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Experimental investigations of the resonant dipole-dipole interaction between cold Rydberg atoms

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This talk will present our on-going effort to control the dipole-dipole interaction between cold Rydberg atoms. In our experiment, we trap individual atoms in two-dimensional arrays of optical tweezers separated by few micrometers and excite them to Rydberg states using lasers. The arrays are produced by a spatial light modulator, which shapes the dipole trap beam. We can create almost arbitrary geometries of the arrays [1]. We have measured the van der Waals interaction between two individual atoms [2], and show efficient Rydberg blockade in arrays of three atoms [3]. We have also demonstrated the control of the interaction between atoms with microwave and DC electric fields [4]. We observe in particular the coherent energy exchange between two atoms resulting from their dipole-dipole interaction [5]. This control of the interaction will find applications in quantum state engineering, quantum information and quantum simulation.

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