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Non-perturbative calculations in scalar theories

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Non-perturbative techniques are needed to study strongly coupled systems.

One popular method is the 2 particle irreducible (2pi) effective theory.

For scalar theories, calculations at the 3 loop level show improved convergence, relative to perturbative results. We present results in ϕ^4 theory at the 4 loop level which show that convergence breaks down at large coupling. This indicates the need for higher order effective theories.

4pi calculations in 4 dimensions have never been attempted, because no method is known to deal with the overlapping sub-divergences that appear in these theories. We present a new technique to renormalize the 4pi effective theory, based on a renormalization group approach.

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