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$1/f^\alpha$ noise in interacting spin systems: a real space RG approach

KARTIEK AGARWAL, Harvard University, IVAR MARTIN, Los Alamos National Laboratory, EUGENE DEMLER, Harvard University — Localized paramagnetic electrons are believed to be the cause of magnetic flux noise that plagues superconducting qubits, but how such interacting spins generate frequency dependent noise of the form $1/f^\alpha$ is not well understood. We describe a novel real space RG procedure that is equipped to calculate directly various dynamical quantities in a strongly disordered Heisenberg spin system (in arbitrary dimensions), including the 'noise' from such systems. In 1-D, we find that the RG procedure describes a fairly temperature-indepedent noise with a power law $\alpha < 1$ that varies smoothly depending on the disorder strength, relative concentration of Ferro/Anti-Ferro bonds and temperature. The dynamic structure factor (of spin-spin correlations) inherits this power law while displaying a crossover to a related power at higher frequencies. In 2-D, the RG results in dynamics that are diffusive at high temperatures but remain anomalous at lower temperatures. A possible connection of the phenomena of $1/f$ noise and Many-Body Localization is also discussed.

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