Remote Atom-pair Entanglements through Rydberg-rydberg Interaction

Jaewook AHN

Department of Physics, Korea Advanced Institute of Science and Technology, Korea

Email: jwahn@kaist.ac.kr

We propose and experimentally demonstrate atom-pair entanglements through Rydberg-Rydberg interaction. Our scheme achieves entanglements between remote atoms even in the presence of closer atoms, which is different from the widely-used entanglement method based on Rydberg-atom blockade. Therefore, the new method overcomes the two limitations of the latter: (1) atoms closer than a Rydberg blockade radius can be entangled, and (2) all atoms within the radius are to be entangled together. For remote and selective entanglements, we adopt a coherent control method using two pi/2 Ramsey interactions that are time-delayed with respect to each other, and as a result controlled phase gates between any pair of atoms among N atoms (currently N=3) can be implemented.