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Two-species Coherent Transport Adiabatic passage and Quantum Gate implementation in an Optical Superlattice[1] KUNAL DAS, Kutztown University of Pennsylvania, USA, MIROSLAV GAJDACZ, TOMAS OPATRNY, Palacky University, Czech Republic — In an optical super-lattice of triple wells, containing two mutually interacting atom species in every cell, we show that one species (A) can be transported from the left well to the right well without ever significantly occupying the central well. This occurs simultaneously in every unit cell in the lattice. We demonstrate that this can be achieved with or without the presence of an atom of the second species (B) in the intermediate well of each cell, thereby allowing species-selective transport that avoids spatial overlap and direct interaction among the two species. Furthermore, by using optimal quantum control, we also demonstrate the lattice-wide parallel implementation of CNOT quantum gates in this configuration by using the presence or absence of an atom B in the central well of each cell as a control bit, and the localization of an atom A in the left well or the right well as the target bit.

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