Pulsed magnetic fields for neutron diffraction: technical challenges and scientific opportunities

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The last two decades have seen the demonstration of the feasibility of neutron diffraction in fields as high as 40 T with the development of dedicated pulsed field devices based either on short or long duration pulsed magnets [1, 2]. These breakthroughs have allowed to extend the field limits beyond current superconducting (15 T split, 17 T solenoid) and resistive installations already available at radiation sources and have allowed to reveal novel field induced states. Outstanding studies are the determination of the magnetic structures of the magnetisation plateaus phases in the frustrated magnetic systems TbB_4 and $CdCr_2O_4$ [1, 3], the spin density wave state of URu_2Si_2 [4] or the field-induced magnon condensate in the spin-dimerised system $Sr_3Cr_2O_8$ [5]. However, diffraction measurements in high magnetic field environment remain challenging, and successful campaigns at neutron sources require adequate topic selection and expert preparation.

Here, I will present an overview of the 40 T pulsed field cryomagnet developed by the LNCMI-Toulouse, the ILL-Grenoble, and the CEA-Grenoble, illustrated by a selection of results obtained on the triple-axis CRG-CEA spectrometer IN22 at the ILL. This will give me the opportunity to discuss technical challenges and improvements required to pave the way for the routinely investigations of materials bearing small magnetic moments like, e.g., high-Tc superconductors or quantum spin systems.

References

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