REVERSAL OF THE UPPER CRITICAL FIELD ANISOTROPY AND SPIN-LOCKED SUPERCONDUCTIVITY IN K$_2$Cr$_3$As$_3$

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We report the first measurements of the anisotropic upper critical field $H_{c2}(T)$ for K$_2$Cr$_3$As$_3$ 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 $T \approx 4$ K, so that the anisotropy parameter $\gamma(T) = H_{c2}^\perp / H_{c2}^\parallel$ increases from $\gamma \approx 0.35$ near $T_c$ to $\gamma \approx 1.7$ 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].


Category: SC
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