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Far-from-equilibrium dynamics of spin models describing ultracold molecules and ions KADEN HAZZARD, JILA/NIST Boulder, SALVATORE MANMANA, Goettingen, MICHAEL FOSS-FEIG, JQI, U. Maryland, JOHN BOLLINGER, NIST Boulder, ANA MARIA REY, JILA/NIST Boulder — Motivated by ongoing ultracold molecule and trapped ion experiments, we show that quenches of internal degrees of freedom lead to rich, informative dynamics already under *present* experimental conditions. Molecules frozen in an optical lattice and trapped ions each implement quantum spin models of great interest in condensed matter physics. Molecules' rotational and ions' nuclear/electronic states serve as effective spins. We show that one can implement quenches via standard microwave Ramsey spectroscopy, and that the resulting dynamics can be used to (i) benchmark how accurately spin models describe the systems, (ii) create entangled, metrologically useful squeezed states, and (iii) explore qualitatively novel regimes of dynamic behavior that display nonanalytic time dependence and universality. For molecules, this is possible even with current ultracold but nondegenerate temperatures and densities [1]. For ions, the temperature and density are better controlled, but decoherence is relevant. Nevertheless, the features described above survive experimentally relevant decoherence [2].

[1] K. R. A. Hazzard, S. R. Manmana, M. Foss-Feig, and A. M. Rey, PRL (to appear), arxiv:1209.4076
[2] M. Foss-Feig, K. R. A. Hazzard, J. J. Bollinger, and A. M. Rey, arxiv:1209.5795

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