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Synchronization in Superradiant Lasers KEVIN COX, JOSHUA WEINER, JILA, NIST, Dept. of Physics, University of Colorado at Boulder, JUSTIN BOHNET, NIST, JILA, Dept. of Physics, University of Colorado at Boulder, JAMES THOMPSON, JILA, NIST, Dept. of Physics, University of Colorado at Boulder — Superradiant (or bad-cavity) lasers based on highly forbidden transitions in cold atoms are expected to produce light with coherence properties exceeding the state-of-the-art, finding applications in optical atomic clocks and other precision measurements. We study experimentally and theoretically the response of a superradiant Raman laser to an applied coherent drive. We observe two forms of synchronization (injection locking) between the superradiant ensemble and the applied drive: one attractive and one repulsive in nature, in which the atomic spin degrees of freedom play a crucial role in determining the dynamics. Additionally, we present time dynamics and steady state behavior of two interacting superradiant lasers. Understanding the synchronization physics of superradiant lasers could inform future implementations with technologically relevant phase noise properties and explorations for understanding synchronization in a quantum regime.

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