Any sign of New Physics in the 1999 OPAL data?

presented by **Magali GRUWÉ**
DESY / University of Hamburg

EPS'99 in Tampere
16/07/99

Any sign of New Physics in the 1999 OPAL data?

In 1999:

E_{cm} = 192 GeV $\quad \mathcal{L} \sim 26\ pb^{-1}$

E_{cm} = 196 GeV $\quad \mathcal{L} \sim 23\ pb^{-1} \rightarrow 40\ pb^{-1}$

↳ **extend the reach for new particle searches:**

- **SM Higgs**
- **SUSY Higgs**
  - neutral
  - charged
  - with invisible decay
  - with photonic decay
- **Other SUSY particles:**
  - gauginos
  - sfermions

  with or without R parity conservation
- **Other more general searches**

ALL PRELIMINARY

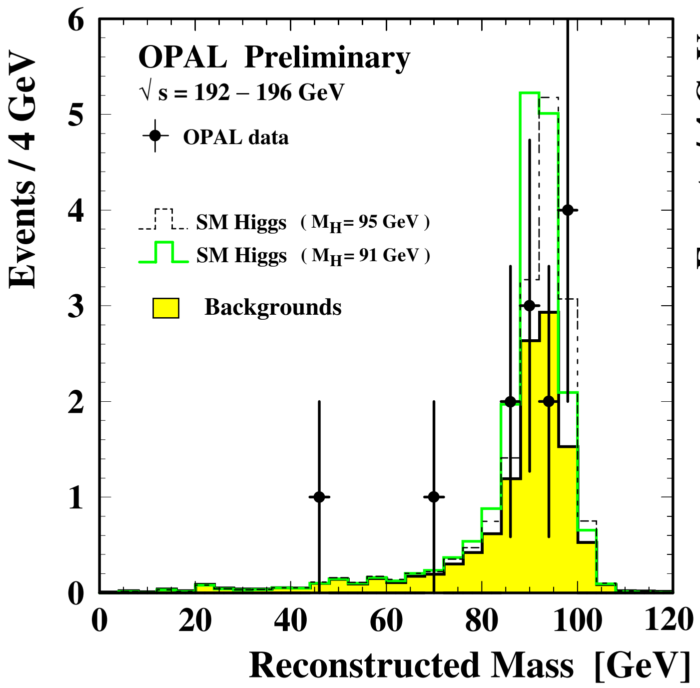
SM Higgs

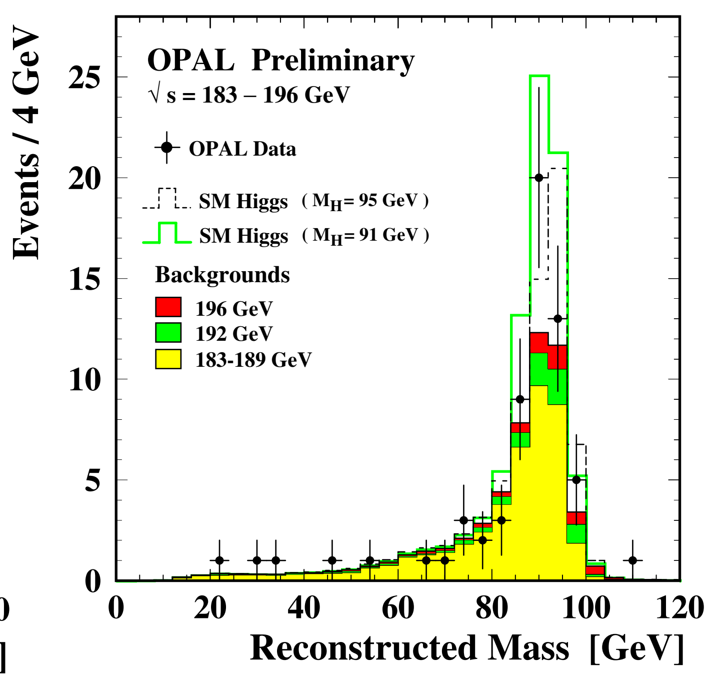
