Superconductivity - Assignment 3

Kees van Kempen (s4853628)
k.vankempen@student.science.ru.nl

March 10, 2022

8 Nb_3Sn cylinder

Consider a cylinder of Nb_3Sb. From lecture 4, we have the following properties for Nb_3Sn: $T_c = 18.2\,\mathrm{K}$, $\xi = 3.6\,\mathrm{nm}$, $\lambda = 124\,\mathrm{nm}$, $\kappa = \frac{\lambda}{\xi} = 34 > \frac{1}{\sqrt{2}}$, which means we are indeed dealing with a type-II superconductor. As $B_{c1} < B_E < B_{c2}$, the cylinder is in the vortex state. From the previous set of assignments, we know what the currents in the cylinder look like.

The average field inside the cylinder is gives as

$$\langle \vec{B} \rangle = \frac{1}{V_{\text{cylinder}}} \int_{\text{cylinder}} \vec{B}(\vec{r}) d\vec{r}.$$

To determine this $\vec{B}$ inside the material, we first need to know how many vortices there are. We assume that every vortex lets through only one flux quantum Φ_0, and that the vortices will arange themselves as far as possible from eachother. If their distance then is large enough to assume there is no overlap between regions of finite $\vec{B}$ around them, we can calculate the average field by just summing over the quanta and lastly over the field that penetrates the material in the outside of the cylinder. For this latter calculation, we can use the field for a type-I superconductor.

9 Superconducting wire

10 Fine type-II superconducting wire

11 Critical currents

12 A weak junction

References