Michela Biglietti

INFN/Napoli Università di Napoli
"Federico II"

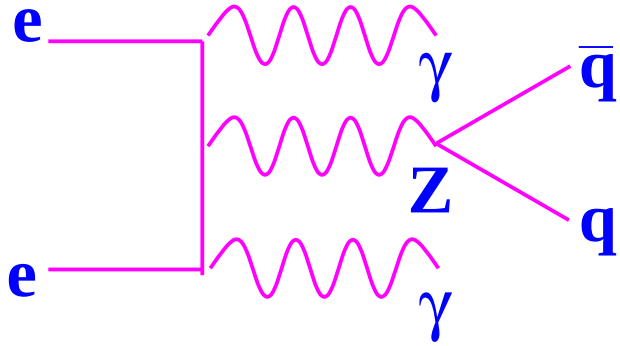
$e^+e^- \to Z\gamma\gamma$ Cross Section and QGCs with L3

- Introduction
- Selection
- Results
- QGCs

XII Convegno sulla Fisica al LEP, Trieste
27th April 2000

Cfr. L3 collab., CERN-EP-2000-006 (`hep-ex/0002037`)

Introduction



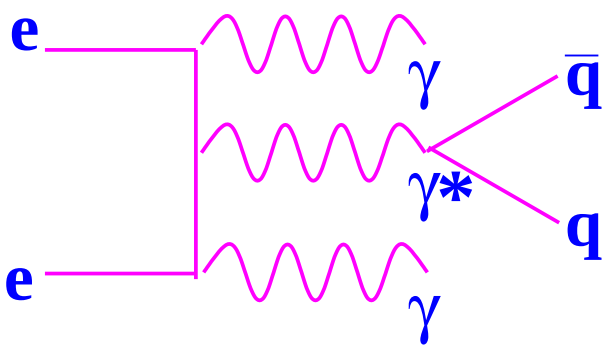
Signal Definition:
KK2f Monte Carlo for $e^+e^- \to$ hadrons (γ)

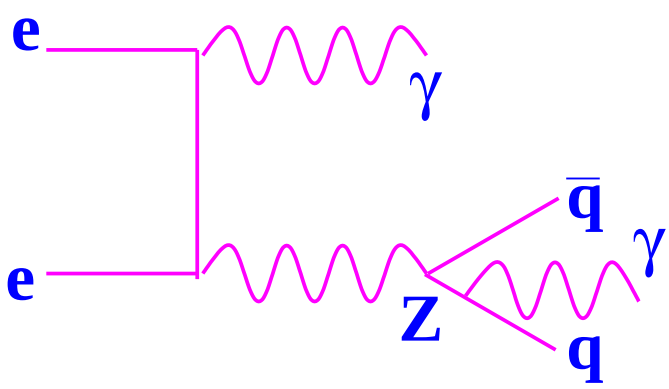
$$E_\gamma > 5 \text{ GeV} \quad 14^\circ < \theta_\gamma < 166^\circ$$
$$m_Z - 2\Gamma_Z < M_{q\bar{q}} < m_Z - 2\Gamma_Z$$

$$\sigma^{SM}_{e^+e^- \to Z\gamma\gamma \to q\bar{q}\gamma\gamma}(183 \text{ GeV}) = 0.396 \text{ pb}$$
$$\sigma^{SM}_{e^+e^- \to Z\gamma\gamma \to q\bar{q}\gamma\gamma}(189 \text{ GeV}) = 0.365 \text{ pb}$$