$e^+e^- \rightarrow H^0 Z^0$

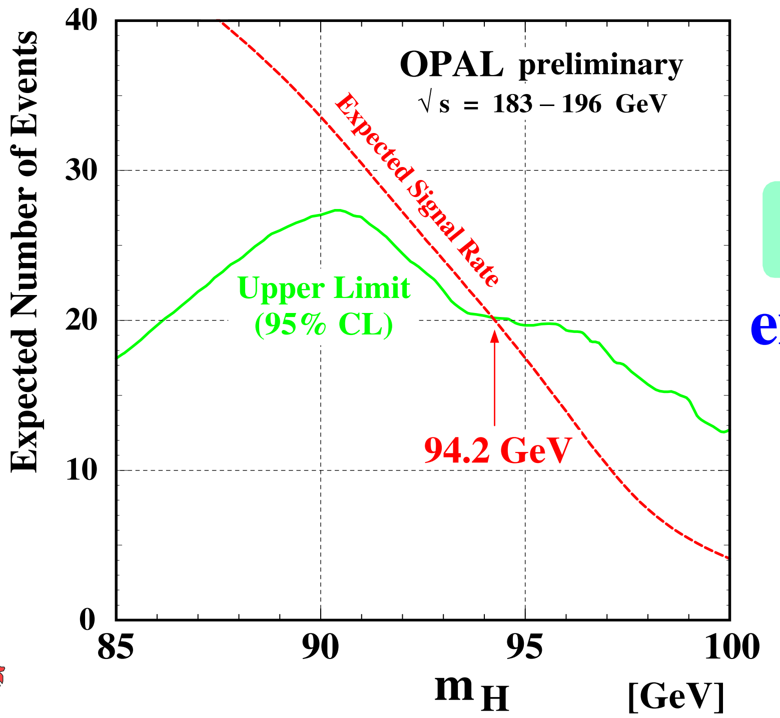
No excess

$N^{obs} = 13$

$N^{bkg} = 11.5 \pm 0.3 \pm 1.4$







$m_{H^0} > 94.2$ GeV

expected: 96.0 GeV

DESY / University of Hamburg

Neutral SUSY Higgs

$e^+e^- \rightarrow h^0 Z^0$ use SM Higgs search

$e^+e^- \rightarrow h^0 A^0$ complementary

$h^0 A^0 \rightarrow bbbb$ $N^{obs} = 8$

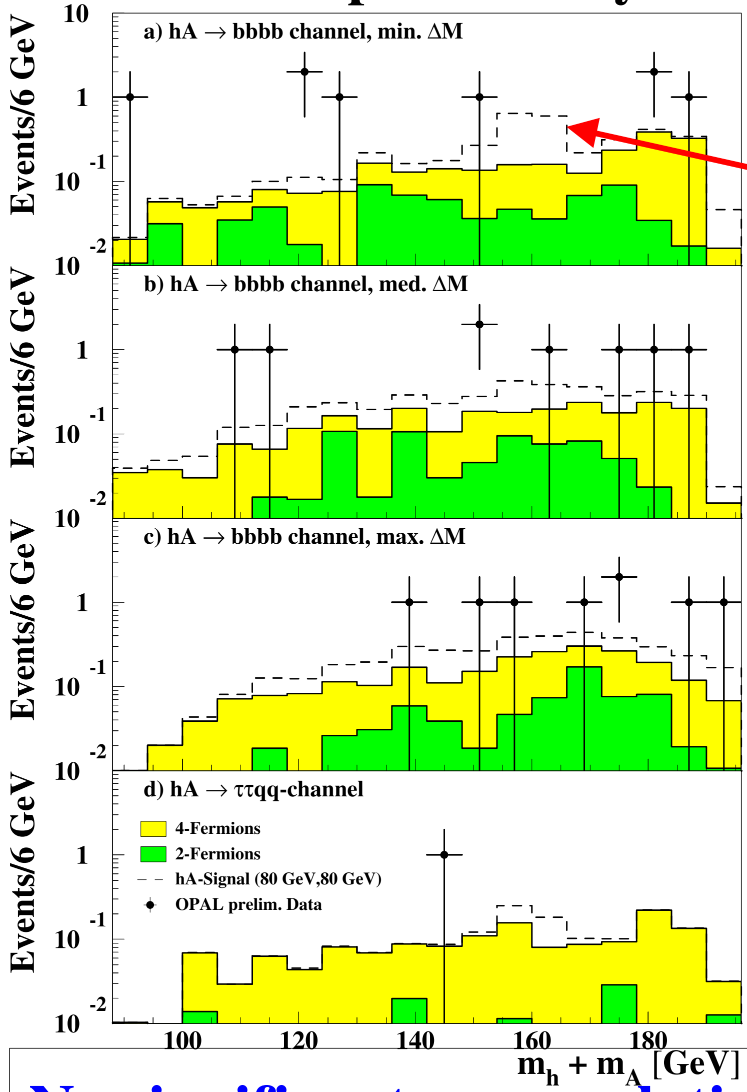
$N^{bkg} = 2.4 \pm 0.1 \pm 0.5$

Excess ?!

$h^0 A^0 \rightarrow \tau\tau bb$ $N^{obs} = 1$

$N^{bkg} = 1.5 \pm 0.1 \pm 0.5$

OPAL preliminary

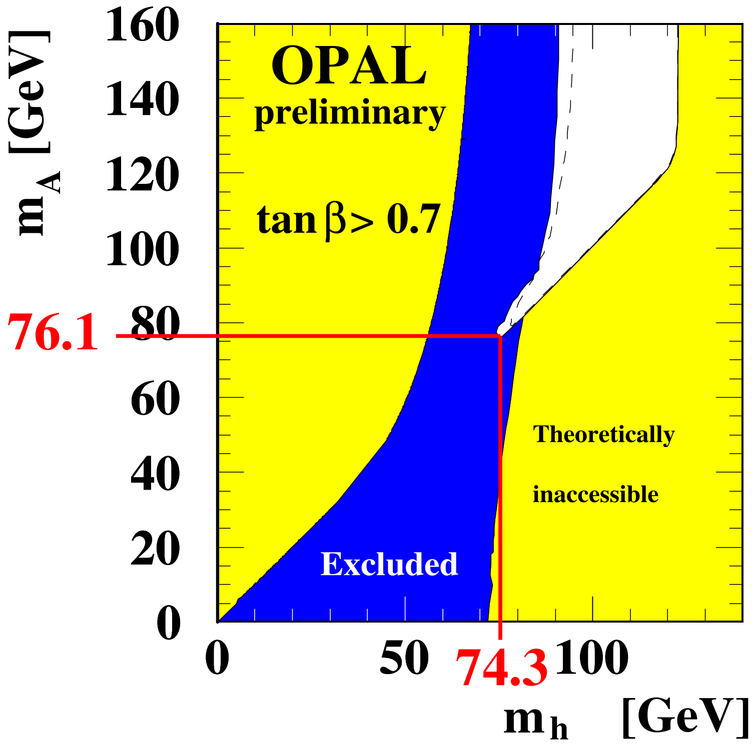


$\left\{ \begin{array}{l} m_{h^0} = 80 \text{ GeV} \\ m_{A^0} = 80 \text{ GeV} \end{array} \right.$

