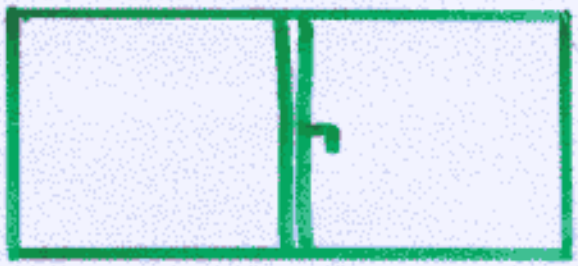
DESY LC meeting
September 2000

The Light Higgs



in 2HDM

at GigaZ

P. Mättig
J. Zochowski
M. Krawczyk

(hep-ph/0009201)

MSSM

→ Higgs sector + supersymmetric particles

→ only 2 parameters independent at tree level (supersymmetry relation $g \sim \lambda$)
eg. $\tan\beta$, M_A

prediction : $M_h \lesssim 135$ GeV

data $M_h, M_A > 90$ GeV

2HDM (II)

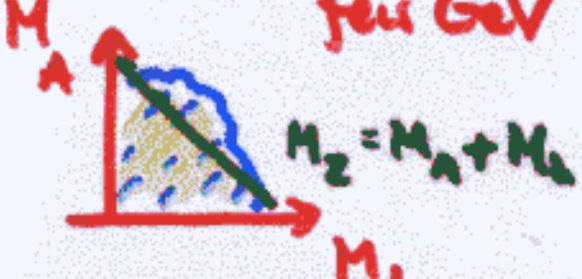
→ formal structure of Higgs sector as in MSSM