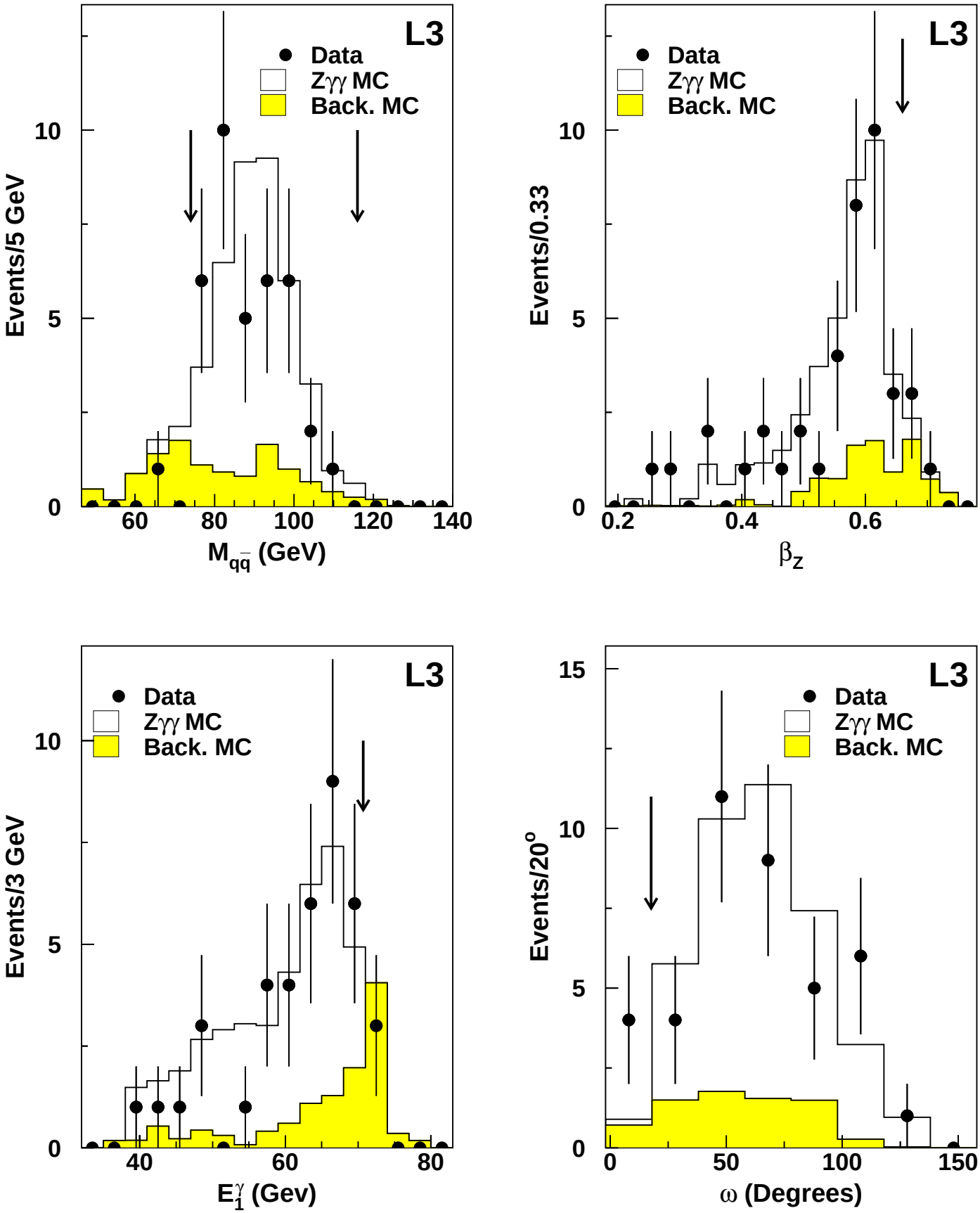
L3 analysis of ~ 231 pb^{-1} @ 183 and 189 GeV

Backgrounds:

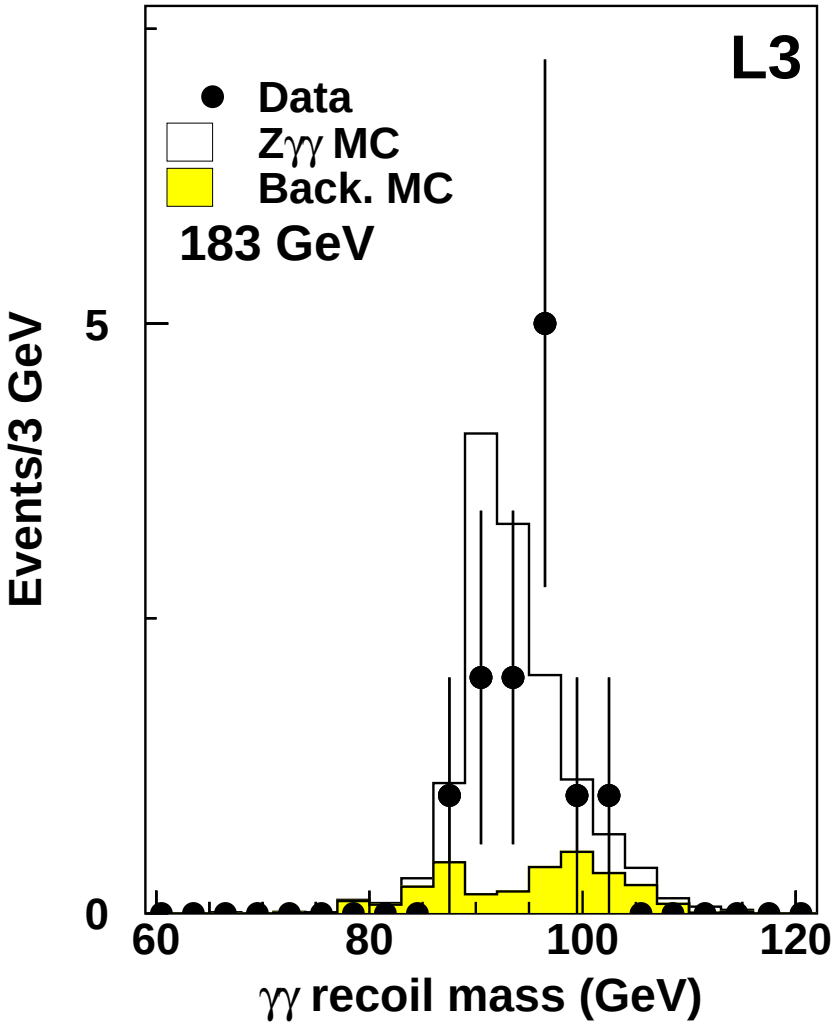


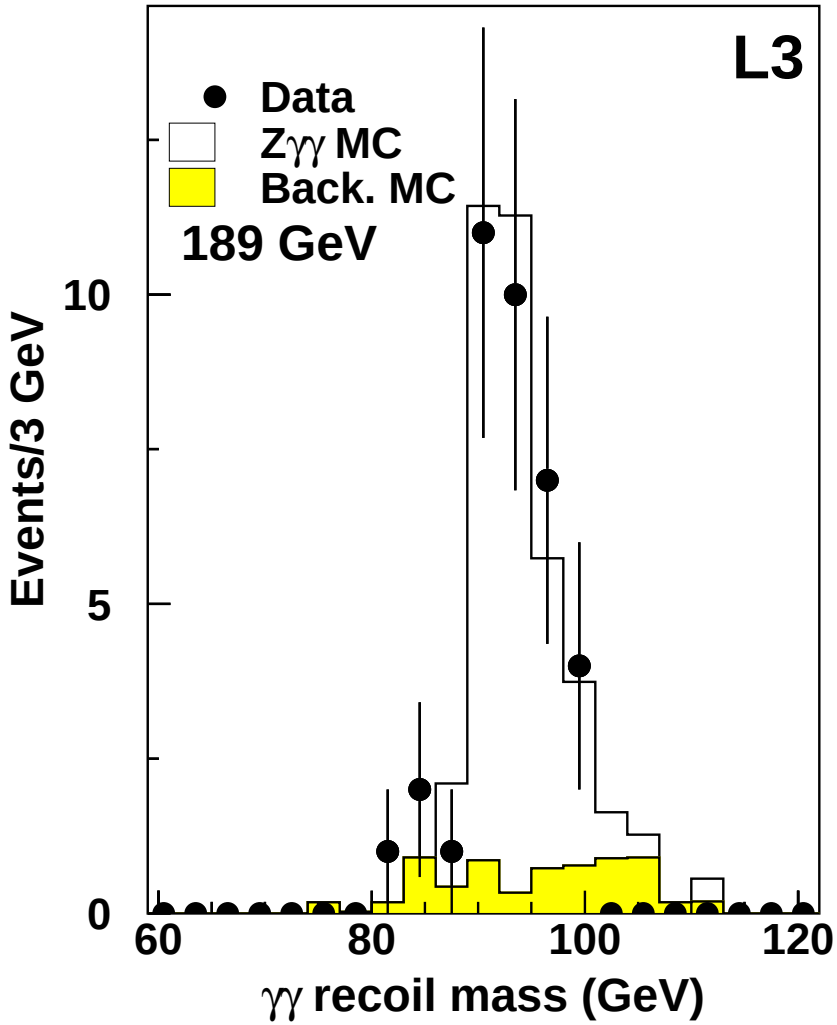


Selection


L3
Data
Zγγ MC
Back. MC
Events/5 GeV
$M_{q\bar{q}}$ (GeV)
Events/0.33
β_Z
Events/3 GeV
E_1^γ (Gev)
Events/20°
ω (Degrees)