No significant accumulation: *No signal*

DESY / University of Hamburg

Neutral SUSY Higgs
➡ MSSM exclusions

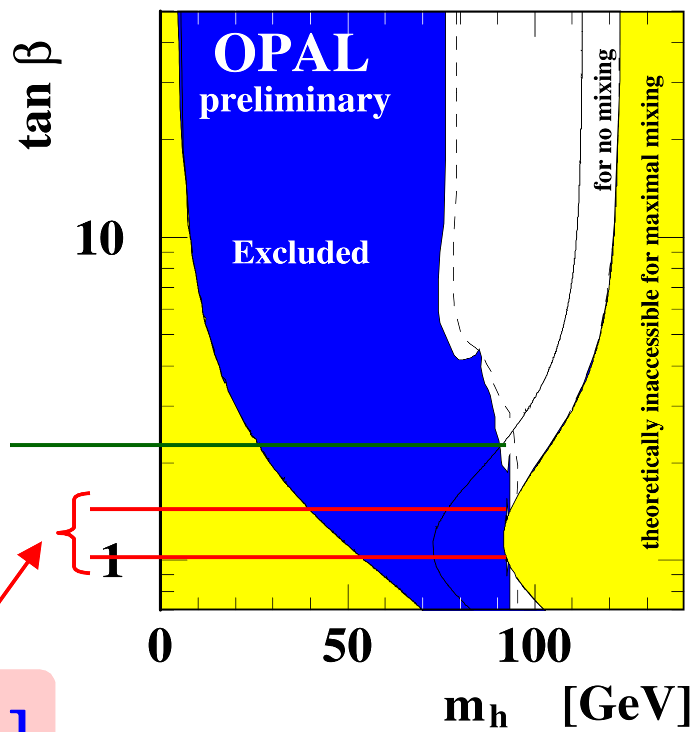


Benchmark scan

$m_t = 175$ GeV
$\mu = -100$ GeV
$M_2 = 1.63$ TeV
$m_0 = 1$ TeV

tg $\beta > 0.7$

$m_{h^0} > 74.3$ GeV (expected 78.0 GeV)
$m_{A^0} > 76.1$ GeV (expected 79.1 GeV)



No $\tilde{t}$ mixing:

tg $\beta \notin$ [0.70,2.23]

Max $\tilde{t}$ mixing:

tg $\beta \notin$ [1.03,1.31]

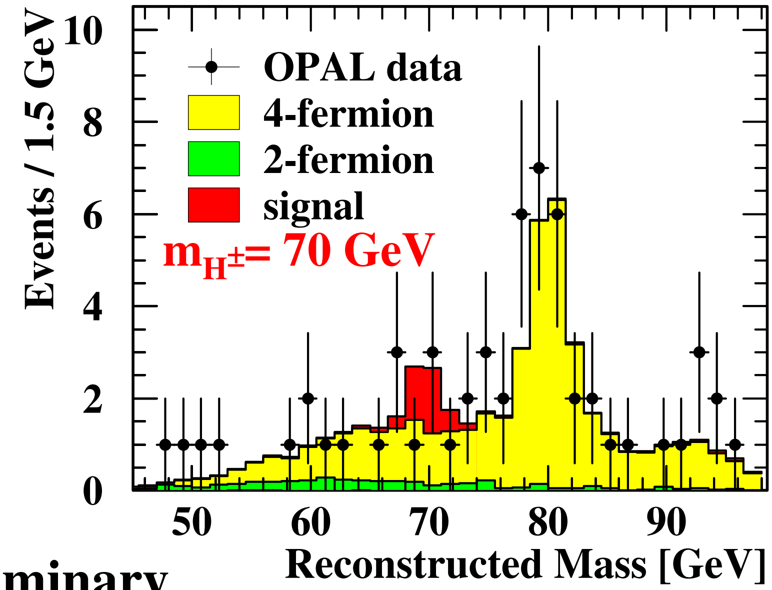
Charged SUSY Higgs

$e^+e^- \rightarrow H^+ H^-$

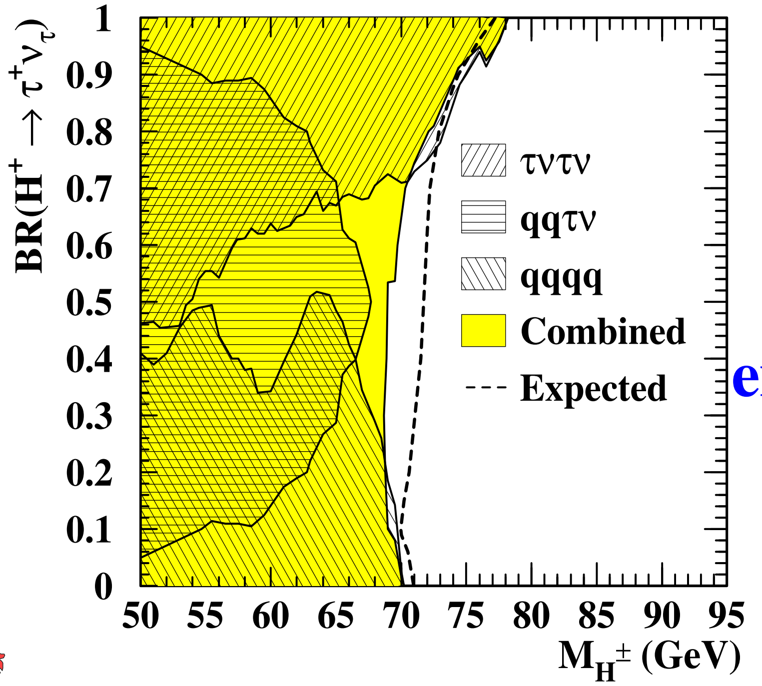
Hadronic	$N^{obs} = 58$	$N^{bkg} = 48.3 \pm 0.8 \pm 2.2$
Semileptonic	$N^{obs} = 19$	$N^{bkg} = 17.2 \pm 0.6 \pm 1.7$
Leptonic	$N^{obs} = 79$	$N^{bkg} = 74.3$

No excess

OPAL preliminary



OPAL preliminary



$m_{H^\pm} > 68.7$ GeV

expected: 70.0 GeV

Other Higgs decays

$e^+e^- \rightarrow h^0 Z^0$ $\quad$ $h^0 \rightarrow$ invisible ($\tilde{\chi}^0_1 \tilde{\chi}^0_1$)