→ no relation between parameters

data:
even very light h or A may exist

↓

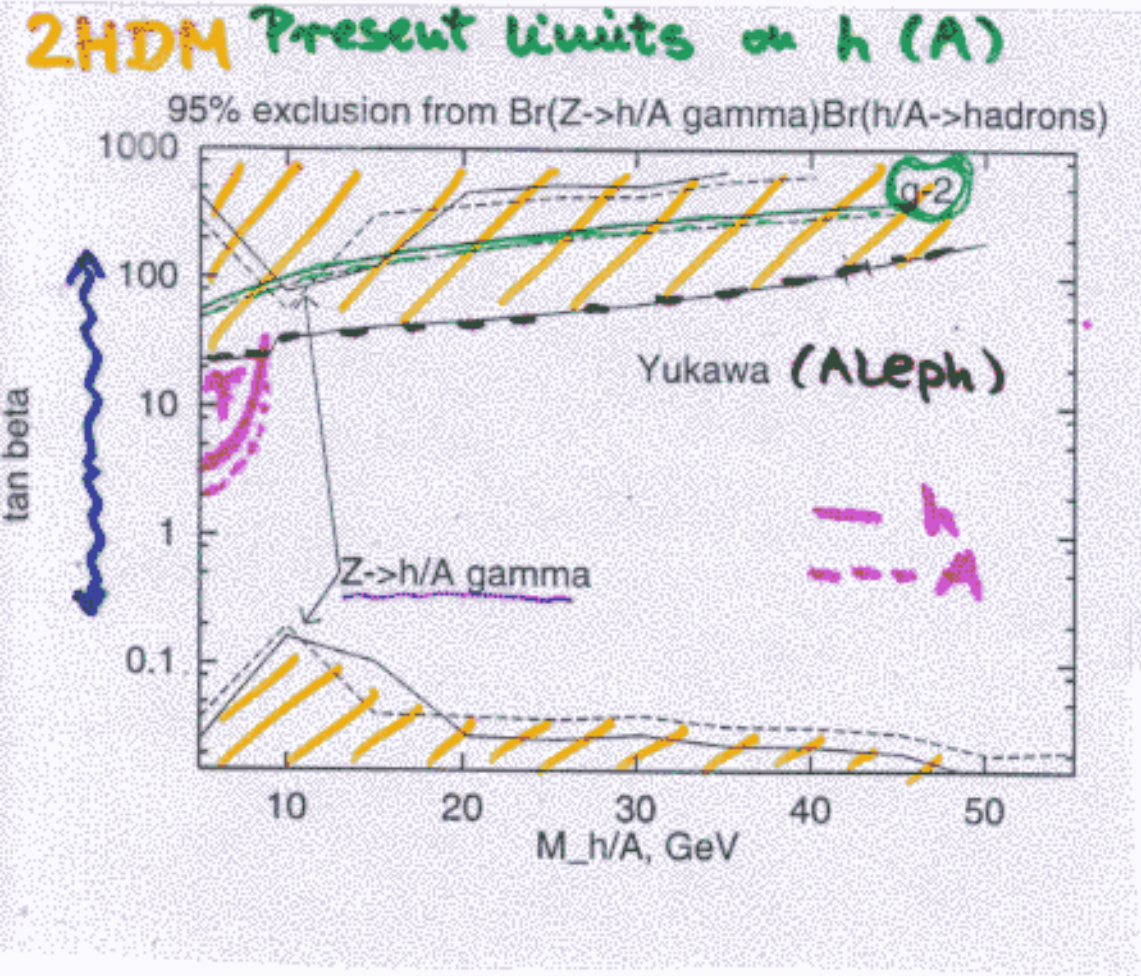
few GeV



LEP | $g-2$ | Yukawa process $Z \to h/A\,\gamma$ | + global fit

HERA, $\bar{p}p$ colliders ..

2HDM Present limits on h (A)



LEP

$+(g-2)_\mu$ Żochowski MK PRD55

$+\Upsilon \to h(A)\gamma$ Keh'

$Z \to h/A\,\gamma$ Hattig, Zoda-Marzi, MK, EPJ.C'99

The general 2HDM (II)

with CP conserv.

- direct searches at LEP

  h OR A → may be very light! (mass $\lesssim$ 40 Ge
  large tan β allowed !

  (heavier H, A, $H^\pm$) (h, H, $H^\pm$)

  $M_{H^+} \gtrsim 80$ GeV (from $b \to s\gamma$ $M_{H^\pm} \gtrsim 200$ GeV)

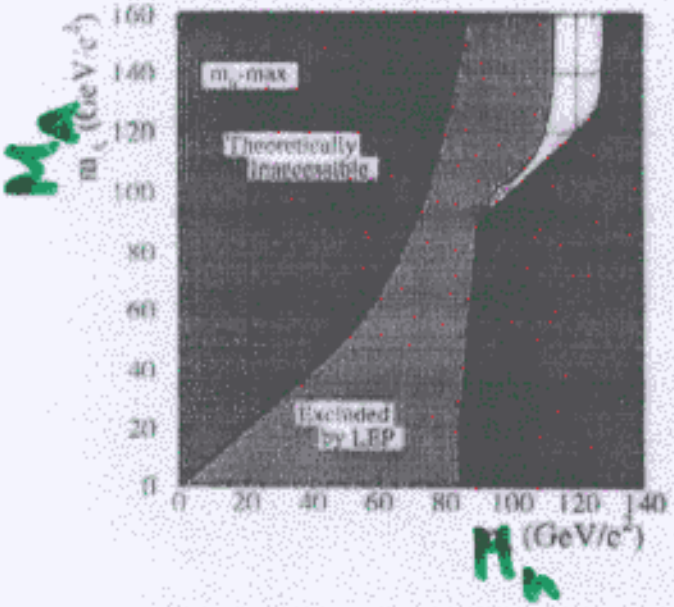
- global fit to EW precision data for very light h OR A } as good as for SM

