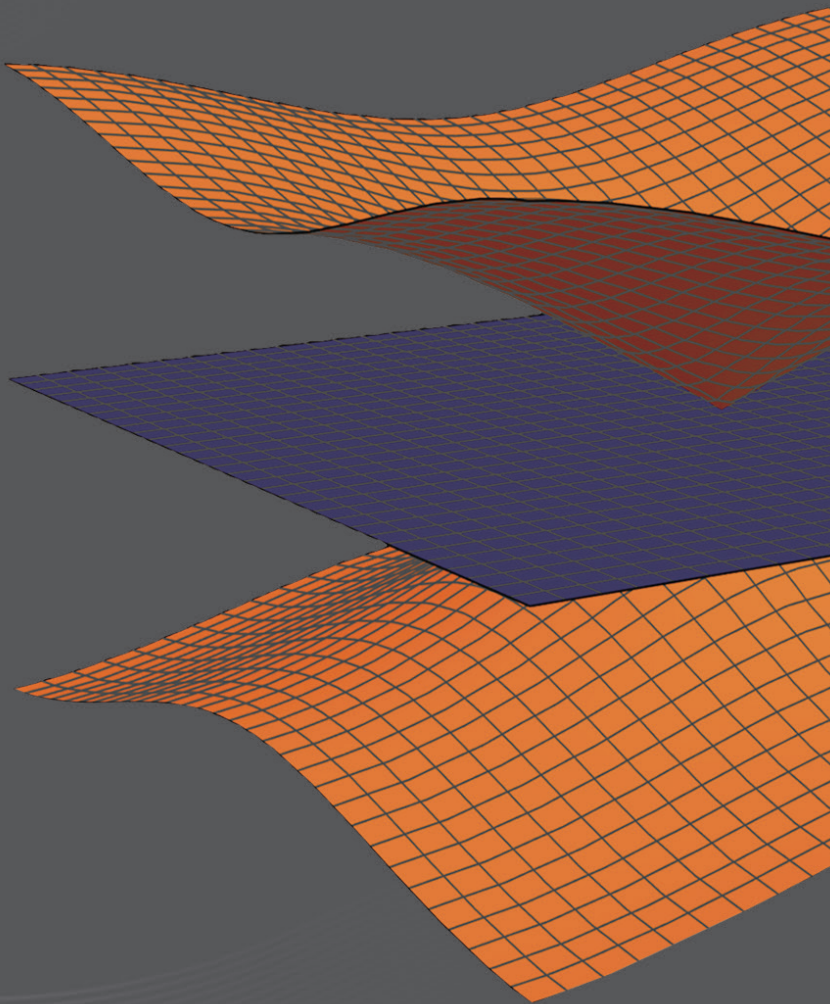
IBS Conference on

Flatbands

symmetries, disorder,
interactions and thermalization

August 16 - 20, 2021

PROGRAM BOOK



PCS Center for Theoretical Physics of Complex Systems

10th A Decade of New Discoveries
IBS Institute for Basic Science

Program
Day 1-5

* All time give in the workshop program refer to the time zone KST

Day 1 Monday, August 16

Chairperson	Sergej Flach
15:40 - 16:00	Sergej Flach, PCS IBS Opening Address
16:00 - 16:40	Hideo Aoki, University of Tokyo, Japan
16:40 - 17:20	Amnon Aharony, Tel Aviv University, Israel
17:20 - 18:00	Chisa Hotta, University of Tokyo, Japan
18:00 - 19:00	Break
Chairperson	Tilen Cadez
19:00 - 19:15	Vadim Ohanyan, Yerevan State University, Armenia
19:15 - 19:30	Sang-Jin Sin, Hanyang University, Korea
19:30 - 19:45	Jie Liu, Xiangtan Univeristy, China
19:45 - 20:00	Oleg Derzhko, ICMP of NAS of Ukraine, Ukraine

