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Asymptotic safety on the lattice: the nonlinear $O(N)$ Sigma model

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We study the non-perturbative renormalization group flow of the nonlinear $O(N)$ sigma model in two and three space-time dimensions using a scheme that combines an effective local Hybrid Monte Carlo update routine, blockspin transformations and a Monte Carlo demon method. In two dimensions our results verify perturbative renormalizability. In three dimensions, we determine the flow diagram of the theory for various N and different truncations and find a non-trivial fixed point, which indicates non-perturbative renormalizability. It is related to the well-studied phase transition of the $O(N)$ universality class and characterizes the continuum physics of the model. We compare the obtained renormalization group flows with recent investigations by means of the Functional Renormalization Group.

Primary authors: Prof. WIPF, Andreas (FSU Jena); Dr WELLEGEHAUSEN, Björn (JLU Gießen); Mr KÖRNER, Daniel (FSU Jena)

Presenter: Mr KÖRNER, Daniel (FSU Jena)

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