

# Novel Phase Transitions and Quantum Advantage in Disordered Quantum Systems

G V SHLYAPNIKOV<sup>1</sup>

<sup>1</sup>*LPTMS, CNRS, Univ. Paris Sud, Université Paris-Saclay, Batiment Pascal No. 530, rue Andre Riviere, Orsay, France. Contact Phone: ++33 6 01 22 90 07  
Contact Email: shlyapn@lptms.u-psud.fr*

I first discuss a single-particle problem and consider a rotational excitation in the system of polar molecules randomly spaced in an optical lattice. It will be shown that in three dimensions all states are extended, but some of them are non-ergodic so that there are novel ergodic-nonergodic transitions. I then turn to many-body problems and consider a one-dimensional Hubbard model for spin-1/2 fermions with on-site disorder and finite on-site interactions. The key issue here is the presence of a variety of ergodic-nonergodic phase transitions. For low-energy states this is established by DMRG in systems as large as several hundred lattice sites.