Magnetism and Superconductivity in Heavy Fermion Superconductor $CeCo(In_{1-x}Cd_x)_5$

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The heavy fermion superconductor $CeCoIn_5$ has the highest T_c (= 2.3 K) in a series of Ce-based materials. Recently, it has been found [1] that Cd substitution on the In site drives the system towards antiferromagnetism (AFM). Remarkably, applying pressure can reverse this effect. Recent NMR studies [2] suggest that the magnetism develops locally in the vicinity of the Cd atoms. Neutron scattering experiments [3] on a sample with a nominal [1] Cd concentration of 10% showed the coexistence of superconductivity and AFM. The AFM order develops below T_N with the commensurate wave vector Q_{AF} = (1/2, 1/2, 1/2) and the magnetic intensity does not increase below T_c.

Zero field μSR measurements on single crystalline samples of $CeCo(In_{1-x}Cd_x)_5$ ($x = 0.03, 0.10$ and 0.15) were performed in order to further elucidate the magnetic and superconducting properties. In contrast to neutron scattering, μSR can independently measure both the magnitude of the local field and the magnetic volume fraction. A single muon precession signal was observed below T_N in both the $x = 0.10$ and 0.15 samples, with different magnetic volume fractions. The muon frequency, which is proportional to the AFM moment, leveled off below $T_c \sim 1.3$ K in $x = 0.10$, similar to the neutron results. The observed frequency in $x = 0.15$ is 20% larger than that in $x = 0.10$, suggesting enhancement of internal field in $x = 0.15$. No magnetic signal in zero applied field was observed for $x = 0.03$. We will discuss these results in view of the microscopic interplay of magnetism and superconductivity in this material.

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