

Radiation: Emission, Absorption, Transport

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High-Frequency Conductivity and the Emission and Absorption Coefficients of a Fully Ionized Plasma

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The problem of the ac conductivity of a fully ionized plasma is investigated for frequencies embracing the plasma frequency. The finite duration of encounters is taken into account in a self-consistent fashion which includes collective effects. The concomitant processes of absorption and emission of electromagnetic radiation are investigated and in particular the bremsstrahlung emission and absorption coefficients near the plasma frequency are given. The conversion of longitudinal to transverse waves by scattering from ions is discussed.

Phys. Fluids 5, 517 (1962)

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Scattering of Electromagnetic Waves by a Nonequilibrium Plasma*

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(Received March 12, 1961)

Incoherent scattering is determined by the spectral density of electron-density fluctuations. This quantity has previously been calculated for a plasma in thermal equilibrium. We have extended the theory to include spatially homogeneous nonequilibrium states of a hot plasma. An elementary derivation of the previous results and the new results is given in terms of dressed test particles. Numerical calculations have been carried out for a plasma with hot electrons and cold ions, and for a plasma in which the electrons have a net drift relative to the ions.

Phys. Fluids 5, 776 (1962)

Electromagnetic Radiation from an Electric Dipole in a Cold Anisotropic Plasma

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The general solution to the problem of monochromatic radiation from an electric dipole in a magnetically biased, cold, tenuous plasma is presented. It is found that, generally, several waves exist in the radiation zone, traveling in different directions with different indices of refraction. For certain ranges of the plasma, gyro, and operating frequencies, the field becomes very large in certain directions compared with that in other directions, producing highly directive radiation characteristics. In general, the expression for the field is quite complicated although several special cases are treated which yield simple solutions. For high operating frequency it is found that the radiation pattern is identical to the isotropic case although a Faraday rotation takes place. Solutions are given for low and very low frequencies which place in evidence the guiding nature of the magnetostatic field. For the case of a large magnetostatic field it is shown that only two waves exist and that the time-average power flow is purely radial.

Phys. Fluids 5, 1095 (1962)

Lowering of the Ionization Energy for a Plasma in Thermodynamic Equilibrium

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In a plasma the ionization energy is decreased due to the presence of the microfield. In the past several attempts have been made to calculate this effect. These calculations, which use statistical and thermodynamical procedures, give different results. They produce either a "polarization term" or a "lattice term" or both of them. Moreover there are quantitative discrepancies. The lowering of the ionization energy is here derived by a statistical method, which is physically conceivable. The results cover a wide density range below and above the so-called critical density. The new results are compared with the results of all earlier calculations and reveal the cause of their discrepancies.

Phys. Fluids 6, 62 (1963)

Diffusion Approximation for a Photon Gas Interacting with a Plasma via the Compton Effect

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RECENTLY, Dreicer¹ discussed the relevant kinetic equations for a photon gas interacting with a plasma by means of spontaneous and induced emission, absorption, Compton scattering, and cyclotron radiation.

The purposes of this note are (a) to give a simple, explicit expression for the following problem: the time development of the energy spectrum of a low-energy homogeneous, isotropic photon gas interacting solely through the Compton effect with a low-density, low-temperature electron gas with a Maxwellian distribution, and (b) to point out that under these idealized conditions the equilibrium distribution of the photons will not, in general, be the Planck function because the photon number is conserved.

Phys. Fluids **8**, 2112 (1965)

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Measurement of Emission and Absorption of Radiation by an Argon Plasma

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Volumetric radiative loss measurements, correlated with temperature in the range of 10 000 to 26 000°K, have been made on an argon plasma. Pressures of 0.5, 1.0, and 2.0 atm have been used. The 1.0-atm measurements have been corrected for both absorption and ultraviolet emission and the results agree with those of Emmons in the common temperature range. The 6965 Ar I line has also been studied yielding lineshifts, halfwidths, absorption and emission coefficients. The line shift and halfwidth results are below theoretical predictions. Transition probabilities determined from both emission and absorption studies are found to be in reasonable agreement.

Phys. Fluids **10**, 1137 (1967)