

The quantization of radiation: role of the vacuum field

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In previous work we have shown that the action of the zero-point radiation field (ZPF) on a bound particle results in the irreversible transition from the initially classical dynamics, towards a stationary regime controlled by the field variables. As a result, the canonical particle variables become expressed in terms of response functions to a set of ZPF modes, which are identified with the matrix elements of x and p , satisfying $[x, p] = i\hbar$. In this work we complete the description by showing that, in reciprocity, also the radiation field becomes expressed in terms of response functions to the relevant set of ZPF modes. The corresponding response coefficients are identified with the matrix elements of the operators a, a^\dagger , satisfying $[a, a^\dagger] = 1$. These results show that particle and field quantization are intertwined, and point to the meaning of the energy eigenvalues (both for particle and field) as the *free* energies that can be interchanged during the matter-field interaction.