2018
拓扑与量子物理青年学者暑期研讨会

会议手册

2018.8.28-31　山西•太原

目　录

一、会议概况

拓扑与量子物理是目前国际科研的前沿与热点领域。 本次会议主要邀请二十几位国内活跃的青年学者共同探讨冷原子物理和拓扑量子物理领域的研究方法和研究进展，包括与拓扑相关的动力学和测量，自旋轨道耦合，少体问题，可积系统，机器学习，非平衡态，第一性原理计算方法，非厄密系统等相关内容，为此领域广大的的青年教师和研究生提供一个平等自由的学术交流平台，加强青年学者间的合作。

资助来源：

国家自然科学基金委员会理论物理专款山西大学平台项目

会议方式：

每天 8 个报告，每个报告时长为 1 个小时，包含 10 分钟讨论时间。

学术顾问：

吴飙、易俗、陈澍、张云波、梁九卿

组织委员会：

徐志浩、王利、郭利平、尹相国

主办单位：

山西大学、北京大学、中国科学院物理研究所、中国科学院理论物理研究所

承办单位：

山西大学理论物理研究所

二、会议日程

2018 拓扑与量子物理青年学者暑期研讨会会议日程

8 月 29 日（星期三）上午

7:55-8:00　开幕致辞：陈澍（中国科学院物理研究所）

Session I: Ultra-cold atoms (I)　　主持人: 徐志浩

8:00-9:00	崔晓玲（中国科学院物理研究所） Majorana correlation for a number-conserving p-wave Fermi gas in 1D lattice
9:00-10:00	王高仁（大连理工大学） Two-body bound and scattering states in harmonic waveguides
10:00-10:10	集体合影，会间休息
10:10-11:10	贺亮（华南师范大学） Nonequilibrium phenomena in driven-open condensates
11:10-12:10	王鹏军（山西大学） Experimental observation of one-dimensional superradiance lattices in ultracold atoms
12:15-	自助餐

8 月 29 日（星期三）下午

Session II: Strongly correlated system (I)　　主持人：王利

14:30-15:30	王磊（中国科学院物理研究所） Neural network renormalization Group
15:30-16:30	任伟（上海大学） Predictions of novel topological materials from first principles
16:30-16:40	会间休息
16:40-17:40	张海军（南京大学） 凝聚态物理中的拓扑量子态研究
17:40-18:40	张学锋（重庆大学） Topological defects in the frustrated optical lattice
18:45-	晚宴

8 月 30 日（星期四）上午

Session III：Ultra-cold atoms (II)　　主持人: 陈立

8:00-9:00	张永平（上海大学） 光晶格中自旋轨道耦合的玻色爱因斯坦凝聚的超流性质
9:00-10:00	张义财（广州大学） Generalized Josephson relation for conserved charges in multi-component bosons
10:00-10:10	会间休息
10:10-11:10	胡颖（山西大学） Non-equilibrium topological insulators with ultracold atoms
11:10-12:10	秦涛（法兰克福大学） 周期性驱动超冷原子系统中非平衡稳态的共振隧穿和拓扑性质
12:15-	自助餐

8 月 30 日（星期四）下午

Session IV: Strongly correlated system (II)　　主持人：梅锋

14:30-15:30	胡自翔（重庆大学） 各向异性分数量子霍尔态及相变
15:30-16:30	乔振华（中国科学技术大学） Introduction of engineering topological phases in various two-dimensional systems
16:30-16:40	会间休息
16:40-17:40	毛力（武汉大学) Plasma quantization and its interaction with other particles
17:40-18:40	张龙（北京大学） Dynamical characterization of topological phases
18:45-	自助餐

8 月 31 日（星期五）上午

Session V: Low-dimensional system　　主持人：尹相国

8:00-9:00	曹鲁帅（华中科技大学） The ab initio numerical tool multi-configuration time-dependent Hartree method (MCTDH): family tree, main concept and application examples
9:00-10:00	郎利君（华南师范大学） 非厄密与非线性对 Su-Schrieffer-Heeger 模型的影响
10:00-10:10	会间休息
10:10-11:10	姜玉铸（中国科学院武汉物理与数学研究所） Understanding the thermodynamic physics of ultra-cold atoms in the one-dimensional exactly solvable model
11:10-12:10	郝亚江（北京科技大学） Hard core anyon gas in one dimension
12:15-	自助餐

8 月 31 日（星期五）下午

Session VI: Topology in other systems　　主持人：郭利平

14:30-15:30	蔡子（上海交通大学） Dissipative Majorana quantum wires
15:30-16:30	石弢（中国科学院理论物理研究所） Variational Study of Fermionic and Bosonic Systems with Non-Gaussian States: Theory and Applications
16:30-16:40	会间休息
16:40-17:40	余睿（武汉大学) 经典电子线路中的拓扑态
17:40-18:40	郭昊（东南大学） Uhlmann 相位和混合态的拓扑
18:40-	闭幕致辞：易俗（中国科学院理论物理研究所）
19:00-	自助餐

三、会议报告摘要

Majorana correlation for a number-conserving p-wave Fermi gas in 1D lattice

崔晓玲(中国科学院物理研究所)

8 月 29 日（星期三）上午 8:00-9:00

In this talk, I will show that the spin-polarized p-wave Fermi gas in 1D lattice can support Majorana edge state. This is facilitated by the strong pairing fluctuations due to the coupling/conversion between atomicand molecular channels, despite the absence of true long-range pairing order. The Majorana edge state manifests itself in the strong edge-edge correlations and their robustness against disorders, as well as a non-trivial winding number for the bulk system with twist boundary. It is found that the three- and four-body collisions can be significantly suppressed to enable its realistic detection in experiments. These results show that the Majorana physicscan be accessible in a very natural and simplenumber-conserving cold atoms setup.

