Abstract Submitted
for the MAR15 Meeting of
The American Physical Society

Probing the many-body localization transition with matrix elements of local operators MAKSYM SERBYN, University of California Berkeley, ZLATKO PAPIC, DMITRY ABANIN, Perimeter Institute for Theoretical Physics — We propose the statistics of matrix elements of local operators as a new probe of the many-body localized (MBL) phase. Matrix elements of a given local operator V encode many physical properties, such as the response of the system to a local perturbation induced by the action of V, spectral functions, and dynamics of the system. The distribution of matrix elements of a local operator between system's eigenstates exhibits qualitatively different behavior in the many-body localized and ergodic phases, allowing for an accurate determination of the two phases. To characterize this distribution, for a given system size L, we introduce a parameter $g(L) = \langle \log \frac{V_{i,i+1}}{\Delta} \rangle$, which is a disorder-averaged ratio of the matrix element of operator V between adjacent eigenstates, and Δ is the level spacing. We find that $g(L)$ decreases with L in the MBL phase, and grows in the ergodic phase. We propose that at the MBL-delocalization transition $g(L)$ is independent of system size, $g(L) = g_c \sim 1$, and use this criterion to map out the phase diagram of a disordered 1D XXZ spin-1/2 chain. By studying the scaling of $g(L)$ as a function of energy density, we locate the many-body mobility edge. We discuss implications for delocalization phase transition.

Maksym Serbyn
University of California Berkeley

Date submitted: 13 Nov 2014 Electronic form version 1.4