$N^{obs} = 12$

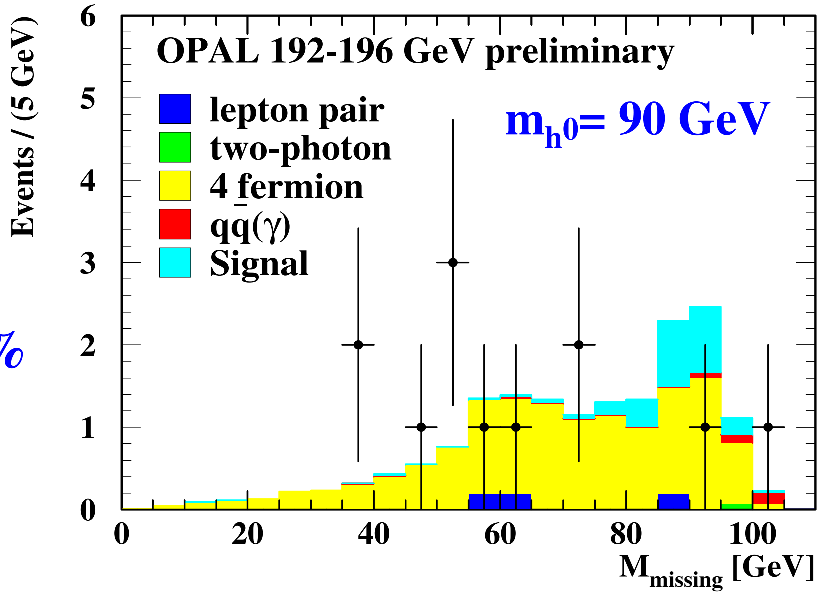
$N^{bkg} = 14.2 \pm 0.3 \pm 1.4$

No excess

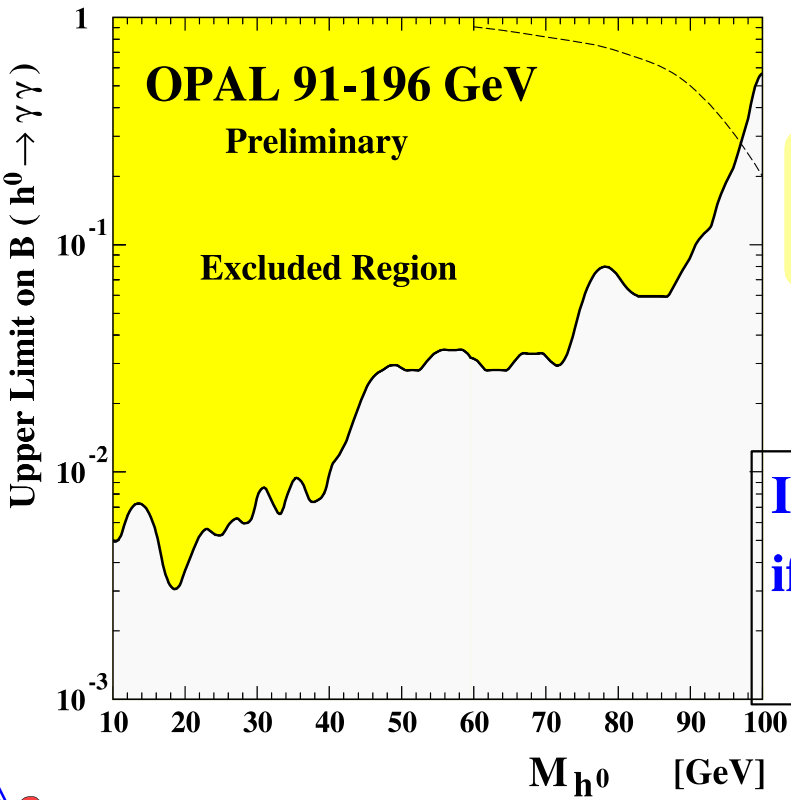
If Br($h^0 \rightarrow$invisible)=100%

and if σ_{SM} :

$m_{h^0} > 91.8$ GeV



$e^+e^- \rightarrow h^0 Z^0$ $\quad$ $h^0 \rightarrow \gamma\gamma$



$N^{obs} = 4$

$N^{bkg} = 6.9 \pm 0.4 \pm 0.4$

No excess

In bosonic Higgs models,

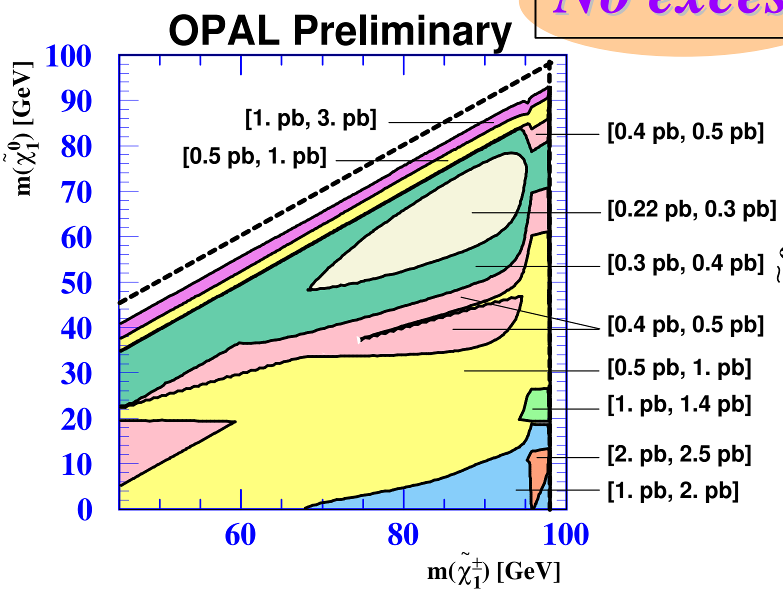
if σ_{SM} :