Two-body bound and scattering states in harmonic waveguides

王高仁(大连理工大学)

8 月 29 日（星期三）上午 9:00-10:00

束缚在外部势阱中的超冷气体为研究低维物理提供了高度可控的平台。理解低维超冷气体中的两体相互作用是解释和预测低维系统性质的重要基础。区域坐标变换(Local frame transformation, LFT)方法被广泛用于计算低维空间的超冷两体散射性质。LFT 方法将外势阱中的散射与自由空间散射通过一个解析的变换矩阵联系起来，可以很方便地处理不同分波间的耦合，非常适合处理低维超冷碰撞过程。我们将介绍 LFT 方法的核心思想和两个 LFT 方法的应用示例。一个是基于 LFT 方法讨论准一维空间 Feshbach 共振附近散射态和束缚态的性质，另一个是基于 LFT 方法讨论准一维空间的偶极束缚态性质。

Nonequilibrium phenomena in driven-open condensates

贺亮(华南师范大学)

8 月 29 日（星期三）上午 10:10-11:10

The last decade has witnessed fast experimental development in realizing driven open quantum systems with many degrees of freedom. Examples include exciton-polaritons in semiconductor heterostructures, ultracold atoms, trapped ions, and microcavity arrays. The common characteristic is explicit breaking of detailed balance on a microscopic level by the presence of both coherent and driven-dissipative dynamics, placing these systems far from thermal equilibrium. This makes them promising laboratories for studying nonequilibrium statistical mechanics, according to which, one expects nonequilibrium features to persist to the macroscopic level of observation. In this talk, I will present our recent study on driven open condensates (DOC) inspired by these experimental developments. In particular, I will show how the intrinsic nonequilibrium character of DOC can give rise to rich noneuqilibrium phenomena, including slow combustion dynamics, vortex turbulence, dynamical arrest, etc.

Experimental Observation of One-Dimensional Superradiance Lattices in Ultracold Atoms

王鹏军(山西大学)

8 月 29 日（星期三）上午 11:00-12:10

In this talk, I will present our recent work on the measurement of the superradiant emission in a 1D superradiance lattice (SL) in ultracold atoms. Resonantly excited to a superradiant state, the atoms are further coupled to other collectively excited states, which form a 1D SL. The directional emission of one of the superradiant excited states in the 1D SL is measured. The emission spectra depend on the band structure, which can be controlled by the frequency and intensity of the coupling laser fields. This work provides a platform for investigating the collective Lamb shift of resonantly excited superradiant states in Bose-Einstein condensates and paves the way for realizing higher dimensional superradiance lattices.

Neural Network Renormalization Group

王磊(中国科学院物理研究所)

8 月 29 日（星期三）下午 14:30-15:30

I will present a variational renormalization group (RG) approach using a deep generative model based on normalizing flows. The model performs a hierarchical of change-of-variables transformations from the physical space to a latent space with reduced mutual information. Conversely, it directly generates statistically independent physical configurations as a form of inverse RG flow. The generative model has an exact and tractable likelihood, which allows unbiased training and direct access to the renormalized energy function of the latent variables. To train the neural network, we employ the probability density distillation of the bare energy function, where the training loss provides a variational upper bound of the physical free energy. We demonstrate practical usage of the approach by identifying mutually independent collective variables of the Ising model and performing accelerated hybrid Monte Carlo sampling in the latent space. I will comment on the connection of the present approach to DeepMind's WaveNet, wavelet formulation of RG, and the modern pursuit of information preserving RG.

Predictions of novel topological materials from first principles

任伟（上海大学）

8 月 29 日（星期三）下午 15:30-16:30

In recent years, the interplay of topology and symmetry derives a rich variety of new topological quantum states in condensed matter physics. For instance, the time reversal symmetry protected topological insulators, Chern insulator, crystalline topological insulators, and crystalline symmetry protected or enforced semimetals have been theoretically proposed and experimentally confirmed.

The predictions of real topological materials from first principles play a critical role to realize the new topological states in experiments.

The Chern insulators can host quantum anomalous Hall effect (QAHE) on their surfaces or edges. We propose realizing the QAHE by proximity coupling graphene to an antiferro-magnetic insulator that provides both broken time-reversal symmetry and spin-orbit coupling. We illustrate our idea by performing ab initio calculations for graphene adsorbed on the (111) surface of BiFeO3 [1]. In this case, we find that the proximity-induced exchange field in graphene is about 70 meV, and that a topologically nontrivial band gap is opened by Rashba spin-orbit coupling. The size of the gap depends on the separation between the graphene and the thin film substrate, which can be tuned experimentally by applying external pressure.

