TGC Measurement in $e^+e^- \to W^+W^- \to 4q$ using total σ and angular distributions

Status Report

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DELPHI week

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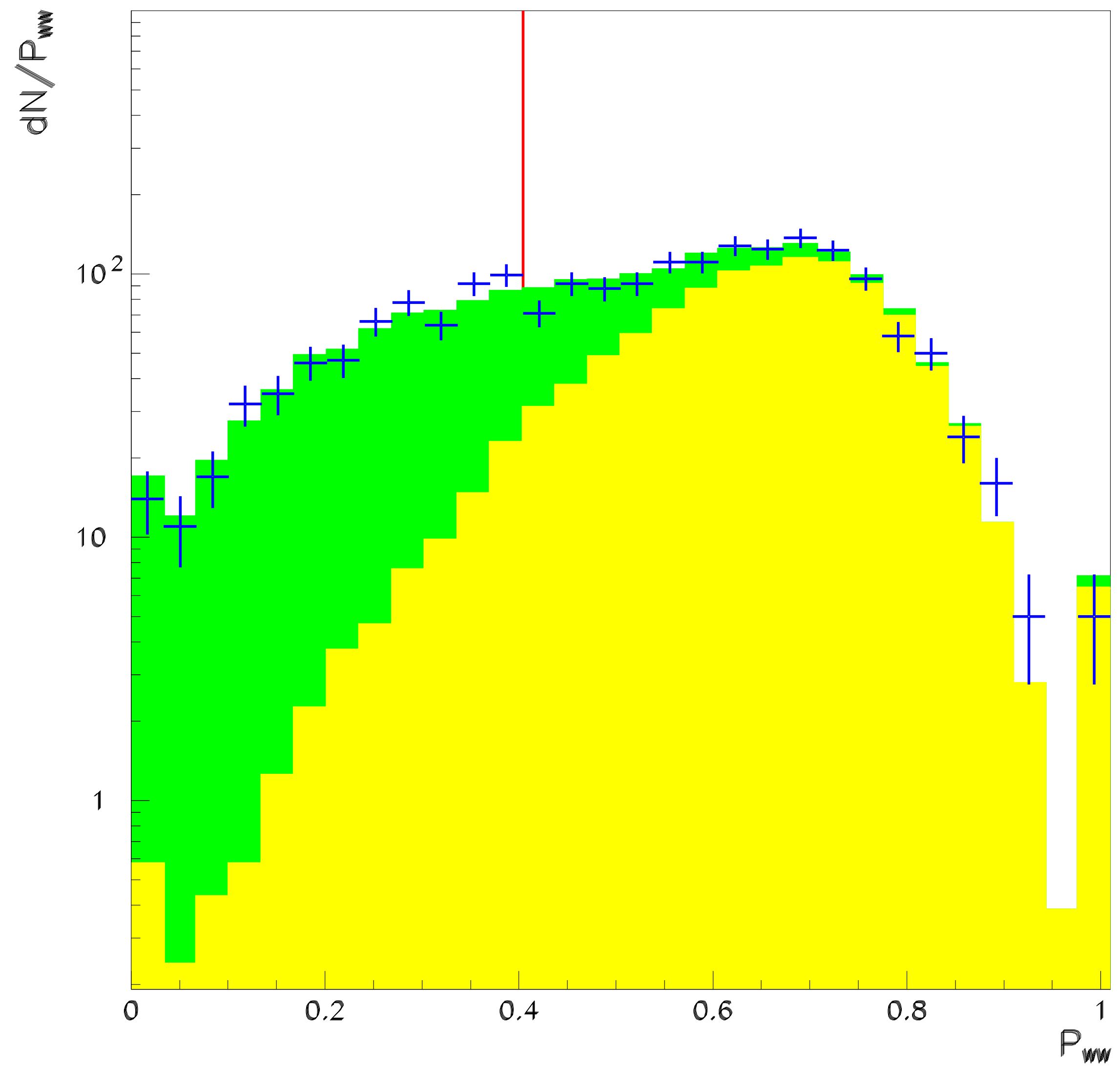
Status

Status:

- D2 processing, no run selection, $L = 157.65pb^{-1}$
- Greater MC samples
- New pairing (Neural network - 78% efficiency)
- No comparison with σ_{Delphi} yet
- Some systematics

Event Selection

Distribution of events according to P_{WW} separator.

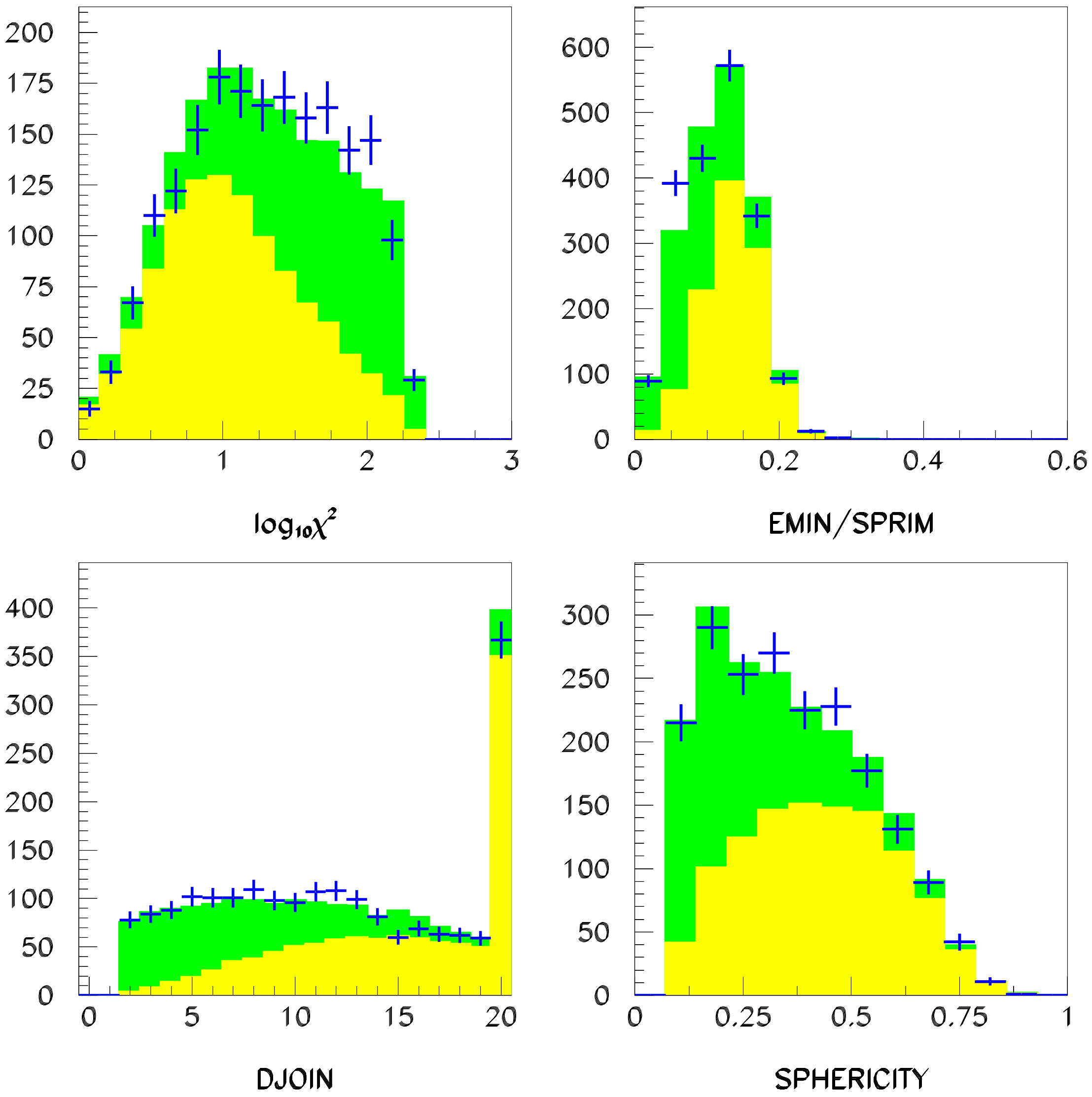


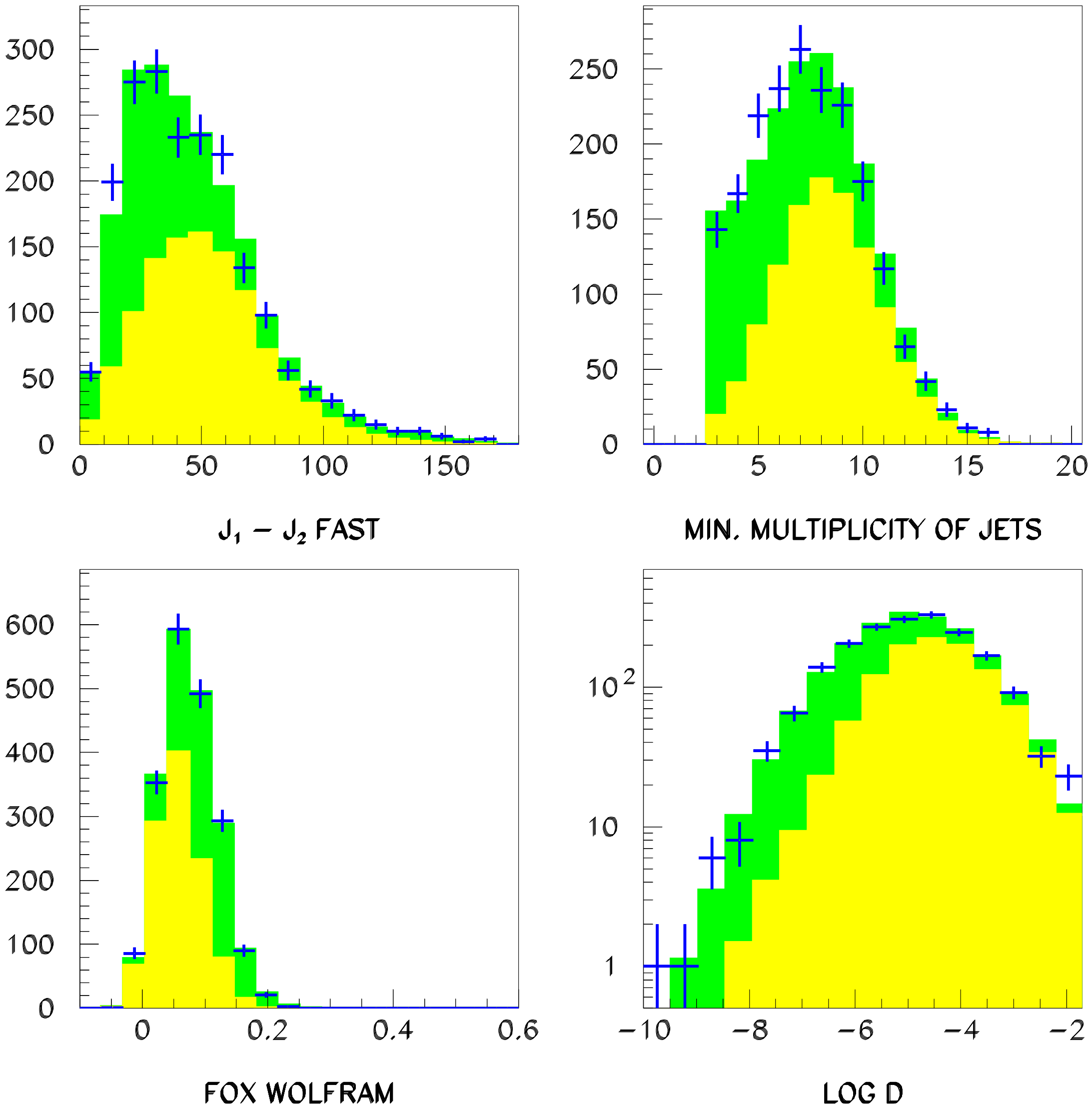
We cut at $P_{WW} = 0.40$ (arrow):

- $\eta = 86.6 \pm 0.2\%$,
- $Pur = 74.4 \pm 0.4\%$
- 1331 measured events survive the cut.

