

## Magnetic fields imaging using polarized neutrons techniques

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In this work, we present a demonstration of performing polarized neutron imaging (PNI) at the beamline BL20 at Chinese Spallation Neutron Source (CSNS). Utilizing the V-cavity supermirror as the polarizer, the in-house developed in-situ polarized <sup>3</sup>He neutron spin filter (NSF) system as the analyzer, and an energy resolved neutron imaging detector, an aluminum cylindrical solenoid as a sample to generate a known magnetic field. Two dimensional polarized neutron images were produced from this PNI experiment. The observed oscillating behavior in the polarization wavelength dependence at specific areas of the sample is a proof of the precession of the neutron polarization vector around the magnetic field inside and beside the sample.

The results of this work show the possibility of applying the PNI at CSNS for visualizing the magnetic field distributions within and around the magnetic materials and electric devices.

### Experiment Components:

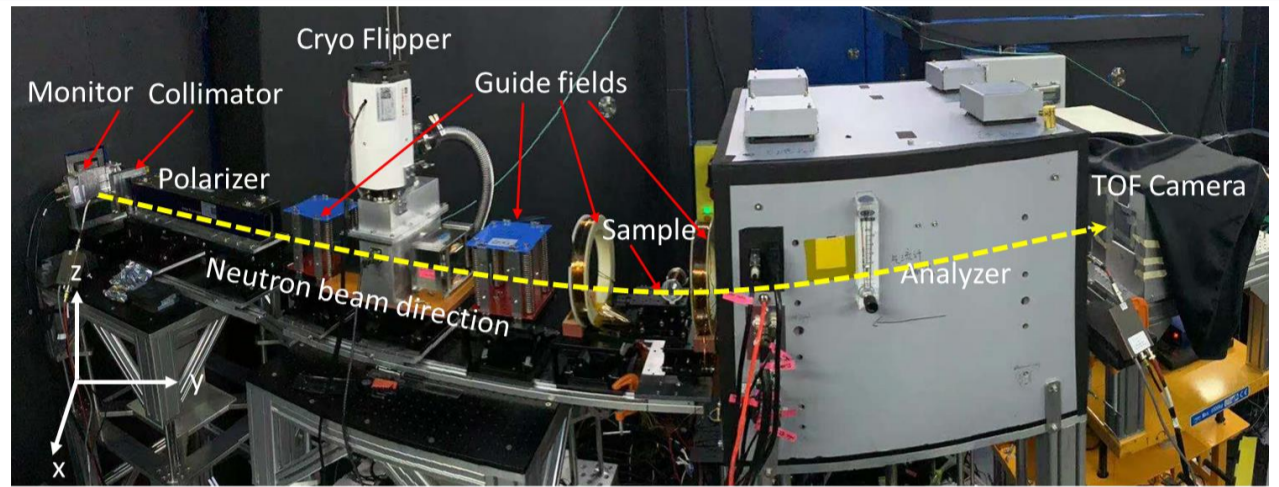
**Polarizer** : V-cavity supermirrors .

**Analyzer** : In-situ polarized <sup>3</sup>He neutron spin filter (In-house developed ).

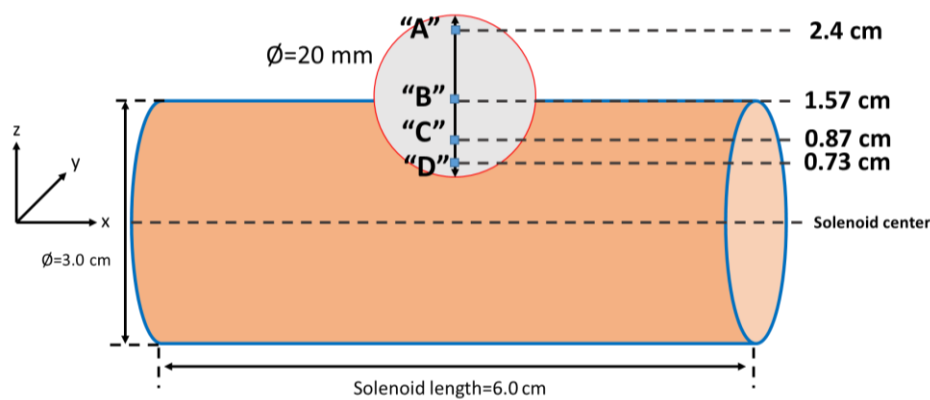
**Guide fields** : Two permanent magnets and two electromagnetic coils.