Day 2 Tuesday, August 17

Chairperson	Alexei Andreanov
16:00 - 16:40	Jun-Won Rhim, Ajou University, Korea
16:40 - 17:20	Yasuhiro Hatsugai, University of Tsukuba, Japan
17:20 - 18:00	Break
17:50- 18:30	Päivi Törmä, Aalto University, Finland
18:30- 19:10	Tero Heikkilä, University of Jyväskylä, Finland

Day 3 Wednesday, August 18

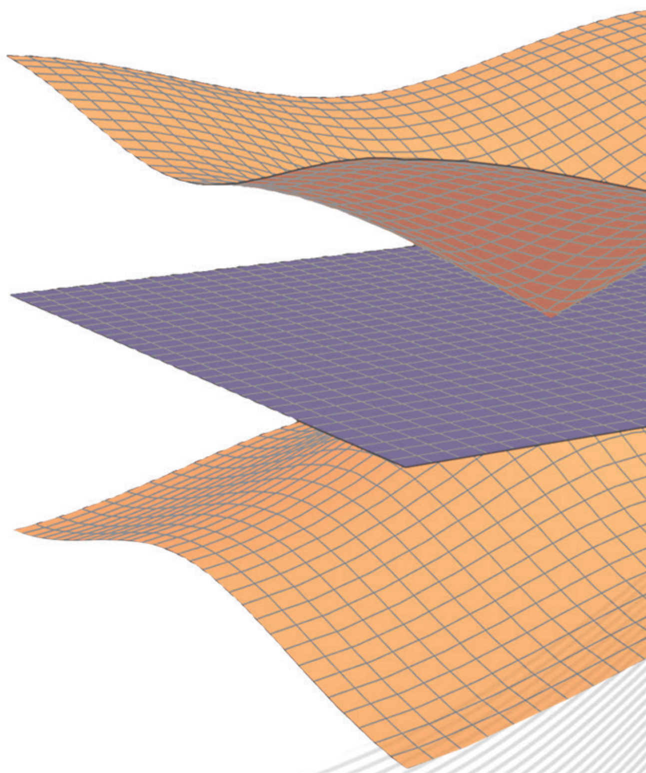
Chairperson	Bohm-Jung Yang
16:00 - 16:40	Hal Tasaki, Gakushuin University, Japan
16:40 - 17:20	Malte Roentgen, University of Hamburg, Germany
17:20 - 18:00	Break
17:50- 18:30	Rudolf Roemer, University of Warwick, UK
18:30- 19:10	Tilen Cadez, IBS PCS

Day 4 Thursday, August 19

Chairperson	Dario Rosa
16:00 - 17:00	IBS Colloquium @Daejeon Daniel Leykam, National University of Singapore, Singapore
17:00 - 17:40	Liqin Tang, Nankai University, China
17:40 - 18:20	Clemens Gneiting, RIKEN, Japan
18:20 - 19:00	Break
Chairperson	Barbara Dietz
19:00 – 19:15	Anupam Bhattacharya, University of Manchester, UK
19:15 – 19:30	Ihor Vakulchyk, IBS PCS
19:30 – 19:45	Yeongjun Kim, IBS PCS
19:45 – 20:00	Arindam Mallick, IBS PCS

Day 5 Friday, August 20

Chairperson	Jun-Won Rhim
16:00 - 16:40	Carlo Danieli, MPI PKS, Germany
16:40 - 17:20	Claudio Castelnovo, University of Cambridge, UK
17:20 - 18:00	Dario Rosa, IBS PCS



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DAY 1

Monday, August 16

Chairperson
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Hideo Aoki
University of Tokyo, Japan

Amnon Aharony
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Chisa Hotta
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Vadim Ohanyan
Yerevan State University, Armenia

Sang-Jin Sin
Hanyang University, Korea

Jie Liu
Xiangtan Univeristy, China

Oleg Derzhko
ICMP of NAS of Ukraine, Ukraine

Flatbands as an arena for superconducting and topological properties

Hideo Aoki
University of Tokyo, Japan

One novel arena for designing superconductors and topological systems is the flat-band systems.

