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Coherent Microwave-to-Optical Conversion via Six-Wave Mixing in Rydberg Atoms CHRISTIAN GROSS, THIBAULT VOGT, JINGSHAN HAN, Centre for quantum technologies, National University of Singapore, DIETER JAKSCH, MARTIN KIFFNER, Clarendon Laboratory, University of Oxford, WENHUI LI, Centre for quantum technologies, National University of Singapore — Interconversion of microwave and optical fields is essential for connecting superconducting qubits and optical photons in future quantum information networks. To achieve the transfer of quantum states between microwave and optical photons, coherent, efficient, and broadband conversion will be required. Here we demonstrate a coherent microwave-to-optical conversion via frequency mixing in Rydberg atoms [1]. In contrast to other physical systems being explored, our scheme requires no cavity and allows free-space and broadband conversion due to the strong coupling of microwaves to Rydberg transitions. Moreover, using electromagnetically induced transparency strongly enhances the efficiency of this process. Our results are in excellent agreement with theoretical predictions based on single-atom physics and indicate that this approach, with optimized geometry and energy level configuration, can lead to a near-unity photon conversion efficiency. [1] J. Han, T. Vogt, Ch. Gross, D. Jaksch, M. Kiffner, and W. Li, arXiv:1701.07969 (2017), accepted for publication in Phys. Rev. Lett.

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