Negative magnetization of $Li_2Ni_2Mo_3O_{12}$ including two spin subsystems, distorted honeycomb lattice and linear chain

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Magnetization is usually positive because of the Zeeman energy. However, in some cases, magnetization can be negative. The negative magnetization has been studied extensively since Néel proposed a theoretical model possessing the negative magnetization.[1] Several materials showing the negative magnetization have been discovered and several models explaining the negative magnetization have been proposed. We also found the negative magnetization in the spin-1 substance $Li_2Ni_2Mo_3O_{12}$. The spin system consists of distorted honeycomb lattices and linear chains. Both spin subsystems have disorder (partial substitution by Li^+ ions). A magnetic phase transition occurs at $T_c = 8.0$ K. In low magnetic fields, the magnetization increases rapidly just below T_c, decreases below 7 K, and finally becomes negative at low temperatures. To investigate the origin of the negative magnetization, it is important to determine the magnetic structure. We performed neutron powder diffraction experiments at HRPT and DMC diffractometers in PSI. The honeycomb lattices and linear chains show antiferromagnetic and ferromagnetic long-range order, respectively. We discuss the origin of the negative magnetization.

[1]L. Néel, Ann. Phys. **3**, 137 (1948).