Optimizing Josephson junction geometry for an enhanced induced gap
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Planar Josephson junction based on two-dimensional electron gas (2DEG) particularly InAs is a promising platform for the study of topological superconductivity and Majorana zero modes (MBSs). While tremendous progress has been made in the search for topological superconductivity and MBSs in this system, there is an increasing concern within the community regarding the nature of the low-energy modes responsible for the experimental observations. Disorder and a small topological gap could effectively create a competition with trivial Andreev bound state physics mimicking some of the MBS signatures. To improve the performance of our Josephson junctions, we follow proposals that suggest zigzag-shaped junctions and Josephson junctions with spatially modulated width could have enhanced topological gaps [1, 2]. We fabricate planar Josephson junctions with various geometries using our epitaxial aluminum on semiconducting indium arsenide quantum wells. Our studies of induced gaps in these junctions suggest enhanced induced gaps at finite fields. We will discuss the implications and future device architectures.

[1] T. Laeven, B. Nijholt, M. Wimmer, and A. R. Akhmerov, Enhanced Proximity Effect in Zigzag-Shaped Majorana Josephson Junctions, Phys. Rev. Lett. 125, 086802 (2020).

[2] P. P. Paudel, T. Cole, B. D. Woods, and T. D. Stanescu, Enhanced topological superconductivity in spatially modulated planar Josephson junctions, Phys. Rev. B 104, 155428 (2021).