Abstract Submitted
for the MAR15 Meeting of
The American Physical Society

Josephson Interference due to Orbital States in Nanowire Proximity Effect Junctions[1] KAVEH GHARAVI, GREGORY HOLLOWAY, JONATHAN BAUGH, Institute for Quantum Computing, University of Waterloo — The Josephson effect in a nanowire-based superconductor-normal-superconductor (SNS) junction is studied theoretically and experimentally, focusing on the effects of nanoscale confinement on the current-phase relationship of the junction. An axial external magnetic field is applied. The theory of a previously unstudied type of Josephson interference is described, based on the coupling between the axial flux and N-section Andreev quasiparticles (continuum states or bound states) occupying subbands of non-zero orbital angular momentum. The Bogoliubov-de Gennes equations are solved while considering the transverse subbands in the N-section, yielding energy-versus-phase curves that are shifted in phase in the presence of the flux. A similar phase shift is observed in the continuum current of the junction. An intuitive, semi-classical version of the theory is presented. The critical current I_c of the junction is numerically calculated, and shown to oscillate versus the axial flux. Experimental observations of the oscillations of I_c in an Nb-InAs nanowire-Nb junction are reported. It is shown that the observed oscillations can be described by the semi-classical picture. The scope and applicability of the theory to experimental devices is discussed.

[1]This work was supported by NSERC, Ontario Ministry for Research and Innovation, Canada Foundation for Innovation, and Industry Canada.

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Date submitted: 14 Nov 2014 Electronic form version 1.4