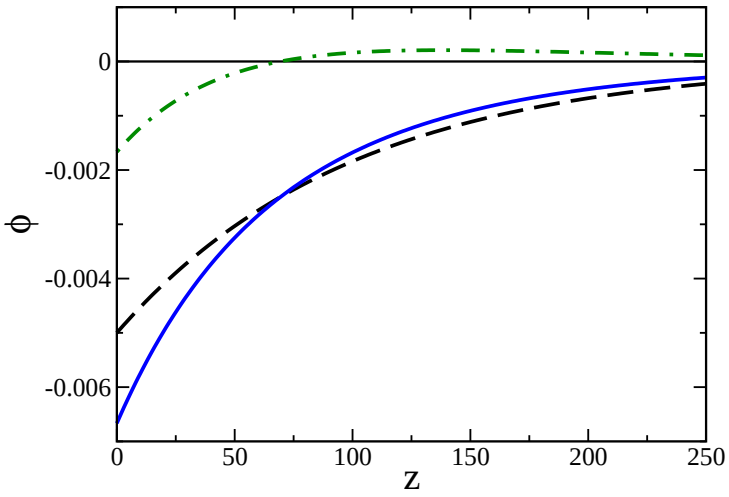

FIG. 1: (Color online) Charge density profiles in the semi-infinite system. The dashed line is the solution of the linearized equation (55), $\phi^{(1)}(z)$, the dash-dotted line is the correction term (74), $\phi^{(2)}(z)$, and the solid line is the sum of the two functions, $\phi^{(1)}(z) + \phi^{(2)}(z)$, for $\kappa = 0.01$, $\sigma = 0.5$, $\xi_b = 100$, and $n_1 = 0.5$. The charge density is in e/v_0 units, where e is the elementary charge, and z is in $v_0^{1/3}$ units, where v_0 is the volume per molecule in the close-packed system and we assume that all molecules are of similar size.

For $T \to T_c$ we have $\xi_b^{-1} \to 0$, and using $\xi_b^{-1} \ll \kappa$ we obtain the approximation

$$\phi^{(2)}(z)/\phi^{(1)}(z) \simeq \frac{n_1}{2}\Big[1 - \kappa\frac{(1 - e^{-z/\xi_b})}{\xi_b^{-1}}\Big] \qquad \kappa \gg \xi_b^{-1} \tag{78}$$

For $z \ll \xi_b$ the above takes the simple form

$$\phi^{(2)}(z)/\phi^{(1)}(z) \simeq \frac{n_1}{2}\Big[1 - \kappa z\Big] \tag{79}$$

The correction term changes sign for $z_0 \approx 1/\kappa$.

Equations for the first corrections to the nonelectrostatic part read

$$\left(\mathbf{v}^{(2)}\right)'' = \mathbf{M}\mathbf{v}^{(2)} + \mathbf{D}, \tag{80}$$

where $\mathbf{v}^{(2)} = (\vartheta^{(2)}, \eta^{(2)})$, and the components of the vector $\mathbf{D}^T = (D_s, D_\rho)$ are

$$D_s = \frac{D^a_{\vartheta\vartheta}\vartheta^2 + D^a_{\vartheta\eta}\vartheta\eta + D^a_{\eta\eta}\eta^2 + D^a_{\phi\phi}\phi^2}{J} \tag{81}$$

$$D_\rho = \frac{D^b_{\vartheta\vartheta}\vartheta^2 + D^b_{\eta\vartheta}\vartheta\eta + D^b_{\eta\eta}\eta^2 + D^b_{\phi\phi}\phi^2}{J} \tag{82}$$