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Random frequency modulation of a superconducting qubit MATTI SILVERI, University of Oulu, JIAN LI, KARTHIKEYAN SAMPATH, JUHA-MATTI PIRKKALAINEN, ANTTI VEPSÄLÄINEN, WEI-CHENG CHIEN, Aalto University School of Science, JANI TUORILA, University of Oulu, MIKA SILLANPÄÄ, PERTTI HAKONEN, Aalto University School of Science, ERKKI THUNEBERG, University of Oulu, GHEORGHE PARAOANU, Aalto University School of Science — Superconducting circuits with Josephson junctions are a promising platform not only for developing quantum technologies, but, importantly, also for the study of effects that typically occur in complex condensed-matter systems. Here, we employ a transmon qubit to conduct an analog simulation of motional averaging, a phenomenon initially observed in nuclear magnetic resonance spectroscopy. To realize this effect, the flux bias of the transmon is modulated by a controllable pseudo-random telegraph noise, which results in stochastic jumping of the energy separation (frequency) between two discrete values. This can also be seen as a simulated fast-fluctuation environment under direct experimental control. Additionally, we discuss the population dynamics using an analytical master equation, and apply the motional averaging analysis on phenomena where the fluctuation of the energy is due to quasiparticles or to photon shot noise.

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