Abstract Submitted
for the MAR14 Meeting of
The American Physical Society

Many-body Localization with Dipoles NORMAN YAO, Harvard University, CHRIS LAUMANN, University of Washington, SARANG GOPALAKRISHNAN, MICHAEL KNAP, Harvard University, MARKUS MUELLER, The Abdus Salam International Center for Theoretical Physics, EUGENE DEMLER, MIKHAIL LUKIN, Harvard University — Statistical mechanics is the framework that connects thermodynamics to the microscopic world. It hinges on the assumption of equilibration; when equilibration fails, so does much of our understanding. In isolated quantum systems, this breakdown is captured by the phenomenon known as many-body localization. I will briefly introduce the basic phenomena of many-body localization and review its theoretical status. To date, none of these phenomena has been observed in an experimental system, in part because of the isolation required to avoid thermalization. I will consider several dipolar systems which we believe to be ideal platforms for the realization of MBL phases and for investigating the associated delocalization phase transition. The power law of the dipolar interaction immediately raises the question: can localization in real space persist in the presence of such long-range interactions? I will review and extend several arguments producing criteria for localization in the presence of power laws and present small-scale numerics regarding the MBL transition in several of the proposed dipolar systems.

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Date submitted: 15 Nov 2013 Electronic form version 1.4