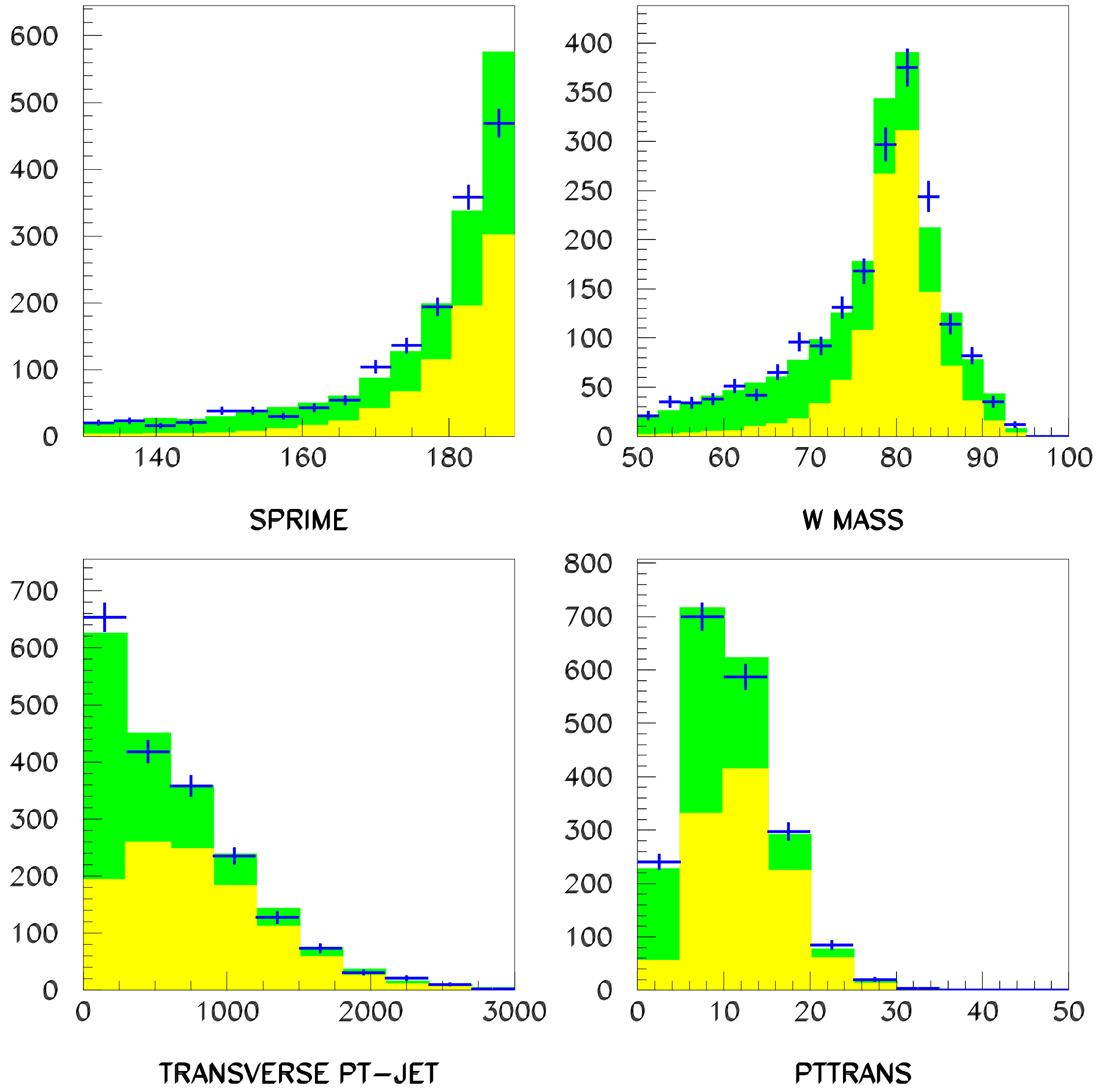
Kinematical distributions

Some kinematical distributions plotted





J1 − J2 FAST
MIN. MULTIPLICITY OF JETS
FOX WOLFRAM
LOG D

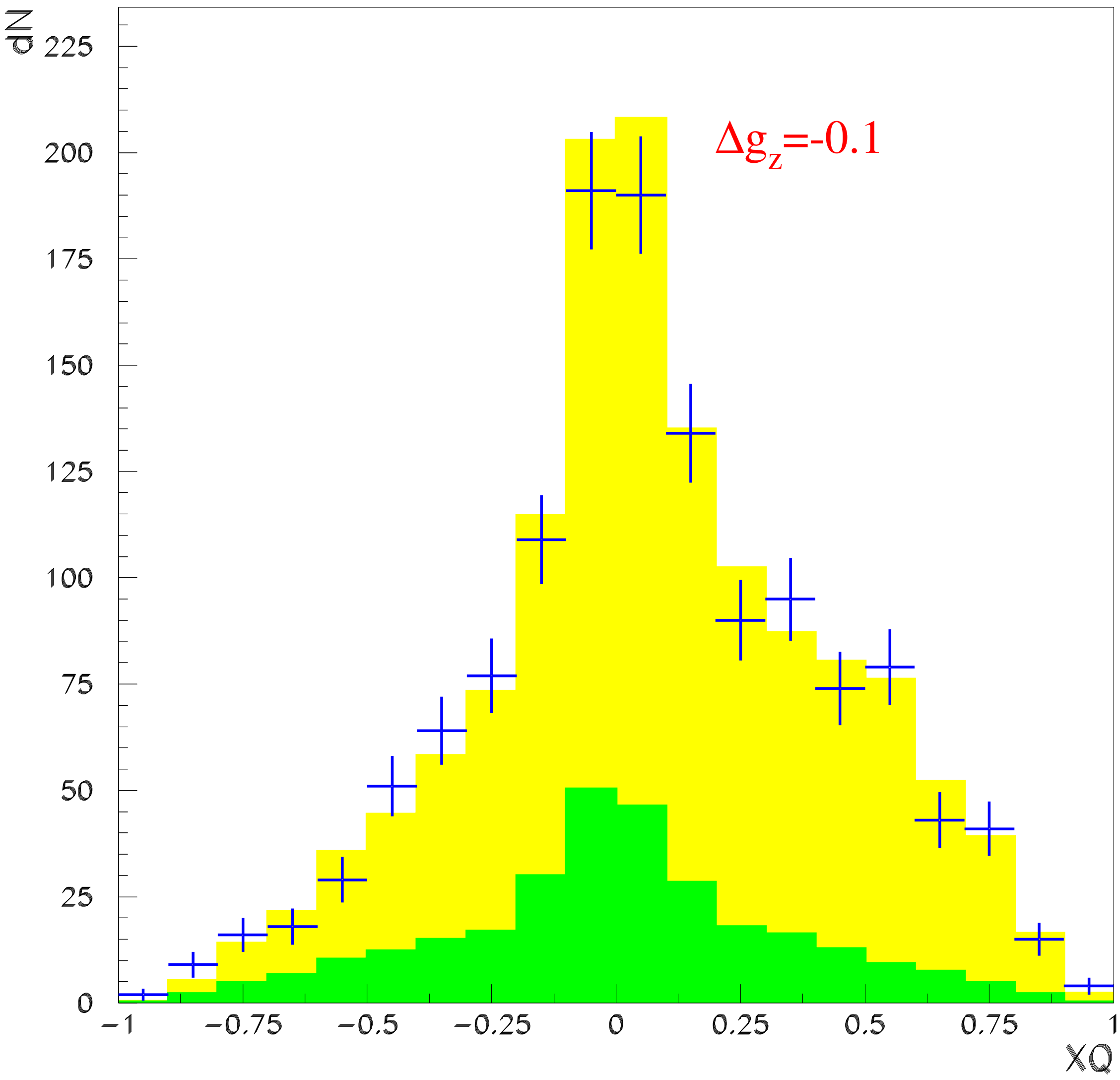


SPRIME
W MASS
TRANSVERSE PT–JET
PTTRANS

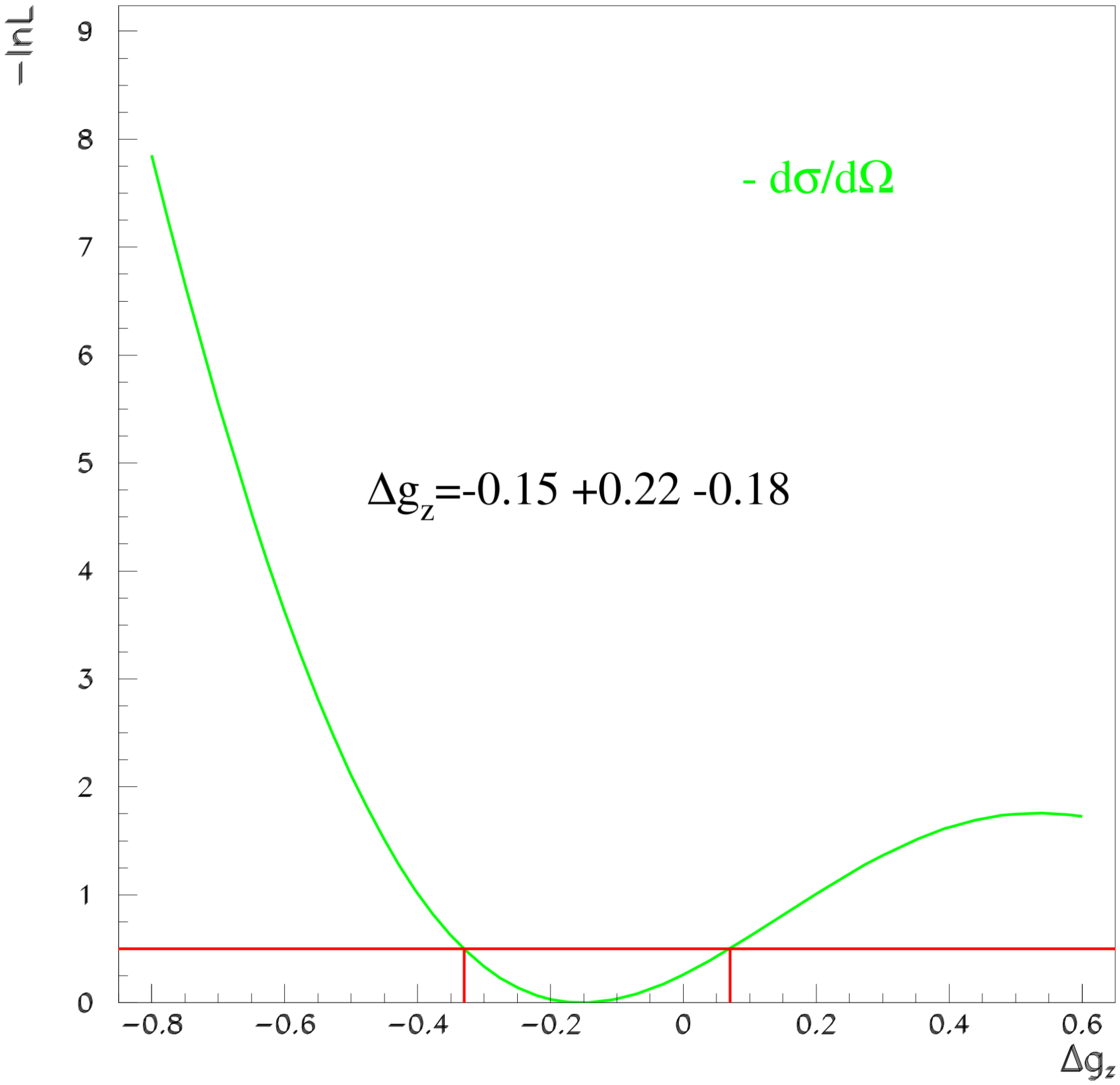
Angular distributions

Distribution of charge weighted $\cos\theta_W$:

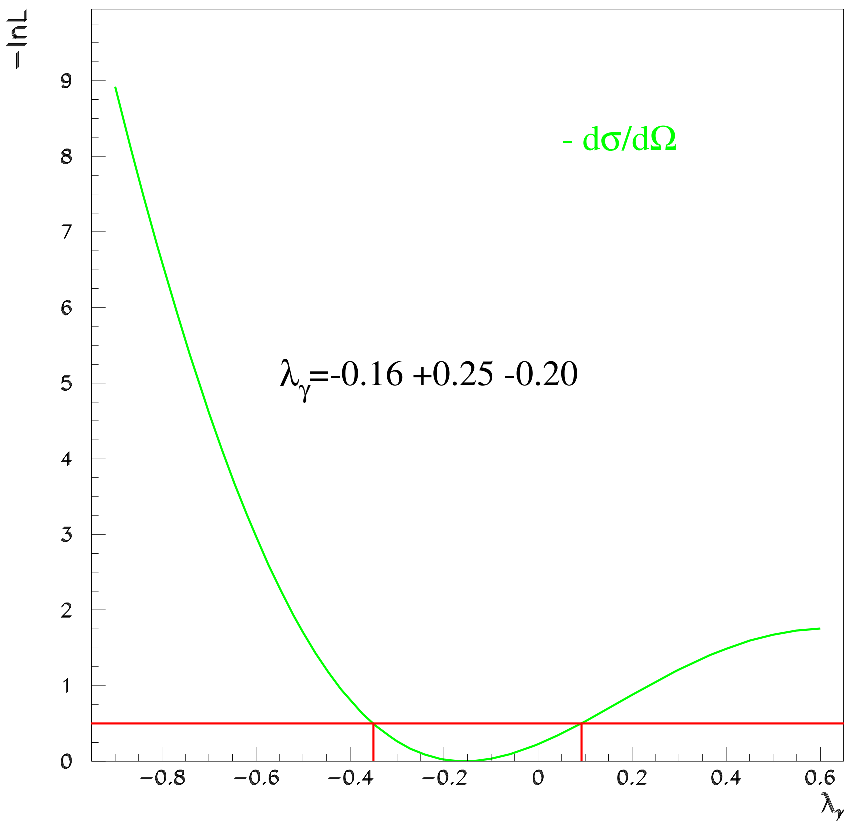
$$XQ = P_{W-}(\Delta Q)\cos\theta_W - (1 - P_{W-}(\Delta Q))\cos\theta_W$$

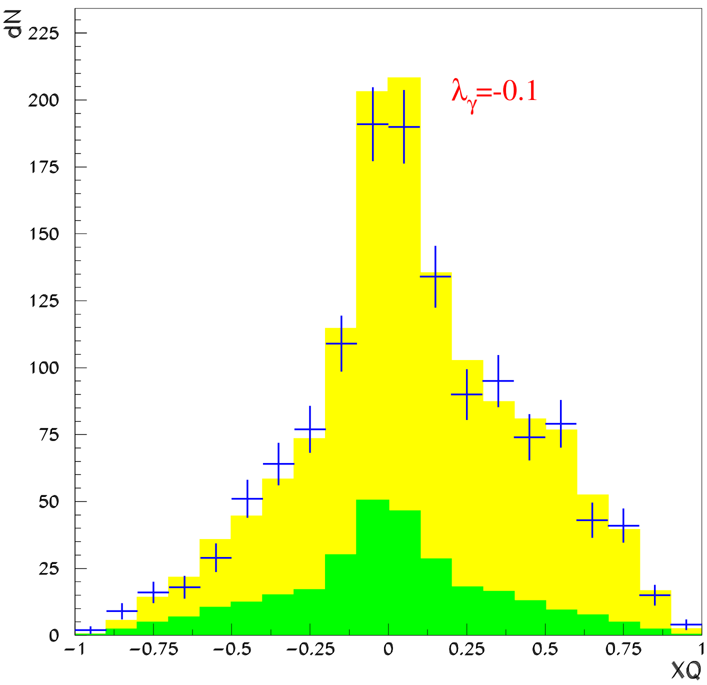


Data-MC comparison for $\Delta g_Z^1 = -0.1$.

