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**Kicking atoms with finite duration pulses** JULIA FEKETE, SHIJIE CHAI, Dodd-Walls Centre for Photonics and Quantum Technologies Department of Physics, University of Otago, BORIS DASZUTA, Department of Mathematics and Statistics, University of Otago, MIKKEL F. ANDERSEN, Dodd-Walls Centre for Photonics and Quantum Technologies Department of Physics, University of Otago
— The atom optics delta-kicked particle is a paradigmatic system for experimental studies of quantum chaos and classical-quantum correspondence. It consists of a cloud of laser cooled atoms exposed to a periodically pulsed standing wave of far off-resonant laser light. A purely quantum phenomena in such systems are quantum resonances which transfers the atoms into a coherent superposition of largely separated momentum states. Using such large momentum transfer "beamsplitters" in atom interferometers may have applications in high precision metrology. The growth in momentum separation cannot be maintained indefinitely due to finite laser power. The largest momentum transfer is achieved by violating the usual delta-kick assumption. Therefore we explore the behavior of the atom optics kicked particle with finite pulse duration. We have developed a semi-classical model which shows good agreement with the full quantum description as well as our experiments. Furthermore we have found a simple scaling law that helps to identify optimal parameters for an atom interferometer. We verify this by measurements of the "Talbot time" (a measurement of h/m) which together with other well-known constants constitute a measurement of the fine structure constant.

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