L3 Report to LEPC

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12 Nov 1998

- Status of Detector
- Physics at 189 GeV
- Running request

All results are preliminary

L3 in 1998

Collected Luminosity:

- 91 GeV: 2.4 + 0.6 pb^{-1} at 92.0% efficiency
- 189 GeV: 176.4 pb^{-1} at 89.3%

Including Z data, LEP delivered more than 200 pb^{-1}, the most luminosity ever delivered to L3 in a single year

Excellent background conditions throughout the year.

Congratulations to the LEP crew for exceeding everyone's expectations!

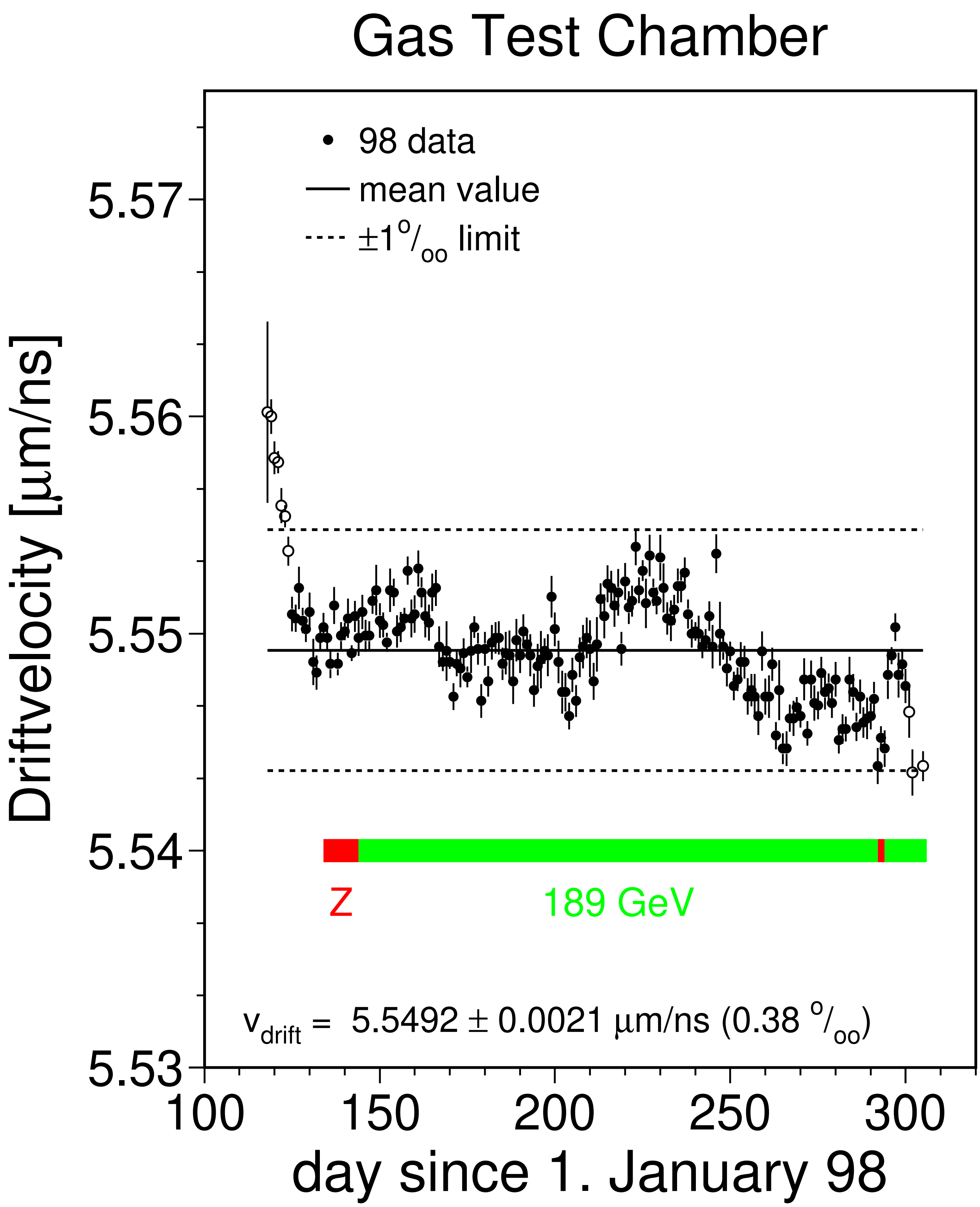
No major problems with the L3 detector.

L3 data taking was smooth; the detector performance was very stable.

Only routine maintenance scheduled for the shutdown.

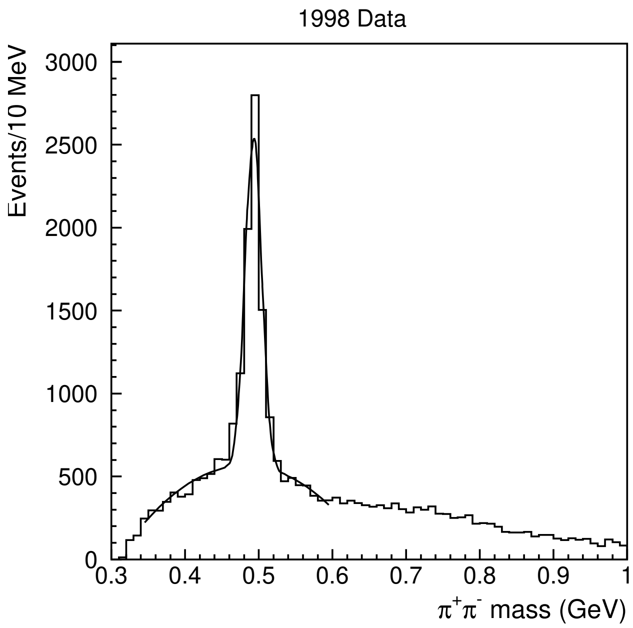
Most results presented here are based on >170 pb^{-1} 189 GeV.

Stability of Central Tracker

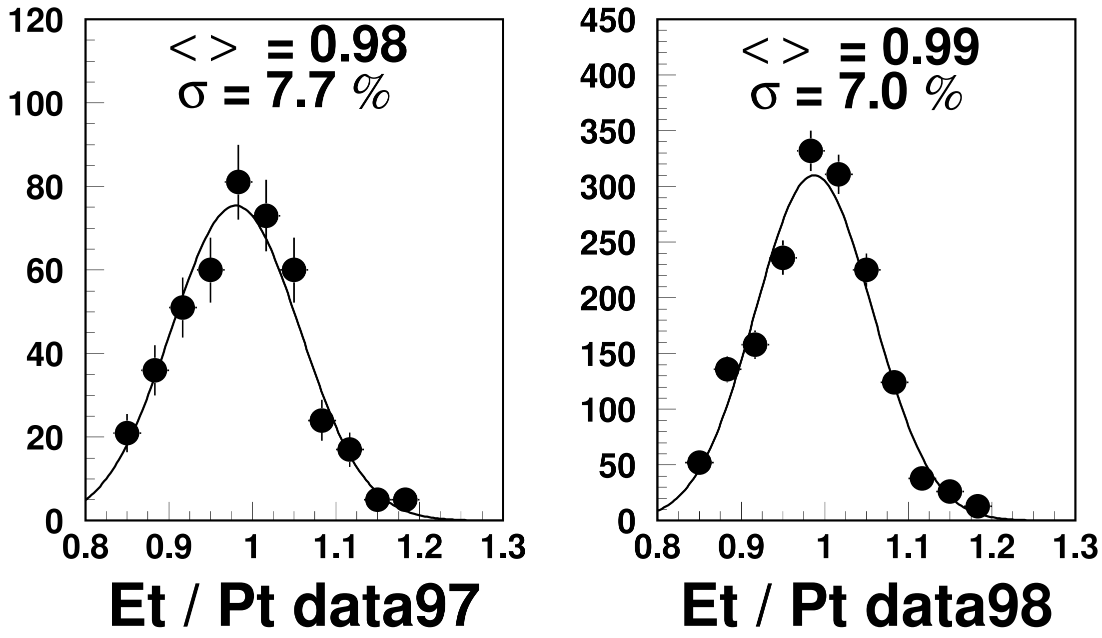


Data Quality

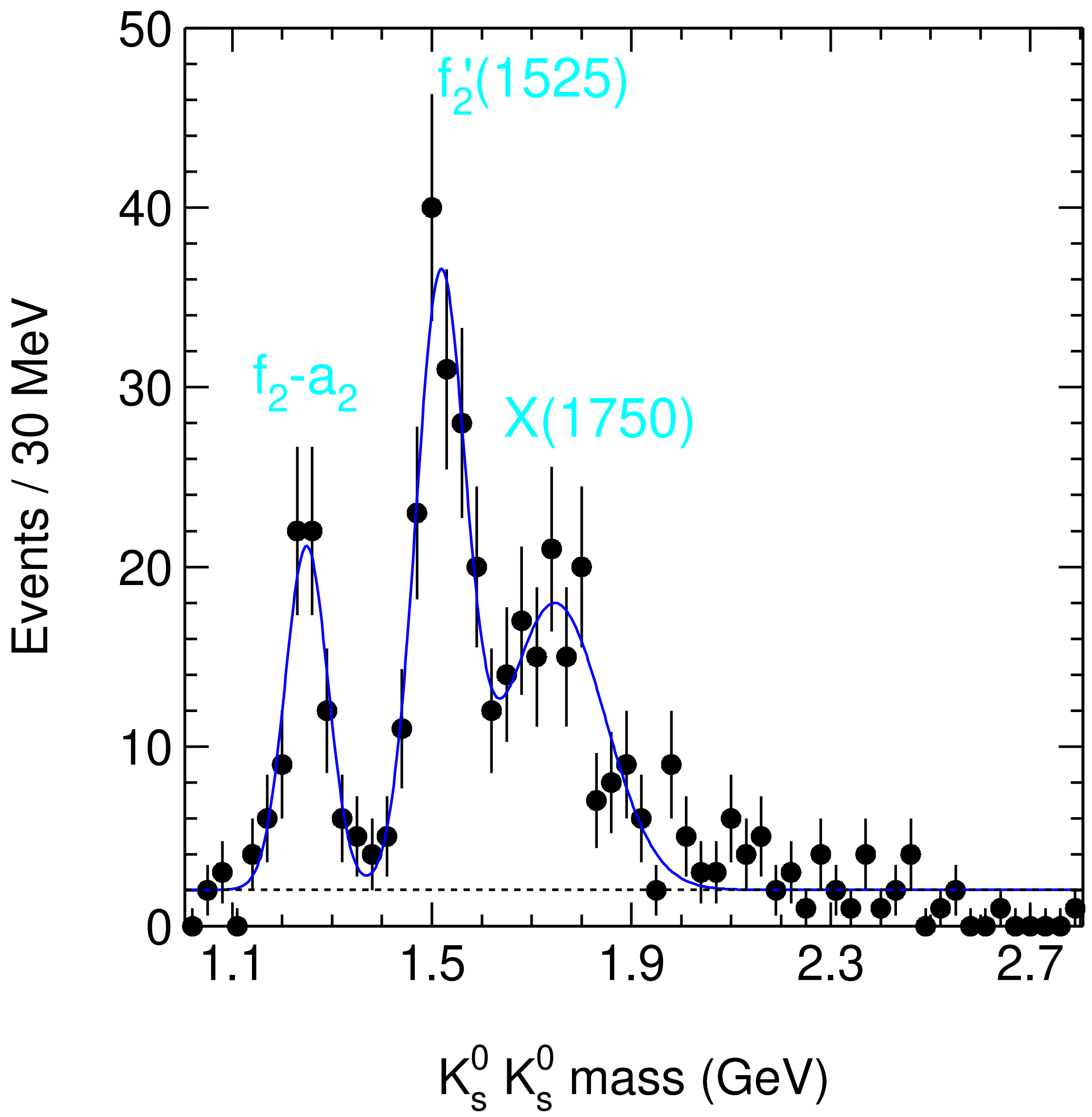
K^0_S in 2 photon events:



Electron resolutions in $\gamma\gamma \rightarrow c\bar{c}$



$K^0_S K^0_S$ Invariant Mass



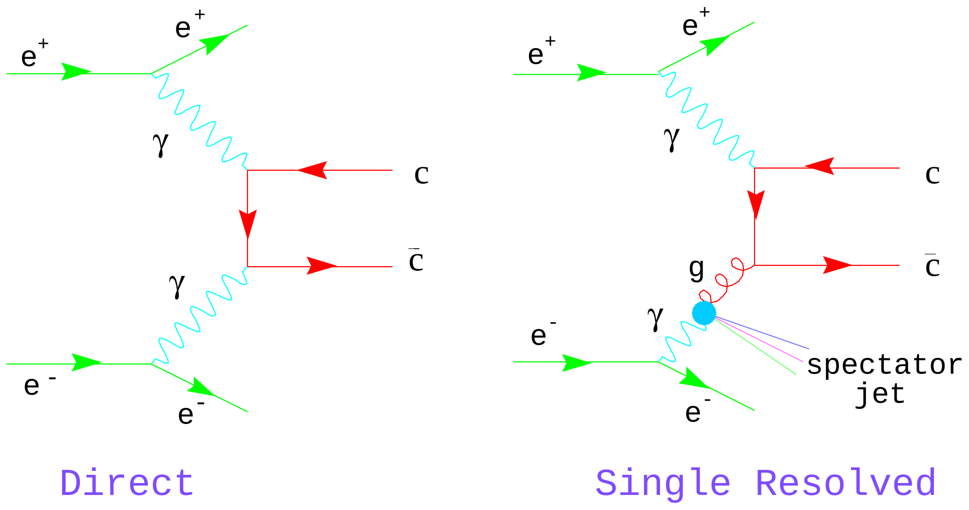
Spin-parity of 1750 region under study:

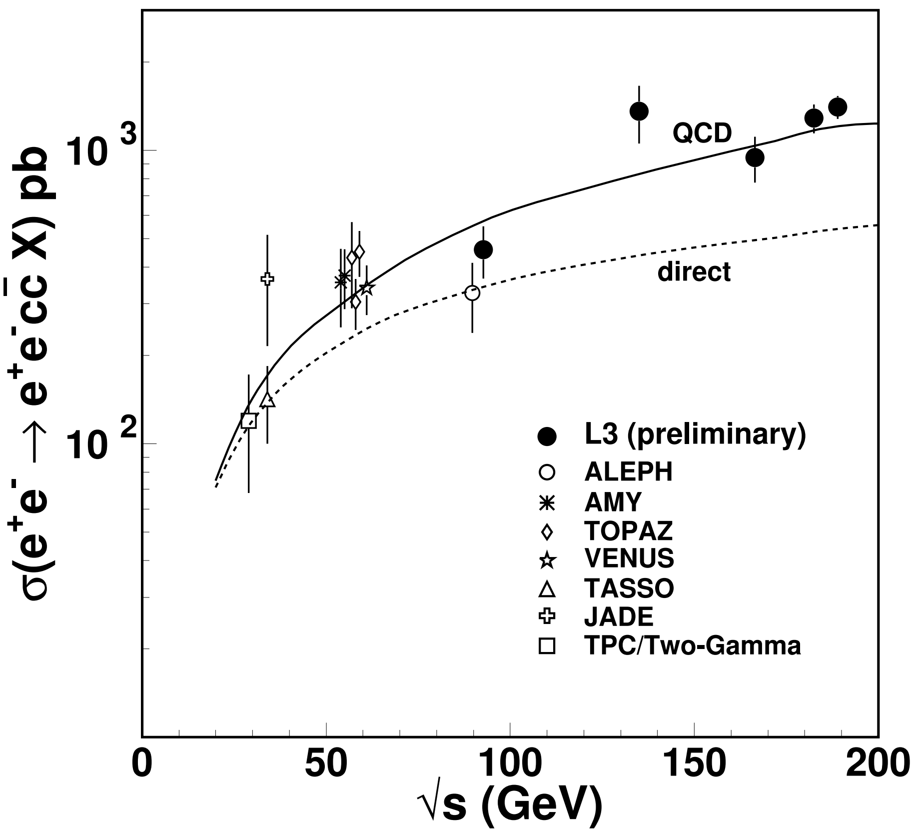
- 2^{++} (f_2' radial recurrence?)
- 0^{++} ($s\bar{s}$ state?)

