Erratum: "A convergence study for the Laguerre expansion in the moment equation method for neoclassical transport in general toroidal plasmas" [Phys. Plasmas 17, 082510 (2010)]

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In making the numerical examples in Sec. IV of Ref. 1, there were two mistakes. One is that the parallel viscosity matrix elements

$$\begin{bmatrix} M^a_{11} & M^a_{12} & M^a_{13} & M^a_{14} \\ M^a_{21} & M^a_{22} & M^a_{23} & M^a_{24} \\ M^a_{31} & M^a_{32} & M^a_{33} & M^a_{34} \\ M^a_{41} & M^a_{42} & M^a_{43} & M^a_{44} \end{bmatrix} \tag{1}$$

are replaced by

$$\begin{bmatrix} M^a_{11} & M^a_{12} & M^a_{13} & M^a_{14} \\ M^a_{21} & M^a_{12} & M^a_{13} & M^a_{14} \\ M^a_{31} & M^a_{31} & M^a_{13} & M^a_{14} \\ M^a_{41} & M^a_{41} & M^a_{41} & M^a_{14} \end{bmatrix}. \tag{2}$$

The detailed definition of these matrix elements is shown in Eqs. (41)–(44) in Ref. 2. Unfortunately, the check of the Onsager symmetry of the transport matrix (Eq. (13) in Ref. 1) $L^{ba}_{ji} = L^{ab}_{ij}$, $L^a_{Ej} = -L^a_{jE}$ could not find this mistake because a symmetric structure of the $\mathbf{M}_a$ matrix is still formally retained. Furthermore, the check of the momentum conservation also failed to find the mistake since replaced $M^a_{j+1,k+1}$ with $j \geq 1$ are irrelative to the parallel force moment of the lowest Laguerre order $j = 0$. The mistake was found by a comparison with an analytical solution (with a small mass ratio approximation) in Appendix C in Ref. 3. This concentration on limited transport matrix elements caused also the second mistake, in which results in Figs. 2–3 were not consistent with radial gradients of the pressure and the temperature $\partial p_a/\partial r$, $\partial T_a/\partial r$ stated in the captions. In Fig. 3, the stated $\partial p_a/\partial r$ and $\partial T_a/\partial r$ are substituted correctly only for $E_r \leq 0$ and invalid values are used for $E_r > 0$. Therefore, the unnatural jumps are caused at $E_r = 0$, but we had a misunderstanding on it that there will be the sharp dependence on E_r due to the boundary layer effect shown in Fig. 1(b). Now, we present the exact numerical examples in which the parallel viscosity coefficients $M^a_{j+1,k+1}$ and the radial gradients in the captions are correctly substituted.

