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Renormalisation of non-perturbative calculations in scalar theories

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Non-perturbative techniques are needed to study strongly coupled systems. One powerful approach is the n-particle irreducible effective action. The technique provides a systematic expansion for which the truncation occurs at the level of the action. However, renormalisation using a standard counterterm approach is not well understood. At the 2PI level one must introduce multiple counterterms, and at higher orders there is no known way to renormalise an nPI theory using counterterms. On the other hand, renormalisation is much simpler using a renormalisation group approach. We present results from a calculation using a scalar theory with quartic coupling in 4 dimensions, at the 4 loop level. The 2PI theory is renormalised using one bare coupling constant which is introduced at the level of the Lagrangian. We show that the method can be generalised to higher order calculations.

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