Harvard Quantum Optics Center

ITAMP

Joint Quantum Sciences Seminar

Wednesday, October 14, 4:00 pm

Jefferson 250

Prof. Tom Killian

Rice University

"Ultralong-range Molecules and Autler-Townes Spectroscopy in StrontiumUltracold Rydberg Gases"

Alkaline-earth metal atoms are attracting increased attention for studies of ultracold Rydberg gases because of new opportunities created by strong core transitions accessible with visible light and the presence of excited triplet states. Core transitions can be used for flexible optical trapping and optical imaging of Rydberg atoms, and triplet levels appear promising for creating stronger optical coupling of ground and Rydberg levels with reduced light scattering. Compared to an alkali metal atom, the existence of both singlet and triplet Rydberg levels creates additional choices of configurations of excited states and associated Rydberg-Rydberg interactions.

We have created and characterized ultralong-range Sr_2 molecules formed from one ground-state $5s^2\ {}^1S_0$ atom and one atom in a $5sns\ {}^3S_1$ Rydberg state for n ranging between 29 and 36. Molecules are created in a trapped ultracold atomic gas using two-photon excitation, near resonance with the $5s5p\ {}^3P_1$ intermediate state. Recent measurements of the lifetimes of Rydberg atoms and molecules in dense gases of ground state atoms indicate longer lifetimes for strontium compared to rubidium.

We have also studied Autler-Townes spectra in the $5s^2\ {}^1S_0$-$5s5p\ {}^3P_1$-$5sns\ {}^3S_1$ ladder system. Well-resolved doublets are visible in the atom-loss signal when a strong 320 nm pump laser on resonance with the $5s5p\ {}^3P_1$-$5sns\ {}^3S_1$ transition and a weak 689 nm probe laser near resonance with the $5s^2\ {}^1S_0$-$5s5p\ {}^3P_1$ are applied. This coherent spectroscopy is very sensitive to Rydberg-Rydberg interactions and reveals effects of underlying spatial correlations between atoms from the Rydberg blockade. Atom loss also shows signatures of an optical bistability.

Student Presentation will begin at 4:00 PM
Guest Presentation will begin at 4:30 PM
Refreshments will be provided