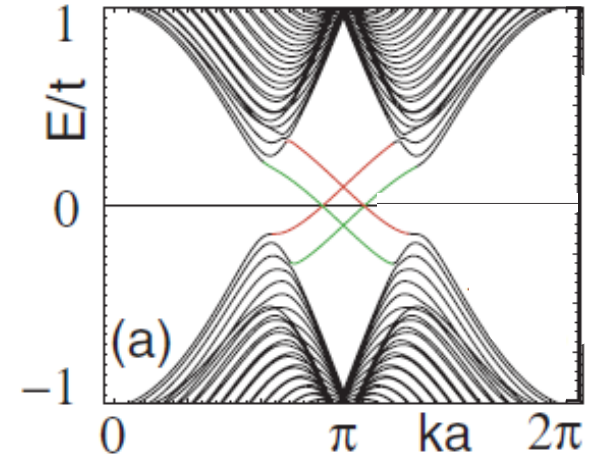# DMFT study of
correlated topological insulators

Department of Physics, Kyoto University

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Introduction

Topological insulator

Existence of gap less edge state

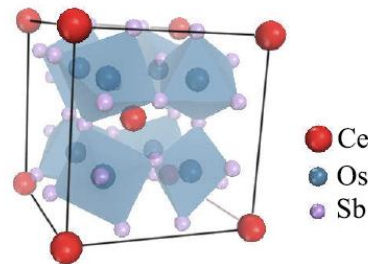(robust against non-magnetic perturbation)

Realization of TBI is proposed in 5d and 4f electron systems.

The interaction effects are
also extensively studied.

Phase competition
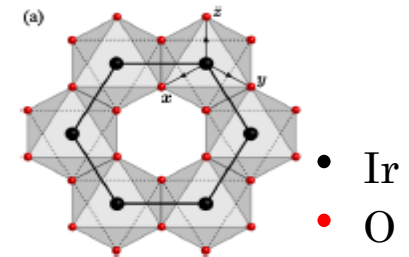between TBI and Mott Ins.

(Mean field level.)

D. Pesin *et al.*
Nat. Phys. **6**, 376 - 381 (2010)

CeOs4Sb12 filled
skutterudite

Ce
Os
Sb

B. Yan *et al.* arXiv:1104.0641

Na2IrO3

• Ir
• O

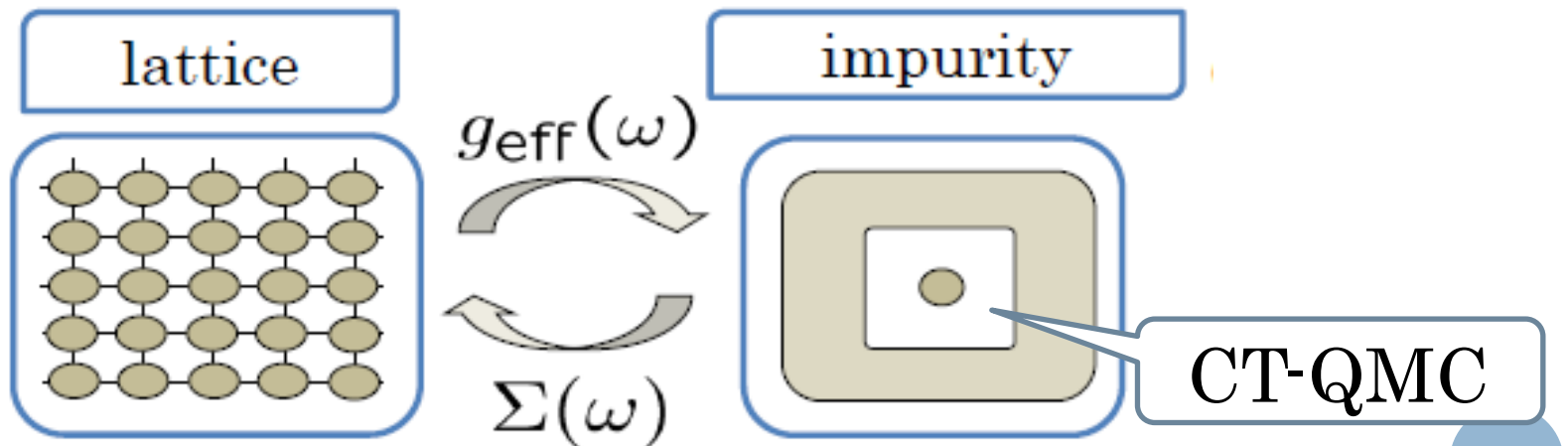A. Shitade *et al.*
PRL. **102** 256403.

Beyond the mean field level.

Model (BHZ model + U)

$$H = H_{BHZ} + U \sum_{i,\alpha} n_{i,\alpha,\uparrow} n_{i,\alpha,\downarrow}$$

