Quantum electrodynamical time-dependent density functional theory for many-electron systems on a lattice[1] MEHDI FARZANEHPOUR, ILYA TOKATLY, Nano-Bio Spectroscopy group and, Departamento de Fisica de Materiales, Universidad del Pais Vasco UPV/EHU, NANO-BIO SPECTROSCOPY GROUP AND ETSF SCIENTIFIC DEVELOPMENT CENTRE TEAM — We present a rigorous formulation of the time-dependent density functional theory for interacting lattice electrons strongly coupled to cavity photons. We start with an example of one particle on a Hubbard dimer coupled to a single photonic mode, which is equivalent to the single mode spin-boson model or the quantum Rabi model. For this system we prove that the electron-photon wave function is a unique functional of the electronic density and the expectation value of the photonic coordinate, provided the initial state and the density satisfy a set of well defined conditions. Then we generalize the formalism to many interacting electrons on a lattice coupled to multiple photonic modes and prove the general mapping theorem. We also show that for a system evolving from the ground state of a lattice Hamiltonian any density with a continuous second time derivative is locally v-representable.

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