Contents

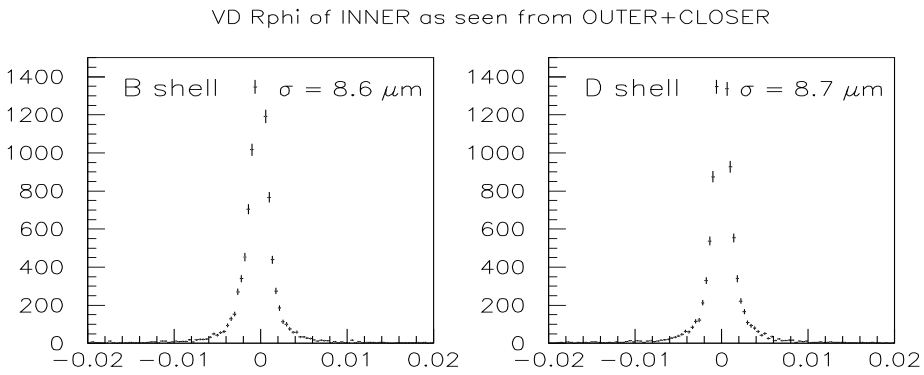
DELPHI Physics results

Presented by Niels Jørgen Kjær
NIKHEF, Amsterdam

- Introduction
- 0-(charged)-fermion final states
- 2-fermion
- 4-fermion
- 6+fermion
- Interpretation
- Outlook and conclusion

DELPHI status and 189 GeV data

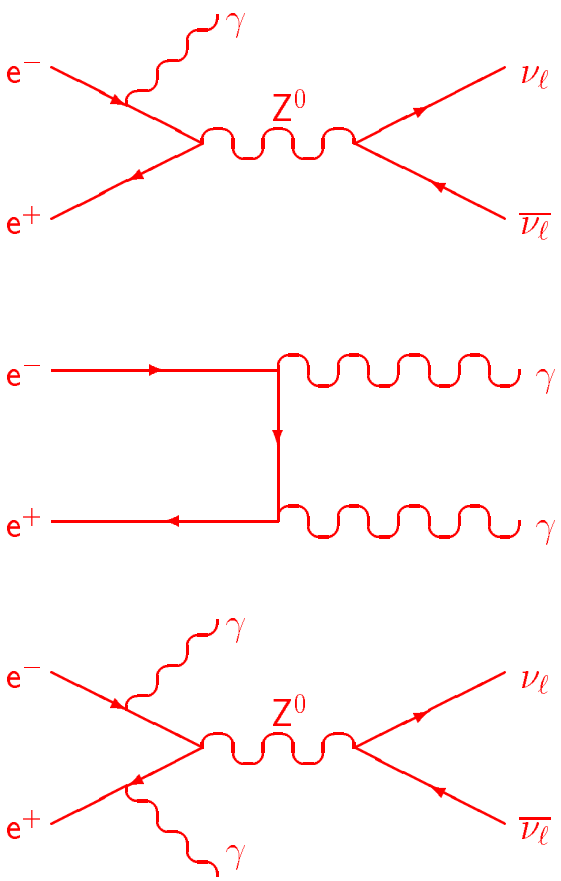
- 158 pb^{-1} collected at $\sqrt{s} = 188.67$ GeV
  - Excellent overall quality:



- All results are preliminary
- All limits at 95% CL.

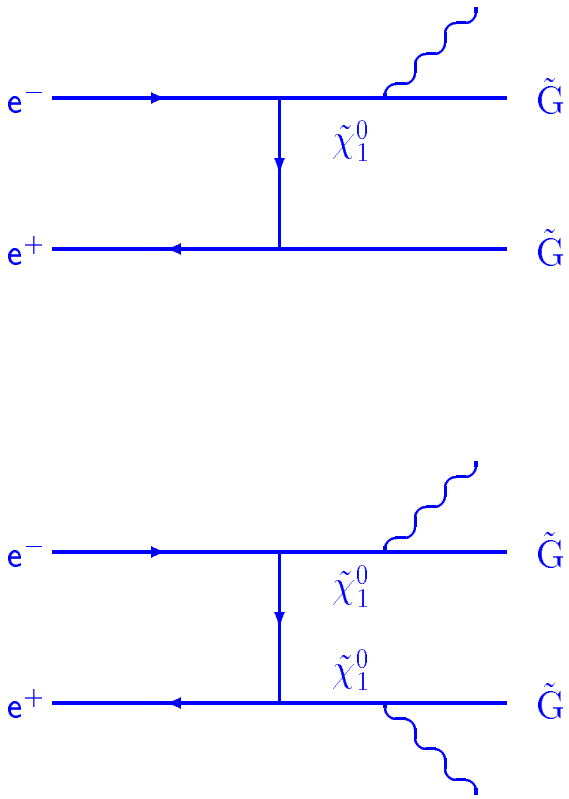
Overview

Standard Model



+ Many more

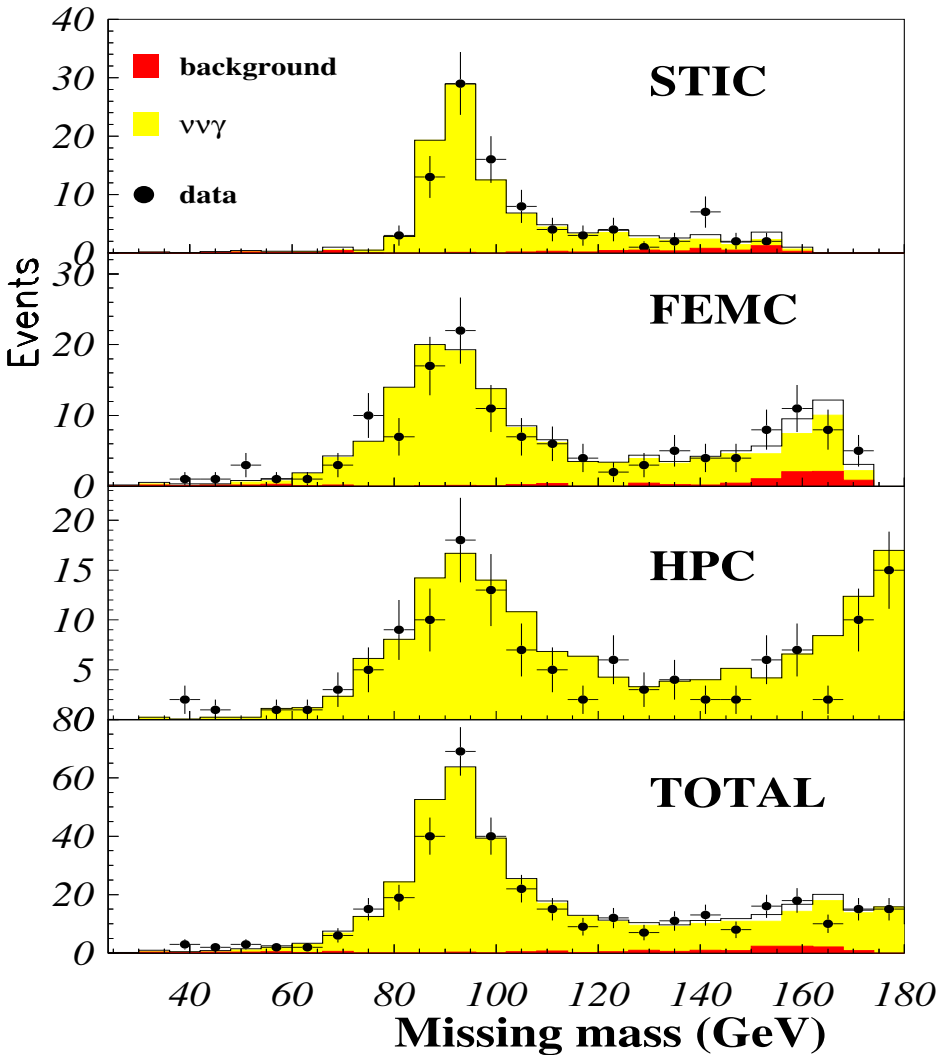
New Physics



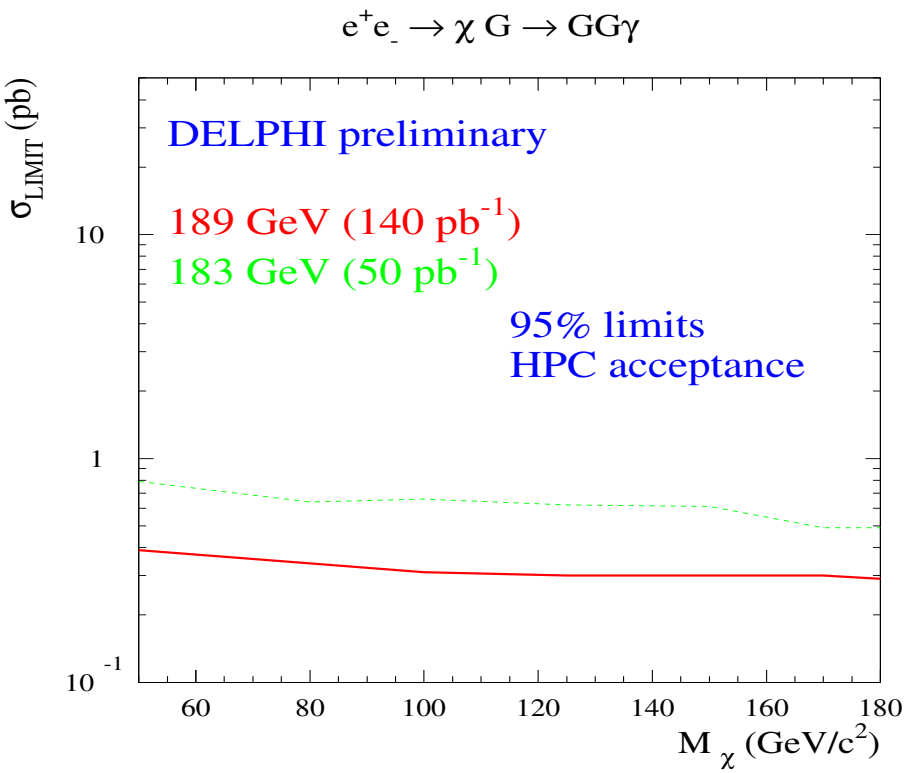
+ Many more

- Extract number of light neutrinos

$$n_\nu = 2.91 \pm 0.13(stat) \pm 0.11(syst)$$

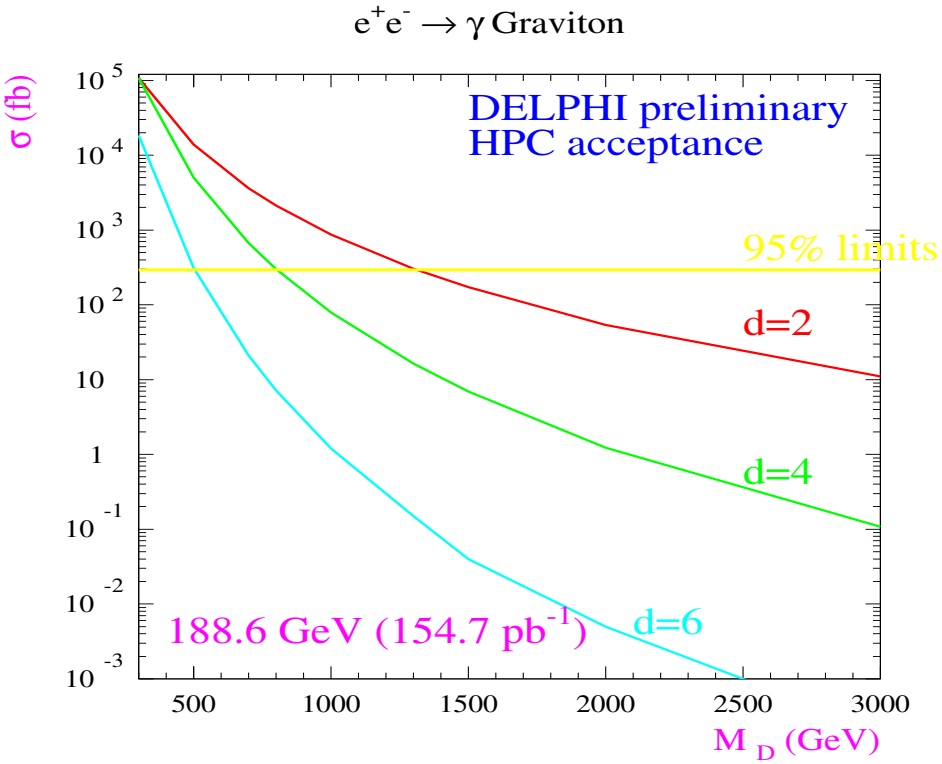


Extract limits on cross-section:



