In the nanoworld, noise helps!

Scientists making sensitive measurements usually think of noise as undesirable energy that inevitably spills from the environment into the system, degrading system performance. For example, in the case of atoms arranged in a periodic array by light (also known as an optical lattice, for long an architectural paradigm for developing new nanotechnology tools), the principal obstacle to achieving controlled nanoscale atomic transport is that the directed motion of the atoms (i.e., the system performance) is overwhelmed by randomly directed recoils due to photon scattering (i.e., the noise). Current efforts to build efficient artificial nanomachines center on the counter-intuitive phenomenon of “stochastic resonance”, which refers to a peak in system response as the strength of the random noise increases. Here, we report on the observation of a resonant enhancement in the directed propagation of atoms in an optical lattice, as the rate of randomly directed recoils due to photon scattering is varied. We perform a first experimental characterization of this stochastic resonance in terms of various lattice parameters. The notion that the controlled addition of random noise fluctuations helps rather than hinders system performance is critical for the development of nano devices capable of operating efficiently in noisy environments.