NQS2011   Poster Preview

Partial disorder in a frustrated periodic Anderson model

Satoru HAYAMI[A], Masafumi UDAGAWA[A,B], and Yukitoshi MOTOME[A]
Department of Applied Physics, University of Tokyo[A]
Max-Planck-Institut für Physik Komplexer Systeme[B]
2011/11/14-18
Novel Quantum States in Condensed Matter 2011 in Kyoto

S. Hayami, M. Udagawa, and Y. Motome, J. Phys. Soc. Jpn. **80** (2011) 073704.
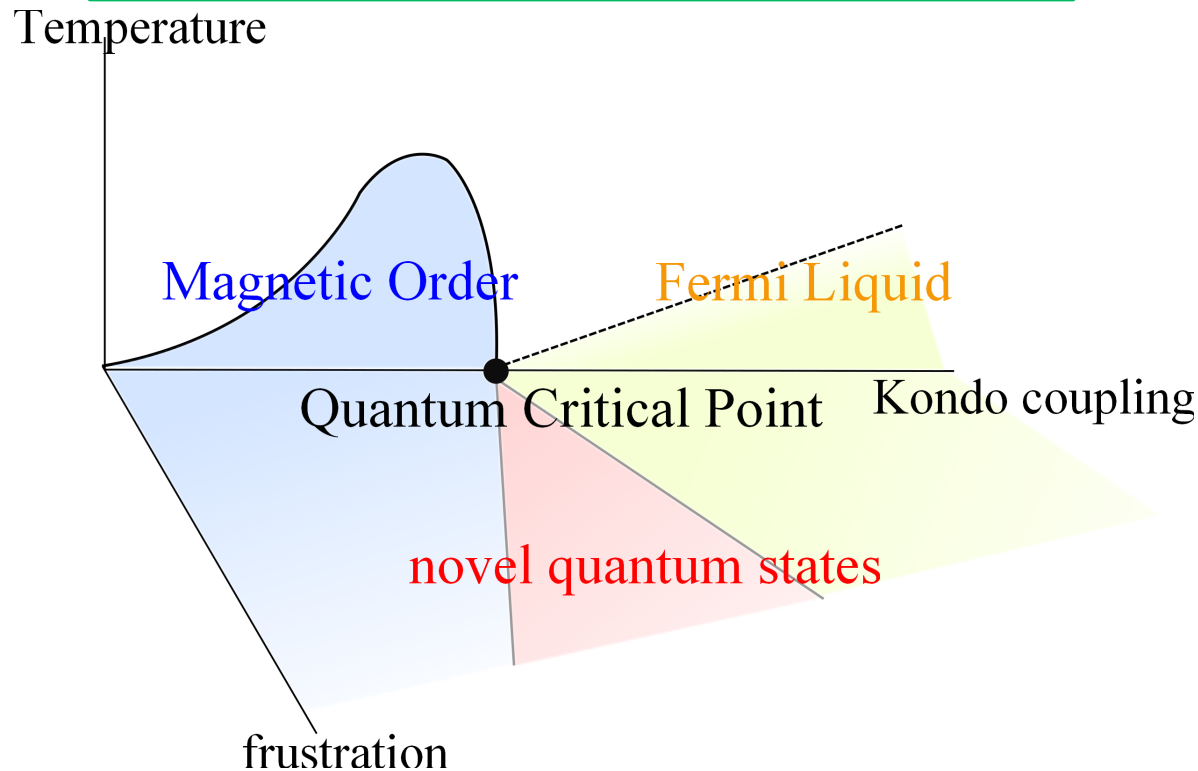S. Hayami, M. Udagawa, and Y. Motome, preprint (arXiv: 1107.4401).

Background

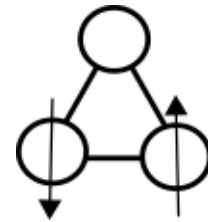Quantum Critical Point(QCP) ➡ many fascinating behaviors

- heavy-quasiparticle formation
- non-Fermi liquid behavior
- superconductivity
- etc.

