

Full positivity bounds for anomalous quartic gauge couplings in SMEFT

Electroweak boson scattering at the LHC provides a crucial avenue for probing physics beyond the Standard Model, particularly regarding deviations in quartic gauge couplings. We derive the complete set of positivity bounds for the 22 dimension-8 anomalous quartic gauge coupling (aQGC) coefficients within the Standard Model Effective Field Theory (SMEFT). Moving beyond previous studies limited to transverse vector bosons, our analysis incorporates all electroweak boson modes, explicitly constructing the extremal rays (ERs) of the positivity cone through a group theoretic framework. We utilize two independent methods—direct construction and Casimir operator analysis—to determine these rays, addressing complexities such as parity-violating operators and continuous parameter degeneracies. Our results indicate that the positivity bounds impose severe constraints, restricting the physically viable parameter space to approximately 0.0313% of the naive total space. Furthermore, we derive linear analytical bounds for various operator combinations and provide an easy-to-use Python package, `{tt SMEFTaQGC}`, which implements algorithms to numerically verify positivity and compute the optimized positivity bounds for general aQGC configurations.

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