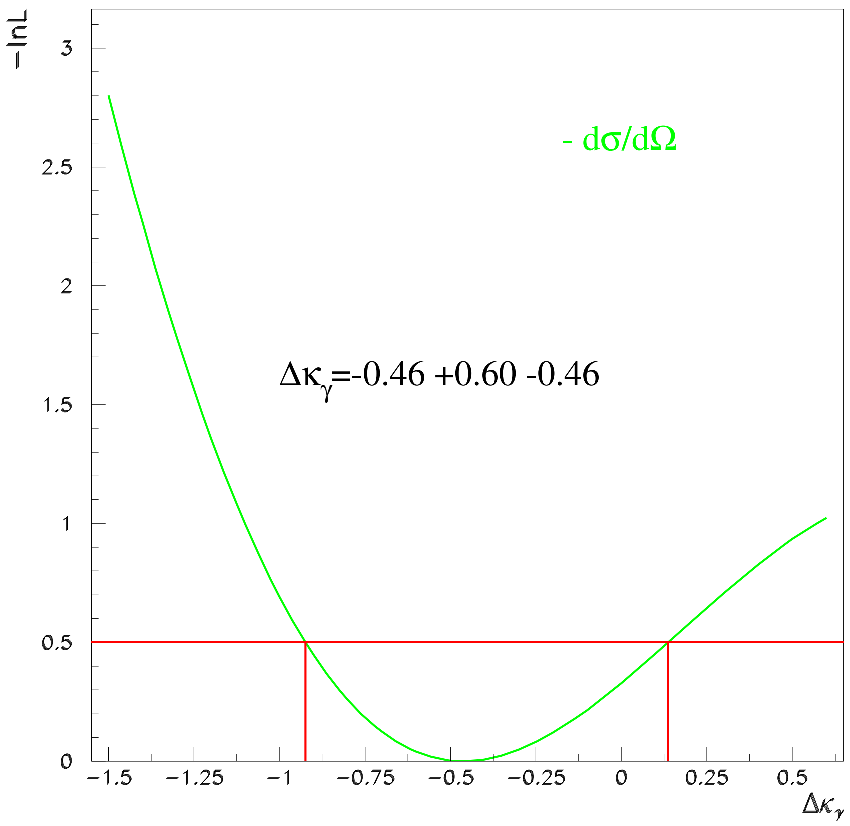


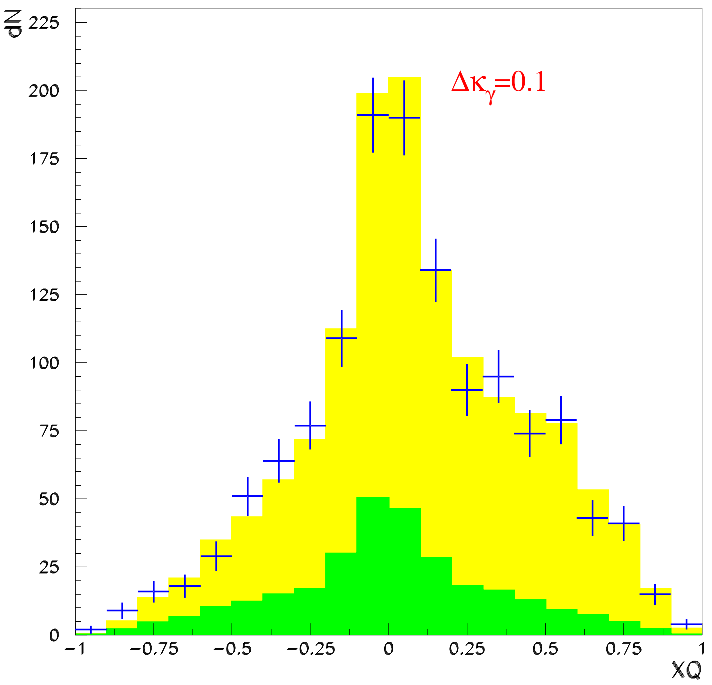
Log likelihood for distribution dependence on Δg_Z^1.





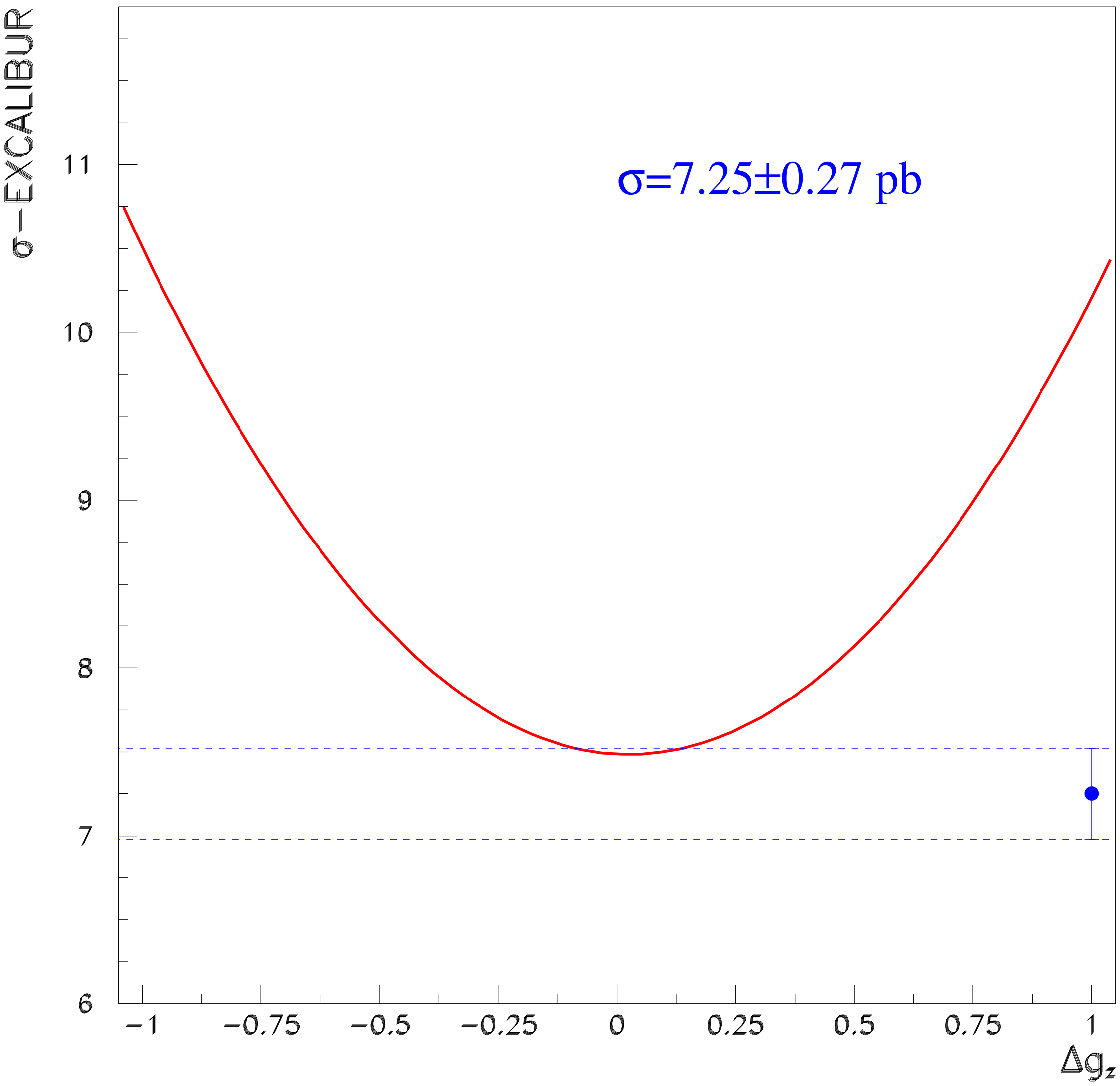
Data-MC comparison for $\lambda_\gamma = -0.1$.