Results

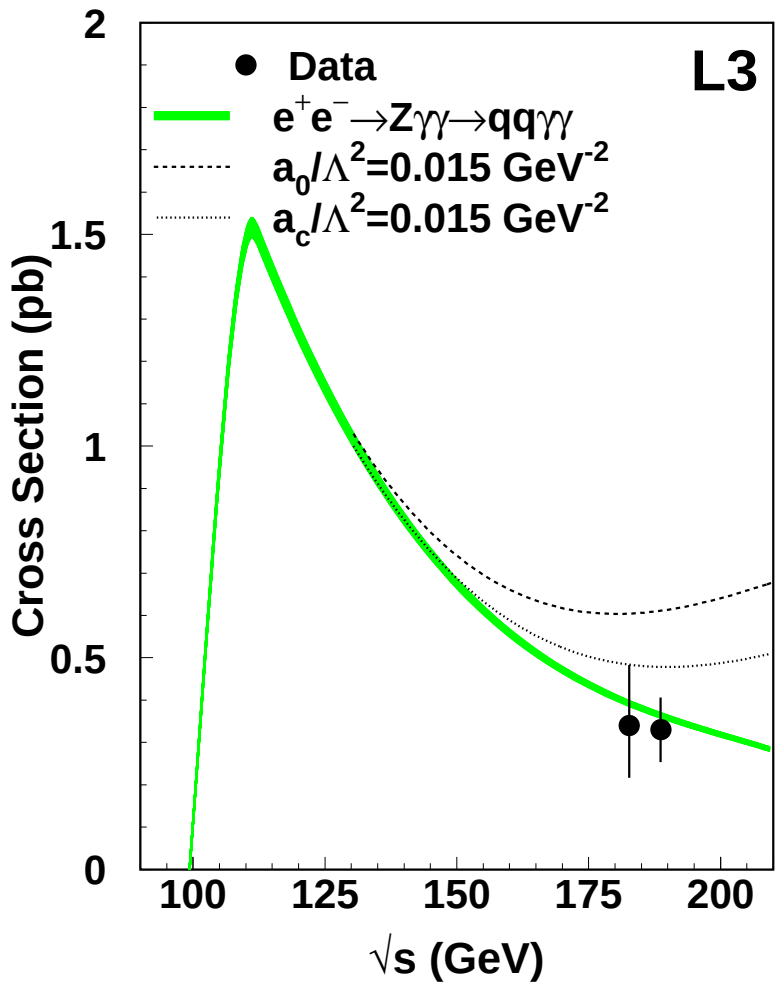

L3
Data
Zγγ MC
Back. MC
183 GeV
Events/3 GeV
0
5
60
80
100
120
γγ recoil mass (GeV)


L3
Data
Zγγ MC
Back. MC
189 GeV
Events/3 GeV
0
5
10
60
80
100
120
γγ recoil mass (GeV)

Results

$\sqrt{s}$	ε	Data	MC	$Z\gamma\gamma$	$QCD\gamma\gamma$	Other
183 GeV	0.49	12	13.4	10.6	2.7	0.1
189 GeV	0.51	36	39.2	32.6	6.0	0.6

$$\sigma_{e^+e^-\to Z\gamma\gamma\to q\bar{q}\gamma\gamma}(183\ \text{GeV}) = 0.34^{+0.14}_{-0.12} \pm 0.03\,\text{pb}$$
$$\sigma_{e^+e^-\to Z\gamma\gamma\to q\bar{q}\gamma\gamma}(189\ \text{GeV}) = 0.33 \pm 0.07 \pm 0.03\,\text{pb}$$

