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Ground state and excitation properties of the quantum kagomé system $ZnCu_3(OH)_6Cl_2$ investigated by local probes. OREN OFER, AMIT KEREN, Physics Department, Technion, Israel Institute of Technology, Haifa 32000, Israel, EMILY NYTKO, MATTHEW SHORES, BART BARTLETT, DANIEL NOCERA, Department of Chemistry, Massachusetts Institute of Technology, Cambridge, MA 02139 USA, ALEX AMATO, CHRIS BAINES, Paul Scherrer Institute, CH 5232 Villigen PSI, Switzerland — We present a comprehensive study on the ground state and excitation spectrum of the $S = 1/2$, analytically pure and perfect kagomé system $ZnCu_3(OH)_6Cl_2$ using the following measurements: magnetization, muon spin rotation frequency shift K, transverse relaxation time T_2^*, and zero field relaxation, and Cl nuclear spin-lattice relaxation T_1. Using our data we address four questions which are at the heart of the investigation of the quantum kagomé system: Do $S = 1/2$ spins on kagomé lattice freeze? Is the ground state magnetic? What is the density of excited states, and is there a gap in the spin energy spectra? Finally, does the lattice distort in order to accommodate spin-Peierls state? We found no sign of singlet formation, no long range order nor spin freezing, and no sign of spin-Peierls transition even at temperatures as low as 60 mK. The density of states has an $E^{1/4}$ energy dependence with a negligible magnetic gap to excitation. Thus $ZnCu_3(OH)_6Cl_2$ is an exotic magnet with no broken continuous symmetry but gapless excitations.

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