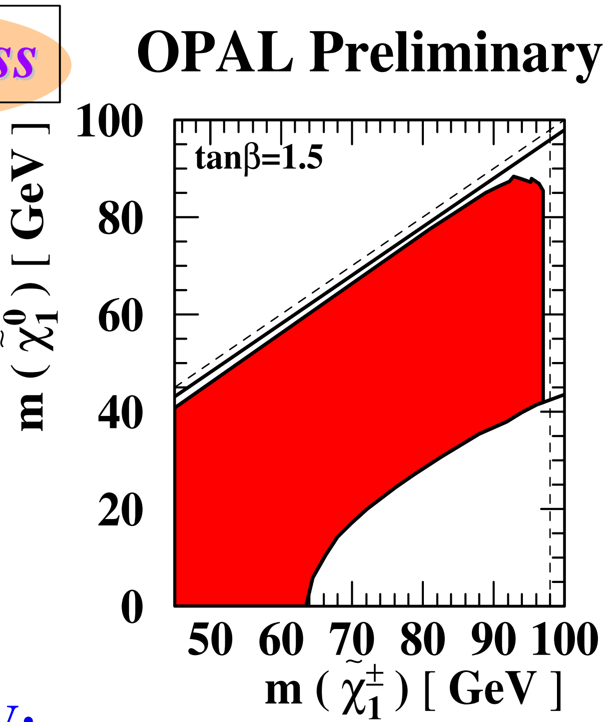
$m_{h^0} > 96.6$ GeV

SUSY particles: gauginos

$e^+e^- \rightarrow \tilde{\chi}_1^+\tilde{\chi}_1^-$ or $\tilde{\chi}_1^0\tilde{\chi}_2^0$ with R-parity conservation

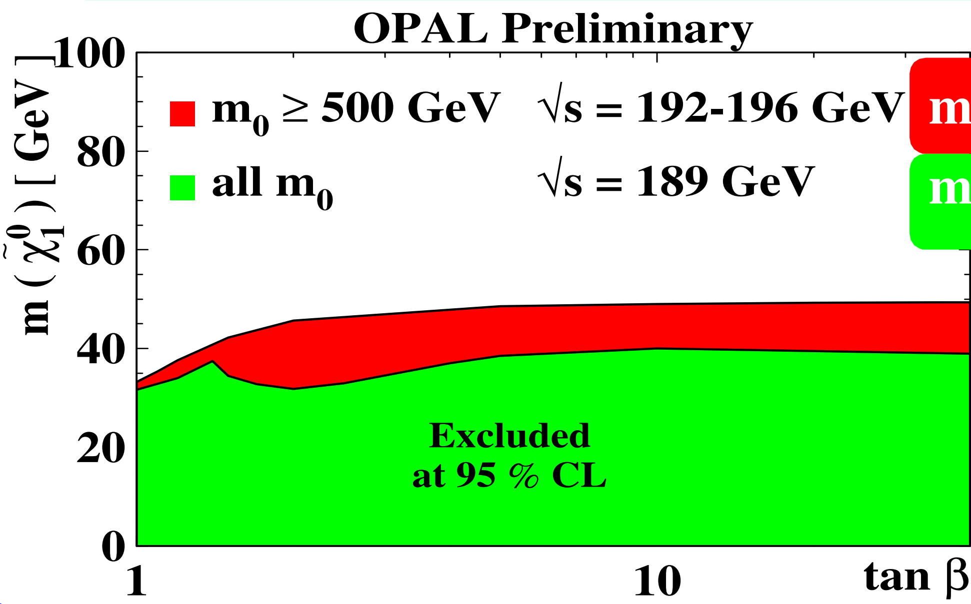
No excess





For $\Delta m > 10$ GeV, $m_0 \geq 500$ GeV:

	$tg\ \beta = 1.5$	$tg\ \beta = 35$
$m\ \tilde{\chi}_1^\pm >$	96.9 GeV	96.7 GeV
$m\ \tilde{\chi}_2^0 >$	71.6 GeV	97.0 GeV

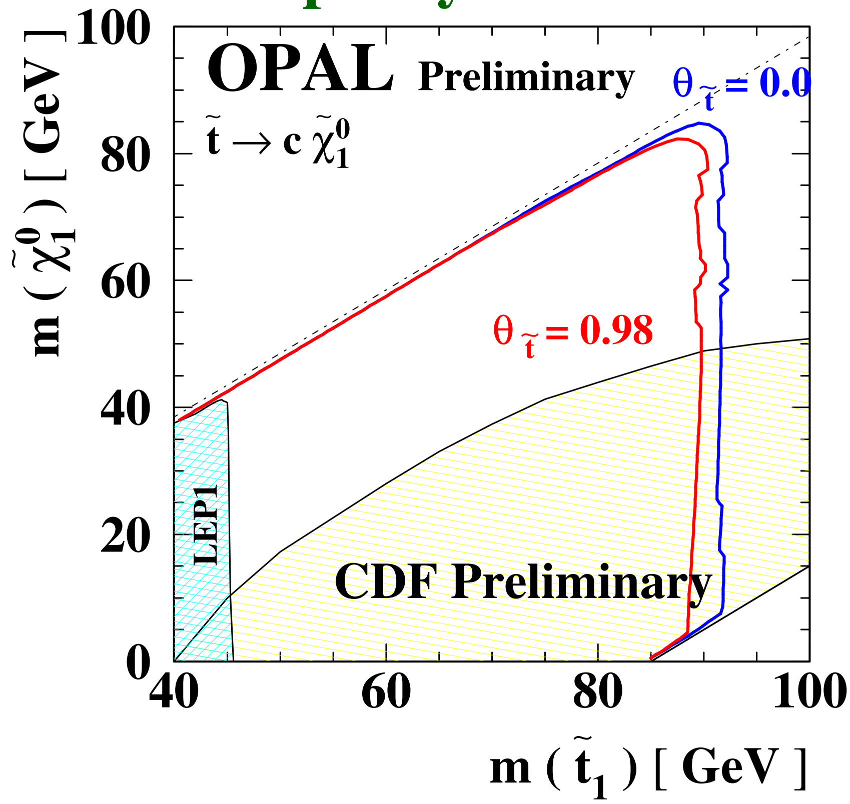


$m_{\tilde{\chi}_1^0} > 34.5$ GeV

$m_{\tilde{\chi}_1^0} > 31.6$ GeV

SUSY particles: sfermions

$e^+e^- \rightarrow \tilde{t}\,\tilde{t}$ or $\tilde{b}\,\tilde{b}$ with R-parity conservation



No excess

For $\Delta m > 10$ GeV:

		no mixing	minimal σ
$\tilde{t}_1 \rightarrow c\,\tilde{\chi}^0_1$	$m_{\tilde{t}} >$	91.5 GeV	89.3 GeV
$\tilde{t}_1 \rightarrow b\,l\,\tilde{\nu}$	$m_{\tilde{t}} >$	91.4 GeV	89.2 GeV
$\tilde{b}_1 \rightarrow b\,\tilde{\chi}^0_1$	$m_{\tilde{b}} >$	90.8 GeV	75.0 GeV

