Abstract Submitted
for the DAMOP18 Meeting of
The American Physical Society

New types of trilobite-like states in hydrogen atoms and negative ions MATTHEW EILES, CHRIS GREENE, Purdue Univ — In recent years long-range Rydberg molecules, known loosely as "trilobite" molecules, have become a vibrant research field. We have explored theoretically some variations on the concept of a trilobite molecule. We propose a method to use static field pulses to coherently manipulate a hydrogen Rydberg atom into the same superposition of Rydberg states that composes the trilobite wave function, thus forming a type of chemical bond with a single atom. Optimal control theory and a machine learning algorithm are used to design the appropriate pulse sequences to achieve this. We also show how an analogue of a Rydberg molecule can form in a system composed of a hydrogen negative ion and a nearby neutral atom. The electronic wave function in a doubly excited resonance state in the "dipole" series of H- extends over a huge spatial volume, similar to a Rydberg wave function. The same Fermi pseudopotential which describes Rydberg molecules leads in this case to short-lived anionic quasi-molecular states, and also could provide a pathway to excite both symmetry-forbidden and very narrow states of H- through the state mixing induced by the perturber.

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Date submitted: 26 Jan 2018 Electronic form version 1.4