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**Quantum memory on topological spin glass** JEONGWAN HAAH, Institute for Quantum Information and Matter, Caltech, SERGEY BRAVYI, IBM Watson Research Center — We show that any topologically ordered local stabilizer model of spins in three dimensional lattices that lacks string logical operators can be used as a reliable quantum memory against thermal noise. It is shown that any local process creating a topologically charged particle separated from other particles by a distance $R$ must cross an energy barrier of height $c \log R$. This property makes the model glassy. We devise an efficient decoding algorithm that should be used at the final read-out, and prove a lower bound on the memory time until which the fidelity between the outcome of the decoder and the initial state is close to 1. The memory time increases as $L^{c\beta}$ where $L$ is the system size and $\beta$ the inverse temperature, as long as $L < L^\star \sim e^\beta$. Hence, the optimal memory time scales as $e^{c\beta^2}$. Our bound applies when the system interacts with thermal bath via a Markovian master equation. We give an example of a strictly local stabilizer code that satisfies all of our assumptions. We numerically verify for this example that our bound is tight up to constants.

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