No signal in $\xi(2230)$ region:

$$\Gamma(\xi \to \gamma\gamma) \times \mathrm{BR}(\xi \to K^0_S K^0_S) < 3\ \mathrm{eV}\ (95\%\ \mathrm{CL})$$

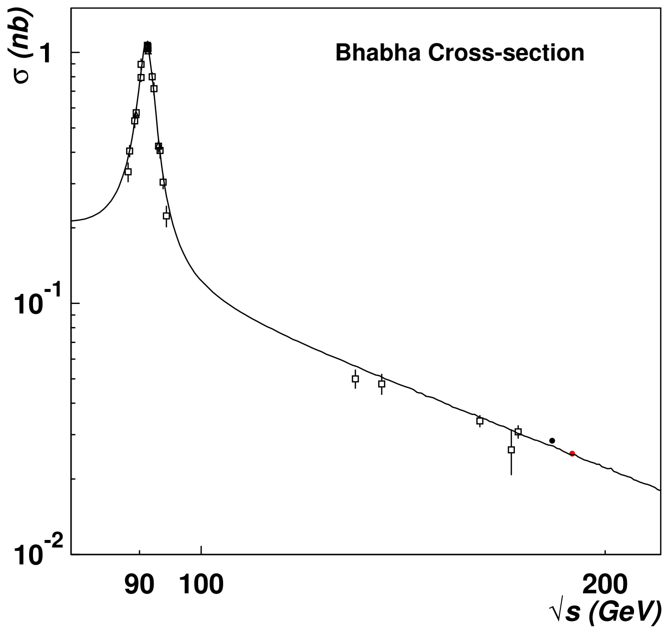
Charm production in $\gamma\gamma$

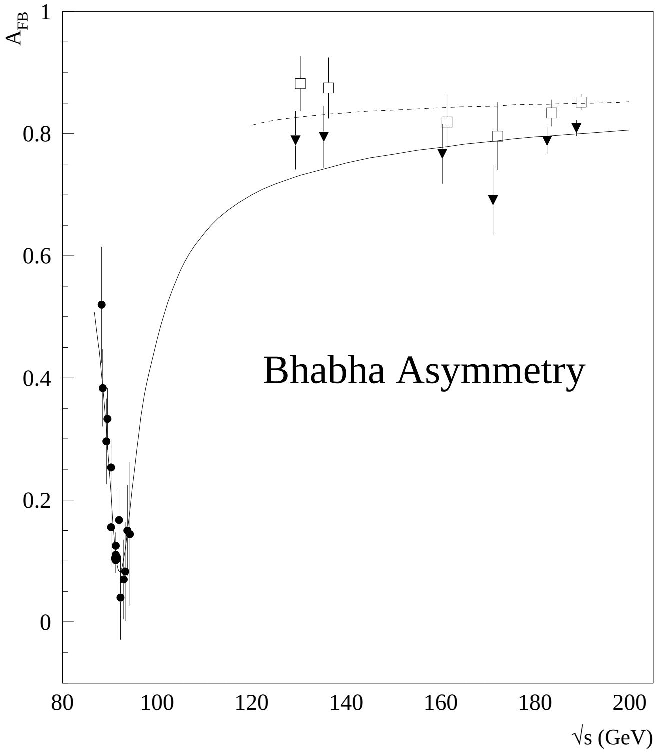


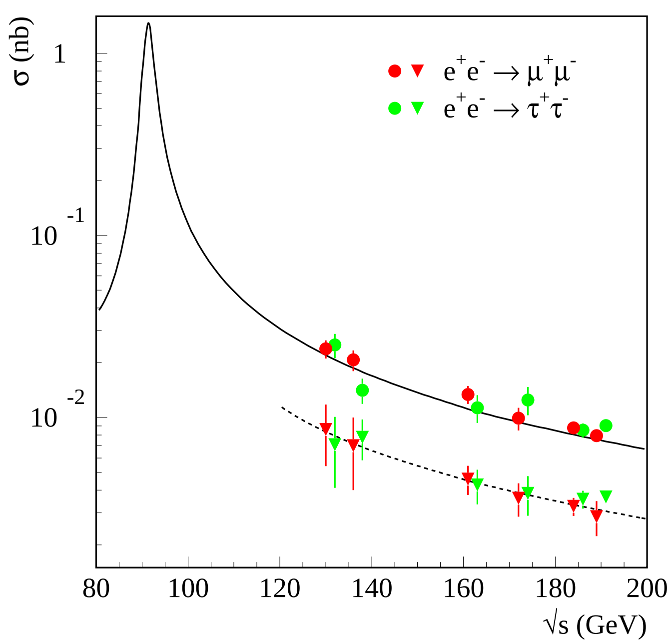


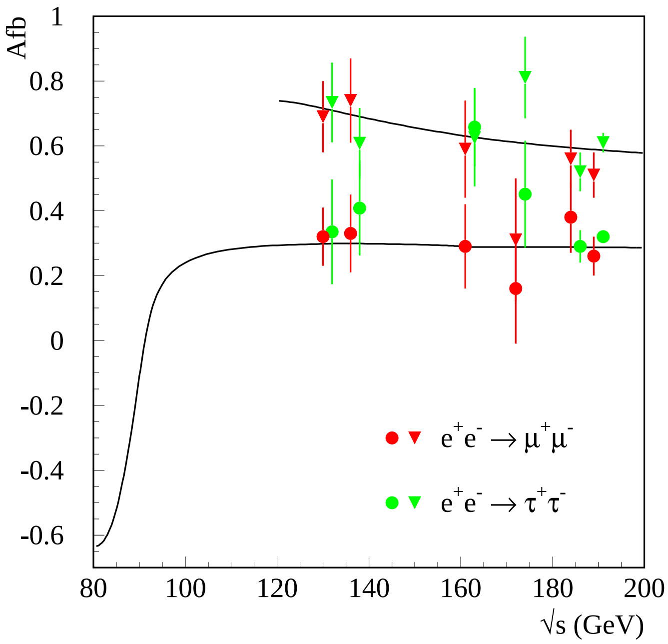
Clear evidence of gluon content of photon.

Lepton-Pair Production



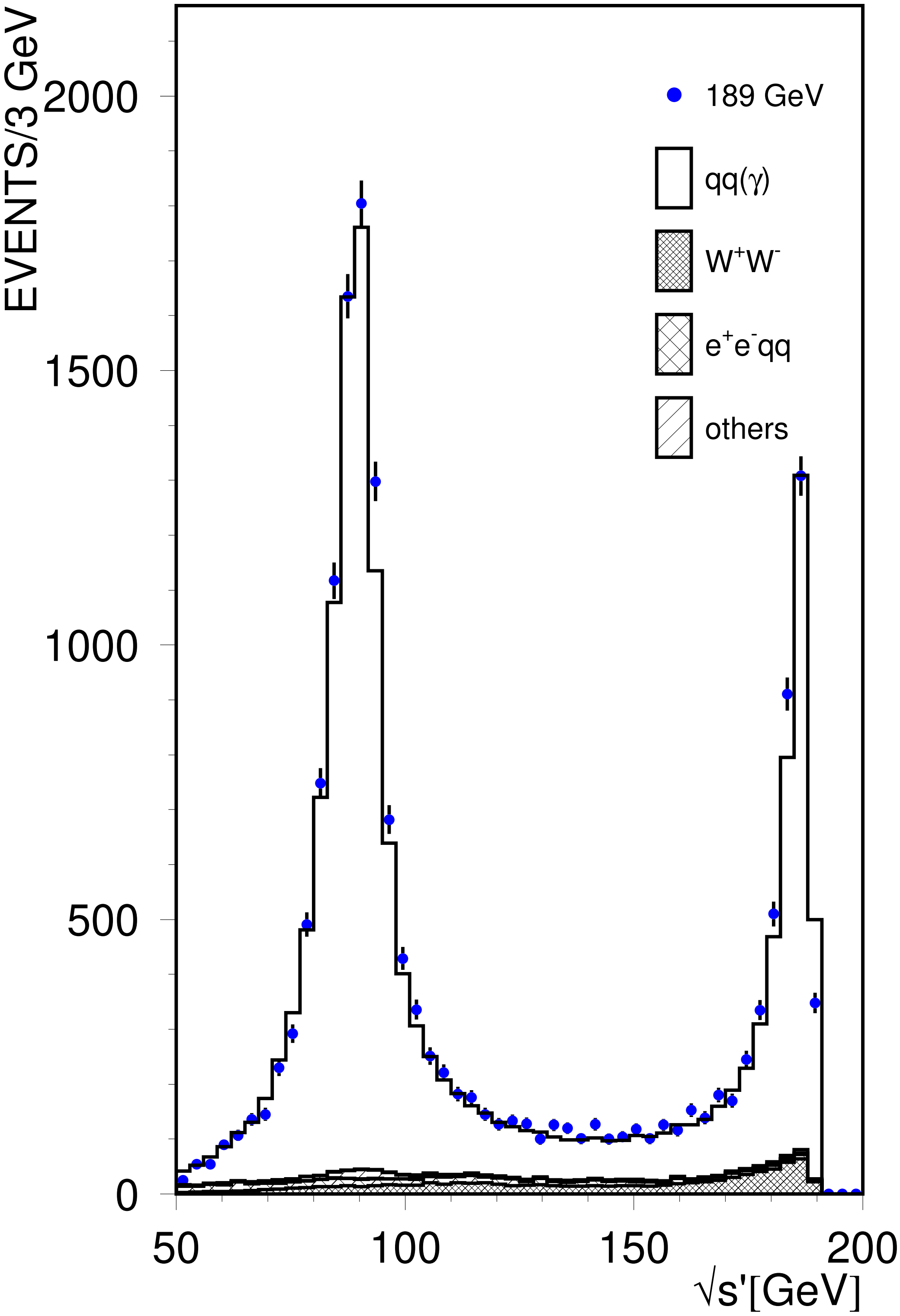






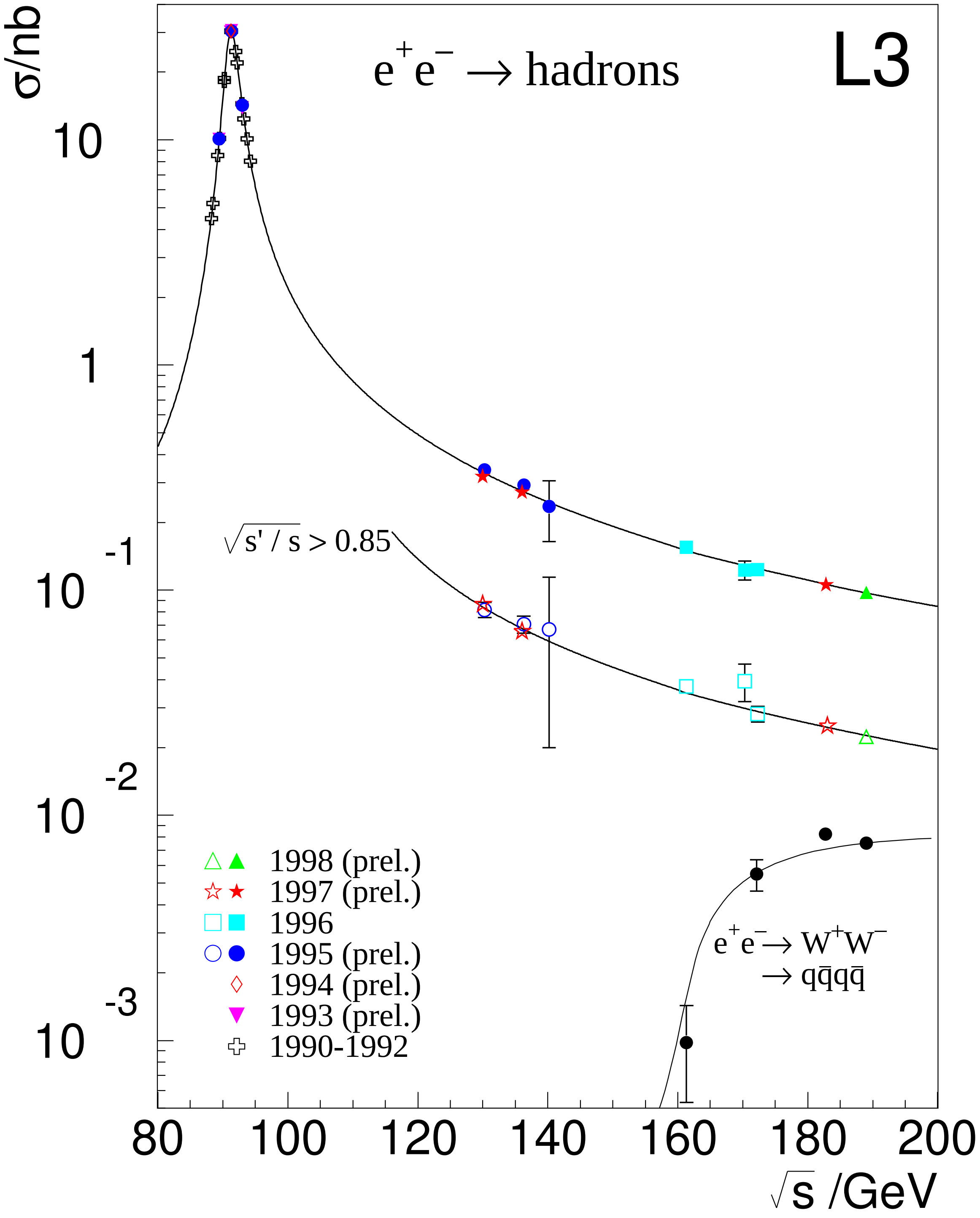
Results in good agreement with SM expectations.

Hadronic Selection



As last year, will be used to cross-check W mass

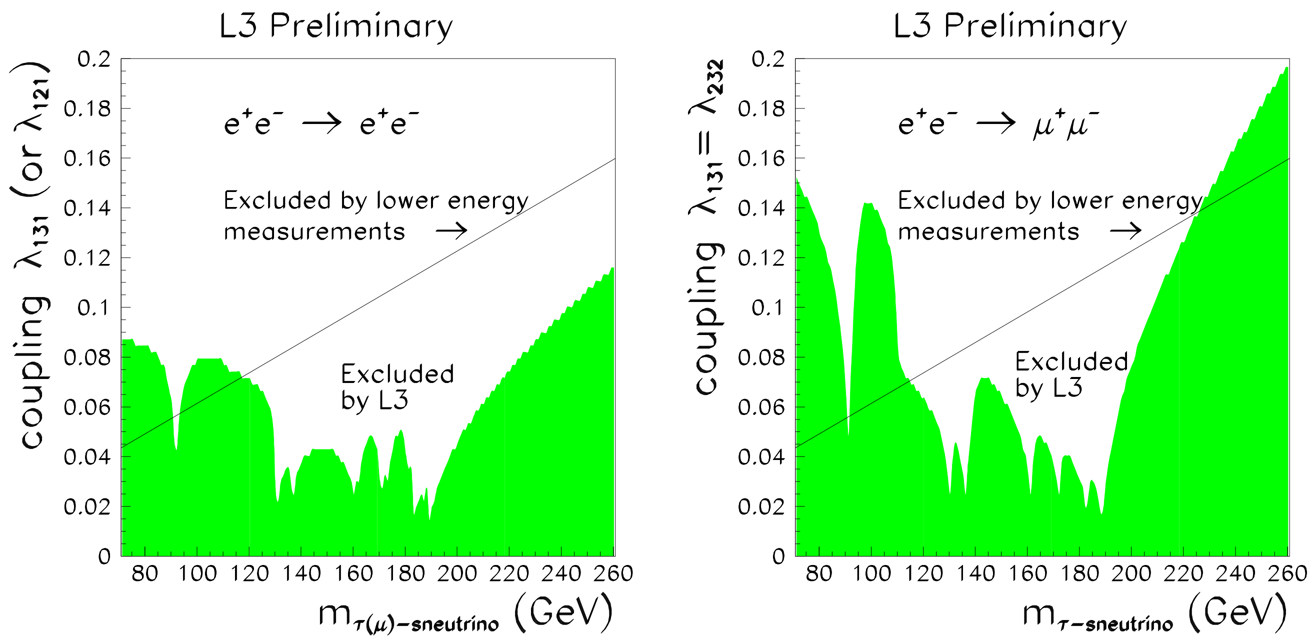
Hadronic Cross-sections



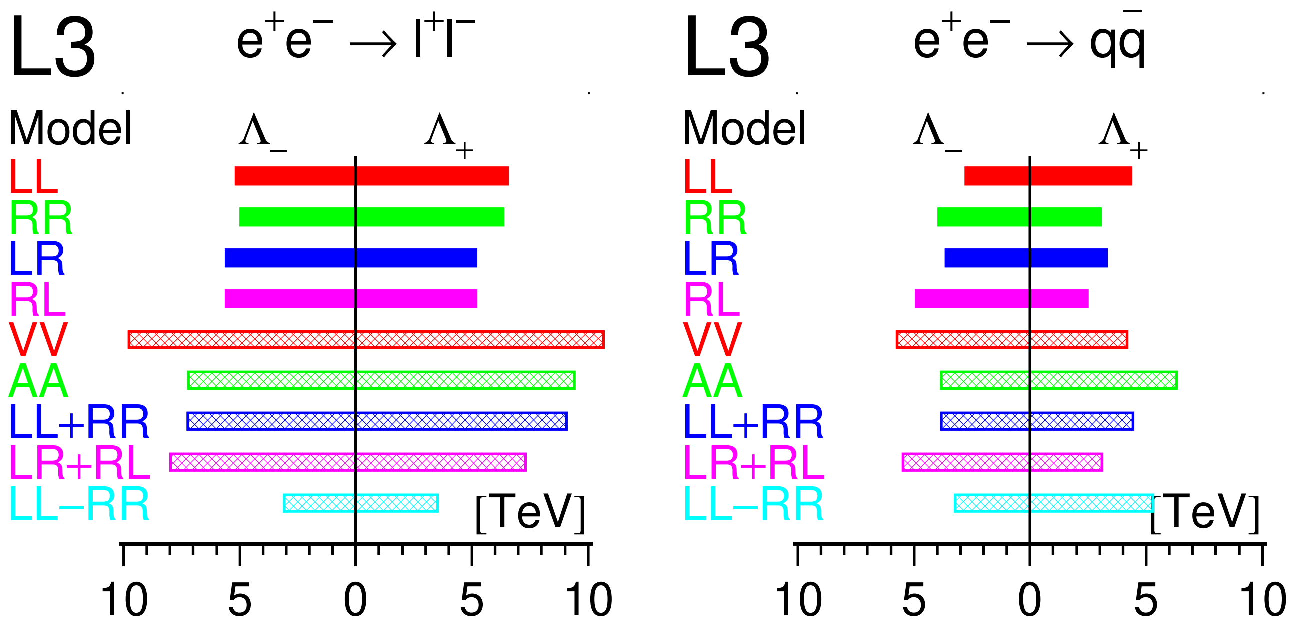
High energy cross-section measured better than 1% ⇒ systematics becoming important.

