Measurements of spectral function of ultra-cold atoms in speckle potential

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We present our work on ultra-cold atoms in a spin dependent disordered potential created by a laser speckle. A BEC of ^{87}Rb is initially prepared in a spin state $|1\rangle$ insensitive to the disorder and is transferred using a radio-frequency spin flip to state $|2\rangle$ which is sensitive to the disorder, as shown in Fig. 1 (left). The disorder amplitude can be tuned from attractive one to repulsive one by changing the laser speckle's frequency. From the transfer rate of the atoms, we obtain the spectral function $A(E, k)$ which is equivalent to the probability to find an atomic state with a momentum k and energy E in the disorder [1]. Such technique has been employed in Fermi gas experiment [2]. We will also discuss two regimes of disorder: the "classical" disorder where the fluctuations of the potential mainly shape the atomic states and the "quantum" disorder where tunneling effects between the potential minima play major roles. Finally, we will discuss the possibility to produce energy-resolved matter wave states. This work provides the venue to explore metal-insulator Anderson phase transition in the condensed matter physics [3].

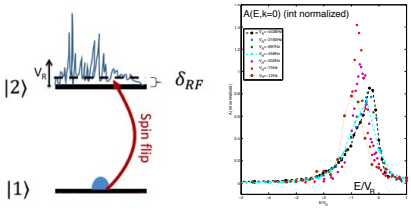

FIG. 1. Experimental scheme (left) and $A(E, k = 0)$ (right); $E = \hbar\delta_{RF}$.

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[3] F. Jendrzejewski *et al.*, *Nature Physics* **8** 5(2012).

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