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A composite grandcolor axion from a composite Higgs model

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In this work we propose a unified model that simultaneously addresses the hierarchy problem and the strong CP problem by combining a composite Higgs scenario with an axion model. To do so, we construct a model in which both the Higgs and the axion arise as pseudo-Nambu-Goldstone bosons (pNGBs) from the same symmetry breaking. In particular, we work with an $SU(4)/Sp(4)$ composite Higgs model, since this coset also contains a CP-odd scalar singlet that can be used as an axion.

To maintain a low compositeness scale while simultaneously avoiding experimental bounds on the axion couplings, we increase the axion mass via additional small instanton contributions coming from a new hidden gauge sector with a confinement scale larger than Λ_{QCD}. Both the SM color group and the additional hidden sector are embedded into a larger non-Abelian grandcolor group. In this way, the topological angles of the two sectors are guaranteed to be the same at tree-level, while we show that other CP-violating sources can be controlled.

After examining the field content and the gauge structure, we study the pNGBs' spectrum, the fermion mass generation mechanism, the axion couplings, and the axion potential to understand under which conditions the CP-odd scalar singlet can solve the strong CP problem while maintaining a natural compositeness scale.

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