Muon Studies of a Molecular 2D Spin-Liquid

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Muon spin relaxation has been used to study the 2D triangular lattice molecular system κ-$ET_2Cu_2(CN)_3$, which has been the focus of much recent experimental and theoretical attention as one of the most convincing examples of a triangular lattice $S = 1/2$ spin-liquid. Previous zero field μSR studies have confirmed that no magnetic ordering takes place down to 20 mK in this system [1], despite an estimated exchange coupling of 250 K [2]. The present studies have been made over a wide range of applied fields, ranging from zero field to 3 T and for temperatures ranging between 120 mK and 80 K. The high field measurements provide good overlap with the regime studied previously with NMR and show a field-induced inhomogeneous broadening at low temperatures that is linear in field and consistent with that seen previously in NMR [3]. Both NMR and μSR suggest that static moments are being induced in the spin-liquid phase by strong applied fields. One particular advantage of the μSR technique is that measurements can be extended to very low fields, where there is less likely to be a significant perturbation of the system by the probe field. Detailed measurements were therefore made in the region below 20 mT, where no significant induced static moments are seen. A field-dependent electronic relaxation is observed here, that may be assigned to spinon-type fluctuations of the the spin-liquid ground state. The fluctuations are analysed in terms of a diffusion model representing Brownian motion of the spin excitations on a 2D lattice, which shows a specific logarithmic dependence on field. The temperature dependence of the diffusion rate obtained from this analysis follows a weak power law, whose power is a little lower than that seen with NMR over the same temperature range [3]. These results are discussed in terms of recent theoretical models for the spin-liquid state in this system.

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