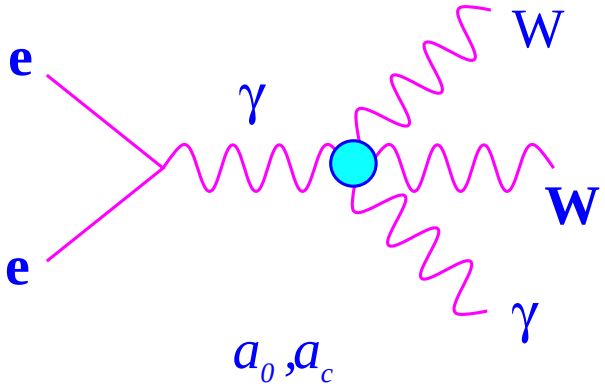


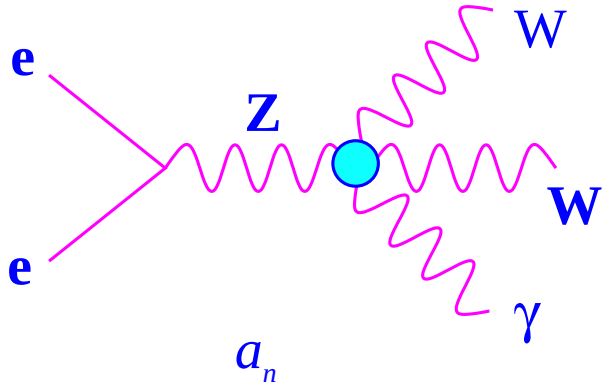
$$\sigma_{e^+e^-\to Z\gamma\gamma}(183\ \text{GeV}) = 0.49^{+0.20}_{-0.17} \pm 0.04\,\text{pb}$$
$$\sigma_{e^+e^-\to Z\gamma\gamma}(189\ \text{GeV}) = 0.47 \pm 0.10 \pm 0.04\,\text{pb}$$

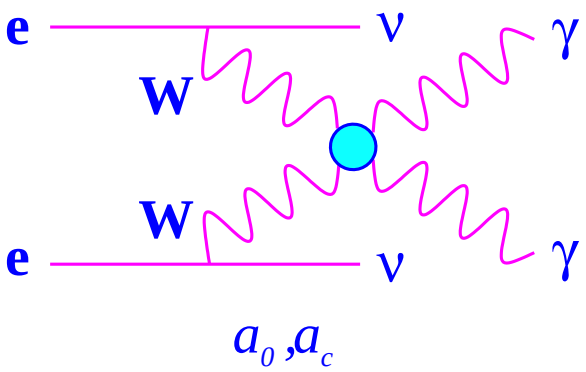
Quartic Gauge Couplings

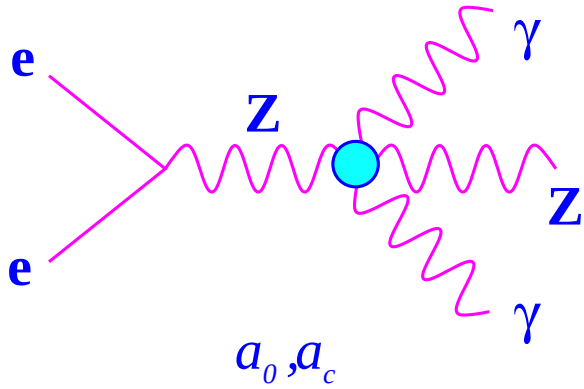
$$\mathcal{L}_6^0 = -\frac{\pi\alpha}{4\Lambda^2} a_0 F_{\mu\nu} F^{\mu\nu} \vec{W}_\rho \cdot \vec{W}^\rho$$
$$\mathcal{L}_6^c = -\frac{\pi\alpha}{4\Lambda^2} a_c F_{\mu\rho} F^{\mu\sigma} \vec{W}^\rho \cdot \vec{W}_\sigma$$
$$\mathcal{L}_6^n = -i\frac{\pi\alpha}{4\Lambda^2} a_n \epsilon_{ijk} W_{\mu\alpha}^{(i)} W_\nu^{(j)} W^{(k)\alpha} F^{\mu\nu}$$

$$\vec{W}_\mu = \left(\frac{1}{\sqrt{2}} \left(W_\mu^+ + W_\mu^- \right), \frac{i}{\sqrt{2}} \left(W_\mu^+ - W_\mu^- \right), Z_\mu / \cos\theta_W \right)$$





