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Comments on "Symmetry of the Linearized Boltzmann Equation" by S. Takata

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Recently, S. Takata published two papers [1, 2] about the Onsager-Casimir reciprocal relations. The main conclusion of the second paper, see the last sentence of Conclusion in Ref. [2], is as follows: "Finally, we presented illustrative examples and pointed out an erroneous conclusion by an existing theory [3, 4], together with a critical argument about its foundation." Note, the theory is presented only in the paper [3], while the work [4] contains just some examples of applications of this theory. The aim of these comments is to point out that the mentioned above conclusion by Takata is completely wrong.

In the footnote 3 to the p. 758 of Ref. [1] Takata wrote: "the key estimate Eq. 33 in [3] is incorrect". First, Eq. 33 in Ref. [3] is not key one, but it is used only for some specific situations, namely, when the gas flow domain is unbounded. Many examples given in Ref. [4] do not need Eq. 33 of Ref. [3]. Second, the estimation was obtained under some assumptions clearly given in the work [3], which contains no erroneous conclusion.

Among numerous illustrative examples given in Ref. [4], Takata questions only that related to the thermophoresis, namely, the last equation given on p. 777 of Ref. [1] is different from Eq. 5.39 given in Ref. [4]. The fact is that, applying the theory to the thermophoresis problem the perturbation function h far from particle is split as $h = h' + h_\infty$, where h' corresponds to the perturbation caused by the particle presence. It vanishes at the infinity and does not appear in the expressions given in both Refs. [4] and [2]. The second term h_∞ is related to both uniform motion of the gas relatively the particle and uniform temperature gradient in the gas. To obtain the expression of h_∞, the part corresponding to the temperature gradient was carelessly omitted in Ref. [4]. In the footnote to p. 777 of Ref. [1], Takata gives the same explanation of the difference. Thus, the reason of the difference is neither

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"incorrect key estimation" nor "erroneous assumptions" as Takata stated many times in his both papers [1, 2], but a flaw to derive Eq. 5.39 in Ref. [4]. This equation does not reprove the conclusions given in the work [3]. All other examples given in Ref. [4] are not questioned by Takata, but some of them were imitated by him in Refs. [1, 2].

The theory elaborated in Ref. [3] was generalized in the subsequent work [5] where less assumptions were used. This generalization allows us to apply the theory to any gaseous systems satisfying the linearized Boltzmann equation and includes all situations considered by Takata [1, 2]. For instance, the last equation on p. 777 of Ref. [1] follows directly from the theory elaborated in Ref. [5].

Summarizing, the papers [1, 2] by Takata contain several unfair statements about the results reported in Refs. [3, 4]. Similar statements were made by Takata in his paper [6] commented in Ref. [7].

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