Design of the Coil System for the SQUID Based Ultra Low Field NMR/MRI

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We designed three dimensional gradient coils and the measurement coil for the SQUID based ultra-low-field (ULF) nuclear magnetic resonance (NMR) and magnetic resonance imaging (MRI). Very homogeneous magnetic field whose strength is about several tenth of micro-Tesla is needed to perform the ULF NMR/MRI experiments. The dimensions of the magnetic shielding room, extra equipments and the effect of magnetization of the mu-metal are also considered during the design of the coil systems. We calculated the magnetic fields for the coil systems using the Biot-Savart law. The maximum strengths of the magnetic fields are 150 μT for the measurement coil and 50 μT / 30 cm for the gradient coils. The degree of the homogeneity (Bz(0)/Bz(0.15)) of the Double Helmholtz coil pairs corresponding to the measurement coil is 1. The degree of the homogeneity (Bz'(0)/Bz'(0.15)) of the gradient coil for the Gz field is about 1.00143 and those for the Gx field and Gy field are about 1.00711 and 1.00768, respectively.

Keywords: NMR, MRI, SQUID, gradient coil.