>26	95	[93] ADEVA	90R L3	$\tan\beta > 1$
none 0.05–3.1	95	[94] DECAMP	90E ALEP	any $\tan\beta$
none 0.05–13	95	[94] DECAMP	90E ALEP	$\tan\beta > 0.6$
none 0.006–20	95	[94] DECAMP	90E ALEP	$\tan\beta > 2$
>37.1	95	[94] DECAMP	90E ALEP	$\tan\beta > 6$
none 0.05–20	95	[95] DECAMP	90H ALEP	$\tan\beta > 0.6$
none 0.006–21.4	95	[95] DECAMP	90H ALEP	$\tan\beta > 2$
> 3.1	95	[96] DECAMP	90M ALEP	any $\tan\beta$

[84] BUSKULIC 93I search for $Z \rightarrow H_1^0 Z^*$ and $Z \rightarrow H_1^0 A^0$. One-loop corrections are included with any m_t, $m_{\tilde{t}} > m_t$. Assumes no invisible H^0 or A^0 decays.

[85] ABREU 92J searched for $Z \rightarrow H_1^0 Z^*$ and $Z \rightarrow H_1^0 A^0$ with $H_1^0, A^0 \rightarrow \tau\tau$ or jet-jet. Small mass values are excluded by ABREU 91B.

[86] ADRIANI 92G search for $Z \rightarrow H_1^0 Z^*$, $Z \rightarrow H_1^0 A^0 \rightarrow 4b$, $bb\tau\tau$, 4τ, $6b$ (via $H^0 \rightarrow A^0 A^0$), and include constraints from $\Gamma(Z)$. One-loop corrections to the Higgs potential are included with $90 < m_t < 250$ GeV, $m_t < m_{\tilde{t}} < 1$ TeV.

[87] AKRAWY 91C result from $Z \rightarrow H_1^0 A^0 \rightarrow$ 4jet or $\tau^+\tau^- jj$ or 4τ and $Z \rightarrow H_1^0 Z^*$ ($H_1^0 \rightarrow q\overline{q}$, $Z^* \rightarrow \nu\overline{\nu}$ or e^+e^- or $\mu^+\mu^-$). See paper for the excluded region for the case $\tan\beta < 1$. Although these limits do not take into account the one-loop radiative corrections, the authors have reported unpublished results including these corrections and showed that the excluded region becomes larger.

[88] ABREU 91B result is based on negative search for $Z \rightarrow H_1^0 f\overline{f}$ and the limit on invisible Z width $\Gamma(Z \rightarrow H_1^0 A^0) <$ 39 MeV (95%CL), assuming $m_{A^0} < m_{H_1^0}$.

[89] ABREU 91B result obtained by combining with analysis of ABREU 90I.

[90] BLUEMLEIN 91 excluded certain range of $\tan\beta$ for $m_{H_1^0} <$ 120 MeV, $m_{A^0} <$ 80 MeV.

[91] DECAMP 91I searched for $Z \rightarrow H_1^0 Z^*$, and $Z \rightarrow H_1^0 A^0 \rightarrow$ 4jets or $\tau\tau jj$ or $3A^0$. Their limits take into account the one-loop radiative corrections to the Higgs potential with varied top and squark masses.

[92] ABREU 90E searched for $Z \rightarrow H_1^0 A^0$ and $Z \rightarrow H_1^0 Z^*$. $m_{H_1^0} <$ 210 MeV is not excluded by this analysis.

[93] ADEVA 90R result is from $Z \rightarrow H_1^0 A^0 \rightarrow$ 4jet or $\tau\tau jj$ or 4τ and $Z \rightarrow H_1^0 Z^*$. Some region of $m_{H_1^0} <$ 4 GeV is not excluded by this analysis.

