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Discrepancies of the Single Field Approximation in Asymptotic Safety

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Motivated by recent studies at Southampton (Morris and Dietz, JHEP 1307:064, 2013) of the $f(R)$ approximation in Quantum Gravity have found that, in certain formulations of the truncated RG flow, the space of relevant eigenoperators is empty. We demonstrate with the well understood model of a single component scalar field in $d=3$ dimensions that the Single Field Approximation (SFA) used in Quantum Gravity, where we identify the background field as the full classical field, can lead to discrepancies in the fixed point structure. In our scalar field example, use of the SFA gives us new non-trivial fixed point but we lose the expected Wilson-Fisher fixed point. As a means to remedy this we apply the modified shift Ward Identity, recovering the standard result and demonstrating a form of universality among RG flows.

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