Kinetics of general electromagnetic fluctuations in unmagnetized plasmas:
Aperiodic thermal noise

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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 fluct-
uations in general unmagnetized 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 radia-
tion law for both collective and non-collective fluctuations is derived, which in station-
ary 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 $|\delta B| = \sqrt{\langle \delta B \rangle^2} = 2.8(n_e m_e c^2)^{1/2} g^{1/2} \beta_e^{7/4}$
and $|\delta E| = \sqrt{\langle \delta E \rangle^2} = 3.2(n_e m_e c^2)^{1/2} g^{1/3} \beta_e^2$, where $g$ and $\beta_e$ denote the plasma param-
ter 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. These electromagnetic fields serve well as cosmological
seed fields for further amplification processes once additional kinetic free energy becomes
available in these plasmas.