New Physics

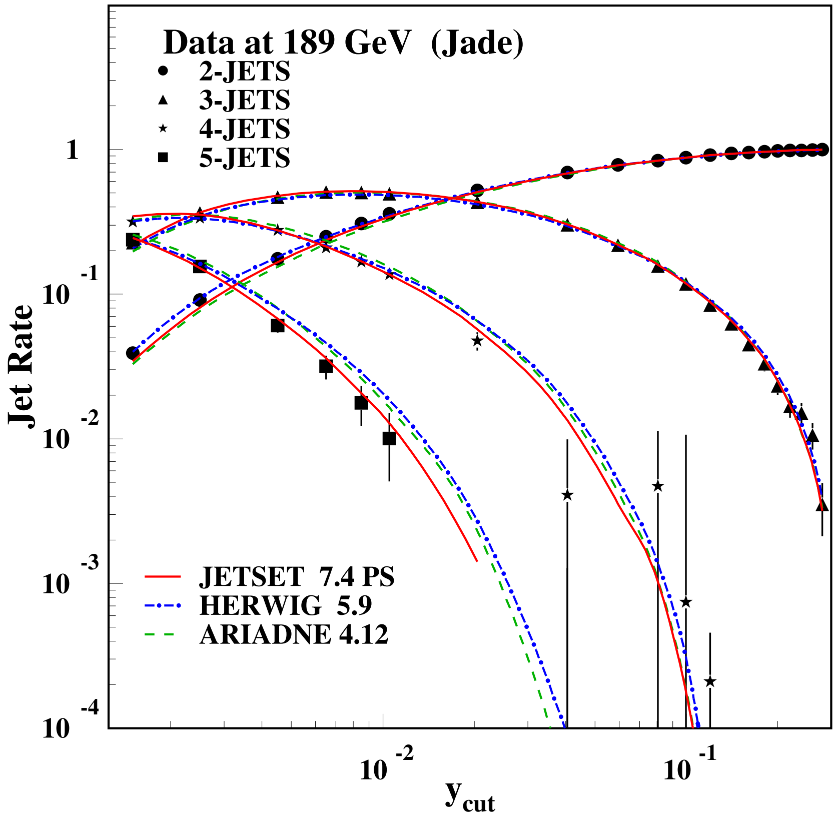
In R-parity violating SUSY, exchange of $\tilde{\nu}_\mu$ and $\tilde{\nu}_\tau$ in e^+e^- and $\mu^+\mu^-$ production.

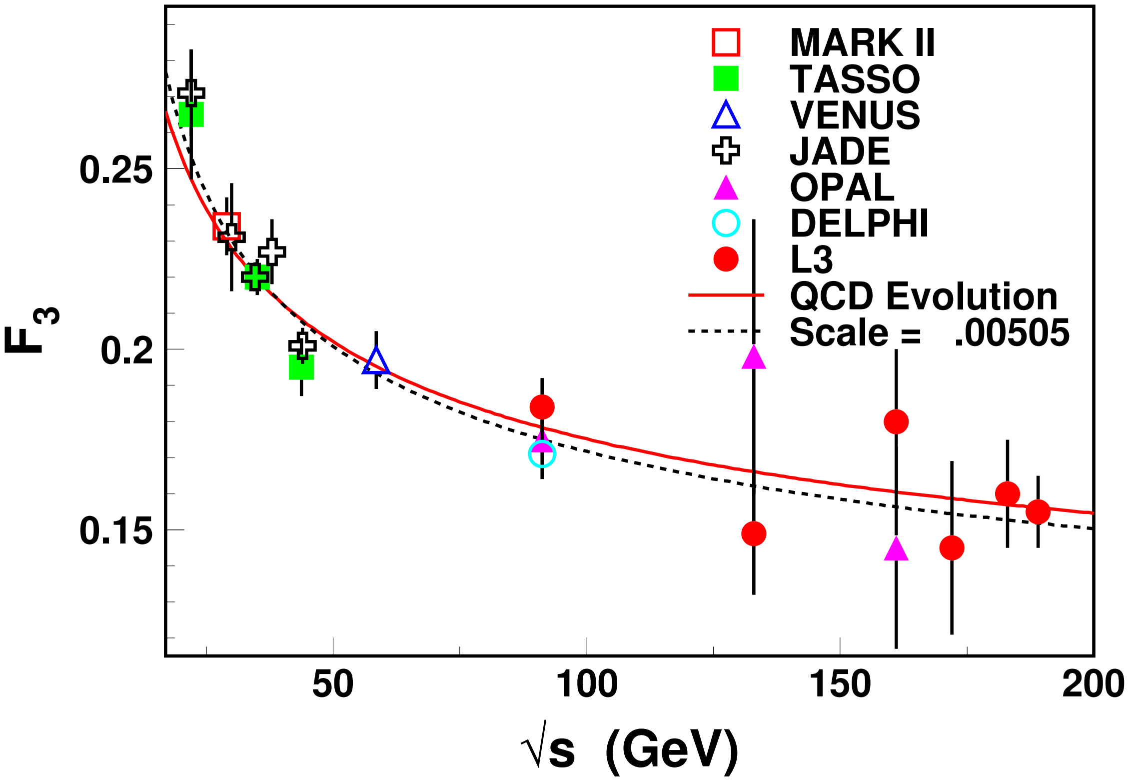


Contact interactions:

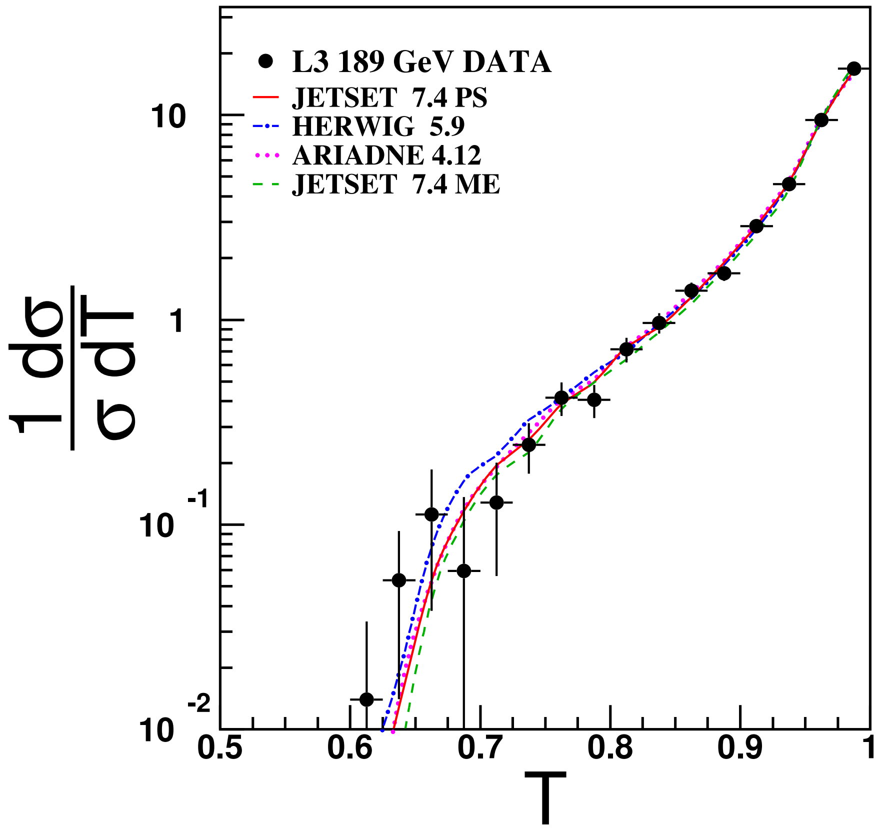


QCD – 3 Jet Rates

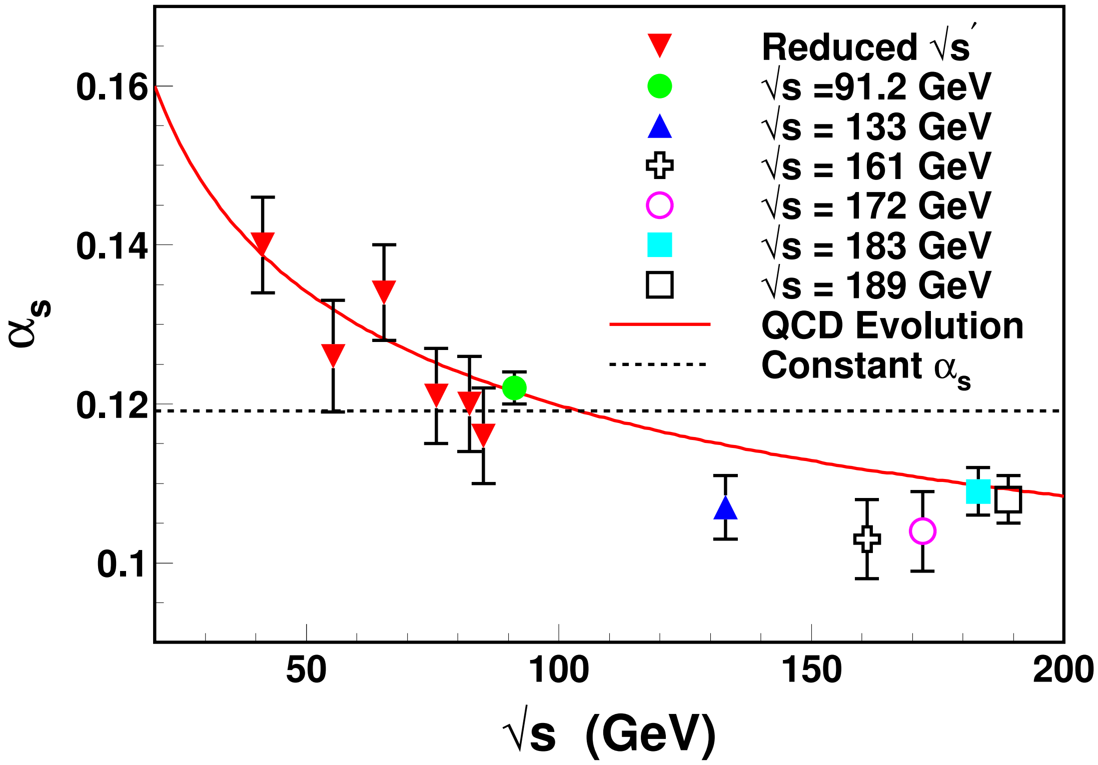




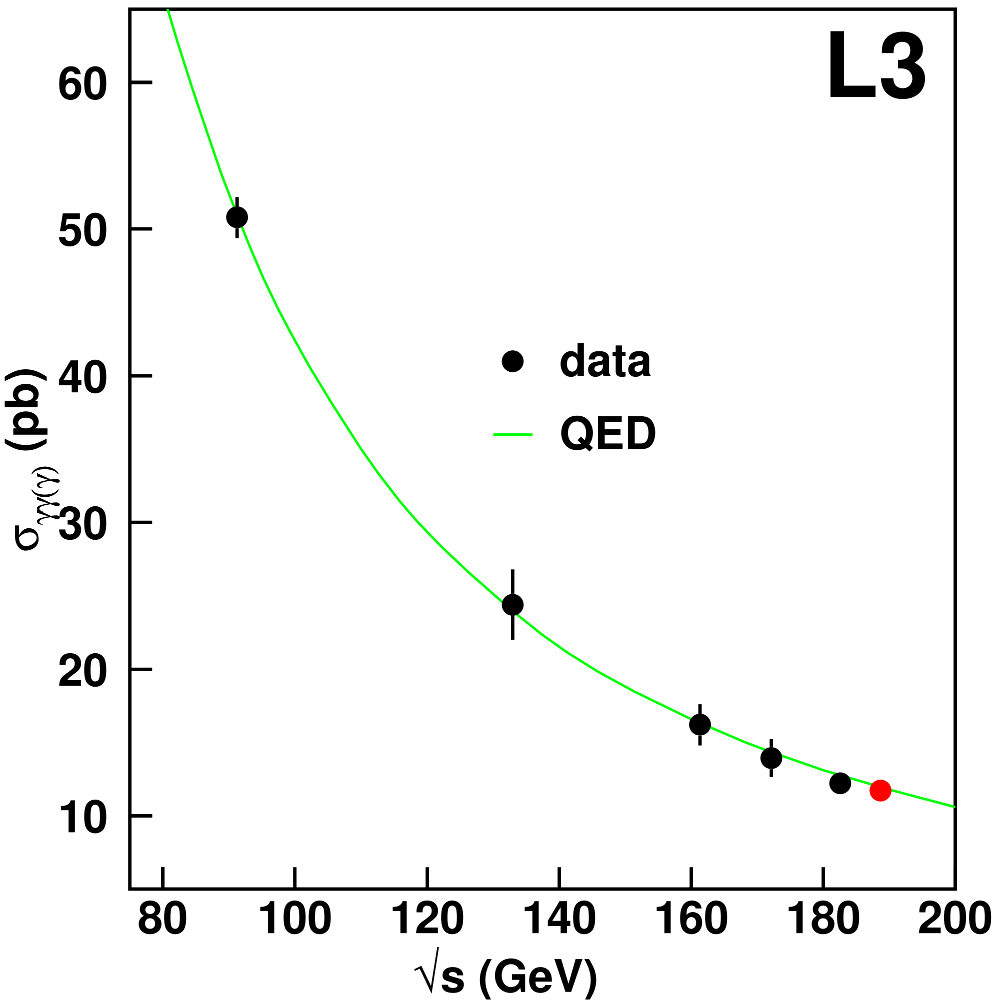
QCD – α_s



$\alpha_s(189\text{ GeV}) = 0.1082 \pm 0.0028\text{ (exp)} \pm 0.0052\text{ (theo)}$



Boson Pair Production: $\gamma\gamma$



Events:

	$\gamma\gamma$	$\gamma\gamma\gamma$	Total
Data	1591	99	1690
Expected	1604	109	1713

Limits:

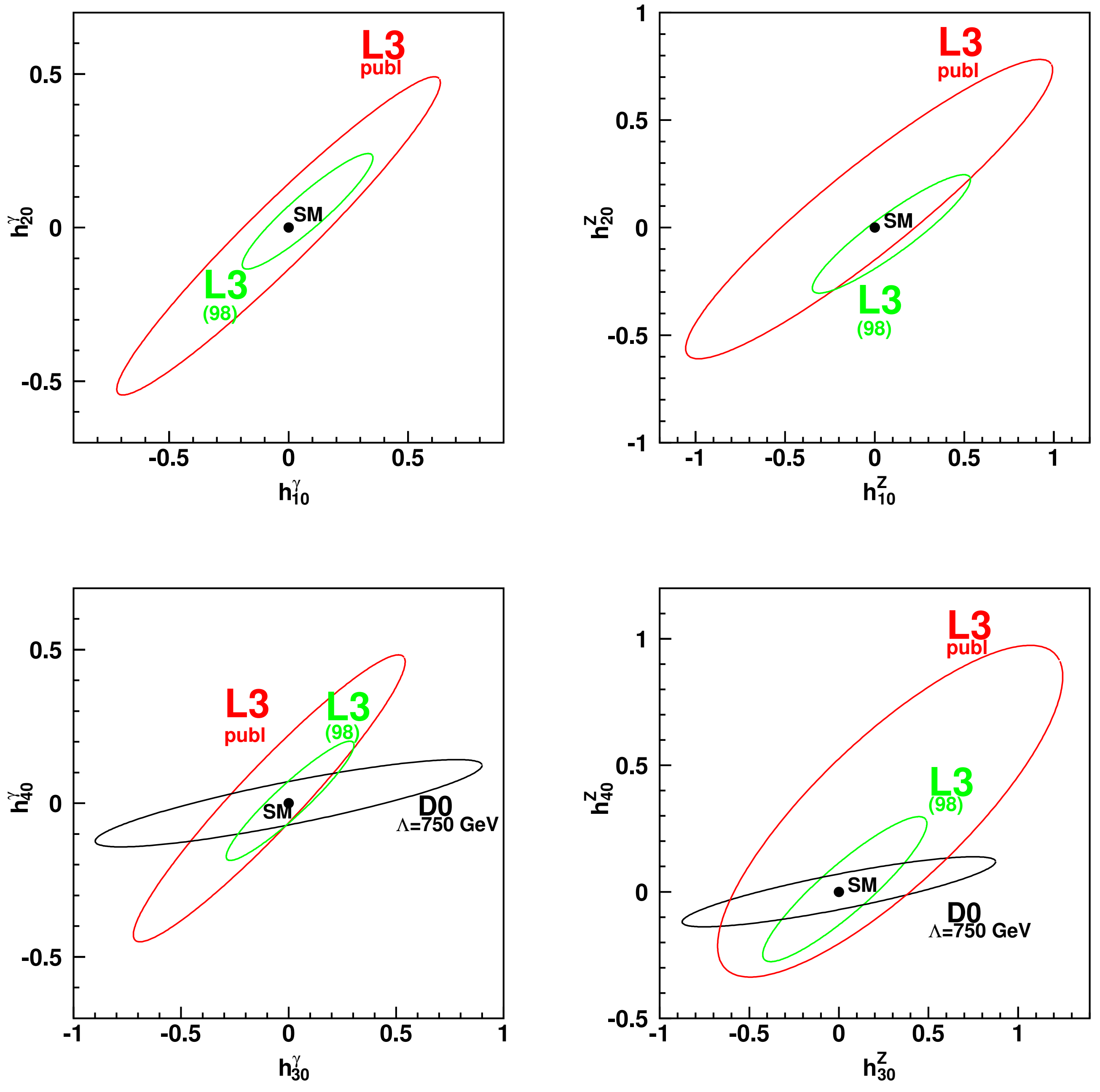
$\Lambda_{-} > 287$ GeV $\quad \Lambda > 1319$ GeV $\quad m_{e^*} > 326$ GeV(L+R)

$\Lambda_{+} > 324$ GeV $\quad \Lambda' > 704$ GeV $\quad m_{e^*} > 254$ GeV(L/R)

Boson Pair Production: $Z\gamma$

Channel	$N_{observed}$	$\sigma_{meas.}$ (pb)	σ_{SM} (pb)
$q\bar{q}\gamma$	1024	19.5 ± 0.6	20.
$\nu\bar{\nu}\gamma$	254	4.7 ± 0.2	5.

