Supplementary Material for "Observation of anomalous Meissner screening in Cu/Nb and Cu/Nb/Co thin films" by M.G. Flokstra *et al.*

This Supplementary Material contains additional information about the low-energy muon-spin spectroscopy measurements and a more detailed graph of Fig.3b of the manuscript. While not essential to the understanding or conclusions of the manuscript, specialist readers may find the additional information useful and informative.

I. LOW-ENERGY MUON-SPIN SPECTROSCOPY

An example measurement of a muon experiment is shown in Fig.1 where $N_{\mathrm{L}}(t)$ and $N_{\mathrm{R}}(t)$ are the measured positron detector histograms of the left and right detector respectively and t is the time at which a positron is detected. The two detectors are placed on opposite sides of the sample and the implanted muons have their initial spin direction pointing towards the left detector, making that from all the muons that decay at $t = 0$ a bigger fraction hits the left detector compared to the right detector. As function of time, the muon-spin precesses around the local field which results in the muon-spin direction alternating between the left and right detector. The main exponential decay of the measurement signal reflects the muon life-time and the superimposed damped oscillations contain the information about the local field and define the asymmetry $A(t)$ of the signal. The histograms can be fitted using $N_{\mathrm{L,R}}(t) = N^0_{\mathrm{L,R}}(1 \pm A(t)) \exp(-t/t_\mu) + K_{\mathrm{L,R}}$ with N^0 the amplitude of the signal, K the time-independent background contribution and $A(t)$ the asymmetry of the signal which carries all the information concerning the field distributions. It can generally be modelled as $A(t) = \int dx A_0 p(x) \cos(\gamma_\mu B(x) t + \phi) G(t)$, with A_0 the (setup dependent) maximum asymmetry that can be measured, $p(x)$ the muon stopping profile, $\gamma_\mu = 851$ Mrad·s^{-1} the gyromagnetic ratio for the muon, $B(x)$ the local flux density, ϕ the starting angle of the muon-spin direction and $G(t)$ the depolarization function ($G \leq 1$), where the integral runs over the full width of the stopping profile.

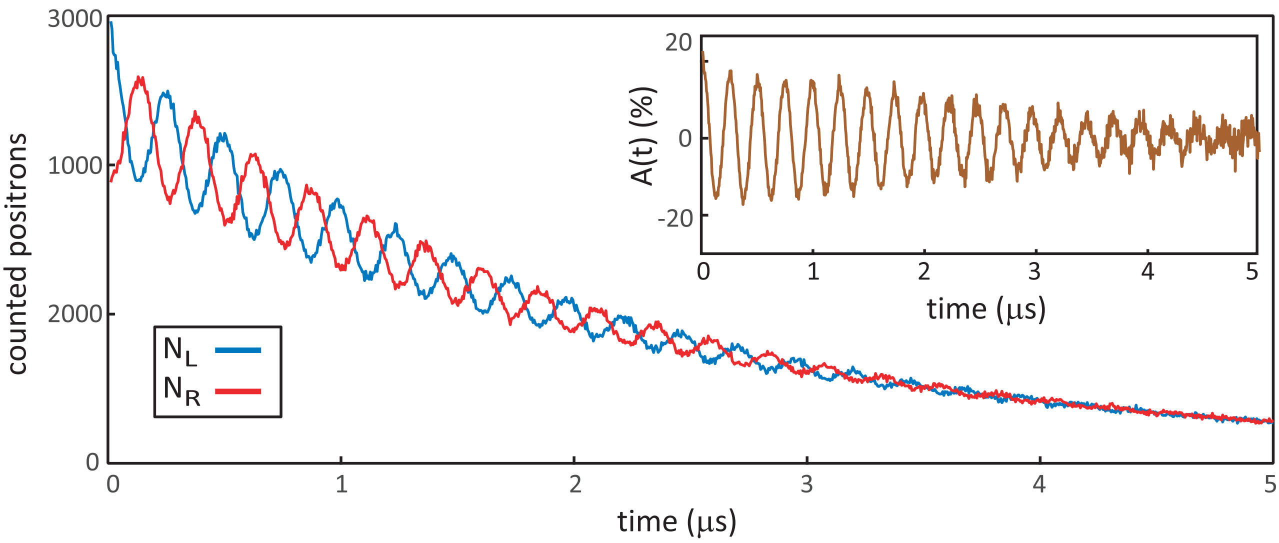

FIG. 1: Example of measured detector histograms $N_{\mathrm{L,R}}(t)$ for the left (L) and right (R) positron detector, taken on the single Nb(50) sample at an applied field of 300 G and a temperature of 2.5 K. Inset shows the asymmetry $A(t)$ of the signal which carries all the information about the local field distribution.

II. TEMPERATURE DEPENDENCE OF THE OBSERVED FLUX EXPULSION

In Fig.4b in the manuscript we present the temperature dependence of $\langle B \rangle$ for all samples of set II and state that the external field isn't expelled until the temperature drops below the T_c of each sample. In Fig.2 we demonstrate this more clearly.

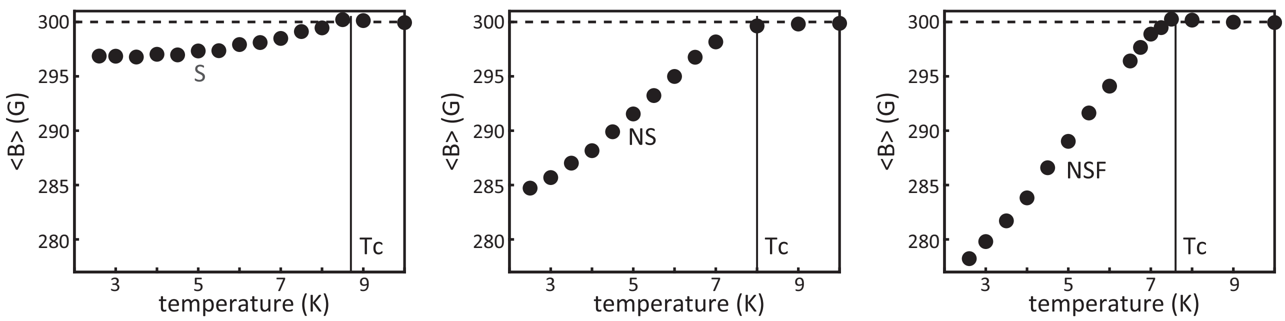

FIG. 2: $\langle B\rangle$ as function of temperature for all samples of set II with the T_c (which are presented in Fig.1 in the manuscript) of each sample marked in the graphs.

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