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**Many-body localization: Entanglement and efficient numerical simulations**

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Many-body localization (MBL) occurs in isolated quantum systems when Anderson localization persists in the presence of finite interactions. To understand this phenomenon, the development of new efficient numerical methods to find highly excited many-body eigenstates is essential. In this talk, we will discuss two complimentary approaches to simulate MBL systems: First, we introduce a variant of the density-matrix renormalization group (DMRG) method that obtains individual highly excited eigenstates of MBL systems to machine precision accuracy at moderate to large disorder. This method explicitly takes advantage of the local spatial structure and the low entanglement which is characteristic for MBL eigenstates. Second, we propose an approach to directly find an approximate compact representation of the diagonalizing unitary by using a variational unitary matrix-product operator.