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Ultracold photodissociation and progress towards a molecular lattice clock with ^{88}Sr CHIH-HSI LEE, BART MCGUYER, MICKEY MCDONALD , FLORIAN APFELBACK, ANDREW GRIER, TANYA ZELEVINSKY, Columbia Univ — Techniques originally developed for the construction of atomic clocks can be adapted to the study of ultracold molecules, with applications ranging from studies of ultracold chemistry to searches for new physics. We present recent experimental results involving studies of fully quantum state-resolved photodissociation of $^{88}Sr_2$ molecules, as well as progress toward building a molecular clock. First, our system has allowed for precise, quantum state-resolved photodissociation studies, revealing not only excellent control over quantum states but also a more accurate way to describe the photodissociation of diatomic molecules and access ultracold chemistry. Second, the molecular clock will allow us to search for a possible time variation of the proton-electron mass ratio. The "oscillator" of such a molecular clock would consist of the frequency difference between two lasers driving a two-photon Raman transition between deeply and intermediately-bound rovibrational levels in the electronic ground state. Accomplishing this task requires exploring several research directions, including the precision spectroscopy of bound states and developing tools for the control and minimization of differential lattice light shifts.

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