[94] DECAMP 90E look for $Z \rightarrow H_1^0 A^0$ as well as $Z \rightarrow H_1^0 \ell^+\ell^-$, $Z \rightarrow H_1^0 \nu\overline{\nu}$ with 18610 Z decays. Their search includes signatures in which H_1^0 and A^0 decay to $\gamma\gamma$, e^+e^-, $\mu^+\mu^-$, $\tau^+\tau^-$, or $q\overline{q}$. See their figures of $m_{H_1^0}$ vs. $\tan\beta$.

[95] DECAMP 90H is similar to DECAMP 90E but with 25,000 Z decays.

[96] DECAMP 90M looked for $Z \rightarrow H^0 \ell\ell$, where H_1^0 decays outside the detector. This excludes a region in the ($m_{H_1^0}$, $\tan\beta$) plane centered at $m_{H_1^0} =$ 50 MeV, $\tan\beta = 0.5$. This limit together with DECAMP 90E result excludes $m_{H_1^0} <$ 3 GeV for any $\tan\beta$.

A^0 (Pseudoscalar Higgs Boson) MASS LIMITS in Supersymmetric Models

VALUE (GeV)	CL%	DOCUMENT ID	TECN	COMMENT
>21	95	[97] BUSKULIC	93I ALEP	$\tan\beta > 1$
>34	95	[98] ABREU	92J DLPH	$\tan\beta > 3$
>22	95	[99] ADRIANI	92G L3	$1 < \tan\beta < 50$
none 3–40.5	95	[100] AKRAWY	91C OPAL	$\tan\beta > 1$, if 3 GeV $< m_{H_1^0} < m_{A^0}$
>12	95	[101] ABREU	90E DLPH	$\tan\beta < 1$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
		[102] ELLIS	93 RVUE	Electroweak
> 0.21	95	[103] BUSKULIC	92 ALEP	$\tan\beta > 1$
>20	95	[104] DECAMP	91I ALEP	$\tan\beta > 1$
>34	95	[101] ABREU	90E DLPH	$\tan\beta > 1$, $m_{H_1^0} < m_{A^0}$
>39	95	[105] ADEVA	90R L3	$\tan\beta > 1$, $m_{H_1^0} < m_{A^0}$

[97] BUSKULIC 93I search for $Z \rightarrow H_1^0 Z^*$ and $Z \rightarrow H_1^0 A^0$. One-loop corrections to the Higgs potential are included with any m_t, $m_{\tilde{t}} > m_t$. For $m_t =$ 140 GeV and $m_{\tilde{t}} =$ 1 TeV, the limit is $m_{A^0} >$45 GeV. Assumes no invisible H^0 or A^0 decays.

[98] ABREU 92J searched for $Z \rightarrow H_1^0 Z^*$ and $Z \rightarrow H_1^0 A^0$ with $H_1^0, A^0 \rightarrow \tau\tau$ or jet-jet. Small mass values are excluded by ABREU 91B.

[99] ADRIANI 92G search for $Z \rightarrow H_1^0 Z^*$, $Z \rightarrow H_1^0 A^0 \rightarrow 4b$, $bb\tau\tau$, 4τ, $6b$ (via $H^0 \rightarrow A^0 A^0$), and include constraints from $\Gamma(Z)$. One-loop corrections are included with $90 < m_t < 250$ GeV, $m_t < m_{\tilde{t}} < 1$ TeV. The region $m_{A^0} < 11$ GeV is allowed if $42 < m_{H_1^0} < 62$ GeV, but is excluded by other experiments.

[100] AKRAWY 91C result from $Z \rightarrow H_1^0 A^0 \rightarrow$ 4jet or $\tau^+\tau^- jj$ or 4τ. See paper for the excluded region for the case $\tan\beta < 1$.

[101] ABREU 90E searched $Z \rightarrow H_1^0 A^0$ and $Z \rightarrow H_1^0 Z^*$. $m_{A^0} <$ 210 MeV is not excluded by this analysis.

[102] ELLIS 93 analyze possible constraints on the MSSM Higgs sector by electroweak precision measurements and find that m_{A^0} is not constrained by the electroweak data.

