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Investigation of quantum chaos using the quantum fidelity in delta-kicked rotor SIAMAK DADRAS, JIATING NI, WAKUN LAM, Department of Physics, Oklahoma State University, Stillwater, Oklahoma 74078-3072, SANDRO WIMBERGER, Dipartimento di Fisica e Science della Terra, Università di Parma, Via G.P. Usberti 7/a, 43124 Parma, Italy, GIL SUMMY, Department of Physics, Oklahoma State University, Stillwater, Oklahoma 74078-3072 — Several quantum phenomena have been experimentally investigated using the system of ultra-cold atoms exposed to a spatially and temporally periodic optical potential, the so-called quantum delta-kicked rotor. This tool has been widely utilized to study many interesting phenomena such as quantum resonances, dynamical localization, ratchets, and accelerator modes by measuring the atomic momentum distribution. However, the chaotic behavior of quantum systems, in the classical sense of exponentially diverging trajectories in phase space, is still difficult to study merely through the evolution of the momentum distribution. In this respect, we investigate the evolution of the quantum fidelity between two quantum systems experienced slightly different interactions to interpret how the system behaves in deterministic and chaotic phases. We present results of a theoretical study showing how the fidelity between these systems, as well as the correlation between their pseudo-classical phase maps, depend on both the strength and the temporal period of the potential in long term. We also demonstrate the results of corresponding delta-kicked rotor experiments with a rubidium-87 Bose-Einstein condensate confirming our theoretical predictions in finite time.

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