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Four-quark operators with ΔF = 2 in the GIRS scheme

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We calculate the mixing matrices of four-quark operators that change flavor numbers by two units. Our approach employs two schemes: the coordinate-space Gauge Invariant Renormalization Scheme (GIRS) and the Modified Minimal Subtraction scheme. From our perturbative computations, we extract the conversion factors between these two renormalization schemes at the next-to-leading order. A significant challenge in the study of four-quark operators is that they mix among themselves upon renormalization. Additionally, computations in GIRS at a given order in perturbation theory require Feynman diagrams with at least one additional loop. The extraction of the conversion factors involves calculating two-point Green's functions, which include products of two four-quark operators, and three-point Green's functions, which involve one four-quark operator and two bilinear operators, with all operators located at distinct spacetime points. Furthermore, we focus on both parity-conserving and parity-violating four-quark operators. This calculation is crucial for determining Cabibbo–Kobayashi–Maskawa (CKM) matrix elements from numerical simulations using the GIRS scheme.

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