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# Solving the strong CP problem with massless grand-color quarks

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We propose a solution to the strong CP problem that specifically relies on massless quarks and has no light axion. The QCD color group $SU(3)_c$ is embedded into a larger, simple gauge group (grand-color) where one of the massless, colored fermions enjoys an anomalous chiral symmetry, rendering the strong CP phase unphysical. The grand-color gauge group $G_{\rm GC}$ is Higgsed down to $SU(3)_c \times G_{c'}$, after which $G_{c'}$ eventually confines at a lower scale, spontaneously breaking the chiral symmetry and generating a real, positive mass to the massless, colored fermion. Since the chiral symmetry has a $G_{c'}$ anomaly, there is no corresponding light Nambu-Goldstone boson. The anomalous chiral symmetry can be an accidental symmetry that arises from an exact discrete symmetry without introducing a domain wall problem. Potential experimental signals of our mechanism include vector-like quarks near the TeV scale, pseudo Nambu-Goldstone bosons below the 10 GeV scale, light dark matter decay, and primordial gravitational waves from the new strong dynamics.

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