Doped DTN at high fields – Theoretical surprise

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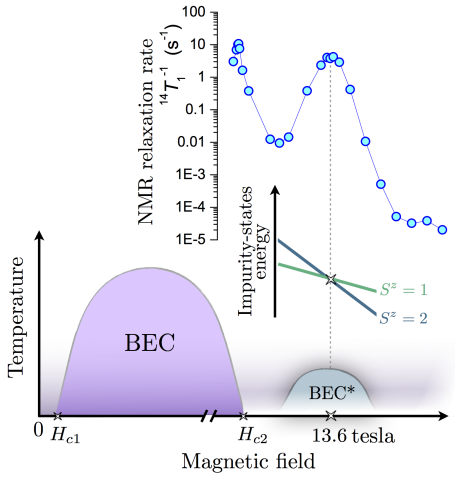
Building on the recent NMR investigation[1] of the doped quasi-one-dimensional $S = 1$ antiferromagnetic material $Ni(Cl_{1-x}Br_x)_2$-4SC$(NH_2)_2$ (DTNX) at high magnetic field, we propose a new theoretical description,[2] which strongly contrasts with earlier proposals.[3] In particular, instead of the previously claimed Bose Glass phase (a zero-temperature many-body localized state) at high magnetic field, we predict a novel type of impurity-induced order with a global quantum coherence over the full sample, yielding a new kind of Bose-Einstein condensation.

Based on an effective model description of interacting impurities and large scale numerical simulations of realistic quantum many-body Hamiltonians, the temperature - field phase diagram of DTNX is strongly reshaped, thus calling for new experimental investigations.



Beyond the canonical Bose-Einstein Condensate (BEC) known for DTN between $H_{c1} = 2.1$ T and $H_{c2} = 12.3$ T, a new type of condensate (BEC*) exists in the vicinity of 13.6 T. This new (disorder-induced) quantum state emerges out of the interaction between localized impurity states, unveiled by a strong NMR relaxation peak as a function of the magnetic field.

[1] A. Orlova *et al.*, Phys. Rev. Lett. **118**, 067203 (2017)

[2] M. Dupont *et al.*, Phys. Rev. Lett. **118**, 067204 (2017).

[3] R. Yu *et al.*, Nature **489**, 379 (2012).