S. Doniach, Physica B **91** (1977) 231.
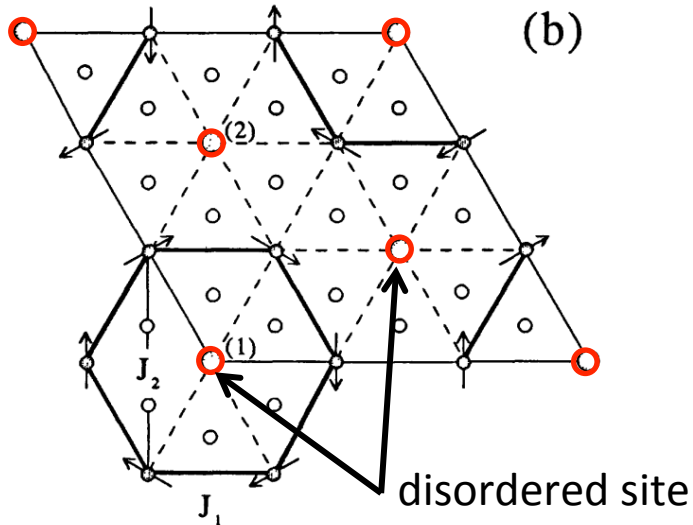
Doniach Phase Diagram + frustration

Temperature

Magnetic Order   Fermi Liquid

Quantum Critical Point   Kondo coupling

novel quantum states

frustration

Partial Disorder

Coexisting of
a magnetic order and
nonmagnetic state
due to Kondo coupling

Partial Disorder

Experiment

UNi$_4$B: triangular lattice

(b)

(2)

(1)

J_2

J_1

disordered site

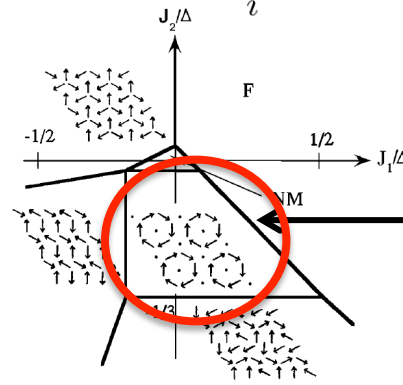S. A. M. Mentink *et al.*, Phys. Rev. Lett. **73** (1994) 1031.

CePdAl : distorted kagome lattice

Theory

mean-field approximation
for an effective pseudo-spin model

$$H = \Delta \sum_i \mu_i^2 - \frac{1}{2} \sum_{i \neq j} J_{ij} \boldsymbol{\mu_i} \cdot \boldsymbol{\mu_j}$$

J_2/Δ

F

$-1/2$

$1/2$

J_1/Δ

NM

partial disorder

C. Lacroix *et al.*, Phys. Rev. Lett. **77** (1996) 5126.

Variational Monte Carlo study for Kondo-necklace
and Kondo-lattice models on a triangular lattice

