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Non-Invertible Peccei-Quinn Symmetry, Natural 2HDM Alignment, and the Visible Axion

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We identify m_{12}^2 as a spurion of non-invertible Peccei-Quinn symmetry in the type II 2HDM with gauged quark flavor. Thus a UV theory which introduces quark color-flavor monopoles can naturally realize alignment without decoupling and can furthermore revive the Weinberg-Wilczek axion. As an example we consider the SU(9) theory of color-flavor unification, which needs no new fermions. This is the first model-building use of non-invertible symmetry to find a Dirac natural explanation for a small relevant parameter.

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