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Neutron scattering study of URu_2Si_2 magnetic properties: from hydrostatic pressure to uniaxial stress

FREDERIC BOURDAROT, SPSMS, UMR-E 9001, CEA-INAC/ UJF-Grenoble 1, MDN, 17 rue des Martyrs, F-38054 Grenoble, France

Since the discovery of the unusual magnetic and superconducting properties of URu_2Si_2 in 1985 by Palstra [1], this heavy fermion has been extensively studied. A "Hidden Order" evidences by bulk properties like specific heat, has been found below T_0=17.8K. Neutron scattering in this case is an efficient probe for the study of this compound as large magnetic excitations and an irremovable tiny antiferromagnetic moment are present in this sample. Even though the tiny antiferromagnetic moment aligned along the c-axis at Q_0 is only $\sim 0.01\mu_B$, the magnetic excitations seem to be associated to a large magnetic moment of ~ 1 μ_B and show two minimums at Q_0=(1,0,0) but also at Q_1=(0.6,0,0). These magnetic responses have been intensively studied in normal conditions by Broholm [2,3] and our group[4], but also versus magnetic field [5], and more recently under hydrostatic pressure [6]. The result of these experiments seem to indicate that the Hidden Order is linked to the excitation at Q_0 and not to the excitation at Q_1. We will present the revisited magnetic properties of URu_2Si_2 under uniaxial stress along the a-axis [7,8]. Both elastic and inelastic contributions have been measured versus the constraints. In the HO state, as the constraint increases, the AF gap excitation at Q_0 decreases and the tiny moment increases: it seems also that there is a relation between both parameters. On the other hand, the excitation gap at Q_1 is slightly increasing. From our measurement we infer a critical pressure of $\sim$ 0.33 GPa, with a large increase of the antiferromagnetic moment. This behavior is very similar to results under hydrostatic pressure. Combining hydrostatic pressure, uniaxial stress along the a-axis and neutron Larmor diffraction measurements, that gives the lattice distribution of our URu_2Si_2 crystal, we conclude that the magnetic exchange integrals are dominated by the lattice parameter a and not the ratio c/a as usually believed.

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