# 凝縮系物理学ゼミナール

# Condensed Matter Seminar

Location: Room 413, School of Science Bldg. 5 (理学 5 号館 413 号室)
Date: 14:15-15:00, Wednesday, 13 November 2013

## Non-equilibrium topological phase transitions in two-dimensional optical lattices

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Abstract:
Topological phases, such as topological insulators and topological superconductors, are one of highly nontrivial properties of matter. Recently, those concepts are extended to non-equilibrium systems, especially periodically driven systems [1,2]. Dynamical induction of topological phases are discussed and explored in several systems, e.g. photo-induced quantum Hall effect in graphene [1] and zero energy edge states in photonic quantum-walk systems [2].

In this study, we propose a model as a new example of non-equilibrium topological phases using ultracold fermions in two-dimensional optical lattices [3]. Based on Floquet theory of periodically driven quantum systems, we demonstrate that Rabi oscillation driven by external light changes the effective band structure in optical lattices and induces (effectively) time-reversal-invariant topological insulators in non-equilibrium situations. Furthermore, if we consider atom-atom interactions, correlation plays a peculiar role due to time-dependence of the system, and novel correlated topological phases might be expected in non-equilibrium. To discuss interaction effects on the non-equilibrium topological phases, we develop Schrieffer-Wolff-type perturbation theory in terms of the external field, and reveal that the time-dependent external field induces emergent effective interactions.

Reference:
[1] T. Oka and H. Aoki, Phys. Rev. B **79**, 081406 (2009)
[2] T. Kitagawa et al., Phys. Rev. A **82**, 033429 (2010)
[3] M. Nakagawa and N. Kawakami, arXiv:1310.4983