Hierarchy in the Static Fluctuation Dissipation Theorem of One-Component Plasmas and Binary Ionic Mixtures

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One of the most outstanding achievements of modern statistical physics is its application to non-equilibrium systems. Whereas equilibrium systems only consider those ensembles of particles which are independent of a past external perturbation, the state of non-equilibrium systems demands a formalism which may describe the kinetic coefficients of the particle distribution only a short time after the disturbance. With the contributions of R. Kubo and others, the theory of linear response may be established, and from this it is a straightforward calculation which leads us to derive to relationship between the fluctuations about equilibrium and the dissipations temporally distant from said time-dependent state. Such a theory, known as the fluctuation-dissipation theorem (FDT) is extremely versatile in the science of non-equilibrium statistical physics by its relation of the equilibrium correlation function and the non-equilibrium response function, thus building a bridge between the equilibrium and non-equilibrium states.

It is using the nonlinear FDT that we expand upon the work of K.I. Golden and G. Kalman in the study of one-component plasmas and binary ionic mixtures. A new form of the hierarchy for the static fluctuation-dissipation relation in coulomb liquids is proposed. From these, we then derive a relationship between screened and external response functions, which then leads us to a formalism for obtaining the four-point correlation function for the 3D one-component plasma. The screened response function that we can calculate in the RPA (or any other suitable approximation that takes account of particle correlational effects), when converted to the external response function vis-a-vis constituent relations, can then be analyzed. Finally, a generalization to the fluctuation-dissipation relations to binary-ionic mixtures (e.g., plasma matter in carbon-oxygen white dwarfs) is being contemplated.