EXTRACTION OF TRIPLE GAUGE COUPLINGS (TGC'S)

Revised March 2000 by C. Caso (Univ. of Genova) and A. Gurtu (Tata Inst.)

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: one common set is $(\kappa_{\gamma}, \kappa_{Z}, \lambda_{\gamma}, \lambda_{Z}, g_{1}^{Z})$, where $\kappa_{\gamma} = \kappa_{Z} = g_{1}^{Z} = 1$ and $\lambda_{\gamma} = \lambda_{Z} = 0$ in the Standard Model at the tree level. 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 $q_{W} = -e \ (\kappa_{\gamma} - \lambda_{\gamma})/M_{W}^{2}$.

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, $\tilde{\alpha}_{BW}$ and $\tilde{\alpha}_{W}$ in the CP-violating TGC parameter space (see e.g., papers by Hagiwara [1], Bilenky [2], and Gounaris [3,4]). The relations between these parameters and those contained in the above set, 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 CPviolating sector. The LEP Collaborations have recently agreed to express their results directly in terms of the parameters Δg_1^Z , $\Delta \kappa_{\gamma}$ and λ_{γ} .

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 bremstrahlung 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).