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Broadband quantum memory in a cavity via zero spectral dispersion

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We seek to design experimentally feasible broadband multiplexed optical quantum memory with near-term applications to telecom bands. Specifically, we devise dispersion compensation for an impedance-matched narrow-band quantum memory by exploiting Raman processes over two three-level atomic subensembles, one for memory and the other for dispersion compensation. Our proposed broadband quantum memory employs three-level atoms with atomic density, cavity quality, and Raman-laser power and detuning chosen such that inverse cavity lifetime equal so ptical depth, the delay-bandwidth product exceeds 10^6, power efficiency exceeding 90% and at least one second of storage time, thereby leading to 10^6 modes for multiplexing. Our design will lead to significant multiplexing enhancement for quantum repeaters to be used for telecom quantum networks.

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