Spectral problems and quantum features of fluid in nanotube

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Fluid flows through nanostructures are intensively studied now. Experiments show that these flows have many specific features, which cannot be explained in classical terms only. Particularly, flow through nanotube is extremely fast in comparison with its classical analog. We suggest a model based on the possibility of existence of molecular clusters (Frenkel crystallites) in the fluid [1]. There are some experimental evidences of such phenomenon. Under this assumption one needs to take into account quantum effects. Particularly, the boundary condition, which plays the crucial role for the flow in nanostructures, takes the form of sliding condition instead of the no-slip condition for the classical flow. The parameters of the boundary conditions are determined by solving of quantum scattering problem for the particle of the fluid by the wall potential. The character of this solution is related with the existence of bands in the spectrum corresponding to surface waves along the nanotube boundary. Main features of the flow are described in the framework of the model. For very narrow nanotubes another phenomena have an influence on the flow- possibility of existence of solitons in nanotube walls. These soliton solutions are similar to Davidov solitons in molecular chains. This model of flow is also described.

[1] S.A.Chivilikhin, V.V.Gusarov, I.Yu.Popov, A.I.Svitenkov. Model of fluid flow in a nano-channel. *R*ussian J. of Math. Phys., **15** (3), 410–412 (2008)