A basic idea is that flat bands give unique opportunities for realising peculiar pairing on the one hand, and for realising topological states on the other. If we turn to non-equilibrium, we can have even more versatile opportunities.This talk theoretically gives an overview of these, embracing superconductivity and topology in and out of equilibrium. I'll start with superconductivity, where I examine flat multi-band and single-band models, where they are both shown to have unusual pairing properties, leading us beyond the conventional "nesting" physics. Then I'll touch upon flat-band topological states.

A totally different way to make the system topological is to illuminate the system with circularly-polarised light. The resulting "Floquet topological insulator" is indeed a prototype of nonequilibrium-induced quantum states. This avenue is then extended to flat-band systems. I'll finally combine these to discuss topological superconductivity.

Non-symmetric diamond chains with magnetic and electric fields: flat bands, edge states and topology

Amnon Aharony and Ora Entin-Wohlman
Tel Aviv University, Israel

The diamond chain is solved with the Aharonov-Bohm (AB) caging, spin-orbit interactions [Aharonov-Casher (AC) caging], Zeeman magnetic fields and Su-Schrieffer-Heeger (SSH) bonds. Limits of the latter yield spin-dependent decoupled trimers. Some symmetric limits yield flat bands, with spin-dependent compact localized states spanning two unit cells (diamonds). Asymmetries and Zeeman fields turn the flat bands into pairs of narrow dispersive bands, with potential full spin filtering. Finite chains yield topological edge states, in a range which is enhanced by AB and AC caging. The outlook contains scattering from finite chains and calculation of the Zak phases.

Perfect flat band induced by strong spin-orbit coupling

Chisa Hotta
University of Tokyo, Japan

We show that the perfect flat band can appear in pyrochlore and kagome lattices when a very large spin-orbit coupling (SOC) is introduced. The SOC manifests itself as a spin-dependent hopping term, where the electrons rotate by an angle determined by the relative strength of the spin-orbit induced and the ordinary transfer integrals. This kind of hopping is described by the SU(2) gauge.

We construct a spinor-line-graph theory that proves the existence of a perfect flat band when the SU(2) gauge takes some particular value.

We also show that the SOC flat band wave function stabilizes a trimerized charge ordering in a pyrochlore lattice when small Coulomg interactions are introduced. The driving force of this charge ordering is not a Coulomb interaction but a destructive interference effect characteristic of a flat band, that forces 1/4 of the pyrochlore sites to become perfectly vacant.

Electric field driven flat bands: Enhanced magnetoelectric and electrocaloric effects in frustrated quantum magnets

Vadim Ohanyan
Yerevan State University, Armenia

The J_1-J_2 quantum spin sawtooth chain is a paradigmatic one-dimensional frustrated quantum spin system exhibiting unconventional ground-state and finite-temperature properties. In particular, it exhibits a flat energy band of one-magnon excitations accompanied by an enhanced magnetocaloric effect for two singular ratios of the basal interactions J_1 and the zigzag interactions J_2.

We demonstrate that one can drive the spin system into a flat-band scenario by applying an appropriate electric field, thus overcoming the restriction of fine-tuned exchange couplings J_1 and J_2 and allowing one to tune more materials towards flat-band physics, that is to show a macroscopic magnetization jump when crossing the magnetic saturation field, a residual entropy at zero temperature as well as an enhanced magnetocaloric effect. While the magnetic field acts on the spin system via the ordinary Zeeman term, the coupling of an applied electric field with the spins is given by the sophisticated Katsura-Nagaosa-Balatsky (KNB) mechanism, where the electric field effectively acts as a Dzyaloshinskii-Moriya spin-spin interaction.

The resulting novel features are corresponding reciprocal effects: We find a magnetization jump driven by the electric field as well as a jump of the electric polarization driven by the magnetic field, i.e. the system exhibits an extraordinarily strong magnetoelectric effect.

Moreover, in analogy to the enhanced magnetocaloric effect the system shows an enhanced electrocaloric effect.

Holography, Topology and the Stability of the flat band.

Sang-Jin Sin
Hanyang University, Korea

I will show that holography provides a natural scheme to provide a stability of the Flat band in strongly interacting system, because it appears as a topological zero mode in AdS bulk.

It has a topological character because the nature of the zero mode is the type of Jackiw-Rebbi solution.