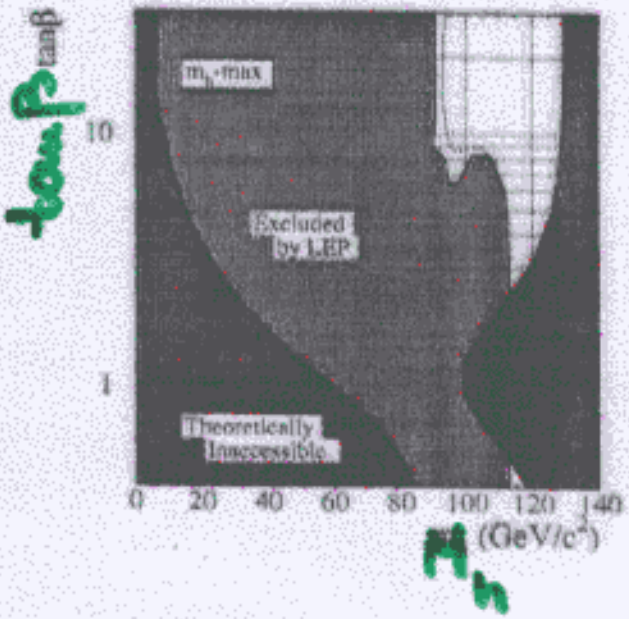
Chankowski, Zochowski, Nu
E.P.J.C 11 (99) 661

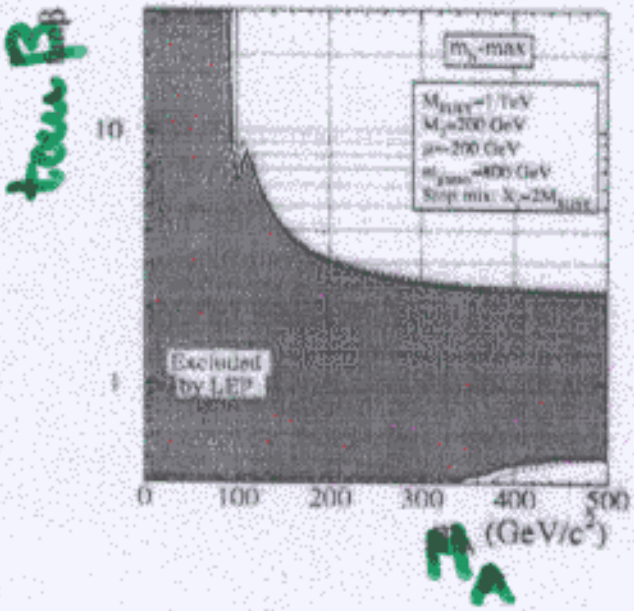
in contrast to MSSM

(... MSSM Higgs)

LEP-combined results ... Max-m_h scenario







Mass limits at 95% CL ... m_h, m_A > 90.5 GeV (any mixing)

Exclusion in tan β ... 0.5 - ≈ 2.3 (m_{top} = 175 GeV)

0.7 - 1.9 (- " - 180 GeV)

$M_{H^\pm} > 77.5$ GeV

2HDM(u) + MSSM

Physics impact at GigaZ

hep-ph/0005024

J. Erler
S. Heinemeyer
W. Hollik
G. Weiglein
P.M. Zerwas

Running TESLA at Z resonance ($\mathcal{L} \sim 7 \cdot 10^{33}\,cm^{-2}s^{-1}$)

→ 10^9 Z events / y

precision measurements

↳ impact on parameters of SM, MSSM

Hättig, Zacharski
Hk (hep-ph/0008201)

The light Higgs in 2HDM (II)

↓ at Giga Z

| also work in progress ....

M_h or $M_A \lesssim 40$ GeV

$Z \to hZ$ $\quad \sim \sin(\beta-\alpha)$

hA $\quad \sim \cos(\beta-\alpha)$

$b\bar{b}\, h/A$, $\tau\bar{\tau}\, h/A$ $\quad \sim \dfrac{\tan\beta}{\sin(\beta-\alpha)}$ ← large

$h/A\, \gamma$ $\quad \sim \dfrac{\tan\beta}{\sin(\beta-\alpha)}$ ← small and large

