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Chiral Anomaly Cancellation and Neutral Triple Gauge Boson Vertices in the SM EFT

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We demonstrate diagrammatically the cancellation of chiral anomalies in the Standard Model Effective Field Theory (SM EFT), achieved through by a consistent choice of loop momentum routing in triangle diagrams with dimension-6 operator insertions. By enforcing gauge invariance and Bose symmetry, we show that Goldstone boson contributions cancel anomalies arising from massive gauge boson vertices, preserving the consistency of the SM EFT. We compute neutral triple gauge boson vertices at one loop, revealing dominant contributions from dimension-6 operators at all energies below the EFT cutoff. A UV-complete anomaly-free model with a heavy vector-like electron validates our approach, illustrating how heavy fermion decoupling generates SM EFT operators while maintaining anomaly cancellation. Our results highlight the phenomenological relevance of these vertices for probing new physics at colliders, particularly through dimension-6 effects that scale as the inverse of the centre of mass energy squared, $1/s$, offering a viable pathway for experimental detection.

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