

Specially Embedding a Composite Axion Model

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We present a novel framework of the post-inflationary composite axion to address the strong CP problem without the cosmological domain wall problem. Conventional composite axion models lead to the domain wall number greater than one, producing stable axion domain walls that overclose the Universe. We show that by considering a special embedding of the confining gauge group responsible for the composite axion as well as QCD into a larger product gauge group, the domain wall number is essentially set to unity in the ultraviolet (UV) theory. In this setup, small instanton effects associated with the UV gauge dynamics induce a controlled explicit breaking of the residual discrete symmetry, providing a bias term in the axion potential. As a result, the domain walls become unstable and decay sufficiently quickly, while the axion solution to the strong CP problem remains intact. We construct an explicit realization of this framework, identify a viable parameter region and analyze the axion dark matter abundance. Decays of exotic hadrons from the composite dynamics are also investigated. Our special-embedding UV completion renders the domain wall problem in composite axion models cosmologically harmless.

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