On the search for quantum criticality in a ferromagnetic system $UNi_{1-x}Co_xSi_2$

Dariusz Kaczorowski, Adam P. Pikul
Institute of Low Temperature and Structure Research, Polish Academy of Sciences,
P. O. Box 1410, 50-950 Wrocław, Poland

The orthorhombic compound $UNiSi_2$ is a ferromagnetically ordered ($T_C = 95$ K) Kondo lattice with rather well localized $5f$ electrons, whereas the isostructural phase $UCoSi_2$ exhibits a spin-fluctuation behavior. Here, we report on our systematic study of the solid solution $UNi_{1-x}Co_xSi_2$ ($0 \leq x \leq 1$) with the main focus on the alloys being close to a ferromagnetic instability, which might be expected to occur for a certain Co-content x_c. Measurements of the magnetic susceptibility, the electrical resistivity and the heat capacity were performed down to 0.35 K in magnetic fields up to 9 T on single crystals of the terminal compounds, i.e. $UNiSi_2$ and $UCoSi_2$, and polycrystalline samples of the mixed alloys. The experimental data have revealed an evolution from strongly anisotropic ferromagnetism with pronounced Kondo effect, observed for the alloys with $x < 0.98$ and being gradually suppressed with rising Co-content, to spin-glass-like states with dominant spin fluctuations seen for the samples with $0.98 < x < 1$. Most interestingly, clear non-Fermi liquid features manifesting the proximity to a ferromagnetic quantum critical point have been found for single-crystalline $UCoSi_2$. The low-temperature behavior of this pure stoichiometric system seems being governed by collective excitations of heavy quasiparticles in the vicinity of spin-density-wave transition.

9.7 cm

13.4 cm

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Corresponding author :
Dariusz Kaczorowski

Address for correspondence :
Institute of Low Temperature and Structure Research, Polish Academy of Sciences,
P. O. Box 1410, 50-950 Wrocaw, Poland

Email address :
d.kaczorowski@int.pan.wroc.pl