Dirac and Weyl semimetals are topological semimetals but they feature different topological properties and require opposite symmetry protections. We propose that the noncentro-symmetric LiGaGe-type hexagonal ABC crystal SrHgPb realizes a new type of topological semimetal that hosts both Dirac and Weyl points in momentum space [2]. The symmetry-protected Dirac points arise due to a band inversion and are located on the sixfold rotation z-axis, whereas the six pairs of Weyl points related by sixfold symmetry are located on the perpendicular $k_z = 0$ plane.

Carbon allotropes have a large family of materials with varieties of crystal structures and properties and can realize different topological phases. We predictedanewtwo-dimensional carbon allotrope, namely penta-octa-graphene, which consists pentagonal and octagonal carbon rings [3]. We find that penta-octa-graphene can host both type-I and -II Dirac line nodes (DLNs) and the band inversion between conduction and valence bands form the type-I DLNs and the two highest valence bands form the type-II DLNs.

References

[1] Zhenhua Qiao, Wei Ren, Hua Chen, L Bellaiche, Zhenyu Zhang, AH MacDonald, Qian Niu, Quantum anomalous Hall effect in graphene proximity coupled to an antiferromagnetic insulator. Phys. Rev. Lett., 112(11), 116404 (2014).

[2] Heng Gao, Youngkuk Kim, Jörn WF Venderbos, CL Kane, EJ Mele, Andrew M Rappe, Wei Ren, The Dirac-Weyl semimetal: Coexistence of Dirac and Weyl fermions in polar hexagonal ABC crystals. arXiv preprint arXiv:1802.04815.

[3] Heng Gao, Wei Ren, Emergence of Type-I and Type-II Dirac Line Nodes in Penta-octa-graphene. in preparation.

凝聚态物理中的拓扑量子态研究

张海军（南京大学）

8 月 29 日（星期三）下午 16:40-17:40

In this talk, I will review two aspects of work. In the first part, I will talk about ideal Weyl semimetals. I will show that a large class HgTe-class compounds, including HgTe, half-Heusler and chalcopyrite compounds,have plenty of topological states ignored previously. HgTe, HgSe and some half-Heusler compounds are topologically nodal-line semimetals, and they could realize ideal Weyl semimetals with four pairs of Weyl nodes and topological surface Fermi arcs. As the simplest HgTe-class compound, alpha-Sn could realize ideal Dirac semimetal phase through the strain tuning due to the inversion symmetry. In the second part, I will review some progress of topological states in these transition metal dichalcogenide (TMD) materials, especially the work focused on by our group, such as, type-II Weyl semimetals, quantum spin Hall state and topological insulators.

Topological Defects in the Frustrated Optical Lattice

张学锋(重庆大学)

8 月 29 日（星期三）下午 17:40-18:40

We analyzed the repulsive particles in the frustrated optical lattice. For the triangular lattice, when introducing the spatial anisotropy, the bosonic domain walls are excited. Such topological defects can continuously change the crystal structure, so that the exotic incommensurate supersolid is observed [1]. Similar phenomena can also be found in the kagome optical lattice. When choosing cylindrical boundary condition, we found a novel edge liquid phase with fractional charges (spinons) linked by quantum strings (effective gauge field) [2].

References

[1] X.-F. Zhang, S.-J. Hu, A. Pelster, and S. Eggert, Phys. Rev. Lett. 117, 193201 (2016)
[2] X.-F. Zhang and S. Eggert, Phys. Rev. Lett. 111, 147201 (2013)

光晶格中自旋轨道耦合的玻色爱因斯坦凝聚的超流性质

张永平（上海大学）

8 月 30 日（星期四）上午 8:00-9:00

自从实验成功地将自旋轨道耦合引入到玻色爱因斯坦凝聚中，自旋轨道耦合的超流性质成为冷原子物理的活跃研究方向之一；另一方面晶格周期势有着丰富的布洛赫能带和能隙结构，我们将自旋轨道耦合的凝聚体载入到光晶格中，理论研究该系统的超流稳定性质，然后通过移动光晶格的手段，从实验上观测超流稳定性。由于自旋轨道耦合破坏了伽利略不变性，实验揭示对于不同方向的移动光晶格，原子超流属性有区别。

Generalized Josephson relation for conserved charges in multi-component bosons

张义财(广州大学)

8 月 30 日（星期四）上午 9:00-10:00

The Josephson relation is generalized for conserved charges in multi-component bosons. With linear response theory, a formula for derivation of generalized superfluid density is given. When there are several conserved charges, the superfluid density is generally a second order tensor in internal spin space. When the rank of Green's function matrix is one, Josephson relation is given explicitly with phase operator method. For two-component bosons, with quantum field theory, we show a generalized Hugenholtz-Pines relation hold and existence of two gapless phonons. When the interactions are U(2) invariant, we show there is a gapless quadratic dispersion excitation no matter how strong the interactions are. The corresponding generalized Josephson relation is expressed with Green's function matrix elements.

