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High quality axions in solutions to the μ problem

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We consider supersymmetric extensions of DFSZ type axion models with the field content of the MSSM plus some extra vectorlike quark and lepton supermultiplets that simultaneously give a solution to the μ problem and the strong CP problem. The extra vectorlike content is chosen such that the perturbative gauge coupling unification is maintained. We identify Peccei-Quinn (PQ) symmetry that is protected to a high degree of accuracy as an accidental symmetry emerging from anomaly-free discrete symmetries with or without a discrete version of the Green-Schwarz mechanism. The PQ symmetry is spontaneously broken with two gauge singlets acquiring intermediate scale vacuum expectation values giving rise to a high-quality invisible axion and a μ term around the TeV scale. After the PQ breaking the axion potential typically acquires more than one inequivalent degenerate minima leading to a cosmological domain wall problem. We therefore pay special attention to the models that evade this problem.

Summary

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