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Spin-orbital short-range order in the honeycomb-based quantum magnet $Ba_3CuSb_2O_9$[1]

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The realization of quantum correlated matter beyond one dimension has been vigorously pursued in geometrically frustrated spin systems for decades. In frustrated magnetic materials, however, symmetry breaking of orbital and chemical origin is usually found to induce semi-classical spin freezing. In this talk, I present a contrast case where spins and possibly orbitals remain in a liquid state down to low temperature even in a highly disordered structure of 6H-perovskite $Ba_3CuSb_2O_9$. Our comprehensive experimental analysis indicates that the geometrical frustration of Wannier's Ising antiferromagnet on a triangular lattice can be exploited to build a nano-structured bipartite honeycomb lattice from electric dipolar spin-1/2 molecules. Despite a strong local Jahn-Teller distortion about the Cu^{2+} ion, the resulting spin-orbital random bond lattice not only retains hexagonal symmetry averaged over time and space, but it supports a gapless excitation spectrum without spin freezing down to ultralow temperatures. This is the work based on the collaboration with K. Kuga, K. Kimura, R. Satake, N. Katayama, E. Nishibori, H. Sawa, R. Ishii, M. Hagiwara, F. Bridges, T. U. Ito, W. Higemoto, Y. Karaki, M. Halim, A. A. Nugroho, J. A. Rodriguez-Rivera, M. A. Green, C. Broholm.

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