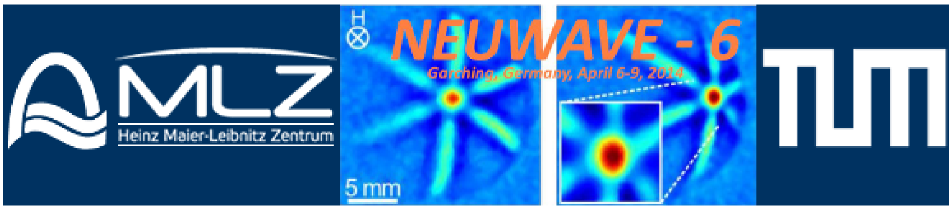

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Neutron Depolarisation Imaging Study of the Weak Itinerant Ferromagnet Ni3Al

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Quantum phase transitions (QPT) are phase transitions that are driven by quantum fluctuations instead of thermal fluctuations. In practice this implies that QPTs even occur at zero temperature as a function of non-thermal control parameters such as hydrostatic pressure, magnetic field, uniaxial stress or chemical composition.

The weak itinerant ferromagnet Ni3Al is a stoichiometric system, which crystallizes in the fcc Cu3Au-structure. At ambient pressure, a Curie Temperature of TC = 42K is found [1]. A small amount x = 0.4 of excess Al in Ni(75−x)Al(25+x) can reduce the magnetic ordering temperature to zero [2], which indicates that Ni3Al is located close to a magnetic instability. This renders Ni3Al an ideal candidate for the investigation of a ferromagnetic QPT as a function of chemical composition.

At the re-designed neutron imaging beam line ANTARES at FRM II, a new and advanced setup for polarized neutron imaging is available, which includes a neutron velocity selector for monochromatization, a polarizer, an analyzer and a manipulation stage which allows to handle a closed cycle cryostat containing the sample and an electromagnet. With this new setup, neutron depolarization imaging studies were performed on two differently treated polycrystalline samples of Ni3Al to investigate the influence of tempering on the spatial distribution of TC. Furthermore, an evaluation procedure was developed to obtain information about the homogeneity of the sample in beam direction from the temperature dependence of the neutron depolarization without performing time-consuming tomographic methods. The information on the variation of TC over the sample can then be used to verify measurements of other physical properties, such as magnetic susceptibility or the magnetic neutron scattering cross section, which both strongly depend on the transition temperature of the sample.

References

[1] P. G. Niklowitz, et al., Spin-fluctuation dominated electrical transport of Ni3Al at high pressure, Physical Review B, 72, p.024424, 2005

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