Non-Equilibrium Topological Insulators with Ultracold Atoms

胡颖(山西大学)

8 月 30 日（星期四）上午 10:10-11:10

There are presently ongoing experiments aimed at observing quantum Hall physics with ultracold gases. At zero temperature, the direct correspondence between the Chern number of the ground state, the Hall conductance, and the chiral edge states is well established. Yet, non-equilibrium scenarios generically occur in cold-atom experiments, where starting from a topologically trivial initial state, the Hamiltonian is parametrically driven into a topological regime. However, the system can never enter a Chern insulator state under such coherent evolution, thus raising the challenge as to which manifestations of topology can be actually observed in cold atom setups. Addressing this experiment relevant issue, we show that the non-equilibrium Hall response can be quantized despite the non-topological nature of the state at all times [1]. I will proceed to discuss how Floquet driving can be harnessed to transcend fundamental constraints in equilibrium systems. Specifically, I show that the perfect spin momentum locking, which in equilibrium only occurs in 2D topological insulators, can emerge in 1D Floquet lattice systems non-adiabatically [2].

References

[1] Ying Hu, Peter Zoller, Jan Carl Budich, Dynamical Buildup of a Quantized Hall Response from Non-Topological States, Phys. Rev. Lett. 117, 126803 (2016)

[2] Jan Carl Budich, Ying Hu, Peter Zoller, Helical Floquet Channels in 1D Lattices, Phys. Rev. Lett. 118.105302 (2017)

周期性驱动超冷原子系统中非平衡稳态的共振隧穿和拓扑性质

秦涛（法兰克福大学）

8 月 30 日（星期四）上午 11:10-12:10

周期性驱动的超冷原子系统是实现具有非平凡拓扑的物理模型的有效平台。利用 Raman 激光支持的隧穿和在圆极化轨道上周期性旋转的六角光晶格，实验上分别实现了 Hofstadter 模型和 Haldane 模型。在相互作用的冷原子系统中实现非平凡拓扑是一个重要方向。但是，由于周期性驱动导致的加热效应，对实验是不利的。驱动频率、幅度、原子的动能、和相互作用等能量尺度间的相互影响使这一问题更加复杂。我们首先回顾了研究强关联 Floquet 系统的方法，主要介绍 Floquet 动力学平均场的方法。我们利用这一方法研究了周期性驱动的 Falicov-Kimball 模型中的非平衡稳态的共振隧穿，发现其能显著改变原子对 Mott 带的占据，并可以用费米黄金规则来描述。我们研究了能实现 Haldane 模型的六角光晶格系统，计算了有 Falicov-Kimball 相互作用的 Haldane 模型中的电荷密度波，展示了相互作用对边缘态和电荷泵浦等拓扑性质的影响。

各向异性分数量子霍尔态及相变

胡自翔（重庆大学）

8 月 30 日（星期四）下午 14:30-15:30

Haldane pseudopotentials have played a key role in the study of the fractional quantum Hall (FQH) effect as they allow an arbitrary rotationally-invariant interaction to be expanded over projectors onto the two-particle eigenstates of relative angular momentum. Here we introduce a more general class of pseudopotentials that form a complete basis in the cases where rotational symmetry is explicitly broken, e.g., due to tilted magnetic field or tilted dipolar fermions. Similar to the standard isotropic pseudopotentials, the generalized pseudopotentials are also parametrized by a unimodular metric, which groups the effective interactions into equivalence classes, and is particularly useful in determining optimal model Hamiltonians of the anisotropic FQH fluids.

Introduction of engineering topological phases in various two-dimensional systems

乔振华（中国科学技术大学）

8 月 30 日（星期四）下午 15:30-16:30

In this talk, first I will review the progress of engineering topological phases (e.g. quantum anomalous Hall effect, quantum spin-Hall effect and quantum valley Hall effect) in graphene and related two-dimensional materials; Then, I will focus on the electronic transport properties of gate-controlled topological state (i.e., zero-line mode) in bilayer graphene systems; In the end, I will briefly talk about the vertical transport properties in rotated bilayer graphene systems.

Plasma quantization and its interaction with other particles

毛力（武汉大学）

8 月 30 日（星期四）下午 16:40-17:40

The collective modes of two dimensional (2D) electron gases are studied with the full electron light interacting Hamiltonian. The complicate operator dynamics which couple electrons and photons can be simplified by separating two kinds of electron density oscillations. Not only the quasi particle energies, but also the wave functions have been derived. The inverse operator transformation, which interprets electron oscillations and photons with quasi particles, has been developed to study the interaction between plasmons and emitters. Besides the ordinary interaction induced by the electric field of plasmon, we find an additional term arising from exchanging electrons between them.

Dynamical characterization of topological phases

张龙 （北京大学）

8 月 30 日（星期四）下午 17:40-18:40

Topological phase of matter is now a mainstream of research in condensed matter physics, of which the classification, synthesis, and detection of topological states have brought many excitements over the recent decade while remain incomplete with ongoing challenges in both theory and experiment. Here we propose to establish a universal dynamical characterization of the topological quantum phases classified by integers, with the framework of the study consisting of two parts.

