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Geometrically frustrated magnetism and quantum atomic properties in hydroxyl salts

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Hydroxyl salts exist in nature. The most familiar might be the hydroxyl chloride $Cu_2(OH)_3Cl$ (atacamite), which forms naturally on copper and bronze as a green patina and is widely recognized as imparting characteristics to the Statue of Liberty. But only in recent years, their intriguing magnetism, with prominent geometric frustration, have been uncovered by us. Geometrically frustrated magnets, in which localized magnetic moments on triangular, kagome or pyrochlore lattices interact through competing exchange interactions, have been of intense recent interest due to the diversity in the exotic ground states that they display and potential applications that they may bring out. The diverse experimental reports of unconventional magnetic properties also provide challenge and testing ground for theoretical models. Till now, we have discovered that the hydroxyl salts of the type $M_2(OH)_3Cl$ or M(OH)Cl, where M is a magnetic ion of Cu^{2+}, Ni^{2+}, Co^{2+}, Fe^{2+}, or Mn^{2+}, are geometrically frustrated magnets resulting from their crystal structures as illustrated in figure I. Furthermore, in some of these compounds we found the occurrence of ferroelectricity with multiferroic features. In this talk, I will review our experimental results on hydroxyl salts, together with a brief introduction to a less-known experimental technique μSR.

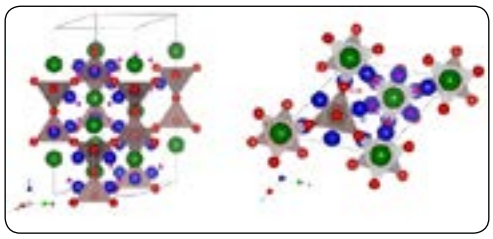

Figure 1: Typical structure in hydroxyl salts $Co_2(OH)_3Cl$.

Recent Publications:

1. X G Zheng et al. (2005) Coexistence of long-range order and spin fluctuation in geometrically frustrated clinoatacamite $Cu_2Cl(OH)_3$. Physical Review Letters. 95(5):057201.
2. X G Zheng et al. (2006) Coexisting ferromagnetic order and disorder in a uniform system of hydroxyhalide $Co_2(OH)_3Cl$. Physical Review Letters. 97(24):247204.
3. X G Zheng et al. (2008) Giant negative thermal expansion in magnetic nanocrystals. Nature Nanotechnology. 3:724-726.
4. Masayoshi Fujihala et al. (2014) Unconventional spin freezing in the highly two-dimensional spin-1/2 kagome antiferromagnet, $Cd_2Cu_3(OH)_6(SO_4)_24H_2O$: evidence of partial order and coexisting spin singlet state on a distorted kagome lattice. Physical Review B. 89:100401.
5. Xing Liang Xu et al. (2017) Critical slowing of quantum atomic deuterium/hydrogen with features of multiferroicity in the geometrically frustrated system $Co_2(OD)3Cl/Co_2(OH)_3Cl$. Physical Review B. 95:024111.

Biography

X G Zheng is received his PhD in Electrical Engineering from School of Engineering, Kyushu University during 1991/03. He worked as Assistant Professor in Department of Physics, Saga University during 1996 - 2005 and at present he is a Professor in Department of Physics, Saga University.

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