EXISTENCE AND CONSTRUCTION OF RESONANCES FOR ATOMS COUPLED TO THE QUANTIZED RADIATION FIELD

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The theory of quantum mechanics asserts that the energy of an atom can be quantized. The possible energies are the eigenvalues of the Schroedinger equation. The lowest eigenvalue is called the ground state energy and the other eigenvalues are the excited energies. The Schroedinger equation predicts that if an atom is in an excited state at some time then it remains in that state forever. Experiments show that the atom does not remain in an excited state, but decays to a lower energy state. During this decay, the atom emits photons. The energies of excited states cannot be represented by eigenvalues of a Hamiltonian but by resonances. These resonances appear when the photon field is introduced. We analyze the Pauli-Fierz model, which represents an atom coupled to the photon field. We prove that the excited eigenvalues give rise to resonances, once the photon field is introduced. We do not assume that there is an infrared regularization but we require an ultraviolet cutoff. We review Sigal's recent construction of resonances based on renormalization group analysis and present a novel alternative construction based on Pizzo's Method. This is a joint work with Volker Bach, Alessandro Pizzo and Marwan Shoufan.