

# Spin density in UCoGe

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The recent discovery of ferromagnetism (FM) coexisting with superconductivity (SC) in uranium compounds have stimulated interest in the study of heavy actinide magnetism. It has been suggested that the superconductivity is mediated by the spin fluctuations associated with the presence of a ferromagnetic quantum critical phase transition.

One such material is UCoGe, a superconductor with a critical temperature of 0.8 K, a ferromagnet with a curie temperature of 3 K and an ordered moment of  $0.03 \mu_B$  [1]. Controversy over the exact magnetic structure and size of relative moments has hampered theoretical studies. Most theoretical work suggest the small total moment is composed of a large ( $> 1 \mu_B$ ) opposing spin and orbital moment on the uranium  $5f$  electrons resulting in the

near cancellation of a moment on the uranium sites. However, these calculations fail to reproduce the total moment of the system measured with bulk magnetometry [2].

In order to investigate the spin and orbital moments we have used magnetic Compton scattering to measure the spin density of UCoGe in its ferromagnetic phase.

Magnetic Compton measurements are able to discern the purely spin polarised magnetic contribution to a moment, and from the shape of the Compton profile can provide information on the degree of localisation of the magnetic moment.

We determined the spin moment to be  $-0.35 \pm 0.05 \mu_B$  (aligned opposite to the total moment) and hence an orbital moment of  $0.52 \pm 0.05 \mu_B$ , in contradiction with recent *ab initio* calculations.

A comparison with deconstructed site-projected LSDA profiles were made to help elucidate the results. These show qualitative agreement with our experimental data as shown in Fig. 1.

We suggest that the moment is mainly uranium  $5f$  in character with a small ( $0.05 \mu_B$ )

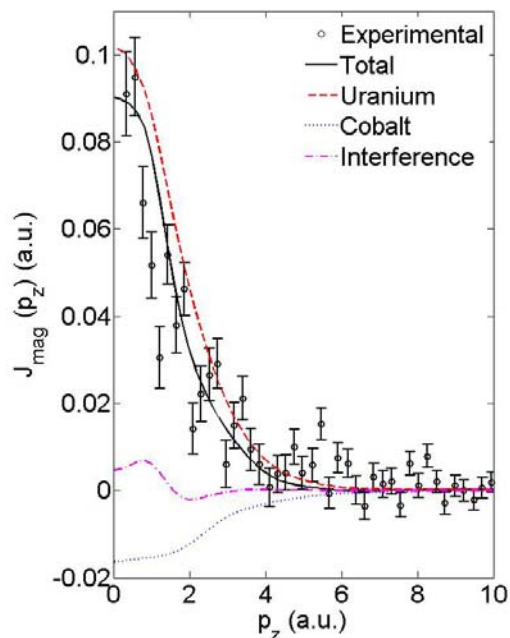


Figure 1: experimental MCP along with deconstructed site specific profiles from KKR calculations

spin moment from the cobalt, the spin moment on the uranium is  $(-0.42 \pm 0.05) \mu_B$  with a corresponding orbital moment of  $(0.52 \pm 0.05) \mu_B$ , very different than those predicted by LDA calculations.

## Reference

- [1] N. T. Huy *et al.*, Phys. Rev. Lett. **99**, 067006 (2007).  
 [2] P. de la Mora and O. Navarro, J. Phys: Condens. Matter, **20**, 285221 (2008), M. Diviš, Physica B: Condensed Matter, **403**, 2505 (2008), M. Samsel-Czekala *et al.* J. Phys: Condens. Matter. **22**, 015503 (2010)