First, we uncover that classifying a generic d-dimensional (*d*D) gapped topological phase can reduce to a (*d*-1)D invariant defined on the so-called band-inversion surface (BIS), rendering a fundamental bulk-surface duality. We further show in quenching across phase boundary the spin dynamics exhibits unique topological patterns on the BIS, which are attributed to the post-quench bulk topology. The topological phase is then classified by a dynamical topological invariant measured from dynamical spin-texture field on the BIS.

Second, we show that the defined (*d*-1)D invariant actually counts the total topological charges of the spin-orbit field in the region enclosed by the BIS. The charges can be characterized by distinctive non-equilibrium spin dynamics caused by a sequence of well-chosen quenches. The topological characterization thus reduces to a dynamical topological invariant defined at several particular points, and the measurement can only involve a single spin component, exhibiting great experimental advantages.

In both of the two parts, applications to quenching experiments on feasible models are studied. Experimentally implementable setup is also proposed for cold atoms. Our work paves a new way to the dynamical classification of topological phases.

The ab initio numerical tool Multi-Configuration Time-Dependent Hartree method (MCTDH): Family tree, main concept and application examples

曹鲁帅(华中科技大学)

8 月 31 日（星期五）上午 8:00-9:00

Multi-Configuration Time-Dependent Hartree method (MCTDH)是一套针对一般的多体量子系统而开发的基于第一性原理的数值算法。自开发以来，MCTDH 已经广泛应用到从大分子到超冷原子等多种化学和物理系统中。同时针对不同领域的需要也相继发展出了第二、三代的衍生算法，例如 ML-MCTDH，MCTDHB 和 ML-MCTDHB(X)等，并逐渐形成了 MCTDH 算法家族。这一系列算法的基本特点是通过对 Hilbert 空间的优化截断，实现利用比较小的波函数展开来计入系统的量子关联。本报告一方面将简单介绍 MCTDH 系列算法的理论框架，包括其基本思想、数学结构和收敛性判断等。此外，本报告还将简要介绍 ML-MCTDHB(X)在超冷原子的基态和动力学研究中的一些应用。

非厄密与非线性对 Su-Schrieffer-Heeger 模型的影响

郎利君（华南师范大学）

8 月 31 日（星期五）上午 9:00-10:00

由于拓扑理论在凝聚态领域成功地解释并预言了一系列新奇的物理现象，近几年来，对拓扑物态的研究兴趣迅速扩展到其他领域。其中，光学领域就积极地引入了拓扑的概念，并非常成功地用经典的麦克斯韦方程模拟了一系列在量子物理中所预言的拓扑现象。除此之外，此领域的优势在于它可以十分方便地引入新元素——非厄密和非线性。本次报告将以著名的 Su-Schrieffer-Heeger 模型为例，简单介绍一下这两个因素对传统拓扑态的影响[1,2]。此系列工作完成于新加坡的南洋理工大学。

References

[1] Lang L J,etal. Effects of Non-Hermiticity on Su-Schrieffer-Heeger Defect State arXiv:1807.07776

[2] Y. Wang et al., to be submitted.

Understanding the thermodynamic physics of ultra-cold atoms in the one-dimensional exactly solvable model

姜玉铸(中国科学院武汉物理与数学研究所)

8 月 31 日（星期五）上午 10:10-11:10

Many integrable models have been realized through the development of experimental techniques of ultra-cold atoms. The exact solutions of these models provide precise results to understand the observed physical phenomenon. In this talk, I will briefly introduce the Bethe ansatz method and the experimental realization of the integrable systems. Then, I will explain, how to reveal their thermodynamic and quantum critical properties by selecting some typical integrable models.

Hard core anyon gas in one dimension

郝亚江(北京科技大学)

8 月 31 日（星期五）上午 11:10-12:10

Using an anyon-fermion mapping method and thermal anyon-ferimon mapping method, we investigate hard-core anyons confined in a one-dimensional harmonic trap. The concise analytical formula of the reduced one-body density matrix is obtained. Based on this formula, we evaluated the momentum distribution, the natural orbitals, and their occupation distributions for different statistical parameters. It is shown that the ground-state properties of anyons interplay between bosons and fermions continuously. We can expect that the hard-core anyons of larger statistical parameters exhibit similar properties to the hard-core bosons although anyon systems satisfy specific fractional statistics. At low temperature hard-core anyon gases exhibit the similar properties as those of ground state, while at high temperature hard-core anyon gases of different statistical properties display the same reduced one-body density matrix and momentum distribution as those of spin-polarized fermions. The Tan's contact of hard-core anyon gas at finite temperature is also evaluated, which take the simple relation with that of Tonks-Girardeau gas C_b as $C=\frac{1}{2}\left[1-\cos\left(\chi\pi\right)\right]C_b$.