Localization, phases and transitions in the three-dimensional extended Lieb lattices

Jie Liu
Xiangtan Univeristy, China

We study the localization properties and the Anderson transition in the 3D Lieb lattice $\mathcal{L}3(1)$and its extensions $\mathcal{L}3(2)$ in the presence of disorder. We compute the positions of the flat bands, the disorder-broadened density of states and the energy-disorder phase diagrams for up to 4 different such Lieb lattices. Via finite-size scaling, we obtain the critical properties such as critical disorders and energies as well as the universal localization lengths exponent. We find that the critical disorder Wc decreases from 16.5 for the cubic lattice, to 8.6 for $\mathcal{L}3(1)$ 5.9 for $\mathcal{L}3(2)$ and 4.8 for $\mathcal{L}3(3)$. Nevertheless, the value of the critical exponent for all Lieb lattices studied here and across disorder and energy transitions agrees within error bars with the generally accepted universal value= 1.590(1.579, 1.602).

Flat-band physics in the S = 1/2 sawtooth-chain systems

Oleg Derzhko
Institute for Condensed Matter Physics, National Academy of Sciences of Ukraine, Svientsitskii Street 1, 79011 L'viv, Ukraine

We consider the strongly anisotropic spin-1/2 XXZ model on the saw-tooth-chain lattice with ferromagnetic longitudinal interaction $J_{zz} = \Delta J$ and aniferromagnetic transversal interaction $J_{xx} = J_{yy} = J > 0$. At $\Delta = 1/2$ the lowest one-magnon excitation band is dispersionless (flat) leading to a massively degenerate set of ground states. Interestingly, this model admits a three-coloring representation of the ground-state manifold [H. J. Changlani et al., Phys. Rev. Lett. 120, 117202 (2018)]. We characterize this ground- state manifold and elaborate the low-temperature thermodynamics of the system. We illustrate the manifestation of the flat-band physics of the anisotropic model by comparison with two isotropic flat-band Heisenberg sawtooth chains. Our analytical consideration is complemented by exact diagonalization and finite-temperature Lanczos method calculations. For further details see Ref. 1.

References

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DAY 2

Tuesday, August 17

Chairperson
Alexei Andreanov

Jun-Won Rhim
Ajou University, Korea

Yasuhiro Hatsugai
University of Tsukuba, Japan

Päivi Törmä
Aalto University, Finland

Tero Heikkilä
University of Jyväskylä, Finland

Novel geometric aspects in flat band systems

Jun-Won Rhim
Ajou University, Korea

Berry curvature is the most crucial geometric quantity in modern topological analysis of solid state systems. While flat bands are usually considered topologically trivial, we show that the flat bands can be geometrically nontrivial in the perspective of other geometric notions of Bloch wavefunctions such as quantum distance and cross-gap Berry connection. First, if a flat band possesses a band-crossing point with nonzero maximum quantum distance, which is classified as a singular flat band, one can have novel boundary modes and topological bulk states called the robust boundary modes and non-contractible loop states respectively. It is shown that the quantum distance manifests itself in anomalous Landau level spreading. Second, we show that even for the nonsingular flat band isolated foremother bands can also exhibit intriguing Landau level spreading characterized by the cross-gap Berry connection.

Molecular orbital construction of flat bands and applications

Yasuhiro Hatsugai
Department of Physics, University of Tsukuba, Japan

Although flatness is unstable for generic perturbation, flat bands are not accidental. We are proposing a molecular orbital (MO) construction scheme to construct a series of model Hamiltonians that possess flat bands [1-5]. Any fine-tuning is not required as far as the Hamiltonian (in momentum space) is written by the MOs and the number of the MOs is less than that of the non-equivalent atomic species. The breathing Kagome lattice is a typical system with a flat band regardless of the breathing parameter [1]. The scheme is based on simple constraints of linear algebra that can also be applied for random systems with (macroscopic) degeneracy [6]. Based on the idea, flat bands of the Metal/Covalent-Organic-Framework (MOF/COF), which is a network compound of organic molecules (linkages) connected by linkers, are discussed [7, 8]. Some of the many-body physics are discussed using the MOs as well [9, 10].

