Cosmological Time Crystal: Cyclic universe with a small cosmological constant in a toy model approach

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A new form Time Crystal has been proposed and some of its consequences have been studied. The model is a generalization of the Friedmann-Robertson-Walker (FRW) cosmology endowed with noncommutative geometry corrections. In the mini-superspace approach the scale factor undergoes the time periodic behavior, or Sisyphus dynamics, which allows us to interpret this Cosmological Time Crystal as a physically motivated toy model to simulate cyclic universe. Analyzing our model purely from Time Crystal perspective reveals many novelties such as a complex singularity structure (more complicated than the previously encountered swallowtail catastrophe) and a richer form of Sisyphus dynamics. In the context of cosmology, the system can serve as a toy model in which, apart from inducing a form of cyclic universe feature, it is possible to generate an arbitrarily small positive effective Cosmological Constant. We stress that the model is purely geometrical without introduction of matter degrees of freedom.

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