EXTRACTION OF ANOMALOUS $ZZ\gamma$, $Z\gamma\gamma$, AND ZZV NEUTRAL COUPLINGS

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In the reaction $e^+e^- \to Z\gamma$, deviations from the Standard Model for the $Z\gamma\gamma^*$ and $Z\gamma Z^*$ couplings may be described in terms of 8 parameters, h_i^V ($i=1,4;\ V=\gamma,Z$) [1]. The parameters h_i^γ describe the $Z\gamma\gamma^*$ couplings and the parameters h_i^Z the $Z\gamma Z^*$ couplings. In this formalism h_1^V and h_2^V lead to CP-violating and h_3^V and h_4^V to CP-conserving effects. All these anomalous contributions to the cross section increase rapidly with center-of-mass energy. In order to ensure unitarity, these parameters are usually described by a form-factor representation, $h_i^V(s) = h_{i\circ}^V/(1+s/\Lambda^2)^n$, where Λ is the energy scale for the manifestation of a new phenomenon and n is a sufficiently large power. By convention one uses n=3 for $h_{1,3}^V$ and n=4 for $h_{2,4}^V$. Usually limits on h_i^V 's are put assuming some value of Λ (sometimes ∞).

Above the $e^+e^- \to ZZ$ threshold, deviations from the Standard Model for the $ZZ\gamma^*$ and ZZZ^* couplings may be described by means of four anomalous couplings f_i^V ($i=4,5;V=\gamma,Z$) [2]. As above, the parameters f_i^γ describe the $Z\gamma\gamma^*$ couplings and the parameters f_i^Z the ZZZ^* couplings. The anomalous couplings f_5^V lead to violation of C and P symmetries while f_4^V introduces CP violation.

All these couplings h_i^V and f_i^V are zero at tree level in the Standard Model.

References

- 1. U. Baur and E.L. Berger Phys. Rev. **D47**, 4889 (1993).
- 2. K. Hagiwara et al., Nucl. Phys. **B282**, 253 (1987).

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