

INVESTIGATION OF TRAPPED FLUX IN SUPERCONDUCTING SAMPLES WITH NEUTRON RADIOGRAPHY

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ABSTRACT: The dynamics of flux expulsion in Nb samples during superconducting transition has been investigated with neutron radiography. Aiming at a reduction of the trapped flux with respect to obtaining a small residual resistance it was attempted to influence the expulsion by applying external AC magnetic fields. The results of these experiments are presented.

KEY INFORMATION

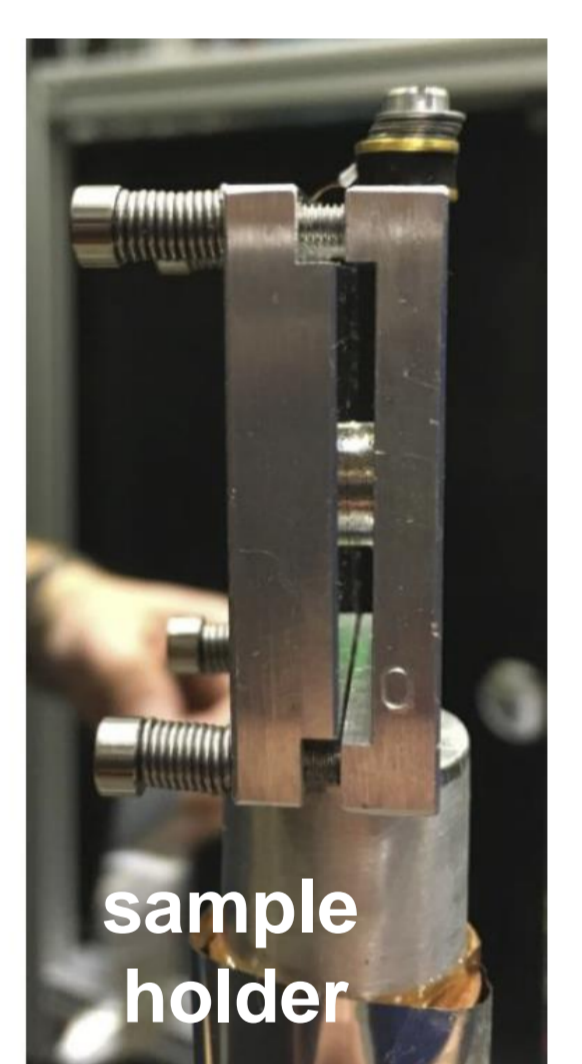
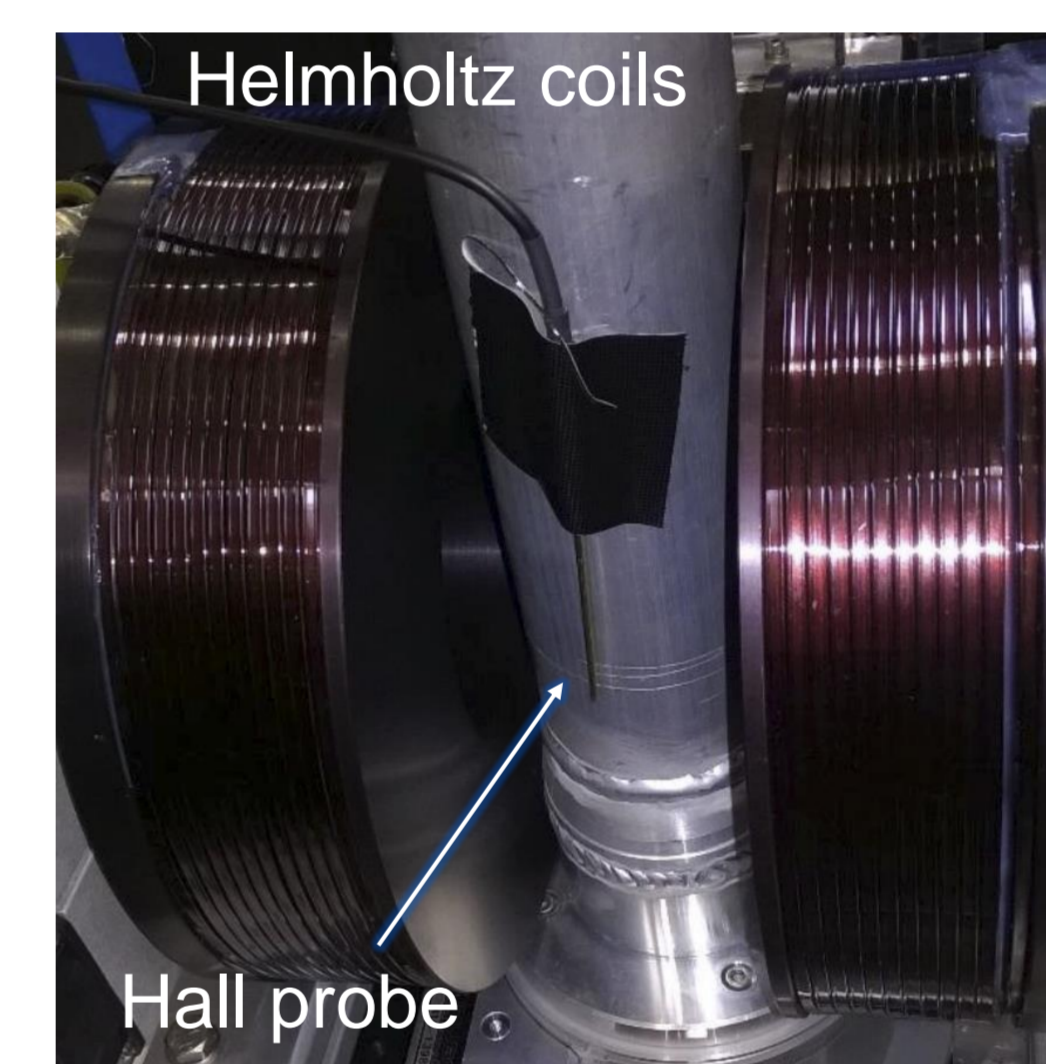
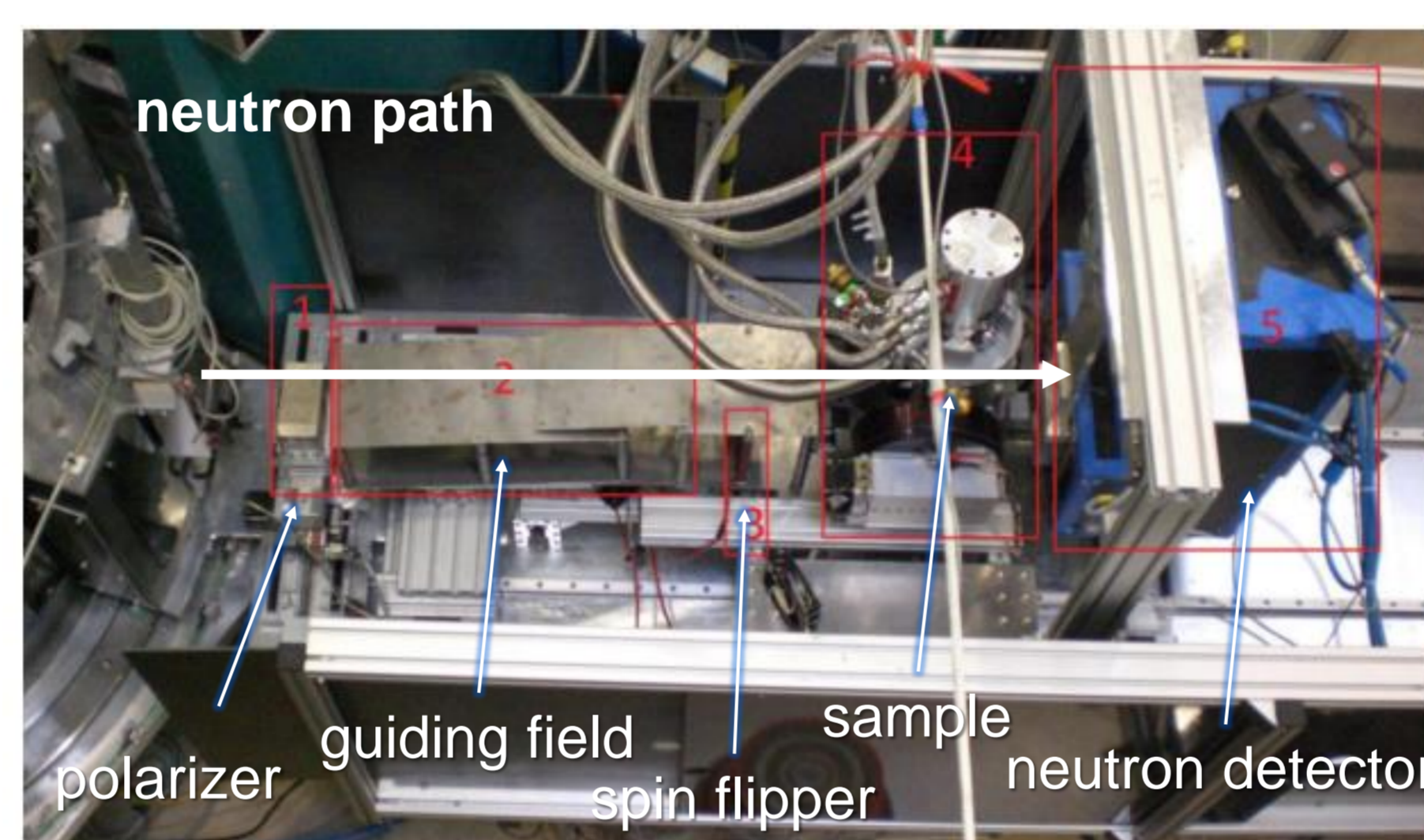
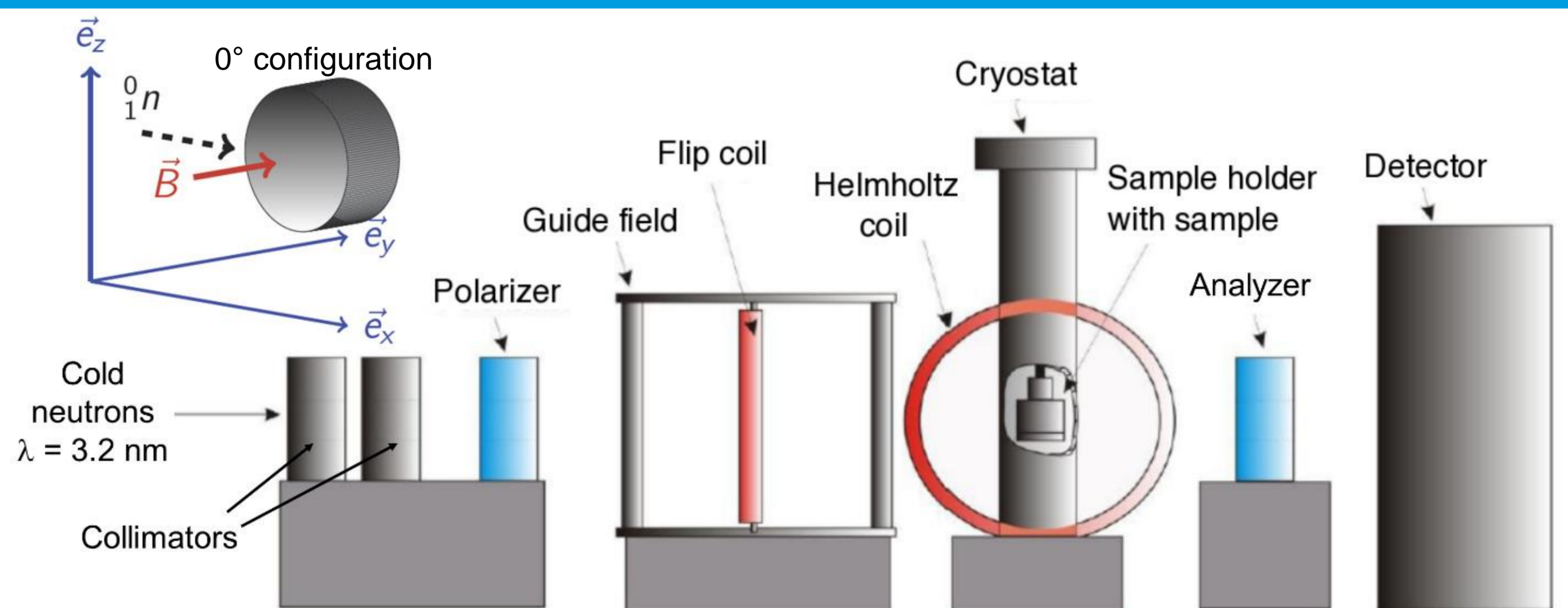
- Trapped magnetic flux is major contribution to the residual resistance in superconducting Nb cavities.
- Can significantly reduce operating costs for superconducting accelerators by minimizing trapped flux.
- Monitor flux trapping behavior using polarized neutron tomography.
- Possibility to measure trapped flux inside the sample directly rather than deriving it from the expelled flux measured outside.
- Conduction cooled sample with cold finger down to 4K
- Investigate influence of cool-down speed on trapped flux
- Investigate influence of applied, ambient field on trapped flux
- Investigate influence of AC external magnetic field
- Field-cooling of samples

