Spin freezing in geometrically frustrated magnetic molecule Fe30 revealed by NMR

Y. Furukawa[a], E. Micotti[b], A. Lascialfari[b], F. Borsa[b], and P. Kögerler[c]

[a]Ames Laboratory, and Department of Physics and Astronomy, Iowa State University, Iowa 50011, USA
[b]Dipartimento di Fisica "A Volta" e Unita'INFM di Pavia, Pavia, Italy
[c]Institute of Inorganic Chemistry, RWTH Aachen University, 52074 Aachen, Germany

Recently much attention has been paid to peculiar magnetic properties of spin frustrated magnetic molecules. The compound $[Mo_{72}Fe_{30}O_{252}(Mo_2O_7(H_2O))_2(Mo_2O_8H_2(H_2O))(CH_3COO)_{12}(H_2O)_{91}]$ (in short Fe_{30}) has 30 Fe^{3+} ($S = 5/2$) ions occupying the 30 vertices of an icosidodecahedron, which makes a closed spherical structure consisting of 20 spin frustrated triangles with antiferromagnetic (AF) exchange coupling ($J = 1.57$ K) between Fe spins. In order to investigate magnetic properties of Fe_{30}, we have carried out proton nuclear magnetic resonance (NMR) measurements at low temperatures down to $T = 0.05$ K using a ^{3}He-^{4}He dilution refrigerator. From a measurement of nuclear spin-lattice relaxation rates as a function of temperature and external field, fluctuation frequency of Fe^{3+} spins is found to become slower on lowering temperature. Broad proton NMR spectrum was observed at low temperatures below $\sim$0.6K. These resluts indicate spin freezing state at low tempertures in Fe_{30}. We will compare our NMR results with those of a quantum spin system, V_{30} (V^{4+}: $S = 1/2$) with the same structure and discuss the similarities and differences in the magnetic properties of these two systems.