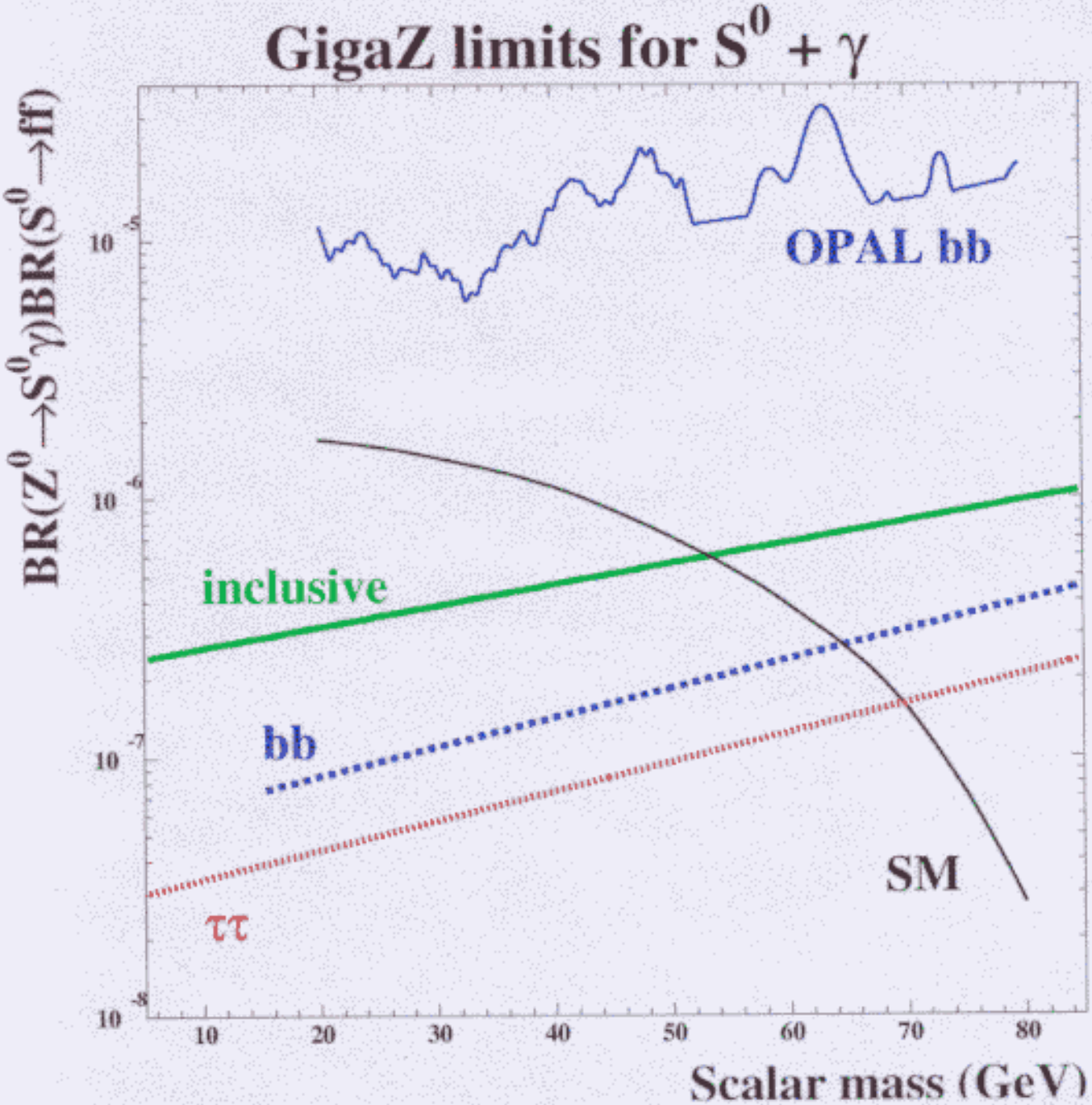
↓

various contributions

