Plasma parameter

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Condition for Debye shielding: number of particles in a Debye sphere is much larger than 1

Plasma parameter: $N_D \equiv \frac{4\pi}{3} n L_D^3 \sim n L_D^3 \sim \sqrt{\frac{(k_B T)^3}{n e^6}} >> 1$

→ $L_D \gg n^{-1/3} = \bar{l}$ (mean interval between particles)

This condition is equivalent to each of the following conditions:

I. mean electrostatic energy << thermal energy => Plasma forms a weakly bounded system.

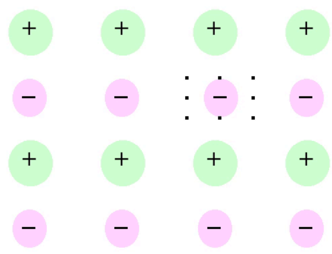
$$L_D^2 \sim \frac{k_B T}{e^2 n} \gg n^{-\frac{2}{3}} \Rightarrow k_B T \gg \frac{e^2}{n^{-\frac{1}{3}}} = \frac{e^2}{\bar{l}} = e\,\bar{\phi}_c$$

This justifies the assumption $e^{-\frac{e\phi_c}{k_B T_e}} \approx 1 - \frac{e\phi_c}{k_B T_e}$ used to derive Debye length.

II. L_D >> effective radius r_{eff}

$$\frac{L_D}{r_{eff}} \sim \frac{\sqrt{k_B T / n e^2}}{e^2 / k_B T} = \sqrt{\frac{(k_B T)^3}{n e^6}} \sim N_D \gg 1$$

Plasma oscillation



When a significant deviation from a charge neutral state temporarily occurs at a local region...