Dissipative Majorana quantum wires

蔡子(上海交通大学)

8 月 31 日（星期五）下午 14:30-15:30

In this paper, we try to formulate and quantitatively examine the effect of dissipation on topological systems. By choosing a specific model of Kitaev quantum wire with onsite Ohmic dissipations, we perform a numerically exact quantum Monte Carlo simulation to investigate this interacting open quantum system with strong system-bath (SB) coupling thus beyond the scope of Born-Markovian approximation. We concentrate on the effect of dissipation on the topological features of the system (e.g. the Majorana edge mode) at zero temperature, and find that even though the topological phase is robust against weak SB couplings as it is supposed to be, it will eventually be destroyed by sufficiently strong dissipations via a continuous quantum phase transition instead of a crossover. The dissipation-driven quantum criticality has also been discussed. In addition, a bosonization analysis has been performed to provide an analytical understanding of the interplay between the pairing and dissipation in our model.

Variational Study of Fermionic and Bosonic Systems with Non-Gaussian States: Theory and Applications

石弢（中国科学院理论物理研究所）

8 月 31 日（星期五）下午 15:30-16:30

We present a new variational method for investigating the ground state and out of equilibrium dynamics of quantum many-body bosonic and fermionic systems. Our approach is based on constructing variational wavefunctions which extend Gaussian states by including generalized canonical transformations between the fields. The key advantage of such states compared to simple Gaussian states is presence of non-factorizable correlations and the possibility of describing states with strong entanglement between particles. In contrast to the commonly used canonical transformations, such as the polaron or Lang-Firsov transformations, we allow parameters of the transformations to be time dependent, which extends their regions of applicability. We derive equations of motion for the parameters characterizing the states both in real and imaginary time using the differential structure of the variational manifold. The ground state can be found by following the imaginary time evolution until it converges to a steady state. Collective excitations in the system can be obtained by linearizing the real-time equations of motion in the vicinity of the imaginary time steady-state solution. Our formalism allows us not only to determine the energy spectrum of quasiparticles and their lifetime, but to obtain the complete spectral functions and to explore far out of equilibrium dynamics such as coherent evolution following a quantum quench. We illustrate and benchmark this framework with several examples: Kondo models and lattice gauge theory.

经典电子线路中的拓扑态

余睿（武汉大学）

8 月 31 日（星期五）下午 16:40-17:40

材料系统中的拓扑态是当前凝聚态物理中的一个热点方向。按照系统是否有能隙，拓扑态可分为拓扑绝缘态和拓扑半金属态。对拓扑半金属态，其材料的能带在动量空间相交形成交点。根据交点在动量空间中的分布形态和简并度，拓扑半金属态可细分为狄拉克态、外尔态、结线、结面态以及更多待发现的新奇物态。此次报告中，报告人将介绍在电容，电感连接成的周期性经典电路中实现结线与外尔态的设计方案。通过计算我们证实了在这两种拓扑电路的表面上存在与体拓扑性质相对应的鼓膜态和“费米”弧态。进一步我们发现电路中的外尔态对电容电感的制造误差有较强的容忍性。这对研究拓扑态提供了一个很方便的实验平台。

Uhlmann 相位和混合态的拓扑

郭昊(东南大学)

8 月 31 日（星期五）下午 17:40-18:40

几何相位，尤其是 Berry 相位在量子系统的拓扑性质的研究中起着极为重要的作用。一个很自然的问题就是，是否能把量子纯态的几何相位推广到混合态？众所周知，量子纯态波函数在几何上构成一个 U(1)主丛（U(1)来自波函数的自由度），当特定的量子态在该空间沿着闭合的（参数）曲线平行输运一周后获得的几何相位就是 Berry 相位。量子纯态被推广到混合态，波函数被替换成密度矩阵，而密度矩阵可做唯一的“相位分解”，从而有一个具有 U(n)自由度的“相位”，Uhlmann 根据混合态的这些性质引入了新的几何相位，即密度矩阵在沿着闭合参数曲线做平行输运一周后获得的相位，也被称为 Uhlmann 相位。在 2014 年，Uhlmann 相位已被应用于具体具体的量子系统以构造混合态的拓扑相位。但是 Uhlmann 相位也有一些缺点，因为密度矩阵的“相位”只能提供一个整体规范(global gauge)，因此 Uhlmann 联络一般是拓扑平庸的，从而一维以上的量子系统的 Uhlmann 相位是拓扑平庸的，因此需要对系统的规范结构做进一步的限制，本报告将基于这一点做一些讨论。

四、会议指南

会议注册：

8 月 28 日现场注册。注册地点：山西大学学术交流中心一层大厅

会议时间：

2018 年 8 月 28 日至 8 月 31 日

会议地点：

山西大学理论物理研究所报告厅，学术交流中心东门往南 700 米。

酒店地址：

（1）山西大学学术交流中心，山西大学校内（山西大学北门往南 50 米）

（2）唐尧商务酒店，学府街 68 号（山西大学北门往西 180 米）

（3）锦臣商务酒店，学府街 26 号（山西大学北门往西 140 米）

自助餐地址：山西大学学术交流中心

晚宴地址：山西会馆

交通信息

乘火车到达：

太原南站----山西大学：

868/849/70 路 火车南站上车，山西大学站下车，大约 31 分钟。

打车：约 10 分钟，约 12 元。

太原站----山西大学：

861 路 火车站上车，坞城路学府街口站下车，大约 42 分钟。

打车：约 20 分钟，约 21 元。

乘飞机到达：

飞机场----山西大学：

打车：约 15 分钟，约 20 元。

会务组联系方式：

姓名	电子邮箱	手机号码
徐志浩	xuzhihao@sxu.edu.cn	17835610808
王　利	liwangiphy@sxu.edu.cn	18835126278
郭利平	guolp@sxu.edu.cn	15536097899
尹相国	yinxiangguo@sxu.edu.cn	15135183175