$$H_{BHZ} = \sum_{i,\alpha,\sigma} \epsilon_\alpha n_{i,\alpha,\sigma} - \sum_{\langle i,j \rangle,\sigma} \hat{c}^\dagger_{i,\alpha,\sigma} \hat{t}_{\sigma\alpha,\alpha'} \hat{c}_{j,\alpha',\sigma}, \qquad -\hat{t}_\sigma = \begin{pmatrix} -t_1 & it_{sp}e^{i\theta\sigma} \\ it_{sp}e^{-i\theta\sigma} & t_2 \end{pmatrix}$$
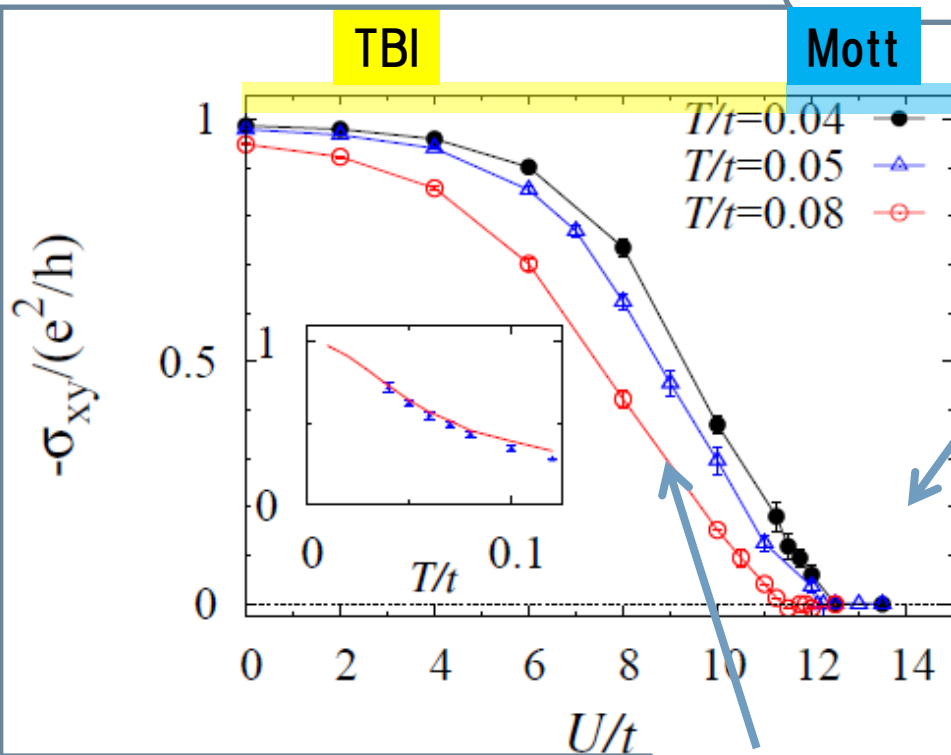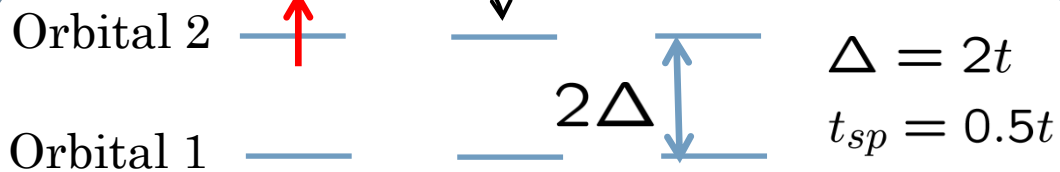
Method （DMFT+CT-QMC）

lattice

impurity

$g_{\text{eff}}(\omega)$

$\Sigma(\omega)$

CT-QMC

Solve self-consistently

make it easy to study
low Temperature region.

Results

Orbital 2 —↑— ——

Orbital 1 —— ——

2Δ

$\Delta = 2t$
$t_{sp} = 0.5t$

TBI   Mott

In spite of the large gap,

$$\sigma_{xy}^{\mathsf{SH}} = 0$$

Trivial Mott Ins.

(f) $U/t=15$

$A(\omega)$

-10.0   0.0   10.0
ω/t

$\sigma_{xy}^{\mathsf{SH}}$ is also quantized in interacting case.
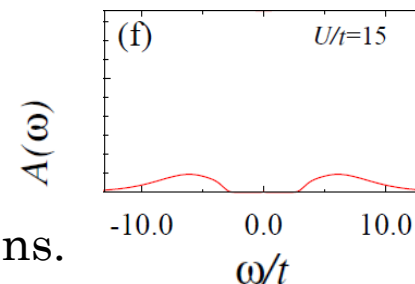
renormalization of the bap

Topological number

$\updownarrow$ the Ward Identity.

$\sigma_{xy}^{\mathsf{SH}}$

K. Ishikawa *et al.*
Nucl. Phys. B **280** 523.

$T/t=0.05$ orbital 1
orbital 2

D_{occ}

10   11   12   13
U/t
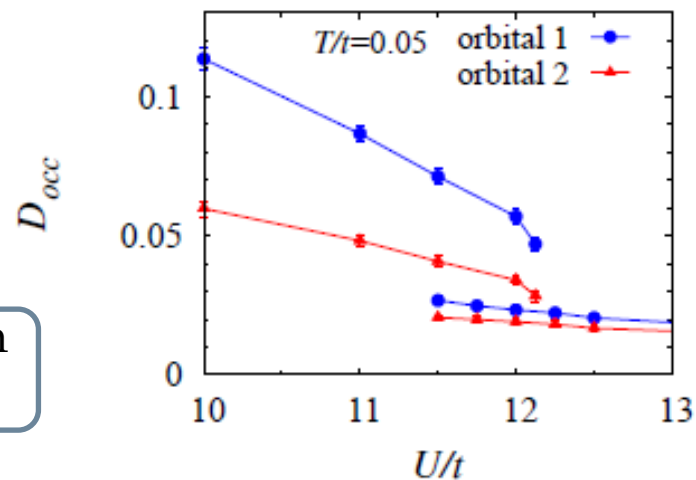
A jump and hysteresis is observed.

First order transition.

Summary

We analyzed local interaction effects
on BHZ model.

- The phase transition between TBI and Mott ins. is observed. （first order transition）

- Behavior of the gap （local spectral function）.

- Magnetic instability.

Details are discussed in the poster presentation.