**TOF camera** : Energy resolved neutron imaging detector (Developed in CSNS).

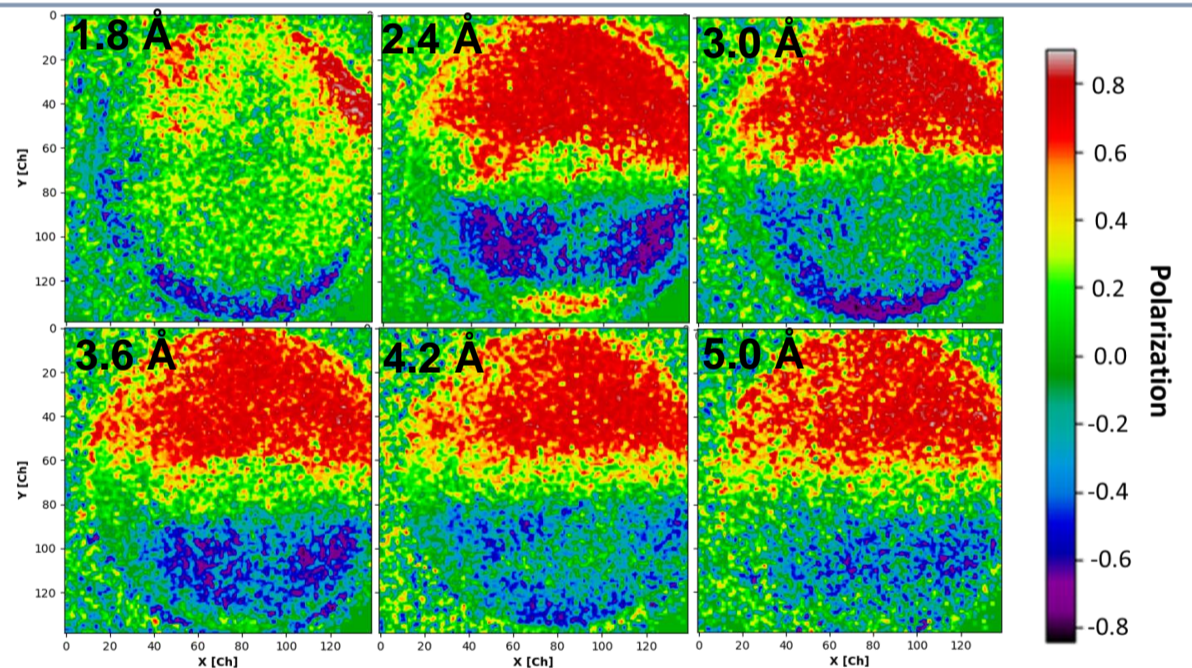
**Sample** : Aluminum solenoid of length 6 cm, radius 1.5 cm, wire diameter of 1.5 mm, and with 37 windings.



