First µSR measurements of SRF samples in strong parallel fields
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Introduction
Muon Spin Rotation (µSR) is a powerful tool to probe local magnetism in matter and hence can be used to diagnose the entry of magnetic flux in superconductors. Previous measurements were done with applied magnetic fields perpendicular to the sample face. A new spectrometer has been developed that allows for sample testing with a field varying from 0 to 300 mT applied along the sample face which is analogous to RF fields in SRF resonators. The geometry is characterized by small demagnetization factors which lead to a reduction in pinning and edge effects on the field of first flux entry. The beamline installation and first results of the parallel field experiments are presented in the poster.

Parallel Field Spectrometer
- The parallel field spectrometer was installed on TRIUMF’s M20 C-leg. The spectrometer consists of a magnet which provides the applied field to the samples, a magnet to compensate for beam deflection due to the presence of the Lorentz force, two muon counters which determine the location of the muon and two position detectors (up and down) which determine the location of emitted positrons.
- The beamline delivers muons with an energy 3.87 MeV +/- 6%. The muons consequently stop at an average distance of 100 µm (bulk) in the niobium. A silver mask is used to make sure muons land only in the center of the sample.

Results
- Field of first entry levels close to $H_c2$ of Nb, 170mT for all samples.
- Steep slopes imply sudden transition from the Meissner state through the mixed state to the normal state.
- Small demagnetization factors, a consequence of the geometry, lead to relatively high field of first entry.
- Pinning appears to be less impactful in parallel field, compared to Transverse Field (see MOPB050).
- CF1 (bulk Nb coated with 2 µm of Nb₃Sn) displays high field resistance up to 190 mT at 2K. This is above all Nb values found here, however below the expected the superhealing field of Nb₃Sn.

Future Testing
- Temperature scans of Nb$_3$Sn.
- Tests of MgB2 and NbTiN/AIN multilayer samples
- Further field tests of other treatments and samples to test the parallel geometry.

Samples
- Four disk-shaped niobium (3x20mm) samples were tested.
- Sample treatments include:
  - TR8 – Untreated (FNAL)
  - TR5 – 1400 °C bake for 5.5 hours + 120 µm BCP etch (FNAL)
  - TR9 – Nitrogen doped + EP etch (FNAL)
  - CF1 – Nb$_3$Sn (Cornell)
*Parentheses indicate sample providers.

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