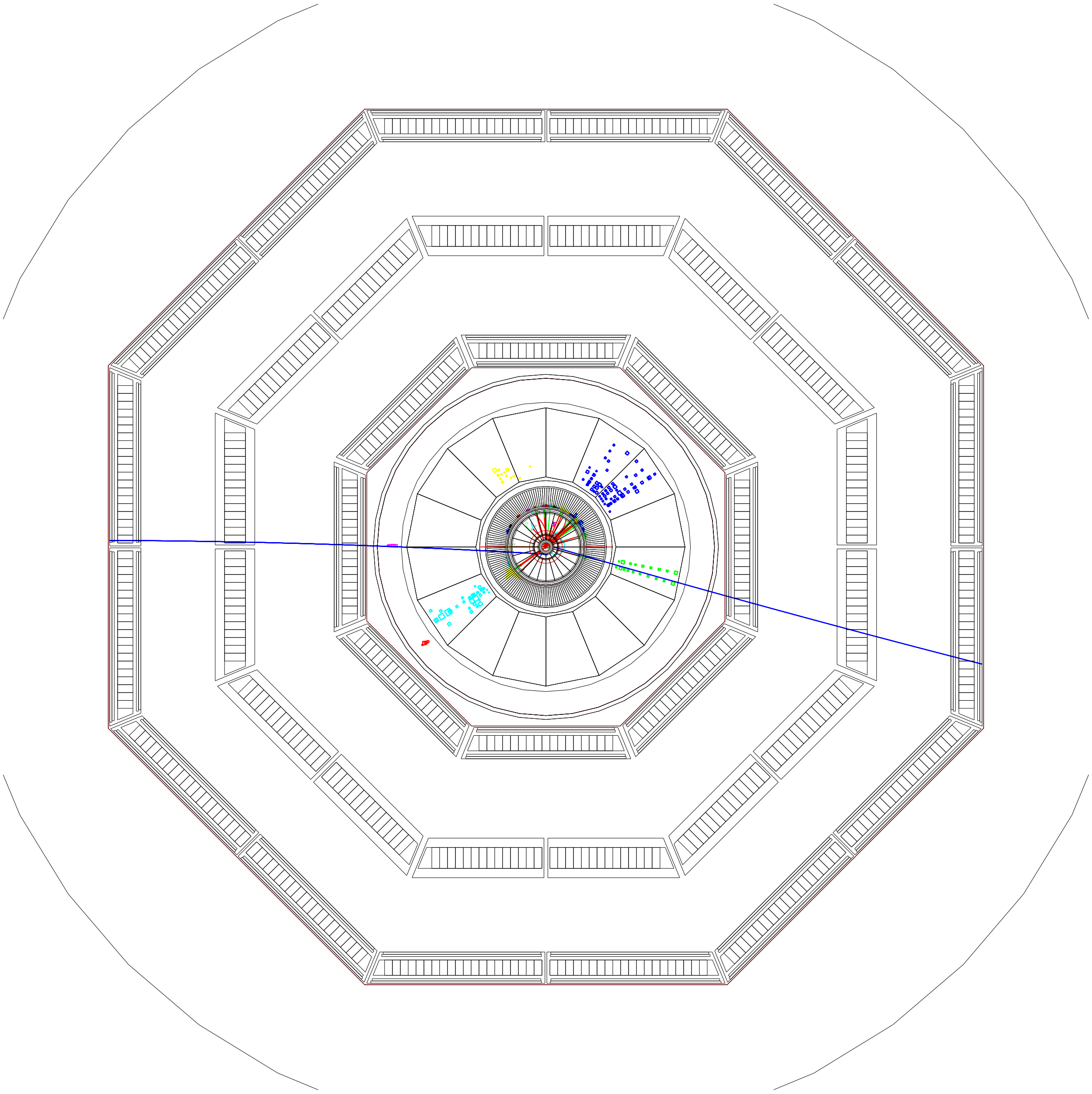
1998 data compared to last year:



Boson Pair Production: ZZ

$ZZ \rightarrow q\bar{q}\mu^+\mu^-$ candidate:

Run # **705301** **Event #** **24** Total Energy : 171.88 GeV

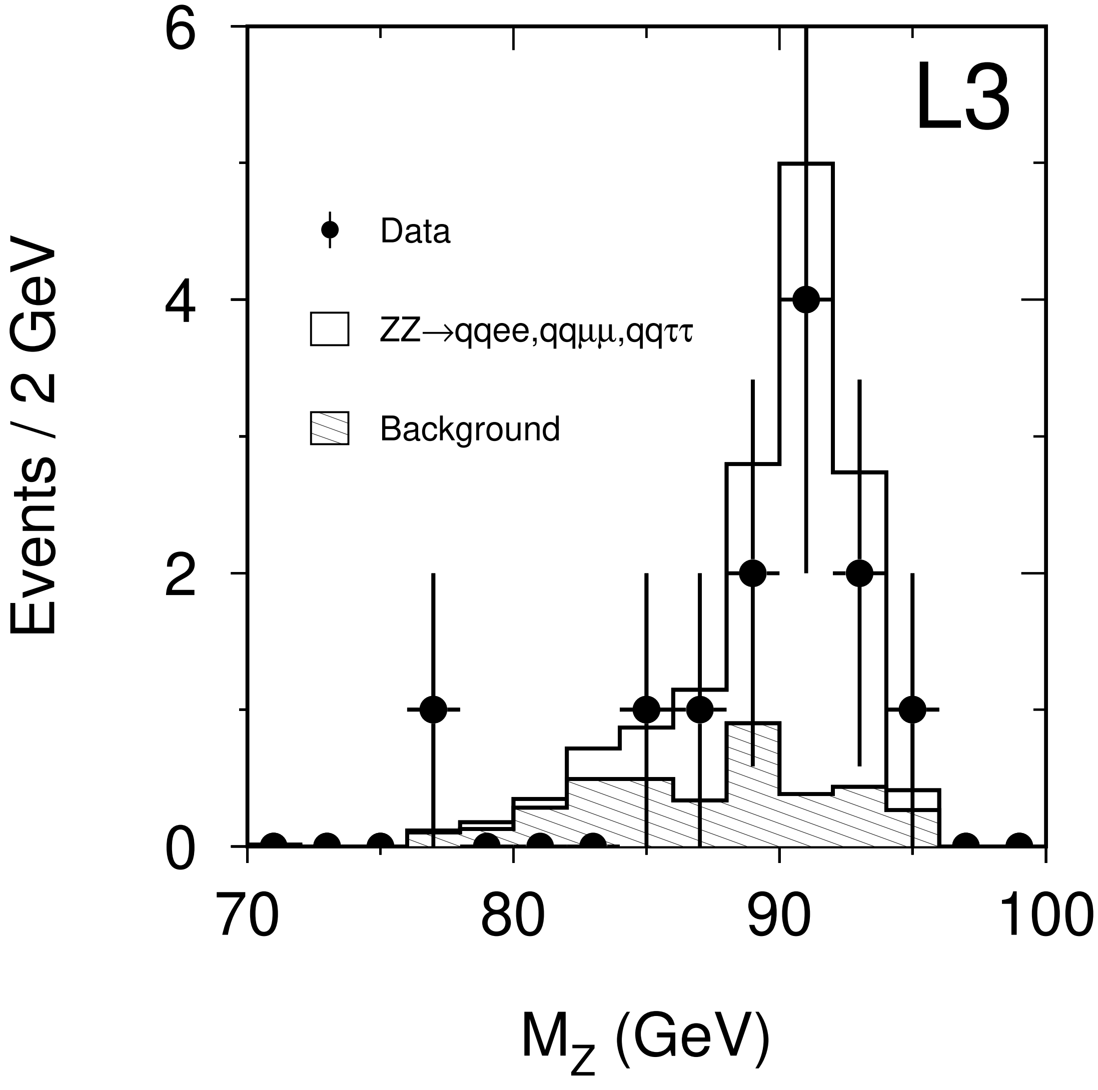


$m_{\mu^+\mu^-} = 93$ GeV $m_{jj} = 93$ GeV

Boson Pair Production: ZZ

$qq\ell\ell$ selection:

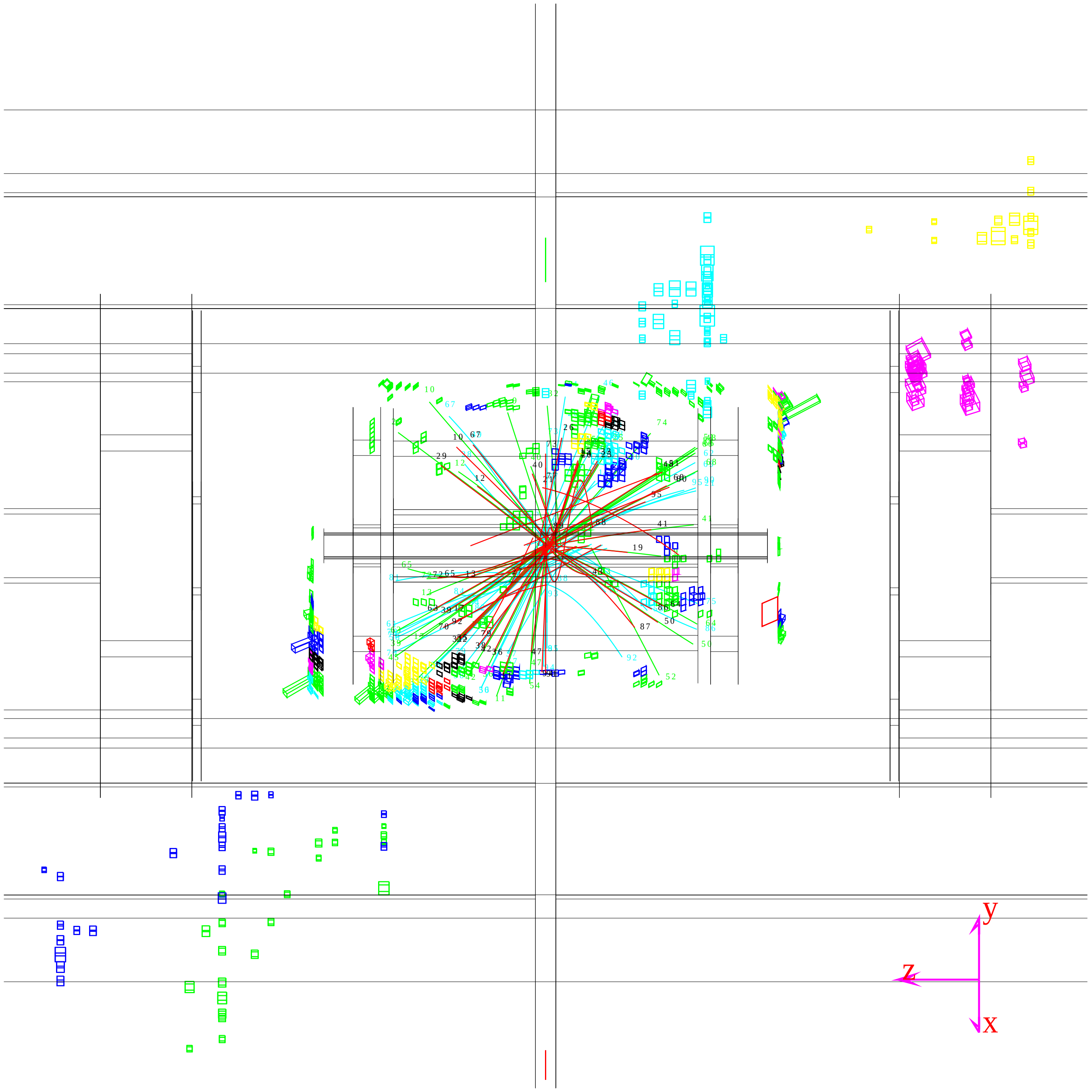
12 events found compared to 14.3 expected (10.5 signal; 3.8 background)



Boson Pair Production: ZZ

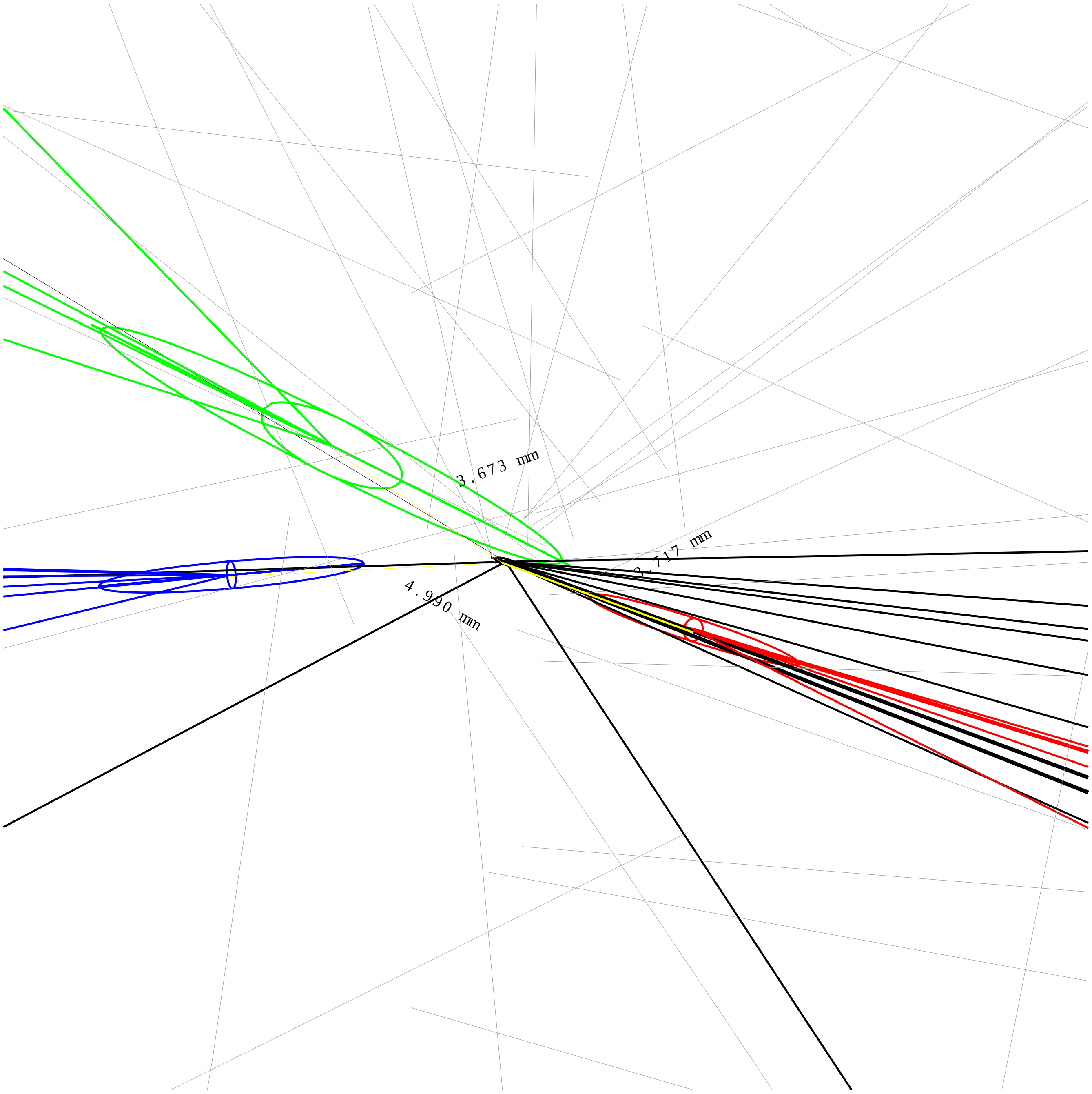
ZZ $\rightarrow q\bar{q}q\bar{q}$ candidate:

Run # 697803 Event # 4765



Boson Pair Production: ZZ

Also a nice HZ candidate:



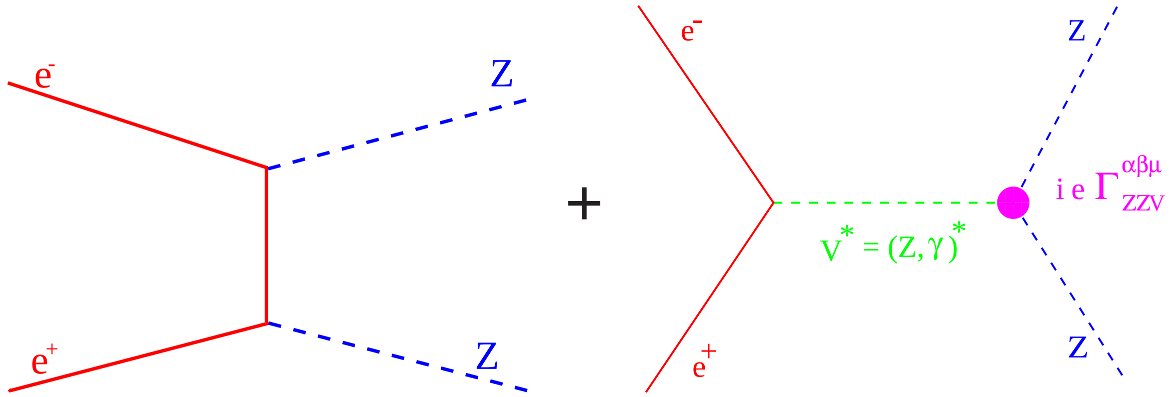
(Ellipses are 3σ contours)

Boson Pair Production: ZZ

Total cross-section (within signal definition cuts):

$$\sigma_{ZZ} = 0.65^{+0.19}_{-0.17} \quad \text{pb (SM 0.75 pb)}$$

Limits on anomalous couplings:



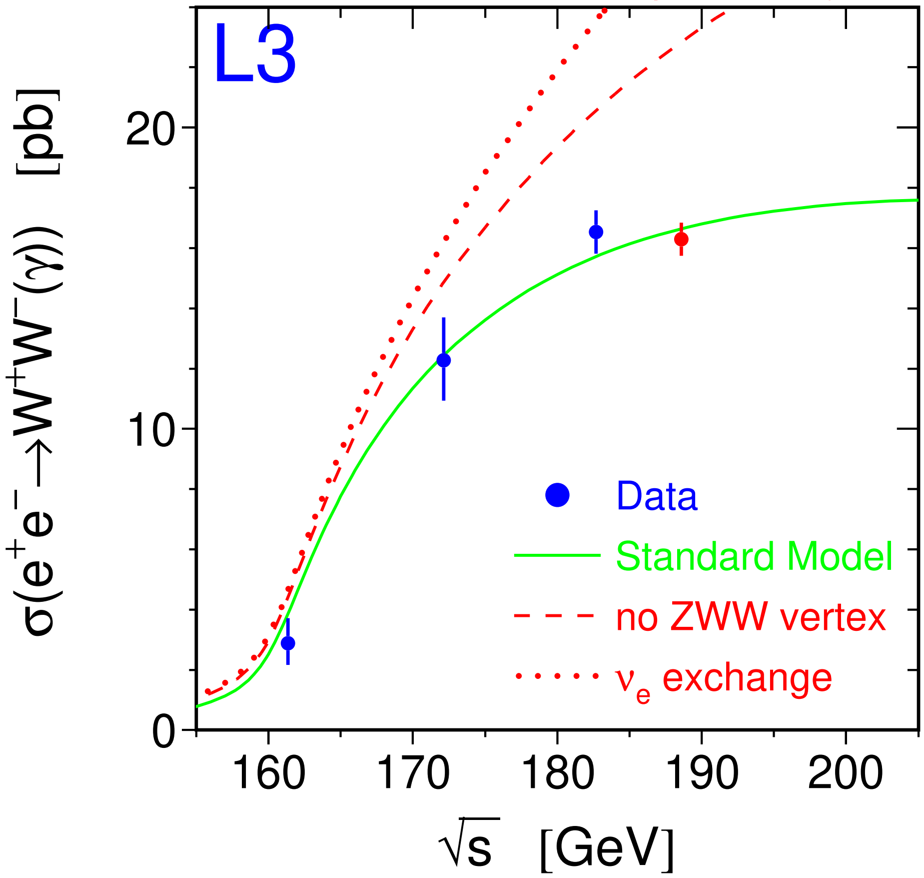
Channel	95% C. L. Limits
qqll	$-1.8 < f_4^Z < 1.8$
	$-5.5 < f_5^Z < 5.4$
	$-1.1 < f_4^\gamma < 1.0$
	$-3.3 < f_5^\gamma < 3.2$

(f_4 is CP conserving; f_5 CP violating)

Boson Pair Production: $W^+ W^-$

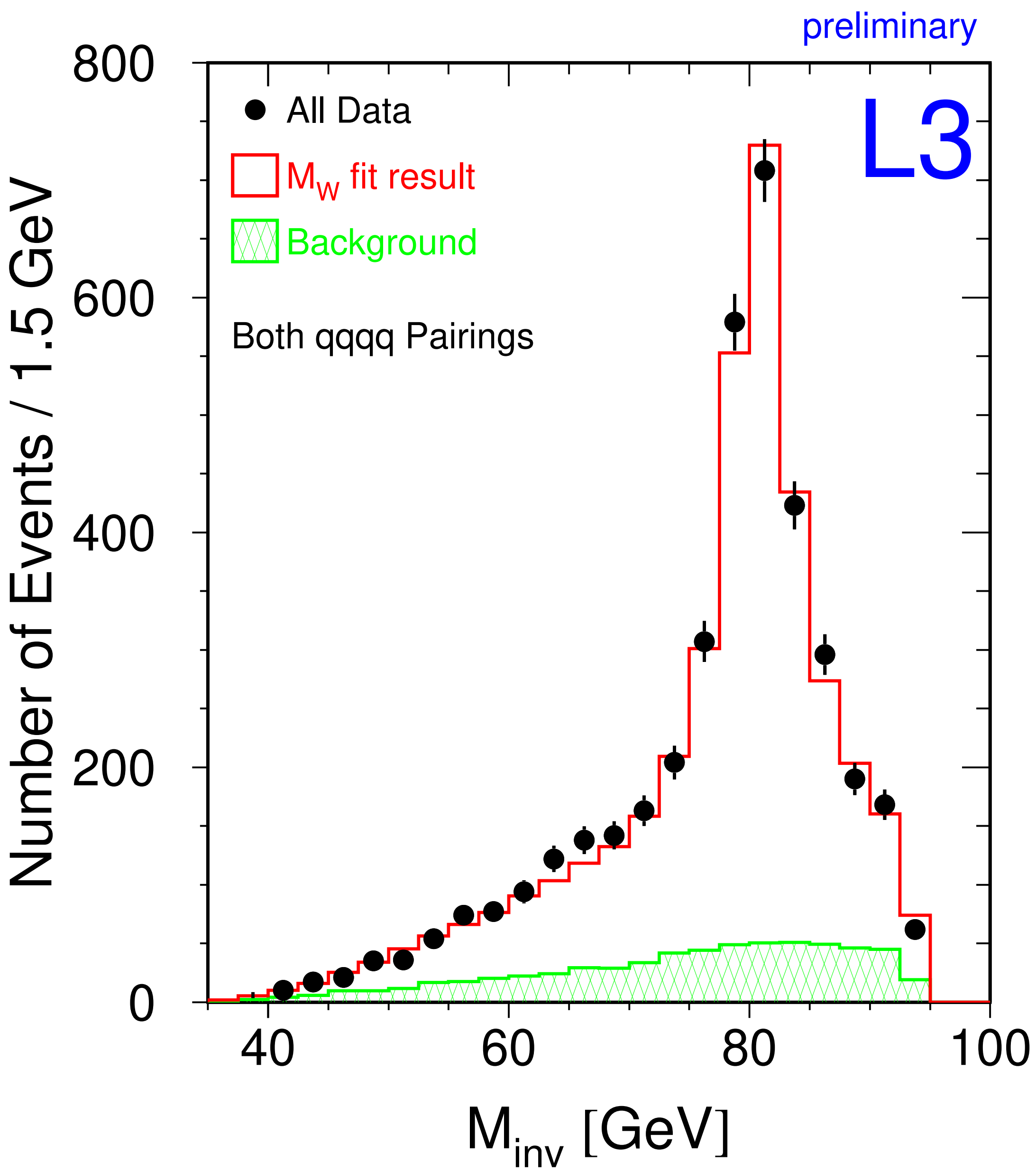
Channel	Events	σ (pb)	σ_{SM} (pb)
$q\bar{q}q\bar{q}$	1450	7.52 ± 0.26	7.60
$q\bar{q}\ell\nu$	1030	7.43 ± 0.24	7.29
$\ell\nu\ell\nu$	169	1.64 ± 0.15	1.75

189 GeV preliminary



channel	Branching Fraction (%)	SM (%)
$W \to e\nu$	10.22 ± 0.45	10.83
$W \to \mu\nu$	10.18 ± 0.47	10.83
$W \to \tau\nu$	11.08 ± 0.62	10.83
$W \to q\bar{q}$	68.53 ± 0.70	67.5

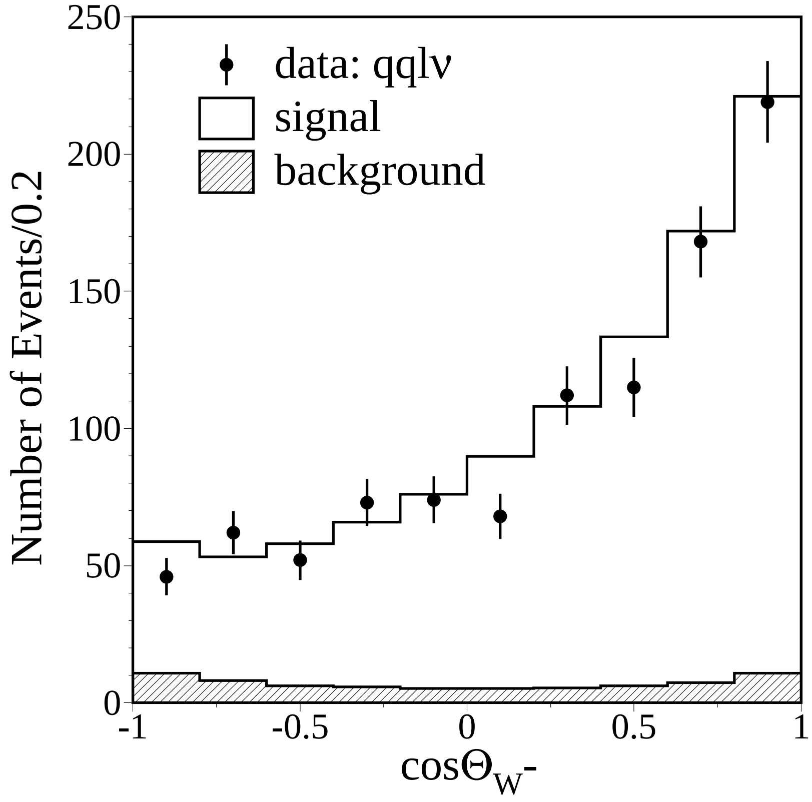
W mass

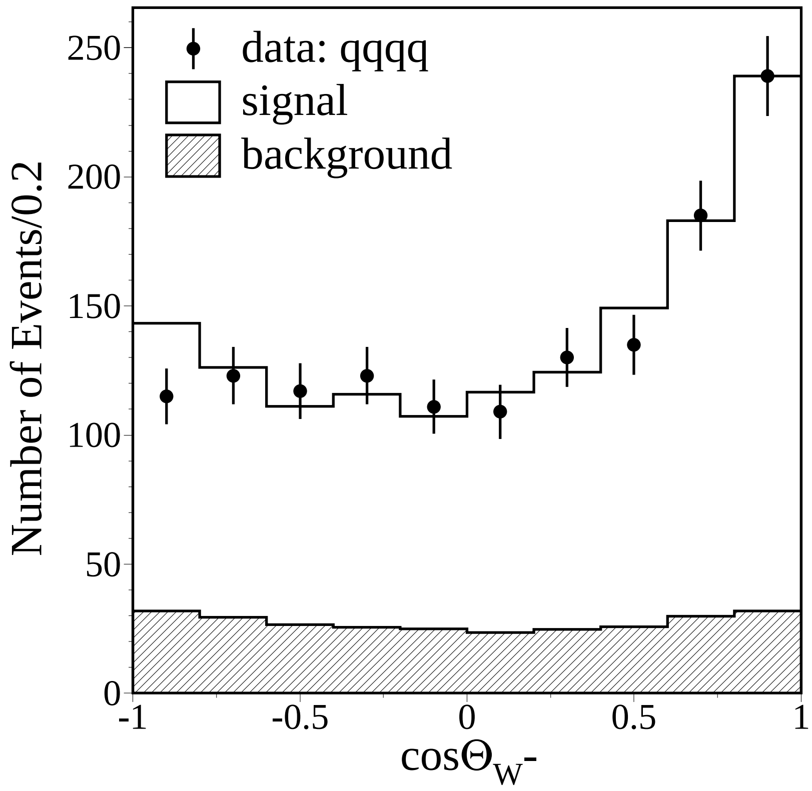


1998 data only: statistical error 93 MeV

All data together: statistical error 76 MeV

Anomalous Couplings



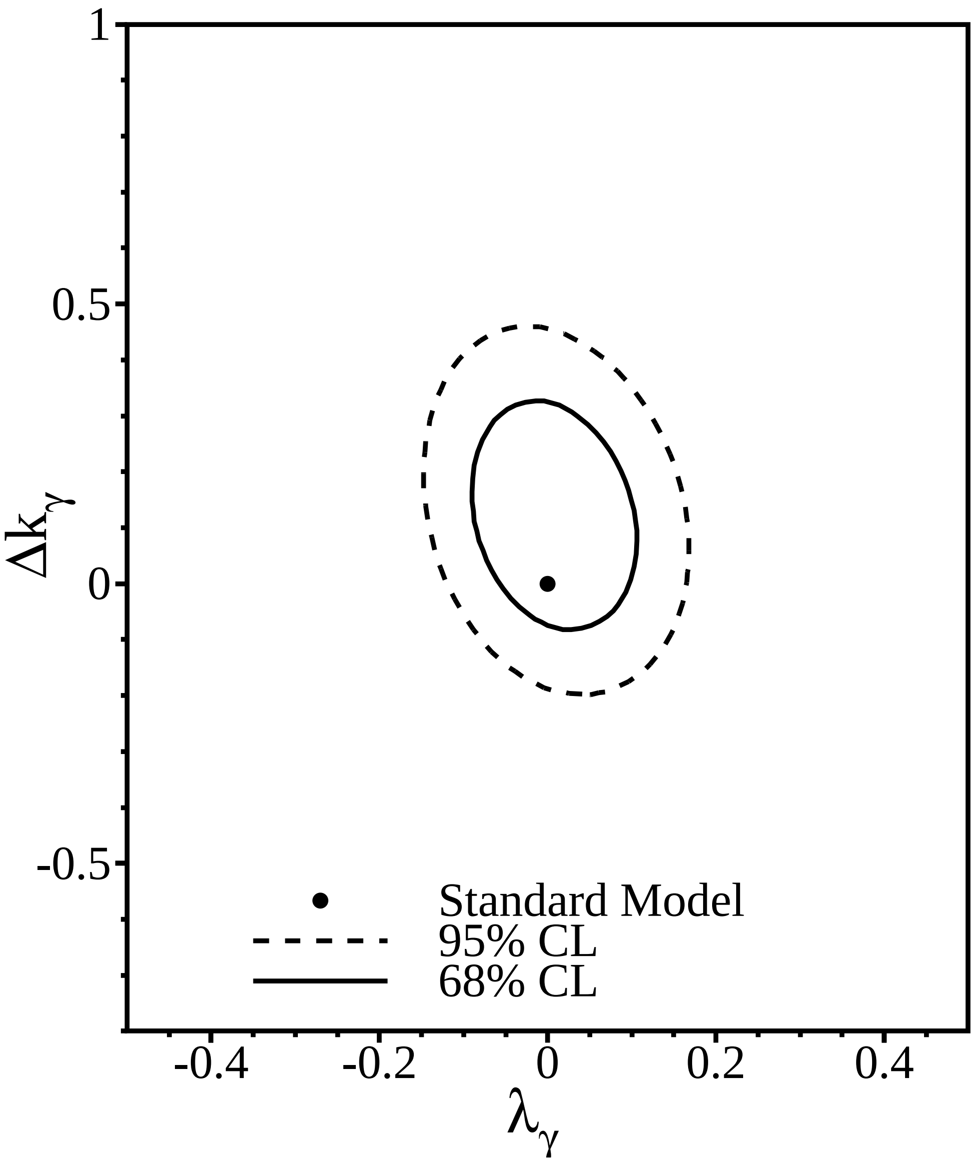


Anomalous Couplings

◦ One-parameter fit:

$$\Delta g_1^Z = -0.03 \pm 0.06$$
$$\Delta\kappa_\gamma = 0.12 \pm 0.13$$
$$\lambda_\gamma = 0.02 \pm 0.06$$