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[2] Y. Hatsugai, K. Shiraishi, and H. Aoki, New J. Phys. 17, 025009 (2015).
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[4] T. Mizoguchi and Y. Hatsugai, Phys. Rev. B 101, 235125 (2020).
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[9] Y. Kuno, T. Mizoguchi, and Y. Hatsugai, Phys. Rev. B 102, 241115 (2020).
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Quantum geometry effects on superconductivity, Bose-Einstein condensation, and light-matter interactions in flat bands

Päivi Törmä
Aalto University, Helsinki, Finland

Superconductivity, superfluidity and Bose-Einstein condensation (BEC) are many-body phenomena where quantum statistics are crucial and the effect of interactions may be intriguing. Superconductors are already widely applied, but theoretical understanding of superconductivity and condensation in several real-world systems is still a challenge, and superconductivity at room temperature remains a grand goal. We have discovered that superconductivity (superfluidity) has a connection to quantum geometry [1]. Namely, the superfluid weight in a multiband system has a previously unnoticed component which we call the geometric contribution. It is proportional to the quantum metric of the band. Quantum metric is connected to the Berry curvature, and this allows to relate superconductivity with the topological properties of the band. Using this theory, we have shown that superconductivity is possible also in a flat band where individual electrons would not move. We and other groups have shown [2] that these results are essential in explaining the observation of superconductivity in bilayer graphene and may eventually help realize superconductors at elevated temperatures. Recently, we have shown that quantum geometry can enhance also light-matter coupling [3], and quantum correlations of a weakly interacting Bose-Einstein condensate [4].

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[3] G. Topp, C.J. Eckhardt, D.M. Kennes, M.A. Sentef, P. Törmä, arXiv:2103.04967 (2021)

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Flat bands in graphene-based systems and crystalline topological insulators

Tero Heikkilä
University of Jyväskylä, Finland

One of the main motivations for studying electronic flat bands is because of their susceptibility to interactions. In particular, the mean-field superconducting critical temperature in flat-band systems scales linearly with the coupling constant instead of the exponential scaling as in Fermi-surface systems. It is also proportional to the size (volume or area) of the flat band. In recently studied graphene-based flat-band systems the flat-band area was rather small and yet the critical temperatures for interaction effects are relatively large. It would nevertheless be desirable to increase the flat-band area to increase the critical temperature. I will show in my talk how one direction is to search for special crystalline topological insulators that instead of the quantized Hall conductivity host surface flat bands and quantized polarization jump. I will describe a toy model for such a crystalline topological insulator state and compare it to the flat bands in graphene-based systems.

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Malte Roentgen
University of Hamburg, Germany

Rudolf Roemer
University of Warwick, UK

Tilen Cadez
IBS PCS

Bose-Einstein Condensation in a System of Interacting Bosons with a Flatband

Hal Tasaki
Gakushuin University, Japan

We propose a new class of tight-binding systems of interacting bosons with a flat band, which are exactly solvable in the sense that one can explicitly write down the unique ground states.

The ground states are expressed in terms of local creation operators, and apparently resemble that of Mott insulators.

Based on an exact representation in terms of a classical loop-gas model, we conjecture that the ground states may exhibit quasi Bose-Einstein condensation (BEC) or genuine BEC in dimensions two and three or higher, respectively, still keeping the Mott insulator-like character.

Our Monte Carlo simulation of the loop-gas model strongly supports this conjecture, i.e., the ground states exhibit a Kosterlitz-Thouless (KT) transition in two dimensions.

Compact localized states by local and latent symmetries

Malte Roentgen
University of Hamburg, Germany

The central mechanism behind compact localization and flat bands is destructive interference. In this talk, I will discuss two tools for the design of lattice geometries allowing for such interference, namely, local and latent symmetries. Local symmetries are symmetries that are generally valid only in a part of a system. Latent symmetries, on the other hand, are in general not visible by direct inspection of the Hamiltonian, and become visible after performing a dimensional reduction of the Hamiltonian. The impact of both types of symmetries in terms of creating destructive interference can be understood by means of graph-theoretical tools, which I will present in detail.

