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Axion quality from the symmetric of $SU(N)$

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The Peccei-Quinn solution to the strong CP problem has a problematic aspect: it relies on a global $U(1)$ symmetry which, although broken at low energy by the QCD anomaly, must be an extremely good symmetry of high-energy physics. This issue is known as the Peccei-Quinn quality problem. We propose a model where the Peccei-Quinn symmetry arises accidentally and is respected up to high-dimensional Planck-suppressed operators. The model is a $SU(N)$ dark gauge theory with fermions in the fundamental and a scalar in the symmetric. The axion arises from the spontaneous symmetry breaking of the gauge group and the quality problem is successfully solved for large enough number of dark colors N . The model includes additional accidentally stable bound states which provide extra Dark Matter candidates beyond the axion.

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