REPORT

of Prof. Mikhail Popov, Leading researcher of St.-Petersburg branch of Steklov Mathematical Institute of Russian Academy of Sciences.

In the period from May 24 to June 7, I was visiting to Physical Department of Loughborough University, UK, headed by Prof. Theodor Kusmartsev under Short Visit Grant № 1039.

The aim of the visit is work on joint research project "Electronic Fabry-Perot interferometer in carbon nanotube quantum dots".

When the size of devices decreases and becomes comparable with the electron coherence length, quantum interference between electron waves becomes increasingly important. This leads to changes in electronic behavior, to quantum coherence and interference. We consider a new electronic device which is analogous to conventional Fabry-Perot interferometer and which is made of molecular quantum dots, such as carbon nanotubes.

Our main results can be described as follows. We develop and present asymptotic analysis of behavior of an electron confined between two electrode interfaces in presence of magnetic field. This analysis inherits some features of mathematical technique having been developed in theory of open resonators for lasers, in particular, in papers by M.Popov. We construct an asymptotic solution of Schrödinger equation in the form of Gaussian beams solitary localized in neighborhood of a classical trajectory of a quantum particle, i.e. in our case an electron. Under condition that the classical trajectory is stable in the linear approximation, we construct subsequence of eigenvalues and eigenfunctions which describe behavior of the electron in Fabry-Perot quantum interferometer. The asymptotic energy spectrum is obtained as a requirement of uniqueness and periodicity of the asymptotic wave functions. We would like to emphasize that the condition of stability of the periodic classical trajectory is essential for the existence of the spectrum. These results are prepared as a paper which will soon be submitted for publication (the paper is attached to the report).

On June 1, on the scientific seminar of the Physical department I made presentation "Summation of space-time Gaussian beams in direct wave propagation problems". In the talk I described an approach which was earlier developed in my papers and which enables one to overcome caustic problems when we consider propagation of waves in complex inhomogeneous acoustic, electrodynamic or elastic media. We hope to develop and apply similar approach to quantum problems in nanoscience in our further joint research.

17.06.2006.   Prof. M.Popov.