NMR Studies of Superconductivity in \( \kappa \)-(BEDT-TTF)\(_2\)Cu(NCS)\(_2\) Beyond the Pauli Limiting Field

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The superconductivity observed in molecular conductors is distinctive in its anisotropy, and consequently many systems are known to exhibit the SC ground state to magnetic fields approaching the Pauli limiting field \( H_p \). We have used \(^{13}\)C as the probe nucleus for studies of superconductivity in \( \kappa \)-(BEDT-TTF)\(_2\)Cu(NCS)\(_2\) (\( T_c = 10\)K) in fields up to \( H = 27\)T (\( H_p = 21.5\)T). The magnetic field is aligned to within 0.2° of the intralayer direction using the hyperfine fields. For \( H=H_p \), the spectra are interpreted as evidence for field penetration by Josephson vortices, and the spectra evolve as they would for the existence of line nodes in the gap over the Fermi surface. For \( T<T_c \), the relaxation rates \( T_\ell(H) \) indicates a phase transition at \( H=H_p \) with superconductivity persisting to higher fields. However, the field dependence \( T_\ell(H) \) behaves inconsistent with expectations for the inhomogeneous state predicted by Fulde and Ferrell, and independently by Larkin and Ovchinnikov, and instead may indicate the presence of antiferromagnetic spin fluctuations.