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Concordant approaches to resonant leptogenesis: comparison for a scalar prototype

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In the recent years, Leptogenesis and Electroweak Baryogenesis have been a developing ground for non-equilibrium thermal quantum field theory techniques. In particular, the generation of a CP asymmetry can be described in terms of the Schwinger-Dyson (SD) equations evaluated over a closed time path (CTP) in the Schwinger-Keldysh formalism. Based on this SD approach the equations of motion for the propagators of the theory appear as non-linear integro-differential equations. A few strategies to reduce these equations into something solvable have been developed based on different choices for the representation of the two arguments of the propagators. The most common approaches use two times (2T) in coordinate space or a hybrid description of momenta and coordinates in Wigner space. Although qualitative comparisons for these two approaches have been made, a systematic and detailed analysis has never been carried out thus far. In this work we perform this inspection for the first time using a simple scalar model, with particular focus on flavour mixing and oscillations of the fields corresponding to sterile neutrinos. We find that, when aiming for the leading accuracy in the produced CP asymmetry, these approaches are in agreement across the whole mass-parameter space ranging from the extremely degenerate mass spectrum to the hierarchical regime. To achieve this, we upgrade the state of the art for the Wigner space solutions and provide a comprehensive description that is valid for all possible mass spectra.

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Summary

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