ORIGIN OF HYSTERESIS IN A PROXIMITY JOSEPHSON JUNCTION

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Contrary to the expected non-hysteretic current–voltage characteristic in a lateral weak link between two superconductors, a significant hysteresis is routinely observed as soon as the critical current is large, largely independent of the nature of the link. We have investigated the hysteresis in the transport properties of proximity Superconductor–Normal metal–Superconductor (SNS) junctions at low temperatures by directly measuring the local electron temperature $T_e$ of the normal metal with a SINIS thermometer [1] that shares the normal metal island with the SNS junction. Our results demonstrate unambiguously that the hysteresis results from an increase of $T_e$ once the junction has switched to the resistive state [2]. An electron temperature of up to 0.6 K is measured while the thermal bath remains at 50 mK. In our geometry, the electron temperature rise is governed by the thermal resistance of the superconducting electrodes of the SNS junction.

Figure 1: Left: Micrograph of a typical sample, showing the electrical measurement setup and calibration of the SINIS thermometer voltage against temperature at a constant SINIS bias current. The enlarged view shows the normal metal copper island connecting to superconducting aluminium electrodes via two clean NS-contacts at its ends, and via two tunnel barriers in the middle. Right: Current–voltage characteristic (bottom) of the SNS junction and the corresponding thermometer response (top). Arrows indicate direction of the current sweep.