[103] BUSKULIC 92 limit is from $\Gamma(Z)$, $Z \rightarrow H_1^0 Z^*$, and $Z \rightarrow H_1^0 A^0$. The limit is valid for any $m_{H_1^0}$ below the the theoretical limit $m_{H_1^0} <$64 GeV which holds for $m_{A^0} \sim 0$ in the minimal supersymmetric model. One-loop radiative corrections are included.

[104] DECAMP 91I searched for $Z \rightarrow H_1^0 Z^*$, and $Z \rightarrow H_1^0 A^0 \rightarrow$ 4jets or $\tau\tau jj$ or $3A^0$. Their limits take into account the one-loop radiative corrections to the Higgs potential with varied top and squark masses. For $m_t =$ 140 GeV and $m_{\tilde{q}} =$ 1 TeV, the limit is $m_{A^0} >$ 31 GeV.

[105] ADEVA 90R result is from $Z \rightarrow H_1^0 A^0 \rightarrow$ 4jet or $\tau\tau jj$ or 4τ and $Z \rightarrow H_1^0 Z^*$. Some region of $m_{A^0} <$ 5 GeV is not excluded by this analysis.

MASS LIMITS for Associated Higgs Production in e^+e^- Interactions

In multi-Higgs models, associated production of Higgs via virtual or real Z in e^+e^- annihilation, $e^+e^- \rightarrow H_1^0 H_2^0$, is possible if H_1^0 and H_2^0 have opposite CP eigenvalues. Limits are for the mass of the heavier Higgs H_2^0 in two-doublet models.

VALUE (GeV)	CL%	DOCUMENT ID	TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
		[106] ADRIANI	92G L3	
>45	95	[107] DECAMP	90H ALEP	$m_{H_1^0} <$ 20 GeV
>37.5	95	[107] DECAMP	90H ALEP	$m_{H_1^0} < m_{H_2^0}$
none 5–45	95	[108] KOMAMIYA	90 MRK2	$m_{H_1^0} <$ 0.5 GeV, $H_2^0 \rightarrow q\overline{q}$ or $\tau^+\tau^-$
> 8	90	[109] KOMAMIYA	89 MRK2	$H_1^0 \rightarrow \mu^+\mu^-$, $H_2^0 \rightarrow q\overline{q}, \tau^+\tau^-$
>28	95	[110] LOW	89 AMY	$m_{H_1^0} \lesssim$ 20 MeV, $H_2^0 \rightarrow q\overline{q}$
none 2–9	90	[111] AKERLOF	85 HRS	$m_{H_1^0} = 0$, $H_2^0 \rightarrow f\overline{f}$
none 4–10	90	[112] ASH	85C MAC	$m_{H_1^0} =$ 0.2 GeV, $H_2^0 \rightarrow \tau^+\tau^-$, $c\overline{c}$
none 1.3–24.7	95	[111] BARTEL	85L JADE	$m_{H_1^0} =$ 0.2 GeV, $H_2^0 \rightarrow f\overline{f}$ or $f\overline{f} H_1^0$
none 1.2–13.6	95	[111] BEHREND	85 CELL	$m_{H_1^0} = 0$, $H_2^0 \rightarrow f\overline{f}$
none 1–11	90	[111] FELDMAN	85 MRK2	$m_{H_1^0} = 0$, $H_2^0 \rightarrow f\overline{f}$
none 1–9	90	[111] FELDMAN	85 MRK2	$m_{H_1^0} = m_{H_2^0}$, $H_2^0 \rightarrow f\overline{f}$

[106] ADRIANI 92G excluded regions of the $m_{H_1^0} - m_{A^0}$ plane for various decay modes with limits $B(Z \rightarrow H_1^0 H_2^0) <$(2–20) $\times 10^{-4}$ are shown in Figs. 2–5.

[107] DECAMP 90H search for $Z \rightarrow H_1^0 e^+e^-$, $H_1^0 \mu^+\mu^-$, $H_1^0 \tau^+\tau^-$, $H_1 q\overline{q}$, low multiplicity final states, τ-τ-jet-jet final states and 4-jet final states.

