PULSED HIGH MAGNETIC FIELD EXPERIMENTS WITH X-RAY FEL

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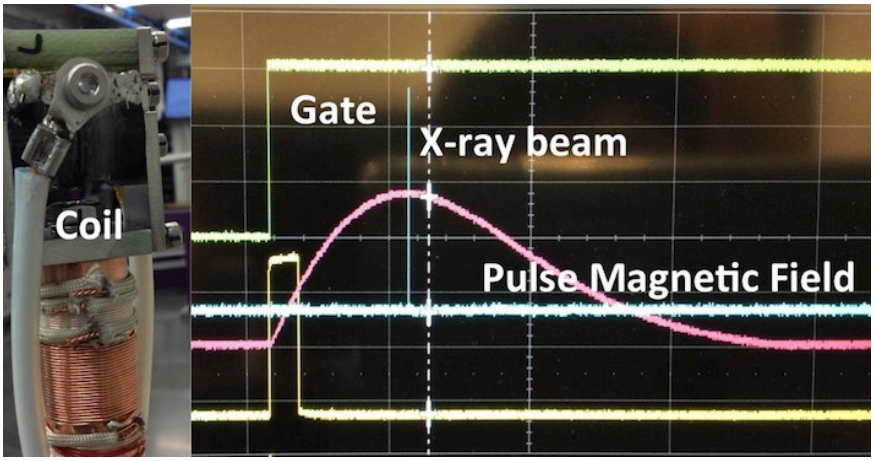
We report recent progresses in high magnetic field X-ray experiments with FEL:free electron laser source. Application of high magnetic fields for X-ray experiments is opening emerging new fields in magnetism, superconductivity and semiconducting sciences. New insights of various magnetic-fields-induced states are examined by their structures, electronic states and magnetic states. Intense, coherent and ultra-short time X-ray produced by X-ray free electron laser enables us to perform various studies in high magnetic fields. Although superconducting magnets are standard in many X-ray facilities, pulsed magnets becomes more and more common in many facilities. In particular, the combination of mini-magnets and portable capacitor banks is the leading force of propagating 30-40 T magnetic fields for X-ray experiments.

Since these experiments are single shot experiments, application for very weak super-lattice structure and/or fast time resolved experiments have not been accomplished. To break through this situation, we have conducted the very first pulsed magnetic field experiment at LCLS.

Free electron laser at LCLS can provide extremely intense radiation of 10^{12} photon/pulse with the pulse width of 50 fs or less. This unique capability enables us to observe a very tiny super-lattice peak as weak as 10^{-6} of the fundamental ones. Recently, we have succeeded in the first diffraction experiments on the CDW peaks of YBCO superconductor in pulsed magnetic fields up to 28 T at LCLS[1]. Thanks to the small size of the coil, the installation of the pulsed coil is made without the modification of the standard beam line setup. The mini split-pair coil attached on the cold head of the closed cycle refrigerator and the waveform of the magnet and X-ray beam are depicted in the figure.



We have also conducted the X-ray absorption spectroscopy on the magnetic field induced valence state transition in $Eu(Rh, Ir)_2Si_2$.

In the presentation, we demonstrate the recent progresses of the X-ray free electron laser experiment in pulsed high magnetic fields.

[1] arxiv.org/abs/1506.07910.

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