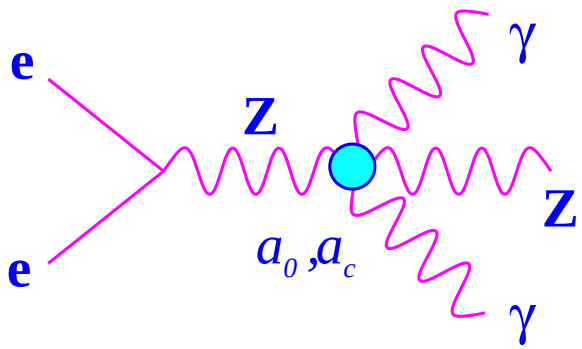




a_0, a_c, a_n are zero in the SM

Cfr. W. Stirling and A. Werthenbach `hep-ph/9903315`

Quartic Gauge Couplings



Quite higher sensitivity wrt WWγ:

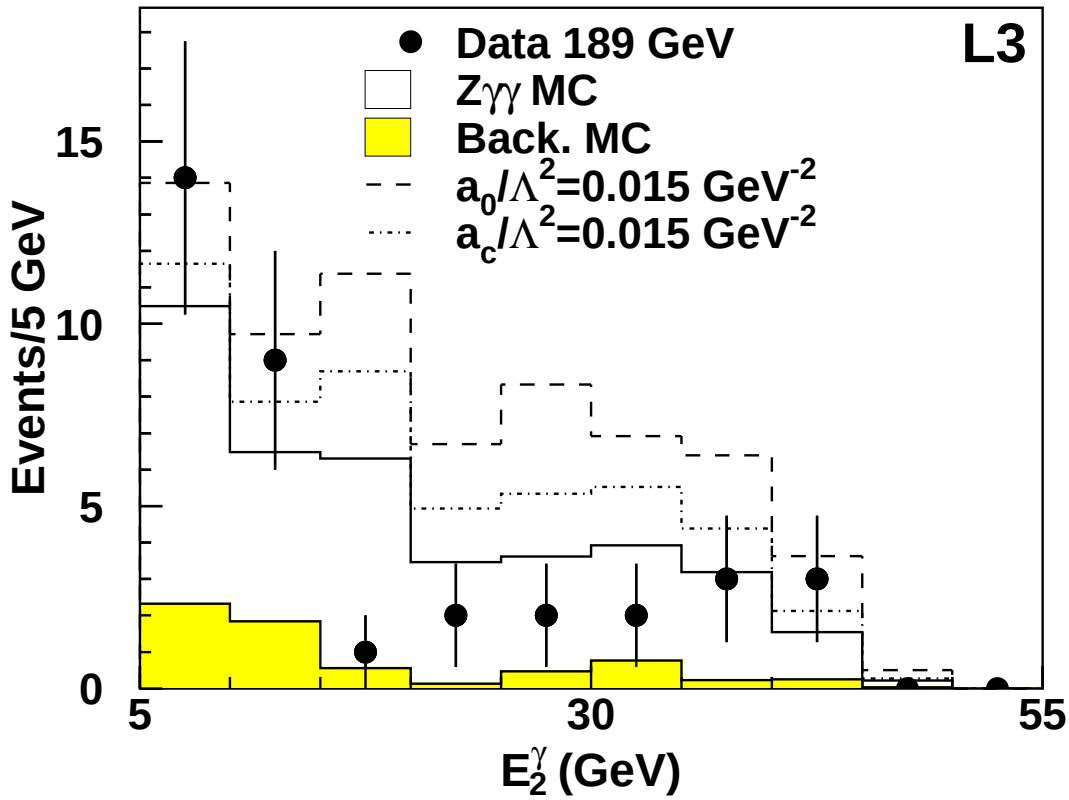
- Larger SM cross section and data statistics
- Factor $1/\cos^4\theta_W$ in QGC cross section
- Smaller number of SM diagrams

...but no sensitivity to the CP violating a_n

Cfr. W. Stirling and A. Werthenbach `hep-ph/9903315`

Quartic Gauge Couplings

Deviations expected for the less energetic photon



Fit it reweighting KK2f events with analitical calculation of SM and QGC matrix elements from W. Stirling and A. Werthenbach `hep-ph/9903315`

$$\mathcal{W}(\Omega, a_0/\Lambda^2, a_c/\Lambda^2) = \frac{|\mathcal{M}_{SM}(\Omega) + \mathcal{M}_{QGC}(\Omega, a_0/\Lambda^2, a_c/\Lambda^2)|^2}{|\mathcal{M}_{SM}(\Omega)|^2}$$