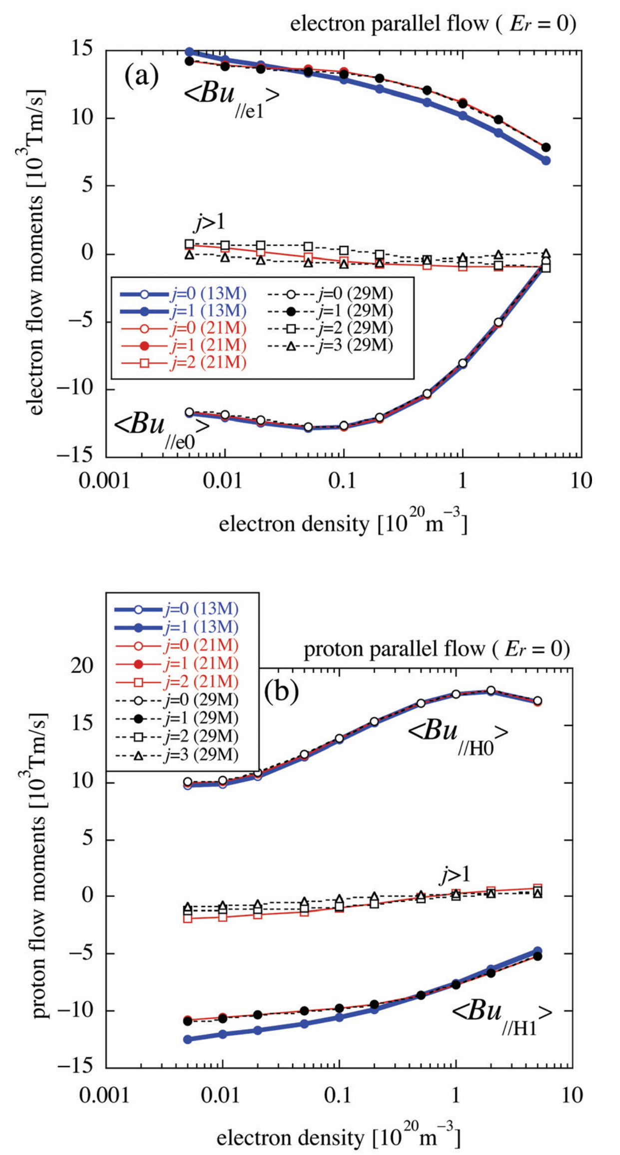

FIG. 1. (Color online) A comparison of flow moments $\langle Bu_{\|aj}\rangle$ for (a) a = e$^-$ and (b) a = H$^+$ obtained by the 13 M, 21 M, and 29 M approximations as functions of the electron density in e$^-$ + H$^+$ plasmas. Assumed parameters are $T_e = T_i = 2.0$ keV, $\partial p_e/\partial r/n_e = \partial p_i/\partial r/n_i = \partial T_e/\partial r = \partial T_i/\partial r = -3.0$ keV/m, and $E_r = \langle BE^{(A)}_{\|}\rangle = 0$.

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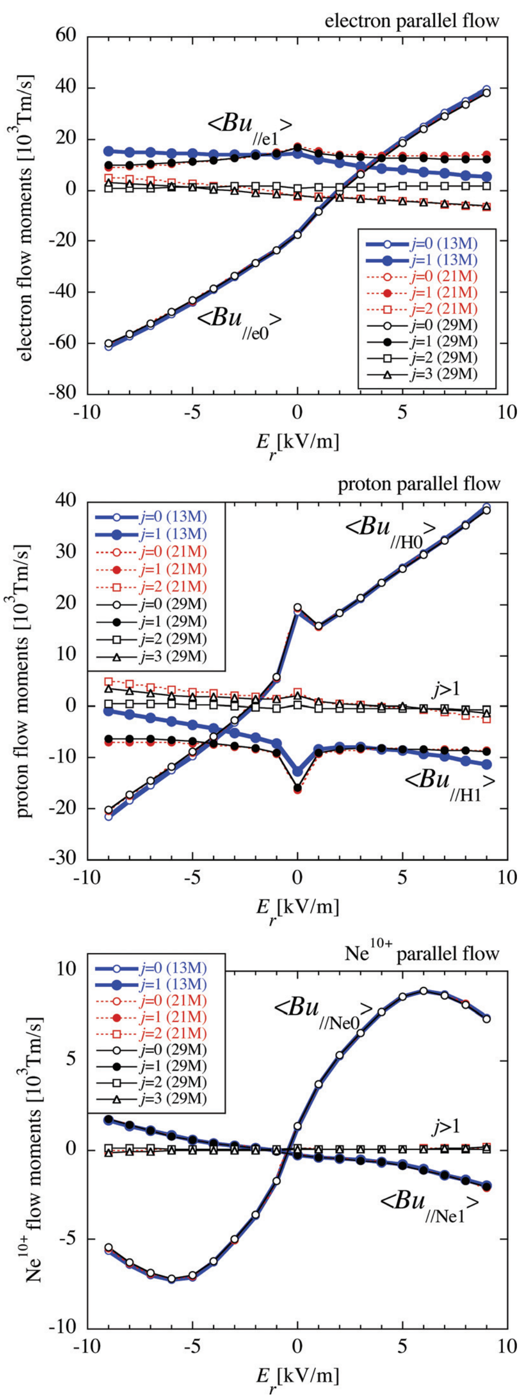

FIG. 2. (Color online) Another comparison of the flow moments $\langle Bu_{\|aj}\rangle$ for $a = e^-$, H^+, Ne^{10+} as functions of the radial electric field strength E_r by the three approximation methods in $e^- + H^+ + Ne^{10+}$ plasmas with $\langle BE_\|^{(A)}\rangle = 0$. Assumed parameters are $T_e = 2.0$ keV, $T_i = 1.0$ keV, $Z_{eff} = 5.74$, $n_e = 1 \times 10^{18}$ m^{-3}, and $\partial p_e/\partial r/n_e = \partial p_i/\partial r/n_i = \partial T_e/\partial r = \partial T_i/\partial r = -3.0$ keV/m.

