Effect of field gradient and disturbance on the ultra-low field NMR signal detecting using a high-T_c dc-SQUID

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We have detected the ultra-low field nuclear magnetic resonance signal from water samples using a high-T_c dc-SQUID sensor. The measurements were carried out in a home-made magnetically shielded room. Resonance spectra of ^1H from tap water and other substance samples were obtained in the field range from $7-70\,T$, corresponding to resonance frequency $300-3k\,Hz$. The signal to noise ratio in a single-shot measurement is around 4 for about $15ml$ water, which would be increased to about 40 after 100 times averaging. The residual magnetic field in the magnetically shielded room is about 100 nT and shows slow variation with time. A field gradient associated with the residual field is also observed. The effect of residual magnetic field in the magnetically shielded room was investigated by applying purposely a field gradient and slow variation field disturbance. Additionally, we have also investigated the signal detection using a Cu coil that is inductively coupled to the SQUID sensor.