

Basis invariants in two-higgs-doublet model: Hilbert series, syzygies, and renormalization-group equation

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Physical questions can be obscured by basis redundancies. We discuss reparametrization invariants in the scalar sector of the general Two-Higgs-Doublet Model (2HDM). These invariants form a polynomial ring, with variables corresponding to a finite generating set. We derive six-loop renormalization group equations (RGEs) for all invariants in this set. Notably, our approach does not involve computing individual Feynman diagrams; instead, we rely on general RGE results for scalar theories. Our methods combine linear algebra with techniques from invariant theory. The latter not only helps determine the number of linearly independent invariants appearing in beta functions at a given loop order (via Hilbert series) but also provides a systematic way to handle polynomial relations (syzygies) among the variables of the ring.

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