$e^+e^- \rightarrow \tilde{l}\,\tilde{l}$ with R-parity conservation

$N^{obs} = 79$

$N^{bkg} = 74.3$

No excess

Consistent with $W\,W \rightarrow l\,\nu\,l\,\nu$

RPV SUSY particles

$e^+e^- \to \tilde{\chi}^+_1\tilde{\chi}^-_1\ ,\ \tilde{\chi}^0_1\tilde{\chi}^0_2\ ,\ \tilde{l}\ \tilde{l}$

direct or indirect decays

λ or λ' couplings

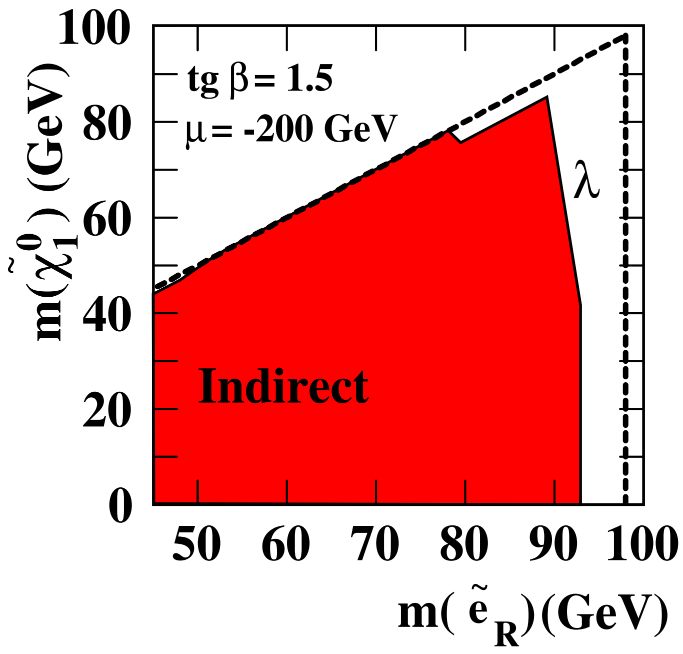
No excess

Limits for $\tilde{e}$, $\tilde{\mu}$, $\tilde{\tau}$

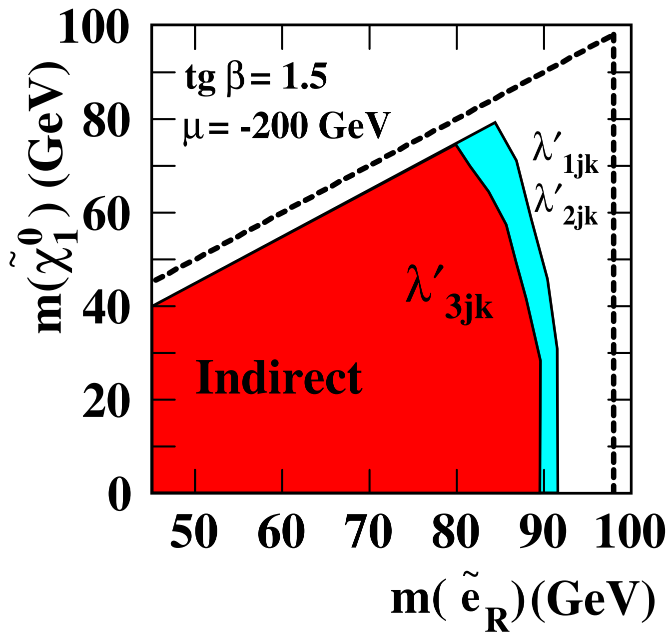
with λ or λ' coupling

indirect decays

OPAL Preliminary



OPAL Preliminary



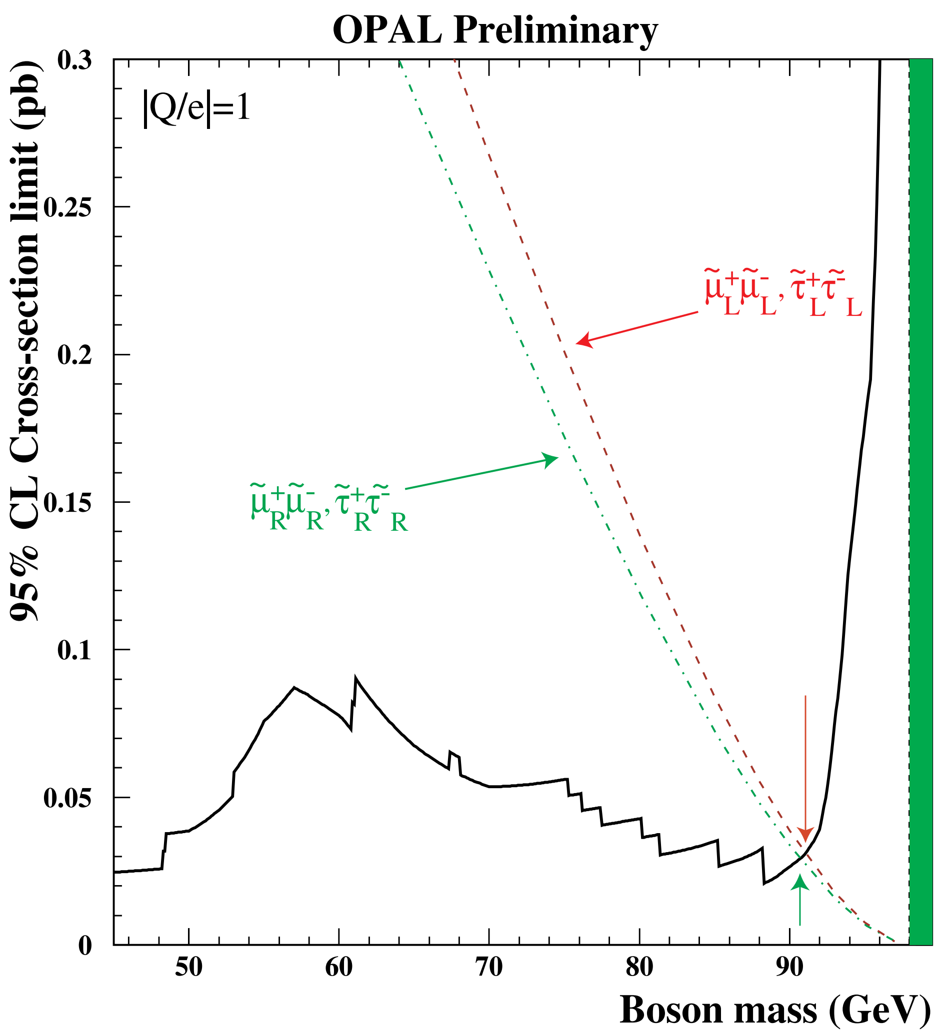
Long-lived massive charged particles

