

Table of contents

Time- and Angle- Resolved Photoelectron Spectroscopy study of n-doped and p-doped Topological Insulators, Andrea Sterzi [et al.]	iv
Long range coherent magnetic bound states in superconductors, Gerbold Ménard	v
Creation and manipulation of low-dimensional electron gases at the surfaces of transition-metal oxides, Zhiming Wang	vi
Structural and electronic properties of the triangular lattice of Sn on SiC(0001), Florian Adler [et al.]	vii
Photo-electromotive force in a conductor tunnel-coupled to 2D topological insulator, Vardan Kaladzhyan	viii
Oxygen vacancies at the spinel/perovskite gamma-Al ₂ O ₃ /SrTiO ₃ heterointerface probed by Resonant Photoemission Spectroscopy, Philipp Schuetz	ix
Interaction induced instabilities in perovskite heterointerfaces, Mathias Scheurer [et al.]	x
Supersymmetric Symplectic Spins and Heavy Fermions, Aline Ramires Neves De Oliveira [et al.]	xi
Chirality density wave of the “hidden order” phase in URu ₂ Si ₂ , Hsiang-Hsi Kung [et al.]	xii
Magnetism of j=1/2 moments on the fcc lattice in double perovskite Mott insulators, Stephanie Matern [et al.]	xiii
Chiral spin liquids with Fermi lines, Willian Natori	xiv
Aging effect of magnetization quantum oscillations in topological insulator Sb ₂ Te ₃ , Yuan Yan	xv

How to investigate Kondo physics with a new spectroscopic-imaging STM, Irene Battisti [et al.]	xvi
Robust topological insulator conduction under strong boundary disorder, Quansheng Wu [et al.]	xvii
Study of the Spin-orbit effects in the metal to Mott insulator transition within the slave spins framework, Oscar Najera	xviii
Continuous-time quantum Monte Carlo study of the asymmetric Hubbard model, Yehua Liu	xix
Functional renormalization for unconventional Fermi surface instabilities, Mario Fink	xx
Zigzag phases within extended Kitaev-Heisenberg model for layered honeycomb iridates - an exact diagonalization study, Juraj Rusnacko	xxi
Propagation of the spin-orbit exciton due to the Jahn-Teller effect in systems with strong on-site spin-orbit coupling, Ekaterina Plotnikova [et al.]	xxii
Terahertz and infrared conductivity of selected Dirac materials, Artem Pronin	xxiii
Magnetic hourglass dispersion and its relation to high-temperature superconductivity in iron- and pressure-tuned $\text{Fe}_{1+y}\text{Te}_{0.7}\text{Se}_{0.3}$, Diane Lancon [et al.]	xxiv
Metallic states at ferroelectric BaTiO_3 film surfaces, Stefan Muff [et al.]	xxv
Flux threaded p-wave loop under the Coulomb blockade regime, Rosa Rodriguez Mota [et al.]	xxvi
Pyrochlore 5d transition metal oxides explored by state of the art scattering techniques, Marein Rahn	xxvii
Self-consistent calculations of magnon-magnon interactions in Heisenberg antiferromagnets, Alex Kruchkov [et al.]	xxviii
Quantum phase transitions and anomalous Hall effect in a pyrochlore Kondo Lattice, Sarah Grefe [et al.]	xxix
Hybridization gap and Sm valence variation in SmB_6 studied by Raman scattering spectroscopy, Michael Valentine [et al.]	xxx
X-boson cumulant approach to the multiplet level systems: study of the first order transition when $J=5/2$, Edwin Ramos Rodríguez	xxxii

Influence of Multi-Orbitals, Hund's Coupling and Electronic Correlations on Electronic Spectrum in Iron Based Superconductors, Ajay Ajay [et al.]	xxxii
Electronic structure studies of CeMIn ₅ (M=Co, Rh) by soft x-ray angle-resolved photoemission spectroscopy, Rui Peng	xxxiii
Signature of high temperature superconductivity in electron doped Sr ₂ IrO ₄ , Haichao Xu	xxxiv
ESR on iridates, Stephan Fuchs	xxxv
Ground state and low-energy magnetic dynamics in the frustrated magnet CoAl ₂ O ₄ as revealed by local spin probes, Stephan Zimmermann	xxxvi
Unusually large Weyl fermion pockets in topological semimetal NbP, Zhen Wang	xxxvii
Preparation and characterization of Sr ₂ Y _{1-x} Ir _{1+x} O ₆ materials, Gizem Cansever	xxxviii
Coherent control of magnetic excitations through resonant lattice stimulation in materials with strong spin-orbit coupling., Tobia Nova	xxxix
Charged Skyrmions on the Surface of a Topological Insulator, Hilary Hurst [et al.]	xl
Correlations in a Weyl semimetal, Sergueï Tchoumakov	xli
Ultrafast electronic dynamics in 3D topological insulator investigated by time-resolved and circular dichroism ARPES, Davide Bugini [et al.]	xlii
Magnetism of j=1/2 moments on the fcc lattice in double perovskite Mott insulators, Ashley Cook [et al.]	xliii

Author Index

xliii

Time- and Angle- Resolved Photoelectron Spectroscopy study of n-doped and p-doped Topological Insulators

Andrea Sterzi ^{* 1}, Alberto Crepaldi ², Federico Cilento ², Giulia Manzoni ³, Michele Zacchigna ⁴, Fulvio Parmigiani ³

¹ Department of Physics, Università degli studi di Trieste – Via A. Valerio 2, 34127 Trieste, Italy

² Elettra – Sincrotrone Trieste S.C.p.A. – Strada Statale 14, km 163.5, 34149 Basovizza, Trieste, Italy

³ Department of Physics, Università degli Studi di Trieste – Via A. Valerio 2, 34127 Trieste, Italy

⁴ École Polytechnique Fédérale de Lausanne ((EPFL)) – CH-1015 Lausanne, Switzerland

The first observation of a persistent electron population in the photo-excited surface state (SSs) of topological insulators (TIs) has recently attracted the attention of the scientific community on their out-of-equilibrium electronic properties. A detailed understanding of the dynamical response of TIs, after optical excitation, is necessary in the perspective of controlling the surface spin transport properties.

Recent experimental works have shown that Time- and Angle- Resolved Photoelectron Spectroscopy (tr-ARPES) may have a key role in the study of these systems, thanks to the combined ability to map the electronic states, both at equilibrium and after optical perturbation, in k -space.

Initially, electron-phonon scattering was proposed as the main mechanism responsible for the relaxation dynamics of the photo-excited electrons. However, from our recent tr-ARPES experiments on a wide set of TIs, displaying a broad range of n-doping (Bi₂Se₃, GeBi₂Te₄) and p-doping (Bi₂Te₃, GeBi₂Te₄, Sb₂Te₃, Sb₂Te), a more complex picture emerges. The dynamics of p-doped Bi₂Te₃ and GeBi₂Te₄ shows similar evolution of the effective Fermi Dirac distribution. However, by comparing these dynamics with heavily p-doped Sb₂Te₃ and Sb₂Te, remarkable differences are observed. In particular, in the latter systems the dynamics in the surface and bulk states are identical, thus indicating a strong coupling between the two families of state. We propose that these findings might point towards an important role played by charge diffusion, and scattering on impurities and defects, in controlling the out-of-equilibrium dynamics of TIs.

