One-Dimensional Short-Range Ordering of Bond-Alternating Antiferromagnetic Chains in F_5PNN

Taiyo Harada[a], **Taku Matsushita**[a], Nobuo Wada[a], and Yuko Hosokoshi[b]

[a]Department of Physics, Nagoya University, Chikusa-ku, Nagoya 464-8602, Japan
[b]Department of Physical Science, Osaka Prefecture University, Naka-ku, Sakai 599-8531, Japan

Pentafulorophenyl nitronyl nitroxide (F_5PNN) is a pure organic magnet with $S = 1/2$ bond-alternating Heisenberg antiferromagnetic chains. The field-induced 3D magnetic ordering between 3 and 6.5 Tesla intermediated by small interchain interaction has been confirmed by heat capacity studies[1].
In this study, we have measured the ac magnetic susceptibility χ_{AC} of F_5PNN single crystals in magnetic fields, in order to examine the short-range ordering in 1D chains, which should occur at higher temperatures prior to the 3D long-range order about 0.2 K. Below $H_{\mathrm{c1}} = 3$ T, exponential decreases of χ_{AC} are observed, which indicate spin gaps due to dimer formation. The gap energy decreases with increasing field until H_{c1}. Between H_{c1} and H_{c2}, a maximum of χ_{AC} is observed at higher temperatures than the 3D ordering temperatures $T_{\mathrm{c}}^{\mathrm{3D}}$. The heights of χ_{AC} maxima diverge in the vicinity of the critical fields with the critical index of 1/2, which agrees with short-range ordering expected for the 1D XY model. At $T_{\mathrm{c}}^{\mathrm{3D}}$, χ_{AC} has no clear anomaly, which suggests that the 3D ordering occurs in spin components transverse to the field. Around critical fields, the boundary of 1D short-range ordered region defined by the maxima of χ_{AC} depends almost linearly on applied fields, which agrees with Tomonaga-Luttinger liquid picture.

[1]Y. Yoshida et al., Phys. Rev. Lett. **94**, 037203 (2005).