[108] KOMAMIYA 90 limits valid for $\cos^2(\alpha - \beta) \approx 1$. They also search for the cases $H_1^0 \rightarrow \mu^+\mu^-$, $\tau^+\tau^-$, and $H_2^0 \rightarrow H_1^0 H_1^0$. See their Fig. 2 for limits for these cases.

[109] KOMAMIYA 89 assume $B(H_1^0 \rightarrow \mu^+\mu^-) =$ 100 %, $2m_\mu < m_{H_1^0} < m_\tau$. The limit is for maximal mixing. A limit of $m_{H_2^0} >$ 18 GeV for the case $H_2^0 \rightarrow H_1^0 H_1^0$ ($H_1^0 \rightarrow \mu^+\mu^-$) is also given. From PEP at $E_{\text{cm}} =$ 29 GeV.

[110] LOW 89 assume that H_1^0 escapes the detector. The limit is for maximal mixing. A reduced limit of 24 GeV is obtained for the case $H_2^0 \rightarrow H_1^0 f\overline{f}$. Limits for a Higgs-triplet model are also discussed. $E_{\text{cm}}^{ee} =$ 50–60.8 GeV.

[111] The limit assumes maximal mixing and that H_1^0 escapes the detector.

[112] ASH 85 assumes that H_1^0 escapes undetected. The bound applies up to a mixing suppression factor of 5.

$H^\pm$ (Charged Higgs or Techni-pion) MASS LIMITS

Most of the following limits assume $B(H^+ \rightarrow \tau^+\nu) + B(H^+ \rightarrow c\overline{s}) = 1$. DECAMP 90I, BEHREND 87, and BARTEL 86 assume $B(H^+ \rightarrow \tau^+\nu) + B(H^+ \rightarrow c\overline{s}) + B(H^+ \rightarrow c\overline{b}) = 1$. All limits from Z decays as well as ADACHI 90B assume that H^+ has weak isospin $T_3 = +1/2$. For a discussion of techni-particles, see EICHTEN 86.

VALUE (GeV)	CL%	DOCUMENT ID	TECN	COMMENT
>41	95	[113] ADRIANI	92G L3	$B(\tau\nu) =$ 0–1
>41.7	95	[114,115] DECAMP	92 ALEP	$B(\tau\nu) =$ 0–1
• • • We do not use the following data for averages, fits, limits, etc. • • •				
		[116] BARGER	93 RVUE	$b \rightarrow s\gamma$
		[117] BELANGER	93 RVUE	$b \rightarrow s\gamma$
		[116] HEWETT	93 RVUE	$b \rightarrow s\gamma$
		[118] ALITTI	92F UA2	$t \rightarrow bH^+$, $H^+ \rightarrow \tau\nu_\tau$
		[119] ALBAJAR	91B UA1	$t \rightarrow bH^+$, $H^+ \rightarrow \tau^+\nu$
none 8.0–20.2	95	[120] YUZUKI	91 VNS	$B(\ell\nu) =$ 0–1
>29	95	[114,121] ABREU	90B DLPH	$B(\tau\nu) =$ 0–1
>19	95	[114,122] ADACHI	90B TOPZ	$B(\tau\nu) =$ 0–1
>36.5	95	[114,123] ADEVA	90M L3	$B(\tau\nu) =$ 0–1
>35	95	[114,124] AKRAWY	90K OPAL	$B(\tau\nu) =$ 0–1
>35.4	95	[114,125] DECAMP	90I ALEP	$B(\tau\nu) =$ 0–1
none 10–20	95	[126] SMITH	90B AMY	$B(\tau\nu) >$ 0.7
>19	95	[125] BEHREND	87 CELL	$B(\tau\nu) =$ 0–1
>18	95	[127] BARTEL	86 JADE	$B(\tau\nu) =$0.1–1.0
>17	95	[127] ADEVA	85 MRKJ	$B(\tau\ \nu) =$0.25–1.0