SFB/TRR 21 - Seminar

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Rydberg-atom spectroscopy in modulated optical lattices

Rydberg-atom spectroscopy in modulated optical lattices Georg Raithel, University of Michigan, Ann Arbor, MI 48109 [graithel@umich.edu] The minimal-coupling Hamiltonian describing the interaction between an atom and a light field includes an A p term, which is employed in spectroscopy, and an A A term, which is relevant in light scattering. Here it is shown that the A A term can be employed in high-precision atomic spectroscopy by providing a strong spatial variation of the field intensity within the volume of the atom, and by modulating the field intensity in time at the atomic transition frequency of interest. These requirements are satisfied for Rydberg atoms trapped in an intensity-modulated optical lattice [1]. Selection rules in this type of spectroscopy are greatly relaxed in comparison with the standard selection rules, allowing access to previously forbidden transitions [2, 3]. We have demonstrated the new spectroscopy by scanning the light modulation frequency over a Rydberg-atom resonance and probing the population in the target Rydberg state [3]. More recently, we have driven transitions at higher harmonics of the drive; this provides convenient access to sub-Terahertz transitions between Rydberg levels. Further, we have shown that optical-lattice Rydberg atom traps support "magic" transitions [4]. Applications in high-precision spectroscopy will be discussed. [1] S. E. Anderson, K. C. Younge, G. Raithel, Phys. Rev. Lett. 107, 263001 (2011). [2] B. Knuffman and G. Raithel, Phys. Rev. A 75, 053401 (2007). [3] K. R. Moore, S. E. Anderson, G. Raithel, Nature Communications 6 (2015). [4] K. Moore, G. Raithel, "Nonlinear and magic ponderomotive spectroscopy," arXiv:1506.01761 (2015) and K. R. Moore, G. Raithel, Phys. Rev. Lett. 115, 163003 (2015).

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