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Renormalization of chiral Gauge Theories with non-anticommuting γ_5 in the BMHV Scheme at the 3-Loop Level and Beyond

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The dimensional renormalization of chiral gauge theories such as the electroweak Standard Model inevitably leads to the problem of accommodating the manifestly 4-dimensional nature of γ_5 in D dimensions. In order to avoid inconsistencies at the multi-loop level, γ_5 can be treated rigorously as a non-anticommuting object using the Breitenlohner-Maison/'t Hooft-Veltman (BMHV) scheme within dimensional regularization (DReg). Employing the BMHV scheme, however, violates gauge invariance, which subsequently needs to be restored using symmetry-restoring counterterms guaranteed to exist by the methods of algebraic renormalization. We have successfully performed this renormalization procedure up to the 3-loop level in an abelian chiral gauge theory, serving as a toy model for the investigation of new theoretical concepts, obtaining a consistently renormalized theory with ultimately restored BRST invariance. The obtained results will soon be published. With this application in mind, serving as a proof of concept of our method at the multi-loop level, we have started first attempts to both, increasing the loop order in the abelian model, as well as applying it to the Standard Model. While this talk mainly focuses on computations in the abelian sector at higher loop-levels, accompanying talks consider 2-loop calculations in non-abelian theories, including difficulties arising due to the more complicated gauge group, as well as conceptual issues regarding the Standard Model. Ultimately, this renormalization procedure will be needed for high-precision calculations of e.g. electroweak observables.

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