$e^+e^- \rightarrow X^+ \; X^- \, (\gamma)$

$\lvert Q/e \rvert = 1$	$N^{obs} = 2$	$N^{bkg} = 0.82$
$\lvert Q/e \rvert = 2/3$	$N^{obs} = 0$	$N^{bkg} = 0.49$

No excess

For lifetimes > 1 µs:



DESY / University of Hamburg

Heavy neutral and excited leptons

$e^+e^- \rightarrow N\,N \rightarrow e\,W, \mu W, \tau W$

$e^+e^- \rightarrow l^*\,l \rightarrow l^+ l^- \gamma$

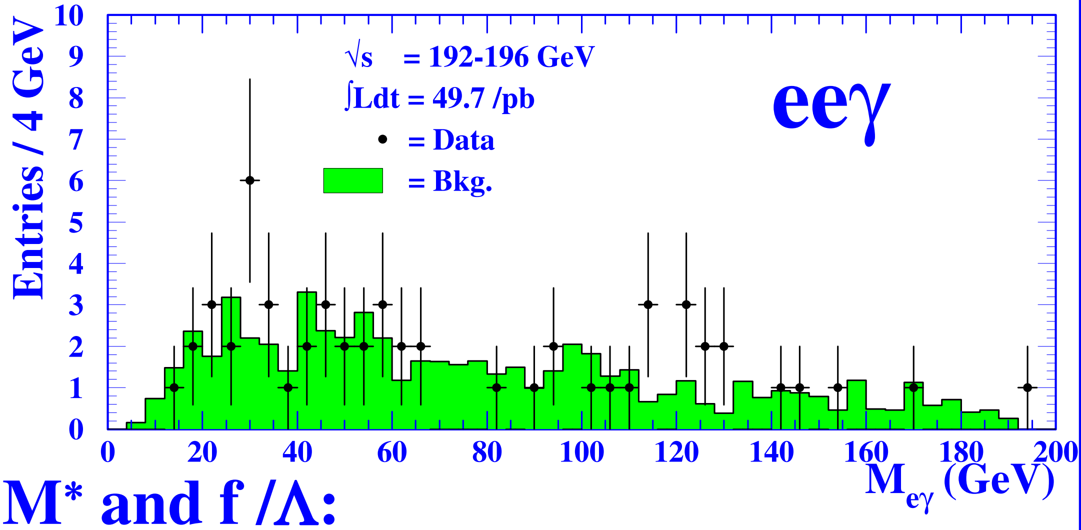
$\rightarrow l^*\,l \rightarrow l\,\nu\,W$

$\rightarrow \nu^*\,\nu \rightarrow l\,\nu\,W$

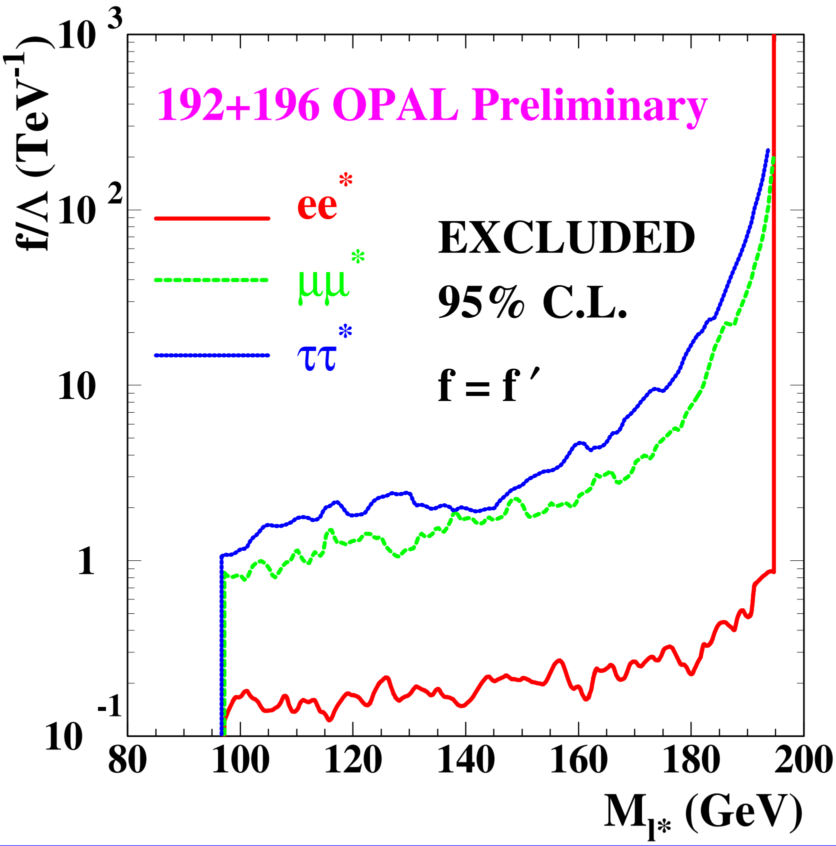
and pair production

No excess

OPAL Preliminary



Limits on M* and f /Λ:

