The magnetic field at which first flux penetrates is a fundamental parameter characterizing superconducting materials for SRF cavities. Therefore, an accurate technique is needed to measure the penetration of the magnetic field directly. The conventional magnetometers are inconvenient for thin superconducting film measurements because these measurements are strongly influenced by orientation, edge and shape effects. In order to measure the onset of field penetration in bulk, thin films and multilayer superconductors, we have designed, built and calibrated a system combining a small superconducting solenoid capable of generating surface magnetic field higher than 500 mT and Hall probe to detect the first entry of vortices. This setup can be used to study various promising alternative materials to Nb, especially SIS multilayer coatings on Nb that have been recently proposed to delay the vortex penetration in Nb surface. In this paper, the system will be described and calibration will be presented.

**EXPERIMENTAL SETUP**

Designed and built to measure onset penetration directly through bulk, thin film and multilayer superconducting samples.

**FIELD FROM THE MAGNET ON THE SAMPLE**

- Variation of the radial magnetic field along the sample radius at 100 A (From Poisson Simulations)
- In the Meissner state the sample acts as a magnetic mirror.
- Vertical component of the magnetic field cancels out.
- The field felt by the sample is equal to twice the radial component of the magnetic field.
- Since the radial magnetic field is parallel only to one side of the sample, this field configuration closely resembles the SRF cavities.

**MAGNET FABRICATION**

Magnetic coil was fabricated by winding NbTi thin wire carefully on dielectric spool using strategies followed in magnet fabrication. An epoxy was used after winding to obtain a good insulation and a monolithic structure which cannot allow any movement of the conductor inside the coil.

**CONCLUSION AND FUTURE WORK**

- The new experimental setup for magnetic field penetration measurements of superconducting samples was designed, built and calibrated successfully at Jefferson Lab. This experimental system is appropriate for bulk samples as well as thin films.
- The linearity of calibration curve confirms that the system is ready for the future measurements to study.
- The dependence of the current at first penetration on the sample thickness

<table>
<thead>
<tr>
<th>Reference sample</th>
<th>Thickness (mm)</th>
<th>Current at first penetration (A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pb</td>
<td>0.5</td>
<td>11.3</td>
</tr>
<tr>
<td>Ta</td>
<td>0.5</td>
<td>14.0</td>
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</tbody>
</table>

**REFERENCES**