ is largest component

Gluon distribution inside photon is not well constrained
Data from HERA, LEP, ...
$\to$ Mostly at low Q^2; have to make big extrapolation
$\to$ Small statistics, not very consistent with fit

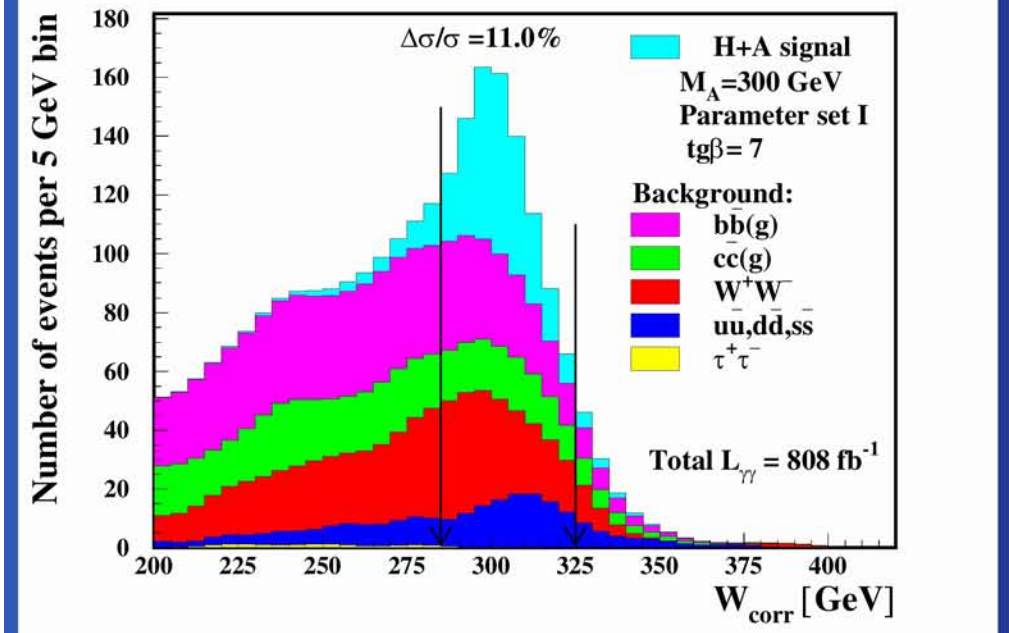
Need photon collider experiment to measure Photon PDF

[talk by Z. Sullivan]

MSSM Higgs discovery: $\gamma\gamma \to A, H \to b\bar{b}$

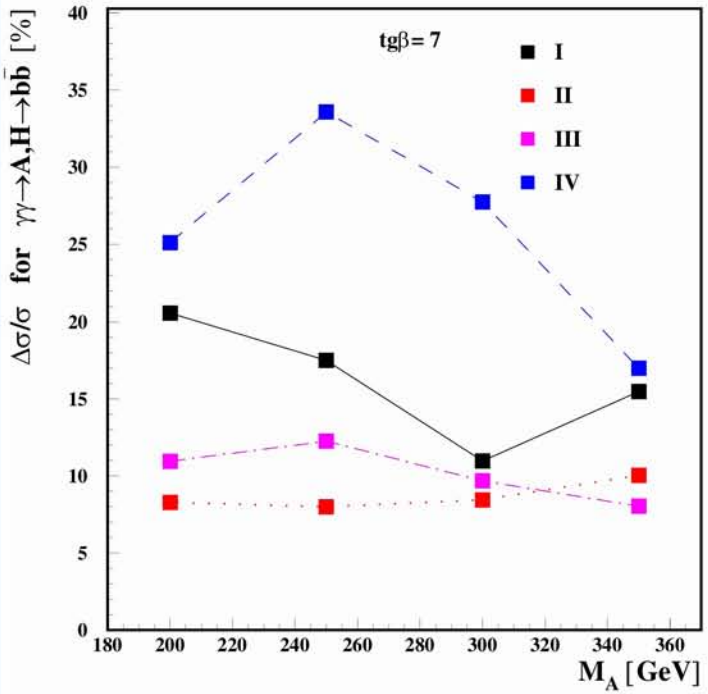
$\sqrt{s_{ee}} = 500$ GeV

Results for $M_A = 300$ GeV



Corrected invariant mass distributions

Results for $M_A = 200$-350 GeV



[talk by J. Ciborowski]

Experimental wish list

- How well could the photon PDF be measured?
  What techniques could be used to do this?

- How would you measure / beat down the resolved photon background (and shape!) in $\gamma\gamma \to H \to b\bar{b}$?

- What is the optimum search strategy to discover A/H in wedge region?
  $\to$ Running at different $\sqrt{s_{ee}}$ values, different photon beam spectrum configurations?

Photon collider $\leftrightarrow$ Machine issues

- Beam crossing angle is necessary for Photon Collider running.
  Needs to be planned from the start

- Radiation issues are very severe
  Issues for Vertex detector, forward detectors