Keywords: ARPES, Topological Insulator, Strongly correlated materials

*Speaker

Long range coherent magnetic bound states in superconductors

Gerbold Ménéard * ¹

¹ Institut des Nanosciences de Paris (INSP) – CNRS : UMR7588, Université Pierre et Marie Curie (UPMC) - Paris VI – Université Pierre et Marie Curie Case 840 4 place Jussieu 75252 Paris Cedex 05, France

The combination of superconductivity and magnetism has been known to give rise to localized states called Shiba states inside the superconducting gap. These states are due to the breaking of a Cooper pair by the magnetic interaction and can be probed by STM. The measured amplitude and position of the peak inside the gap associated to these Shiba states depend on the specific parameters describing the interaction between the impurity and the conduction electrons. The precise control and tuning of magnetic impurity chains could lead to the observation of Majorana fermions which could be of great interest in quantum computation due to their topological properties. Using low temperature scanning tunneling spectroscopy we access through the local density of states to the spectra associated to magnetic impurities as well as their spatial dependence. We studied samples of superconducting containing a really small concentration of native magnetic impurities. We observed the appearance of star-shaped structures around individual impurities with a size of the order of the coherence length of the superconductor. Our theoretical approach to this problem underlines the role of the dimensionality of the superconductor.

Keywords: bound states, superconductors

*Speaker

Creation and manipulation of low-dimensional electron gases at the surfaces of transition-metal oxides

Zhiming Wang * ¹

¹ Paul Scherrer Institut (PSI) – Paul Scherrer Institut, Villigen PSI, CH5232 Villigen, Suisse, Switzerland

Transition-metal oxides (TMOs) surfaces and interfaces are emerging as new avenues for creation and manipulation of novel quantum states. Here we will present our recent results on low-dimensional electron gases (LDEGs) at the surfaces of SrTiO₃, anatase TiO₂, as well as EuTiO₃ thin films using high-resolution and spin-resolved ARPES. We will demonstrate how surface and interface engineering can be used to tune properties of LDEGs at the surface of TMOs. First we show the polaronic nature of charge carriers in low-carrier density SrTiO₃-based 2DEGs and how the polaronic state breaks down with increasing carrier density. Then we show the formation of quasi-1DEG at the surface of anatase TiO₂ thin films. Last, we show the formation of spin-polarized 2DEG at the surface of EuTiO₃ thin films.

Keywords: transition metal oxide, 2DEG, SrTiO₃, electron, phonon coupling

*Speaker

Structural and electronic properties of the triangular lattice of Sn on SiC(0001)

Florian Adler ^{* 1}, Stefan Glass ¹, Gang Li ², Julian Aulbach ¹, Werner Hanke ², Ralph Claessen ¹, Jörg Schäfer ¹

¹ Physikalisches Institut and Röntgen Center for Complex Material Systems, Universität Würzburg – Germany

² Institut für Theoretische Physik und Astrophysik Universität Würzburg – Germany

Here we report on a novel two-dimensional electron system on a triangular lattice, namely the $\sqrt{3}\times\sqrt{3}$ reconstruction of Sn on SiC(0001). Using a newly developed recipe of gas phase hydrogen etching, well ordered SiC surfaces could be prepared. By evaporation of Sn and subsequent annealing, a triangular lattice of Sn on SiC(0001) with a coverage of $1/3$ monolayer was realized. Both the substrate preparation and the evaporation process were monitored by low-energy electron diffraction and high-resolution scanning tunneling microscopy. While simple electron counting results in a half-filled valence band and therefore metallic behavior, first angle-resolved photoemission data shows a broad, weakly dispersing band with no spectral weight at the Fermi level, indicating Mott-Hubbard physics. The system is isostructural to the well explored Mott-insulator $\sqrt{3}\times\sqrt{3}$ Sn on Si(111), but with a 20% smaller lattice constant. Surprisingly, despite the reduced adatom spacing, the hopping via the substrate is drastically reduced, owing to the inert character of SiC. The large bandgap will also change the effective Hubbard U due to weakened substrate-related screening. This renders Sn on SiC(0001) as a spin-orbit-coupled lattice with strong Coulomb correlations.

Keywords: electronic correlations, ARPES, scanning tunneling microscopy, SiC(0001)

*Speaker

Photo-electromotive force in a conductor tunnel-coupled to 2D topological insulator

Vardan Kaladzhyan * ¹

¹ Laboratoire de Physique des Solides (LPS) – CNRS : UMR8502, Université Paris XI - Paris Sud – Bat. 510 91405 Orsay cedex, France

TBA

Keywords: topological insulator, photo, electromotive force

*Speaker

Oxygen vacancies at the spinel/perovskite gamma-Al₂O₃/SrTiO₃ heterointerface probed by Resonant Photoemission Spectroscopy

Philipp Schuetz * ¹

¹ Experimentelle Physik IV, Universität Würzburg (EP 4, Universität Würzburg) – Experimentelle Physik 4 Physikalisches Institut Am Hubland 97074 Würzburg Germany, Germany

The spinel/perovskite heterointerface between the band insulator gamma-Al₂O₃ and SrTiO₃ hosts a two-dimensional electron system (2DES) with exceptionally high electron mobility. Soft x-ray resonant photo-electron spectroscopy at the Ti L-absorption edge is used to probe the Ti 3d derived interface states. Marked differences in the resonance behavior are found for the SrTiO₃ valence band and the different interface states, which are observed in the band gap of SrTiO₃. A comparison to x-ray absorption spectra of Ti 3d₀ and Ti 3d₁ systems reveals the presence of different types of electronic states with Ti 3d character, i.e., oxygen vacancy induced, trapped in-gap states and itinerant states contributing to the 2DES. Exposure to low doses of oxygen during irradiation allows for the controlled and reversible manipulation of the interfacial electronic structure, i.e., the in-gap state intensity and the valence band offset between SrTiO₃ and gamma-Al₂O₃.

Keywords: Resonant Photoemission Spectroscopy

*Speaker

Interaction induced instabilities in perovskite heterointerfaces

Mathias Scheurer ^{*} ¹, Jörg Schmalian ¹

¹ Karlsruhe Institute of Technology (KIT) – P.O. Box 3640 76021 Karlsruhe Germany, Germany

To pinpoint the microscopic mechanism for superconductivity has proven to be one of the most outstanding challenges in the physics of correlated quantum matter. Thus far, the most direct evidence for an electronic pairing mechanism is the observation of a new symmetry of the order parameter, as done in the cuprate high-temperature superconductors. Like distinctions based on the symmetry of a locally defined order parameter, global, topological invariants allow for a sharp discrimination between states of matter that cannot be transformed into each other adiabatically. Combining symmetry and energetic arguments with microscopic calculations, we propose an unconventional pairing state for the electron fluid in two-dimensional oxide interfaces and establish a direct link to the emergence of nontrivial topological invariants. Topological signatures, such as Majorana edge modes, can then be used to detect the microscopic origin of superconductivity. In addition, we show that the density wave states that compete with superconductivity have very rich spatial textures (vortices, Skyrmions) and sensitively depend on the nature of the pairing interaction. Our conclusions are based on the special role played by the spin-orbit coupling and the shape of the Fermi surface in SrTiO₃/LaAlO₃-interfaces and closely related systems.

Keywords: spin, orbit coupling, superconductivity, topology, phase competition, renormalization group, symmetry, time, reversal

*Speaker

Supersymmetric Symplectic Spins and Heavy Fermions

Aline Ramires Neves De Oliveira * ¹, Piers Coleman ¹

¹ Rutgers, The State University of New Jersey (Rutgers University) – 136 Frelinghuysen Road
Piscataway, NJ, 08854, USA, United States

Heavy fermion materials are systems in which the presence of local moments leads to new physics. The phase diagram of these systems is very rich, usually presenting an antiferromagnetic (AFM) phase, a heavy Fermi liquid regime (HFL), and non Fermi-liquid behavior above the AFM quantum critical point (QCP). Our understanding of what happens to the local moments in different extremes of this phase diagram is based in two different representation for the spin: a Schwinger boson representation, appropriate for the description of AFM, and an Abrikosov fermion representation, suitable for the understanding of the HFL development. The theoretical approaches to this problem so far have been restricted to describe only extremes of this phase diagram, and are not reliable for the description of the more interesting region of the diagram, around the QCP. In this region the magnetic and Kondo energy scales interplay and can lead to dramatic changes in the character of the quantum phase transition. Here we use supersymmetric symplectic spins in order to investigate this intermediate regime.

