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Resurrecting Low-Mass Axion Dark Matter Via a Dynamical QCD Scale

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In the framework where the strong coupling is dynamical, the QCD sector may confine at a much higher temperature than it would in the Standard Model, and the temperature-dependent mass of the QCD axion evolves in a non-trivial way. We find that, depending on the evolution of Λ_{QCD} , the axion field may undergo multiple distinct phases of damping and oscillation leading generically to a suppression of its relic abundance. Such a suppression could therefore open up a wide range of parameter space, resurrecting in particular axion dark-matter models with a large Peccei-Quinn scale $f_a \gg 10^{12}$ GeV, i.e., with a lighter mass than the standard QCD axion.

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