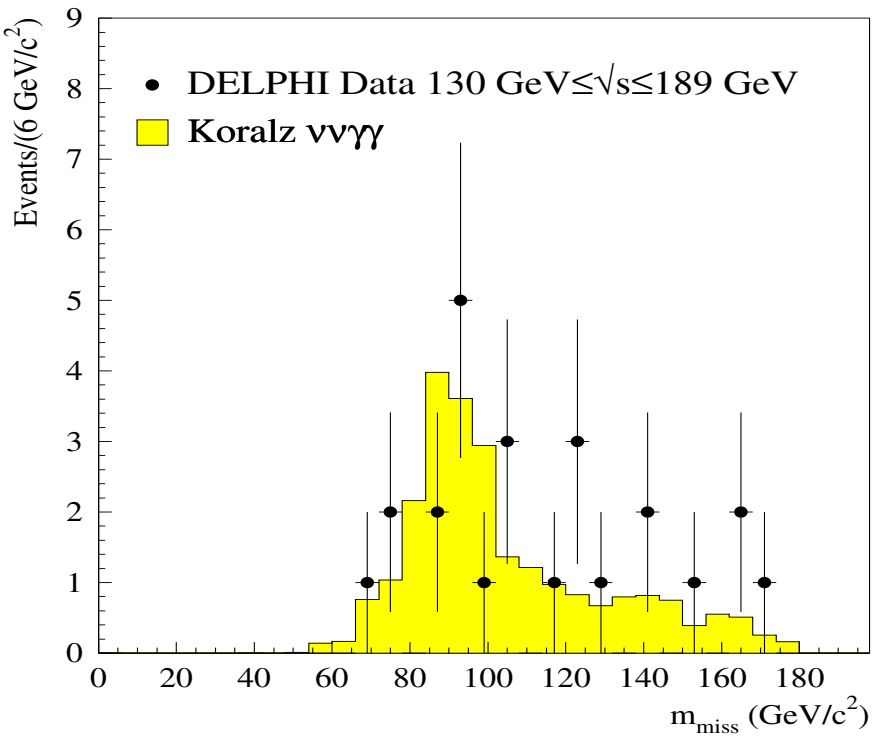
0-fermion: Single gamma

- Cross-section predicted (gravity scale M_D)
- hep-ph/9811337 $E_\gamma > 6$ GeV, Barrel region
- With d=2 extra dimension
  DELPHI data limits the size to 0.4 mm.

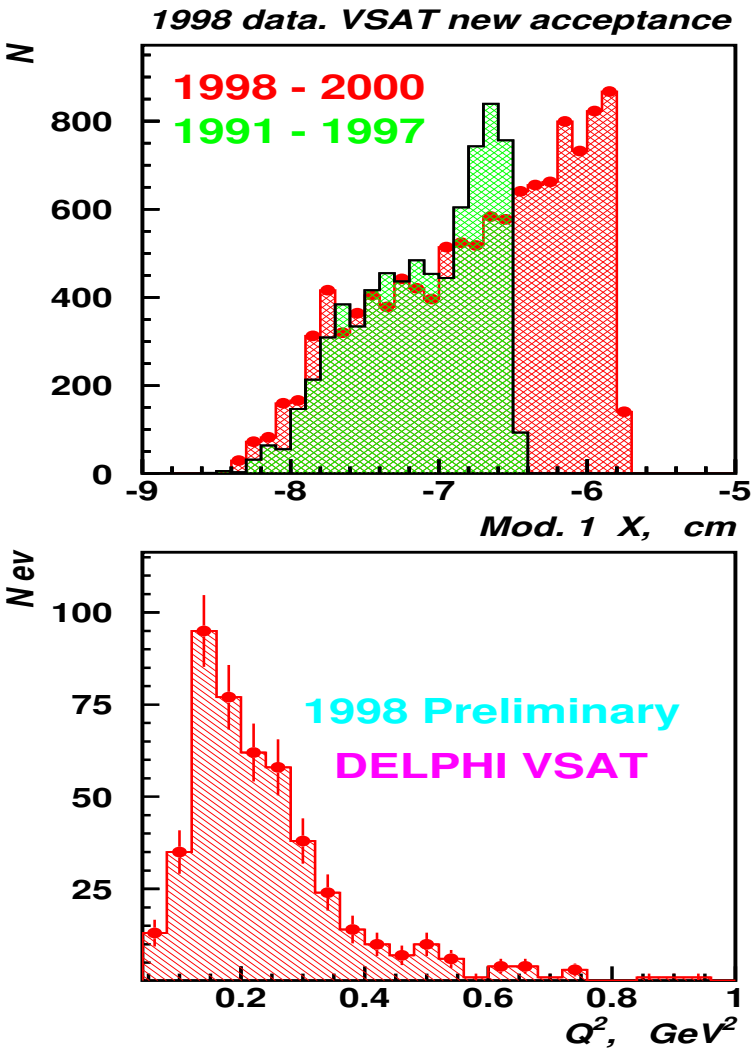


Acoplanar photons

- Dominated by radiative return to the Z^0.

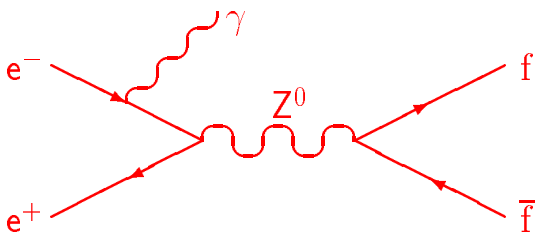


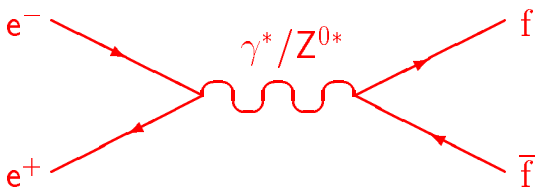
- Improved acceptance for single and double tagged events.
- Data are being analysed.



Overview

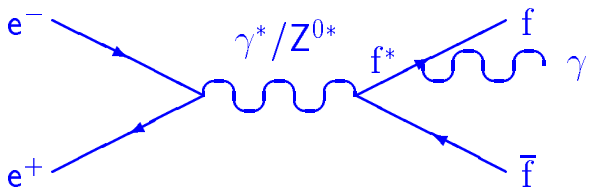
Standard Model

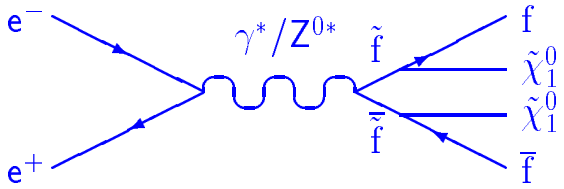


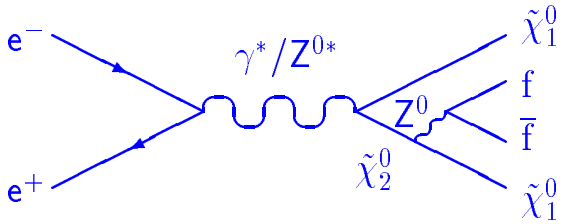


+ Many more

New Physics



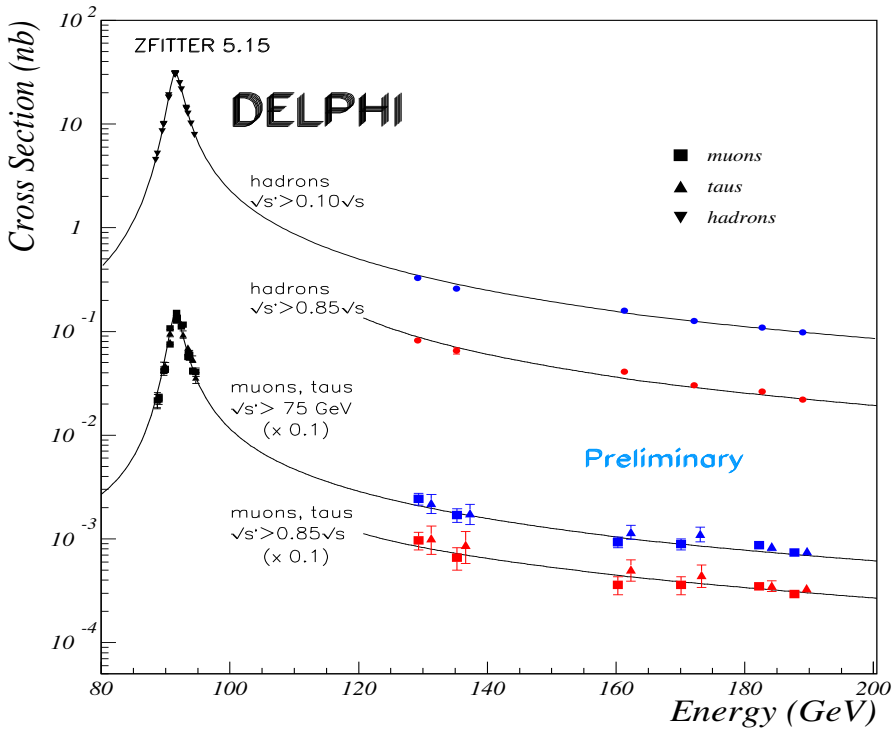




+ Many more

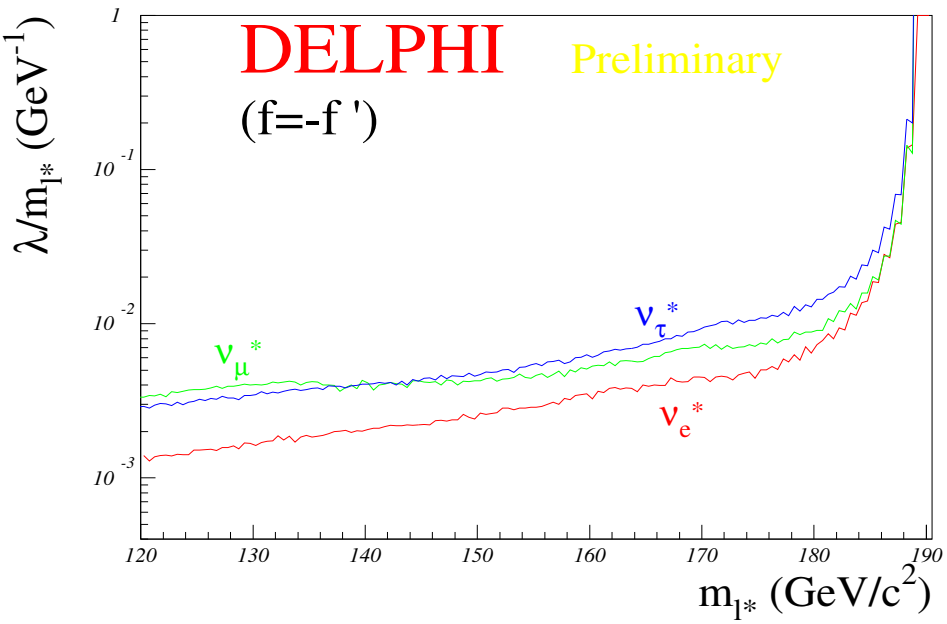
2-fermion Cross-section

- All measurements still in reasonable agreement with Standard Model.
- Abundant limits on new physics



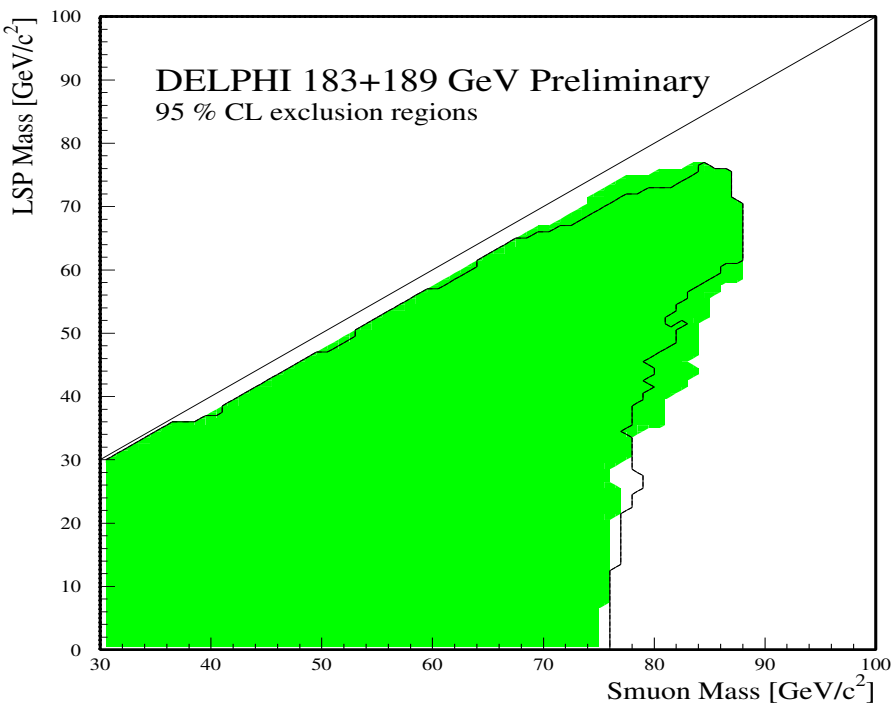
Excited Leptons

- Similar limits on charged leptons (2-fermion) and neutrinos (0-fermion):



