EXTRACTION OF TRIPLE GAUGE COUPLINGS (TGC'S)

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Fourteen independent couplings, 7 each for ZWW and γWW, completely describe the VWW vertices within the most general framework of the electroweak Standard Model (SM) consistent with Lorentz invariance and $U(1)$ gauge invariance. Of each of the 7 TGC's, 3 conserve C and P individually, 3 violate CP, and one TGC violates C and P individually while conserving CP. Assumption of C and P conservation and electromagnetic gauge invariance reduces the independent VWW couplings to five: $\kappa_\gamma, \kappa_Z, \lambda_\gamma, \lambda_Z, g_1^Z$. The W magnetic dipole moment, μ_W, and the W electric quadrupole moment, q_W, are expressed as $\mu_W = e\,(1 + \kappa_\gamma + \lambda_\gamma)/2M_W$ and $q_W = -e\,(\kappa_\gamma - \lambda_\gamma)/M_W^2$ where κ_γ and λ_γ have the values 1 and 0 at the tree level within the SM.

Precision measurements of suitable observables at LEP1 has already led to an exploration of much of the TGC parameter space. Three linear combinations of the TGC's, $\alpha_{W\phi}$, $\alpha_{B\phi}$ and α_W, have been proposed to investigate the leftover "blind" directions in the CP-conserving TGC parameter space, and two linear couplings, $\widetilde{\alpha}_{BW}$ and $\widetilde{\alpha}_W$ in the CP-violating TGC parameter space (see *e.g.*, papers by Hagiwara [1], Bilenky [2], and Gounaris [3,4]). The relations between these, expressed as *deviations* from the SM, are $\Delta g_1^Z = \alpha_{W\phi}/c_w^2$, $\Delta\kappa_\gamma = \alpha_{W\phi} + \alpha_{B\phi}$, $\Delta\kappa_Z = \alpha_{W\phi} - t_w^2\alpha_{B\phi}$ and $\lambda_\gamma = \lambda_Z = \alpha_W$, where c_w and t_w are the cosine and tangent of the electroweak mixing angle. Similarly, $\widetilde{\kappa}_\gamma = \widetilde{\alpha}_{BW}, \widetilde{\kappa}_Z = t_w^2\widetilde{\alpha}_{BW}$ and $\widetilde{\lambda}_\gamma = \widetilde{\lambda}_Z = \widetilde{\alpha}_W$ within the CP-violating sector.

At LEP2 the VWW coupling arises in W-pair production via s-channel exchange or in single W production via the radiation of a virtual photon off the incident e^+ or e^-. At the TEVATRON hard photon bremsstrahlung off a produced W or Z signals the presence of a triple gauge vertex. In order to extract the value of one TGC the others are generally kept fixed to their SM values.

References

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2. M. Bilenky *et al.*, Nucl. Phys. **B409**, 22 (1993).
3. G. Gounaris *et al.*, CERN 96-01 525.
4. G. Gounaris *et al.*, Eur. Phys. J. **C2**, 365 (1998).