Localization properties in disordered Lieb lattices and their extensions

Jie Liu (a), Carlo Danieli (b), Jianxin Zhong (a), Rudolf A Roemer (c,a)
(a)School of Physics and Optoelectronics, Xiangtan University, Xiangtan 411105, China
(b)Max-Planck-Institut für Physik komplexer Systeme, Nöthnitzer Straße 38, 01187 Dresden, Germany
(c)Department of Physics, University of Warwick, Coventry, CV4 7AL, United Kingdom

We study the localization properties of generalized three-dimensional Lieb lattices in presence of different types of spatial disorder using the transfer matrix method (TMM) and r-value-based level statistics of eigenenergies obtained from sparse-matrix diagonalization methods. Firstly, we briefly review the localization properties of disordered, extended Lieb lattices. We then proceed by choosing a specific disorder distributions such that the compactly-localized states at flat band energies remain unaltered. Our aim is to establish the phase boundaries, distinguishing extended from Anderson-localized regimes, in the energy-disorder diagrams in the presence of these compact states.

Metal-insulator transition in infinitesimally weakly disordered flatbands

Tilen Cadez
IBS PCS

We study the effect of infinitesimal onsite disorder on d-dimensional all bands flat lattices. The lattices are generated from diagonal Hamiltonians by a sequence of (d + 1) local unitary transforma-tions parametrized by angles θ_i.

Without loss of generality, we consider the case of two flat bands separated by a finite gap Δ. The perturbed states originating from the flat bands are described by an effective tight binding network with finite on- and off-diagonal disorder strength which depends on the manifold angles θ_i.

The original infinitesimal onsite disorder strength W is only affecting the overall scale of the effective Hamiltonian. Upon variation of the manifold angles for d = 1 and d = 2 we find that localization persists for any choice of local unitaries, and the localization length can be maximized for specific values of θ_i . Instead, in d = 3 we identify a non-perturbative metal-insulator transition upon varying the all bands flat manifold angles.

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DAY 4

Thursday, August 19

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Daniel Leykam
National University of Singapore, Singapore

Liqin Tang
Nankai University, China

Clemens Gneiting
RIKEN, Japan

Anupam Bhattacharya
University of Manchester, UK

Ihor Vakulchyk
IBS PCS

Yeongjun Kim
IBS PCS

Arindam Mallick
IBS PCS

Flat bands, sharp physics

Daniel Leykam
National University of Singapore, Singapore

Flat bands arise in periodic media when symmetries or fine-tuning result in perfect wavepacket localization. Flat band localization is fragile and exhibits remarkably sharp sensitivity to perturbations including interactions and disorder, leading to a variety of interesting quantum and classical phenomena. Originally a theoretical curiosity, advances in fabrication methods over the past decade now allow flat band physics to be observed down to the nanoscale. I will discuss how I first became interested in flat bands, summarise what we have learned to date, and speculate on where this exciting field is headed.

Novel phenomena in photonic flatband lattices

**Liqin Tang, Daohong Song, Wenchao Yan, Shiqiang Xia,
Shiqi Xia, Jina Ma, and Zhigang Chen**
*The MOE Key Laboratory of Weak-Light Nonlinear Photonics, TEDA
Applied Physics Institute and School of Physics, Nankai University, Tianjin
300457, China*

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Flat-band systems have attracted considerable interest in many different branches of physics in the past decade, providing a flexible platform for studying a variety of fundamental phenomena. In this talk, we will present a brief overview of our recent work on design and demonstration of photonic flat-band lattices and associated novel phenomena, including unconventional line states and noncontractable loop states arising from real-space topolgy, realization of photonic square-root higher-order topological insulators in flatband lattices, and higher-order exceptional point and Landau-Zener Bloch oscillations in non-Hermitian flatband lattices. We show that such photonic structures offer a convenient platform for probing the underlying physics of flat-band systems, which may provide inspiration for exploring fundamentals and applications of flat-band physics in other structured media from metamaterials to nanophotonic materials.