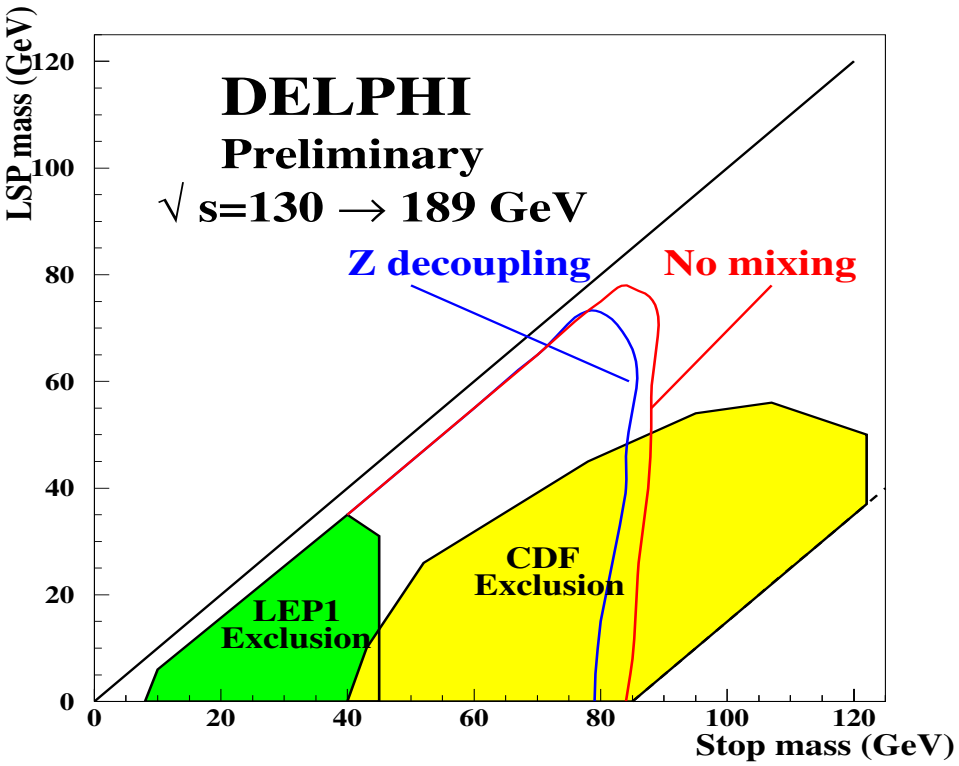
Sleptons

- Limits close to kinematical limit:



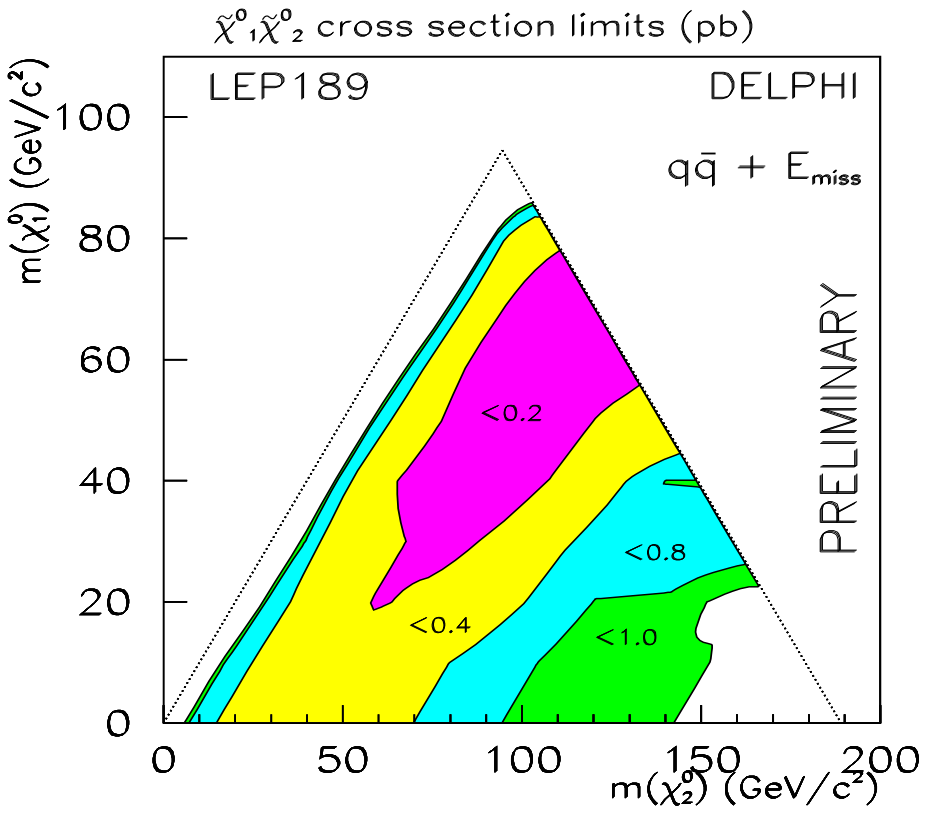
Squarks

- $\tilde{t} \rightarrow \tilde{\chi}^0 c$
- Depends on Mixing



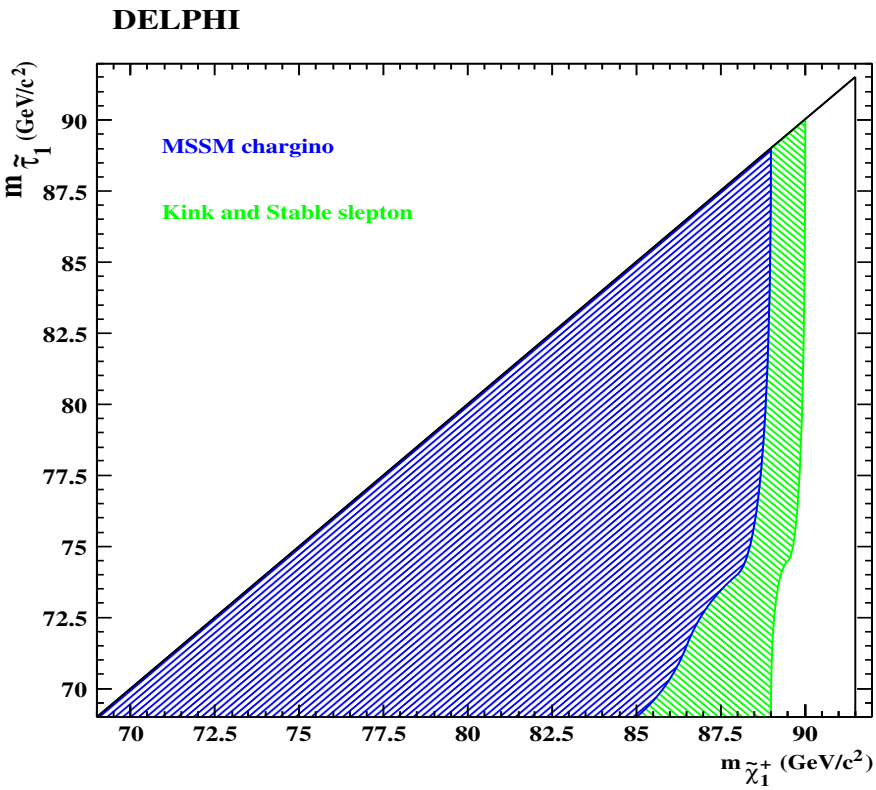
Neutralino

- Dominant mode is $q\bar{q}$ with missing energy:



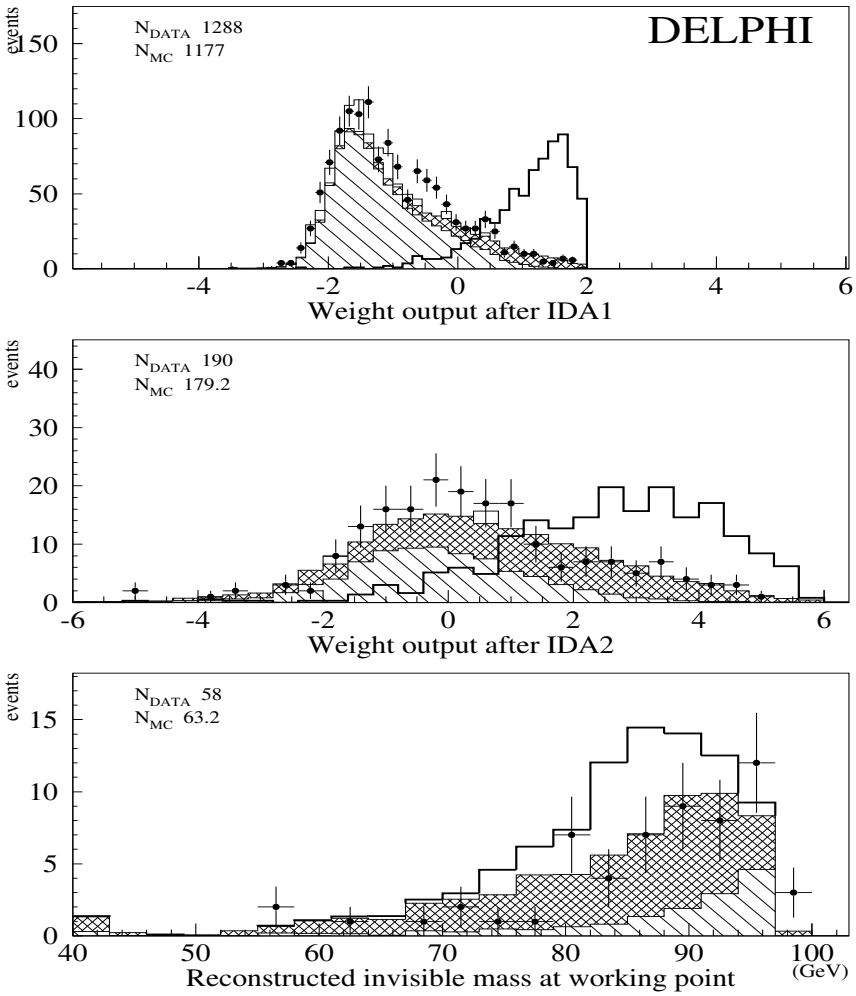
Chargino in GMSB

- Same topology as stau analysis.
- Chargino production (183 GeV)