Keywords: Heavy Fermions, Spin Representations, Large, N

*Speaker

Chirality density wave of the “hidden order” phase in URu2Si2

Hsiang-Hsi Kung ^{* 1}, Ryan Baumbach ², Eric Bauer ², Verner Thorsmølle ¹, Wei-Lu Zhang ¹, Kristjan Haule ¹, John Mydosh ³, Girsh Blumberg^{† 1}

¹ Rutgers, The State University of New Jersey [New Brunswick] (RUTGERS) – 100 George Street, New Brunswick, NJ 08901, United States

² Los Alamos National Laboratory [Los Alamos] (LANL) – P.O. Box 1663, Los Alamos, NM, 87545, United States

³ Leiden Institute of Physics (LEIDEN) – Niels Bohrweg 2, 2333 CA Leiden, Netherlands

The heavy fermion superconductor URu2Si2 displays a second-order phase transition into the so called “hidden order” (HO) state at $T_0=17.5\text{K}$ before entering the superconducting state below $T_c=1.5\text{K}$. We use polarization resolved Raman spectroscopy to specify the symmetries of the low energy excitations above and below the HO transition. Above T_0 , the Raman response can be described by a Drude-like continuum with the scattering rate decreasing from 5.3meV at 300K to 1.3meV at 23K . Below T_0 , the response function develops a gap of about 6meV in the continuum, and a sharp in-gap mode centered at 1.6meV . The symmetry dependence of this mode suggests that the HO parameter breaks local vertical and diagonal reflection symmetries. This results in the uranium $5f$ states with distinct chiral properties, which order to a commensurate chirality density wave ground state.

Keywords: Raman spectroscopy, heavy fermion, hidden order, phase transition, symmetry breaking, chirality, strongly correlated

*Speaker

†Corresponding author: girsh@physics.rutgers.edu

Magnetism of $j=1/2$ moments on the fcc lattice in double perovskite Mott insulators

Stephanie Matern ^{*} ¹, Simon Trebst ¹, Arun Paramakanti ², Adam Aczel ,
Ashley Cook , Ciaran Hickey ³

¹ University of Cologne – Germany

² University of Toronto – Department of Physics, University of Toronto, 60 St. George St., Toronto,
Ontario, M5S 1A7, Canada, Canada

³ UNIVERSITY OF TORONTO – Canada

Motivated by studies of Mott insulating double perovskites $\text{La}_2\text{ZnIrO}_6$ and $\text{La}_2\text{MgIrO}_6$, we consider magnetism of spin-orbit coupled $j=1/2$ iridium moments on the geometrically frustrated face-centered cubic (fcc) lattice. Symmetry dictates that the nearest-neighbor exchange interaction includes, in addition to a Heisenberg term, compass-type and symmetric off-diagonal exchange couplings. Using a combination of Luttinger-Tisza and simulated annealing, we find a rich variety of magnetic phases, including collinear A-type antiferromagnetism as in $\text{La}_2\text{ZnIrO}_6$ and $\text{La}_2\text{MgIrO}_6$, collinear stripe order with moments along the $\{111\}/\{\bar{1}\bar{1}\bar{1}\}$ directions, and incommensurate non-coplanar multimode spirals. Using Monte Carlo simulations, we determine the magnetic transition temperature in these phases, and discuss experimental implications for $\text{La}_2\text{ZnIrO}_6$ and $\text{La}_2\text{MgIrO}_6$.

Keywords: Mott insulator, double perovskite

*Speaker

Chiral spin liquids with Fermi lines

Willian Natori * ¹

¹ Rodrigo Gonçalves Pereira (R. G. Pereira) – Brazil

Quantum spin liquids (QSLs) are strongly correlated spin systems that remain magnetically disordered down to zero temperature. They have received both experimental and theoretical attention because of predicted phenomena like quantum fractionalization, topological order, and gapless excitations in the absence of spontaneously broken symmetry. Although they are known to be the ground state of many model Hamiltonians, it is not yet possible to claim that they have been experimentally found, underlining the importance of research on spin liquid states arising from realistic Hamiltonian models. This work deals with a spin-orbital model in double ordered perovskites that present both strong electronic interaction and spin-orbit coupling. In terms of angular momentum operators, the model presents multipolar terms that hide a global $SU(2)$ symmetry. This is made explicit through the use of pseudospin and pseudo-orbital operators, which appear in a Heisenberg-like and compass model-like form, respectively. The Hamiltonian is rewritten in terms of Majorana fermion operators plus a Z_2 gauge field. It is shown that two time-reversed states characterized by degenerated gapless Fermi lines are found at mean-field level. Such a discovery is reminiscent of recent developments of the Kitaev model in three dimensional lattices and results from topological nodal semimetals, indicating another connection between QSLs and topologically nontrivial band systems. The symmetries, some physical properties, the stability of the phase and the non-abelian Berry phase of this state are studied. Finally, comparison between experimental data and these results are made and future improvements in this study are indicated.

Keywords: Quantum spin liquids, strong spin, orbit coupling, Majorana fermions, compass models, topological semimetals

*Speaker

Aging effect of magnetization quantum oscillations in topological insulator Sb₂Te₃

Yuan Yan * ¹

¹ the First Institute of Physics (Stuttgart University) – Pfaffenwaldring 57, Stuttgart, Germany

TBA

Keywords: De Haas–van Alphen oscillation, Sb₂Te₃, torque, O₂ plasma

*Speaker

How to investigate Kondo physics with a new spectroscopic-imaging STM

Irene Battisti * ¹, Milan Allan

¹ Leiden Institute of Physics (LION) – Netherlands

We are developing novel spectroscopic-imaging scanning tunneling microscopy (SI-STM) tools in order to explore and understand new quantum states of electronic matter on the atomic scale. On this poster, I will give an overview of the progress and future plans of this project. SI-STM measures a 3D map of the local density of states as a function of locations and energy. Our goal is to combine new techniques such as high frequency measurements with the state-of-the-art SI-STM, in order to expand its capabilities. We are particularly interested in studying correlated quantum materials, such unconventional superconductors, iridium oxides and topological materials.

One of the first systems we plan to investigate with our new SI-STM are Kondo systems.

Keywords: SI, STM, correlated electron systems, Kondo physics

*Speaker

Robust topological insulator conduction under strong boundary disorder

Quansheng Wu ^{*} ¹, Du Liang ¹, Sacksteder Vincent[†] ¹

¹ Institute of Physics, Chinese Academy of Sciences, Beijing 100190, China – China

Topological insulators are characterized by specially protected conduction on their outer boundaries. We show that the protected edge conduction exhibited by 2D topological insulators (and also Chern insulators) is independent of nonmagnetic boundary disorder. In particular, the edge states residing inside the bulk gap remain conducting even when edge-state inhomogeneities destroy the characteristic linear Dirac relation between energy and momentum. The main effects of boundary disorder on the in-gap states are to decrease the Fermi velocity, increase the density of states, pull the states into the disordered region if spin is conserved, and at very large disorder shift the states to the boundary between the disordered edge and the clean bulk. These effects, which may be useful for device engineering, are controlled by a resonance between the disordered edge and the bulk bands. The resonance's energy is set by the bulk band width; protection of the in-gap edge states' plane-wave character is controlled by the bulk band width, not the bulk band gap.

