Magnetism and Non-Fermi Liquid Behaviour in stoichiometric and Non-Stoichiometric $\mathbf{Nb_{1-x}Fe_{2+x}}$

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$NbFe_2$ has a C14 hexagonal Laves phase structure and can be doped with excess Nb and Fe. Utilising magnetometry, electrical and thermal transport measurements and high pressure techniques, we investigate its novel magnetic phase diagram in which ferromagnetism appears on either side of stoichiometry. Materials with low ferromagnetic transition temperatures are rare, which makes $NbFe_2$ an ideal candidate to explore quantum critical behaviour. At Stoichiometry it has a record high stoner coefficient of ∼150, which indicates its proximity to ferromagnetism. The magnetic structure of stoichiomtric $NbFe_2$ is ambiguous and has previously been reported as being antiferromagnetic [1], [2]. We present indirect evidence of a spiral spin density wave of small wavenumber $\mathbf{Q}$=0.1 $\mathring{A}^{-1}$ showing similarities to $MnAu_2$ [3] and investigate the evolution of this state towards ferromagnetism with increased doping and high pressure techniques. In addition to its remarkable magnetic properties, the low temperature resistivity shows a clear departure from fermi liquid theory with $\rho \propto T^{1.5}$ for samples close to stoichiometry and $\rho \propto T^{1.66}$ for ferromagnetic samples. We also investigate the departure from non-fermi liquid and the magnetic phase transitions as a function of pressure.

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