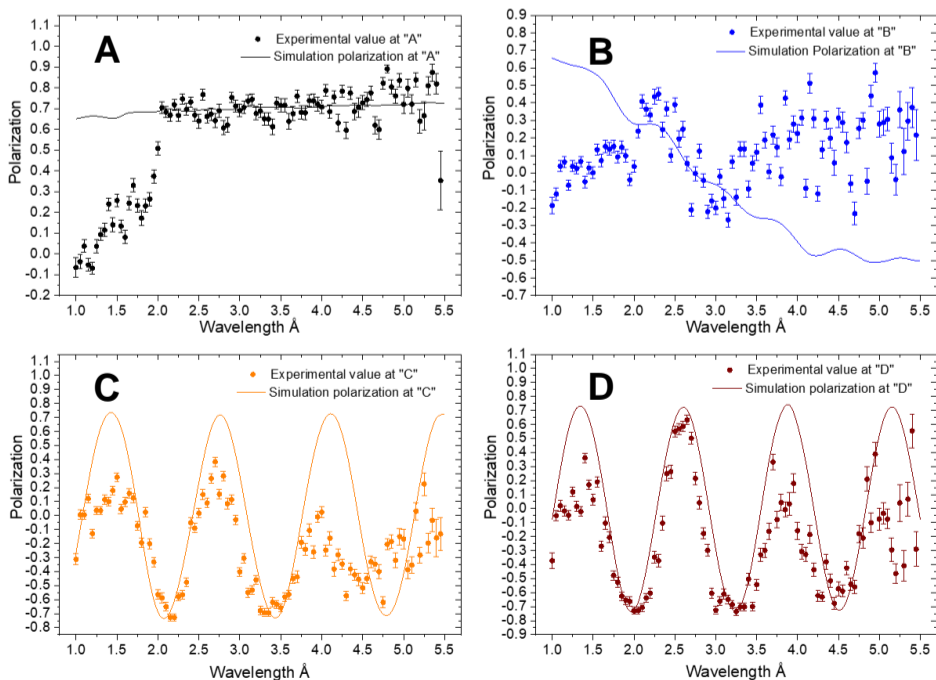
Polarized neutron imaging setup in time-of-flight transmission mode at BL20.



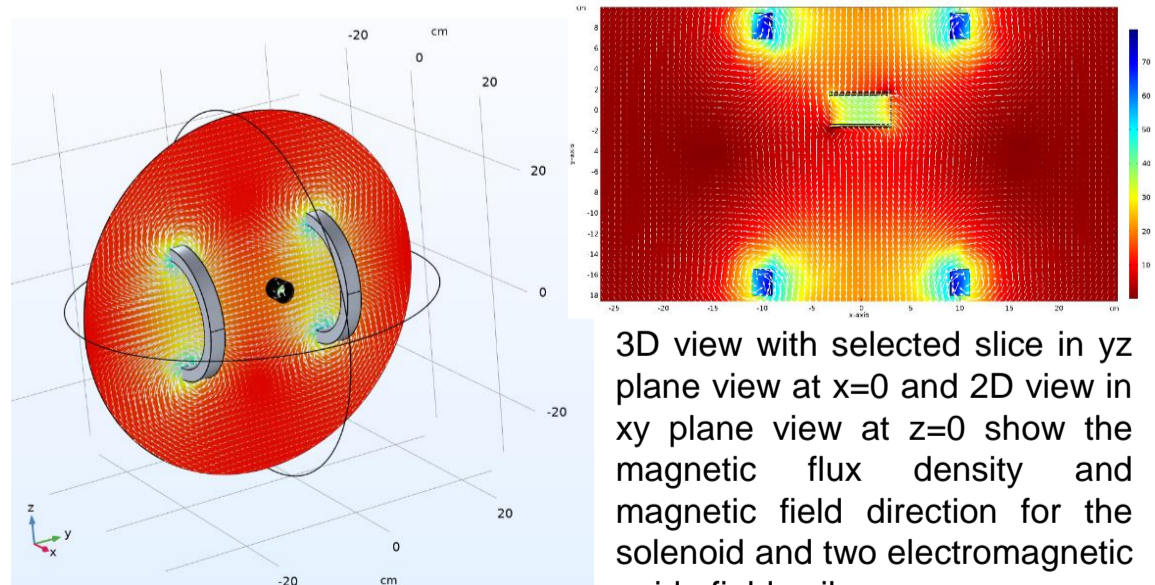
A sketch of the solenoid sample with the circular irradiated area of diameter 20 mm. "A", "B", "C", and "D" represent four selected regions of interest with different distances from the solenoid center.



Polarization images at different wavelengths. The circle in the images represents the irradiated area that defined by a circular slit placed in front of the TOF detector.



The experimental and simulated polarization results exhibit a similar trend inside and around the solenoid. Though the mismatch between the experimental and simulated results, this experiment will guide us for the improvements in future PNI experiments.



3D view with selected slice in yz plane view at x=0 and 2D view in xy plane view at z=0 show the magnetic flux density and magnetic field direction for the solenoid and two electromagnetic guide field coils.

The simulated neutron polarization for areas "A", "B", "C", and "D" were obtained using magnetic field simulation for the solenoid and two electromagnetic guide field.

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