Sign reversal diode effect in superconducting Dayem nanobridges

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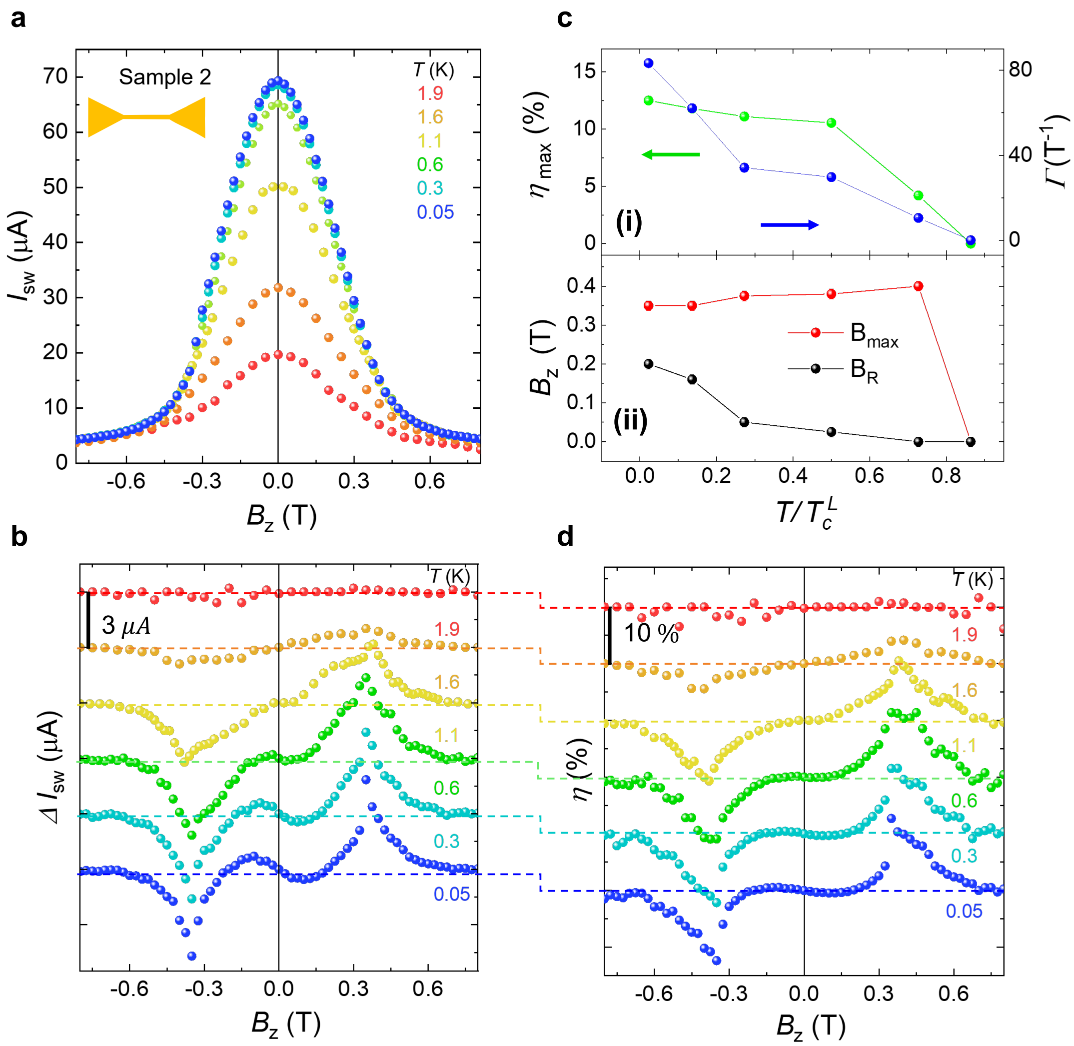
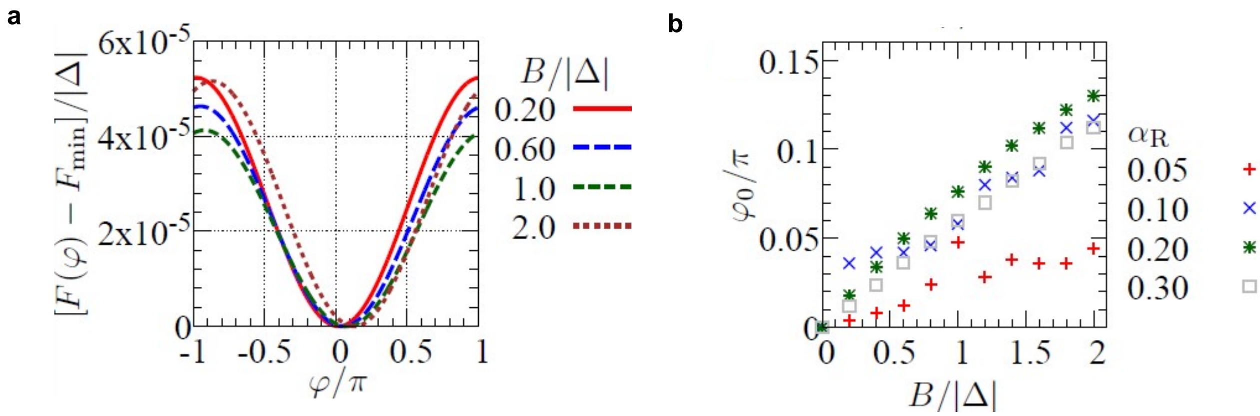
Supplementary Information