Keywords: topological insulator, transport

*Speaker

†Corresponding author: vincent@sacksteder.com

Study of the Spin-orbit effects in the metal to Mott insulator transition within the slave spins framework

Oscar Najera * ¹

¹ Laboratoire de Physique des Solides (LPS) – CNRS : UMR8502, Université Paris XI - Paris Sud – Bat. 510 91405 Orsay cedex, France

The spin-orbit interaction, although usually considered as a small relativistic correction, has indeed shown to be able to drive systems into new states of matter, like the topological insulators, whose nature has remained unnoticed up to now. An interesting question, recently arising in the context of 5d-electron system (like Sr₂IrO₄), is whether the spin-orbit interaction may also act in conjunction or competition with the Mott strong correlation and determine unusual ground-state properties.

In this work a three-orbital Hubbard model is taken as playground to study 5d-electron physics. We map the phase-diagram as a function of the spin-orbit and electronic correlation within the framework of the slave-spins mean-field approximation. The out coming behaviour is used to cast some light over the physical behaviour of Sr₂IrO₄

Keywords: Slave spins, Spin orbit, Mott insulator

*Speaker

Continuous-time quantum Monte Carlo study of the asymmetric Hubbard model

Yehua Liu * ¹

¹ Eidgenössische Technische Hochschule Zürich (ETH Zürich) – Hauptgebäude Rämistrasse 101 8092
Zürich Schweiz Telefon: +41 44 632 11 11 Telefax: +41 44 632 10 10, Switzerland

We present sign-problem-free continuous-time quantum Monte Carlo methods for asymmetric Hubbard models on bipartite lattices at half-filling, where the two spin species have different hopping constants. For a demonstration, we simulate the ground-state phase diagram on the honeycomb lattice. The results connect the known exact solution of the Falicov-Kimball model and quantum Monte Carlo simulations of the SU(2)-symmetric Hubbard model.

Keywords: Monte Carlo, Hubbard Model

*Speaker

Functional renormalization for unconventional Fermi surface instabilities

Mario Fink * ¹

¹ Institute for Theoretical Physics and Astrophysics, University of Würzburg (ITPA Uni Wü) – Am Hubland 97074 Würzburg, Germany

The functional renormalization group has been successfully employed to describe the pairing mechanism in e.g. the cuprates and iron pnictides. For the latter, the expansion to multi-orbital models proved both necessary and revealing, providing a concise microscopic understanding of the extended s-wave order parameter. As another aspect of complexity of the electronic band structure, spin-orbit coupling (SOC) has been identified as an essential ingredient for the appearance of topological superconductors and further intricate unconventional Fermi surface instabilities. We present an expanded scheme of the functional renormalization group that incorporates the coupling between orbital and spin degrees of freedom. We consider atomic SOC as well as Rashba SOC in order to explore unconventional phases that mix singlet and triplet pairing instabilities in the particle-particle and the particle-hole channel. We illustrate our approach at the example of representative two-orbital spin-orbit models.

Keywords: Unconventional superconductivity, Spin orbit coupling, Functional renormalization

*Speaker

Zigzag phases within extended Kitaev-Heisenberg model for layered honeycomb iridates - an exact diagonalization study

Juraj Rusnacko * ¹

¹ Faculty of science, Masaryk University Brno (MUNI) – Kotlářská 267/2, 602 00 Brno, Czech Republic

Mutual interactions among magnetic moments in magnetic materials are usually of Heisenberg type and thus isotropic in spin space. In Mott insulators containing ions characterized by a large spin-orbit coupling, the on-site entanglement of spin and orbital degrees of freedom translates the bond-directional nature of orbitals into bond-anisotropy of the interactions. Direct evidence for such bond-anisotropic interactions has been found recently in layered honeycomb iridate Na₂IrO₃ [1].

We study the corresponding spin model containing all the symmetry-allowed nearest-neighbor interaction terms. Our focus is on the experimentally relevant ordered phases characterized by a zigzag type of magnetic order. By employing exact diagonalization on 24-site cluster, we identify the extent of these phases within the global phase diagram of the model and analyze them paying particular attention to the ordered moment direction that can be compared to the recent experimental data [1].

1. S.H. Chun et al., Nature Physics <http://dx.doi.org/10.1038/nphys3322> (2015).

Keywords: iridates, magnetic order, heisenberg model, kitaev model, zigzag phase

*Speaker

Propagation of the spin-orbit exciton due to the Jahn-Teller effect in systems with strong on-site spin-orbit coupling

Ekaterina Plotnikova ^{*† 1}, Maria Daghofer ², Jeroen Van Den Brink ¹,
Krzysztof Wohlfeld ^{3,4}

¹ Leibniz Institute for Solid State and Materials Research - IFW Dresden (Dresden, Germany) –
Germany

² University of Stuttgart – Germany

³ Stanford University and SLAC laboratory – United States

⁴ Institute for Theoretical Physics, University of Warsaw – Poland

Peculiar quantum phenomena arising in transition metal oxides with partly filled 3d shells, as e.g. in the manganites (colossal magnetoresistance) or cuprates (high temperature superconductivity), owe their existence to the interplay between the kinetic energy of the electrons, strong electron-electron repulsion, and electron-phonon interaction.

In the oxides with partially filled 5d shells, this interplay is even more interesting – the on-site (relativistic) spin-orbit coupling is far larger than in the 3d systems and can no longer be neglected. However, unlike in the 3d case, so far the electron-phonon coupling has been assumed to be weak and has not been included in the studies of these systems.

Nevertheless, we show that even relatively weak electron-phonon coupling may lead to qualitatively different physics of the 5d oxides than the one discussed so far. Thus, we derive the effective interaction between the j ‘spin-orbit’ coupled isospins which follows from the orbital-only interaction induced by the cooperative Jahn-Teller effect. Next, we show that such interaction may, inter alia, lead to a novel type of propagation of the $j = 3/2$ spin-orbit exciton in the ordered $j = 1/2$ antiferromagnet which, unlike in the pure superexchange model, does not require coupling to the $j = 1/2$ ‘magnon’ excitations. The influence of Jahn-Teller effect on collective behaviour of electrons such as spin-orbital exciton in the 5d 5 materials is a topic of a great interest and can lead to a better understanding of recent experimental works, e.g. RIXS.

Keywords: Spin, orbit coupling, strong correlations, Jahn, Teller effect, superexchange, RIXS

*Speaker

†Corresponding author: ekaterina.plotnikova@ifw-dresden.de

Terahertz and infrared conductivity of selected Dirac materials

Artem Pronin * ¹

¹ 1. Physikalisches Institut, Universitaet Stuttgart – Germany

The interest to the measurements of optical conductivity, OC, in materials with Dirac fermions [i.e. the electrons with their (pseudo)spin locked to their momentum] is dictated by the fact that the optical conductivity of such systems is expected to demonstrate a peculiar behaviour: the interband OC should follow a power-law frequency dependence with the exponent $(d - 2)/z$, where d is the dimension of the system and z is the exponent in the band-dispersion relation, $E(k) \sim k^z$.

For example, for a 3D Dirac system, OC should be linear in frequency. Such behaviour is quite unusual for common metals and semiconductors. From the onset point of the linear conductivity, one can directly obtain the value of the gap. This is not a trivial task for ARPES, the currently major method used to establish the Dirac physics in a material. As the gaps in such systems are expected to be very small (below at least 0.1 eV), if existing at all, standard ARPES resolution is not sufficient to be able to resolve them. Further, the slop of linear OC is directly related to the Fermi velocity v_F of Dirac fermions. Thus, measurements at (far)infrared frequencies allow an independent determination of v_F for a Dirac material.

In the presentation, our recent THz and infrared conductivity measurements performed on 3D Dirac systems (such as Cd₃As₂ and SrMnBi₂) will be presented and compared to results obtained on topological insulators (i.e. 2D Dirac systems).