◦ Combined fit $\Delta\kappa_\gamma$, λ_γ:

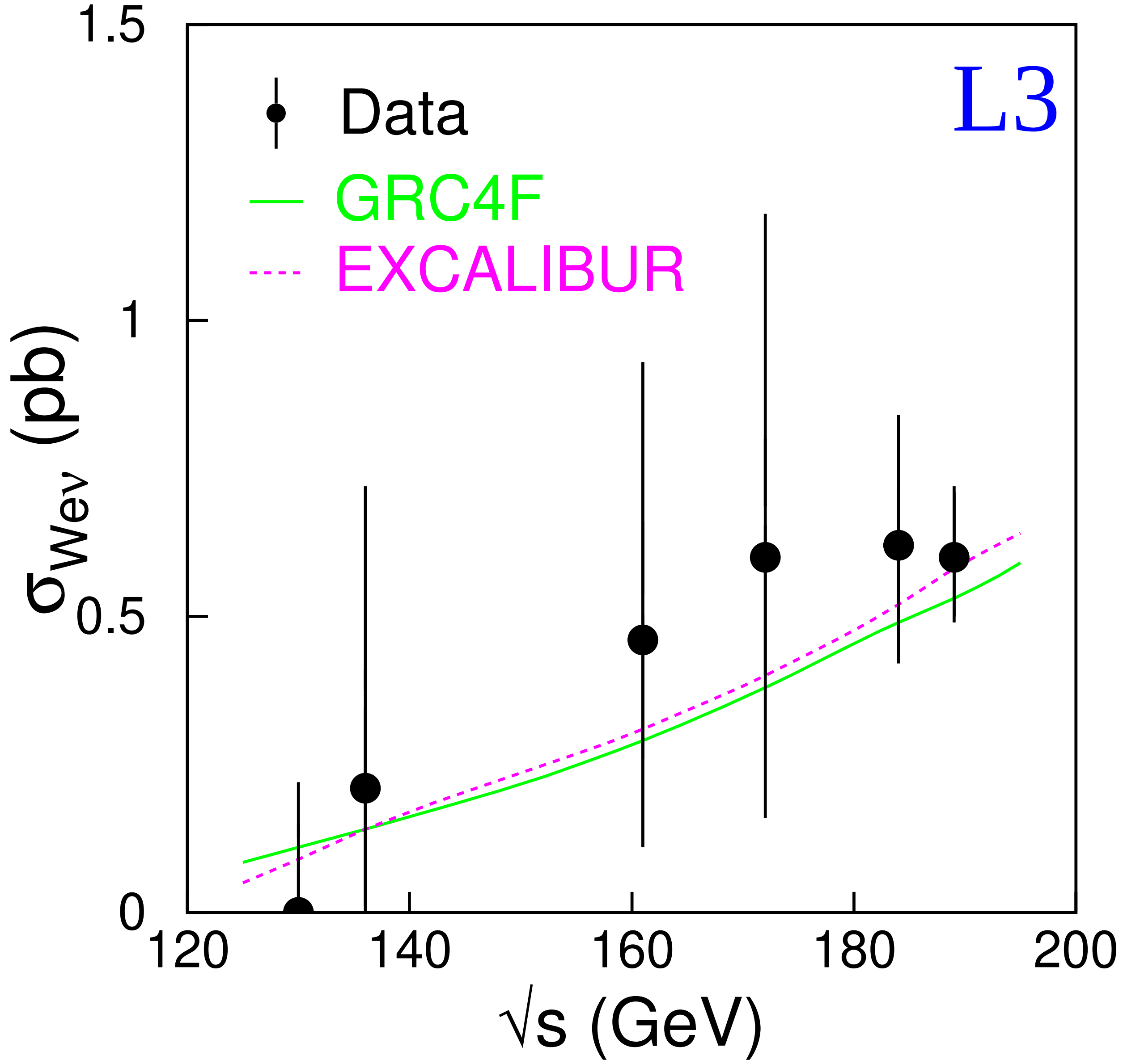


Single W Production

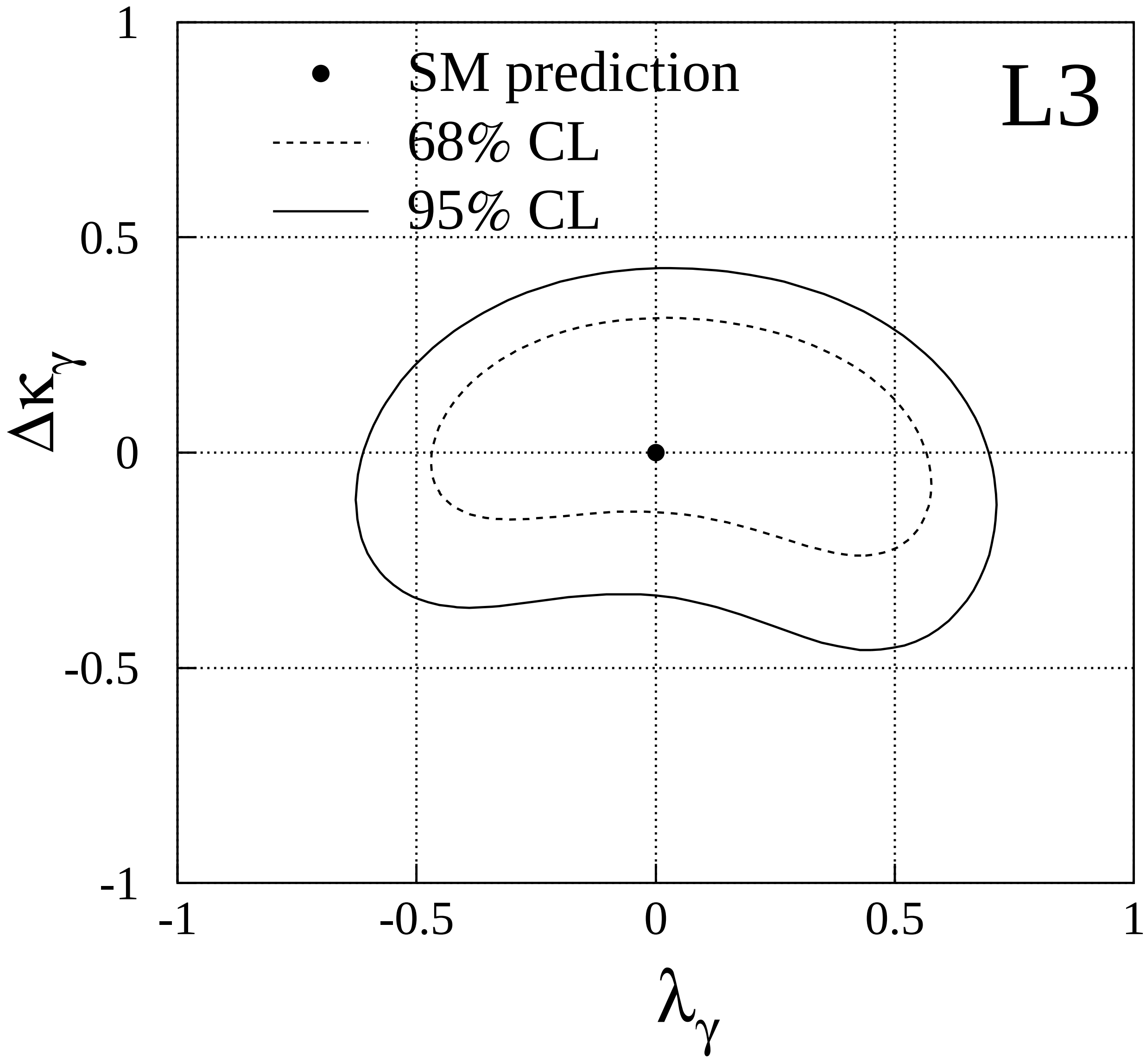
Leptonic W decays: 21 events found; 25 expected

Hadronic W decays: fit to NN distribution

Measured cross-section: 0.60 ± 0.12 pb (SM: 0.52 pb)



Single W Production



$\Delta\kappa_\gamma$ limit is comparable to that from W pairs.

New Heavy Leptons

No signal seen

Unstable Neutral Lepton

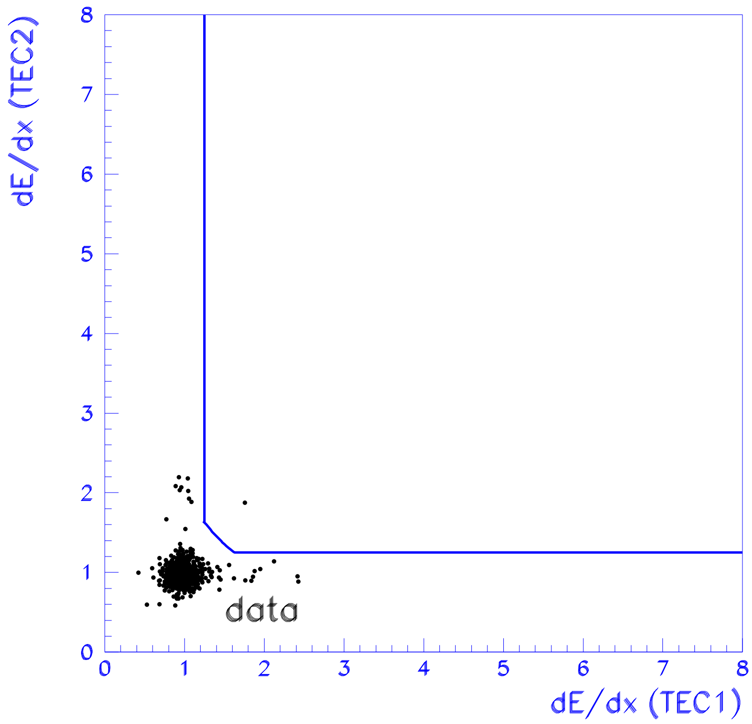
Decay Mode	Dirac	Majorana
$L^0 \rightarrow eW$	$m > 92.3$	81.1 GeV
$L^0 \rightarrow \mu W$	$m > 93.3$	83.1 GeV
$L^0 \rightarrow \tau W$	$m > 82.5$	71.3 GeV

Unstable Charged Lepton

$L^{\pm} \rightarrow \nu W$ $m > 90$ GeV

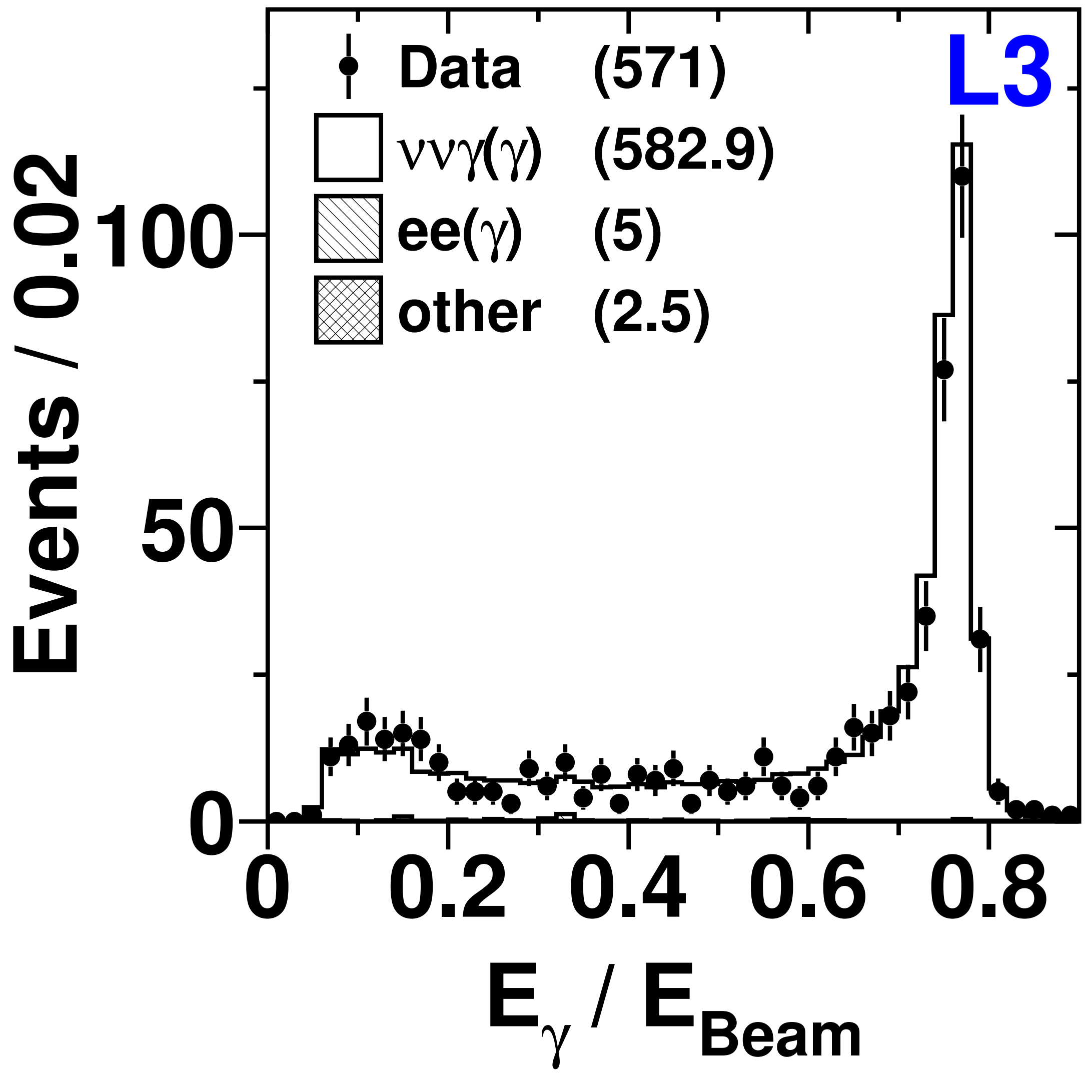
Stable Charged Lepton

189 GeV Data L=176pb-1

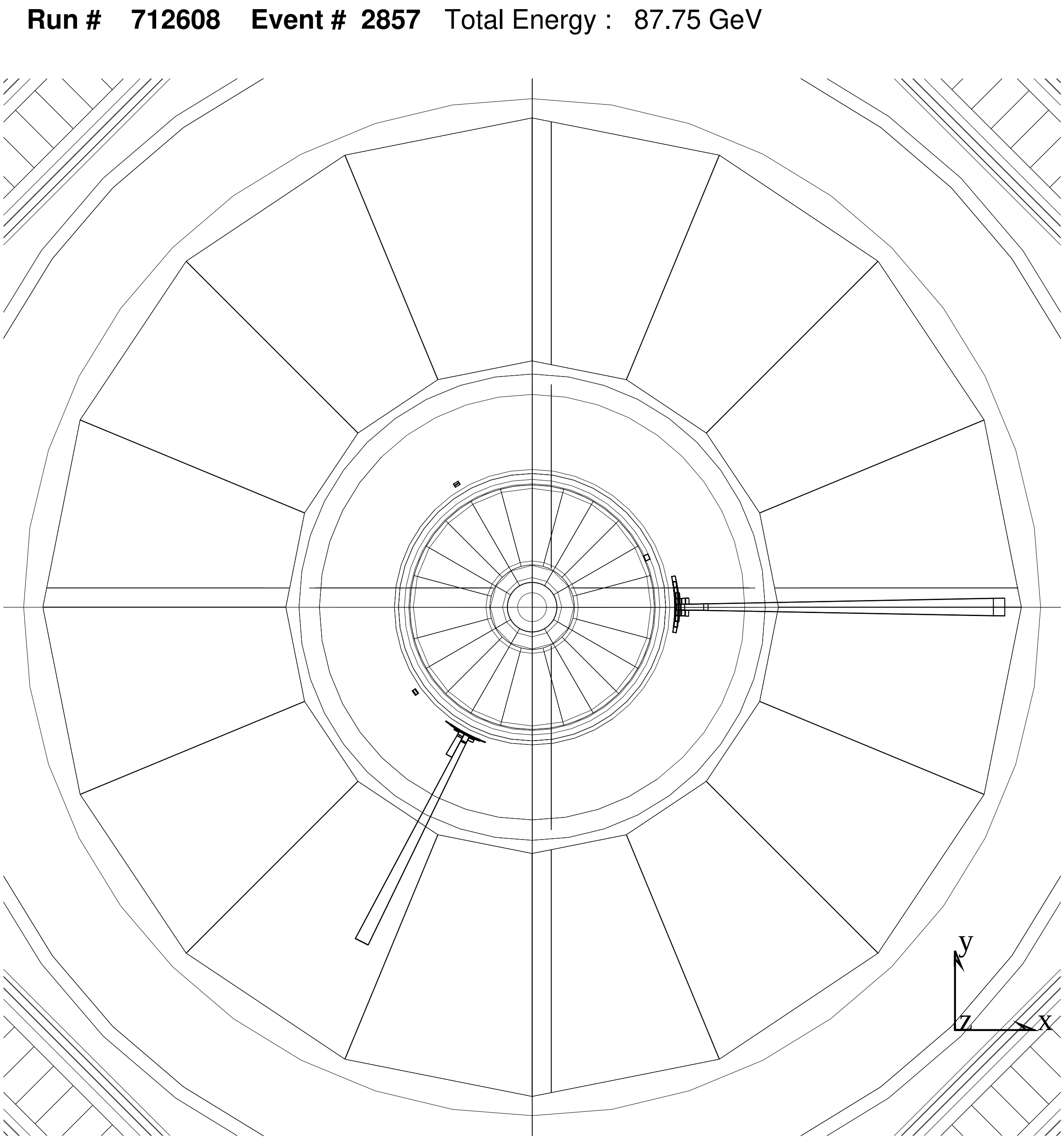


$m > 93.5$ GeV

$\nu^*\nu$ events would contribute to this spectrum:



A $\nu^*\nu^*$ event would look like:



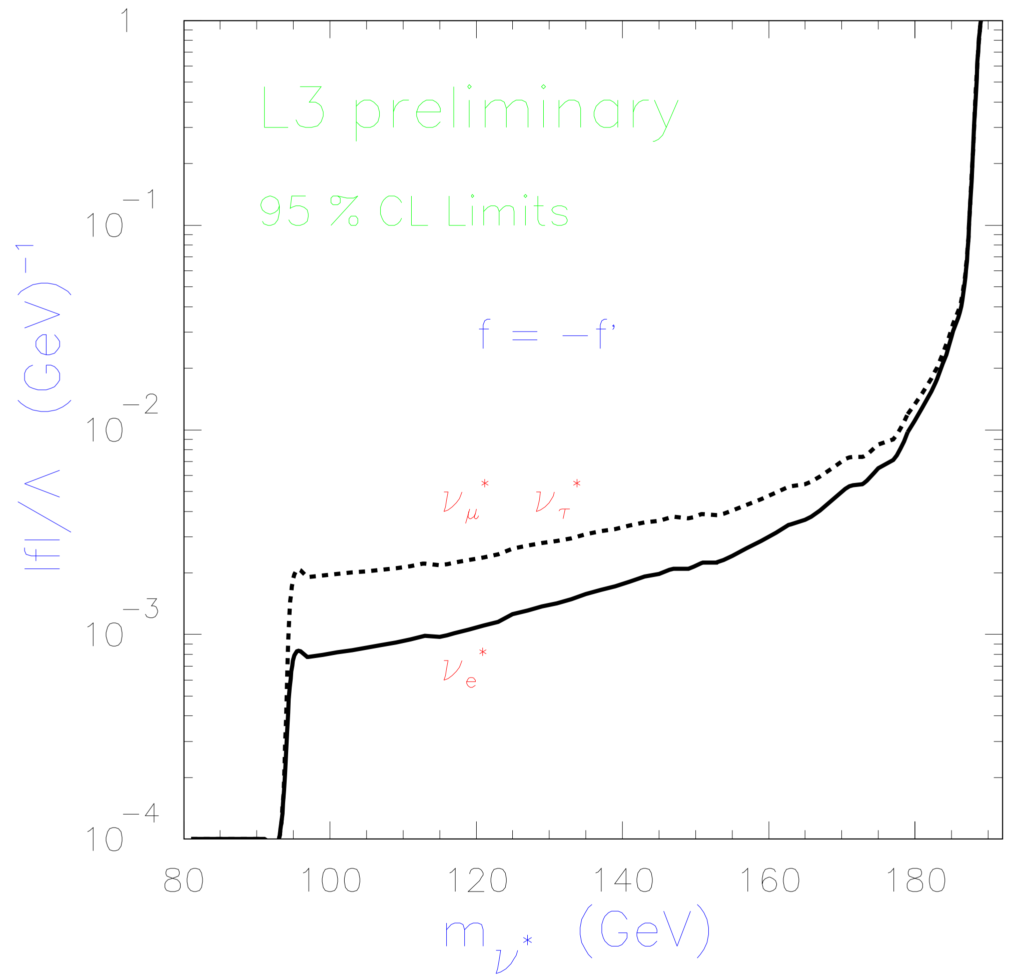
Excited Lepton Searches

Pair Production :

$$\left.\begin{array}{l} m_{e^*} > 94.2 \text{ GeV} \\ m_{\mu^*} > 94.2 \text{ GeV} \\ m_{\tau^*} > 94.2 \text{ GeV} \end{array}\right\} \quad (f = f')$$

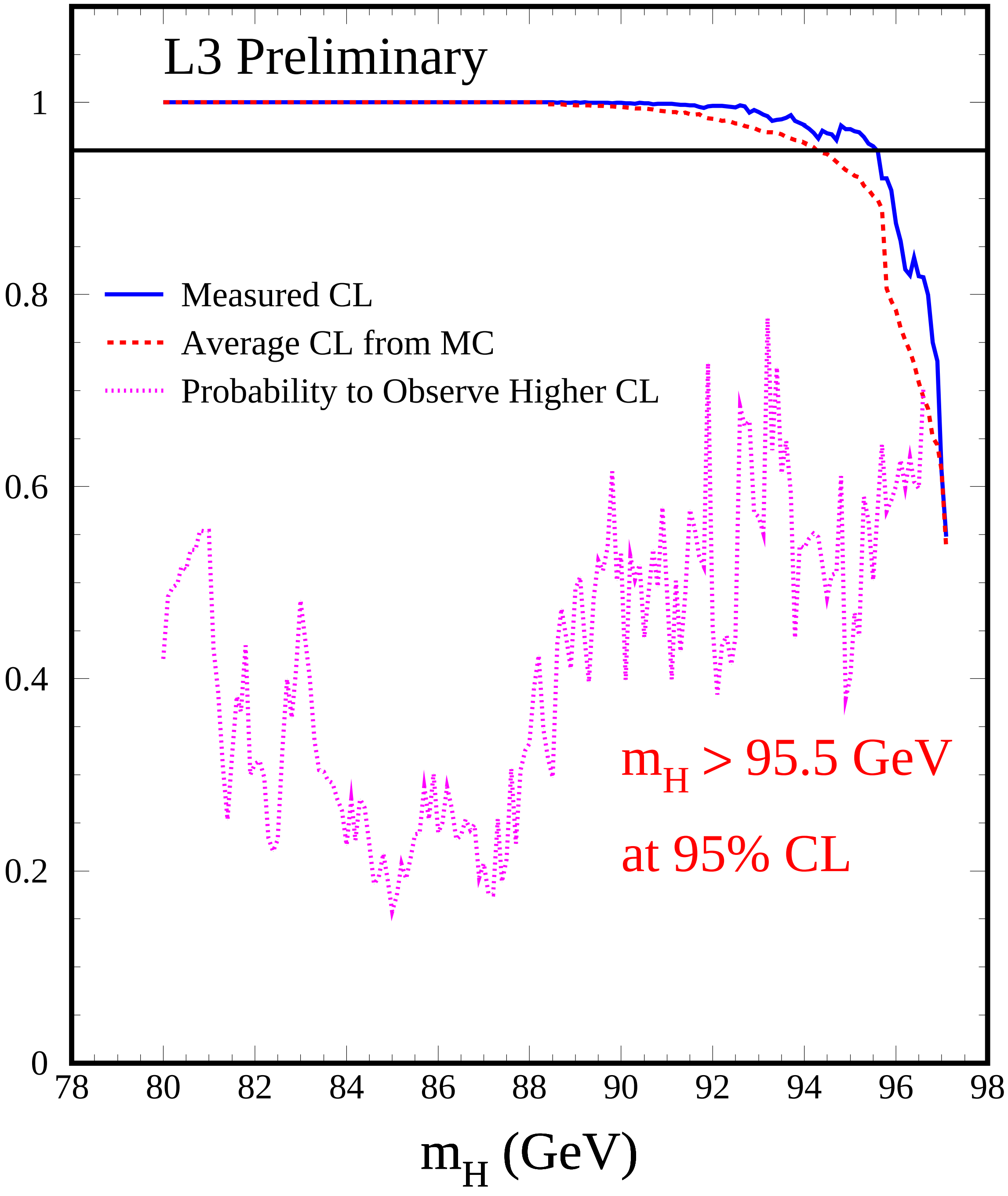
$$m_{\nu^*} > 94.0 \text{ GeV} \quad (f = -f')$$

Single production of excited neutrinos:



Standard Model Higgs

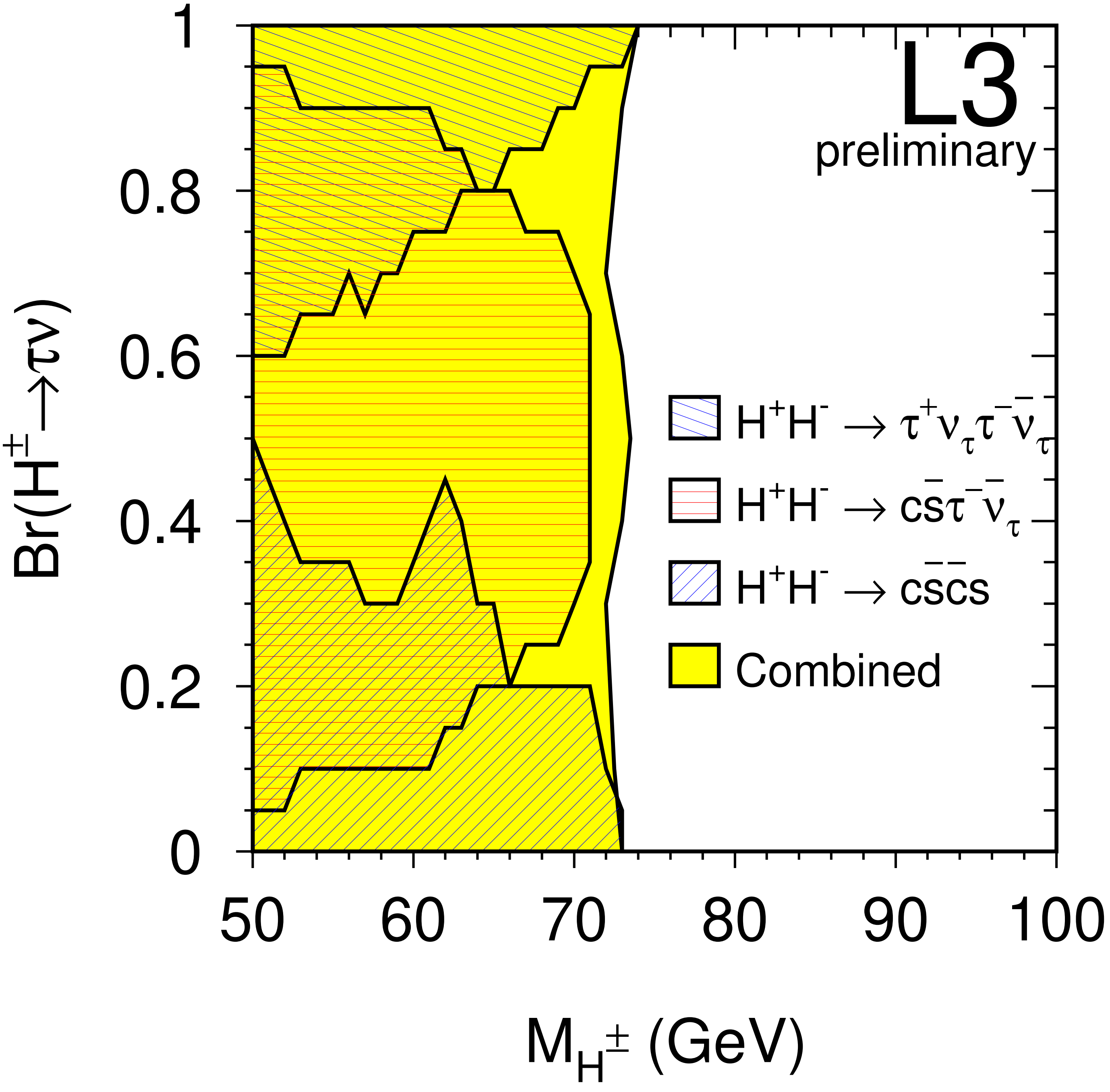
No Standard Model Higgs Signal Observed in 189 GeV Data.



$m_H > 95.5$ GeV

Charged Higgses

No Charged Higgs Signal Observed in 189 GeV Data.



$m_{H^\pm} > 72.0$ GeV

SUSY Searches

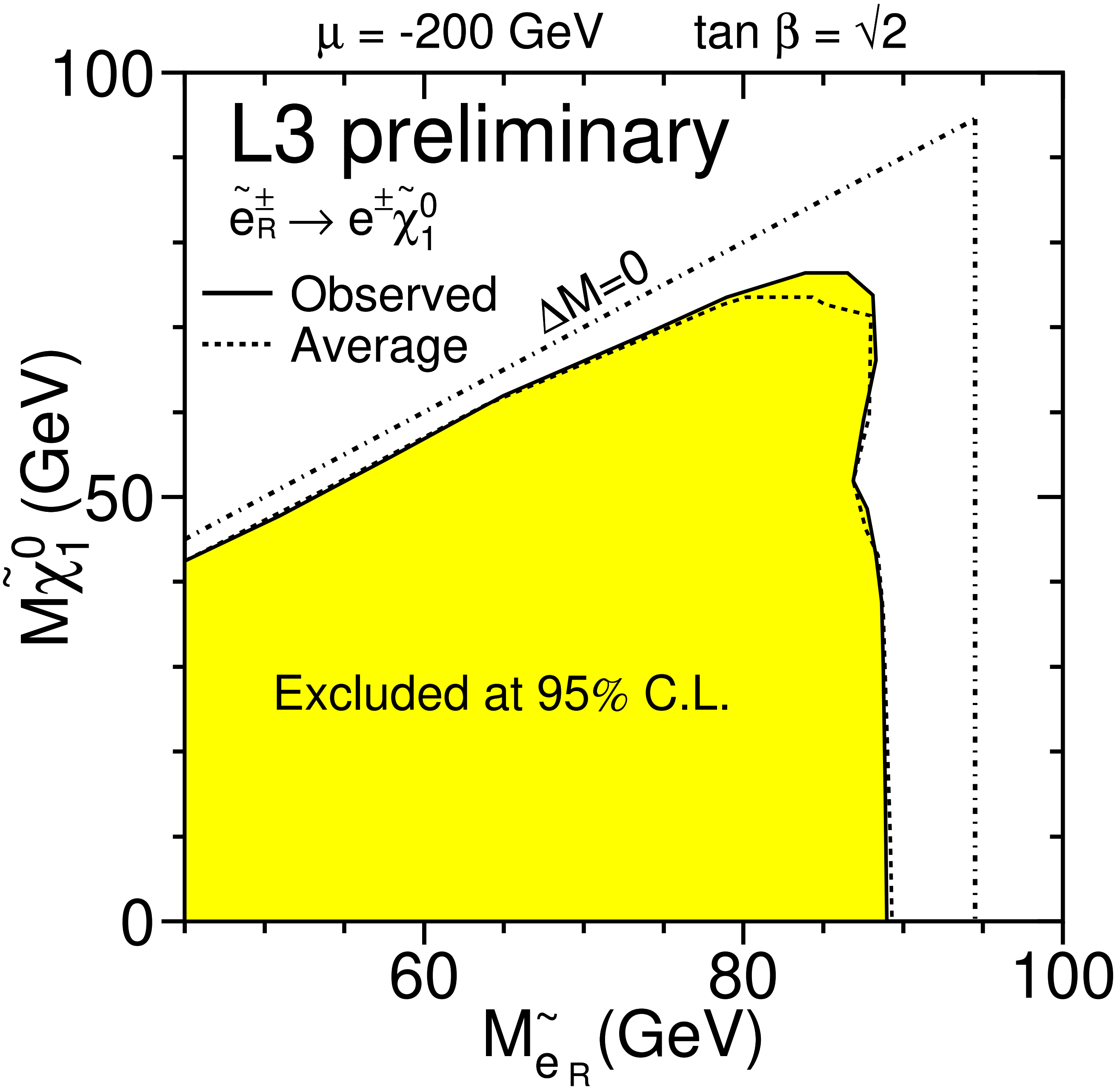
- Chargino selections
  - 4 jets and $\not\!\!E$
  - 1 e/μ, 2 jets and $\not\!\!E$
  - 1 τ, 2 jets and $\not\!\!E$
  - 2 e/μ and $\not\!\!E$
  - 2 τ and $\not\!\!E$
- selectron: 2 e and $\not\!\!E$
- smuon: 2 μ and $\not\!\!E$
- stau: 2 τ and $\not\!\!E$

For each selection, 3 ΔM ranges.