Y. Motome *et al.*, Phys. Rev. Lett. **105** (2010) 036403.

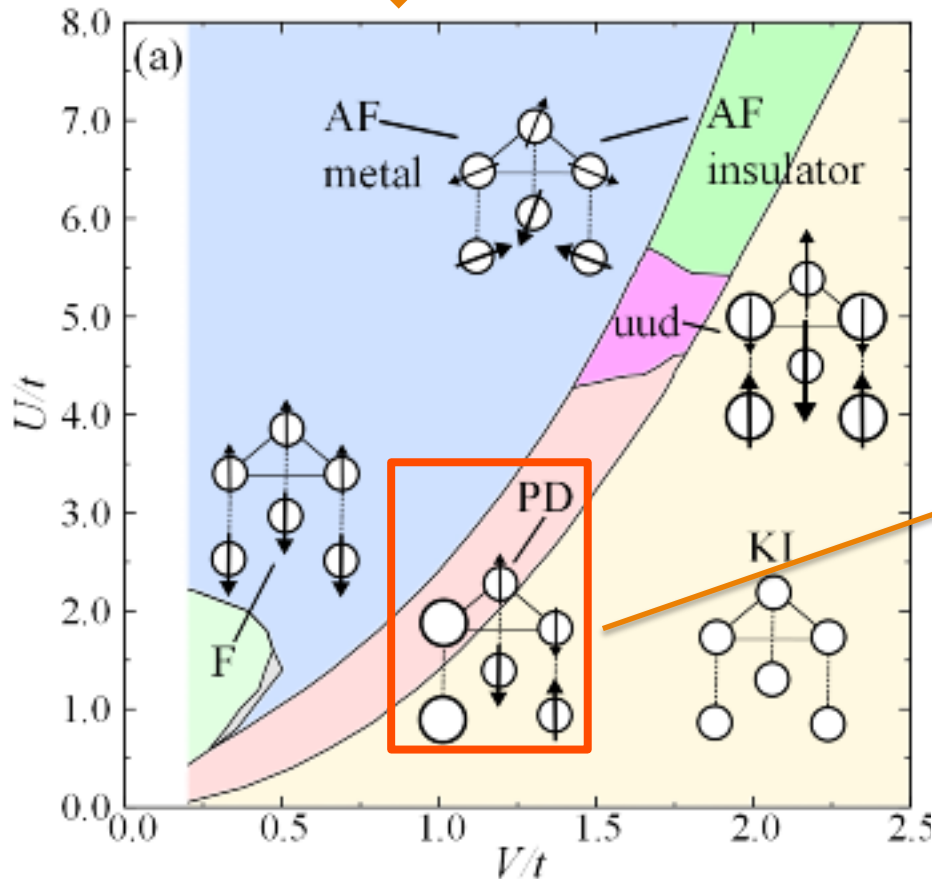**Fundamental properties of partial disorder states remain unclear theoretically.**

metal or insulator
electronic structure
transport property
etc.

Model and Phase Diagram
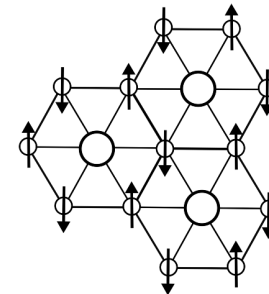
Periodic Anderson model on a triangular lattice

$$\mathcal{H} = -t \sum_{\langle i,j \rangle, \sigma} (c_{i\sigma}^{\dagger} c_{j\sigma} + \text{H.c.}) - V \sum_{i,\sigma} (c_{i\sigma}^{\dagger} f_{i\sigma} + \text{H.c.}) + U \sum_{i} f_{i\uparrow}^{\dagger} f_{i\uparrow} f_{i\downarrow}^{\dagger} f_{i\downarrow} + E_0 \sum_{i,\sigma} f_{i\sigma}^{\dagger} f_{i\sigma}$$

Result @ half filling (n=2.0)

Partial disorder(PD): collinear AF order on the unfrustrated honeycomb subnetwork and nonmagnetic state at remaining sites

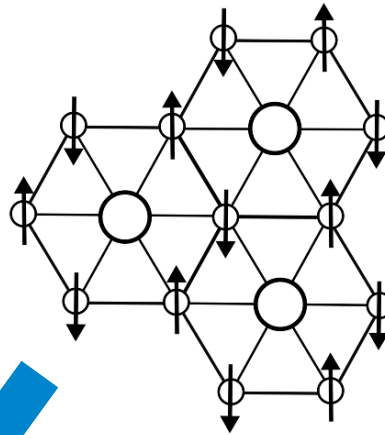PD is insulating and accompanied by charge disproportionation

Contents of Poster

Partial disordered state

Carrier Doping
- near half filling
- metallic PD states?

Spin Anisotropy
- Effect of spin anisotropy?

Other commensurate fillings
- 1/6 filling, 2/3 filling
- Different PD states?

Magnetic Field
- response to magnetic field?
- magnetization process?

We will discuss the partial disorder state in detail !!