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New class of photonic quantum error correction codes MATTI SILVERI, MARIOS MICHAEL, R. T. BRIERLEY, JUHA SALMILEHTO, VICTOR V. ALBERT, LIANG JIANG, S. M. GIRVIN, Departments of Physics and Applied Physics, Yale University — We present a new class of quantum error correction codes for applications in quantum memories, communication and scalable computation. These codes are constructed from a finite superposition of Fock states and can exactly correct errors that are polynomial up to a specified degree in creation and destruction operators. Equivalently, they can perform approximate quantum error correction to any given order in time step for the continuous-time dissipative evolution under these errors. The codes are related to two-mode photonic codes[1] but offer the advantage of requiring only a single photon mode to correct loss (amplitude damping), as well as the ability to correct other errors, e.g. dephasing. Our codes are also similar in spirit to photonic "cat codes" but have several advantages including smaller mean occupation number and exact rather than approximate orthogonality of the code words. We analyze how the rate of uncorrectable errors scales with the code complexity and discuss the unitary control for the recovery process. These codes are realizable with current superconducting qubit technology[2] and can increase the fidelity of photonic quantum communication and memories. [1] I.Chuang et al., Phys. Rev. A 56, 1114 (1997).[2] R.Heeres et al., Phys. Rev. Lett. 115, 137002 (2015).

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