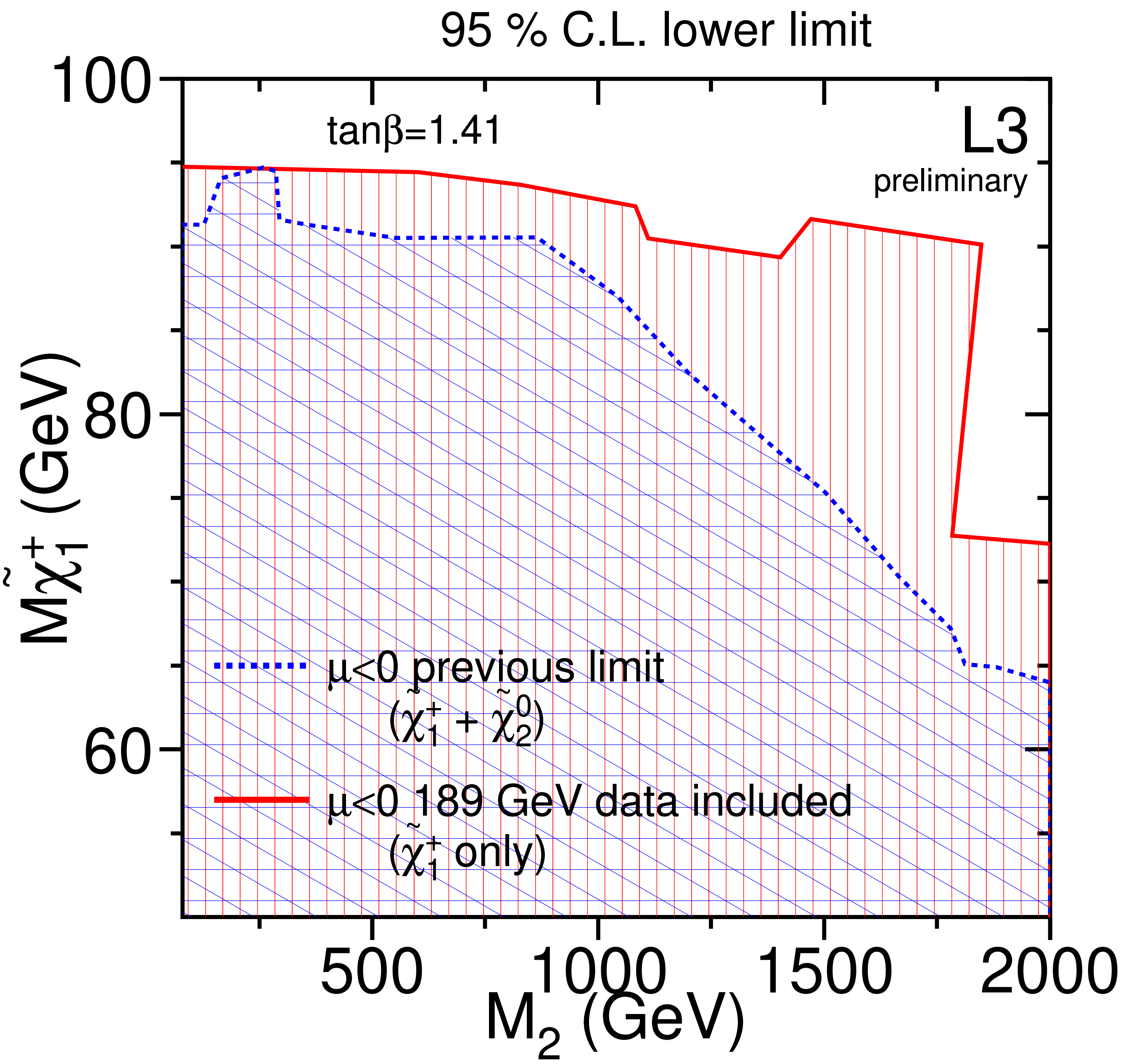
	Low ΔM		Medium ΔM		High ΔM		.OR.	
	N_{data}	N_{exp}	N_{data}	N_{exp}	N_{data}	N_{exp}	N_{data}	N_{exp}
$\tilde{\chi}^{\pm}$	11	8.51	7	3.69	7	11.1	24	22.1
$\tilde{e}$	0	2.19	1	0.60	4	3.44	5	6.04
$\tilde{\mu}$	2	0.50	2	0.71	5	4.77	7	5.48
$\tilde{\tau}$	6	1.51	4	3.46	3	5.50	11	7.60
.OR.	17	12.4	11	6.94	15	19.8	38	34.4

No signal seen

Example exclusion:



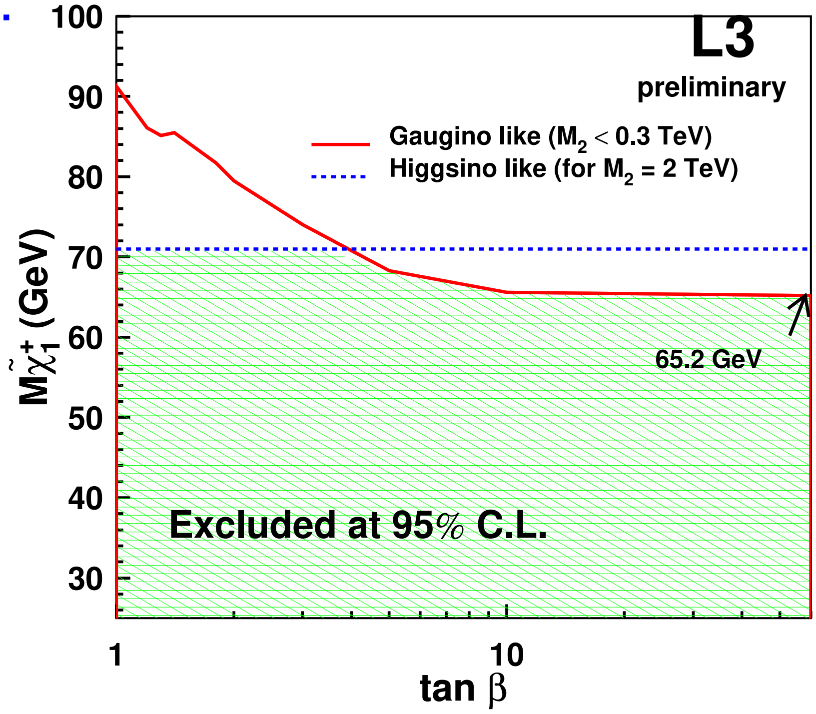
Chargino limits



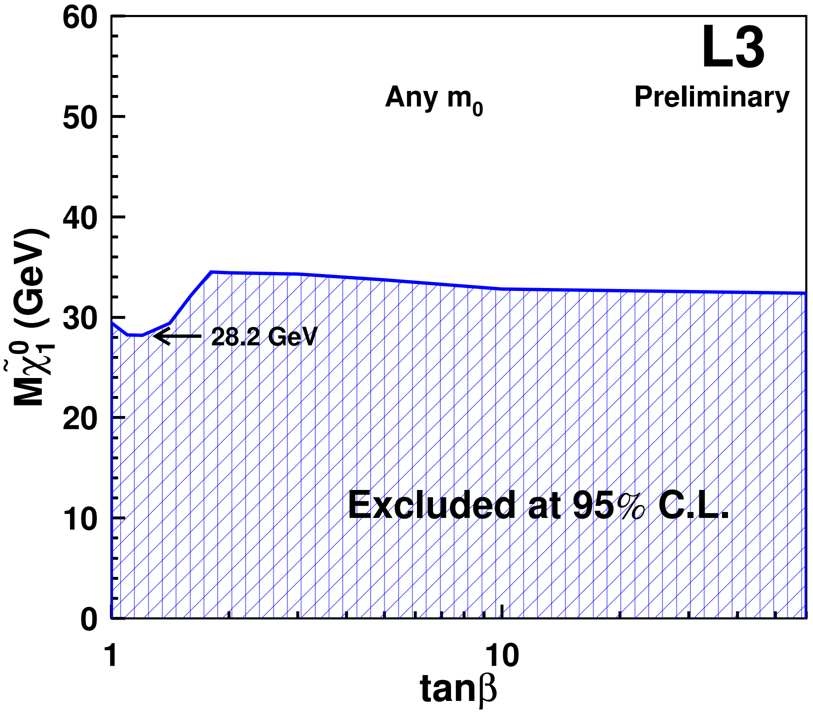
Significant improvement due to increased luminosity and more refined chargino analysis.

Chargino and Neutralino Limits

For any m_0:

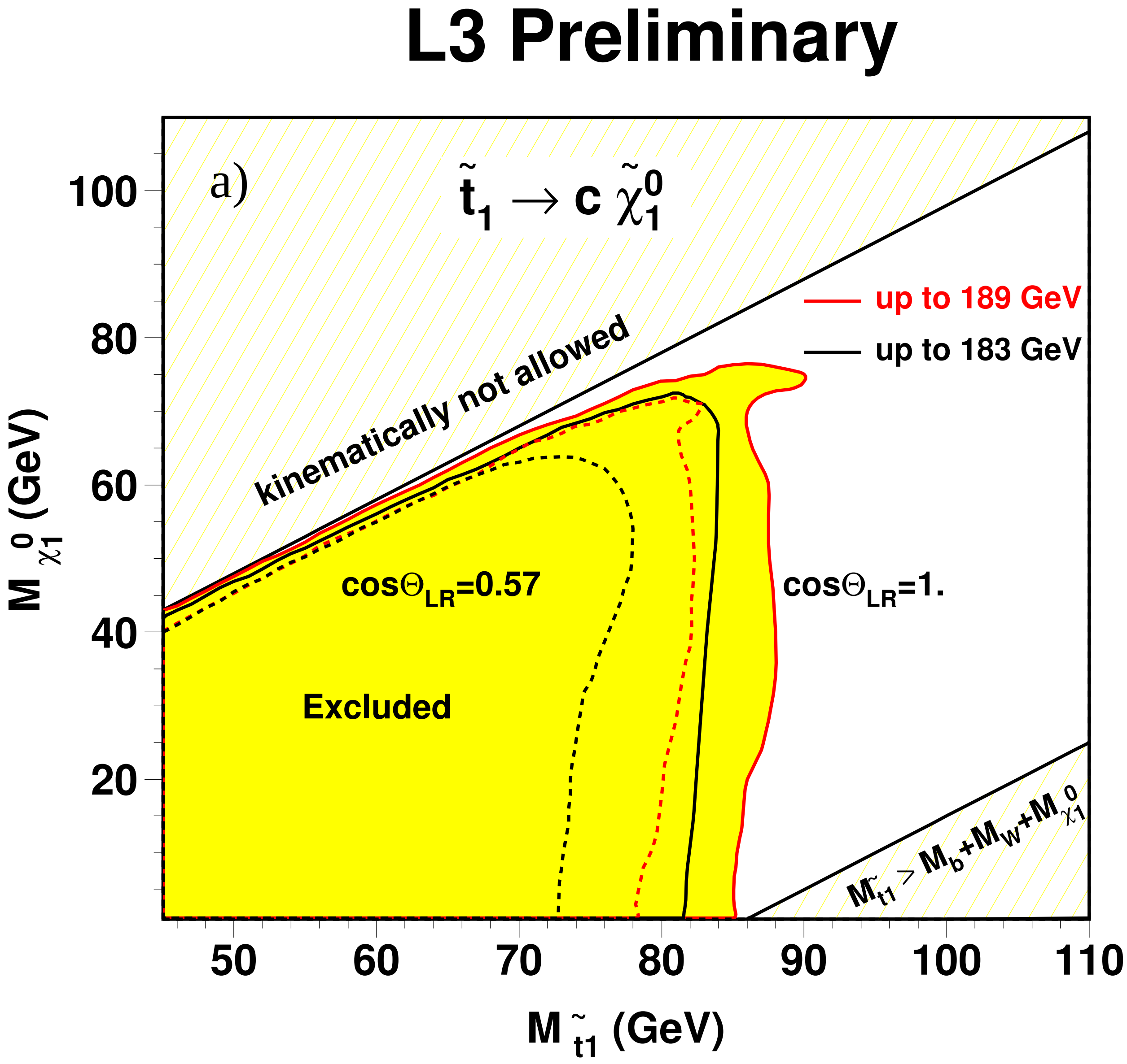


$m_{\tilde{\chi}_1^+} > 65.2$ GeV



$m_{\tilde{\chi}_1^0} > 28.2$ GeV

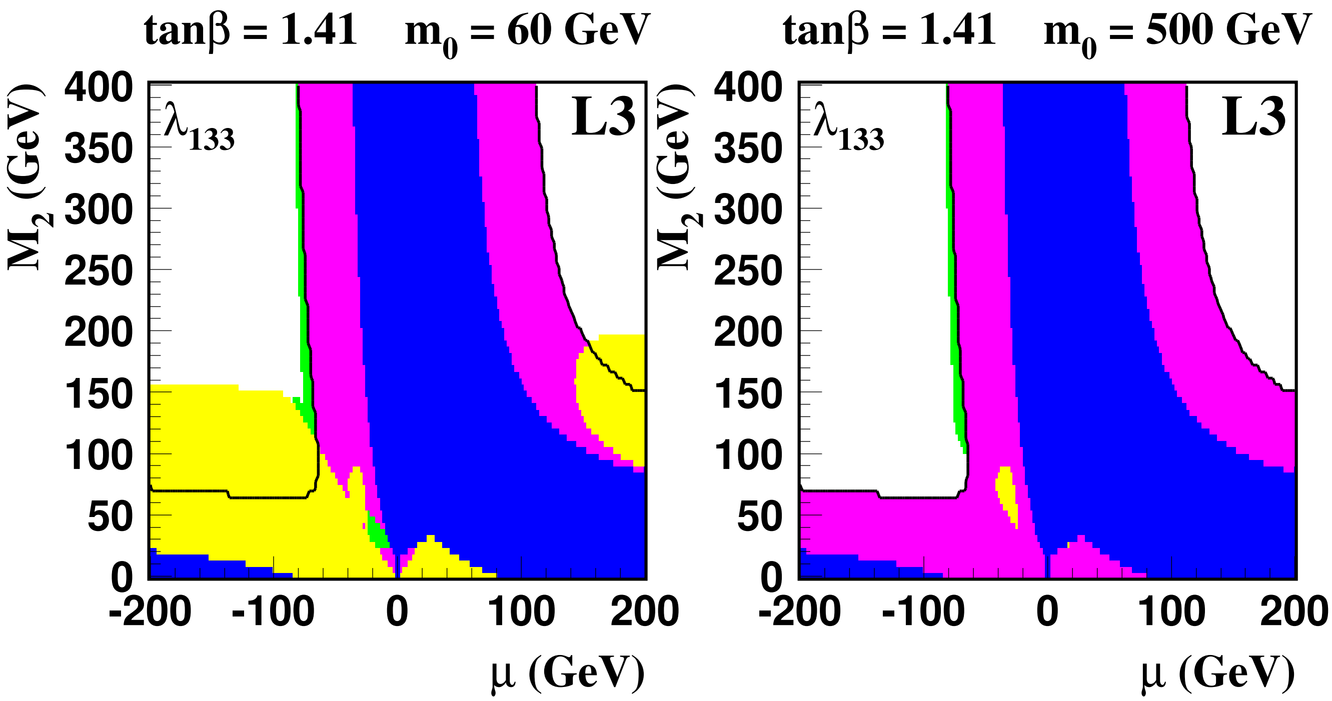
Also here, no signal seen...



R-parity violating SUSY

Selections similar to “normal” SUSY, except $\not{E}$ replaced by jets or leptons...

5 events found; 4.5 background expected



$m_{\tilde{\chi}^0_1} > 30.6$ GeV

Results similar to the “normal” SUSY.

Running in 1999

- We need 2.5 pb^{-1} at Z at the beginning of the run.

- Once this has been done, we would like to go to the highest possible energy as soon as compatible with good running conditions

- A reasonable number of steps in energy is OK

- We are looking forward to seeing LEP **200** realized next year.