Abstract Submitted
for the DAMOP18 Meeting of
The American Physical Society

Many-body dipolar dynamics in 3D lattice clocks CHUNLEI QU, JILA and Department of Physics, University of Colorado, Boulder, ANA MARIA REY, JILA, NIST and Department of Physics, University of Colorado, Boulder — Alkaline-earth-metal atoms have recently attracted an intensive research interest in the cold-atom community as they can be used for the development of atomic clocks with unprecedented stability and accuracy. Typical 1D optical lattice clocks (OLCs) suffer from clock shifts induced by the atomic collisions and this has stimulated the built up of next-generation OLCs in a 3D lattice operating in the regime where there is at most one atom per site and thus the clock becomes immune to atomic collisions. In these 3D lattice clocks, however, atoms can still interact via long-range dipolar interactions which can impact the performance of the clock. At the same time, the state-of-the-art spectral sensitivity of these clocks can open a promising platform for studying dipolar many-body quantum physics. In this talk, we will present our systematical investigation of the role of both elastic and dissipative long-range interactions in clock interrogation. We will report the observation of intriguing dynamics and phases depending on the lattice geometry and dipole orientation. Our results not only will aid in the design of the future generation of ultra-precise atomic clocks but also illuminates the rich physics that emerges in driven-dissipative open quantum many-body systems.

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Date submitted: 26 Jan 2018 Electronic form version 1.4