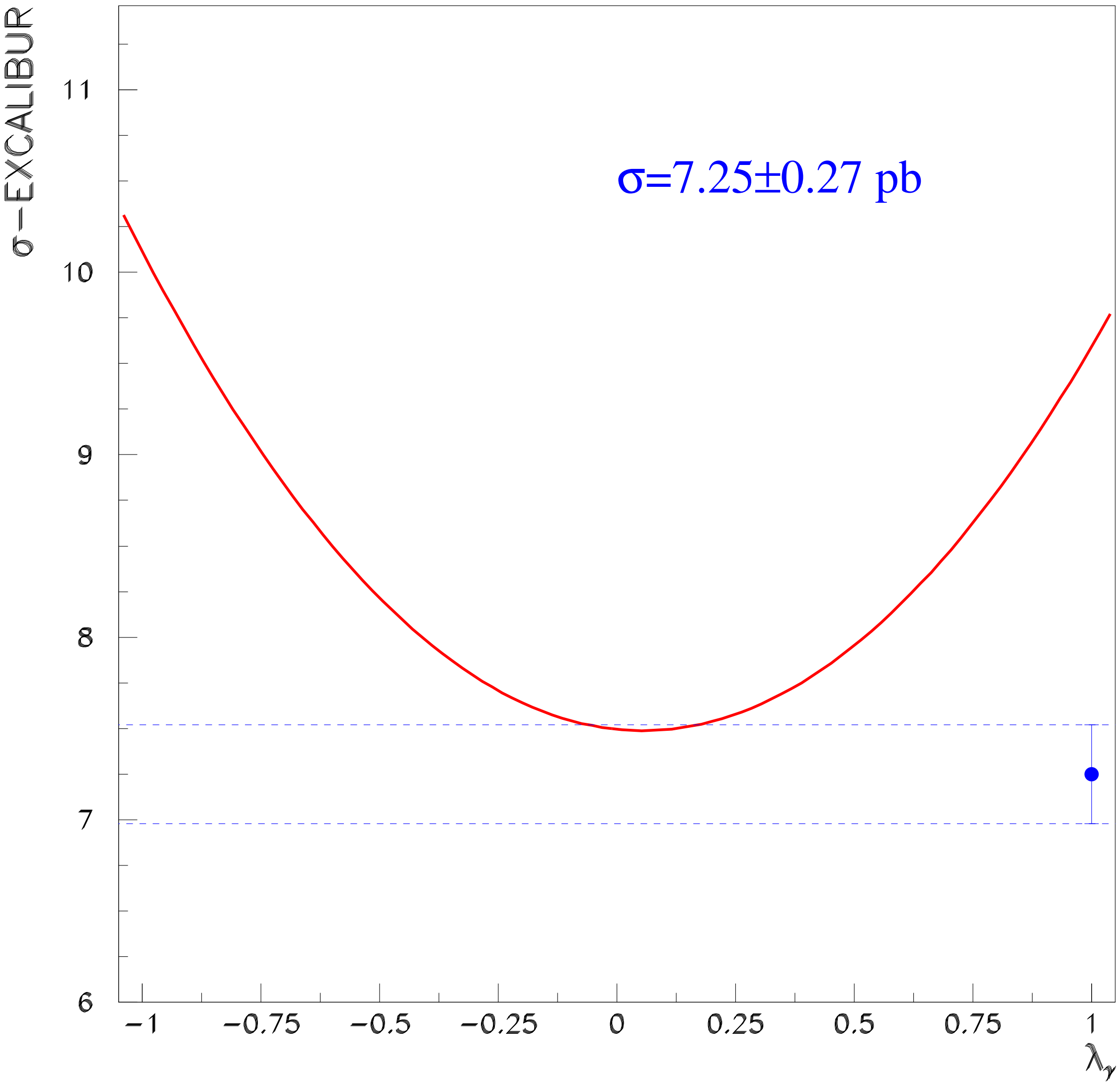


Data-MC comparison for $\Delta\kappa_\gamma = 0.1$

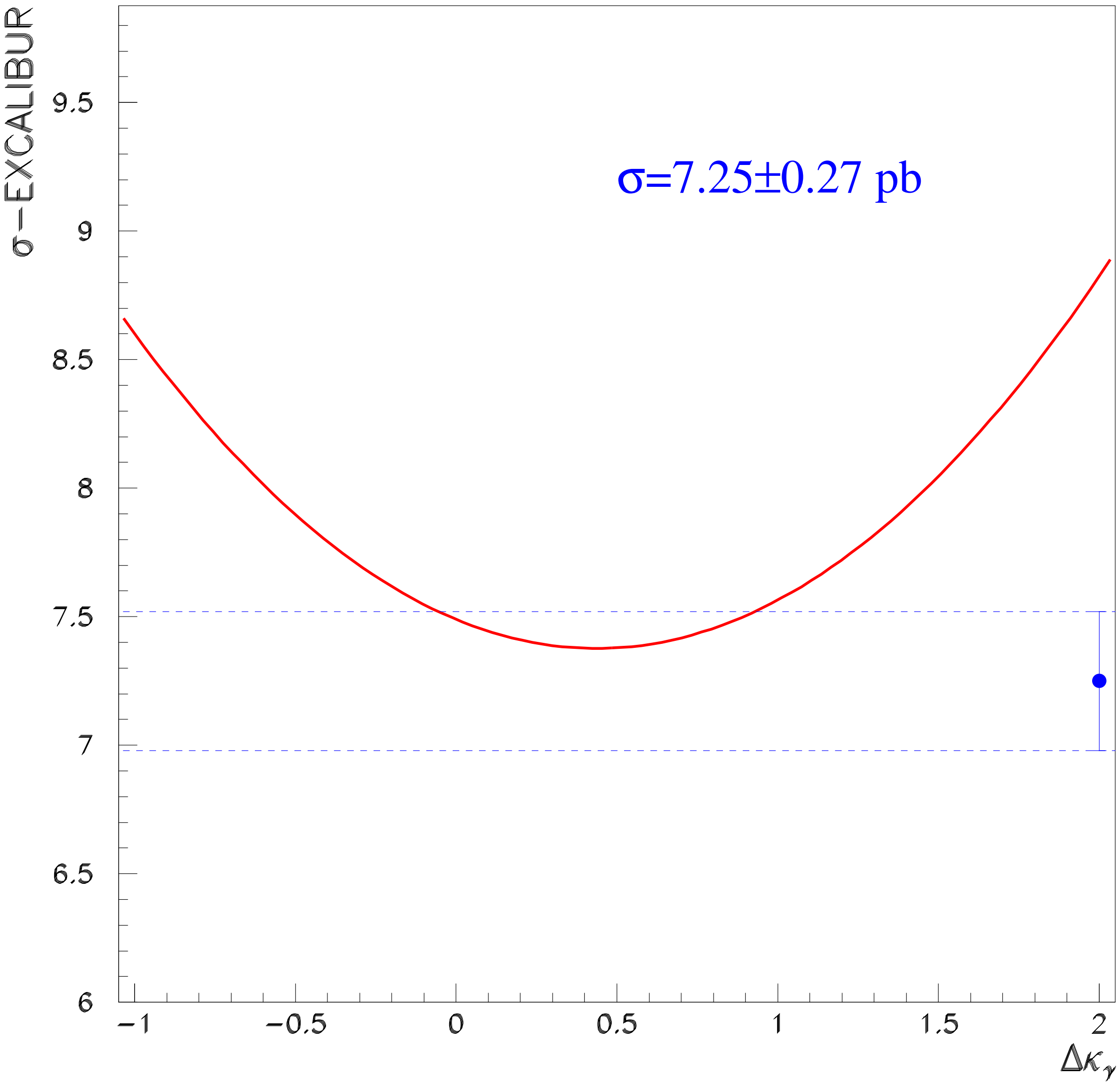
$4q$ cross-section



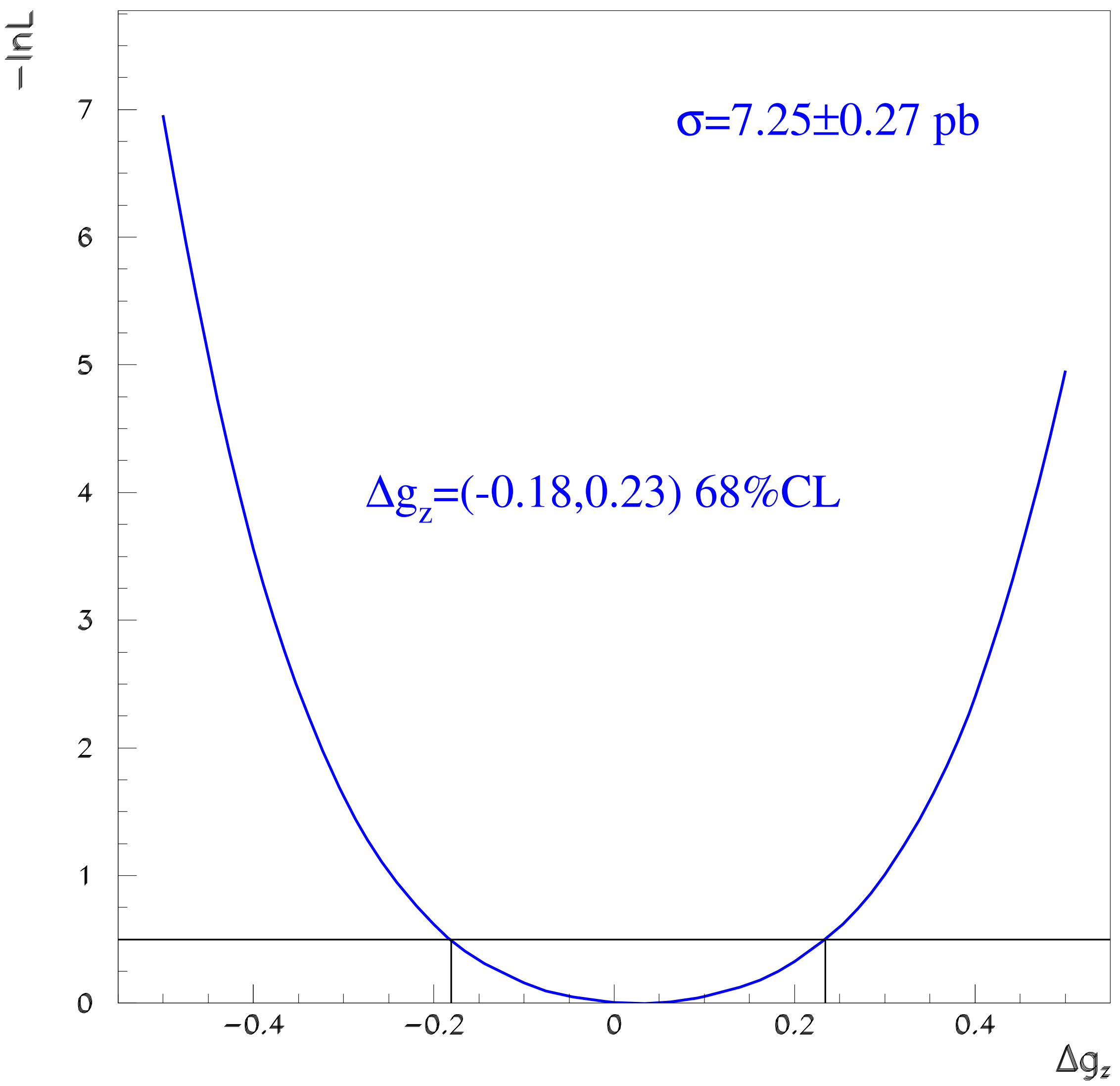
Cross-section dependence on Δg_Z^1.



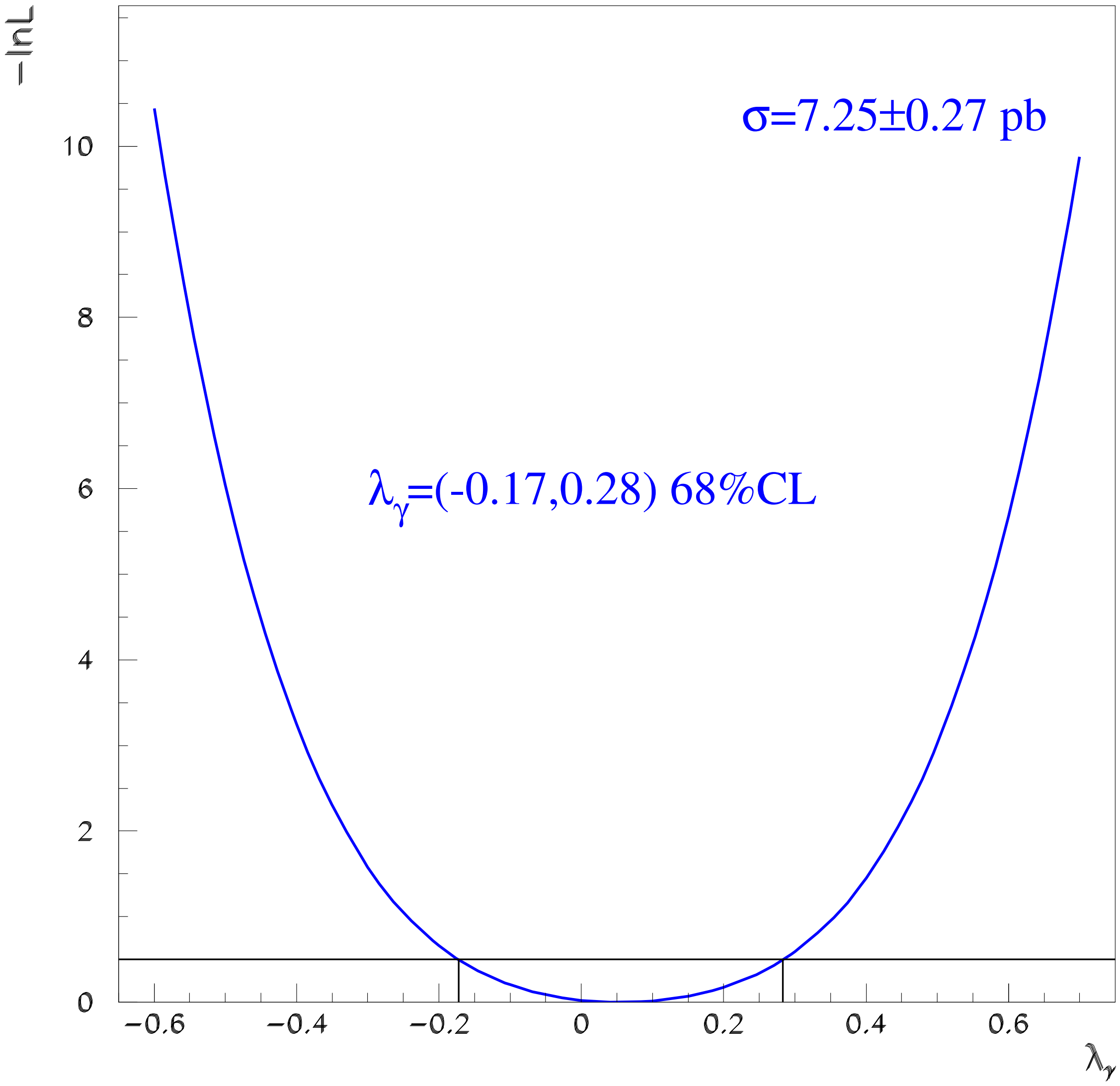
Cross-section dependence on λ_γ.



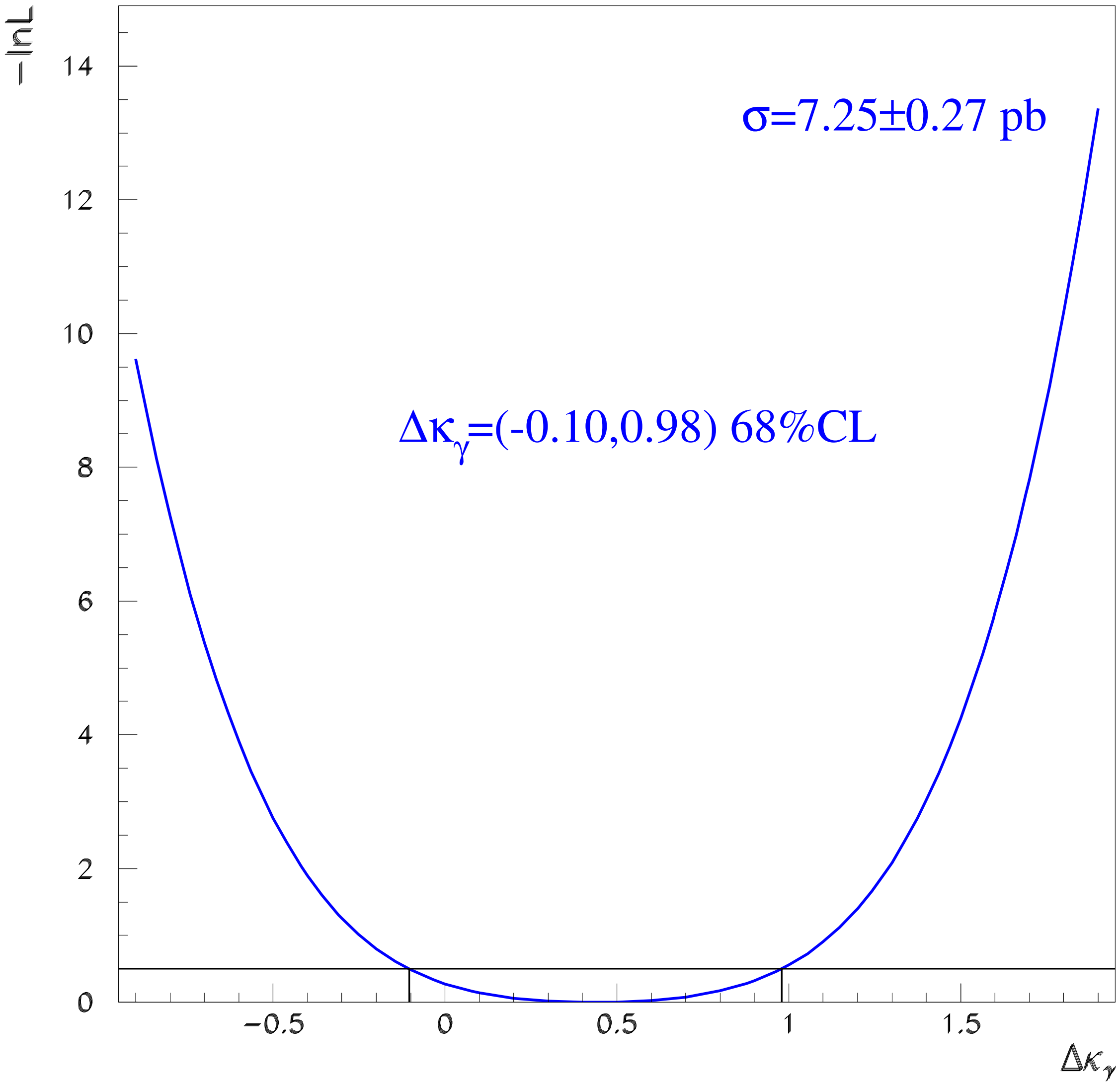
Cross-section dependence on $\Delta\kappa_\gamma$.