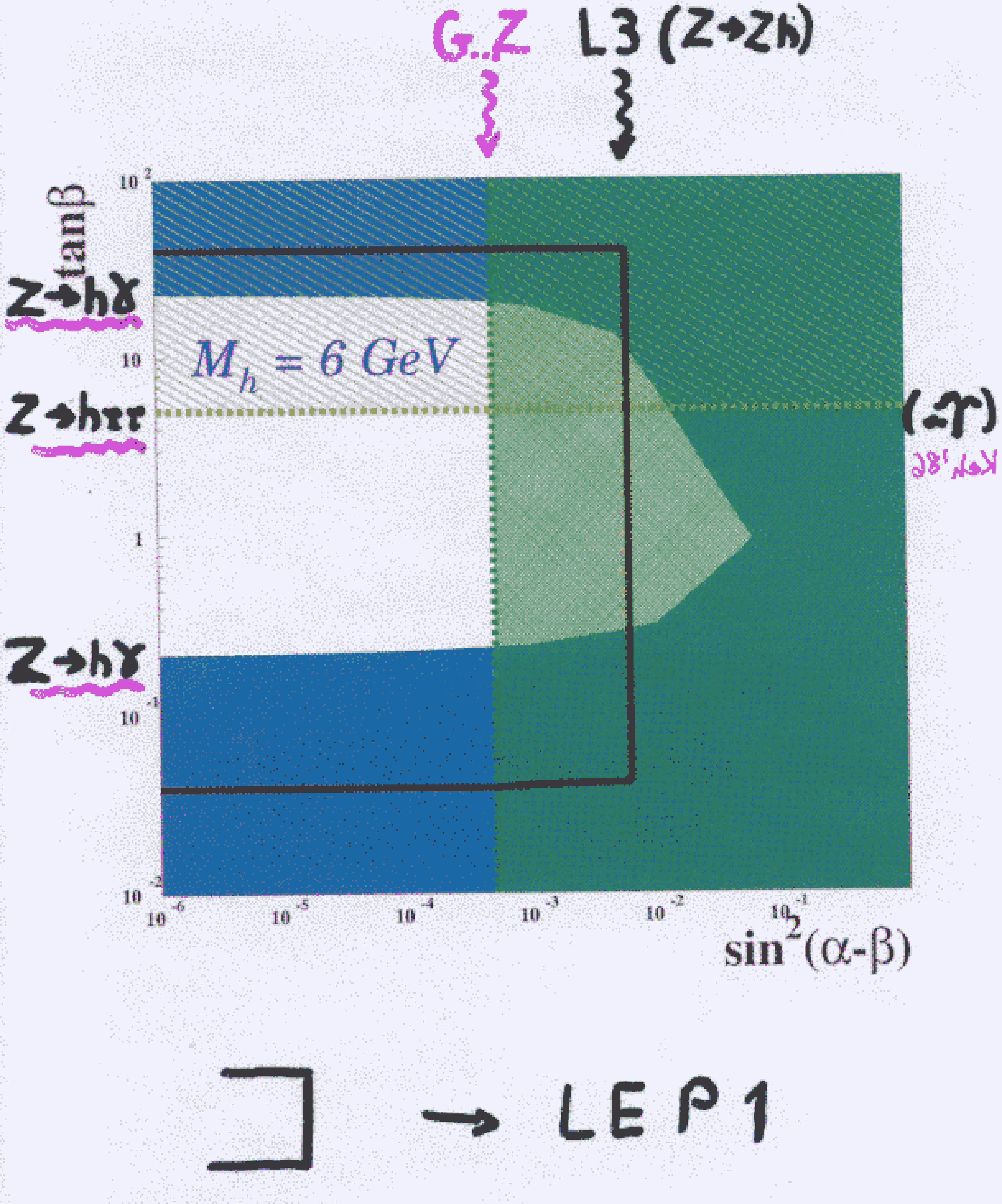
$W^\pm$ (for h only)

$H^\pm$ (for h only)

