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Decoherence of cosmological perturbations: boundary terms and the WKB wave functional

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We revisit the decoherence of primordial scalar curvature and tensor perturbations in minimal single-field inflation, by considering the slow-roll unsuppressed non-Gaussian phase in their wave functional. The phase can be seen either from boundary (total time-derivative) terms in the action, produced by the usual integration-by-parts procedure, or the WKB approximation of the Wheeler-DeWitt equation. By tracing out unobserved degree of freedom which interacts with observed modes, such a phase can cause much faster cosmic decoherence, compared to those by bulk interactions. We thus provide a better estimation of the decoherence effect to some recent proposals probing the quantum nature of primordial perturbations such as the cosmological Bell test, showing a possible window of around 5 e-folds.
Related papers: JHEP 06 (2023) 101 (arXiv:2305.08071), JHEP 04 (2023) 092 (arXiv:2207.04435), arXiv:2405.07141"

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