

ANSWER to REFEREES

“Comments on the manuscript#MS:2012 PRRI 2773, "Application of Non-local Quantum Hydrodynamics to" by Alexeev and Ovchinnikova

First of all our thanks to Referees for their valuable and useful work. We took into account practically all remarks as it follows from the revised text. All the corrections in the revised manuscript are highlighted in yellow colour. Nevertheless we would like to underline the main corrections:

1. ‘The authors use the non-dimensional, non-local quantum hydrodynamics/generalized hydrodynamics equations to describe the charge density waves (CDWs)/solitons dynamics in graphene. It is suggested that the model should be given in dimensional form in the beginning. It will then be easy for the readers to conceive the relevant scales of the model.’

The system of generalized quantum hydrodynamic equations (describing the soliton motion in two species mixture) is written in dimensional form (see (3.1) - (3.6)). The generalized quantum hydrodynamic equations for the multi-component system is written also in the dimensional form (see (2.1)-(2.6)).

2. “The existence and characteristics/conditions of solitons in graphene needs to be elaborated”.

The problem of existing and propagation of solitons in graphene and in the perspective high superconducting materials belong to the class of significantly non-local non-linear problems which can be solved only in the frame of vast numerical modeling. This problem is discussed in the item 5.

3. “The authors describe the inability of the Madelung hydrodynamics for such problems due to destruction of the wave packets. Some detail is required on the differences between the Madelung approach and the present one. Does the quantum potential as in the Madelung hydrodynamics has no role here?”

Madelung quantum hydrodynamics (and therefore Schrödinger equation) is a deep particular case of generalized quantum hydrodynamics created by B.V. Alexeev. Shortly this problem in Introduction now is discussed. But general theory is rather complicated and published in details earlier. ([7] in References). For Referee convenience we sent to Referee the corresponding Alexeev’s paper as attached file. We hope it could be interesting for Referee.

4. “Quantum electron pressure is given by $p_e = p_0 V_0^2 p_e$. If the temperature T is not too large, the electron Fermi energy should have a role here which is not discussed. It also makes the Thomas-Fermi length scale relevant to shielding distances. The authors should point out why these aspects are not important in non-local description.”

In this paper only the quantum hydrodynamic approach is used for investigation of the wave propagation in graphene. In this case the distribution function is not considered in the explicit form. All transport properties manifest itself

via the non-local hydrodynamic terms which are proportional to approximated quantum non-local parameter τ . We indicated also that the transport properties in graphene can be described at low energies by a massless Dirac-fermion model with chiral quasiparticles [30, 31]. The Boltzmann and Schrödinger approaches are used also [32], [33]. The non-local kinetic equations also are used by the authors of this article for calculation of graphene electrical conductivity [34].

5. “The role of chirality and correlations in low temperature single layered graphene is notable (e.g., see Y. Barlas et. al., Phys. Rev. Lett. 98, 236601 (2007)). The authors should justify the neglect of such effects in their model.”

Only the quantum hydrodynamic methods are used in the consideration. Taking into account this remark we introduce the additional discussion in item 2 and introduced the additional references ([30], [31]). On the hydrodynamic level all possible symmetry effects (including hypothetical chiral superconductivity, which breaks time-reversal symmetry), manifest itself as result of the self-consistent numerical solution of the non-linear problem and cannot be discussed beforehand.

6. “The presentation of the manuscript is weak. Particularly, formatting (typos) and grammar is needed to be checked carefully on many places. The authors should consult a native English speaker in this regard. In addition, the figure captions are not well written and seemingly ambiguous on some places which need clarity.”

Of course English is not our mother tongue. We introduced corrections and did our best. Many thanks to Referee for the concrete English corrections.

7. “While applying the results to graphene, the authors use typical parameters. For example, on page 14-15. Some standard reference(s) needed here to justify the worth of the data”.

Taking into account this remark we introduced in References the additional papers [35-38] with data, which were used in our calculations.