The class C quantum network model and its nonlinear sigma model representation

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Superconductors with broken time-reversal symmetry represent a platform for the realization of the spin quantum Hall effect. Although such systems are actively studied numerically and analytically, deriving the parameters of the nonlinear sigma model (NLSM) directly from the microscopic model for a disordered superconductor remains a nontrivial task. We consider a quantum network model in Altland-Zirnbauer symmetry class C with random tunneling between chiral links. We find that ballistic renormalization group flow for the action averaged over disorder generates couplings between non-neighbouring links. For arbitrary coupling between links we derive a NLSM with topological term and find explicit formulas for longitudinal and Hall spin conductances as well as density of states in terms of microscopic disorder parameters. The resulting action allows us to consider both a slowly changing and a rapidly oscillating in space Zeeman field. In the process of derivation of NLSM, we obtain additional Hubbard-Stratonovich fields that are zero on the saddle manifold, but can have soft modes for certain ratios of the disorder parameters. The results obtained in the work show that the Chalker-Coddington model may not be the most successful for numerical simulation of the spin quantum Hall effect.