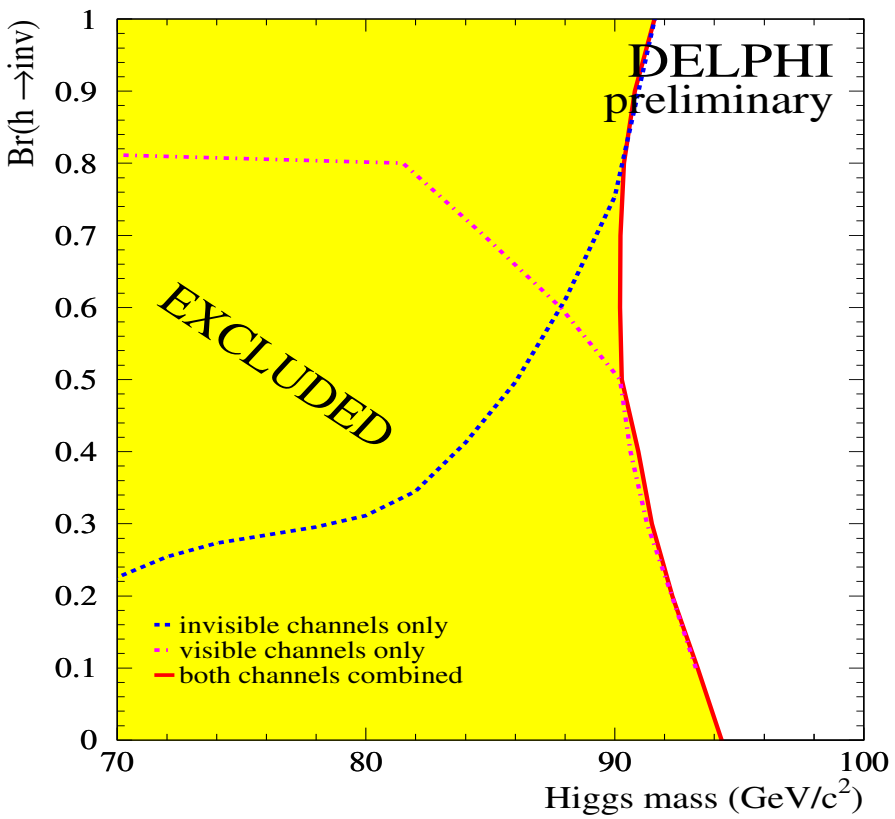


Invisible Higgs

- Light Higgs ⇒ SUSY ⇒ ?
- Analysis analogous to Higgs search without b-tag

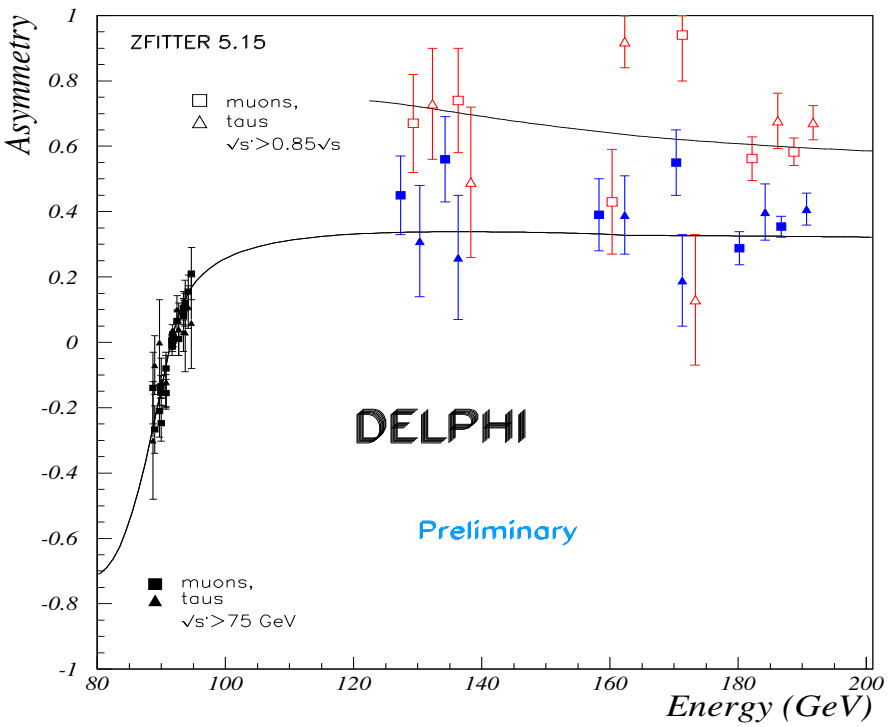


- Assuming SM Higgs cross-section.
- Lower invisible Higgs limit: 91.6 GeV/c^2.



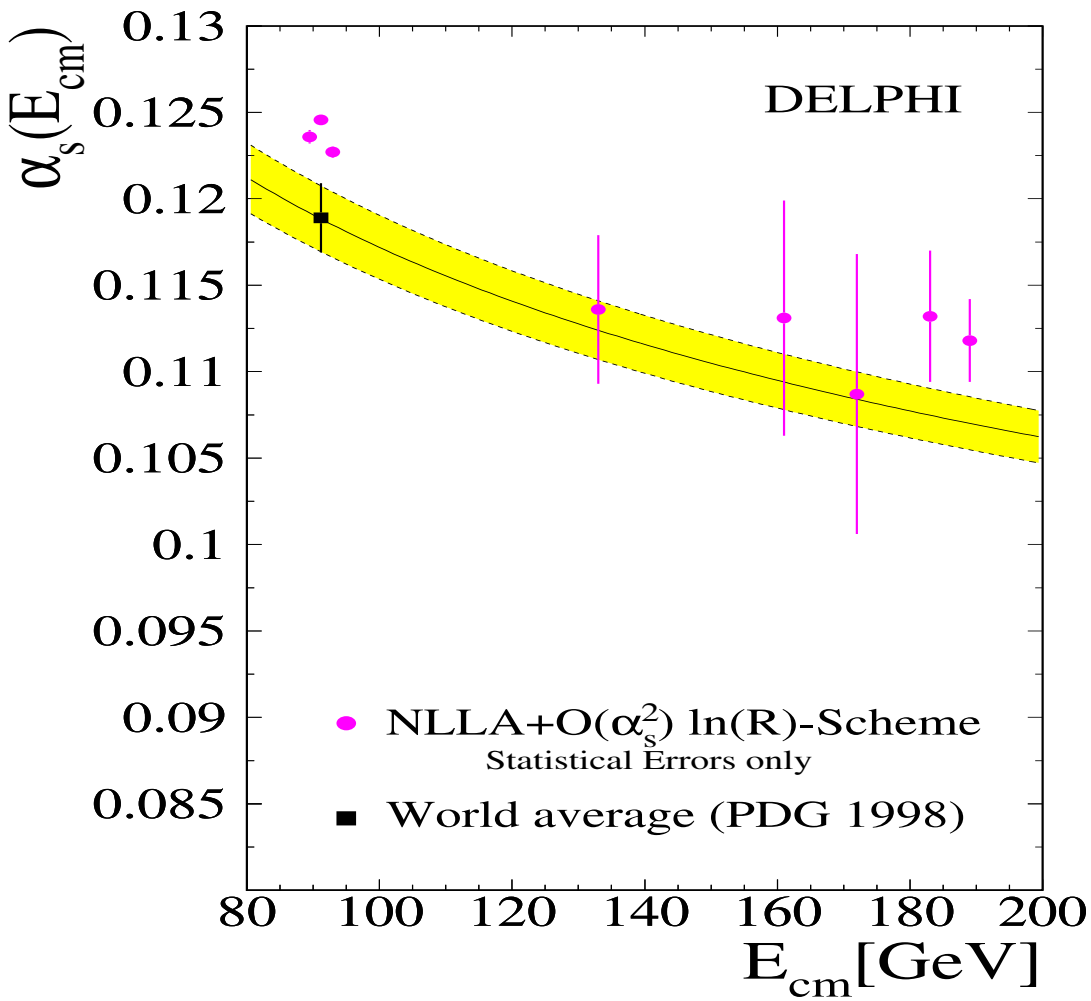
Assymmetries

- Probes SM V-A couplings
- Probes new physics
- Good new agreement without new physics.



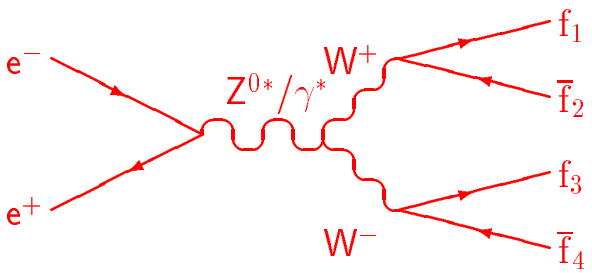
Running of α_S

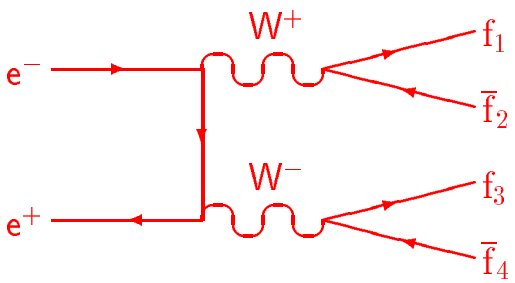
- Still large overall systematic uncertainty
- Small uncertainty on running

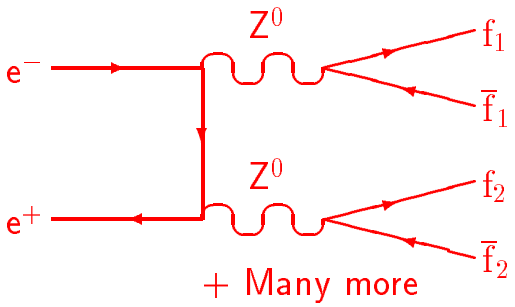


Overview

Standard Model

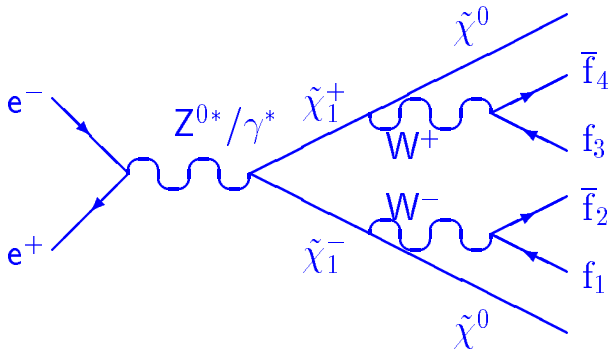


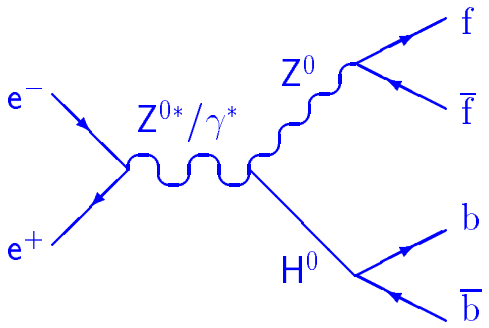




+ Many more

New Physics



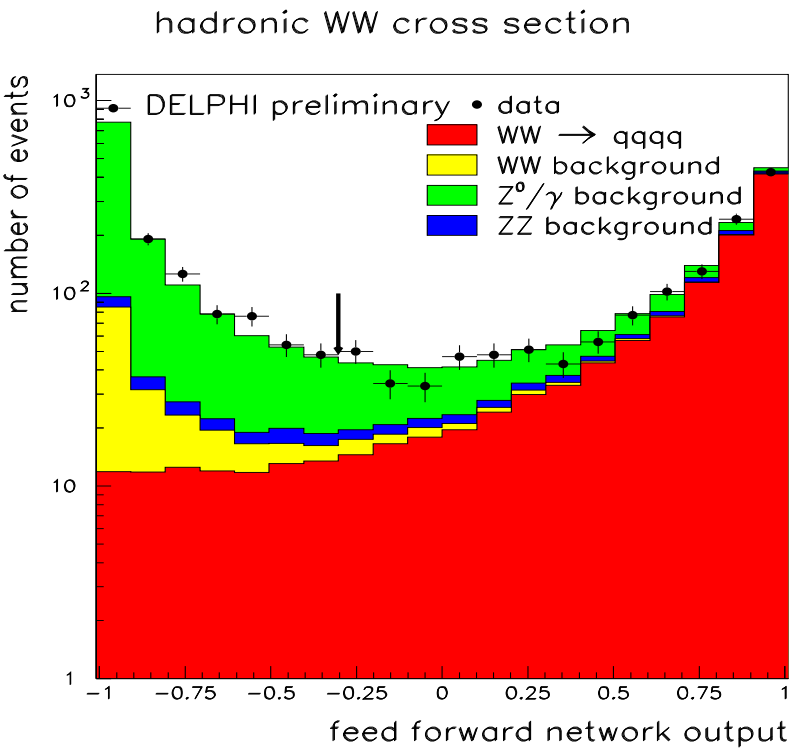


+ Many more

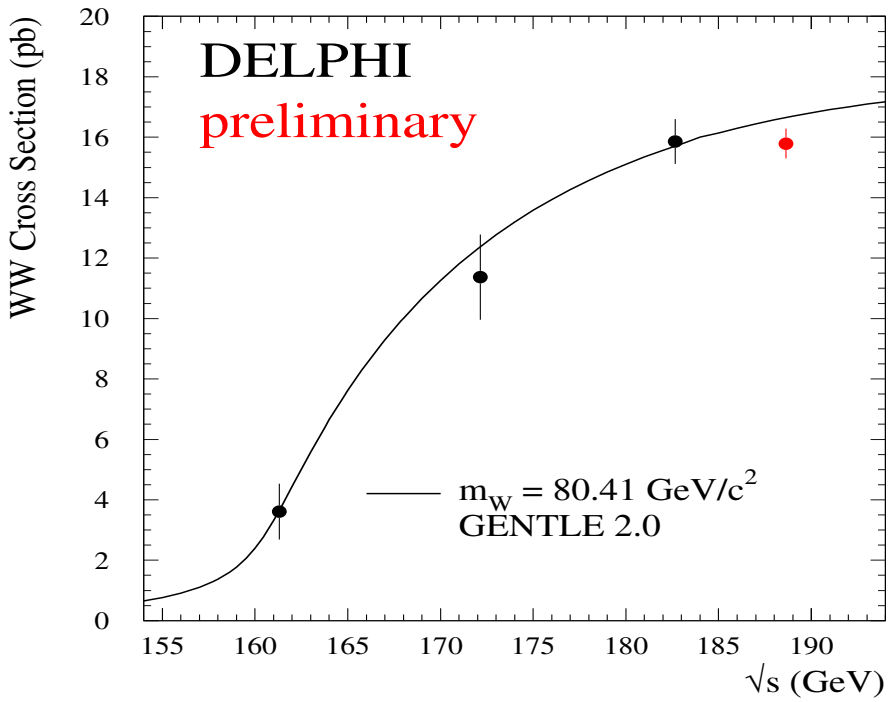
WW cross-section

- Similar analyses as previously
- New neural network hadronic analysis
- Conservative estimation of systematic errors

