Talk at Splinter Meeting

Splinter E

Spontaneously emitted field fluctuations and the genesis of cosmic magnetic seed fields

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Any fully-ionized collisionless plasma with finite random particle velocities contains electric and magnetic field fluctuations. The fluctuations can be of three different types: weakly damped, weakly propagating or aperiodic. The kinetics of these fluctuations in general unmagetized plasmas, governed by the competition of spontaneous emission, absorption and stimulated emission processes, is investigated, extending the well-known results for weakly damped fluctuations. The generalized Kirchhoff radiation law for both collective and non-collective fluctuations is derived, which in stationary plasmas provides the equilibrium energy densities of electromagnetic fluctuations by the ratio of the respective spontaneous emission coefficient and the true absorption coefficient. As an illustrative example the equilibrium energy densities of aperiodic transverse collective electric and magnetic fluctuations in an isotropic thermal electron-proton plasmas of density n_e is calculated as $|\delta B| = \sqrt{(\delta B)^2} = 2.8(n_e m_e c^2)^{1/2} g^{1/2} \beta^{7/4}$ and $|\delta E| = \sqrt{(\delta E)^2} = 3.2(n_e m_e c^2)^{1/2} g^{1/3} \beta^2$, where g and β denote the plasma parameter and the thermal electron velocity in units of the speed of light, respectively. For densities and temperatures of the reionized early intergalactic medium $|\delta B| = 6 \cdot 10^{-18}$G and $|\delta E| = 2 \cdot 10^{-16}$G result.