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The Minimal Supersymmetric Standard Model with Non-Invertible Selection Rules

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We investigate a framework of the Minimal Supersymmetric Standard Model (MSSM) in which the quark and lepton flavor structure and suppression of flavor-changing neutral currents (FCNCs) are governed by non-invertible selection rules. By implementing such non-group-like fusion rules for matter fields, arising from gauging the outer automorphism Z2 of a discrete ZN symmetry, we obtain realistic Yukawa textures that reproduce the observed quark and lepton masses and mixings while ensuring diagonal soft supersymmetry (SUSY) breaking masses and hence suppressing dangerous FCNC processes. We analyze mass insertion parameters under random O(1) coefficients and find that all flavor-violating effects are consistent with experimental limits on processes such as $\mu \longrightarrow e\gamma$ and meson mixings. We show that the Yukawa textures and soft terms remain stable under renormalization group evolution. Our results demonstrate that non-invertible selection rules provide a compelling new mechanism to address both the flavor structure and FCNC problems in supersymmetric models.

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