Keywords: 3D Dirac systems, optical conductivity

*Speaker

Magnetic hourglass dispersion and its relation to high-temperature superconductivity in iron- and pressure-tuned $\text{Fe}_{1+y}\text{Te}_{0.7}\text{Se}_{0.3}$

Diane Lancon * ¹, Nikolay Tsyruhin , Martin Böhm , Romain Viennois , Saba Zabihzadeh , Anna Kusmartseva , Enrico Giannini , Henrik Ronnow

¹ Laboratory for Quantum Magnetism, EPFL (LQM, EPFL) – LQM-ICMP-EPFL Station 3 1015
Lausanne, Switzerland

Iron based high temperature superconductors have several common features with superconducting cuprates, including the square lattice and the proximity to an antiferromagnetic phase. The magnetic excitation spectrum below T_c shows an hourglass-shaped dispersion with a resonance around the commensurate point . In a previous inelastic neutron scattering study, we showed that the hourglass-shaped dispersion is most likely a prerequisite for superconductivity, while the consequences are the opening of a gap and a shift of spectral weight. We followed the evolution of the hourglass shaped dispersion under applied pressure up to 12 kbar. Our results show that the pressure-induced 37% increase of T_c is concomitant with a change in the magnetic excitation spectrum, with an increase of the hourglass energy by 38%.

Keywords: iron based superconductors

*Speaker

Metallic states at ferroelectric BaTiO₃ film surfaces

Stefan Muff ^{*} ^{1,2}, Nicolas Pilet ², Mauro Fanciulli ^{1,2}, Gabriel Landolt ^{2,3},
Zoran Ristic ², Nicholas Plumb ², Milan Radovic ^{2,4}, Hugo Dil ^{1,2}

¹ Institut de Physique de la Matière Condensée (ICMP-EPFL) – Ecole Polytechnique Fédérale de Lausanne, CH-1015 Lausanne, Switzerland

² Swiss Light Source (SLS-PSI) – Paul Scherrer Institut, 5232 Villigen PSI, Switzerland

³ Physik Institut Universität Zürich (UZH) – Universität Zürich, Winterthurerstrasse 190, 8057 Zürich, Switzerland

⁴ SwissFEL (PSI) – Paul Scherrer Institut, 5232 Villigen PSI, Switzerland

The transition metal oxide BaTiO₃ is well known as a ferroelectric with a high dielectric constant. Although it is completely transparent and insulating, transport measurements of the clean surface have shown the existence of a conducting layer for substrates polarized in out of plane direction [1]. In our recent experiments, we studied films of BaTiO₃ with different thicknesses grown with pulsed laser deposition on multiple substrates by the help of angle-resolved photoelectrons spectroscopy. We are able to directly map the existence of a metallic state at the clean surface of all of the prepared films. These states appear after exposing the surface to UV light for a couple of minutes and stay for hours once they are established. In contrast to the two dimensional states, observed at the surface of the closely related compounds SrTiO₃ [2,3,4] and KTaO₃ [5,6], the states at the surface of BaTiO₃ have a three dimensional dispersion. The ferroelectricity of our films is verified with piezo response force microscopy. The films show no intrinsic polarization but have a preferred, stable polarization direction in out of plane direction.

The population of these metallic states under UV radiation is most likely related to a polarization of the surface by the UV light. This is in agreement with the transport measurements mentioned above [1]. The direct observation of metallic states at the surface of a ferroelectric material and the linking of their presence with ferroelectric polarization will improve our understanding of the observed transport phenomena and paves the way towards ferroelectric transport control in these materials.

References:

1. Y. Urakami et al., *Ferroelectrics* 346, 32-36 (2007)
2. A.F. Santander-Syro et al., *Nature* 469, 189 (2011).
3. N.C. Plumb et al. *Phys. Rev. Lett.* 113, 086801 (2014).
4. A.F. Santander-Syro et al., *Nature Mater.* 13, 1085-10901 (2014)
5. P.D.C. King et al., *Phys. Rev. Lett.* 108, 117602 (2012).
6. A.F. Santander-Syro et al., *Phys. Rev. B.* 86, 121107(R) (2012).

Keywords: transition metal oxides, ferroelectricity, surface states, film, arpes

*Speaker

Flux threaded p-wave loop under the Coulomb blockade regime

Rosa Rodriguez Mota * ¹, Tami Pereg-Barnea ¹, Vishveshwara Smitha ²

¹ McGill University – 740 Dr Penfield Avenue, Montréal QC, Canada

² University of Illinois at Urbana Champaign (UIUC) – University of Illinois at Urbana-Champaign •
College of Engineering Department of Computer Science 201 North Goodwin Avenue Urbana, IL
61801-2302 webmaster@cs.illinois.edu, United States

Topological superconductors have gathered the attention of the scientific community due to their capability of holding excitations that obey non-Abelian statistics, called Majorana modes. Despite growing evidence of their existence, Majorana modes have not been unequivocally detected. The existence of Majorana modes can have important consequences in the transport properties of the superconductor. An example of this is the doubling of the periodicity of the current vs phase/flux relation across a tunnelling junction, known as the 4π Josephson effect. In this work, we study a Coulomb blockaded topological p-wave loop with the aim of providing feasible ways to detect Majorana modes. We discuss the relation between our results and the 4π Josephson effect. Our results could also add to the discussion of how to use Majorana modes for quantum computation.

Keywords: Topological Superconductors, Coulomb Blockade, Majorana Modes, 4π Josephson Effect

*Speaker

Pyrochlore 5d transition metal oxides explored by state of the art scattering techniques

Marein Rahn * ¹

¹ University of Oxford (UK) (<http://xray.physics.ox.ac.uk/boothroyd/>) – Clarendon Laboratory, Parks Road OX13PU UK, United Kingdom

I plan to present an overview of key results of my PhD work. I will summarise the key questions, technical and conceptual hurdles and will present data from neutron and resonant x-ray scattering studies on iridates and osmates.

Keywords: osmate iridate pyrochlore

*Speaker

Self-consistent calculations of magnon-magnon interactions in Heisenberg antiferromagnets

Alex Kruchkov ^{*† 1}, Henrik Ronnow ¹, Mike Zhitomirsky ²

¹ Ecole Polytechnique Fédérale de Lausanne (EPFL) – Swiss Federal Institute of Technology
EPFL-FSTI IEL-LTS2, Station 11 Lausanne 1015 - Switzerland, Switzerland

² Institut Nanosciences et Cryogénie (ex DRFMC) (INAC) – CEA – Grenoble, France

The discovery of quantum anomaly in the magnetic spectrum along zone boundary in square lattice antiferromagnets has stimulated significant interest in the topic during the last decade [Christensen et al, PNAS 104, 39 (2007); Headings et al., Phys. Rev. Lett. 105,247001 (2010)]. In parallel, predictions have been made that in high magnetic field magnons may spontaneously decay for certain regions of wave vectors [Fuhrman et al, Phys. Rev. B 85, 184405 (2012)]. Here we present self-consistent treatment of spin-wave interactions, aiming to explore links between these two phenomena. In our current work, we study magnetic-field influence on the anomaly within the non-linear spin wave theory. We consider the Heisenberg Hamiltonian to be bozonized up to fourth order in terms of bose operators. The technique is implemented numerically both on-shell and off-shell.