Log likelihood for cross-section dependence on Δg_Z^1.

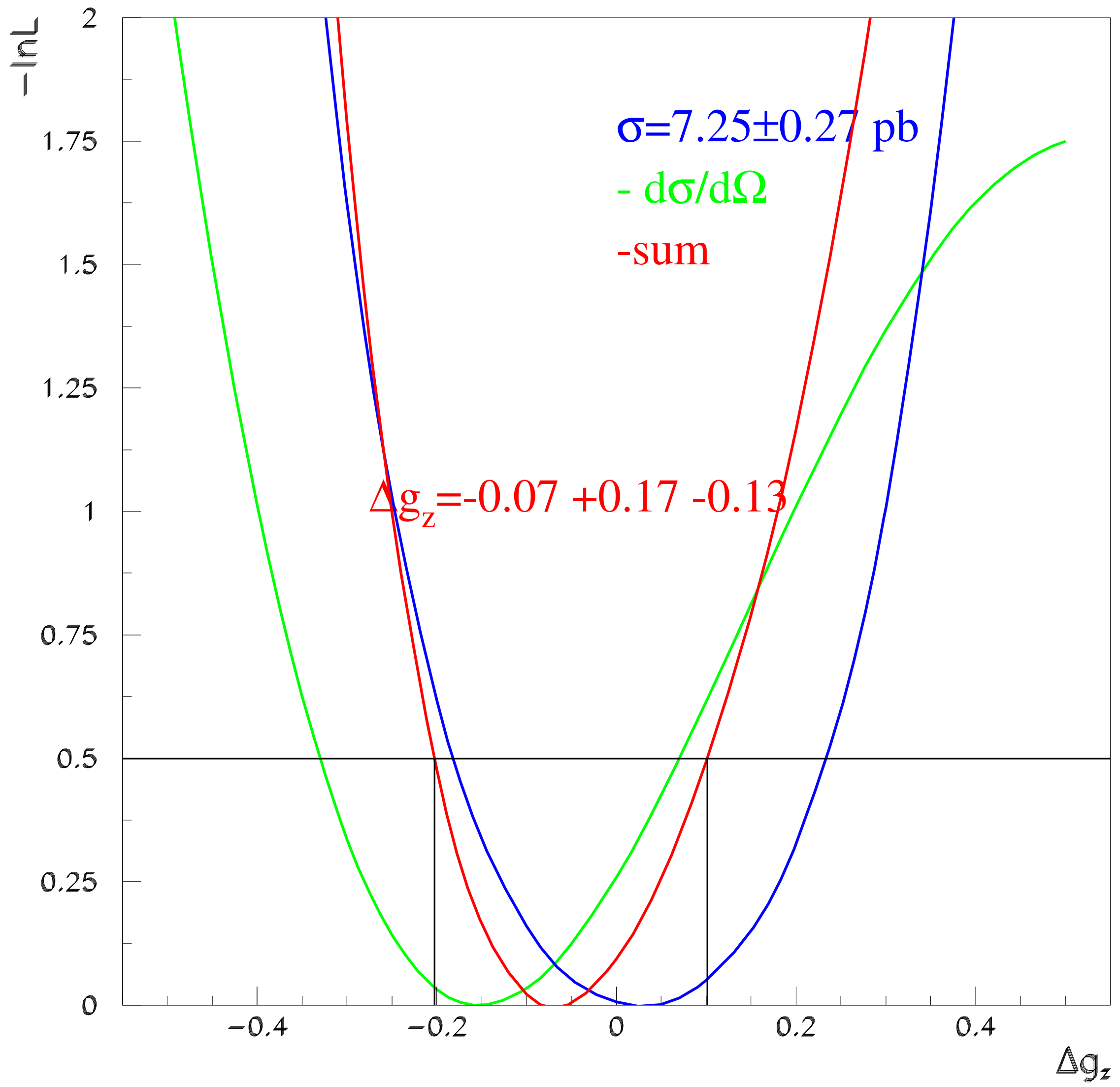


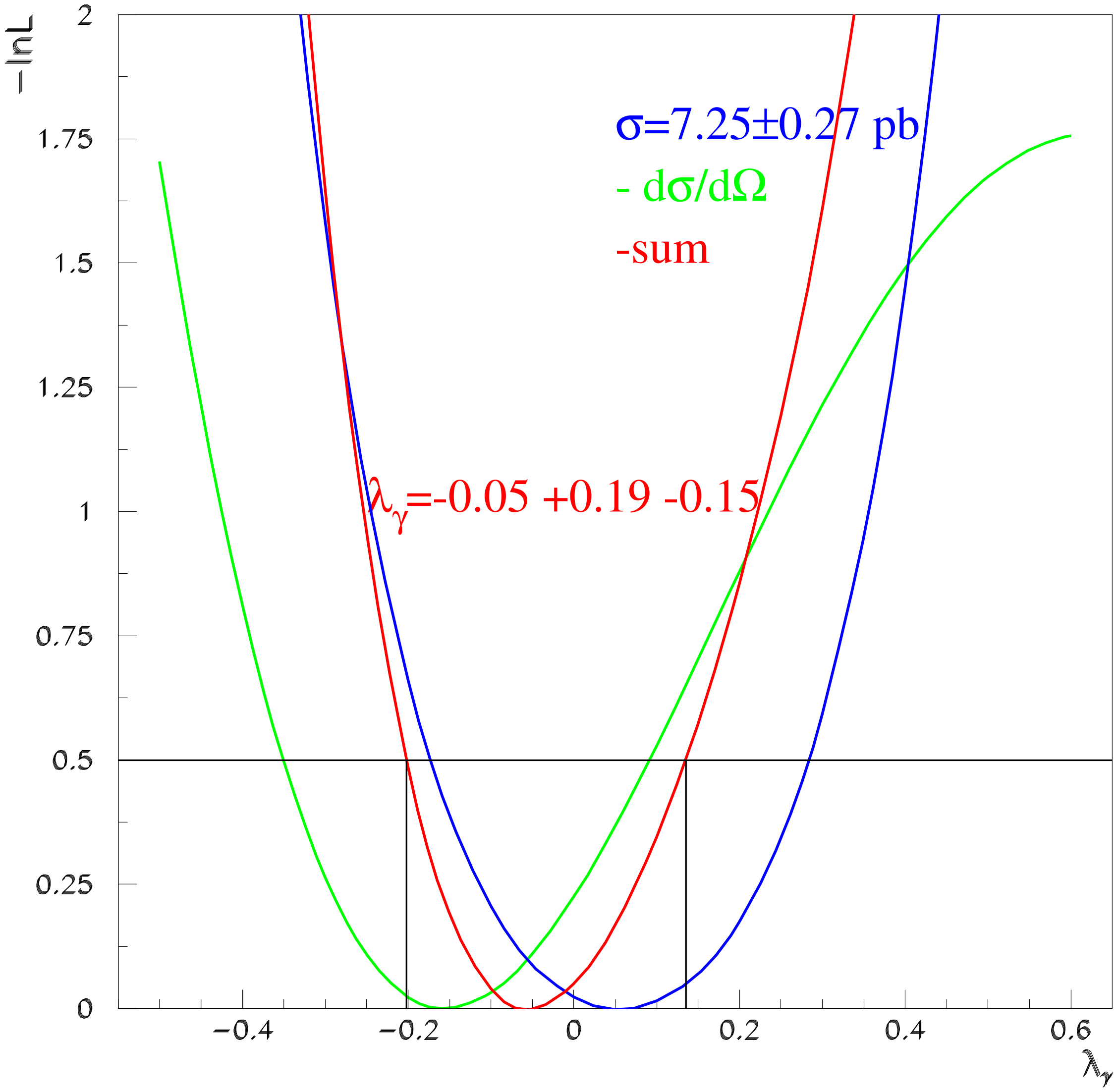
Log likelihood for cross-section dependence on λ_γ.



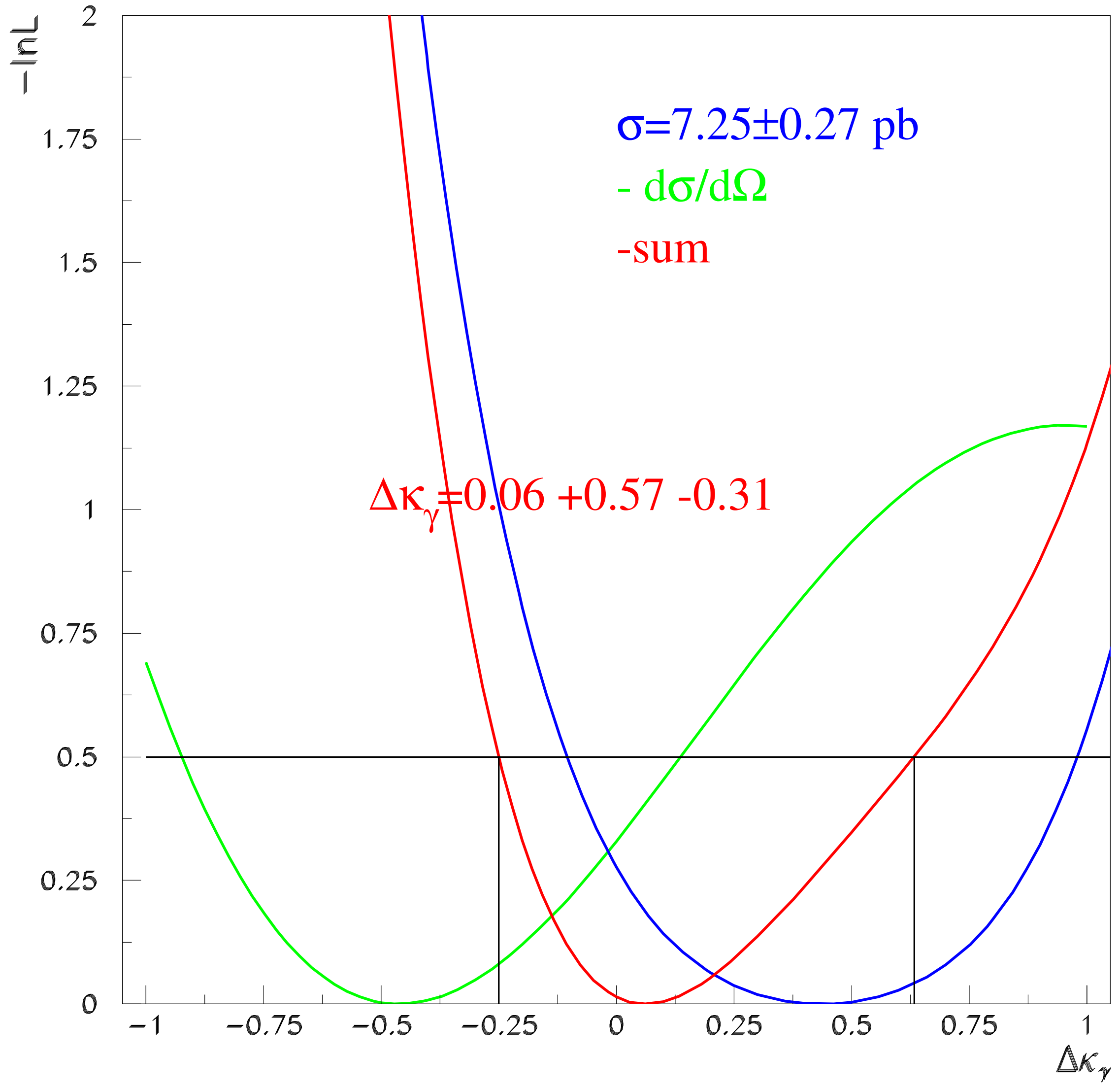
Log likelihood for cross-section dependence on $\Delta\kappa_\gamma$.

Combined results





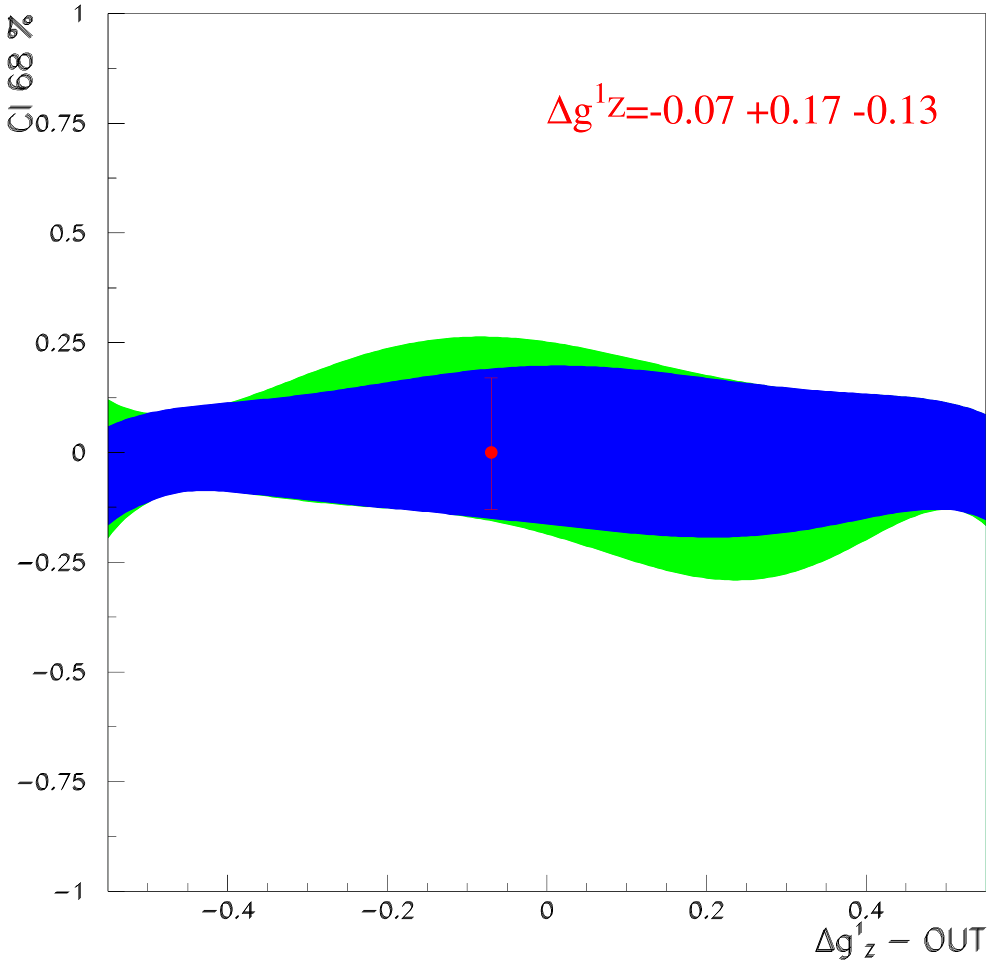
Combined log likelihood for λ_γ using distribution and cross-section dependence.



