

# Ultrafast many-body electron dynamics in a strongly correlated ultracold Rydberg gas

Kenji Ohmori

*Institute for Molecular Science, National Institutes of Natural Sciences,  
Myodaiji, Okazaki 444-8585, Japan  
E-mail: [ohmori@ims.ac.jp](mailto:ohmori@ims.ac.jp)*

Many-body correlations govern a variety of important quantum phenomena such as the emergence of superconductivity and magnetism in condensed matter. Understanding quantum many-body systems is thus one of the central goals of modern sciences. Here we demonstrate a new pathway towards this goal by generating a strongly correlated ultracold Rydberg gas with a broadband picosecond laser pulse. We have applied our ultrafast and ultrahigh-precision coherent control [1-8] to this strongly correlated Rydberg gas, and have successfully observed and controlled its many-body electron dynamics on the attosecond timescale [9]. Our approach will offer a versatile platform to observe and manipulate nonequilibrium dynamics of strongly correlated quantum many-body systems on the ultrafast timescale.

## References

- [1] K. Ohmori *et al.*, *Phys. Rev. Lett.* **91**, 243003 (2003).
- [2] H. Katsuki and K. Ohmori *et al.*, *Science* **311**, 1589 (2006).
- [3] K. Ohmori *et al.*, *Phys. Rev. Lett.* **96**, 093002 (2006).
- [4] H. Katsuki and K. Ohmori *et al.*, *Phys. Rev. Lett.* **102**, 103602 (2009).
- [5] K. Hosaka and K. Ohmori *et al.*, *Phys. Rev. Lett.* **104**, 180501 (2010)  
(Highlighted by *Nature* **465**, 138 (2010); *Physics* **3**, 38 (2010)).
- [6] H. Goto and K. Ohmori *et al.*, *Nature Physics* **7**, 383 (2011)  
(Highlighted by *Nature Physics* **7**, 373 (2011); *Nature Photonics* **5**, 382 (2011)).
- [7] H. Katsuki and K. Ohmori *et al.*, *Nature Commun.* **4**, 2801 (2013).
- [8] H. Katsuki and K. Ohmori *et al.*, *Phys. Rev. B* **92**, 094511 (2015).
- [9] N. Takei, C. Sommer, C. Genes, G. Pupillo, H. Goto, K. Koyasu, H. Chiba, M. Weidemüller, and K. Ohmori, *Nature Commun.* **7**, 13449 (2016)  
(Highlighted by *Science* **354**, 1388 (2016); *IOP PhysicsWorld.com* (2016)).