五、会议通讯录

邀请报告人联系方式：

序号	姓名	单位	E-mail
1	曹鲁帅	华中科技大学	Lushuai_cao@hust.edu.cn
2	崔晓玲	中国科学院物理研究所	xlcui@iphy.ac.cn
3	蔡　子	上海交通大学	zcai@sjtu.edu.cn
4	郭　昊	东南大学	guohao.ph@seu.edu.cn
5	贺　亮	华南师范大学	liang.he@scnu.edu.cn
6	郝亚江	北京科技大学	haoyj@ustb.edu.cn
7	胡　颖	山西大学	huying@sxu.edu.cn
8	胡自翔	重庆大学	zxhu@cqu.edu.cn
9	姜玉铸	中国科学院武汉物理与数学研究所	jiangyuzhu@wipm.ac.cn
10	郎利君	华南师范大学	langlijun84@gmail.com
11	毛　力	武汉大学	maoli@whu.edu.cn
12	秦　涛	法兰克福大学	qintaophy@163.com
13	乔振华	中国科技大学	qiao@ustc.edu.cn
14	任　伟	上海大学	renwei@shu.edu.cn
15	石　弢	中国科学院理论物理研究所	tshi@itp.ac.cn
16	王高仁	大连理工大学	gaoren.wang@dlut.edu.cn
17	王　磊	中国科学院物理研究所	wanglei@iphy.ac.cn
18	王鹏军	山西大学	Pengjun_wang@sxu.edu.cn
19	余　睿	武汉大学	yurui1983@foxmail.com
20	张海军	南京大学	zhanghj@nju.edu.cn
21	张　龙	北京大学	lzhang.phys@pku.edu.cn
22	张学锋	重庆大学	zhangxf@cqu.edu.cn
23	张义财	广州大学	zhangyicai123456@163.com
24	张永平	上海大学	yongping11@t.shu.edu.cn

参会教师联系方式：

序号	姓名	单位	E-mail
25	陈冠军	太原师范学院	chengj@tynu.edu.cn
26	陈洁菲	华东师范大学	jfchen@phy.ecnu.edu.cn
27	陈　澍	中国科学院物理研究所	schen@iphy.ac.cn
28	陈　星	北京无线电计量测试研究所	chenxing08@mails.ucas.ac.cn
29	陈园园	上海大学	cyyuan@staff.shu.edu.cn
30	段　皓	北京应用物理与计算数学研究所	duan_hao@iapcm.ac.cn
31	惠宁菊	西安理工大学	huiningju@163.com
32	韩　伟	中国科学院国家授时中心	weihan@ntsc.ac.cn
33	胡　勇	华中科技大学	huyong@mail.hust.edu.cn
34	金　亮	南开大学	jinliang@nankai.edu.cn
35	金家森	大连理工大学	jsjin@dlut.edu.cn
36	靳晶晶	中北大学	jinjing850908@163.com
37	刘超飞	江西理工大学	liuchaofei0809@163.com
38	刘　京	华中科技大学	liujingphys@hust.edu.cn
39	刘继兵	湖北师范大学	liujb@hbnu.edu.cn
40	刘吉利	山西师范大学	liujili2006@aliyun.com
41	刘　娜	湖北师范大学	liun@hbnu.edu.cn
42	刘永恺	山西师范大学	liuyongkai86@163.com
43	罗小兵	井冈山大学	xiaobingluo2013@aliyun.com
44	李再东	河北工业大学	lizd@hebut.edu.cn
45	乔勇军	吕梁市离石区高级职业中学	qiaodong3601@163.com
46	苏晓强	山西师范大学	suxq@mail.ustc.edu.cn
47	陶红帅	内蒙古工业大学	taohs@imut.edu.cn
48	吴　飙	北京大学	wubiao@pku.edu.cn
49	王红梅	太原师范学院	stwhmei@163.com
50	王继国	石家庄铁道大学	wangjiguo@stdu.edu.cn
51	武松林	大连民族大学	slwu@dlnu.edu.cn
52	肖进鹏	井冈山大学	xiaojinpengdan@163.com
53	易　俗	中国科学院理论物理研究所	syi@itp.ac.cn
54	闫伟斌	大连民族大学	yanweibin1983@163.com
55	钟宏华	中南林业科技大学	hhzhong115@163.com
56	张　杰	太原理工大学	zhangjie01@tyut.edu.cn
57	张少良	华中科技大学	shaoliang@hust.edu.cn
58	张玉娟	西安电子科技大学	zhangyuj05@126.com
59	周　政	湖南工学院	zhouzheng872@163.com

