Phase-modulated Thermal Conductance in HgTe 3DTI Josephson Junctions

Y. Ho[1], S. Piatrusha[1], M. P. Stehno[1] and L. W. Molenkamp[1]

[1]*Institute of Topological Insulators and Physikalishces Institut, Experimentelle Physik III, Universität Würzburg, Am Hubland, 97074, Würzburg, Germany*

yi-ju.ho@uni-wuerzburg.de

In Josephson junctions incorporating weak links with three-dimensional topological insulators, the emergence of counter-propagating Majorana modes at the interface between the superconductors and the 3DTI is anticipated when tuning the junction phase to π. [1] These exotic modes can potentially be detected through quantized, phase-coherent heat transport [2,3]. Motivated by this, we study the transverse heat transport in H-bar-shaped Josephson junctions, as illustrated in Fig. 1. We employ highly sensitive Johnson-noise thermometry methods to detect the heat flow. Our preliminary results show a phase-modulated thermal conductance with a period corresponding to one flux quantum of the superconducting loop. Notably, the change of the signal with gate voltage suggests, the thermal transport is mediated by the topological surface states.

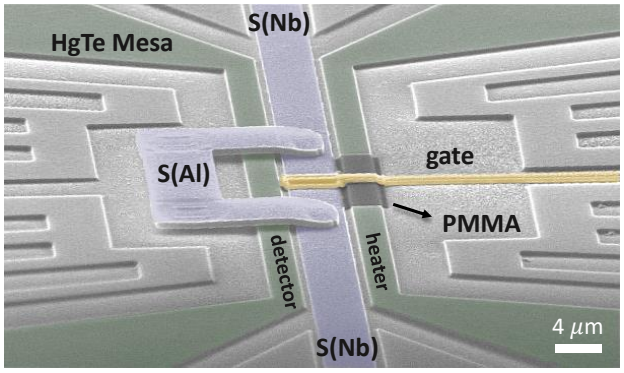

Fig.1. False-color scanning electron microscope image of the H-bar Josephson junction device. Two 3DTI channels serve as the heater and detector for thermal conductance measurements. These channels are laterally attached to the weak link of a 3DTI Josephson junction, side-contacted by Nb electrodes. The carrier density of the top surface in the junction is tunable with a top gate. A free-standing structure made of Al bridges the detector channel and forms a superconducting loop with the Nb leads for phase-biasing.

References

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