Keywords: Heisenberg antiferromagnet, magnetic excitations, anomaly, non, linear spin wave theory, magnon pairs, external magnetic field, dynamical structure factor

*Speaker

†Corresponding author: alex.kruchkov@epfl.ch

Quantum phase transitions and anomalous Hall effect in a pyrochlore Kondo Lattice

Sarah Grefe ^{*† 1}, Wenxin Ding ¹, Qimiao Si

¹ Rice University [Houston] – 6100 Main St., MS-61, Houston, Texas 77005, United States

Motivated by the recent experimental evidence for a possible chiral spin liquid phase in the metallic pyrochlore heavy fermion iridates (Pr₂Ir₂O₇) as well as quantum critical behavior in this system [Nat. Mater. 13, 356 (2014)], we study the effect of Kondo coupling on various spin liquid states of the Heisenberg model on pyrochlore lattices. Using a slave fermion representation for the f-moments which are coupled to conduction electrons, we study the large-N limit to determine the ground state energies of various feasible states and map out the zero-temperature phase diagram. We show that this mechanism leads to a large anomalous Hall effect, on the order comparable to the experimental observation. Moreover, across the quantum phase transition from the Kondo destroyed phase to the Kondo screened phase, the anomalous Hall effect displays an intriguing jump.

Keywords: Kondo effect, frustrated magnetism, pyrochlore iridates, quantum spin liquids, anomalous hall effect

*Speaker

†Corresponding author: seg5@rice.edu

Hybridization gap and Sm valence variation in SmB6 studied by Raman scattering spectroscopy

Michael Valentine * ¹, Seyed Koohpayeh ¹, William Phelan ¹, Tyrel Mcqueen ¹, Collin Broholm ¹, Natalia Drichko ¹, Xiangfeng Wang ², Yasuyuki Nakajima ², Johnpierre Paglione ², Priscila Rosa ³, Zachary Fisk ³

¹ Johns Hopkins University (JHU) – Baltimore, USA, United States

² Department of Physics [Maryland] (UMD) – University of Maryland College Park, MD 20742-4111, United States

³ University of California, Irvine (UCI) – United States

SmB6 is proposed as an example of a topological Kondo insulator, where its topological insulator properties can be tuned by tuning Sm valence [1]. In order to find an influence of average Sm valence and carbon doping on the size of hybridization gap in the bulk, we used Raman scattering technique at temperatures from 300 to 10 K. The study was done for SmB6 samples grown with different techniques, as well as those Sm deficient and doped with carbon. In the electronic Raman spectra below 100 K we observe an appearance of a maximum at about 100 meV, assigned to intra-band excitations from hybridized d-f states to unoccupied 5d states [2]. These intra-band excitations shift to lower frequencies on the increase Sm valence. At temperatures below 50 K we observe an opening of a gap at about 40 meV, associated with the hybridization gap [3]. The Raman feature of the hybridization gap is suppressed in samples disordered due to doping. While analysis of Raman active phonons points on high disorder in all the samples, an intensity of a Sm Raman-forbidden phonon at 10 meV can characterize the number Sm vacancies.

References

1. V. Alexandrov, M. Dzero, P. Coleman. Phys. Rev. Lett. 111, 226403 (2013).
2. V. N. Antonov, B. N. Harmon, and A. N. Yaresko. Phys. Rev. B 66, 165209 (2002)
3. P. Nyhus, S. L. Cooper, Z. Fisk and J. Sarrao. Phys. Rev. B, 52, R14308 (1998).

Keywords: topological kondo insulator

*Speaker

X-boson cumulant approach to the multiplet level systems: study of the first order transition when $J=5/2$

Edwin Ramos Rodríguez * ¹

¹ Instituto de Física, Universidade Federal Fluminense (IF.UFF) RJ-Brasil (Instituto de Física, IF-UFF) – Av. Gal. Milton Tavares de Souza s/n°. Gragoatá, Niterói, 24210-346, Brasil, Brazil

In this work we present a generalization of our previous research with the X-boson approach to the periodic Anderson model (PAM) [1],[2] adequate to study multiplet level systems. The work has a strong appeal to describe a novel class of intermetallic 4f and 5f orbitals materials: the topological Kondo insulators, whose paradigmatic material is the compound SmB6. For simplicity, we consider a version of the PAM on a 2D square lattice, adequate to describe Cerium(Ce) based compounds in two dimensions. The starting point of the model is the 4f Ce ions orbitals, with $J = 5/2$ multiplet, in the presence of spin-orbit coupling and crystal field splitting. Our technique works well for all parameters of the model and avoids the unwanted phase transitions of the slave boson mean field theory (SBMFT)[3]. Considering for simplicity, the G7 Kramers doublet in a 2D square lattice, we obtain a new valence first order transition which we attribute to the particular k dependence of the G7 Kramers doublet in a 2D square lattice, we obtain a new valence first order transition. Kramers doublet in a 2D square lattice, we obtain a new valence first order transition which we attribute to the particular k dependence of the G7 symmetry Doublet.

We present an analysis of the hysteresis exhibited by the occupation number curves as a function of the chemical potential. We also calculate the Helmholtz free energy in order to characterize this first order transition. We think that it can be associated with the first order phase transition of the Cerium volume collapse problem. [4].

References

1. R. Franco, M. S. Figueira and M. E. Foglio Phys. Rev. B, 66 045112 (2002)
2. E. Ramos, R. Franco, J. Silva-Valencia, M. E. Foglio and M. S. Figueira, Journal of Physics: Conference series 568 052007 (2014)
3. P Coleman Phys. Rev. B 29 3035 (1984)
4. J.W. Allen and R.M. Martin, Phys. Rev. Lett . 49 , 1106 (1982) , 1106 (1982)

Keywords: Topological Kondo Insulators, Kondo effect, phase transition.

*Speaker

Influence of Multi-Orbitals, Hund's Coupling and Electronic Correlations on Electronic Spectrum in Iron Based Superconductors

Ajay Ajay * ¹, Luxmi Rani

¹ Indian Institute of Technology Roorkee India (IIT Roorkee India) – Dept. of Applied Science Engineering IIT Roorkee, Saharanpur campus-247001, UP., India

To analyse the influence of Multi orbitals, Hund's coupling and electronic correlations on electronic properties, the recent Angle Resolved Photoemission Spectroscopic (ARPES) and Scanning Tunnelling Microscopic measurements (STM) have provided an important insight into the nature of electronic states close to Fermi level in Iron Based superconductors [1-4]. Motivated from these facts, we present a theoretical study of the electronic spectral function and quasi-particle energy dispersion within two orbital (dxz, dyz) and three orbital (dxz, dyz & dxy) per site of Fe-atom for iron pnictide LaFeAs(O, F) Superconductors. Two orbital and three orbital tight binding Hamiltonian model contain various orbitals hopping energies, onsite Coulomb electronic correlations and Hund's coupling energy in Fe 3d orbitals. The expressions of single particle spectral function and quasi-particle energy dispersion within BCS-mean-field Green's function approach for superconducting state of iron pnictides have been obtained. The electronic spectral function at different points of the Brillouin zone is numerically calculated for extended s-wave pairing symmetry as a function of various model parameters applicable for these systems. It is found that a well-defined three peak electronic spectra is observed at X(0,) point of Brillouin zone while the electronic spectra show two peaks due to crossing of electronic state at -point. The presence of third dxy orbital dominates three band electronic states near the Fermi level only at X point of BZ. It is also predicted that intra-orbital Coulomb correlation suppress electronic states near the Fermi level at (0, 0) and (0,) momentum point while at (0,0) point, second quasi-particle peak shows suppression in spectral weight in three orbital model while an increment in spectral weight in two orbital model [6-9]. The band structure has also been analysed theoretically at different point of Brillouin Zone in two orbital and three orbital models and viewed in terms of existing ARPES and STM measurements in iron based superconductors.