Chann	eff.	bckg [pb]	events	$\sigma \times$ BR[pb]
qqqq	90.2 $\pm$ 1.4%	2.06 $\pm$ 0.10	1340	7.37 $\pm$ 0.26(stat) $\pm$ 0.24(syst)
qq$\ell\nu$	75.4 $\pm$ 1.4%	0.81 $\pm$ 0.06	906	6.72 $\pm$ 0.26(stat) $\pm$ 0.15(syst)
$\ell\nu\ell\nu$	63.4 $\pm$ 2.3%	0.16 $\pm$ 0.02	188	1.68 $\pm$ 0.14(stat) $\pm$ 0.07(syst)

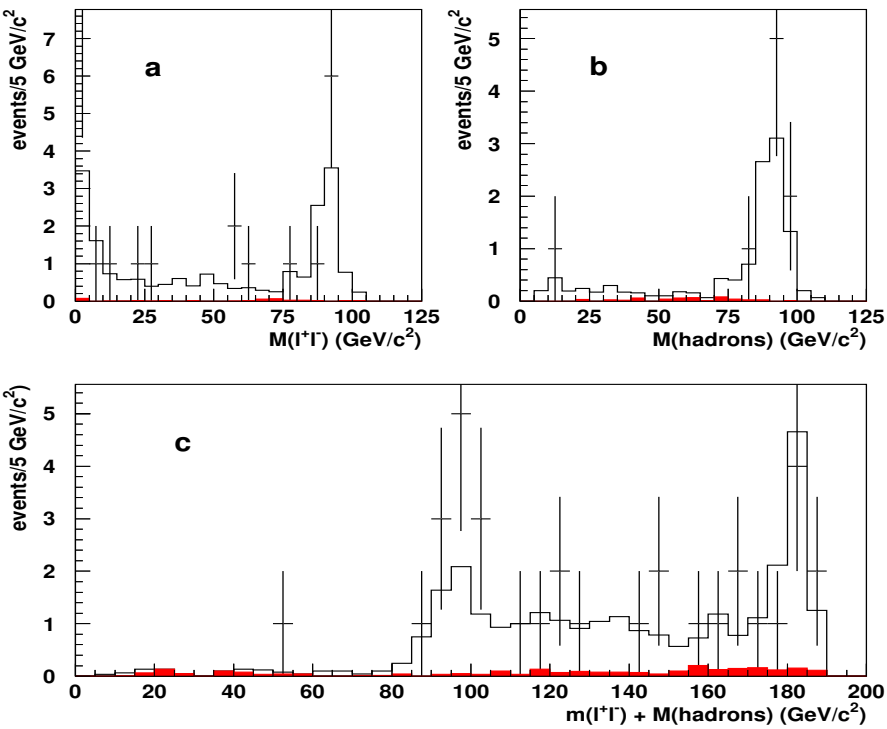


- Branching Fractions (all LEP2 data):
  - BF(W $\rightarrow$ eν) = 0.1011 $\pm$ 0.0062 (stat) $\pm$ 0.0028 (syst)
  - BF(W $\rightarrow \mu\nu$) = 0.1067 $\pm$ 0.0055 (stat) $\pm$ 0.0022 (syst)
  - BF(W $\rightarrow \tau\nu$) = 0.1119 $\pm$ 0.0083 (stat) $\pm$ 0.0036 (syst)
  - BF(W $\rightarrow$ hadrons) = 0.6813 $\pm$ 0.0084 (stat) $\pm$ 0.0058 (syst)
- σ_{WW} (188.7 GeV) (CC03)
  $= 15.79 \pm 0.38$ (stat) ± 0.31 (syst) pb



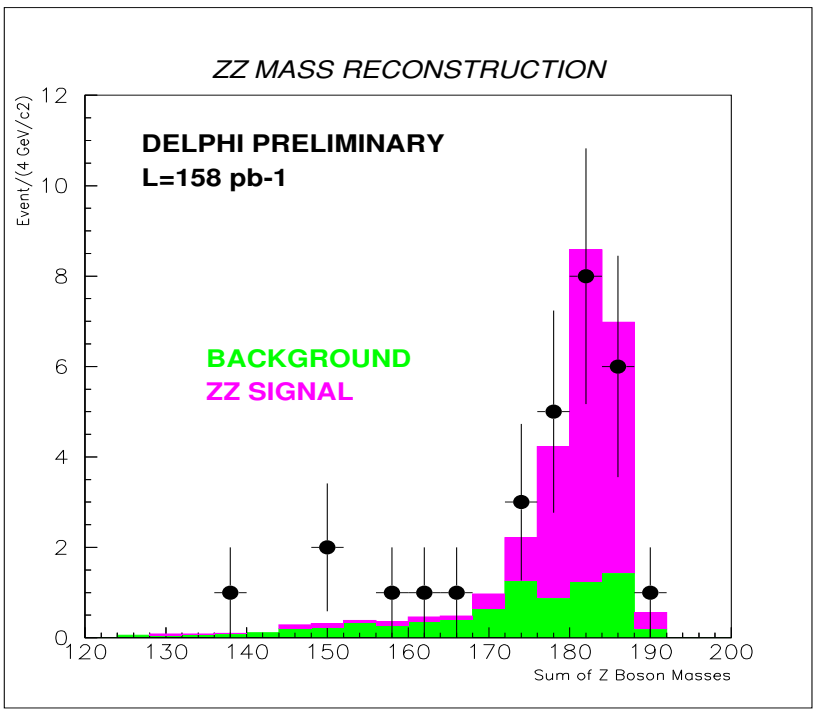
Z^0Z^0 ($Z^0\gamma^*$) production

- $\ell^+\ell^-\ell^+\ell^-$: Low branching ratio.
- $q\bar{q}\ell^+\ell^-$: Clean signal
- $q\bar{q}\nu\bar{\nu}$: Mass information important
- $q_1\bar{q}_1q_2\bar{q}_2$: b-tag necessary



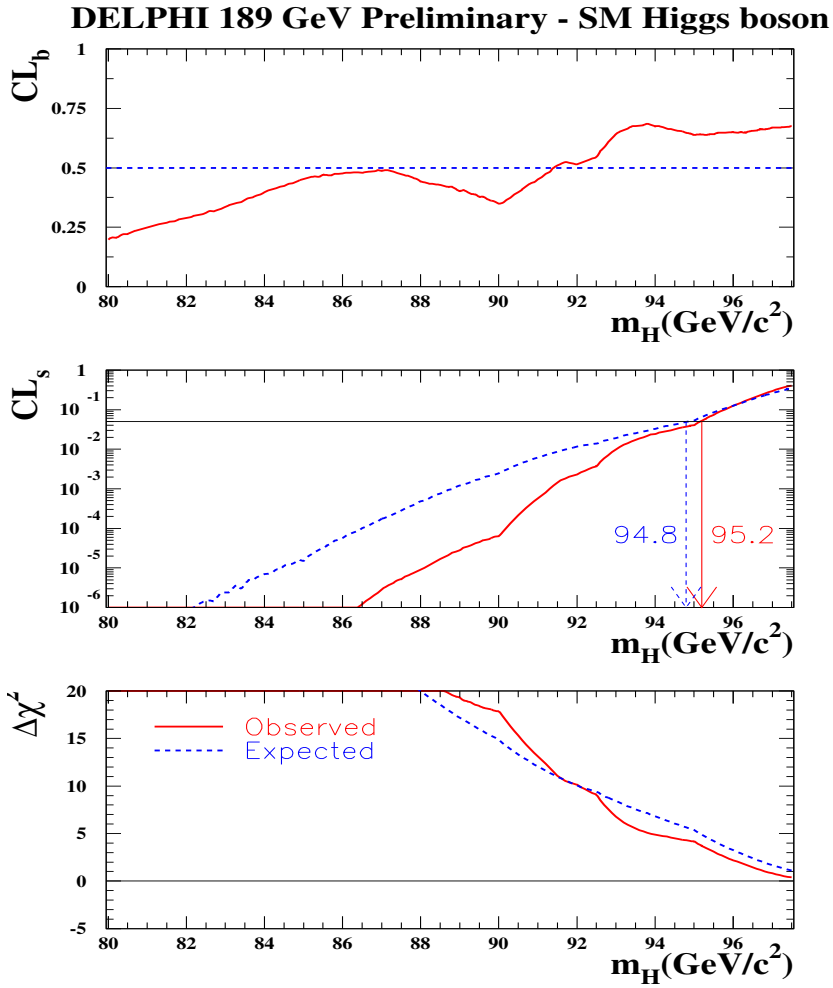
Channel	Data	Signal	Bckg.	R_{NC02}
$\ell^+\ell^-\ell^+\ell^-$	1	0.6	0.3	-
$e^+e^-q\bar{q}$	2	3.7	0.8	0.88
$\mu^+\mu^-q\bar{q}$	6	4.0	0.5	1.05
$\nu\bar{\nu}q\bar{q}$	6	5.7	2.0	1.05
$b\bar{b}q\bar{q}$	6	3.5	1.4	1.14
Total	21	17.5	5.0	-

$$\sigma_{ZZ(NC02)}(188.7\text{GeV}) = 0.58 \pm 0.17\text{pb}(\text{SM} : 0.64\text{pb})$$

