Unconventional magnetism in CuNCN

Andrej Zorko[1], Peter Jeglič[1], Denis Arčon[1], Anton Potočnik[1], Andrei Tchougréeff[2], Richard Dronskowski[2]

[1]*Jožef Stefan Institute, Jamova 39, 1000 Ljubljana, Slovenia*
[2]*Institute of Inorganic Chemistry, RWTH Aachen University, Landoltweg 1, D-52056 Aachen, Germany*

Copper oxides continue to fascinate with a plethora of exotic electronic ground states, including high-temperature superconductivity and cooperative quantum magnetic states. Replacing oxygen with "organic" bridges provides an exciting opportunity to extend this class of materials. Recently, the first nitrogen-based analogue CuNCN of the cupric oxide has been synthesized [1], where the oxygen anion O^{2-} is replaced with isolobal carbodiimide group NCN^{2-}. In CuNCN neither susceptibility nor neutron diffraction measurements could detect long-range magnetic ordering (LRO) [2]. Even more surprisingly, the susceptibility of CuNCN is reminiscent of parent cuprates, being heavily suppressed and only weakly temperature dependent, which has triggered lively theoretical activities [3].

We have investigated magnetic properties of CuNCN employing various complementary local-probe techniques, including muon spin relaxation (μSR), electron spin resonance (ESR) and ^{14}N nuclear magnetic resonance (NMR) measurements [4]. Our results confirm the absence of LRO down to at least 63 mK. They reveal a highly unusual magnetic behavior. Inhomogeneities are observed below 80 K and partial spin freezing sets in below 20 K. We shall compare two possible unconventional ground states.

[1] X. Liu et al., Z. Natuforsch. B **60** (2005) 593.

[2] X. Liu et al., J. Phys. Chem. C **112** (2008) 11013.

[3] A. A. Tsirlin et al., Phys. Rev. B **81** (2010) 024424; A. L. Tchougréeff et al., arXiv:1008.0182.

[4] A. Zorko et al., preprint.