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A qubit realization of O(N) sigma models

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We construct a qubit formulation of the lattice $O(N)$ non-linear sigma model in $d + 1$ dimensions. For the $O(3)$ model, our construction uses two qubits per lattice site. We show that this Hamiltonian in two spatial dimensions has a quantum critical point where the well known scale invariant physics of the Wilson-Fisher fixed point is reproduced. Free massive bosons arise in three spatial dimensions. Simple modifications to our Hamiltonian also give us $O(2)$ and Z_2 qubit models.

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