Novel Field-Induced Quantum Phase Transition of the Kagome-Lattice Antiferromagnet

Tôru Sakai[a] and Hiroki Nakano[b]

[a]Japan Atomic Energy Agency, SPring-8, Hyogo, Japan
[b]Graduate School of Material Science, University of Hyogo, Hyogo, Japan

The magnetization process of the $S = 1/2$ kagome-lattice quantum antiferromagnet is investigated using the numerical exact diagonalization up to 39-site clusters, in comparison with the triangular-lattice one. The finite-size scaling analysis[1] indicates the "magnetization ramp" phenomenon[2], as a novel field-induced quantum phase transition, at 1/3 of the saturation magnetization in the kagome-lattice system, while the conventional 1/3 magnetization plateau in the triangular-lattice one. The magnetization ramp is characterized by the following properties; (i) there is a single critical field H_c (no plateau), (ii) the field derivative dm/dH is divergent at the lower-field side, and (iii) dm/dH is vanishing at the higher-field side. The spin gap issue of the kagome-lattice antiferromagnet is also studied by the numerical diagonalization up to 42-spin clusters[3]. The finite-size scaling analysis suggests that the system has no spin gap (gapless), as well as the triangular-lattice one. Our present estimation of the critical exponent in the magnetization curve also supports the conclusion.

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[2]H. Nakano and T. Sakai, J. Phys. Soc. Jpn, **79**, 053707 (2010).
[3]H. Nakano and T. Sakai, to appear in J. Phys. Soc. Jpn.; arXiv.1103.5829.