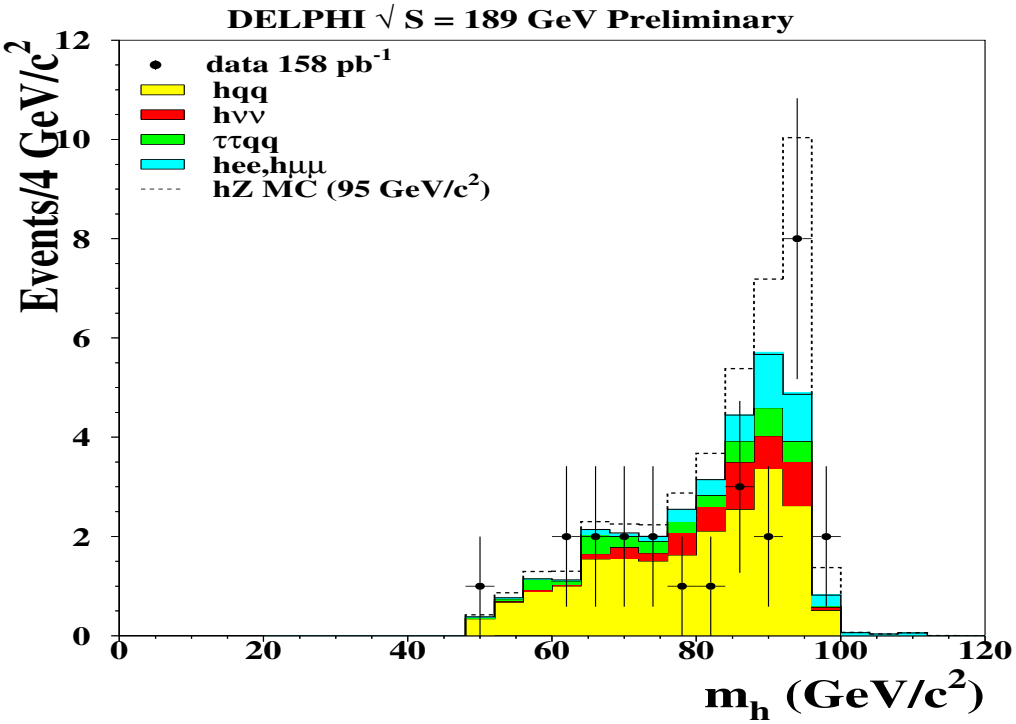


SM Higgs

- Analysis unaltered
- New limits using 2-dimensional mass information

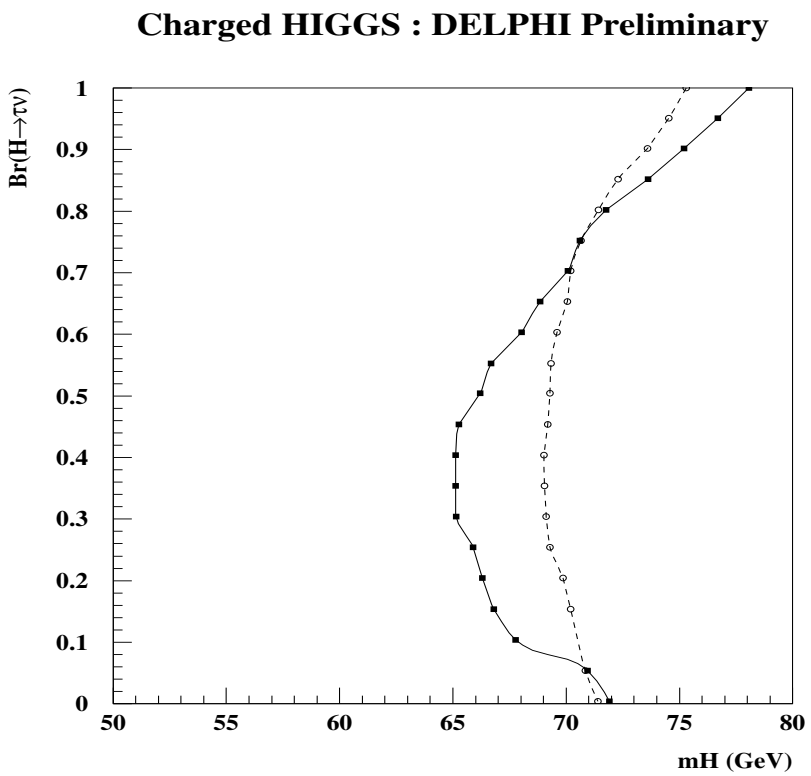


Still good agreement in mass spectrum



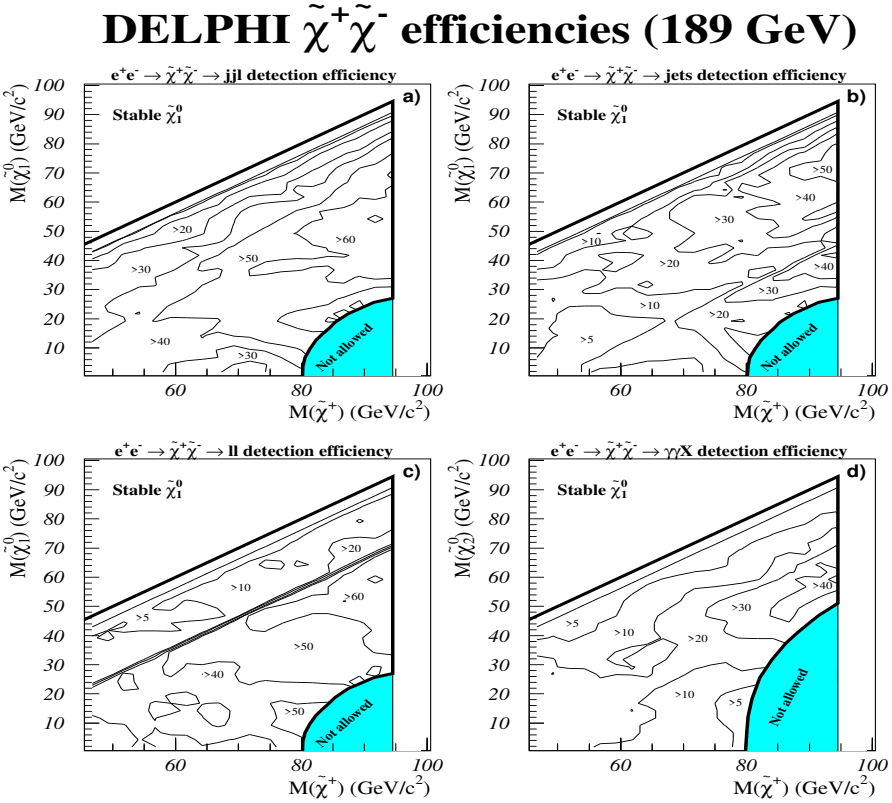
Charged Higgs search

- Probes new heavy objects below m_{W}
- Quark flavour tagging included ($\mathrm{H}^{+} \rightarrow \mathrm{c\bar{s}}$)
- Large WW background
- Open cricles: Expected limit.



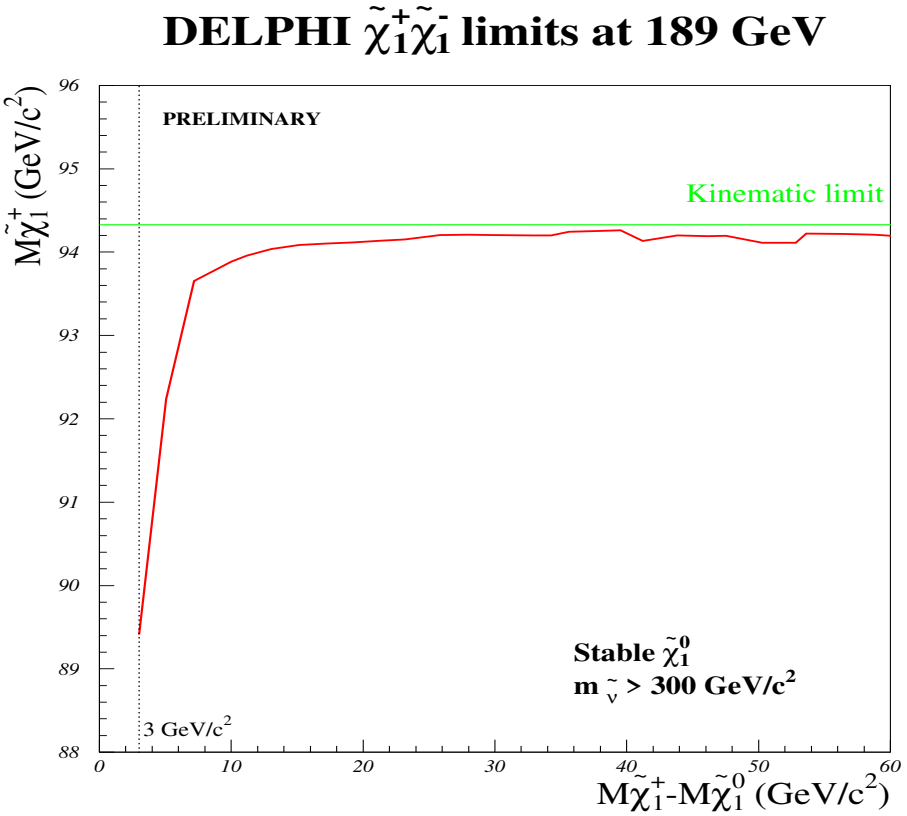
Chargino search

- New probability ratio analysis
- Many $\Delta m = m_{\chi^+} - m_{\chi^0}$ bins
- Better efficiency.

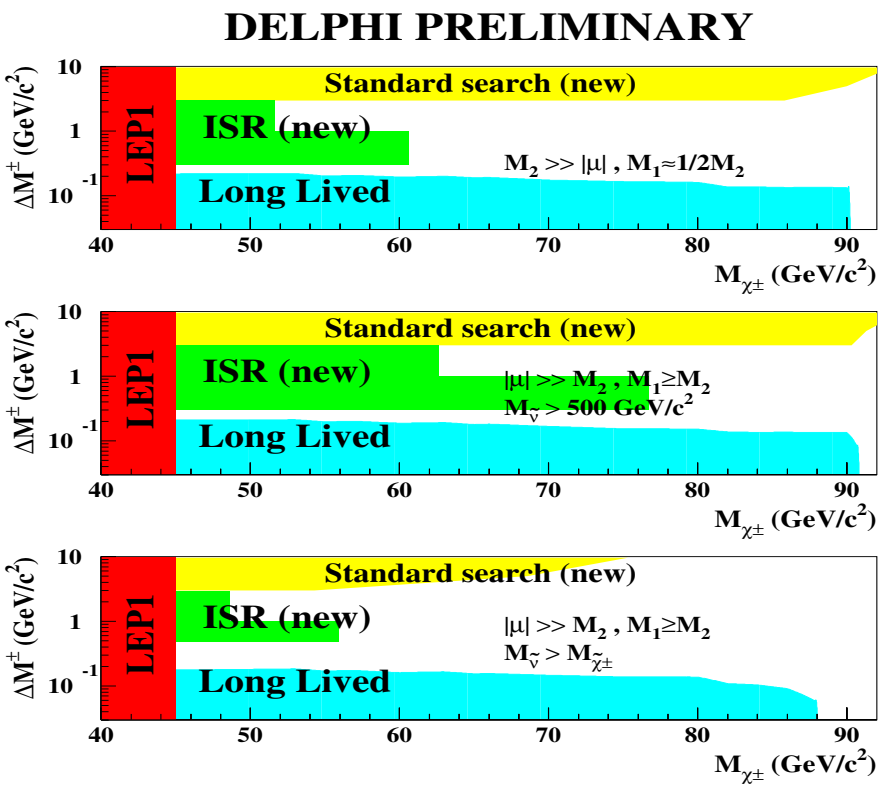


Chargino search

- Large coverage:

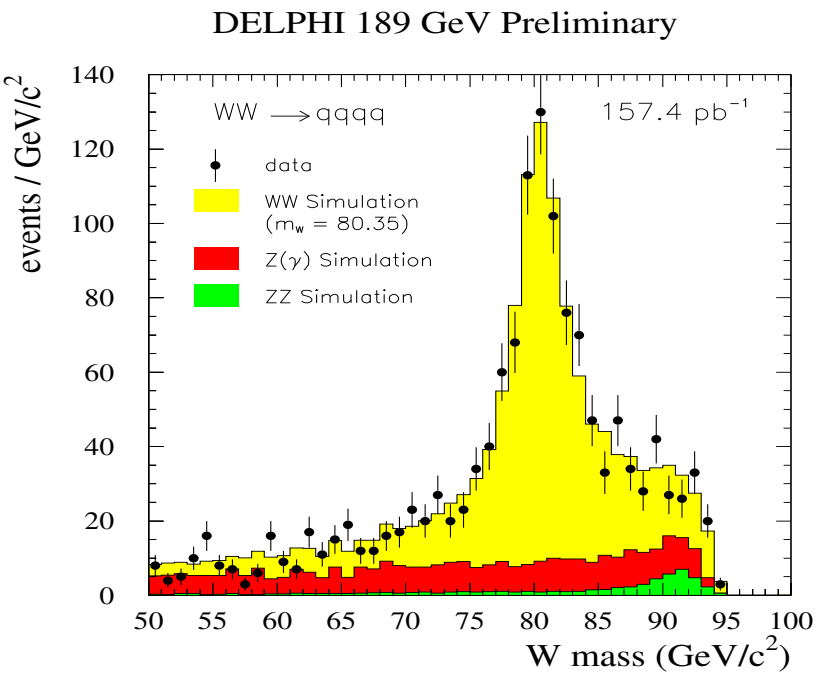


- Low Δ_m region
- Overlapping regions of lifetimes:



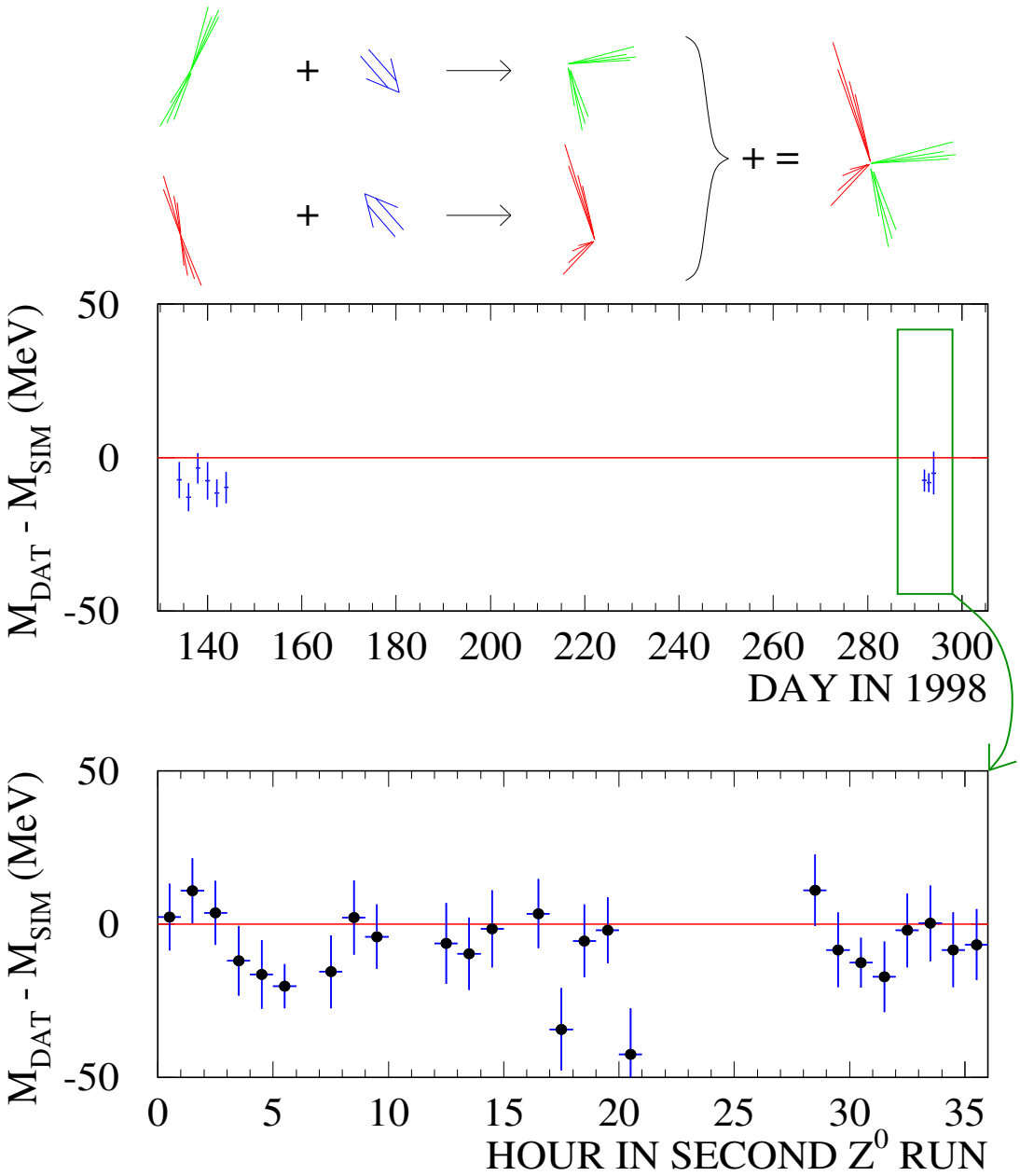
W mass measurement

- Analyses very similar to 183 GeV
- Ideograms
- Calibration curves to correct for bias
- Detector systematics mainly evaluated from Z^0



