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Determination of classical distributions of electrons and ions with inertias containing Boltzmann relations and equation of electron to ion temperature ratio α for non-thermal plasma composition

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The simple consideration of inertia less electrons i.e. m_e tending to zero in the momentum equation of motion of electrons gives rise to the Boltzmann relation $n_e=\exp(\phi)$. The investigation of nonlinear solitary waves in multi component plasma or in dusty plasma through 'Energy Integral' is mostly confined to the application of this simple Boltzmann relation of electrons or even of ions to get rid of complexity. Contextually in multi component plasma, the perturbative method needs to be applied as the energy integral cannot be deduced (except in simple cases with Boltzmann relation). But the occurrence of nanoparticles in the modern dynamical scenario demands inclusion of electron inertia so that m_e is non- zero. In conformity with this the Cairns distribution of electrons and ions $n_e = (1-\beta\varphi+\beta\varphi^2)\exp(\varphi)$ and $n_e=(1+\beta\varphi+\beta\varphi^2)\exp(-\varphi)$ respectively have already been established for non-thermal parameter β which contain the Boltzmann relations for β=0. Similarly, Kappa distribution and some other distributions are in great use in non-thermal situations. These ideas prompt us to develop new distributions of electrons and ions with inertias as an extension of the simple Boltzmann relations. For this purpose, the following relations of electrons and ions are established for the first time: $n_e=1+\frac{\phi}{\quad}+\frac{1-6A}{(1-2A)^2}\phi^2+\frac{1-8A+60A^2}{3!(1-2A)^5}\phi^3+\cdots n_i=1+\frac{\phi}{c^2-\alpha}+\frac{3c^2-\alpha}{2!(c^2-\alpha)^3}\phi^2+\frac{15c^4-4c^2\alpha+\alpha^2}{3!(c^2-\alpha)^5}\phi^3$ Where $A=\frac{Q}{2}(v'_\phi-\frac{M}{k_z})^2$ and $c^2=(v_0-\frac{M}{k_z})^2$ Comparison of the author's ion's distribution and Cairns ion's distribution the following important equation of electron to ion temperature ratio $\alpha\left(=\frac{T_e}{T_i}\right)$ namely $\alpha^3-(1+5c^2)\alpha^2+c^2(5.5+7c^2)\alpha-3c^4(3.5+c^2)=0$ is established.

Biography

Bhaben Chandra Kalita has completed his PhD from Gauhati University in the field of Non- Linear Plasma Waves. He is serving as Professor Emeritus at present in the Department of Mathematics, Gauhati University after retirement. He has published more than 40 papers in reputed journals like *Physics of Fluids-B in brief communication, Physics of Plasmas, Astrophysics and Space Science, Journal of Plasma Physics, Physical Society of Japan, Communication in Theoretical Physics, Plasma Physics Reports, Journal of Mathematics-A Gen.*, etc.

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