Superconductivity in (TMTSF)$_2$ClO$_4$ probed by $^{77}$Se NMR

J. SHINAGAWA, UCLA, Y. KUROSAKI, University of Tokyo, S. E. BROWN, UCLA, D. JEROME, Université de Paris, Sud, J. B. CHRISTENSEN, K. BECHGAARD, Orsted Institute, Copenhagen — Superconductivity in the Bechgaard salts (TMTSF)$_2$X, with X=PF$_6$, ClO$_4$, survives well beyond the paramagnetic limit set by the transition temperature $T_c \approx 1$K. As a result, it has been hypothesized that the spin pairing is triplet. We report on measurements of the $^{77}$Se Knight shift and spin-lattice relaxation rate $T_1^{-1}$, conducted in situ with interlayer resistivity, deep within the superconducting state of (TMTSF)$_2$ClO$_4$. At fields $H_0 \approx 10$kOe aligned along the a- and b'-axes, the Knight shift reveals a decrease in spin susceptibility $\chi_s$ that is likely consistent with singlet pairing. The field dependence of $T_1^{-1}$ at temperatures $T \ll T_c$ exhibits a very sharply-defined increase at a field $H_s \approx 15$kOe. For $H_0 > H_s$, $T_1^{-1}$ is close to the normal state value, even though $H_{c2} > H_s$ and $R_{zz} = 0$ to within experimental uncertainty. We discuss the implications for interpreting the results as evidence for a crossover, or a phase transition within the superconducting state.

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