References:

1. Y. Kamihara, T. Watanabe, M. Hirano, and H. Hosono; J. Am. Chem. Soc. 130, 3296 (2008).
2. D. H. Lu, et al.; Nature 455, 81-84 (2008).
3. S. Raghu et al.; Phys. Rev. B 77, 220503R (2008).
4. M. Daghofer, A. Nicholson, A. Moreo, and E. Dagotto; Phys. Rev. B 81, 014511 (2010).
5. I. I. Mazin, D. J. Singh, M. D. Johannes, and M. H. Du; Phys. Rev. Lett. 101, 057003 (2008).
6. T. Hanaguri et al.; Phys Rev. B 85 214505 (2012).
7. L. Rani and Ajay; J. Supercond. Nov. Magn. 26, 527-538 (2013).
8. L. Rani and Ajay; Material Express Vol. 4, No. 5, 400-415 (2014).
9. L. Rani and Ajay; Physica C (Superconductivity & Its applications), 510, 31-41 (2015)

Keywords: Key words: Electronic band structure in Iron pnictides, Electronic correlations & Hund's Coupling

*Speaker

Electronic structure studies of CeMIn₅(M=Co, Rh) by soft x-ray angle-resolved photoemission spectroscopy

Rui Peng * ¹

¹ Fudan University [Shanghai] – Shanghai, Yangpu, China

TBA

Keywords: CeMIn₅, x, ray

*Speaker

Signature of high temperature superconductivity in electron doped Sr₂IrO₄

Haichao Xu * ¹

¹ Fudan University [Shanghai] – Shanghai, Yangpu, China

TBA

Keywords: high temperature superconductivity, Sr₂IrO₄

*Speaker

ESR on iridates

Stephan Fuchs * ¹

¹ Stephan Fuchs – Germany

Iridates are a playground for new condensed matter physics due to its very strong spin orbit coupling. Some fascinating effects are for example spin-mott insulators or spin-liquids. High field ESR herefor provides a very sensitive method to detect important magnetic properties like the gyromagnetic tensor. This text will be fulfilled later on.

Keywords: iridates, ESR

*Speaker

Ground state and low-energy magnetic dynamics in the frustrated magnet CoAl₂O₄ as revealed by local spin probes

Stephan Zimmermann * ^{1,2}

¹ Leibniz Institute for Solid State and Materials Research Dresden (IFW Dresden) – IFW Dresden
Helmholtzstraße 20 01069 Dresden, Germany

² Technische Universität Dresden (TUD) – TU Dresden 01062 Dresden, Germany

We report a combined experimental study of magnetic properties of a single crystal of the frustrated diamond lattice antiferromagnet CoAl₂O₄ with Co²⁺ electron spin resonance, ²⁷Al nuclear magnetic resonance, and muon spin rotation/relaxation techniques. With our local probes, we show that the frustration of spin interactions and the Co/Al site disorder strongly affect the spin dynamics. The experimental results evidence inhomogeneous and slow magnetic fluctuations and the occurrence of short-range electron spin correlations far above a characteristic temperature $T^* = 8$ K at which the spin system turns into a quasistatic state. Our data indicate that this spin order is likely short range and unconventional with spin fluctuations persistent even at temperature far below T^* . The results of three spectroscopy techniques highlight a nontrivial role of structural disorder for the magnetism of a frustrated diamond spin lattice at the proximity to the critical point.

References

M. Iakovleva, E. Vavilova, H.-J. Grafe, S. Zimmermann, A. Alfonsov, H. Luetkens, H.-H. Klauss, A. Maljuk, S. Wurmehl, B. Buechner, V. Kataev; Phys. Rev. B 91 (2015) Nr. 14, S. 144419 (<http://dx.doi.org/10.1103/PhysRevB.91.144419>)

Keywords: quantum spin magnets, frustration, electron spin resonance, nuclear magnetic resonance, muon spin resonance

*Speaker

Unusually large Weyl fermion pockets in topological semimetal NbP

Zhen Wang * ¹

¹ Zhejiang University – 866 Yuhangtang Road * Hangzhou * Zhejiang Province * 310058 * P. R. China, China

Noncentrosymmetric transition metal monpnictides are emerging Weyl semimetals (WSMs) with exotic physical properties. Although chiral WSM states have been observed in TaAs, there is no conclusive evidence to correlate the extremely large magnetoresistance and ultrahigh mobility of NbP to the topological electronic structure. Here, we use angle-dependent quantum oscillations to probe the Fermi surface of high quality NbP single crystals with exceptional carrier mobility of $107 \text{ cm}^2\text{V}^{-1}\text{s}^{-1}$ at 1.5 K. We unambiguously show that NbP has four large electron pockets enclosing the WSM nodes in the $k_z=0$ plane near the high symmetry points of Γ , coexisting with the small Weyl fermion pockets in the $k_z=0.579/c$ plane. The large WSM electron pockets are highly anisotropic in k space and approaching the parabolic band top along the internode direction, manifested as a strong phase offset to the non-trivial Berry's phase of π in quantum oscillations. Chiral anomaly induced negative magnetoresistance, which is another quantum signature of Weyl fermions, has also been demonstrated. Our results suggest NbP as a fascinating platform for studying Weyl fermion physics and novel WSM-based device applications.

Keywords: Weyl semimetals, Negative magnetoresistance, Quantum oscillation

*Speaker

Preparation and characterization of $\text{Sr}_2\text{Y}_{1-x}\text{Ir}_{1+x}\text{O}_6$ materials

Gizem Cansever * ¹

¹ Leibniz Institute for Solid State Research, IFW Dresden – Helmholtzstraße 20 D-01069 Dresden,
Germany

TBA

Keywords: strontium iridium

*Speaker

Coherent control of magnetic excitations through resonant lattice stimulation in materials with strong spin-orbit coupling.

Tobia Nova * ¹

¹ Max Planck Institute for the Structure and the Dynamics of Matter – Germany

The excitation of a spin-wave in the rare-earth orthoferrite ErFeO₃ is achieved by resonantly driving an high energy optical phonon with intense mid-IR pulses.

Keywords: phonon, magnon, mid, IR

*Speaker

Charged Skyrmions on the Surface of a Topological Insulator

Hilary Hurst ^{*† 1,2}, Dmitry Efimkin ^{1,2}, Jiadong Zang ³, Victor Galitski ^{1,2}

¹ Joint Quantum Institute and Condensed Matter Theory Center, Department of Physics (UMD) – University of Maryland College Park, MD 20742-4111, United States

² School of Physics (Monash) – Monash University, Melbourne, Victoria 3800, Australia

³ Institute for Quantum Matter, Department of Physics and Astronomy (JHU) – Johns Hopkins University, Baltimore, Maryland, 21218, United States

We consider the interplay between magnetic skyrmions in an insulating thin film and the Dirac surface states of a 3D topological insulator (TI), coupled by proximity effect. The magnetic texture of skyrmions can lead to confinement of Dirac states at the skyrmion radius, where out of plane magnetization vanishes. This confinement can result in charging of the skyrmion texture. The presence of bound states is robust in an external magnetic field, which is needed to stabilize skyrmions. It is expected that, for relevant experimental parameters, skyrmions will have a few bound states that can be tuned using an external magnetic field. We argue that these charged skyrmions can be manipulated directly by an electric field, with skyrmion mobility proportional to the number of bound states at the skyrmion radius. Coupling skyrmionic thin films to a TI surface can provide a more direct and efficient way of controlling skyrmion motion in insulating materials. This provides a different dimension in the study of skyrmion manipulation. 10.1103/PhysRevB.91.060401

Keywords: topological insulators, skyrmions, magnetic thin films

*Speaker

†Corresponding author: hhurst@umd.edu

Correlations in a Weyl semimetal

Sergueï Tchoumakov * ¹

¹ LPS, Orsay – LPS – France

TBA

Keywords: Weyl, interactions

*Speaker

Ultrafast electronic dynamics in 3D topological insulator investigated by time-resolved and circular dichroism ARPES