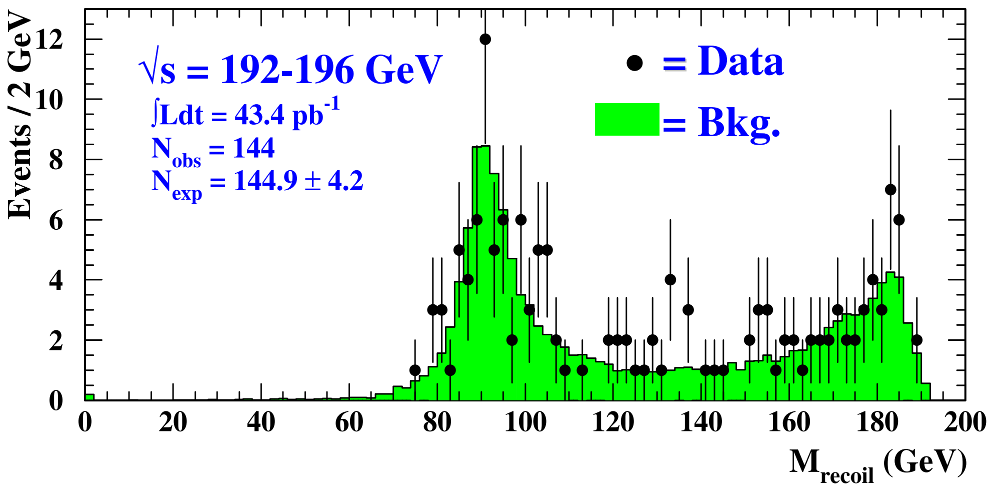


DESY / University of Hamburg

Anomalous photonic events

One or two γ with missing energy

OPAL Preliminary



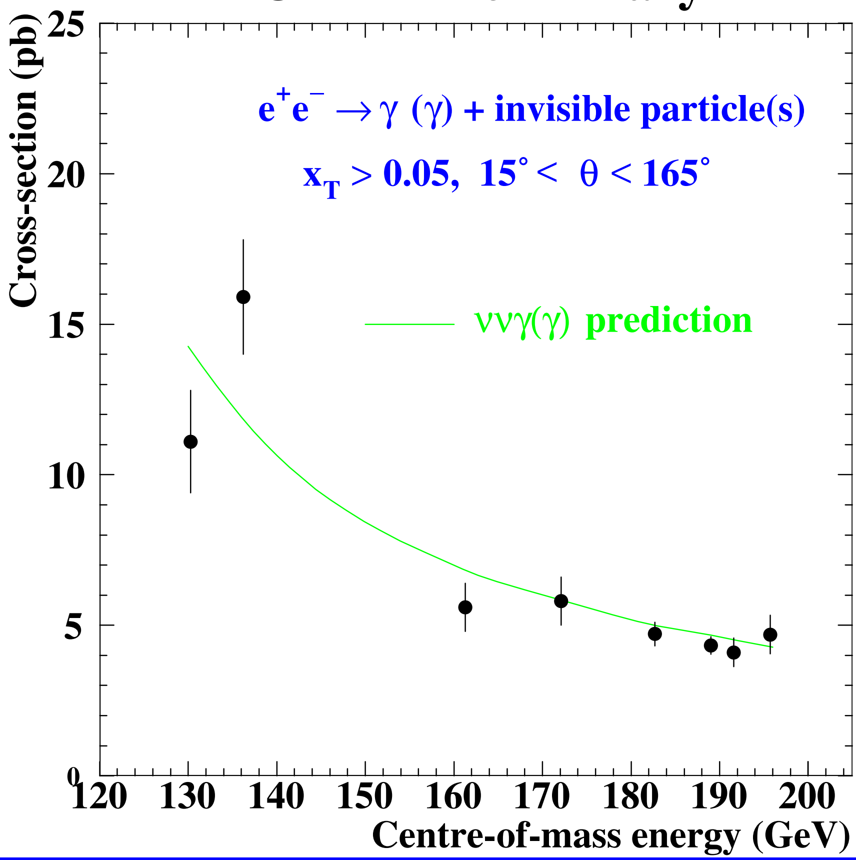
Expected:

$e^+e^- \rightarrow \nu\bar{\nu}\gamma(\gamma)$

No excess

Single γ	$N^{obs} = 144$	$N^{exp} = 145.9 \pm 4.2$
Acoplanar $\gamma\gamma$	$N^{obs} = 4$	$N^{exp} = 6.2 \pm 0.4$

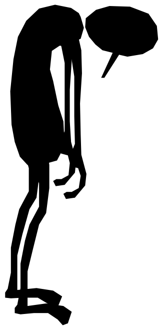
OPAL Preliminary



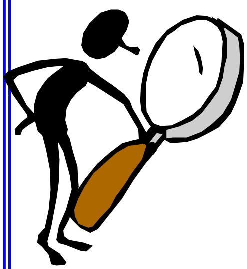
DESY / University of Hamburg

Conclusion

Any sign of New Physics in the 1999 OPAL data?



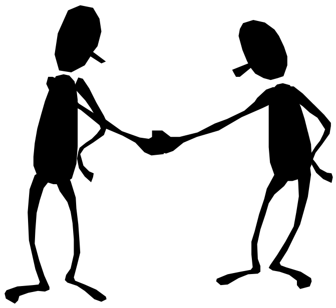
No evidence has been found yet… unfortunately

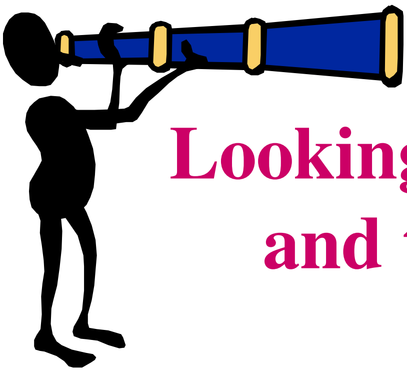


A wide variety of new particles searched for:

Limits have been extended

Successful operation of both LEP and OPAL





Looking forward to more luminosity and then higher energies (200 GeV)

The results presented here can be found in:
http://www.cern.ch/Opal/pubs/physnote/html/pn398.html
pn405.html