CONCLUSION

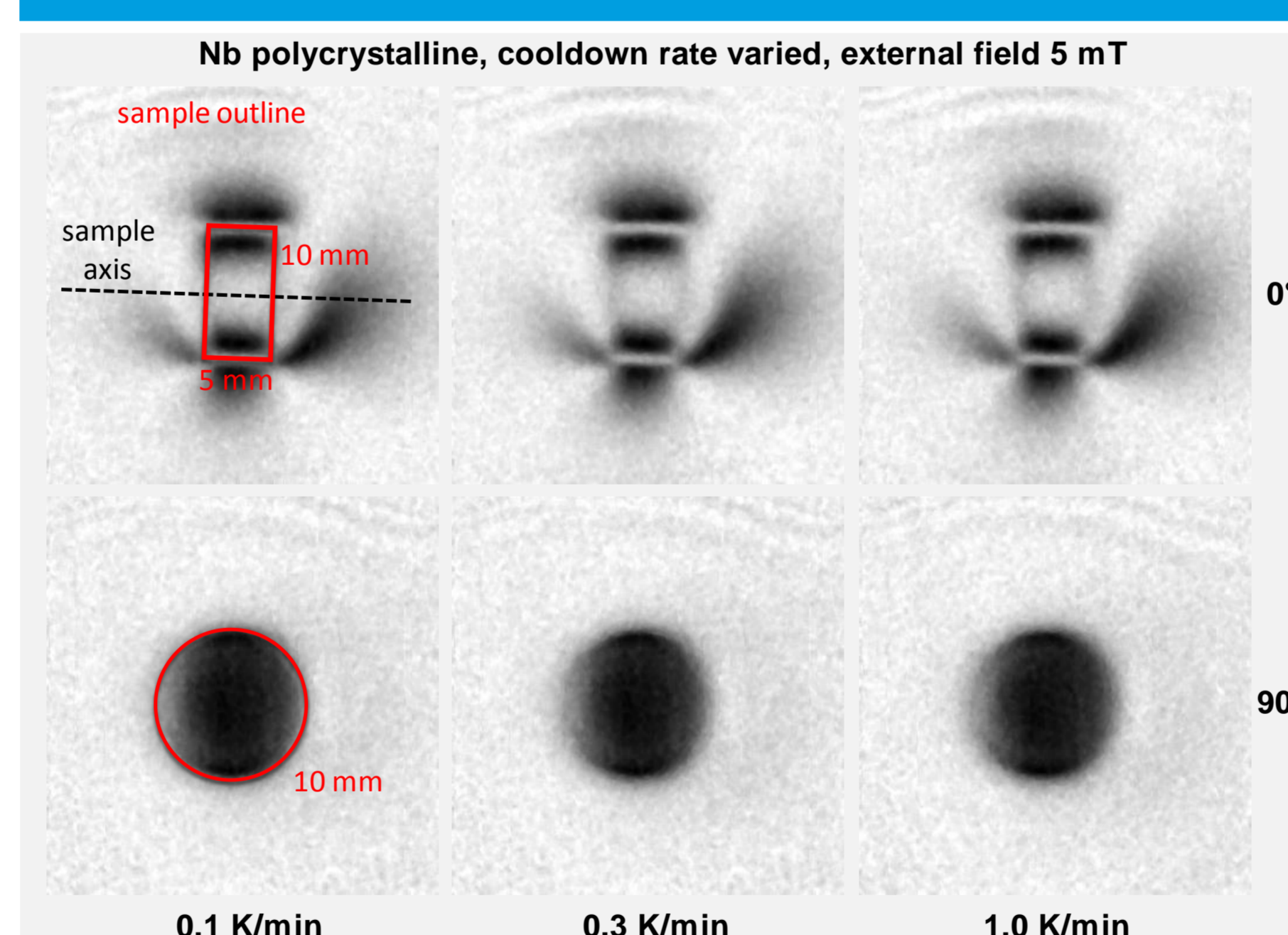
- Flux trapping independent on cooling rate
- Flux trapping proportional to applied magnetic field
- Field cooling in AC field: Trapping efficiency dropping with frequency

