Exact scattering eigenstates for double quantum-dot systems

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We study a double quantum-dot (DQD) system that consists of two leads of noninteracting spinless electrons and two quantum dots with an interdot Coulomb interaction. We deal with arbitrary complex values for lead-dot couplings and a dot-dot coupling. By taking special values for the coupling parameters, we reproduce various DQD systems such as parallel-coupled DQD systems, serial-coupled DQD systems and T-shaped DQD systems. In order to study the electron transport in the DQD system, we construct exact many-electron scattering eigenstates whose incident states are free-electronic plane waves. The incident plane waves are partially scattered to two-body and three-body bound states, by which we investigate the interplay of the Coulomb interaction and geometrical interference. We also show that the many-body bound states are understood by many-body resonances of the scattering.