Exploring new scientific frontiers using programmable atom arrays

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Abstract

Learning how to create, study, and manipulate highly entangled states of matter is key to understanding exotic phenomena in condensed matter and high energy physics, as well as to developing useful quantum computers.
In this talk, I will discuss recent experiments where we demonstrated the realization of a quantum spin liquid phase using Rydberg atoms on frustrated lattices [1] and a new architecture based on the coherent transport of entangled atoms through a 2D array [2]. Combining these results with novel technical tools on atom array platforms could open a broad range of possibilities for the exploration of entangled matter, with powerful applications in quantum simulation and information.

Figures

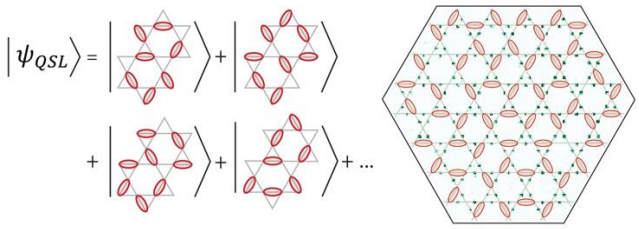

Figure 1: A quantum spin liquid state is generated using Rydberg atoms in frustrated ruby lattices [1].

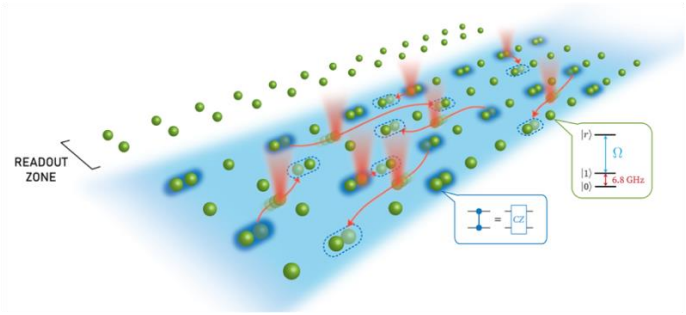

Figure 2: To achieve non-local connectivity in the quantum processor, atoms are coherently transported through the entire 2D array by means of movable optical tweezers [2].

References

[1] G. Semeghini, H. Levine, A. Keesling, S. Ebadi, T. T. Wang, D. Bluvstein, R. Verresen, H. Pichler, M. Kalinowski, R. Samajdar, A. Omran, S. Sachdev, A. Vishwanath, M. Greiner, V. Vuletic and M. D. Lukin, Science 374 (2021) 1242-1247.

[2] D. Bluvstein, H. Levine, G. Semeghini, T. T. Wang, S. Ebadi, M. Kalinowski, A. Keesling, N. Maskara, H. Pichler, M. Greiner, V. Vuletic and M. D. Lukin, Nature 604 (2022) 451-456.