

Spin Moment and Spin-polarized Electron Momentum Density in Ferromagnetic Superconductor UGe₂

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Introduction

The coexistence of superconductivity with magnetism has recently renewed an interest in condensed matter physics. UGe₂ has a collinear magnetic structure with the ferromagnetically ordered moment of $1.4 \mu_B$. The Curie temperature $T_c = 52$ K at ambient pressure decrease under pressure, vanishing at 1.6 GPa. Around 1.2 GPa, UGe₂ becomes superconducting while remaining strongly ferromagnetic with a moment of $1\mu_B/U$, providing an attractive case of coexistence of the superconductivity with strong ferromagnetism.

The magnetic structure of UGe₂ is a rather open question. The aim of this experiment is to obtain a microscopic picture of magnetism in ferromagnetic UGe₂ that is conceivably the ground for developing a theory on the novel superconductivity.

Experimental Details

The spin-polarized electron momentum density distribution, so-called magnetic Compton profile (MCP), was measured by the magnetic Compton scattering (MCS) technique, and the spin moment of UGe₂ was determined from the magnetic effect on MCS. The measurement was carried out at 20 K with a magnetic field of 0.5 T. The incident x-ray energy was 113 keV. A iron sample was also measured at room temperature to calibrate the spectrometer for obtaining an absolute value of the spin moment. The experiment was performed at the AR-NE1A1 beamline

Results and Discussion

The magnetic effect was -0.89 ± 0.08 % along the easy axis (a-axis). This gives the spin moment of $-1.03 \pm 0.09 \mu_B$ at 20 K. The negative value indicates that the orbital moment dominates the magnetization. The total magnetic moment (spin moment + orbital moment) was measured by a SQUID and was $+1.38 \mu_B$ at 20K under 0.5 T. From the results, we determined the orbital moments at

$2.41 \pm 0.09 \mu_B$. The ratio of orbital to spin moments (L/S) is 2.33. Figure 1 shows the magnetic Compton profile at $T=20$ K.

We are now analyzing the shape of the profile for clarifying the magnetic structure in ferromagnetic UGe₂.

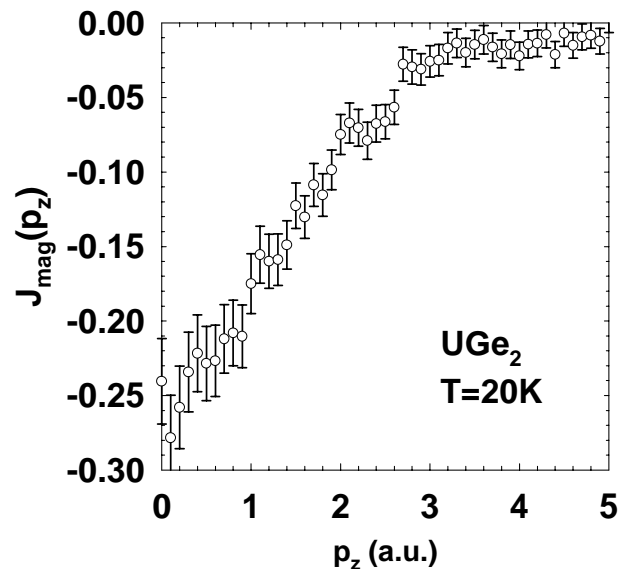


Figure 1 :
Magnetic Compton profile of UGe₂ along the a-axis
at 20 K.

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