The calculations of thermophysical properties of low-temperature bismuth plasma [[1]](#footnote-1)\*)

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Apfelbaum E.M.

JIHT RAS, Moscow, Russia, [apfel\_e@mail.ru](mailto:email@email.ru)

The equations of states and electronic transport coefficients are necessary to solve various fundamental and applied tasks of the physics of plasma, appearing in the processes of metallic wire explosions of interaction of the radiation or particle beams with a substance. In spite of all difficulties, which manifest themselves both in the high temperature measurements or in the corresponding calculations, presently there are gathered relatively much data about these properties for different substances at the temperatures T > 5 kK. For metals and semiconductors these area includes the low-temperature plasma region. Several reviews [1-3], published during recent decade, witness this fact. However, Bi is disposed apart from other metals, as far as the data under study for this element in the range T ~ 10-100 кК the densities ρ below several g/cm3 are practically absent.

Bismuth has the relatively low melting temperature Тm = 544.7 K, which gives rise to high number of experimental and calculation data for the liquid state, i. e. at T > Тm and ρ near the melting line (at Т = 300 К solid Bi has ρn = 9.79 g/cm3, while liquid Bi at Т = Тm has ρm =10.05 g/cm3 , so the inverse melting is observed for Bi). It allows one to construct relatively exact equation of stated [4] and even estimate the critical point position (~4 kK) [5]. At higher T the shock-wave measurements are carried out for more than 60 years [6], but the most of them atudy the compressed states at ρ > ρn. If the porous samples are used then it is possible to get into the rarefied area down to ρ ~ ρn/3 [7]. But there are much less corresponding experiments and the temperature is not measured directly in shock-wave experiments. The modern ab initio calculations both for the thermodynamics and transport coefficients is also oriented to the area near the melting line and to the region of the shock-wave measurements, i. e. at ρ ~ ρm and higher [2,3]. Thus the data at relatively low densities for Bi plasma are absent. So the aim of present study is to consider this area (T~ 10-100 kK, ρ < ρn/3).

Previously we have created the model to calculated the thermophysical properties of low-temperature partially ionized plasma (with neutral component) in the area pointed above области. It is constructed on the basis of the chemical approach and the relaxation time approximation. This model was successfully applied to the plasma of a number of metals and semiconductors (see [8,9] and references therein). In present study this model was modified and used for analogous calculations in Bu plasma. The comparison between the present data and the results of [7], located in the applicability area of the model, have shown good agreement.

References

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