Abstract Submitted
for the MAR16 Meeting of
The American Physical Society

Symmetry breaking in SNS junctions: edge transport and field asymmetries[1] HENRI SUOMINEN, FABRIZIO NICHELE, MORTEN KJAERGAARD, ASBJORN RASMUSSEN, JEROEN DANON, KARSTEN FLENSBERG, Center for Quantum Devices Station Q Copenhagen, LEONID LEVITOV, Department of Physics, Massachusetts Institute of Technology, JAVAD SHABANI, Physics Department, City College of New York, CHRIS PALMSTROM, California NanoSystems Institute, University of California Santa Barbara, CHARLES MARCUS, Center for Quantum Devices Station Q Copenhagen — We study magnetic diffraction patterns in a tunable superconductor-semiconductor-superconductor junction. By utilizing epitaxial growth of aluminum on InAs/InGaAs we obtain transparent junctions which display a conventional Fraunhofer pattern of the critical current as a function of applied perpendicular magnetic field, $B_\perp$. By studying the angular dependence of the critical current with applied magnetic fields in the plane of the junction we find a striking anisotropy. We attribute this effect to dephasing of Andreev states in the bulk of the junction, leading to SQUID like behavior when the magnetic field is applied parallel to current flow. Furthermore, in the presence of both in-plane and perpendicular fields, asymmetries in $\pm B_\perp$ are observed. We suggest possible origins and discuss the role of spin-orbit and Zeeman physics together with a background disorder potential breaking spatial symmetries of the junction.

[1]Research supported by Microsoft Project Q, the Danish National Research Foundation and the NSF through the National Nanotechnology Infrastructure Network

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Date submitted: 06 Nov 2015 Electronic form version 1.4