VACUUM FLUCTUATIONS VERSUS RADIATION REACTION

J. Dalibard, J. Dupont-Roc and C. Cohen-Tannoudji

École Normale Supérieure et Collège de France
Paris, France

The apparent indefiniteness in separating vacuum fluctuations and radiation reaction is removed by requiring the corresponding rates of variation to have a well defined physical meaning (hermiticity requirements).

Such a procedure is very general and can be extended to the case of a small system ρ interacting with a large reservoir R. The results of the calculation can be expressed in terms of simple statistical functions of the two interacting systems, leading to simple physical pictures: R fluctuates and polarizes ρ (reservoir fluctuations effects); ρ fluctuates and polarizes R (self-reaction effects).

When applied to the case of an atomic electron interacting with the vacuum field, such a procedure gives results in complete agreement with the usual pictures associated with vacuum fluctuations and self-reaction. All self-reaction effects, which are independent of $\hbar$, are strictly identical to those derived from classical radiation theory. All vacuum fluctuation effects, which are proportional to $\hbar$, can be interpreted by considering the vibration of the electron induced by a random field having a spectral power density equal to $\hbar\omega/2$ per mode.

Reference

J. Dalibard, J. Dupont-Roc and C. Cohen-Tannoudji, J. Physique *43*, 1617 (1982).