**Magnetostriction of UN Single Crystals in Pulsed Magnetic Fields up to 65 T**

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**Introduction**

Magnetism and long-range magnetic ordering in rare-earth 4*f* compounds can be understood by the *RKKY* interaction, essentially based on a localized behavior of 4*f*-electrons. On the contrary, the origin of magnetism in actinides materials has been not well understood, since the 5*f*-electrons can show properties of both itinerant and localized nature. Even though a large number of studies on the magnetism of actinide-based compounds have been performed, only a few cases where the origin of magnetism has been directly revealed were found. These issues are perfectly exemplified in uranium mononitride (UN). It crystalizes in a NaCl-type face center cubic (*fcc*) crystal structure. Below 50 K uranium mononitride undergoes a transition into the type-I antiferromagnetic (AFM) structure where spins are aligned along the [100] direction with small µord = 0.75 µB and large µeff = 2.66 µB. In spite of large theoretical and experimental studies it is still unclear whether an itinerant or localized picture should be applied to describe the nature of 5*f* electrons in UN and their relationship to physical properties.

**Experimental**

The longitudinal magnetostriction was measured on high quality single crystals of UN in pulsed magnetic fields up to 65 T. We used a fiber Bragg grating dilatometry technique at the NHMFL-LANL pulsed field facility.

**Results and Discussion**

Figure 1(a) shows the temperature dependence of thermal expansion of UN single crystal. The thermal expansion is quite anomalous, especially below magnetic ordering temperature where influence of magnetism on lattice is clearly observed. Figure 1(b) shows the longitudinal magnetostriction measured up to 65 T at a number of temperatures between 1.2 K and 55 K (only few temperature points are shown for clarity). A dramatic change of Strain is observed below TN with two clear anomalies at small and high magnetic fields. By tracking the transitions we were able, for the first time, to construct *H(T)* phase diagram for uranium mononitride (Figure 1(c)). These results together with high magnetic field magnetization data will be vital to understand origin of the phase transitions and to finally resolve nature of 5*f*-electrons in this material.

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Figure 1. (a) Left: The temperature dependence of thermal expansion of UN single crystal. Right: First derivative of the change of length. The arrow marks TN at 51 K. (b) the magnetic field dependence of Strain of UN at different temperatures. The arrows mark high field transitions. (c) *H(T)* phase diagram of UN. The arrow marks TN.