参会博士后和学生联系方式：

序号	姓名	单位	E-mail	导师
60	陈　经	湖北师范大学	2928437453@qq.com	刘继兵
61	陈欣诣	上海大学	317322576@qq.com	任　伟
62	邓　星	华中科技大学	Dengxing@hust.edu.cn	曹鲁帅
63	高　恒	上海大学	gaoheng1015@shu.edu.cn	任　伟
64	高　祥	华中科技大学	gaoxiang_aim@hust.edu.cn	曹鲁帅
65	桂智谦	上海大学	mccoygui@i.shu.edu.cn	张永平
66	贾春玉	浙江师范大学	1977615593@qq.com	梁兆新
67	刘　畅	上海大学	cxtxlc@shu.edu.cn	任　伟
68	卢国愿	浙江师范大学	2528383159@qq.com	梁兆新
69	刘科验	上海大学	liukeyan@shu.edu.cn	张永平
70	李　青	兰州大学	liqing16@lzu.edu.cn	谭　磊
71	李淑静	北京应用物理与计算数学研究所	269141224@qq.com	张　平
72	刘　通	东南大学	t6tong@126.com	郭　昊
73	苗承明	河北师范大学	1105251940@qq.com	张迎涛
74	慕奇雄	湖北师范大学	374455029@qq.com	黄燕霞
75	马少强	北京航空航天大学	274545712@qq.com	张国锋
76	马婷婷	大连理工大学	1600219998@qq.com	于长水
77	阮书奇	河北师范大学	15232189527@163.com	张迎涛
78	孙　杰	上海大学	ayson@shu.edu.cn	陈圆圆
79	田茂彬	北京航空航天大学	510353115@qq.com	张国锋
80	王军标	北京航空航天大学	962905494@qq.com	张国锋
81	王昭阳	上海大学	sugege@i.shu.edu.cn	张永平
82	吴驭飙	中国科学技术大学	wyb1996@mail.ustc.edu.cn	邹旭波
83	杨传生	中国科学技术大学	yangcs2010@gmail.com	邹旭波
84	袁方正	上海大学	yuan1994@shu.edu.cn	张永平
85	徐　凯	北京航空航天大学	2580166028@qq.com	张国锋
86	张旦波	华南师范大学	dbzhang@m.scnu.edu.cn	朱诗亮
87	朱汉杰	北京航空航天大学	2210073026@qq.com	张国锋
88	周黎红	中国科学院物理研究所	lihzhou@iphy.ac.cn	崔晓玲
89	周楠楠	大连理工大学	2927027885@qq.com	于长水
90	郑　晓	北京航空航天大学	1198766637@qq.com	张国锋
91	郑振飞	中国科学技术大学	zfzheng@mail.ustc.edu.cn	邹旭波

六、太原周边旅游信息

推荐路线一：平遥古城 + 双林寺

平遥古城位于山西省中部，距太原市约 85 公里，古城内的街道、店铺和民居依旧保持着传统的布局和风貌，是我国保存最为完好的四大古城之一，也是中国仅有的以整座古城申报世界文化遗产获得成功的两座古城市之一。平遥古城曾经是晚清时期中国的金融中心，走进这座曾经繁华的古城，处处可以感受到当年晋商文化的气息。

主要景点：平遥县衙、日升昌票号、孔庙、平遥城墙、又见平遥情景剧演出。

双林寺位于山西省平遥县西南六公里桥头村。双林寺以彩塑闻名，寺内藏有两千多尊宋、元、明、清等各朝代的彩绘泥塑，它们继承了我国唐代以来彩塑的优良传统，具有高度写实的风格，个个都是稀世珍宝。

推荐路线二：汾酒文化景区 +贾家庄文化生态旅游区

汾酒文化景区，隶属于山西杏花村汾酒集团，位于汾阳市杏花村镇，距离汾阳市约15公里。景区主要景点有汾酒博物馆、复古生产线、现代化汾酒酿造车间、陈年酒库、万吨酒海。汾酒是我国清香型白酒的典型代表，素以入口绵、落口甜、饮后余香、回味悠长而著称。晚唐诗人杜牧曾写下诗句“借问酒家何处有，牧童遥指杏花村”让汾酒名声大震。游客来到景区参观，可以了解汾酒从古至今的发展历程和生产过程，同时还能品鉴原浆汾酒以及竹叶青、白玉、玫瑰汾酒等。

贾家庄位于吕梁山东麓，全村占地面积4.2平方公里。大道以南是农业科技园，各类农作物呈丰字型布局，以块分类，高低相间、优种纷呈、硕果累累。大道以北有供人游乐的射箭场、万紫千红的花卉园和整齐茂密的苗圃丛林。大道东端在临近瀑布处，有一个半园型广场，广场南北对称地座落着两幢新颖别致的鸽子园。登上生态园的最高处——龙山顶。只见丹青笔塔竖直挺拔，汾州美景尽收眼底，贾家庄风情一览无遗。