μSR study on the low-temperature anomaly in triangular-lattice antiferromagnet CuOHCl

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Recently we found a new magnetodielectric triangular-lattice compound CuOHCl. It showed geometric frustration and antiferromagnetic transition at $T_N = 11$ K. Then we observed an anomaly below ~5 K, with magnetic susceptibility and specific heat change, as well as an increase in the dielectric constant.[1)]

Our μSR experiments on powder sample showed additional precession frequency for $T < 5$ K with an increase in its value. Considering the observed results of i) the small specific heat anomaly at 5 K; ii) the apparently stable antiferromagnetic spin arrangement revealed by neutron diffraction experiments; iii) the continuity of the other muon precession frequencies, and iv) the dielectric increase below 5 K, it is reasonable to assume a multiferroic transition occurring in CuOHCl.[1)] However, the mechanism for this multiferroic-like state is unclear and further study is demanded. Since we succeeded in growing single crystals, we proposed the use of single crystals for μSR experiments. Related experiments along three crystal-axis directions were planned, but unfortunately due to limited beam time, only a part of them were performed.

As shown in Fig. 1, we observed an additional muon spin precession frequency below $T \sim 5$ K, which suggests that the low-temperature change is an intrinsic property in CuOHCl and further detailed experiments using the single crystals should be planned.

A new result has been obtained from the present experiment. LF-μSR measurements as shown in Fig. 2 suggested a dynamical nature for the low-temperature state below ~5 K.

In summary, we performed ZF-μSR and LF-μSR on a newly found magnetodielectric compound CuOHCl using high-quality single crystals. The intrinsic nature of the low-temperature phase below $T <$ ~5 K has been verified. Further, persisting spin fluctuations have been found to exist in the low-temperature phase. There are only few experimental realizations of triangular-lattice, in special, multiferroic systems in slightly nonstoichiometric oxides, *i.e.*, $CuFeO_2$ ($S = 5/2$), $CuCrO_2/AgCrO_2$ ($S = 3/2$) and $RbFe(MoO_4)_2$($S = 5/2$).[2)] The present system provides a precious structurally two-dimensional triangular lattice showing quantum spin-related properties with perfect chemical stoichiometry.

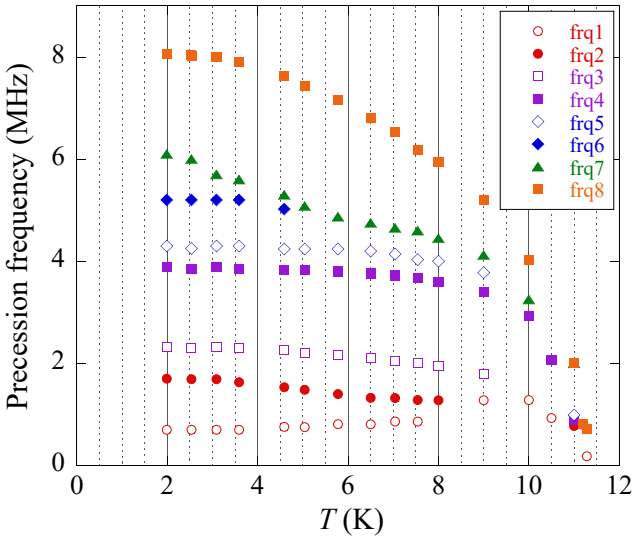

Fig. 1. Muon spin precession frequencies in single crystal CuOHCl.

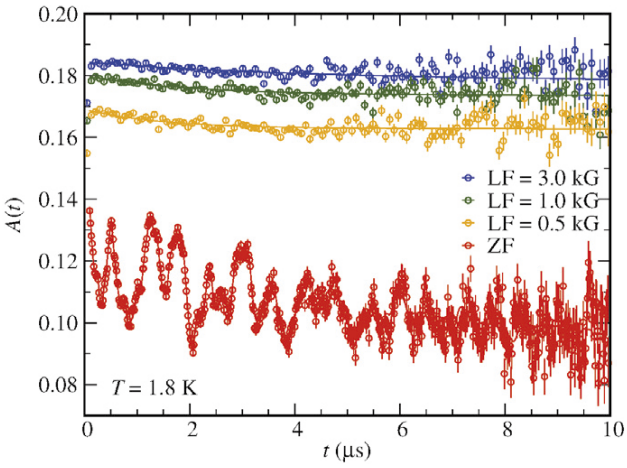

Fig. 2. μSR asymmetries in longitudinal external fields for single crystal CuOHCl.

References

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