Magnetic neutron diffraction on triangular Kagome lattice

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Geometrical frustration prevents conventional N el order and induces novel magnetic state at low temperature. Particularly in case of classical Kagome-lattice antiferromagnet its characteristic geometry brings macroscopic degeneracy [1] and a coplanar 120 °structure is realized by order-by-disorder mechanism [2]. In Kagome-lattice antiferromagnets NaBa2Mn3F11 is a new model compound [3]. The crystal structure and space group is R-3c. Mn2+ ion carries spin S = 5/2 and the MnF7 pentagonal bipyraids form Kagome-lattice in the ab plane. Remarkable difference from conventional Kagome-lattice is the exchange pathway of 2nd neighbor interaction J2. Recent theory suggests that J2 plays key role in determining the ground state [4] and the unique J2 network of NaBa2Mn3F11 give rise to a novel type of magnetic state. We measured magnetic susceptibility at H = 0.1 T. We found that a peak anomaly due to a magnetic phase transition at T = 2K. We analyzed the data by the Curie Weiss law and the Curie constant C and Weiss temperature ?cw were obtained C = 4.184 cm3 K mol-Mn-1 and ?cw = -32.3 K. Thus we performed neutron powder diffraction to reveal the magnetic structure of NaBa2Mn3F11.

We prepared polycrystalline sample of NaBa2Mn3F11 by a solid state reaction method and the total mass of the obtained sample was 5.351g. We put it in vanadium-made cell and the cell was installed in 3He cryostat. We used powder diffraction spectrometer ECHIDNA installed in ANSTO. We chose Ge 331 monochromator and the monochromized neutron wave length was 2.4395 . We set the sample temperature at 3 K and 0.45 K; above and below the N el temperature. It took 3 hours for T = 3K and 14 hours for T = 0.45 K to collect the data having reasonable statistical errors. Figure (c) shows the diffraction profile at 3 K and Figure (d) shows the profile at 0.45 K. All peaks in the former were identified as nuclear Bragg peaks. Diffuse scattering were observed at 2theta < 40 deg., which indicated the existence of short range order. In the latter we observed several magnetic peaks in addition to the nuclear ones. By performing Rietveld analysis we found that the magnetic peaks were expressed by two propagation vectors, q = (0,0,0) and (0,1/2,1). Magnetic structure analysis in detail is now in progress.

Reference

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