

REVERSAL OF THE UPPER CRITICAL FIELD ANISOTROPY AND SPIN-LOCKED SUPERCONDUCTIVITY IN $K_2Cr_3As_3$

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We report the first measurements of the anisotropic upper critical field $H_{c2}(T)$ for $K_2Cr_3As_3$ single crystals up to 60 T and $T > 0.6$ K. $H_{c2}(T)$ was determined via resistivity [1] and proximity detector oscillator (PDO) techniques. Our results show that the upper critical field parallel to the Cr chains, H_{c2}^{\parallel} , exhibits a paramagnetically-limited behavior, whereas no evidence of paramagnetic pair breaking was observed with field perpendicular to the Cr chains. As a result, the curves H_{c2}^{\perp} and H_{c2}^{\parallel} cross at $T \sim 4$ K, so that the anisotropy parameter $\gamma(T) = H_{c2}^{\perp} / H_{c2}^{\parallel}$ increases from $\gamma \sim 0.35$ near T_c to $\gamma \sim 1.7$ at 0.6 K (Figure 1). This behavior of $H_{c2}(T)$ is inconsistent with triplet superconductivity but suggests a form of singlet superconductivity with the electron spins locked onto the direction of Cr chains [2].

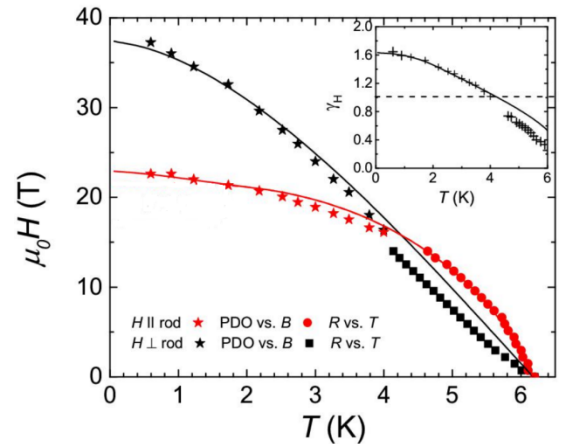


Figure 1. Upper critical fields H_{c2} along c-axis (red) and perpendicular to c-axis (black), symbols. Solid lines are fits to Werthamer-Helfand-Hohenberg theory for a uniaxial superconductor. Inset shows $\gamma(T) = H_{c2}^{\perp} / H_{c2}^{\parallel}$.

[1] T. Kong, S. L. Bud'ko, and P. C. Canfield, Phys. Rev. B 91, 020507 (2015)

[2] F. F. Balakirev, *et al.*, Phys. Rev. B 91, 220505 (2015)

Category: SC

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