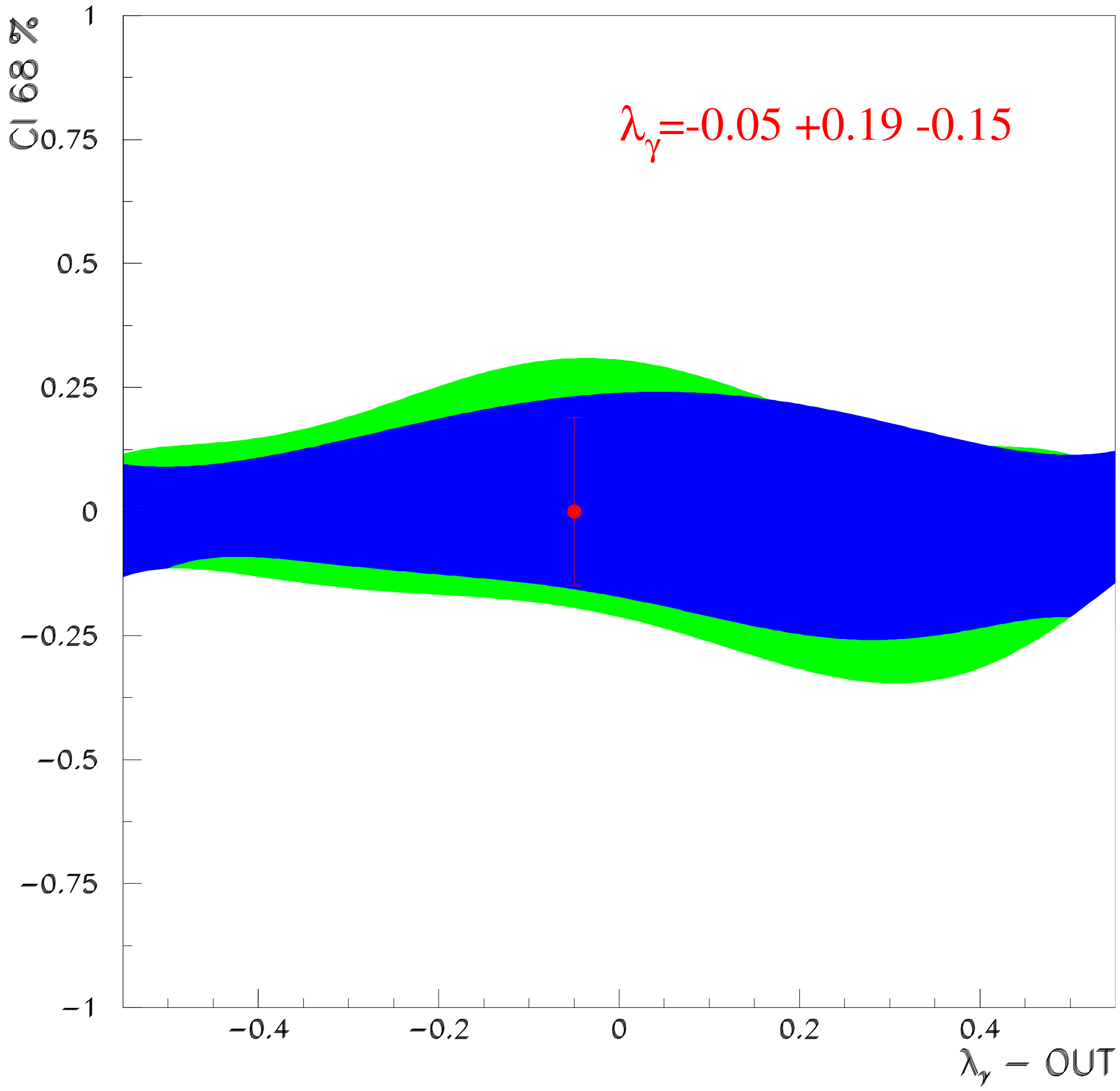
Combined log likelihood for $\Delta\kappa_\gamma$ using distribution and cross-section dependence.

Expected errors

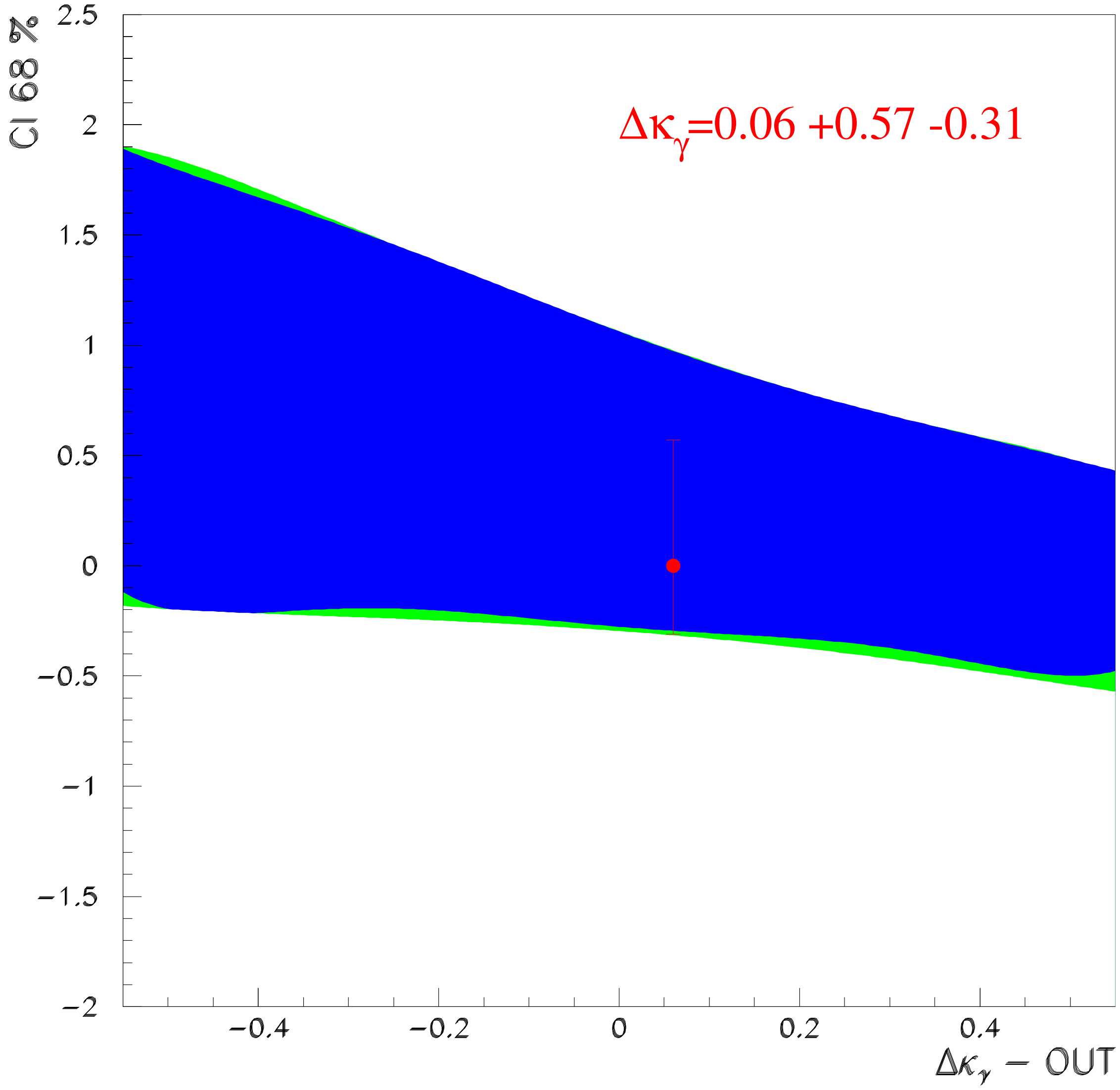
Distribution of expected errors according to TGC parameters. The green area is the exp. error obtained from folded $\cos\theta_{W-}$ and the blue area is the expected error obtained from folded optimal observables for comparison. The obtained result is drawn as a red error bar.



Expected errors for Δg_Z^1. The probability to obtain errors which are less or equal than the ones obtained on data is determined to be $P = 24.8 \pm 0.4\%$.



Expected errors for λ_γ. The probability to obtain errors which are less or equal than the ones obtained on data is determined to be $P = 29.8 \pm 0.4\%$.

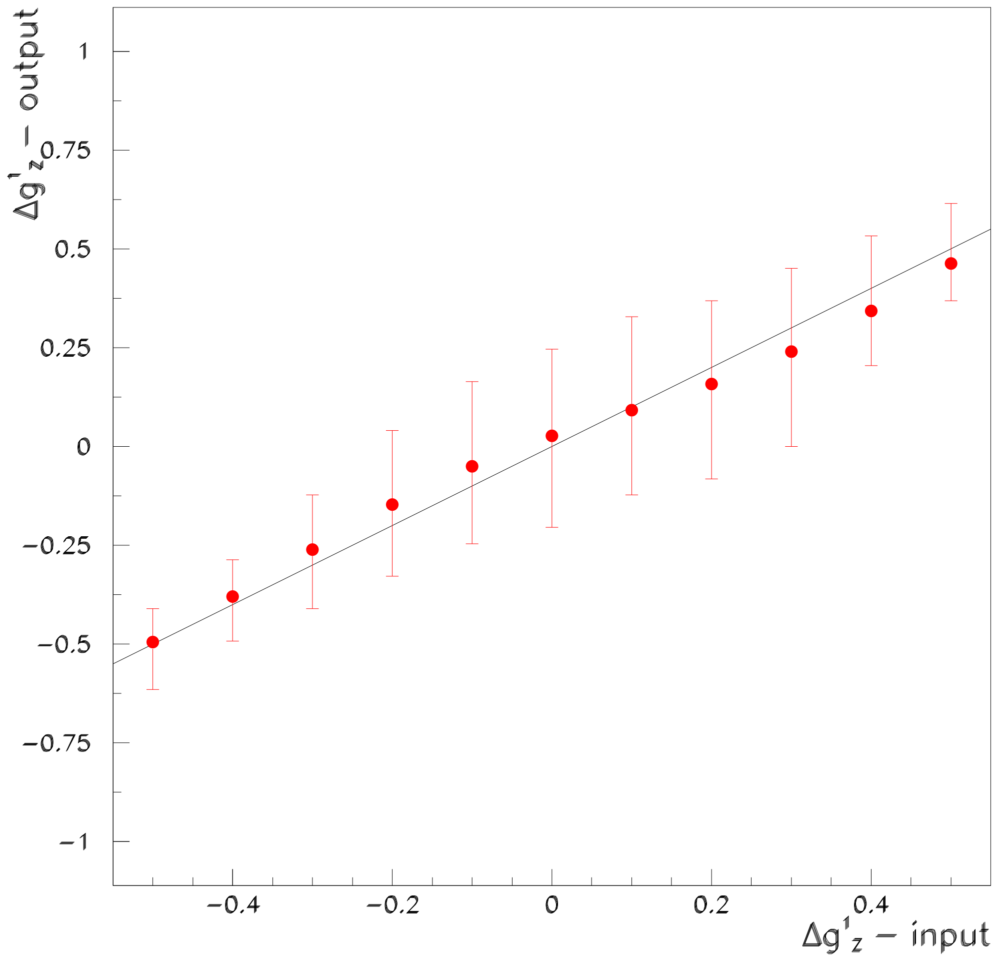


Expected errors for $\Delta\kappa_\gamma$. The probability to obtain errors which are less or equal than the ones obtained on data is determined to be $P = 39.9 \pm 0.5\%$.

