UV Sensitivity of the Axion Mass from Instantons in Partially Broken Gauge Groups

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We examine the contribution of small instantons to the axion mass in various UV completions of QCD. We show that the reason behind the potential dominance of such contributions is the non-trivial embedding of QCD into the UV theory. The effects from instantons in the partially broken gauge group appear as "fractional instanton" corrections in the effective theory. These will exhibit unusual dependences on the various scales in the problem whenever the index of embedding is non-trivial. We present a full one-instanton calculation of the axion mass in the simplest product group models, carefully keeping track of numerical prefactors. We verify that the small instantons may dominate over the QCD contribution for very high breaking scales and at least three group factors.

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