

Contribution Title: AHARONOV-BOHM ANSATZ AND TONOMURA ET AL. EXPERIMENTS: RIGOROUS PROOFS.  
Authors: M. Ballesteros, R. Weder  
Presenting author: Ballesteros M.  
Affiliation: Institut National de Recherche en Informatique et en Automatique (INRIA, Paris) And Universidad Nacional Autonoma de Mexico (UNAM).  
E-mail: Miguel.Ballestros\_Montero@inria.fr  
Invited speaker:  
YRS seminar: NO

The Aharonov-Bohm effect is a fundamental issue in physics, it describes the physical important electromagnetic quantities in quantum mechanics and its experimental verification constitutes a test of the theory of quantum mechanics itself. In the fundamental paper of Aharonov and Bohm (1959), they provide an approximate solution to the Schrödinger equation when the electron stays in simple connected regions where the magnetic field is zero, by a change of gauge formula from the zero vector potential. The formula that they give shows explicitly the dependence on the magnetic potential over regions where the magnetic field is zero. The formula of Aharonov and Bohm was experimentally confirmed by the fundamental experiments of Tonomura et al., giving a conclusive evidence of the existence of the Aharonov-Bohm effect. In this talk we provide a rigorous proof that the Aharonov-Bohm formula is a good approximation in the case of the Tonomura et al. experiments. We give a simple (uniform in time) formula for the error bound that estimates the difference between the Aharonov-Bohm approximated solution and the exact solution to the Schrödinger equation and we show that under certain properties of the electron, the Aharonov-Bohm solution differs from the real one by  $10^{-314}$ .