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A Muon Study of Mobile Topological Excitations in the Neutral-Ionic System TTF-CA

The organic charge transfer salt TTF-CA contains 1D chains with alternating molecules of the electron donor TTF and the electron acceptor chloranil (CA). At high temperatures the molecules are in a charge neutral state (N), but below 80 K there is an ionic state (I) with a partial charge transfer from TTF to CA. Various topological excitations are possible in this system [1], e.g. domain walls between N and I regions and spin or charge solitons at the boundaries between I regions with different order. In NMR the spin solitons are only observed for pressure above 7 kbar [2], however our μ SR studies show that mobile spin solitons are also produced in TTF-CA under ambient pressure, with the help of muon addition to the molecules. The dependence of the muon relaxation rate on magnetic field B shows the $B^{-1/2}$ power law, consistent with 1D diffusion [3]. Information about the degree of charge transfer can also be obtained from studies of the time domain signal within a low-field avoided level crossing resonance associated with the CA molecule.

1. K. Sunami et al, 'Topological Excitations in Neutral-Ionic Transition Systems', Symmetry 14, 925 (2022).
2. K. Sunami et al, 'Evidence for solitonic spin excitations from a charge-lattice-coupled ferroelectric order', Sci Adv. 4, eaau7725 (2018).
3. Y. Sakai and C. Hotta, 'Diffusive dynamics of fractionalised particles and the enhanced conductivity at the border of the neutral-ionic transition', Phys. Rev. B 110, 174306 (2024).

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