FUNDAMENTAL PLASMA PARAMETERS

All quantities are in Gaussian cgs units except temperature (T, T_e, T_i) expressed in eV and ion mass (m_i) expressed in units of the proton mass, $\mu = m_i/m_p$; Z is charge state; k is Boltzmann's constant; K is wavelength; γ is the adiabatic index; $\ln\Lambda$ is the Coulomb logarithm.

Frequencies

electron gyrofrequency	$f_{ce} = \omega_{ce}/2\pi = 2.80 \times 10^6 B\,\mathrm{Hz}$
	$\omega_{ce} = eB/m_e c = 1.76 \times 10^7 B\,\mathrm{rad/sec}$
ion gyrofrequency	$f_{ci} = \omega_{ci}/2\pi = 1.52 \times 10^3 Z\mu^{-1} B\,\mathrm{Hz}$
	$\omega_{ci} = ZeB/m_i c = 9.58 \times 10^3 Z\mu^{-1} B\,\mathrm{rad/sec}$
electron plasma frequency	$f_{pe} = \omega_{pe}/2\pi = 8.98 \times 10^3 {n_e}^{1/2}\,\mathrm{Hz}$
	$\omega_{pe} = (4\pi n_e e^2/m_e)^{1/2}$
	$= 5.64 \times 10^4 {n_e}^{1/2}\,\mathrm{rad/sec}$
ion plasma frequency	$f_{pi} = \omega_{pi}/2\pi$
	$= 2.10 \times 10^2 Z\mu^{-1/2} {n_i}^{1/2}\,\mathrm{Hz}$
	$\omega_{pi} = (4\pi n_i Z^2 e^2/m_i)^{1/2}$
	$= 1.32 \times 10^3 Z\mu^{-1/2} {n_i}^{1/2}\mathrm{rad/sec}$
electron trapping rate	$\nu_{Te} = (eKE/m_e)^{1/2}$
	$= 7.26 \times 10^8 K^{1/2} E^{1/2}\,\mathrm{sec}^{-1}$
ion trapping rate	$\nu_{Ti} = (ZeKE/m_i)^{1/2}$
	$= 1.69 \times 10^7 Z^{1/2} K^{1/2} E^{1/2} \mu^{-1/2}\,\mathrm{sec}^{-1}$
electron collision rate	$\nu_e = 2.91 \times 10^{-6} n_e \ln\Lambda {T_e}^{-3/2}\,\mathrm{sec}^{-1}$
ion collision rate	$\nu_i = 4.80 \times 10^{-8} Z^4 \mu^{-1/2} n_i \ln\Lambda {T_i}^{-3/2}\,\mathrm{sec}^{-1}$

Lengths

electron deBroglie length	$\lambda\!\!\!^{-} = \hbar/(m_e kT_e)^{1/2} = 2.76 \times 10^{-8} {T_e}^{-1/2}\,\mathrm{cm}$
classical distance of minimum approach	$e^2/kT = 1.44 \times 10^{-7} T^{-1}\,\mathrm{cm}$
electron gyroradius	$r_e = v_{Te}/\omega_{ce} = 2.38 {T_e}^{1/2} B^{-1}\,\mathrm{cm}$
ion gyroradius	$r_i = v_{Ti}/\omega_{ci}$
	$= 1.02 \times 10^2 \mu^{1/2} Z^{-1} {T_i}^{1/2} B^{-1}\,\mathrm{cm}$
plasma skin depth	$c/\omega_{pe} = 5.31 \times 10^5 {n_e}^{-1/2}\,\mathrm{cm}$
Debye length	$\lambda_D = (kT/4\pi n e^2)^{1/2}$
	$= 7.43 \times 10^2 T^{1/2} n^{-1/2}\,\mathrm{cm}$

Velocities	
electron thermal velocity	$v_{Te} = (kT_e/m_e)^{1/2}$
	$= 4.19 \times 10^7 {T_e}^{1/2}\,\mathrm{cm/sec}$
ion thermal velocity	$v_{Ti} = (kT_i/m_i)^{1/2}$
	$= 9.79 \times 10^5 \mu^{-1/2} {T_i}^{1/2}\,\mathrm{cm/sec}$
ion sound velocity	$C_s = (\gamma Z k T_e/m_i)^{1/2}$
	$= 9.79 \times 10^5 (\gamma Z T_e/\mu)^{1/2}\,\mathrm{cm/sec}$
Alfvén velocity	$v_A = B/(4\pi n_i m_i)^{1/2}$
	$= 2.18 \times 10^{11} \mu^{-1/2} {n_i}^{-1/2} B\,\mathrm{cm/sec}$
Dimensionless	
(electron/proton mass ratio)$^{1/2}$	$(m_e/m_p)^{1/2} = 2.33 \times 10^{-2} = 1/42.9$
number of particles in Debye sphere	$(4\pi/3) n {\lambda_D}^3 = 1.72 \times 10^9 T^{3/2} n^{-1/2}$
Alfvén velocity/speed of light	$v_A/c = 7.28 \mu^{-1/2} {n_i}^{-1/2} B$
electron plasma/gyrofrequency ratio	$\omega_{pe}/\omega_{ce} = 3.21 \times 10^{-3} {n_e}^{1/2} B^{-1}$
ion plasma/gyrofrequency ratio	$\omega_{pi}/\omega_{ci} = 0.137 \mu^{1/2} {n_i}^{1/2} B^{-1}$
thermal/magnetic energy ratio	$\beta = 8\pi n k T/B^2 = 4.03 \times 10^{-11} n T B^{-2}$
magnetic/ion rest energy ratio	$B^2/8\pi n_i m_i c^2 = 26.5 \mu^{-1} {n_i}^{-1} B^2$
Miscellaneous	
Bohm diffusion coefficient	$D_B = (ckT/16eB)$
	$= 6.25 \times 10^6 T B^{-1}\,\mathrm{cm}^2/\mathrm{sec}$
transverse Spitzer resistivity	$\eta_\perp = 1.15 \times 10^{-14} Z \ln \Lambda T^{-3/2}\,\mathrm{sec}$
	$= 1.03 \times 10^{-2} Z \ln \Lambda T^{-3/2}\,\Omega\,\mathrm{cm}$

The anomalous collision rate due to low-frequency ion-sound turbulence is

$$\nu^* \approx \omega_{pe} \widetilde{W}/kT = 5.64 \times 10^4 {n_e}^{1/2} \widetilde{W}/kT\,\mathrm{sec}^{-1},$$

where $\widetilde{W}$ is the total energy of waves with $\omega/K < v_{Ti}$.
Magnetic pressure is given by

$$P_{\mathrm{mag}} = B^2/8\pi = 3.98 \times 10^6 B^2\,\mathrm{dynes/cm}^2 = 3.93 (B/B_0)^2\,\mathrm{atm},$$

where $B_0 = 10\,\mathrm{kG} = 1\,\mathrm{T}$.
Detonation energy of 1 kiloton of high explosive is

$$W_{\mathrm{kT}} = 10^{12}\,\mathrm{cal} = 4.2 \times 10^{19}\,\mathrm{erg}.$$