Abstract Submitted
for the DAMOP17 Meeting of
The American Physical Society

Steady-state spin synchronization through the collective motion of trapped ions ATHREYA SHANKAR, JOHN COOPER, JILA, NIST, and Department of Physics, University of Colorado Boulder, Boulder, JUSTIN BOHNET, JOHN BOLLINGER, Time and Frequency Division, National Institute of Standards and Technology, Boulder, MURRAY HOLLAND, JILA, NIST, and Department of Physics, University of Colorado Boulder, Boulder — Ultranarrow-linewidth atoms coupled to a lossy optical cavity mode synchronize, i.e. develop correlations, and exhibit steady-state superradiance when continuously repumped. This type of system displays rich collective physics and promises metrological applications. These features inspire us to investigate if a model inspired from cavity superradiance can generate analogous spin synchronization in a different platform that is one of the most robust and controllable experimental testbeds currently available: ion-trap systems. We design a system with a primary and secondary species of ions that share a common set of normal modes of vibration. In analogy to the lossy optical mode, we propose to use a lossy normal mode, obtained by sympathetic cooling with the secondary species of ions, to mediate spin synchronization in the primary species of ions. Our numerical study shows that spin-spin correlations develop, leading to a macroscopic collective spin in steady-state. We propose an experimental method based on Ramsey interferometry to detect signatures of this collective spin; we predict that correlations prolong the visibility of Ramsey fringes, and that population statistics at the end of the Ramsey sequence can be used to directly infer spin-spin correlations.

Athreya Shankar
Univ of Colorado - Boulder

Date submitted: 27 Jan 2017 Electronic form version 1.4