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Domain Walls in the Early Universe and Matter-Antimatter Domains

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We present a model of spontaneous (or dynamical) C and CP violation where it is possible to generate domains of matter and antimatter separated by cosmologically large distances. Such C(CP) violation existed only in the early universe and later it disappeared with the only trace of generated baryonic and/or antibaryonic domains. So the problem of domain walls in this model does not exist. These features are achieved through a postulated form of interaction between inflaton and a new scalar field, realizing short time C(CP) violation.

For the realization of this scenario the width of the domain wall should grow exponentially. Though there is a classical result found in paper by Basu and Vilenkin that the width of the wall tends to the one of the stationary solution. That is why we considered thick domain walls in a de Sitter universe following paper by Basu and Vilenkin. However, we are interested not only in stationary solutions found therein, but also investigated the general case of domain wall evolution with time. When the wall thickness parameter, δ_0, is smaller than $H^{-1}/\sqrt{2}$, where H is the Hubble parameter in de Sitter space-time, then the stationary solutions exist, and initial field configurations tend with time to the stationary ones. However, there are no stationary solutions for $\delta_0 \geq H^{-1}/\sqrt{2}$. We have calculated numerically the rate of the wall expansion in this case and have found that the width of the wall grows exponentially fast for $\delta_0 \gg H^{-1}$. An explanation for the critical value $\delta_{0c} = H^{-1}/\sqrt{2}$ is also proposed.

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Abstract Title

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