Lifetime of flatband states

Clemens Gneiting
RIKEN, Japan

Flatbands ideally feature static, distortion-free compact localized states of tailorable shape, which may recommend them, e.g., for the storage of quantum information. The reliable storage sojourn of such states is, however, limited by the presence of disorder, which generically causes uncontrolled coupling into dispersive bands. We demonstrate that, while detuning flatband states from band intersections suppresses their direct decay into dispersive bands, disorder-induced state distortion causes a delayed, dephasing-mediated decay, lifting the static nature of flatband states and setting a finite lifetime for the reliable storage sojourn. We exemplify this generic, disorder-induced decay mechanism at the cross-stitch lattice. Our analysis, which applies platform-independently, relies on the time-resolved treatment of disorder-averaged quantum systems with disorder-dressed evolution equations.

References
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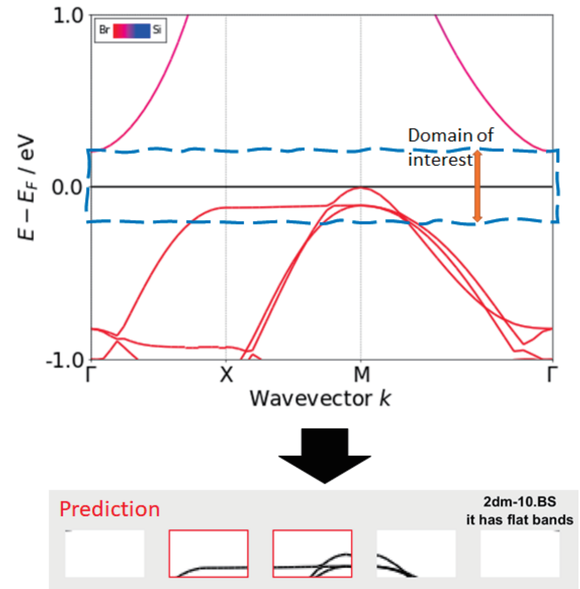
Identification of flat bands in 2D materials using neural network

A. Bhattacharya[1], A. Mishchenko[1]
[1]*Department of Physics and Astronomy, University of Manchester, UK*

Quantum interference of Bloch wavefunctions often result dispersionless states which are called flat bands. They are predicted to host a range of exotic quantum phenomena including correlated insulating, superconducting, or magnetic states. This has fuelled research to identify these degeneracies in 3D, and, in particular, 2D materials, in very recent time [arXiv:2106.05287, arXiv:2104.14167]. To accelerate research in this direction, we employ machine learning algorithms to navigate open materials science databases searching for flat band candidate systems. To this end, we used the Materials Project database [APL Materials, 2013, 1(1), 011002] to train our machine learning code to identify flat bands in band-structure images. Then we used this code to identify 2D materials with flat bands from 2dmatpedia database [Phys. Rev. Lett. 118, 106101 (2017)]. From approximately 6350 materials of the database, the machine learning code identified 750 materials which have flat bands within 0.2eV of the Fermi energy. We then sorted these materials based on a band flatness score and identified novel materials promising for experimental confirmation.



Percolation Transitions in Interacting Many-Body Flatband Systems

Ihor Vakulchyk
IBS PCS

Translationally invariant finetuned single-particle lattice Hamiltonians host flat bands only. Suitable short-range many-body interactions result in complete suppression of particle transport due to local constraints and Many-Body Flatband Localization. Heat can still flow between spatially locked charges. We show that heat transport is forbidden in dimension one. In higher dimensions heat transport can be unlocked by tuning filling fractions across a percolation transition for suitable lattice geometries.

Metal-insulator transitions for weakly disordered flatbands: Additional details

Yeongjun Kim
IBS PCS

We consider all bands flat lattice manifolds connected to their parent detangled (diagonal) Hamil- tonian through a finite number of local unitary transformations parametrized by the manifold angles and gap Δ between the flat bands. We add an infinitesimal onsite potential disorder of strength $W \ll \Delta$. The perturbed states originating from a flat band are described by an irreducible tight binding network at nonperturbative finite disorder, with W only rescaling the entire irreducible network Hamiltonian. For $d = 1$ and $d = 2$ we find that localization persists upon variation of the manifold angles. For $d = 3$ we identify a metal-insulator transition upon varying the manifold angles.

