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Superconducting Quantum Interference Devices based on InSb Nanoflag Josephson Junctions

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In mesoscopic physics, interference effects play a major role in determining the behavior and the transport properties of quantum devices. Superconducting quantum interference devices, known as SQUIDs, are particularly important in applications regarding quantum computing, magnetometry, scanning probe microscopies, and others. Besides, SQUIDs are also used to directly measure fundamental properties of Josephson junctions, like the Current Phase Relationship (CPR).

Here we report the fabrication and characterization of SQUIDs made with InSb nanoflag-based Josephson junctions [1]. These devices are the first DC-SQUIDs realized with two-dimensional nanostructures of InSb [2]. Making use of the elongated shape of the nanoflags, both symmetric and asymmetric SQUID geometries are realized. Characterization at low temperature is performed by magneto-transport measurements, showing supercurrent interference for various values of temperature and back gate.

In the symmetric geometry, the typical SQUID interference pattern is observed. Interference can be controlled by the back gate, which allows to tune from partial to total destructive interference. An additional tuning knob is the applied perpendicular magnetic field, which allows us to choose a working point within the single junction "Fraunhofer" pattern.

In the asymmetric geometry, the different response of the two nanoflags to the global back gate leads to the disappearance of interference for certain working points, as shown in Figure 1. SQUID-type oscillations are present at back gate voltage V_{bg} = 4.5 V or higher, but not at V_{bg} = 4.0 V, where the supercurrent in one Josephson junction has been suppressed.

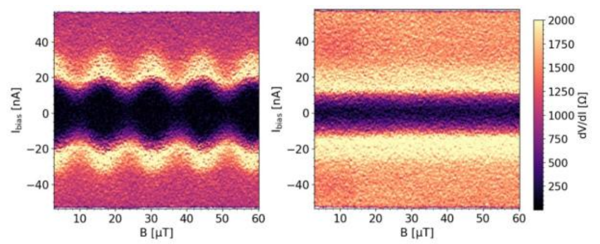

Fig. 1: Interference pattern of an asymmetric SQUID. Left: at V_{bg} = 4.5 V. Right: at V_{bg} = 4.0 V.

References:
[1] S. Salimian *et al.*, Appl. Phys. Lett. **119** (2021) 214004.
[2] I. Verma *et al.*, ACS Appl. Nano Mater. **4** (2021) 5825 – 5833.

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