ANOMALOUS W/Z QUARTIC COUPLINGS

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The Standard Model predictions for $WWWW$, $WWZZ$, $WWZ\gamma$, $WW\gamma\gamma$, and $ZZ\gamma\gamma$ couplings are small at LEP, but expected to become important at a TeV Linear Collider. Outside the Standard Model framework such possible couplings, a_0, a_c, a_n, are expressed in terms of the following dimension-6 operators [1,2];

$$L_6^0 = -\frac{e^2}{16\Lambda^2}\, a_0\, F^{\mu\nu}\, F_{\mu\nu}\vec{W}^{\alpha}\cdot\vec{W}_{\alpha}$$

$$L_6^c = -\frac{e^2}{16\Lambda^2}\, a_c\, F^{\mu\alpha}\, F_{\mu\beta}\vec{W}^{\beta}\cdot\vec{W}_{\alpha}$$

$$L_6^n = -i\frac{e^2}{16\Lambda^2}\, a_n \epsilon_{ijk}\, W_{\mu\alpha}^{(i)}\, W_{\nu}^{(j)}\, W^{(k)\alpha} F^{\mu\nu}$$

where F, W are photon and W fields, L_6^0 and L_6^c conserve C, P separately and generate anomalous $W^+W^-\gamma\gamma$ and $ZZ\gamma\gamma$ couplings, L_6^n violates CP and generates an anomalous $W^+W^-Z\gamma$ coupling, and Λ is a scale for new physics. For the $ZZ\gamma\gamma$ coupling the CP-violating term represented by L_6^n does not contribute.

At LEP the processes studied in search of these quartic couplings are $e^+e^- \to WW\gamma$, $e^+e^- \to \gamma\gamma\nu\overline{\nu}$, and $e^+e^- \to Z\gamma\gamma$ and limits are set on the quantities $a_0/\Lambda^2, a_c/\Lambda^2, a_n/\Lambda^2$. The sensitive measured variables are the cross sections for these processes as well as the energy and angular distributions of the photon and recoil mass to the photon pair.

Combining results from all LEP experiments and channels, the limits presented at the Osaka Conference [3] are $-0.0049 < a_0/\Lambda^2 < 0.0056$, $-0.0054 < a_c/\Lambda^2 < 0.0098$, $-0.45 < a_n/\Lambda^2 < 0.41$.

References

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2. J.W. Stirling and A. Werthenbach, Eur. Phys. J. **C14**, 103 (2000).
3. S. Spagnolo: "Measurement of Quartic Gauge Boson Couplings", Electroweak parallel session, *XXXth International Conference on High Energy Physics*, Osaka, Japan, July 27 – August 2, 2000.