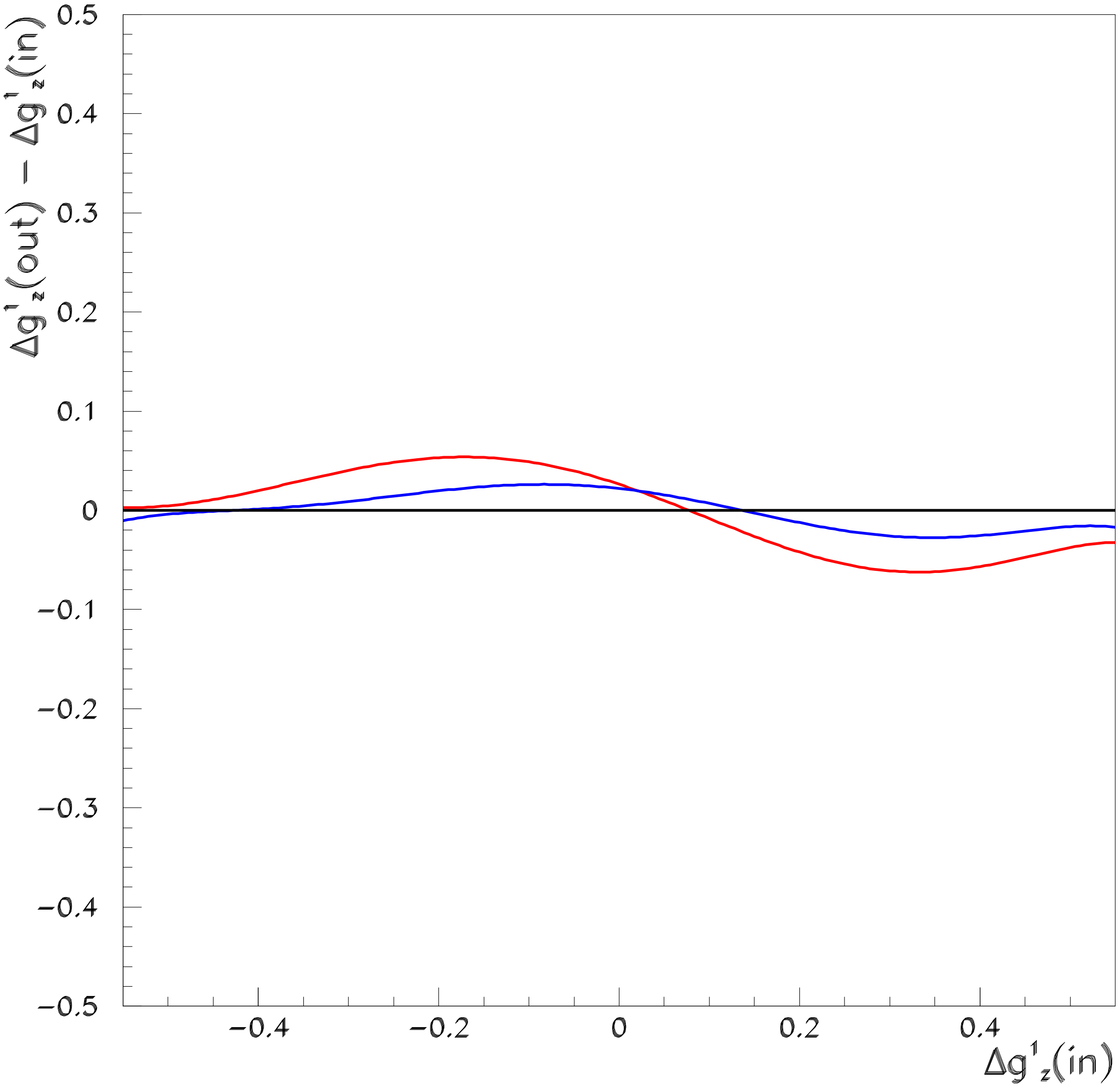
Bias

- Extended max. likelihood
- 10000 *fast* MC experiments
- red lines represent the bias obtained from folded $\cos\theta_{W-}$ and
- blue lines the bias obtained in case of optimal observables for comparison.
- Error bars corespond to expected errors for experiments with the same

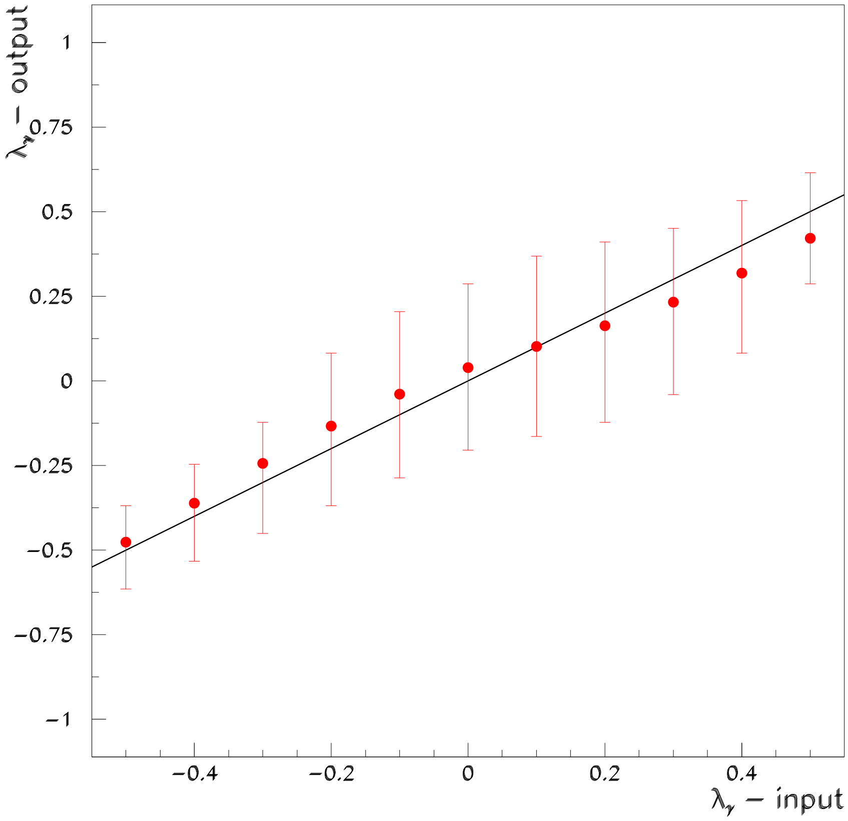
statistics as on the data.

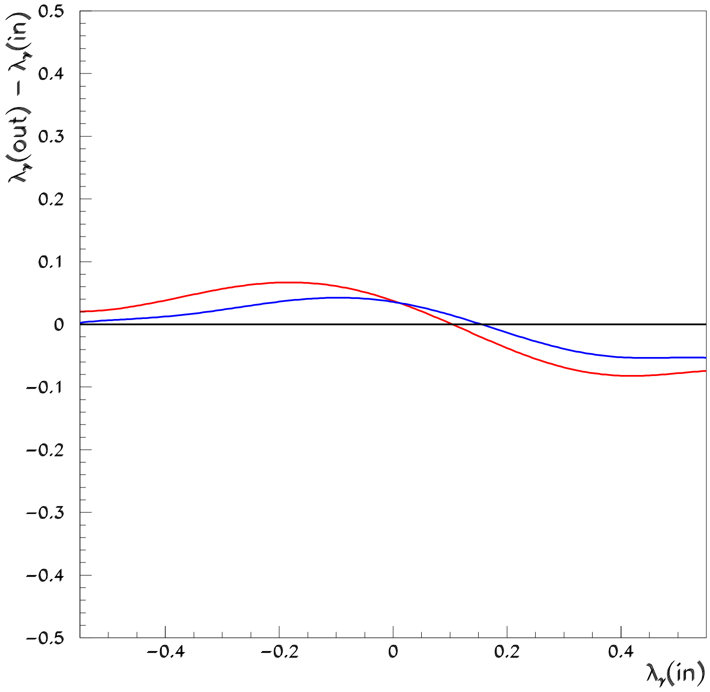


Expected values and errors for Δg^1_Z.

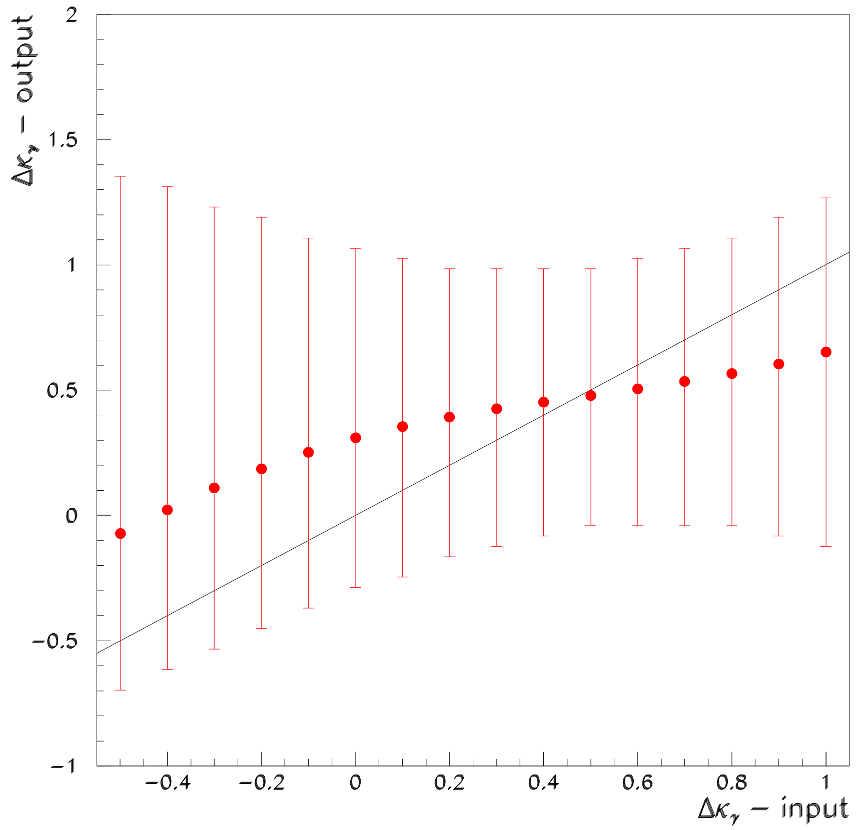


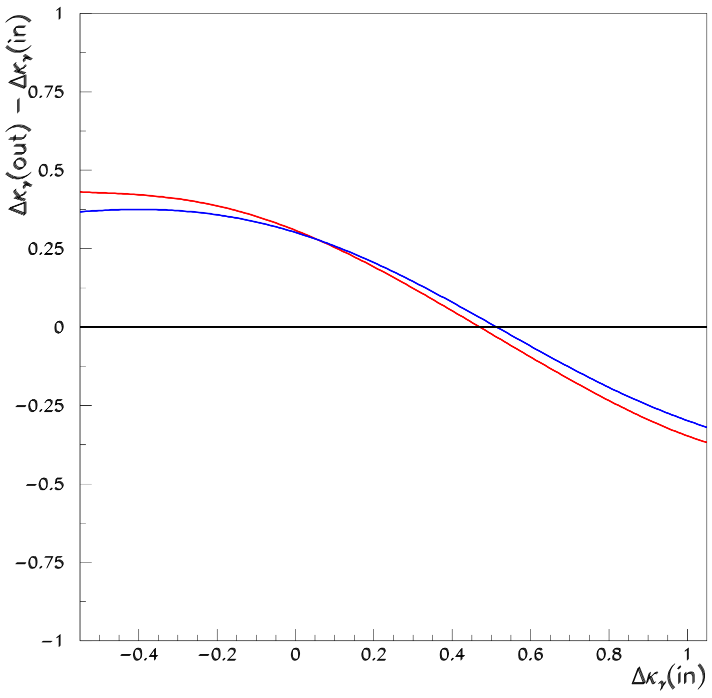
Bias for Δg_Z^1.





Bias for λ_γ.



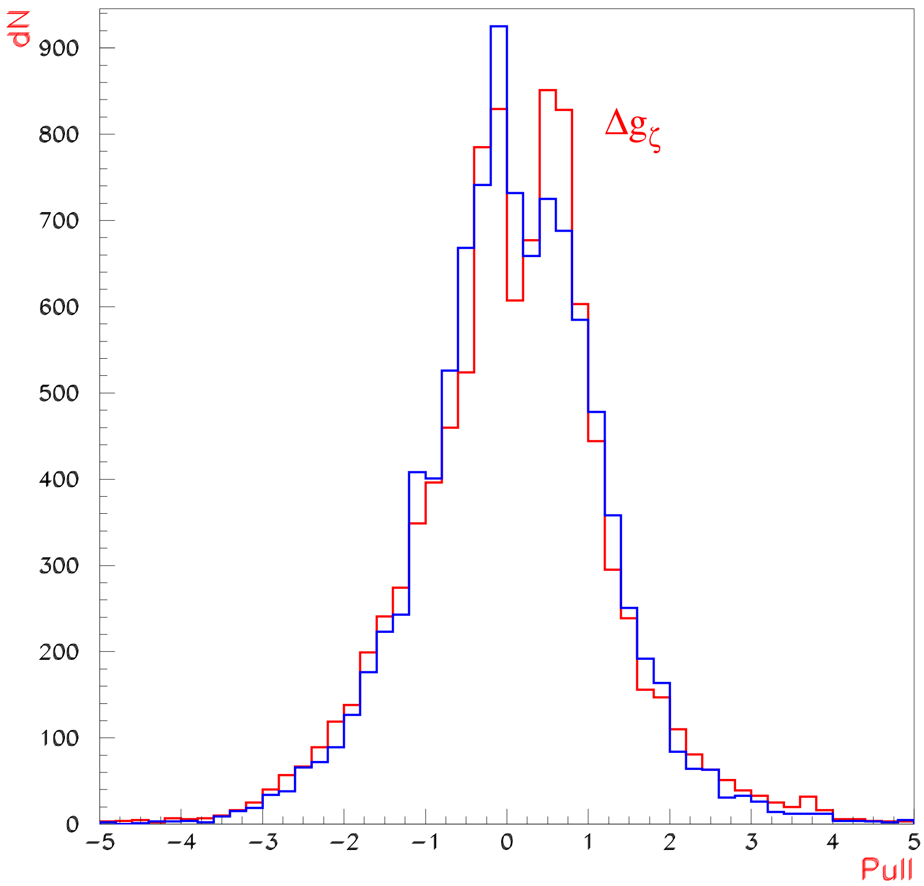


Bias for $\Delta\kappa_\gamma$.