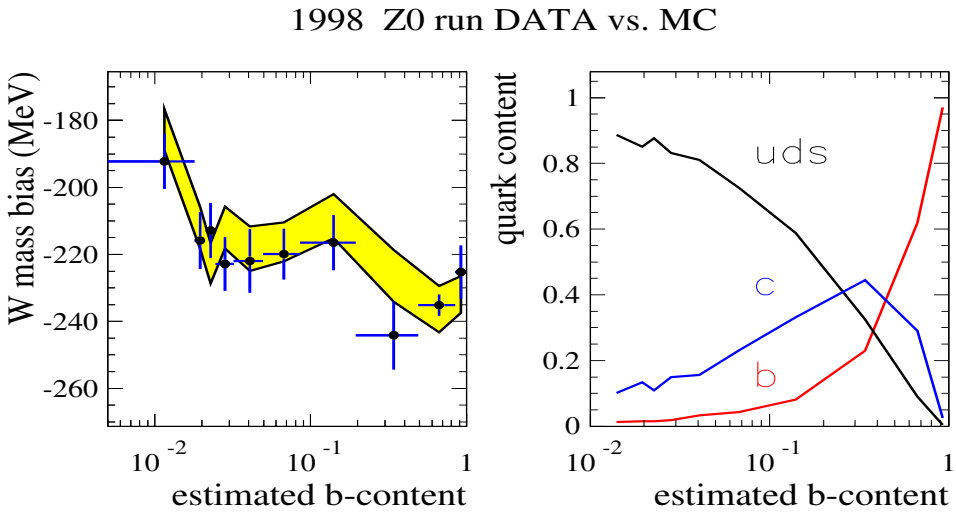
- 189 GeV data
  - 2q: $m_{\mathrm{W}} = 80.163 \pm 0.174(\mathrm{stat}) \pm 0.067(\mathrm{syst})\,\mathrm{GeV}/c^2$
  - 4q: $m_{\mathrm{W}} = 80.477 \pm 0.110(\mathrm{stat}) \pm 0.067(\mathrm{syst})\,\mathrm{GeV}/c^2$
- All LEP2 data
  - 2q: $m_{\mathrm{W}} = 80.297 \pm 0.141(\mathrm{stat}) \pm 0.064(\mathrm{syst})\,\mathrm{GeV}/c^2$
  - 4q: $m_{\mathrm{W}} = 80.367 \pm 0.094(\mathrm{stat}) \pm 0.066(\mathrm{syst})\,\mathrm{GeV}/c^2$
  - 4f: $m_{\mathrm{W}} = 80.342 \pm 0.078(\mathrm{stat}) \pm 0.051(\mathrm{syst})\,\mathrm{GeV}/c^2$
  - $m_{4\mathrm{q}} - m_{2\mathrm{q}} = 0.070 \pm 0.174(\mathrm{stat}+\mathrm{syst}) \pm 0.054(\mathrm{FSI})\,\mathrm{GeV}/c^2$
- Dominant systematics
  - Final State Interactions (4q)
  - Beam energy (LEP energy group)
  - Hadronic system (Fragmentation and detector)

Mixed Lorentz Boosted Z^0 events



MLBZ properties

- MLBZ events are different from WW final states
- Most differences are adequately described by simulation:

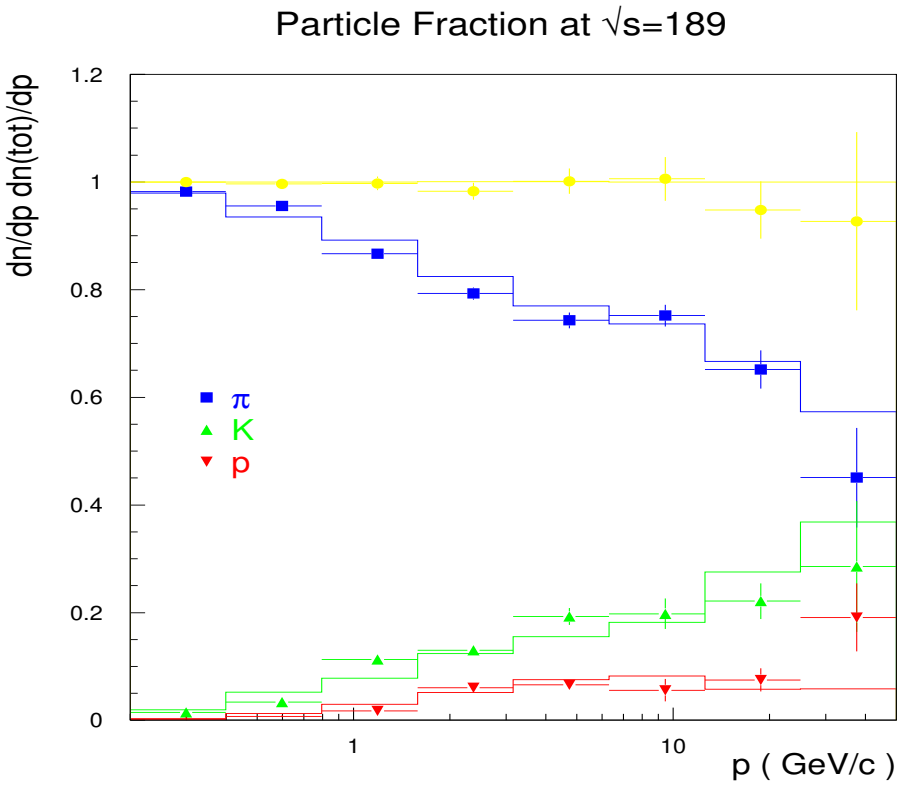


Hadronic W decays

- Comparison between 4q decays and two 2q decays
- Charged multiplicity ratio:

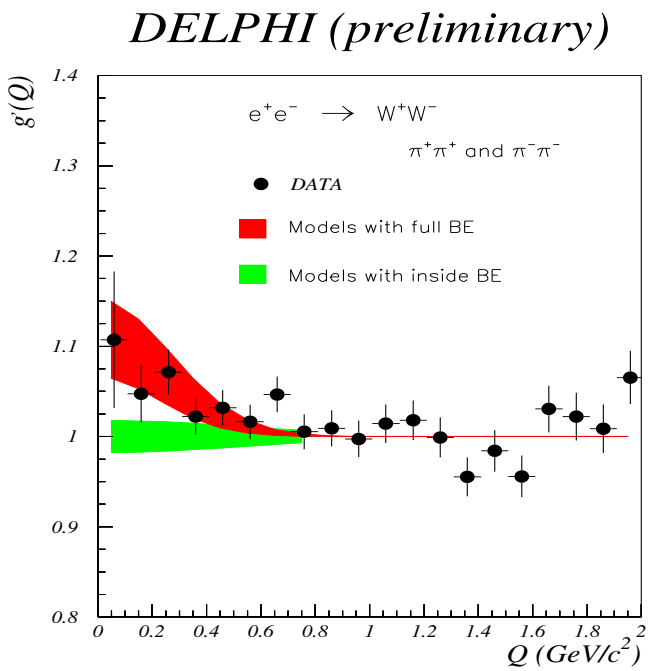
$$\frac{n_{4q}}{2n_{2q}} = 0.977 \pm 0.017 \pm 0.027$$

- Particle content:



Bose-Einstein Correlations

- Substantial systematics for m_{W}
- Well defined quantum mechanical effect
- Difficult simulation
- Less systematics comparing 4q and 2q WW decays

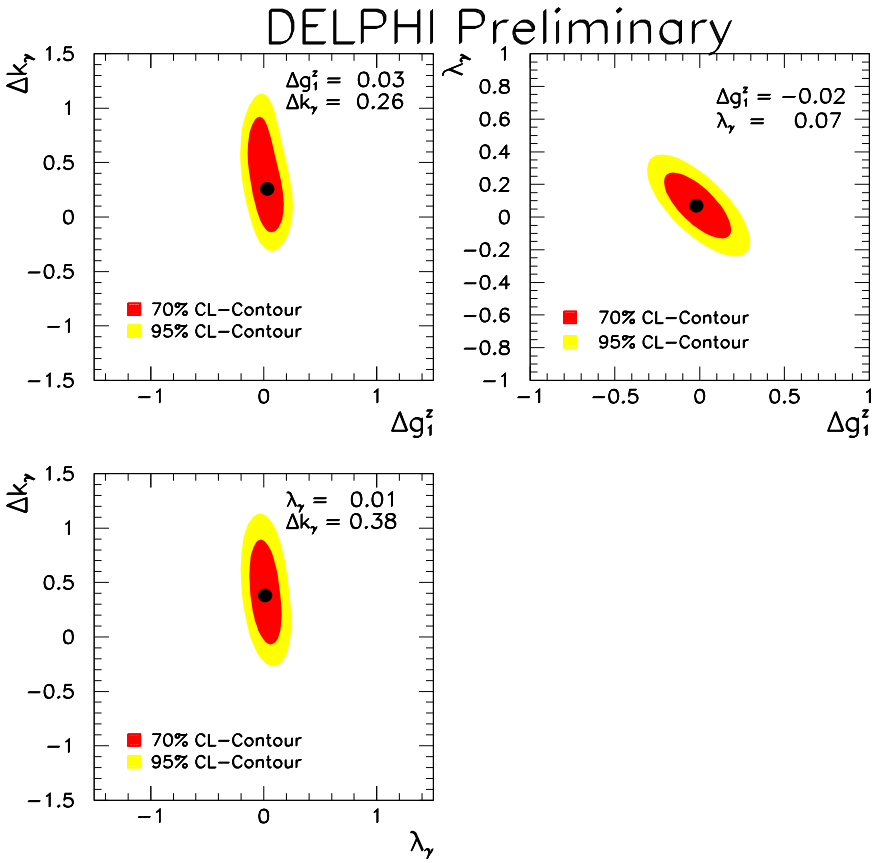


Triple Gauge Couplings

Analysis like at 183 GeV (No single W) Limits:

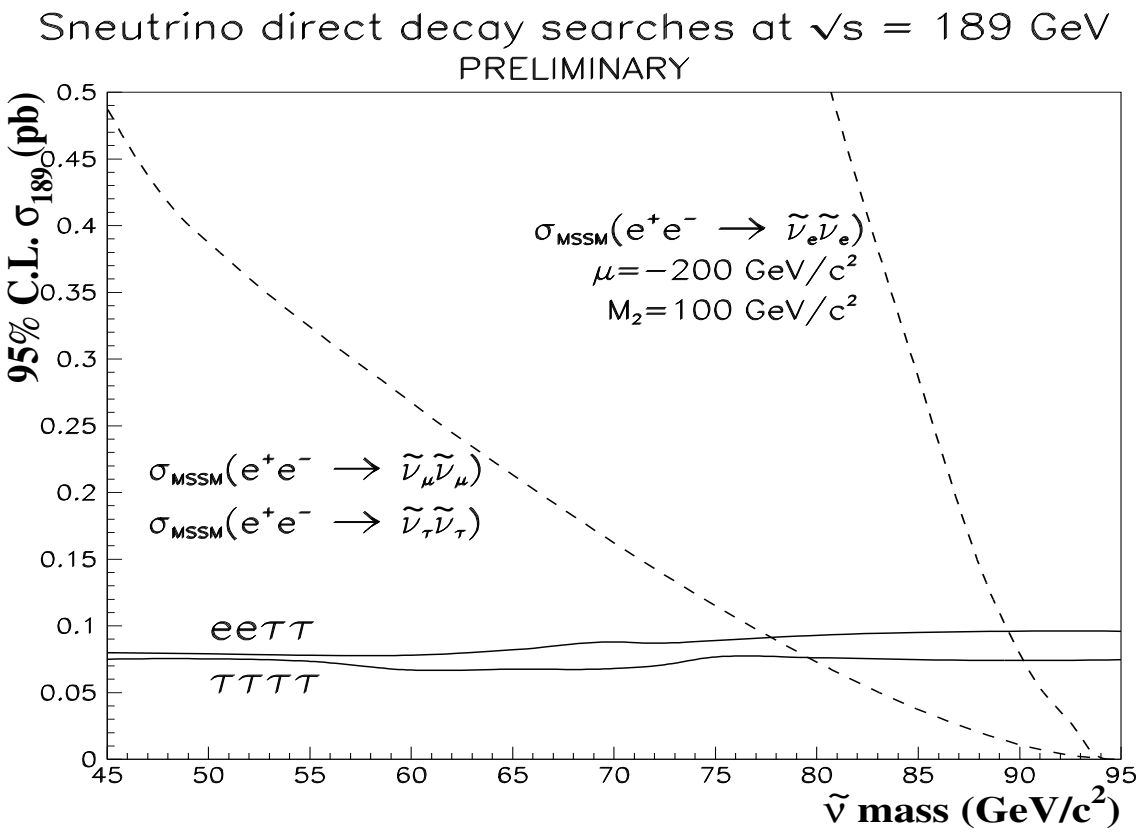
$-0.14 < \Delta g_1^Z < 0.15$
$-0.14 < \Delta\kappa_\gamma < 0.82$
$-0.11 < \lambda_\gamma < 0.23$

2-dimensional fits:



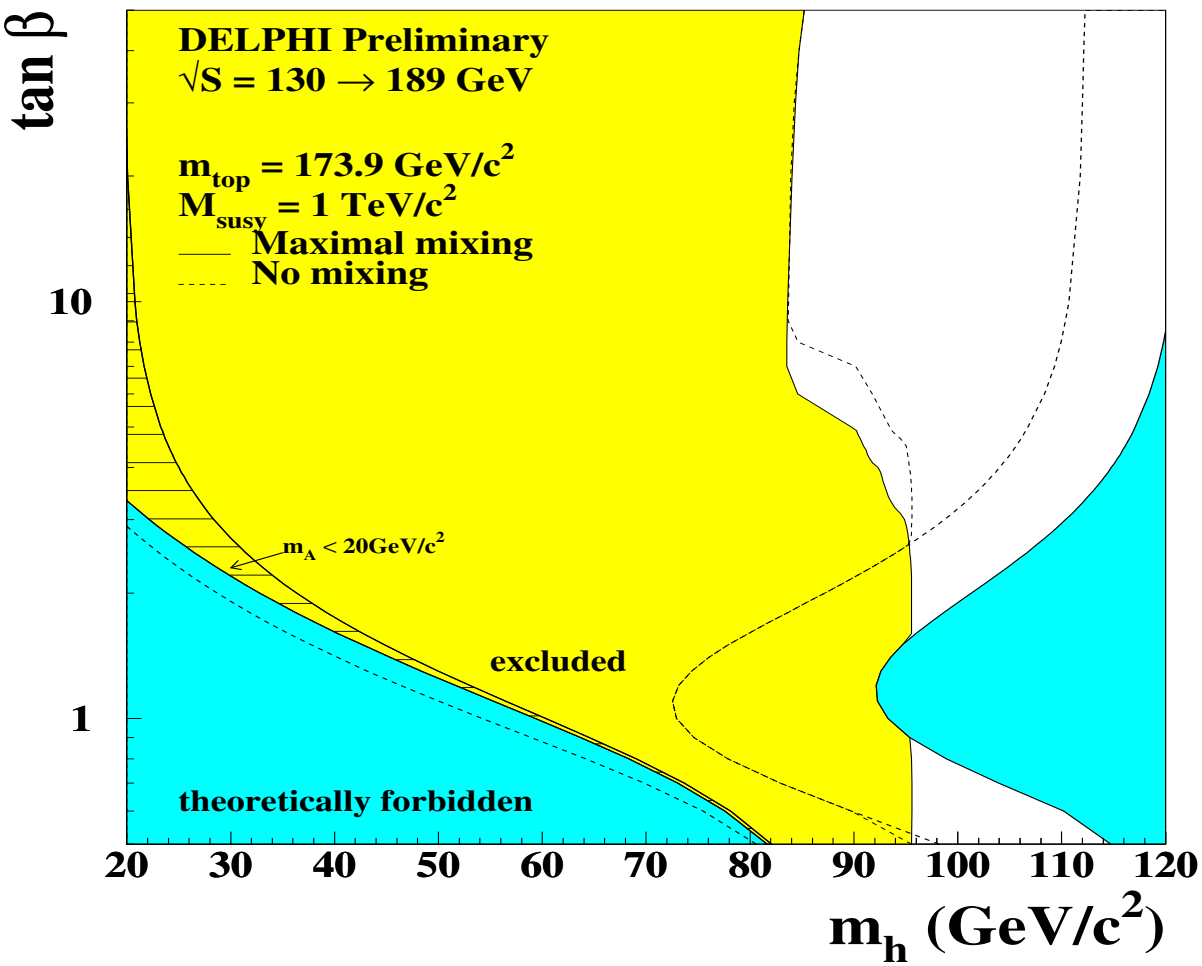
Rp Violating SUSY searches

- Many couplings
- Many final states: 4 to 12 fermions
- Many limits:



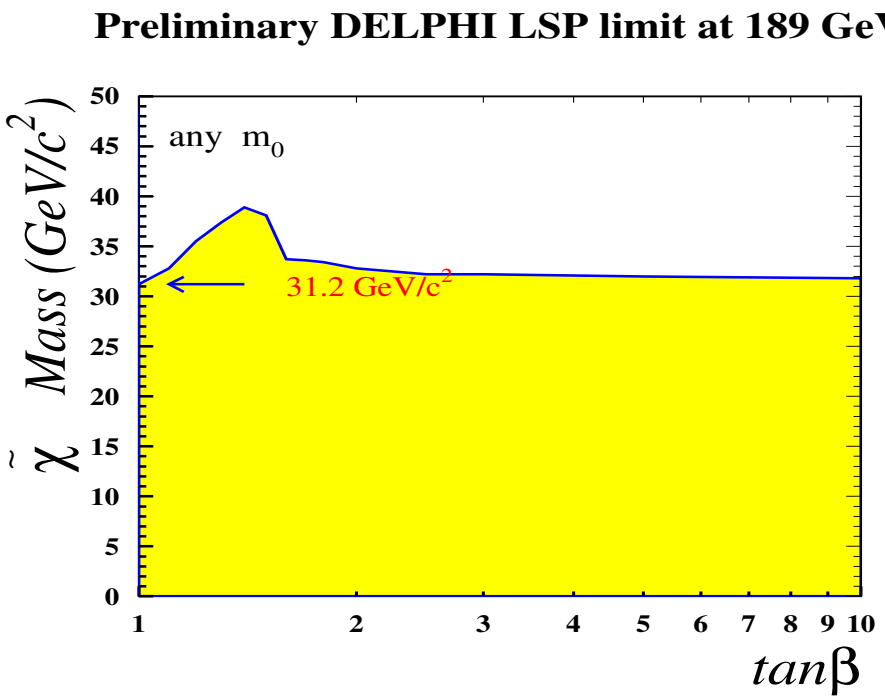
The MSSM Higgs

- New H^0Z^0 and hA limits included



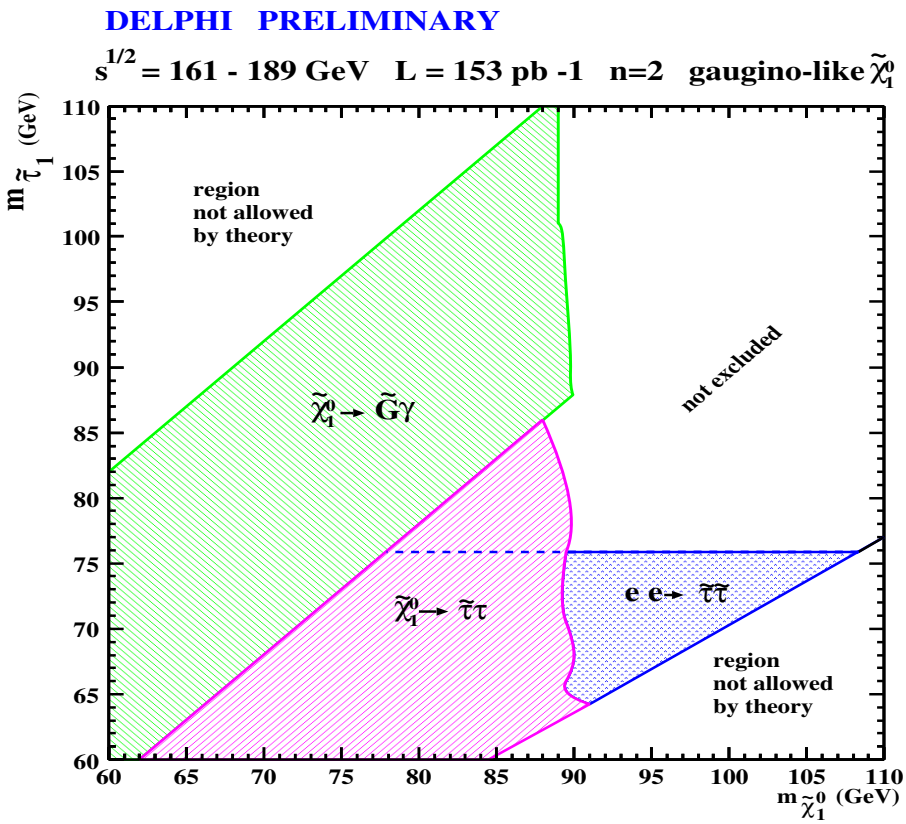
Limit on LSP

- Limit independent of m_0



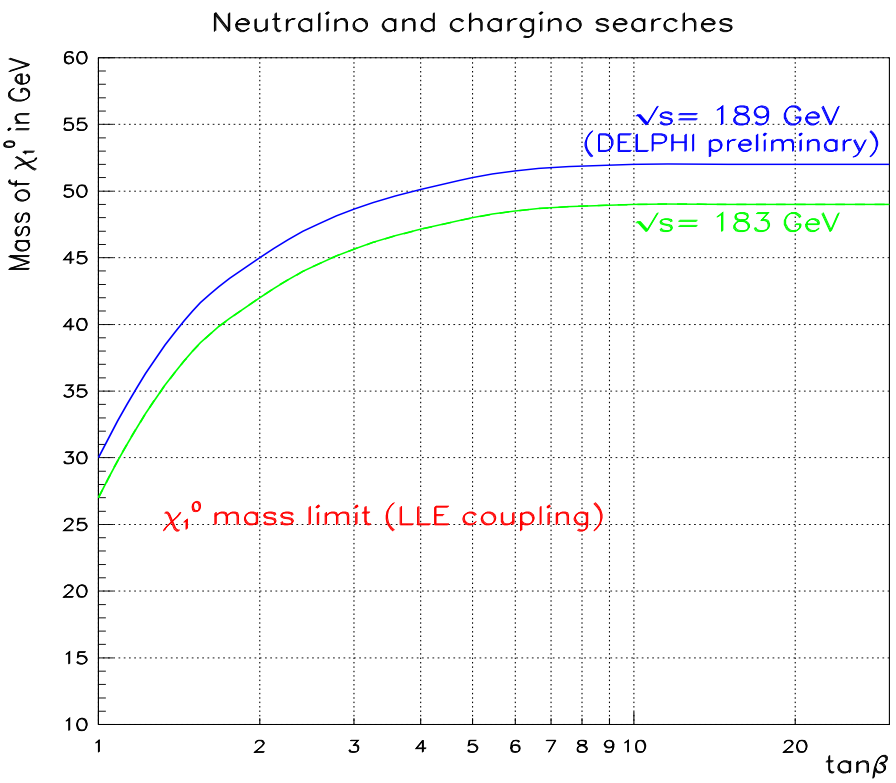
GMSB

- Limit on NLSP:



RP interpretation

- Limit on LSP:



Outlook

- LEP1 physics analysis ongoing
  - Final lineshape measurements
  - Final B_s^0 mixing measurement
  - ...
- LEP2 physics will not be over at the end of Y2K.
  - Final m_W will take time.
  - Wish for measurement of Colour Reconnection.
  - ...
- Surprises are maybe not expected, but welcome

Conclusion

- The Standard Model reigns
- Higgs sector
  - Ready for Higgs bosons beyond Z mass.
  - W mass measurement improves indirect limit
- Quiet DELPHI shutdown 1998-1999
  - Cryogenics OK
  - Magnet OK
  - Delphi will be ready