

Transient Bias for CP Domain Wall Decay and Dark Matter

Spontaneous CP violation (SCPV) provides an attractive solution to the strong CP problem. However, SCPV after inflation suffers from the formation of CP domain walls, requiring the maximal temperature of the Universe to lie below the CP-breaking scale. In the present work, we then propose a dynamical mechanism that removes this cosmological constraint without introducing permanent explicit CPV. We consider a new scalar field that acquires a large field value with a nontrivial phase in the early Universe and induces a transient bias among degenerate CP vacua through a higher-dimensional interaction with a CP-breaking scalar field. This bias triggers the decay of CP domain walls after they form. As the new scalar field evolves toward the origin, the bias disappears, leaving the low-energy CP structure intact. We derive the conditions for successful domain wall decay and identify the viable parameter space. Furthermore, we point out that the coherent oscillation of the new scalar field naturally survives as dark matter, linking the resolution of the CP domain wall problem to the origin of dark matter.

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