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Topological aspects of particle production in the early universe

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We study topological aspects of particle production using Stokes phenomenon. An explicit map between the standard β-coefficient computation, and Stokes constants from the perspective of the F-matrix formalism is presented. In scenarios where the particle dispersion relation reduces in the long wavelength limit ($k \to 0$) to the form z^n ($n \in \mathbb{Z}_{>0}$) in complexified time z, the corresponding mode equation satisfies a $\mathbb{Z}_{n+2}$ symmetry. This symmetry, combined with the F-matrix formalism fixes the Stokes constants and the β-coefficient as simple trigonometric functions of n. Here we extend the above computation to small non-zero values of k by computing the lowest order corrections to the Stokes constants for scenarios where the mode equation retains a $\mathbb{Z}_{n+2}$ symmetry. These corrections are then used to estimate the topological contribution corresponding to $k \approx 0$ to the total particle production in two scalar field models of interest for early universe cosmology.

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