Davide Bugini ^{*† 1}, Claudia Dallera ¹, Hamoon Roodsari ¹, Giulio Cerullo ¹, Cristian Manzoni ², Fabio Boschini ³, Ettore Carpene ², Hemian Yi ⁴, Xingjiang Zhou ⁴, Chaoyu Chen ⁴

¹ Politecnico di Milano [Milan] (Polimi) – Piazza Leonardo da Vinci, 32 20133 Milano, Italy

² Istituto di fotonica e nanotecnologie - CNR (IFN-CNR) – piazza Leonardo da Vinci 32 20133 Milano, Italy

³ The University of British Columbia [Vancouver] (UBC) – 2329 West Mall Vancouver, B.C. V6T 1Z4, Canada

⁴ Beijing National Laboratory for Condensed Matter Physics – China

Topological Insulators (TI) represent a charming hot-topic both for basic physics and for promising applications because of the in-plane spin-polarized surface states (TSS) arising within the bulk insulating energy gap. The backscattering protection and the control of the spin polarization using ultrashort light pulses opens new scenarios in the use of this class of materials for future opto-spintronic devices.

Using time- and angle-resolved photoemission spectroscopy on Bi₂Se₃, the prototypical 3D TI, we studied for the first time the ultrafast dynamics of the circular dichroism of the second TSS i.e. the ultrafast response of photoexcited TSS to ultrashort circularly-polarized pulses. The dichroic signal shows a k -dependent temporal evolution that suggests a flow of spin-ordered electrons along the linear dispersive branch to the center of the Brillouin zone. We found that the dichroism decays in few tens of femtoseconds while the electronic population decays in 120 fs. The spin-order of the second TSS is rapidly lost by interactions with the unpolarized bulk band electrons. We believe that our findings have to be taken into account to better understand the recently reported time-resolved magneto-optical results in which the spin signal relaxes much faster than the charge one.

We also found an unexpected dichroic signal coming from the first Image Potential State (IPS). This is the first evidence of an exotic order parameter involving spin from the first IPS that opens novel questions about its origin.

Keywords: Topological insulators, time, resolved ARPES, circular dichroism, ultrafast dynamics

*Speaker

†Corresponding author: davide.bugini@polimi.it

Magnetism of $j=1/2$ moments on the fcc lattice in double perovskite Mott insulators

Ashley Cook * ¹, Stephanie Matern , Ciaran Hickey , Adam Aczel , Arun Paramakanti

¹ Department of Physics - University of Toronto (UofT) – Department of Physics - University of Toronto - 60 St. George St. - Toronto, Ontario - CANADA - M5S 1A7, Canada

Motivated by studies of Mott insulating double perovskites $\text{La}_2\text{ZnIrO}_6$ and $\text{La}_2\text{MgIrO}_6$, we consider magnetism of spin-orbit coupled $j=1/2$ iridium moments on the geometrically frustrated face-centered cubic (fcc) lattice. Symmetry dictates that the nearest-neighbor exchange interaction includes, in addition to a Heisenberg term, compass-type and symmetric off-diagonal exchange couplings. Using a combination of Luttinger-Tisza and simulated annealing, we find a rich variety of magnetic phases, including collinear A-type antiferromagnetism as in $\text{La}_2\text{ZnIrO}_6$ and $\text{La}_2\text{MgIrO}_6$, collinear stripe order with moments along the $\{111\}/\{\bar{1}\bar{1}\bar{1}\}$ directions, and incommensurate non-coplanar multimode spirals. Using Monte Carlo simulations, we determine the magnetic transition temperature in these phases, and discuss experimental implications for $\text{La}_2\text{ZnIrO}_6$ and $\text{La}_2\text{MgIrO}_6$.

Keywords: double perovskites, transition metal oxides, fcc, iridates, Mott, spin, orbit coupling

*Speaker

Author Index

- Aczel, Adam, 11, 41
Adler, Florian, 5
Ajay, Ajay, 30
Allan, Milan, 14
Aulbach, Julian, 5
- Böhm, Martin, 22
Battisti, Irene, 14
Bauer, Eric, 10
Baumbach, Ryan, 10
Blumberg, Girsh, 10
Boschini, Fabio, 40
Broholm, Collin, 28
Bugini, Davide, 40
- Cansever, Gizem, 36
Carpene, Ettore, 40
Cerullo, Giulio, 40
Chen, Chaoyu, 40
Cilento, Federico, 2
Claessen, Ralph, 5
Coleman, Piers, 9
Cook, Ashley, 11, 41
Crepaldi, Alberto, 2
- Daghofer, Maria, 20
Dallera, Claudia, 40
Dil, Hugo, 23
Ding, Wenxin, 27
Drichko, Natalia, 28
- Efimkin, Dmitry, 38
- Fanciulli, Mauro, 23
Fink, Mario, 18
Fisk, Zachary, 28
Fuchs, Stephan, 33
- Galitski, Victor, 38
Giannini, Enrico, 22
Glass, Stefan, 5
Grefe, Sarah, 27
- Hanke, Werner, 5
Haule, Kristjan, 10
Hickey, Ciaran, 11, 41
- Hurst, Hilary, 38
- Kaladzhyan, Vardan, 6
Koohpayeh, Seyed, 28
Kruchkov, Alex, 26
Kung, Hsiang-Hsi, 10
Kusmartseva, Anna, 22
- Lancon, Diane, 22
Landolt, Gabriel, 23
Li, Gang, 5
Liang, Du, 15
Liu, Yehua, 17
- Ménard, Gerbold, 3
Manzoni, Cristian, 40
Manzoni, Giulia, 2
Matern, Stephanie, 11, 41
McQueen, Tyrel, 28
Muff, Stefan, 23
Mydosh, John, 10
- Najera, Oscar, 16
Nakajima, Yasuyuki, 28
Natori, Willian, 12
nova, tobia, 37
- Paglione, Johnpierre, 28
Paramekanti, Arun, 11, 41
Parmigiani, Fulvio, 2
Peng, Rui, 31
Pereg-Barnea, Tami, 24
Phelan, William, 28
Pilet, Nicolas, 23
Plotnikova, Ekaterina, 20
Plumb, Nicholas, 23
Pronin, Artem, 21
- Radovic, Milan, 23
Rahn, Marein, 25
Ramires Neves de Oliveira, Aline, 9
Ramos Rodríguez, Edwin, 29
Rani, Luxmi, 30
Ristic, Zoran, 23
Rodriguez Mota, Rosa, 24

Ronnow, Henrik, 22, 26
Roodsari, Hamoon, 40
Rosa, Priscila, 28
Rusnacko, Juraj, 19

Schäfer, Jörg, 5
Scheurer, Mathias, 8
Schmalian, Jörg, 8
Schuetz, Philipp, 7
Si, Qimiao, 27
Smitha, Vishveshwara, 24
sterzi, andrea, 2

Tchoumakov, Sergueï, 39
Thorsmolle, Verner, 10
Trebst, Simon, 11
Tsyruhin, Nikolay, 22

Valentine, Michael, 28
van den Brink, Jeroen, 20
Viennois, Romain, 22
Vincent, Sacksteder, 15

Wang, Xiangfeng, 28
Wang, Zhen, 35
WANG, Zhiming, 4
wohlfeld, krzysztof, 20
Wu, QuanSheng, 15

Xu, Haichao, 32

Yan, Yuan, 13
Yi, Hemian, 40

Zabihzadeh, Saba, 22
Zacchigna, Michele, 2
Zang, Jiadong, 38
Zhang, Wei-Lu, 10
Zhitomirsky, Mike, 26
Zhou, Xingjiang, 40
Zimmermann, Stephan, 34