Supplementary Figure 1. **Diode effect in a second long Dayem bridge.** **a**, Magnetic field dependence of the switching current I_{sw}^{+} for positive bias current at selected temperatures. **b**, ΔI_{sw}, for the given temperatures. Compared with the device results presented in the main manuscript, the sign reversal of the rectification occurs at lower fields and vanishes at lower temperatures $T \simeq 0.6\,\mathrm{K}$, while the rectification peak at B_{max} remains unaffected by temperature up to to $T \simeq 1.6\,\mathrm{K}$. **c**, Rectification parameters: $\eta_{max} \equiv (\eta_{max}(B_z > 0) + \eta_{max}(B_z < 0))/2$ (green dots), field-to-rectification efficiency transfer function Γ (blue dots) **(i)**, B_{max} (red dots) and B_R (black dots) magnetic fields **(ii)** versus normalized temperature. T_c^L denotes the critical temperature of the long bridge. η_{max} is the rectification value of the low-field peak at B_{max}. **d** $\eta(B_z)$ for selected bath temperatures marked by dashed lines in panel **b**. Curves are vertically offset for clarity.



Supplementary Figure 2. **Free energy of a weak link in the presence of an out-of-plane magnetic field yielding an anomalous phase shift. a** Free energy F as a function of the phase difference φ for a $SS'S$ weak link forming a slab with $w < l$ for selected B-field values. We assume that both Rashba and Dresselhaus interactions are not negligible due to the mirror symmetry breaking at grain boundaries and slab interfaces. For the calculations, we choose a representative amplitude of the Rashba and Dresselhaus interactions ($\alpha_{\mathrm{R}} = \alpha_{\mathrm{D}} = 0.2t$), where t is the hopping amplitude that sets the kinetic energy scale. The anomalous phase φ_0 is given by the free energy minima. For clarity, we use $F_{\min}$ as an offset value of the energy for each free energy evaluated. **b**, Anomalous phase φ_0 as a function of the applied magnetic field B (in units of superconducting gap amplitude Δ) for different strengths of $\alpha_{\mathrm{R}}(= \alpha_{\mathrm{D}}$, in t units). The value of φ_0 is extracted as in **a**. We set the chemical potential as $\mu = 0.005\,t$. The anomalous phase scales almost linearly with the magnetic field, reaching an amplitude of about $0.1\,\pi$ when $B \sim \Delta$.