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Ultrafast Quantum Simulator using Ultracold Rydberg Excited atomic Mott-Insulator

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Ensemble of Rydberg atoms are a unique platform for quantum simulation and quantum computation because of their special properties [1,2]. In our research group, we are developing a novel approach for Rydberg-based quantum simulations and computations, where we use broadband pulsed lasers to excite 87Rb atoms, in Bose-Einstein condensates (BEC), Mott-Insulator (MI) lattice and optical tweezers, to Rydberg states in a timescale of 10 to 100 picoseconds at the speed limit set by the Rydberg splitting [3-5].
Here, I will give the overview of our ultrafast quantum simulator in which we generate a strongly correlated ultracold Rydberg ensemble of 87Rb atoms excited from an unity filling MI using broadband picosecond laser pulses [3]. We observe and control its ultrafast many-body electron dynamics by performing the time-domain Ramsey interferometry with attosecond precision [4]. I will also discuss the future prospects and outlook of our ultrafast quantum simulator.

References

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Primary author: CHAUHAN, VIKAS SINGH (Institute for Molecular Science)

Presenter: CHAUHAN, VIKAS SINGH (Institute for Molecular Science)

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