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Magnetic field and gate tunable supercurrent fluctuations in multimode semiconductor nanowires VINCENT MOURIK, Univ of New South Wales, KUN ZUO, DANIEL SZOMBATI, Delft University of Technology, DMITRY PIKULIN, University of California Santa Barbara, BAS NIJHOLT, Delft University of Technology, VIACHESLAV OSTROUKH, Leiden University, ANTON AKHMEROV, DAVID VAN WOERKOM, ATTILA GERESDI, DIANA CAR, Delft University of Technology, SEBASTIEN PLISSARD, CNRS-LAAS, ERIK BAKKERS, Eindhoven University of Technology, LEO KOUWENHOVEN, Delft University of Technology, SERGEY FROLOV, University of Pittsburgh — Semiconducting nanowires coupled to superconductors are crucial in proposals for inducing, detecting, and controlling topological superconductivity and Majorana fermion bound states. Using NbTiN-InSb-NbTiN Josephson junctions, we study supercurrents flowing in quasi-ballistic nanowires with strong spin-orbit interaction and in high magnetic fields, thus combining the essential ingredients required for Majorana fermions. Operating in a multimode regime, we observe aperiodic supercurrent fluctuations with several nodes at a finite magnetic field. The node fields are gate tunable. By numerically calculating the supercurrent in a realistic, three dimensional device geometry, we analyze the possible causes of these fluctuations: Zeeman splitting, spin-orbit interaction, and interference between modes. We find that interference dominates over the other effects in the investigated magnetic field range of 0-2 T. Demonstrating and controlling supercurrent interference effects is crucial to understanding the signatures of Majorana fermions in Josephson junctions, and it will benefit the future construction of topological quantum circuits.

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