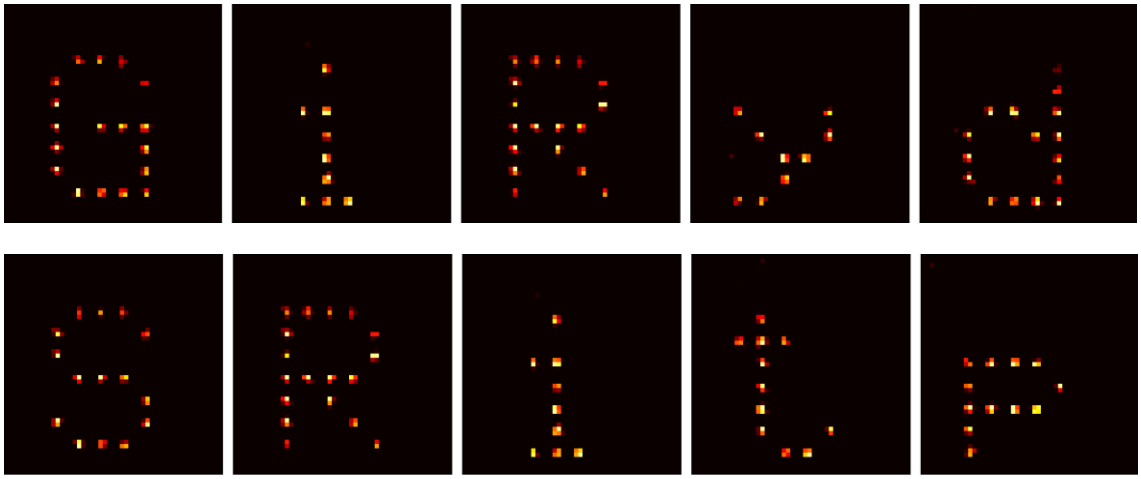
Many-body physics with arrays of individual Rydberg atoms

This talk will present our effort to control the interaction between cold Rydberg atoms in order to implement spin Hamiltonians that may be useful for quantum simulation of condensed matter problems. 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. I will present the implementation of the quantum Ising model in a system of 50 atoms with van der Waals Rydberg interaction. We also use the resonant dipole-dipole interaction to realize the XY spin model and study elementary excitations in a di-merized spin chain featuring topological properties, thus implementing the Su-Schrieffer-Heeger model. These experiments demonstrate an interesting platform for quantum simulation using neutral atoms complementary to the ones based on ions, magnetic atoms or dipolar molecules.



Fluorescence images of individual atoms trapped in arrays of optical tweezers separated by a few micrometers