- (1) Aull, S., O. Kugeler, and J. Knobloch, "Trapped magnetic flux in superconducting niobium samples". *Physical Review Special Topics - Accelerators and Beams*, 2012. 15: p. 1-6.
- (2) Kardjilov, N., et al., "Three-dimensional imaging of magnetic fields with polarized neutrons". *Nature Physics*, 2008. 4: p. 399-403.
- (3) Treimer, W., O. Ebrahimi, and N. Karakas, "Observation of partial Meissner effect and flux pinning in superconducting lead containing non-superconducting parts". *Applied Physics Letters*, 2012. 101: p. 162603.
- (4) Treimer, W., et al., "Polarized neutron imaging and three-dimensional calculation of magnetic flux trapping in bulk of superconductors". *Physical Review B*, 2012. 85: p. 184522.

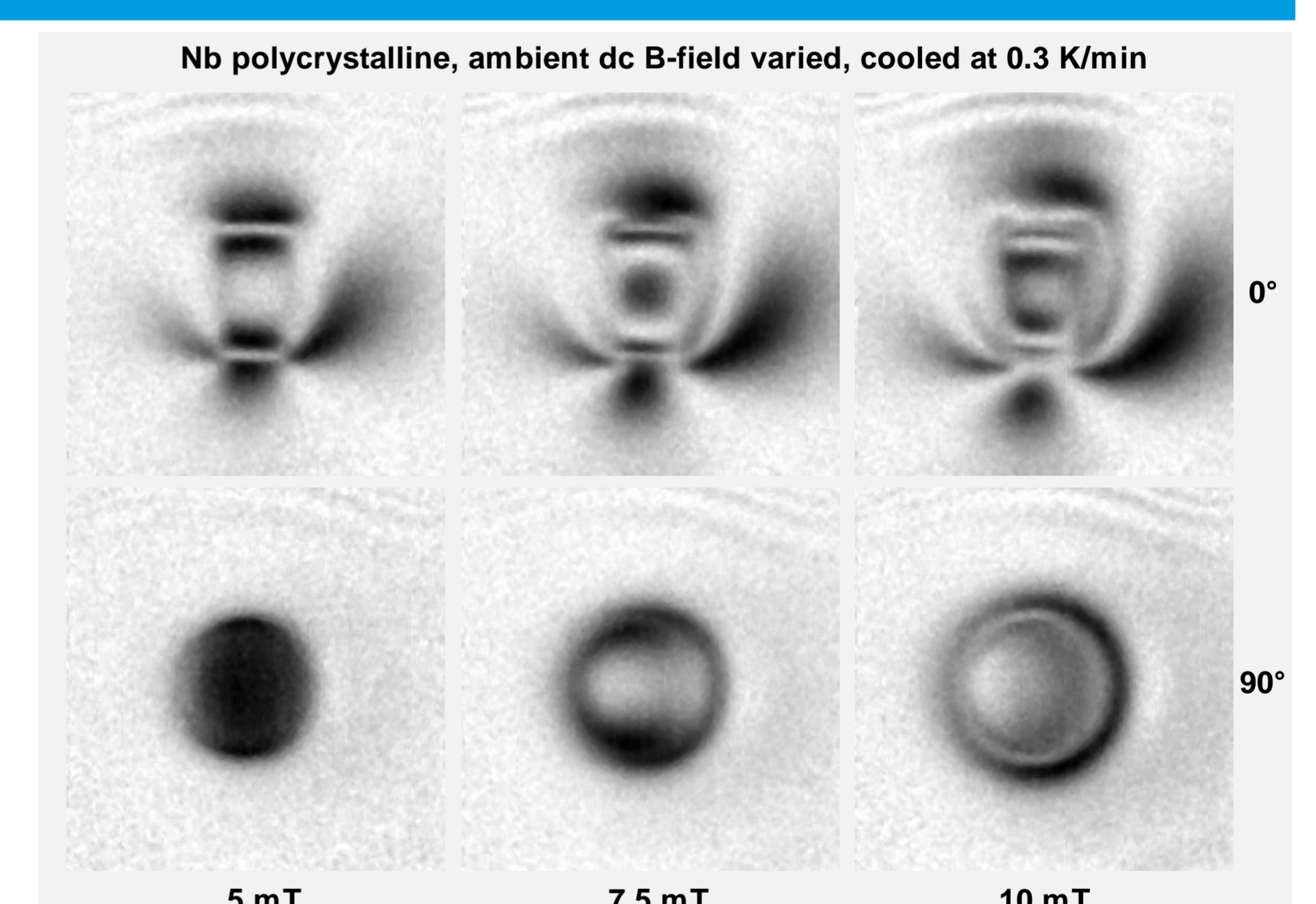
EXPERIMENTAL SETUP: Neutron tomography



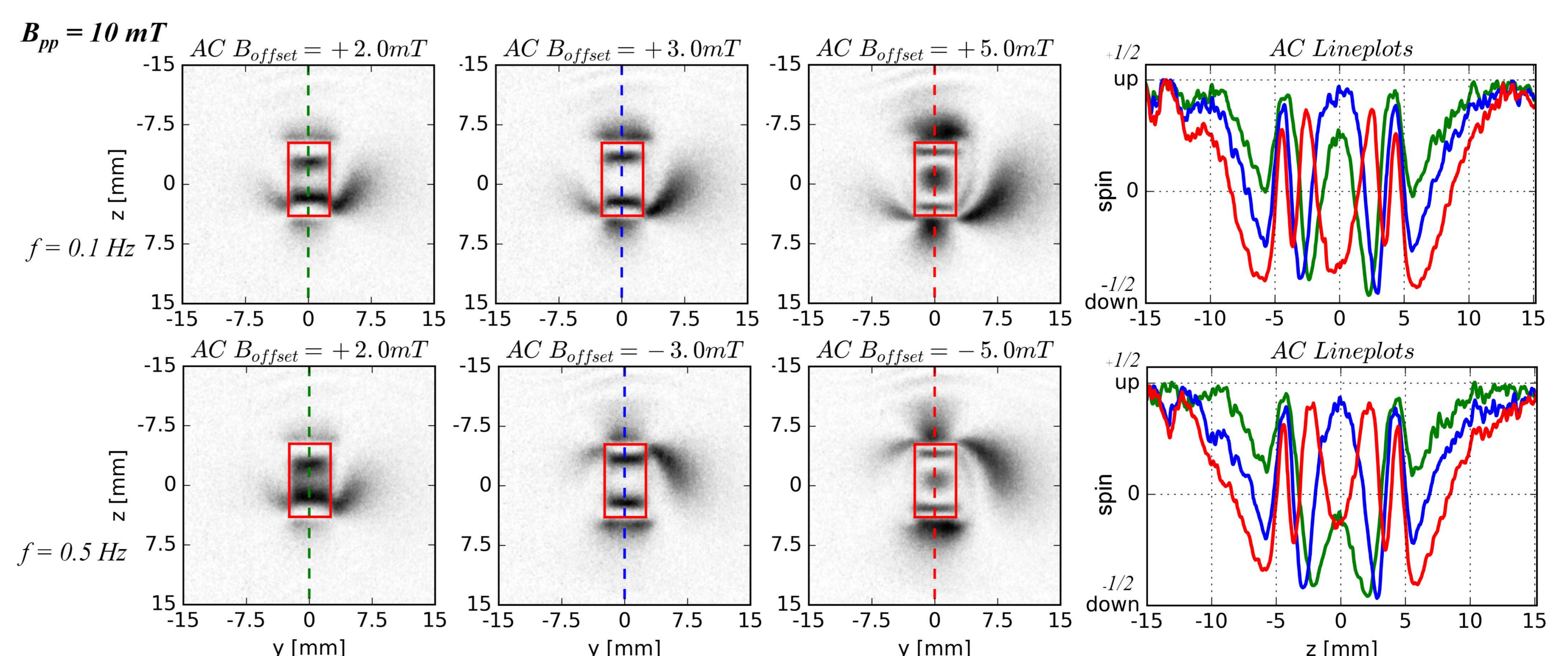
RESULTS



Flux trapping is independent on cooling rate



Flux trapping is proportional to applied field



Flux trapping in AC-DC field-cooling depends on frequency. Higher frequency traps less flux.