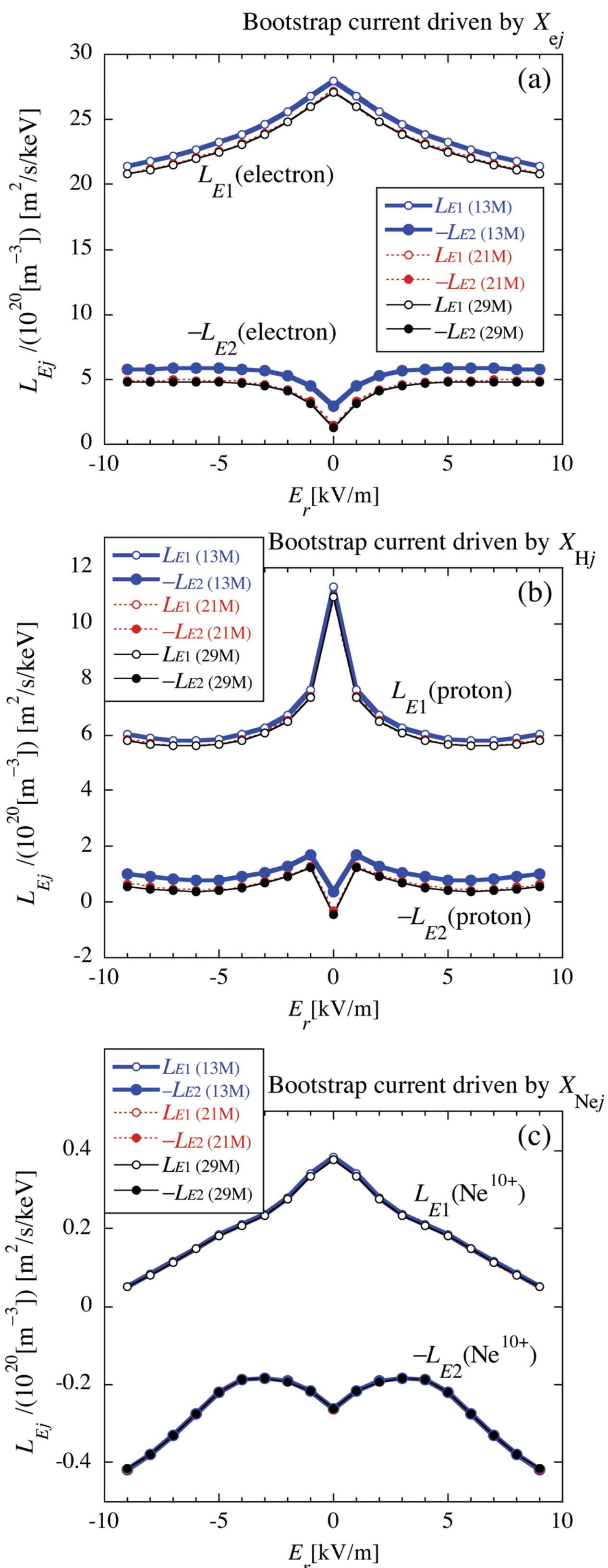

FIG. 3. (Color online) A comparison of the bootstrap current and Ware pinch coefficients $L_{E1}^a = -L_{1E}^a$ and $-L_{E2}^a = L_{2E}^a$ defined in Eq. (13) for the $e^- + H^+ + Ne^{10+}$ plasmas. Figures indicate the bootstrap current driven by (a) the electron forces $a = e^-$, (b) the proton forces $a = H^+$, and (c) the neon forces $a = Ne^{10+}$. The assumed parameters are those in Fig. 2.

These corrections (especially that of $\partial p_a/\partial r$, $\partial T_a/\partial r$) mainly change the absolute values of the flow moments $\langle Bu_{\|aj}\rangle$ and the bootstrap current and Ware pinch coefficients $L_{Ej}^a = -L_{jE}^a$. Their dependence on j_{max} (the maximum order of the Laguerre expansion) with relation to the particle mass and the radial electric field effect, which is an essential discussion point in Ref. 1, is unchanged.

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discussions triggering our recalculation. This work is supported by coordinated research programs NIFS06KUHL007 and NIFS07KNXN103 in National Institute for Fusion Science.

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