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Proposal of a Robust Quantum Switch with Rydberg excitations[1]

JING QIAN, Department of Physics, School of Physics and Material Science, East China Normal University, Shanghai 200062, People's Republic of China, DEPARTMENT OF PHYSICS, SCHOOL OF PHYSICS AND MATERIAL SCIENCE TEAM — Depending on a Y-typed level configuration of atoms, we develop a scheme of efficiently switching Rydberg excitations between two Rydberg states via opening or closing the intrastate interaction on the strongly-coupled Rydberg state (the other Rydberg state is weakly-coupled). When such interaction is open, a large number of atoms will be counterintuitively excited to the weakly-coupled state, rather than the strongly-coupled state as in the case of that interaction is closed. By systematically investigating relevant parameters we find the scheme is quite robust and very insensitive to the intrastate interaction on the weakly-coupled state, the spontaneous decay rate of middle excited state, and the duration time of conversion. Moreover, we simulate a switching cycle under realistic experimental parameters and find the single Rydberg excitations can indeed be switched in which the switch efficiency reaches as high as 0.92. This scheme may serve as a new route to the selective excitations with multiple Rydberg states, enabling new applications in developing various quantum devices.

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