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Essential renormalization group

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In the many years since K. Wilson first conceived of it, the exact RG, a.k.a. the non-perturbative functional renormalisation group has become a powerful technique that can be used to investigate a wide range of physical systems without relying on perturbation theory. Its modern formulation is based on an exact flow equation for a functional that interpolates between the bare Action and the Effective Action, called the Effective Average Action (EAA). The general strategy to treat such an exact equation consists of choosing an operator basis, depending on the symmetry of the underlying theory, and calculate the flow of the couplings associated with each operator. In practice, we must make approximations considering a finite number of terms, and then we verify the stability of the results by including more terms. The aim of my research consists of finding a way to make simplifications in practical calculations of the EAA flow equation: indeed, its complexity increases very fast as we include more and more terms in the expansion of EAA. It is possible to achieve such simplifications using the generalised form of the flow of the EAA which incorporates field redefinitions along the RG flow. To exemplify its utility, I present results of the Wilson-Fisher fixed point in three dimensions and pure quantum gravity.

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