Search for Broken Time Reversal Symmetry Near the Surface of YBa$_2$Cu$_3$O$_{7-\delta}$.


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Beta-detected NMR ($\beta$-NMR) of $^8$Li$^+$ stopped within a 15 nm layer of Ag on top of a (110)-oriented YBa$_2$Cu$_3$O$_{7-\delta}$ film ($T_c = 86.6$ K) has been carried out to search for spontaneous magnetism near the surface of the underlying superconductor. The average depth of the $^8$Li stopped within the Ag layer was adjusted to 8 nm by decelerating the incoming beam to 2 keV prior to reaching the sample surface. The $^8$Li NMR lineshape measures the magnetic field distribution just outside the superconductor. Measurements were made with weak magnetic fields applied parallel to the sample surface. These show a marked increase in resonance linewidth but no change in frequency on cooling below $T_c$. Spectra taken in 10 G show the same temperature dependence in linewidth as in 20 G, rising from 350 Hz (the nuclear dipolar width of Li in Ag) just above $T_c$ to 800 Hz at 5 K. This broadening indicates the presence of a static, randomly-oriented magnetic field of about 0.7 G associated with superconductivity in the YBa$_2$Cu$_3$O$_{7-\delta}$, perhaps arising from a time reversal symmetry breaking complex order parameter.