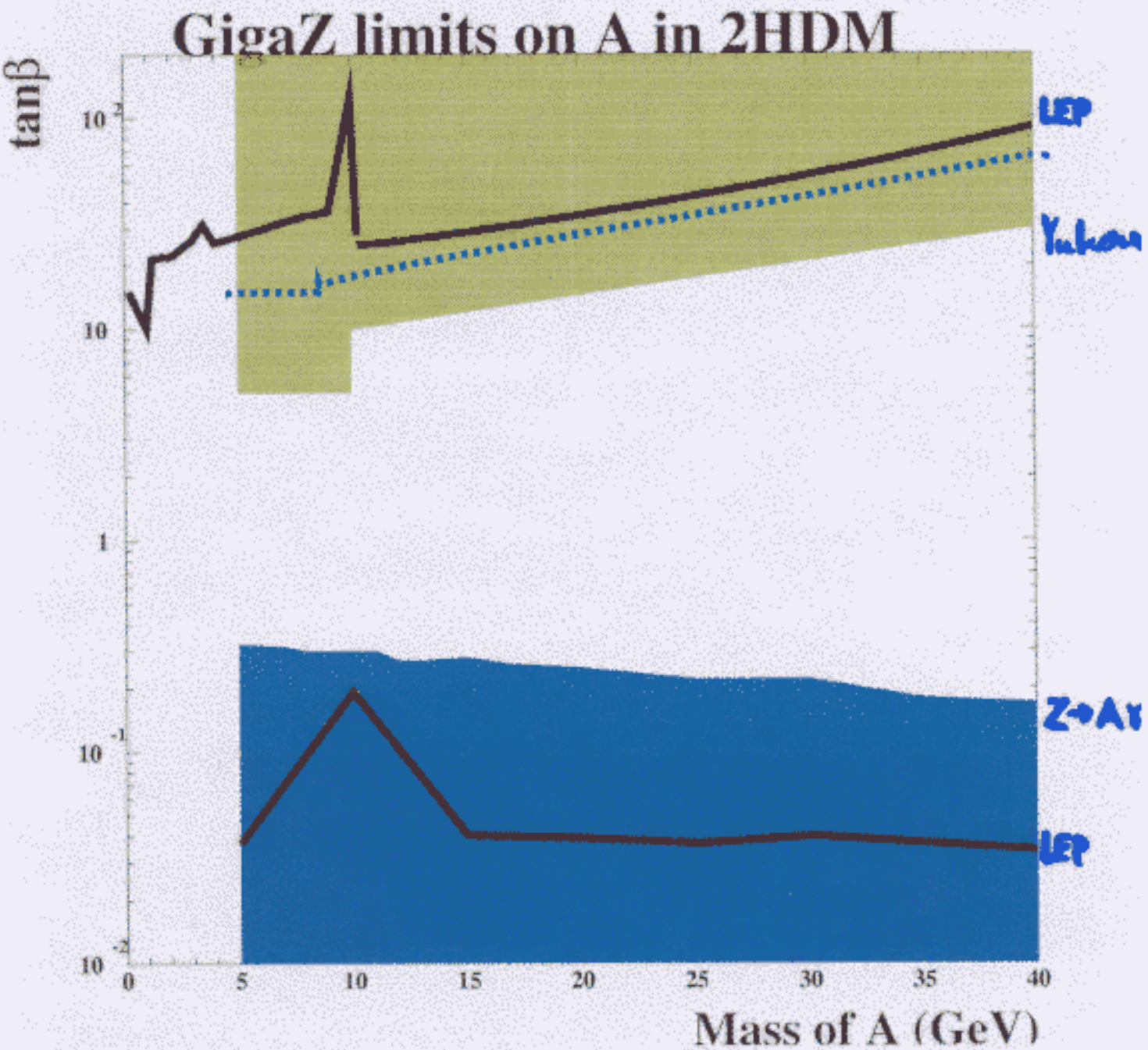
fermions



$$S_{LC} = S_{LEP}\sqrt{\frac{\mathcal{L}_{LEP}}{\mathcal{L}_{LC}}}\sqrt{\frac{(dM_{ff})_{LC}}{(dM_{ff})_{LEP}}}\frac{\epsilon^{LEP}_{sig}}{\epsilon^{LC}_{sig}}\frac{\sqrt{\epsilon^{LC}_{bc}}}{\sqrt{\epsilon^{LEP}_{bc}}}$$