Wannier-Stark Flatbands

Arindam Mallick
IBS PCS

Flatband systems emerged as building blocks for quantum devices to realize---many exotic phenomena of condensed matter physics, quantum information processing. The possibility of flatband production by the presence of external DC bias in tight-binding Hamiltonians is analyzed while the original Hamiltonian does not possess it. The Wannier-Stark flatband eigenstates are localized, by introducing two-body contact interaction in such a system we observed bounded motion of particles. We will also discuss anti-PT symmetry based flatband generator and the robustness of these flatbands in the presence of DC field.

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DAY 5

Friday, August 20

Chairperson
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Carlo Danieli
MPI PKS, Germany

Claudio Castelnovo
University of Cambridge, UK

Dario Rosa
IBS PCS

Finetuned localization in interacting flatband networks

Carlo Danieli
Max-Planck-Institut für Physik komplexer Systeme, Nöthnitzer Str. 38, 01187 Dresden, Germany

Linear wave equations on translationally invariant flatband networks exhibit one or more dispersionless bands in their Bloch spectrum, and host compact localized eigenstates (CLS) with nonzero amplitudes restricted to a finite volume. While yielding remarkable single particle localization features, CLSs are typically highly sensitive to perturbations (e.g. disorder, interaction). In this talk, we focus on the impact of interaction in flatband networks, and present netuning protocols involving the interaction terms (both classical and quantum) and the network geometry which yield localization features. We in particular discuss how quantum two-body interaction netuning may result in the emergence of an extensive number of local integrals of motions, which in the case of lattices lacking dispersion (i.e.all bands are flat) of arbitrary spatial dimension, can lead to the complete suppression of charge and heat transport - regime known as many-body flatband localization.

Localisation phenomena in frustrated magnets

Claudio Castelnovo
University of Cambridge, UK

Elementary excitations in frustrated magnetic systems often take the form of fractionalised point-like quasiparticles. In recent years significant progress was made to understand the nature of these excitations and the importance of their effective description to gain insight into the thermodynamic properties of frustrated systems. Their dynamics on the other hand remains to date a significantly taller order. Whereas in a few cases the quasiparticles can be modelled as free, their interplay with the underlying spin vacuum from which they are borne is generally highly nontrivial. The result is a rich playground of constrained motion, reduced (fractal) dimensionality, and self-generated disorder, giving rise to intriguing instances of slow dynamics and localisation which may be accessible in state of the art experiments on magnetic systems. This talk reviews some key examples in the context of U(1) quantum spin ice and -- time permitting -- Z_2 quantum spin liquids and in a compass model of complex oxides. In the U(1) case, dynamical constraints lead to quasi-1D motion on random comb structures where configurational disorder produces compact localised states that survive in presence of interactions. In the Z_2 case, correlation holes induced by semionic statistics give rise to long-lived metastable states and strong out-of-equilibrium behaviour. Finally, in the compass model, disorder free localisation results in dynamical behaviour characteristic of many-body-localised system, including the logarithmic growth of entanglement; this is all the more exciting since signatures are accessible in certain components of the dynamical structure factor, experimentally measurable in the magnetic oxides described by this model.

An Overview Of The SYK Model And Its Relatives

Dario Rosa
IBS PCS

In the last years, the so-called Sachdev-Ye-Kitaev (SYK) model has received an enormous amount of attention from very different communities, ranging from high-energy physics to condensed matter.

The main reason for its success lies in its almost unique feature of being strongly chaotic but analytically solvable in the thermodynamic limit.

Several setups to experimentally realize the model have been suggested, including a proposal using flatbands.

In this talk, I will provide an overview of the main unique features of the model itself, together with a description of its most interesting generalizations which have been studied in the literature.

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IBS Conference on

Flatbands

symmetries, disorder,
interactions and thermalization

August 16 - 20, 2021

PROGRAM BOOK