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Quantum-coherent phase oscillations in synchronization TALITHA WEISS, STEFAN WALTER, FLORIAN MARQUARDT, Max Planck Institute for the Science of Light (Erlangen) — Recently, synchronization of quantum systems has attracted increasing attention. So far, in these studies the synchronization dynamics itself remained overdamped and thus necessarily incoherent. We study the generic model of a quantum Van der Pol oscillator synchronized to an external drive and show that regimes of underdamped and even quantum-coherent phase motion exist. To this end, we derive an effective quantum model which allows us to quantify the quality of quantum coherence. We identify the quantum-coherent regime and illustrate the long-lived coherence by showing that initial negativities of a Wigner density can persist many oscillations of the system dynamics. Possible experimental implementations can be envisioned with optomechanical systems, trapped ions, and microwave circuits.

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