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Observation of high-order quantum resonances in the delta kicked rotor M. PARTLOW, J.F. KANEM, S. MANESHI, C. ZHUANG, A.M. STEINBERG, Centre for Quantum Information & Quantum Control and Institute for Optical Sciences, Department of Physics, University of Toronto, CANADA, M. SPANNER, Centre for Quantum Information & Quantum Control and Department of Chemistry, University of Toronto, CANADA — Quantum resonances in the delta kicked rotor[1] are characterized by a dramatically increased energy absorption rate in direct contradiction to the momentum localization generally observed. These resonances exist where the scaled Planck's constant $\tilde{\hbar} = \frac{r}{s} \cdot 4\pi$, for integers r and s. However only the $\tilde{\hbar} = r \cdot 2\pi$ resonances are easily observable. We report on the observation of high-order quantum resonances ($s > 2$) utilizing a sample of low temperature, non-condensed atoms and a pulsed optical standing wave. Resonances are observed for $\tilde{\hbar} = \frac{r}{16} \cdot 4\pi$ for integers $r = 2 - 6$. The behavior of the resonances with variation of kick number and kick strength is examined. Quantum numerical simulations suggest that our observation of high-order resonances indicates a much longer spatial coherence than expected from an initially thermal atomic sample.

[1]F.L. Moore, J.C. Robinson, C.F. Bharucha, B. Sundaram, M.G. Raizen, *Phys. Rev. Lett.* **75** 4598 (1995).

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