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Naturalizing Supersymmetry with a Two-Field Relaxion Mechanism (15' + 5')

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We present a supersymmetric version of a two-field relaxion model that naturalizes tuned versions of supersymmetry. This arises from a relaxion mechanism that does not depend on QCD dynamics and where the relaxion potential barrier height is controlled by a second axion-like eld. During the cosmological evolution, this allows the relaxion to roll with a nonzero value that breaks supersymmetry and scans the soft supersymmetric mass terms. Electroweak symmetry is broken after the soft masses become of order the supersymmetric mass scale, causing the relaxion to stop rolling at values corresponding to superpartner mass scales up to ˜10ˆ9 GeV. This helps to explain the tuning in supersymmetric models, including split-SUSY models at the PeV scale, while preserving the QCD axion solution to the strong CP problem. Besides predicting two very weakly-coupled axion-like particles, the supersymmetric spectrum contains an extra Goldstino, which could be a viable dark matter candidate.

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