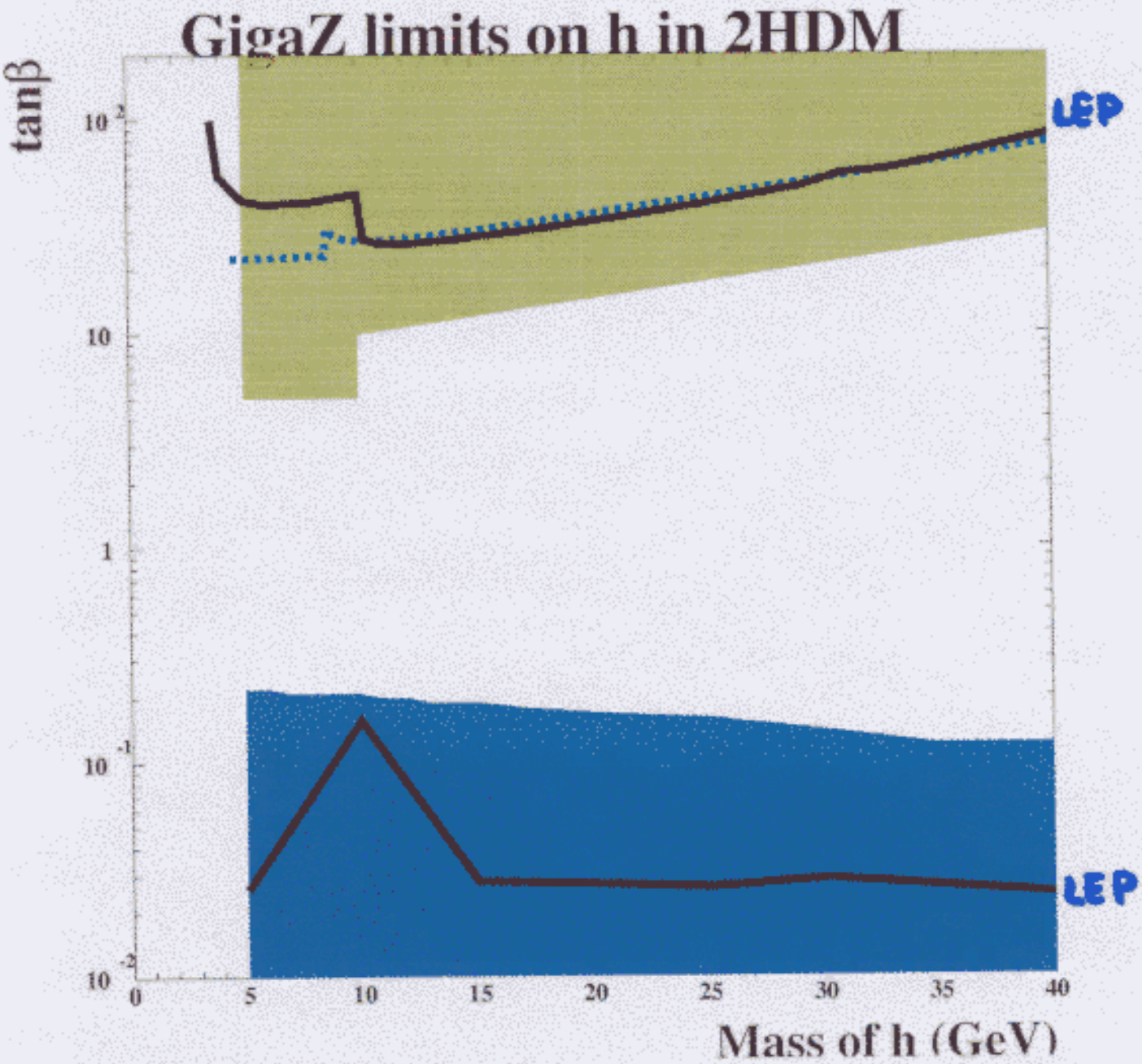


G.Z
L3 (Z→Zh)
Z→hγ
Z→hττ
Z→hγ
(-Υ)
tanβ
M_h = 6 GeV
10^2
10
1
10^-1
10^-2
10^-6
10^-5
10^-4
10^-3
10^-2
10^-1
sin^2(α-β)
→ LEP1



$Z \to f\bar{f}A$

$\to A\gamma$



$\sin(\beta-\alpha)=0$

Open light Higgs window in 2HDM

even at Giga Z

Can we close it by

→ looking at heavier Higgs boson ?

→ EW precision measurements at Giga Z

- constraints on light h/A

(work in progress)