MS41.O02

Neutron Diffractions in Pulsed High Magnetic Fields

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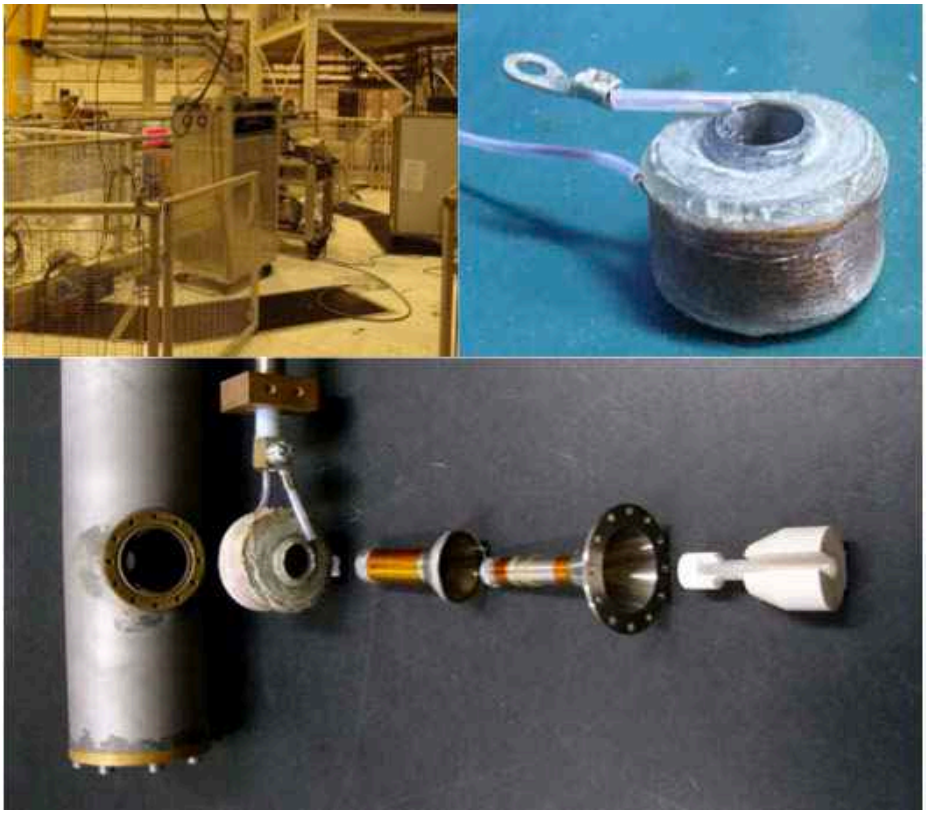
In frustrated magnets, varieties of exotic states appear under high magnetic fields. Examples are found as complex magnetic phase diagram in multi-ferroics, a quantum phase transition in strongly correlated 5f intermetallics and quantum magnetic plateau in low-dimensional magnets. The most important basis to understand such exotic phases is the determination of their magnetic structures. Neutron diffraction is the unique and the direct method for this purpose. However, experiments in strong magnetic fields have been quite limited for technical difficulties. We have developed the techniques to combine pulsed high magnetic fields with neutron diffractions. The use of pulsed magnets have broken the technical limit of 17.5 T achieved by superconducting magnets and enabled us to access the extremely high magnetic fields of 30-40 T. At present, we have four different lines of pulsed magnet devices for practical experiments as follows. 1. Compact potable 30 T horizontal solenoid magnet system combined with an orange cryostat, 2. Compact 40 T horizontal solenoid with a custom cryostat, 3. Compact 25 T vertical split-pair magnet with a custom cryostat, 4. Middle size horizontal 50 T solenoid magnet with a custom cryostat. The temperature as low as 1.7 K is possible for all of those systems. The compact 30 T system is used in ILL, SNS, ISIS and JRR3. Upgraded 40 T version is installed in ISIS and ILL. The split-pair and the middle size system are used in J-PARC. In reactor sources, a very week magnetic peak can be detected for low background. A continuous field variation of the peak intensity is monitored by means of time-resolved technique. In spallation sources, multiple Bragg-peaks are captured by using the white beam Laue method. It is very useful to trace the change of magnetic wave vectors. We report the overview of the recent activities examining magnetic phase diagrams of multi-ferroic compounds and URu2Si2 with a multi-step meta-magnetic transition.

[1] *Phys. Rev. Lett. 110(2013)216406,* ***[2]*** *SRN 25(2012) 12-17.*



Keywords: High Magnetic Field, Field Induced Phase Transition, Magnetic structure