Direct Measurement of the 3D Anderson Transition with Ultracold Atoms in Speckle Disorder

X Yu[1,2], N Myneni[2], K Xie[2], H M Quach[2], J P Banon[2,3], A Aspect[2], and V Josse[2]

[1] *Experimental Physics, University of Innsbruck, Innsbruck, Austria*
[2] *Laboratoire Charles Fabry, Institut d'Optique, Palaiseau, France*
[3] *Laboratoire Hubert Curien, Université Jean Monnet, Saint-Etienne, France*
Contact Email: yuxudong2016@gmail.com

The Anderson Localization has been intensively studied both theoretically and experimentally since its discovery in 1958. In recent decades, the ultracold atoms manipulated by lasers emerge as an excellent candidate to perform experiment on the Anderson Localization. The realization of Anderson Localization in 1D and 3D, performed on our setup, has been major breakthroughs on this topic, showing the encouraging potential to study this phenomenon with ultracold atom experiments.

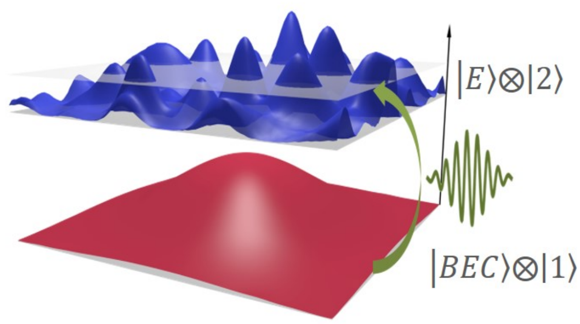

Figure 1: An illustration of the spectroscopic scheme used in the experiment

Our research has focused on a direct experimental determination of the mobility edge in 3D, which is the energy at which the Anderson Transition occurs and divides the localized and diffusive phases. Previous experiments have shown large discrepancies with numerical predictions, which highlights the need for more accurate measurements. Additionally, the large energy distribution of atoms in disorder in those experiments prevents direct measurement.

In this talk, I will present the first direct and precise observation of the Anderson transition in the real space. We have developed a novel spectroscopic scheme with bichromatic speckles that enables a direct and precise measurement of the mobility edge. This method allows us to launch the atoms in a well-defined energy, controlled by an RF pulse, in the disorder. New experimental techniques extend the observation of dynamics up to 5s, minimizing the effects of slow diffusion and offering unprecedented insight into the transition dynamics. These experimental efforts lead to precise determination of the mobility edge in a 3D speckle disorder.