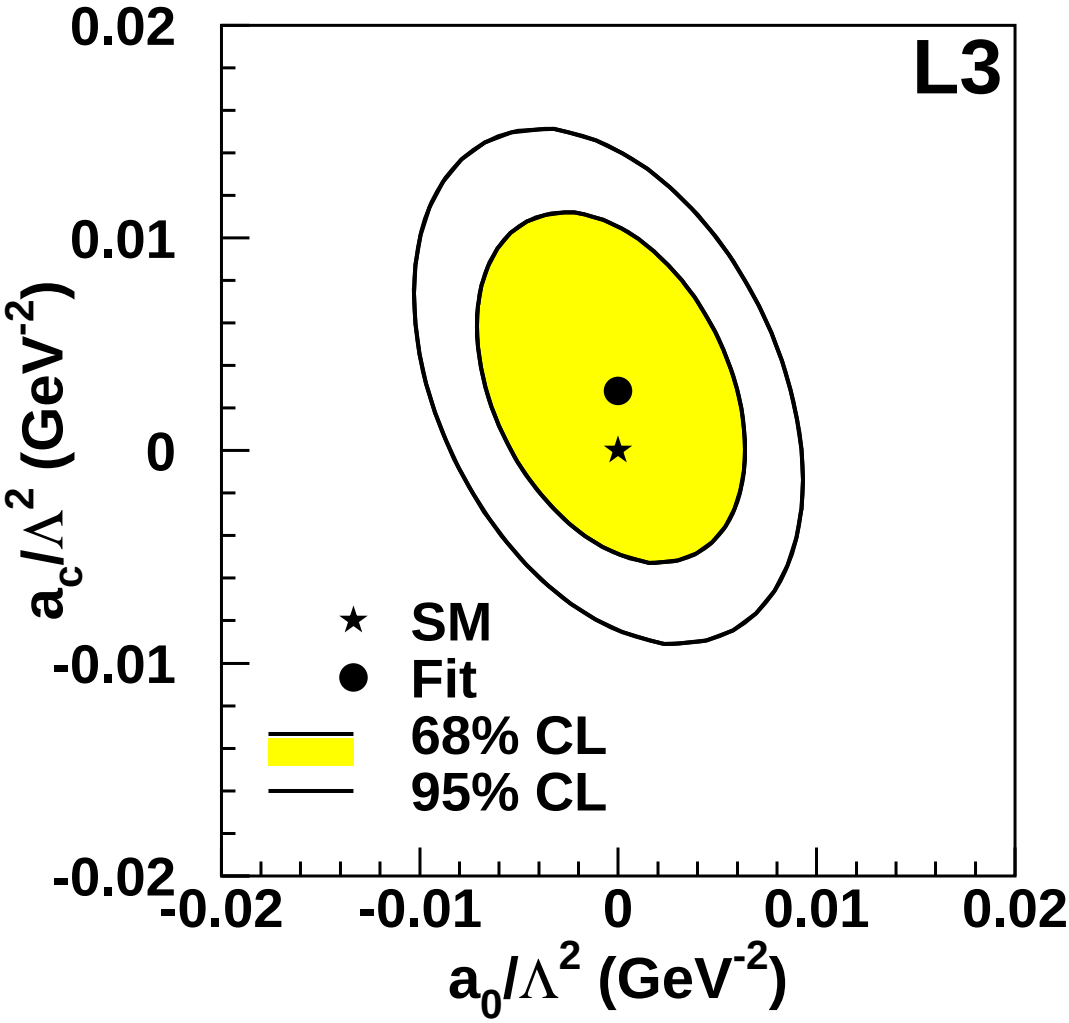
Quartic Gauge Couplings

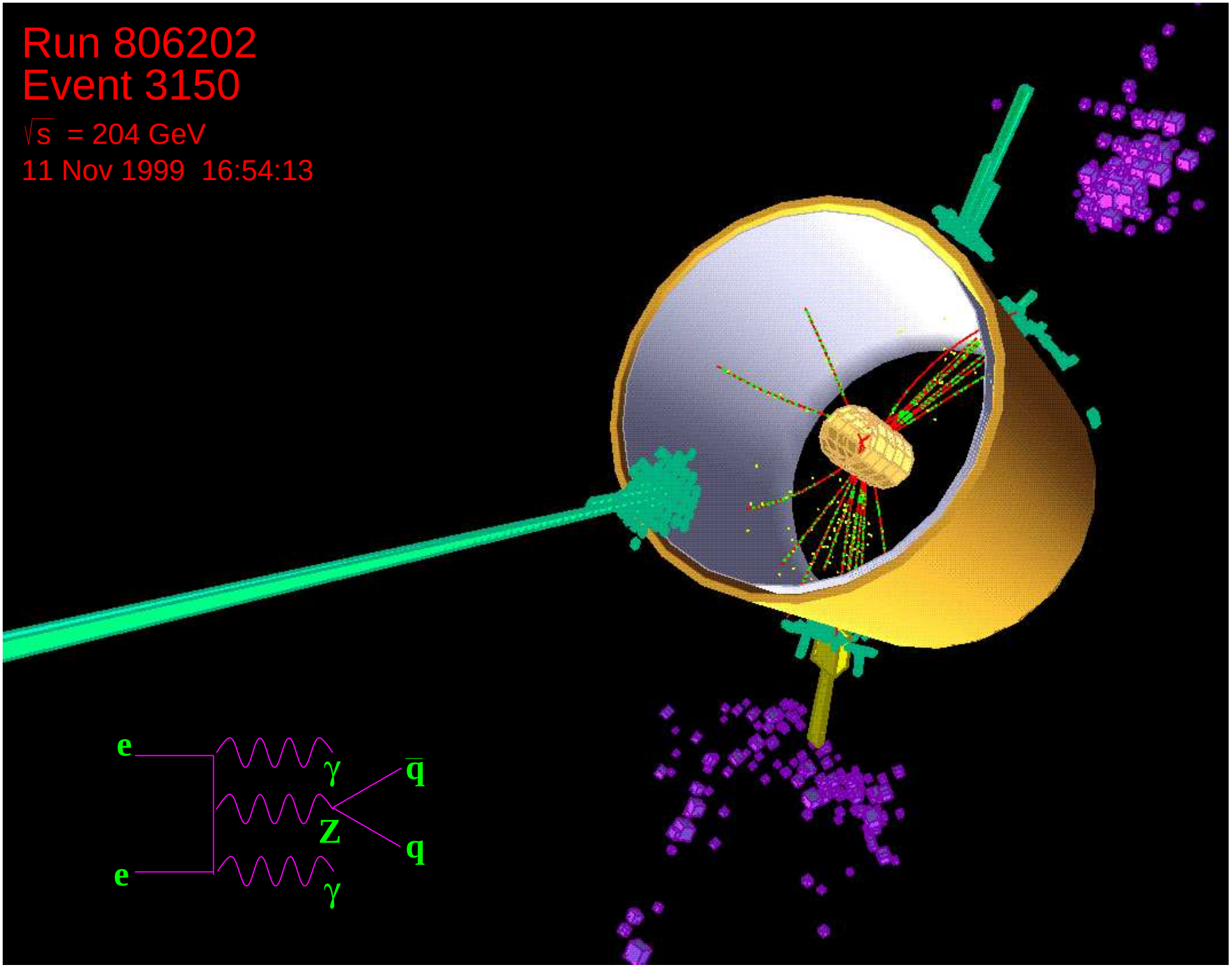
One Dimensional 68% CL measurements:

$$a_0/\Lambda^2 = 0.001 \pm 0.004 \text{ GeV}^{-2}$$
$$a_c/\Lambda^2 = 0.003 \pm 0.005 \text{ GeV}^{-2}$$

Two Dimensional 95% CL limits:

$$-0.009 \text{ GeV}^{-2} < a_0/\Lambda^2 < 0.008 \text{ GeV}^{-2}$$
$$-0.007 \text{ GeV}^{-2} < a_c/\Lambda^2 < 0.013 \text{ GeV}^{-2}$$




Run 806202
Event 3150
$\sqrt{s}$ = 204 GeV
11 Nov 1999 16:54:13
e
e
γ
γ
Z
$\bar{q}$
q