「対称性のやぶれを伴わない量子液体相」

Informal Meeting
on Quantum liquids without symmetry breaking

平成21年度第一回研究会

平成２１年７月１０日（金）１０：３０より

筑波大学総合Ｂ棟１０８号プレゼンテーションルーム

アクセス

筑波エキスプレス終点つくば　関東バス、5番乗り場より

大学循環右回り（10時00分）または、大学中央行き（10時08分）で約10分

つくばセンター5番バス停

第一エリア前バス停下車、

バス進行方向に向かって右手前方に見える

図の建物（総合Ｂ棟１階108）

徒歩２分程度

Program (Tentative: more breaks, if possible)

10:30-11:00 Y. Hatsugai (Univ. of Tsukuba)
“Geometrical phases to characterize quantum liquids”

11:00-12:00 H. Takayanagi
(Tokyo Univ. of Sci. & NIMS, MANA WPI Center)
“Andreev Reflection in Quantum Hall Regime"

12:00-12:30 T. Morimoto (Univ. of Tokyo)
“Optical Hall conductivity in ordinary and graphene QHE systems”

12:30-13:30 LUNCH

13:30-14:00 Toru Kawarabayashi (Toho Univ.)
"Quantum Hall transition in graphene
with correlated bond disorder"

14:00-14:30 H. Aoki (Univ. of Tokyo)
“Photovoltaic Hall effect in graphene”

14:30-15;00 P. A. Maksym (Univ. of Leicester, UK)
“Confinement-deconfinement transition
in graphene quantum dots”

15:00-15:30 Break

15:30-16:00 S. Nomura (Univ. of Tsukuba)
「低電子密度二次元電子系の発光分光」
"Photoluminescence spectroscopy of
two-dimensional electron system in low electron density regime"

16:00-16:30 M. Arai (NIMS)
“Numerical study of quantum Hall effects
in two-dimensional multi-band system:
single- and multi-layer graphene”

16:30-17:00 T. Fukui (Ibaragi Univ.)
“Z2 index of Dirac operator with time reversal symmetry”

17:00-17:30 M. Arikawa (Univ. of Tsukuba)
“Edge state of graphene in magnetic field”

17:30-18:00]I. Maruyama (Osaka Univ.)
“Topological identification by quantized Berry phases:
spin-singlet pairs and edge states”

18:00 Closing

ABSTRACTS

[1] Yasuhiro Hatsugai (Univ. of Tsukuba)
"Geometrical phases to characterize quantum liquids"
I will give a shot introduction of our project entitled as "Quantum liquid phases without symmetry breaking". Our basic strategy with focus on quantum interferences will be given after short discussion of its physical background.

[2] Hideaki Takayanagi (Tokyo Univ. of Sci. & NIMS, MANA WPI Center)
"Andreev Reflection in Quantum Hall Regime"
First I will talk about a relatively old result : Superconducting junctions using AlGaAs /GaAs heterostructures with high Hc2 NbN electrodes.
We investigated a superconductor-semiconductor-superconductor junction formed by two superconducting NbN electrodes and a two-dimensional electron gas (2DEG) in an AlGaAs/GaAs hetero structure. We obtained a good ohmic contact between NbN/AuGeNi electrodes and 2DEG by annealing them at 450°C for 1 min in an N2 atmosphere. We observed a decrease in the resistance caused by Andreev refection (AR) within the superconducting energy gap voltage in a zero magnetic field in this structure. We found that the peculiar features of the magneto resistance in the transition region can be qualitatively explained by considering the existence of the AR in high magnetic fields."
Then I will explain an idea to apply this combination (superconductivity and QHE) to graphene.

[3] Takahiro Morimoto (Univ. of Tokyo)
"Optical Hall conductivity in ordinary and graphene QHE systems",
We calculated the optical Hall conductivity in 2DEG and in graphene in the quantum Hall (QHE) regime and found that the Hall plateaus are retained even in the ac (THz) regime. We also mention experimental feasibility in terms of Faraday rotations.

[4] Toru Kawarabayashi (Toho Univ.)
"Quantum Hall transition in graphene with correlated bond disorder"
Influence of bond disorder on the quantum Hall transition in graphene is investigated numerically based on the honeycomb lattice model in a strong magnetic field. It is found that the criticality of the transition at the n=0 Landau level depends sensitively on the spatial correlation of disorder.

[5] Hideo Aoki (Univ. of Tokyo)
“Photovoltaic Hall effect in graphene”
（青木秀夫：グラフェンにおける光誘起ホール効果）
A photovoltaic Hall effect, i.e., a dc Hall current photo-induced in the absence of static, uniform magnetic fields is predicted for graphene as a geometric effect.
（グラフェンにおいて、レーザー光を照射すると、dcホール効果が 生じる幾何学的位相効果を予言する。）

[6] P. A. Maksym (Univ. of Leicester, UK)
“Confinement-deconfinement transition in graphene quantum dots”,
The quantum states of electrons in a graphene dot are investigated theoretically. The dot is formed by an external potential and an external magnetic field. The confinement is conditional and a confinement-deconfinement transition takes place when the magnetic field increases beyond a critical value. This enables the character of the quantum states to be controlled at will. Quantum states for a linearly increasing potential with circular symmetry are used to illustrate this effect. The physical origin of the effect is explained by considering the classical dynamics of charged, massless particles. Quantum states are also computed for a realistic dot model where the potential is found from a solution of the Poisson equation. The results suggest that the transition may be experimentally observable.

[7] Sintaro Nomura (Univ. of Tsukuba)
「低電子密度二次元電子系の発光分光」

"Photoluminescence spectroscopy of two-dimensional electron system in low electron density regime"

Photoluminescence spectroscopy is demonstrated to be one of the most effective methods to observe the phenomena reflecting the carrier-carrier interactions. We present our recent results of photoluminescence spectroscopy in the low electron density regime.

[8] Masao Arai (NIMS, Tsukuba)

"Numerical study of quantum Hall effects in two-dimensional multi-band system: single- and multi-layer graphene"

We numerically studied quantum Hall effects in several two-dimensional system, which show Dirac-like band dispersions. The validity of the semi-classical interpr

[9] Takahiro Fukui (Ibaragi Univ.)

"Z2 index of Dirac operator with time reversal symmetry",

With time reversal symmetry a Dirac operator has vanishing index and Chern number. We show that we can nevertheless define a nontrivial Z2 index as well as a corresponding topological invariant given by gauge field, which implies that such a Dirac operator is topologically nontrivial.

[10] Mitsuhiro Arikawa (Univ. of Tsukuba)

"Edge state of graphene in magnetic field",

We analyze the charge density of n=0 Landau level on the edges of the graphene. To characterize the edge behavior we also examine the entanglement entropy.

[11]Isao Maruyama (Osaka Univ.)

"Topological identification by quantized Berry phases: spin-singlet pairs and edge states"

We have demonstrated that quantized Berry phases can be used as a new tool for exploring gapped systems which do not exhibit symmetry breaking. This approach is an alternative to usual correlation functions and is related to edge states through the bulk-edge correspondence.