Static magnetic order in metallic triangular antiferromagnet $\text{Ag}_2\text{MnO}_2$

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Layered transition-metal dioxides $\text{AMO}_2$, which consist of alternating stacks of $A$ and $\text{MO}_2$ planes, where $A^+$ stands for an alkali ($\text{Li}^+$, $\text{Na}^+$, $\text{K}^+$, $\text{Rb}^+$, and $\text{Cs}^+$), $\text{Ag}^+$, or ($\text{Ag}_2)^+$ ion and $\text{M}^{3+}$ for a transition metal ion, and in which $M$ ions form a two-dimensional (2D) triangular lattice by connection of edge-sharing $\text{MO}_6$ octahedra, have been heavily investigated due to their complex magnetic behavior [1] and a discovery of superconductivity in $\text{Na}_x\text{CoO}_2\cdot 1.3\text{H}_2\text{O}$. Although the 2D interaction is thought to play an essential role for determining the magnetic nature of $\text{AMO}_2$, the inter-plane (3D) interaction sometimes contributes to form long-range order in the $\text{AMO}_2$ compounds.

In order to reduce the 3D interaction and to make $\text{AMO}_2$ close to an ideal 2D system, one could increase the inter-plane distance ($d_{\text{IP}}$) of $\text{AMO}_2$ by using $A$ ions with larger ionic radius; in particular, the largest $d_{\text{IP}}$ is achieved for $A=\text{Ag}_2$ for $\text{AMO}_2$. Furthermore, metallic conduction in the $\text{Ag}_2$ plane [2] naturally hinders the interaction between the adjacent $\text{MO}_2$ planes, i.e., the 3D interaction via the $\text{Ag}_2$ plane. This implies that $\text{Ag}_2\text{MO}_2$ is most likely to be a candidate for an ideal 2D triangular lattice system. However, among several combinations between $\text{Ag}_2$ and $M$ for $\text{AMO}_2$, only $\text{Ag}_2\text{NiO}_2$ and $\text{Ag}_2\text{MnO}_2$ have been prepared thus far.

Following upon the experiment on $\text{Ag}_2\text{NiO}_2$ [3], we have hence extended our $\mu^+\text{SR}$ experiments to $\text{Ag}_2\text{MnO}_2$. The $\text{wTF}$- and $\text{ZF}$-measurements using a powder sample of $\text{Ag}_2\text{MnO}_2$ have demonstrated the existence of a static antiferromagnetic (AF) order below $T_{\text{AF}}^\text{end}=30$ K, while short-range order appears below $T_{\text{N}}^{\text{on}}=80$ K. The strongly damped oscillatory signal in the ZF-spectrum, however, indicates a wide field distribution at the muon sites even at 1.8 K due to the geometrical frustration of the triangular lattice. Although the AF spin structure is still unknown, further studies of the magnetic properties of the $\text{MnO}_2$ plane, particularly the ground state of the AF phase should yield significant new information on the physics of these unique frustrated systems.