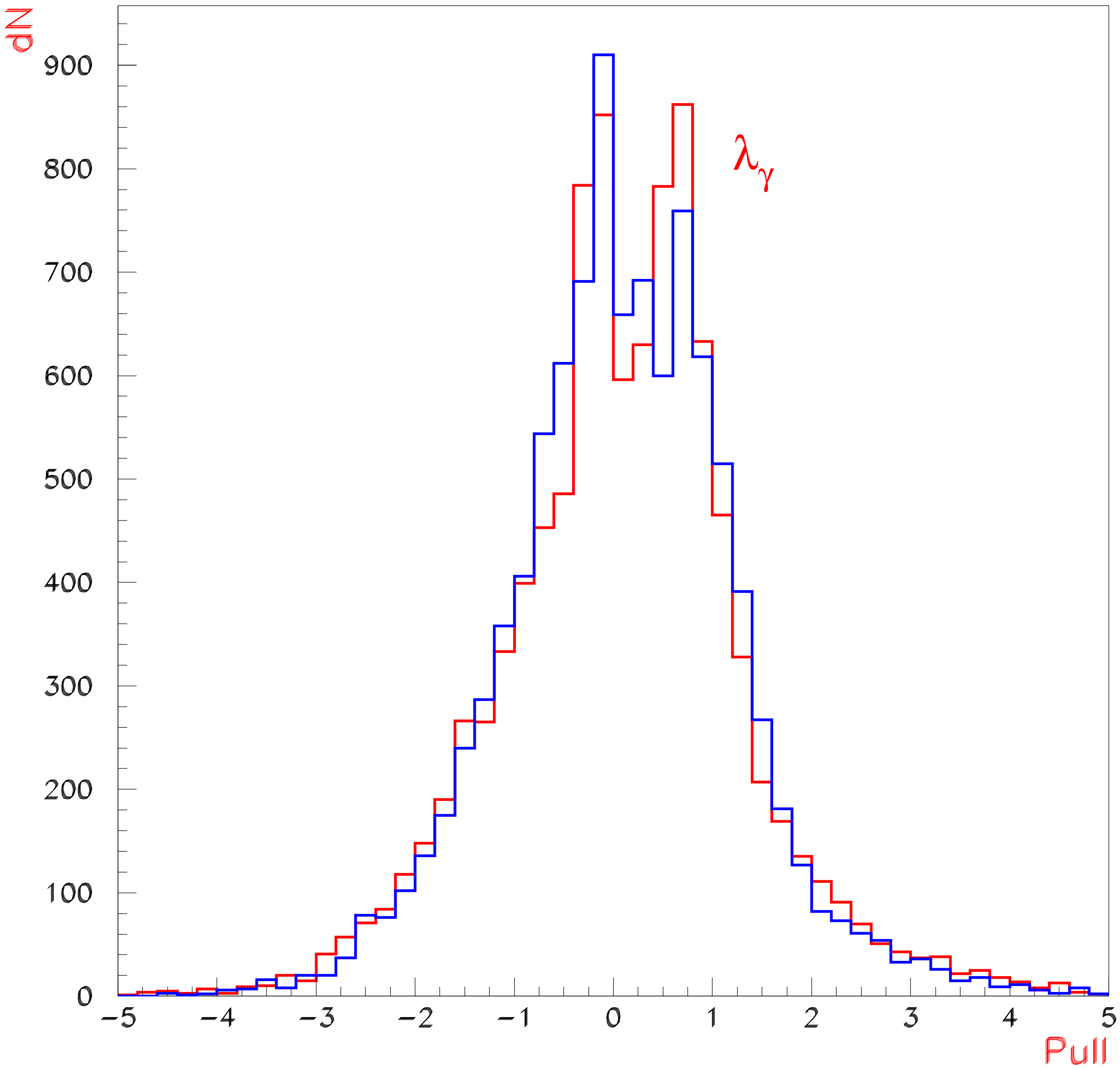
Pulls

- Extended max. likelihood
- 10000 MC experiments (SM)
- asym. errors taken into account
- red histos represent the pull for folded $\cos\theta_{W-}$ and
- blue histos represent the pull obtained from optimal observables.
- Double peak structure is due to events where a measured cross-section is

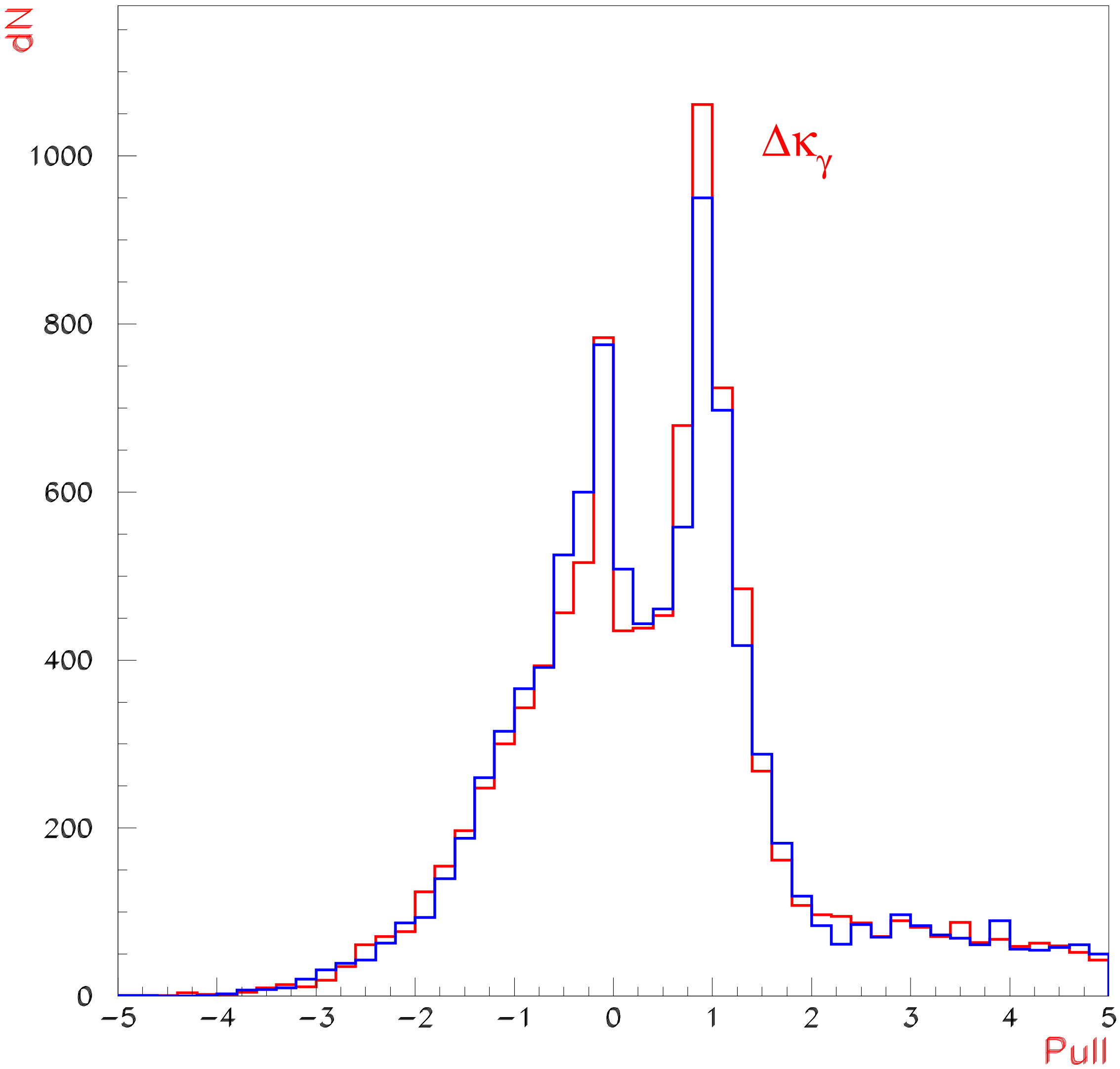
higher than the minimal theoretical value (two solutions).



Pull for Δg_Z^1.



Pull for λ_γ.



Pull for $\Delta\kappa_\gamma$.

Test

- Excalibur Fullsim samples generated at diff. TGC values used.

TGC par.	Gen. value	Output - Ang. dist.	Output - Comb.
Δg_z	-0.5	$-0.46\,^{+0.14}_{-0.14}$	$-0.49\,^{+0.07}_{-0.06}$
Δg_z	+0.5	$+0.53\,^{+0.49}_{-0.35}$	$+0.46\,^{+0.09}_{-0.11}$
λ_γ	+0.5	$-0.63\,^{+0.16}_{-0.10}$	$-0.53\,^{+0.08}_{-0.07}$
λ_γ	-0.5	$+0.13\,^{+1.16}_{-0.24}$	$+0.50\,^{+0.10}_{-0.12}$
$\Delta\kappa_\gamma$	-1.0	$-1.18\,^{+0.41}_{-0.40}$	$-0.99\,^{+0.12}_{-0.14}$
$\Delta\kappa_\gamma$	+1.0	$+0.63\,^{+1.34}_{-0.75}$	$+1.20\,^{+0.20}_{-0.28}$

Systematics

Source	Δg_z	λ_γ	$\Delta\kappa_\gamma$
M_W	0.01	0.01	0.02
$\int Ldt$	0.02	0.02	0.08
ϵ	0.05	0.05	0.24
$P_{W-}(\Delta Q)$	0.01	0.02	0.05
σ_{bkg}	0.03	0.03	0.06
σ_{sig}	0.04	0.04	0.07
MC stat.	0.05	0.05	0.09
Comb.	± 0.09	± 0.09	± 0.29

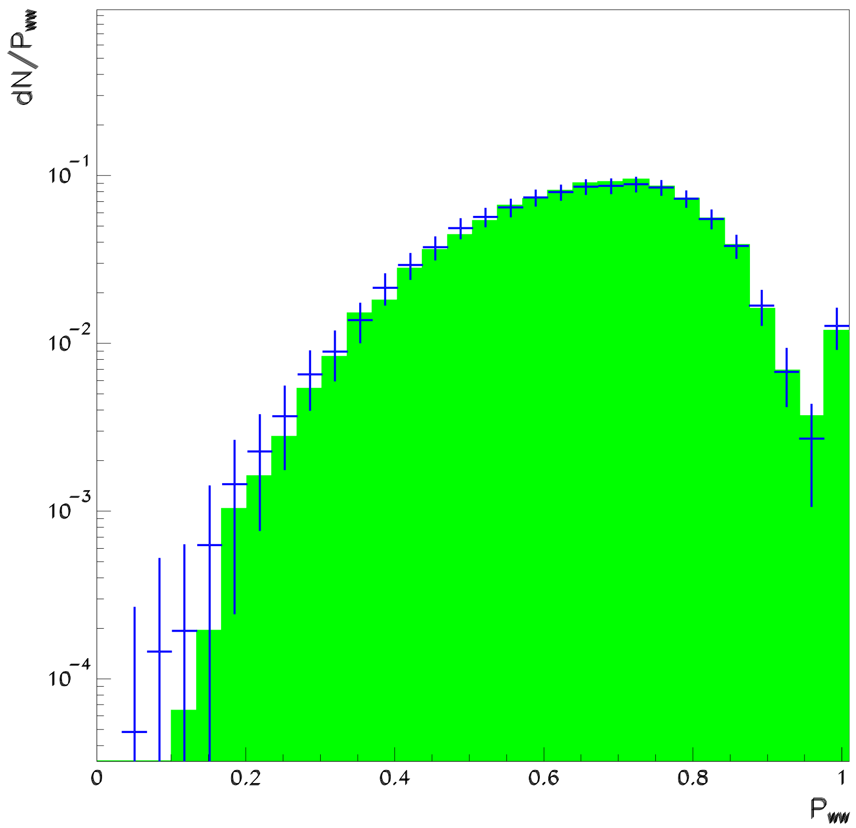
Missing:

- Energy dependence
- Colour reconnection

Eff. estimation

Merged Z^0 events used:

- tracks boosted to $s = 189 GeV$.
- angular dist. combined to correspond SM.
- '98D2 Z^0 data and MC merged.
- Check of fragmentation and detector effects.
- Relative difference in efficiency between merged Z0 data and MC samples is found to be $\pm 4\%$, mostly due to preselection cuts.



Distribution of events according to P_{WW} separator.

Conclusion

Results:

method	Δg_z	λ_γ	$\Delta\kappa_\gamma$
Ang. distrib.	$-0.15\,^{+0.22}_{-0.18}$	$-0.16\,^{+0.25}_{-0.20}$	$-0.46\,^{+0.60}_{-0.46}$
$\sigma(W^+W^- \to 4j)$	[-0.18,0.23]	[-0.17,0.28]	[-0.10,0.98]
Combined	$-0.07\,^{+0.17}_{-0.13}$	$-0.05\,^{+0.19}_{-0.15}$	$0.06\,^{+0.57}_{-0.31}$

Stat. error scales in accordance with 183 data errors.

With systematics:

$$\Delta g_Z^1 = -0.07\,^{+0.17}_{-0.13} \pm 0.09 \quad (1)$$

$$\Delta\lambda_\gamma = -0.05\,^{+0.19}_{-0.15} \pm 0.09 \quad (2)$$

$$\Delta\kappa_\gamma = +0.06\,^{+0.57}_{-0.31} \pm 0.29 \quad (3)$$