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Time-domain grating with a periodically driven qutrit YINGYING HAN, Wuhan University, China, TIE-FU LI, Beijing Computational Science Research Center AND Tsinghua University, China, WENXIAN ZHANG, Wuhan University, China, J. Q. YOU, Zhejiang University, China, FRANCO NORI, RIKEN Cluster for Pioneering Research, Japan AND The University of Michigan, USA — Physical systems in the time domain may exhibit analogous phenomena in real space, such as time crystals and time-domain Fresnel lenses. We report the experimental realization of time-domain grating using a superconducting qutrit in periodically modulated probe and control fields via two schemes: Simultaneous modulation and complementary modulation. Both experimental and numerical results exhibit modulated Autler-Townes (AT) and modulation-induced diffraction (MID) effects. Theoretical results also confirm that the peak positions of the interference fringes of AT and MID effects are determined by the usual two-level relative phases, while the observed diffraction fringes, appearing only in the complementary modulation, are however related to the three-level relative phase. Further analysis indicates that such a single-atom time-domain diffraction originates from the correlation effect between the two time-domain gratings. Moreover, we find that the widths of the diffraction fringes are independent of the control-field power. Our results shed light on the experimental exploration of quantum coherence for modulated multi-level systems and may find promising applications in fast all-microwave switches and quantum-gate operations in the strong-driving regime.

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