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**Time-Translation Symmetry Breaking and Reentrant First Order Transition in Periodically Driven Quantum Oscillators** JENNIFER GOSNER, Institute for Complex Quantum Systems and IQST, Ulm University, YAXING ZHANG, Department of Physics, Yale University, BJOERN KUBALA, JOACHIM ANKERHOLD, Institute for Complex Quantum Systems and IQST, Ulm University, MARK DYKMAN, Department of Physics and Astronomy, Michigan State University — Breaking of discrete time-translation symmetry is a well-known phenomenon in dissipative periodically driven systems. An example is a parametric oscillator that displays period doubling when the drive frequency is close to twice the eigenfrequency. Here we show that this phenomenon also occurs in a quantum coherent regime. It emerges when there cross Floquet eigenvalues that differ by a simple fraction of the driving frequency. Specific examples are provided by a nonlinear quantum oscillator driven close to two or three times its eigenfrequency. In both cases multiple crossings occur with the varying parameters of the driving field. Physically, they result from the interference of the Floquet wave functions in the classically inaccessible region. For driving close to three times the eigenfrequency, we find that, a dissipative oscillator supports three states of period-three vibrations that co-exist with the state of no vibrations. The detuning controlls a reentrant kinetic transition, where the state populations change exponentially strongly. We study the rates of switching between the stable states and their peculiar scaling behavior near bifurcation points. The results allow revealing 'time crystals' in simple quantum systems, including the systems studied in circuit QED.

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