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Deterministic generation of many-photon GHZ states using quantum dots in a cavity[1] MICHAEL LEUENBERGER, MIKHAIL EREMENTCHOUK, AHMED ELHALAWANY, University of Central Florida — We propose a novel theoretical scheme based on the off-resonant interaction of N photons with four InAs/GaAs semiconductor quantum dots (QDs) in an GaAs microdisk cavity to create many-photon GHZ states deterministically in the polarization degree of freedom at a wavelength of 1.3 μm with probability $p = 1$ for N up to 60, without the need of any projective measurement or local unitary operation. Taking advantage of off-resonant interaction, the time evolution of the N-photon state is robust against decoherence due to exciton-phonon and hyperfine interactions. However, decoherence due to leakage of the photons out of the cavity is not negligible and is therefore considered. Remarkably, by taking advantage of a cascaded multilevel Landau-Zener transition, we are able to reduce the GHZ state generation time to below 100 ps for N up to 60, which allows for the creation of GHZ states with N up to 60 in cavities with $Q = 10^6$ with fidelity above 70% including decoherence due to leakage. Our method paves the way to the miniaturization of many-photon GHZ state sources to the nanoscale regime, with the possibility to integrate them on a computer chip based on semiconductor materials.

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