Abstract Submitted
for the MAR08 Meeting of
The American Physical Society

Destruction of global coherence in long superconducting nanocylinders VU HUNG DAO, LIVIU CHIBOTARU, University of Leuven and INPAC — Recent realizations of the Little-Parks experiment on long hollow cylinders with nanoscale diameter have shown the destruction of superconductivity at zero temperature around half quanta of applied magnetic flux. In addition the observed resistive transition unexpectedly broadens when departing from zero magnetic field. A quantum phase transition near half flux quanta has been argued to explain this anomalous behavior. However this theory does not explain the step-like features observed in the temperature variations of the resistance. We show here that the puzzling behavior of the resistance results from an alternation of normal and superconducting sections along the tube. First within the Ginzburg-Landau theory we have found that the transition is of second order if the studied cylinders are homogeneous, which precludes the existence of nonhomogeneous phases. From this we conclude that the phase separation must be triggered by the tube inhomogeneities. Within a minimal model where cylinder properties vary along its axis, our BCS calculations of the superconducting state are in a good agreement with experimental data, in particular, the multistep transitions are naturally explained. A small discrepancy near half flux quanta may be ascribed to the charge imbalance induced by the normal electron flow.

Liviu Chibotaru
University of Leuven

Date submitted: 22 Dec 2007 Electronic form version 1.4