University of Stuttgart
Germany

iRyd

SPP 1929 – Seminar

03. Mai 2017, 15:00 Uhr

Universität Stuttgart
NWZ II, Raum 2.136
Pfaffenwaldring 57, 70569 Stuttgart

Geol Moon
(University of Bonn)

Realization of two-dimensional quantum walks of neutral atoms

I will report on the experimental realization of a spin-dependent square optical lattice to implement the two-dimensional discrete-time quantum walks of Cs atoms.

We demonstrate high-resolution images of single atoms through an objective lens with very high numerical aperture (NA~0.92) which is installed inside the home-built ultra-low-birefringence dodecagonal vacuum glass cell [1,2]. Our system provides an ideal platform to study the topological features of 2D quantum walk as the simulator of topological phases, which can particularly expect to observe exotic matter wave flow at the boundary between different topological domains [3,4].

Furthermore, manipulating the phase of single atoms accumulated through the movement from site to site on the 2D lattice make it possible to realize artificial gauge fields and to study the effect of magnetic fields on the 2D quantum walk [5].

[1] C. Robens, et al., *High numerical aperture objective lens for imaging and addressing of cold atoms,* Optics Letters **42**, 1043 (2017).
[2] S. Brakhane, et al., *Ultra-low birefringence dodecagonal vacuum glass cell*, Rev. Sci. Instrum. **86**, 126108 (2015).
[3] T. Kitagawa, et al., *Exploring topological phases with quantum walks*, Phys. Rev. A **82**, 033429 (2010).
[4] Thorsten Groh, et al., *Robustness of topologically protected edge states in quantum walk experiments with neutral atoms*, Phys. Rev. A **94**, 013620 (2016).
[5] P. Arnault and F. Debbasch, *Quantum Walks and discrete Gauge Theories*, Phys. Rev. A **93**, 052301 (2016).