MaNEP

This session has been organised in conjunction with the Association MaNEP.

Monday, 30.06.2014, Room G 140

Time	ID	**MaNEP I** *Chair: Thierry Giamarchi, Uni Genève*
13:45	**101**	**The tunable 2D topological insulator (TI) system InAs/GaSb** *Werner Wegscheider, Christophe Charpentier, Stefan Fält, Christian Reichl, Fabrizio Nichele, Atindra Nath Pal, Patrick Pietsch, Thomas Ihn, Klaus Ensslin* *Laboratory for Solid State Physics, ETH Zürich, Otto-Stern-Weg 1, 8093 Zürich* Combined quantum wells composed of adjacent InAs and GaSb layers offer the unique advantage that, as a consequence of the spatial separation of electron and hole wave functions, the resulting state of matter, i.e. a 2D TI, a conventional insulator or a metal, becomes electric-field tuneable. In this talk I will present growth investigations of InAs/GaSb heterostructures and correlate these with the transport properties of the 2D TI system. In gate-tunable structures we observe the crossover from electron to hole transport. At the charge neutrality point a giant nonlocal response, indicative for the presence of helical quantum Hall edge channels, is observed under strong perpendicular magnetic fields.
14:15	**102**	**Correlation effects in electron-doped metal-organic complexes** *Pietro Gambardella, Department of Materials, ETHZ, Hönggerbergring 64, 8093 Zürich* The electronic properties of metal-organic interfaces are defined, to a great extent, by the competition between intramolecular interactions and hybridization between the molecule and substrate electronic states. By combining scanning tunneling spectroscopy and x-ray magnetic circular dichroism measurements, we show that molecular layers on metals behave as strongly-correlated electron systems with either pure valence or mixed-valence behavior. Examples of phthalocyanine complexes with strong, weak, and zero mixed-valence character will be presented, together with a systematic investigation of the effects of electron doping on different molecular sites, leading to a consistent description of the charge and spin of metal-organic adsorbates.
14:45	**103**	**Intraribbon band gap variation** **in atomically precise graphene nanoribbon heterostructures** *Hajo Söde [1], Leopold Talirz [1], Oliver Gröning [1], Roman Fasel [1], Carlo Pignedoli [1], Klaus Müllen [2], Xinliang Feng [2], Pascal Ruffieux [1]* *[1] EMPA, Überlandstrasse 129, 8600 Dübendorf* *[2] Max Planck Institute for Polymer Research, Ackermannweg 10, DE-55124 Mainz* Here, we present armchair graphene nanoribbons (AGNR) of different lengths which have been synthesized in order to explore the length dependence of the electronic band gap. Fourier transformed STS was used to determine the band dispersion of occupied and unoccupied bands of AGNRs with various widths. Based on this data, we determined the effective masses and energy-dependent charge carrier velocities for the frontier bands. Within this research, heterostructures of different AGNRs have been studied. In addition, the experimental results are discussed by a detailed comparison with ab initio simulations of the band structure.

15:00	104	**Opto-electronics with Mono-layer Transition Metal Dichalcogenide Semiconductors** *Sanghyun Jo [1,2], Nicolas Ubrig [1], Helmuth Berger [3], Alexey B. Kuzmenko [1], Alberto F. Morpurgo [1,2]* *[1] DPMC, Université de Genève, 24, quai Ernest-Ansermet, 1211 Genève* *[2] GAP, Université de Genève, 24, quai Ernest-Ansermet, 1211 Genève* *[3] EPFL FSB LPMC, Station 3, 1015 Lausanne* We report the first ambipolar ionic liquid gated field-effect transistors based on WS_2 mono- and bi-layers, and discuss their opto-electronic properties. These devices allow us to extract the band gap of WS_2 mono- and bi-layers directly from transport measurements. In the ambipolar regime, light emission originating from electron-hole recombination is clearly observed. From the comparison of the optical transition energies and the band gaps determined from transport, we estimate quantitatively the excitonic binding energies. Our results demonstrate the power of ionic liquid gating in combination with nano-electronic systems, and the rich physics accessible in 2D semiconducting transition metal dichalcogenides.
15:15	105	**Chiral CDW in *1T*-$TiSe_2$ investigated by STM/STS** *Alessandro Scarfato [1], Anna Maria Novello [1], Alberto Ubaldini [1], Ivar Martin [2], Christoph Renner [1]* *[1] Dep. of Condensed Matter Physics, University of Geneva, 24, Quai E.-Ansermet, 1211 Geneva* *[2] Theoretical Division, Los Alamos National Laboratory, P.O. Box 1663, Los Alamos 87545, New Mexico, USA* A chiral character of the CDW in *1T*-$TiSe_2$ has been inferred from optical and STM experiments. The chirality is currently understood in terms of the superposition of three 3D-CDWs. The relative phase shift between them yields an ordered change of orientation in the stacking direction of the layers. This helical state has been identified in the Fourier Bragg peaks of STM micrographs. Here we compare the CDW registry and contrast on adjacent terraces in STM micrographs acquired across step edges. These results are not compatible with the current 3D-CDWs model, leading us to propose an alternative model.
15:30	106	**Doping nature of native defects in *1T*-$TiSe_2$** *Baptiste Hildebrand [1], Clément Didiot [1], Anna Maria Novello [2], Gaël Monney [1], Alessandro Scarfato [2], Alberto Ubaldini [2], Helmuth Berger [3], David R. Bowler [4], Christoph Renner [2], Philipp Aebi [1]* *[1] Département de physique, Université de Fribourg, Chemin du Musée 3, 1700 Fribourg* *[2] Département de physique de la Matière Condensée, University of Geneva, 24 Quai Ernest-Ansermet, 1211 Genève* *[3] Ecole Polytechnique Fédérale de Lausanne, Station 3, 1015 Lausanne* *[4] London Centre for Nanotechnology and Department of Physics and Astronomy, 17-19 Gordon Street, London WC1E 6BT, UK* The transition metal dichalcogenide *1T*-$TiSe_2$ is a quasi two-dimensional layered material with a charge density wave (CDW) transition temperature of $T_{CDW} \approx 200K$. Self-doping effects for crystals grown at different temperatures introduce structural defects, modify the temperature dependent resistivity and strongly perturbate the CDW phase. Here we study the structural and doping nature of such native defects combining scanning tunneling microscopy/spectroscopy and ab initio calculations. The dominant native single atom dopants we identify in our single crystals are intercalated Ti atoms, Se vacancies and Se substitutions by residual iodine and oxygen.
15:45	107	**Optical response of Sr_2RuO_4 reveals universal Fermi-liquid scaling and quasiparticles beyond Landau theory** *Damien Stricker, DPMC, Université de Genève, 24 Quai Ernest-Ansermet, 1211 Genève* We report optical measurements demonstrating that the low-energy relaxation rate ($1/\tau$) of the conduction electrons in Sr_2RuO_4 obeys scaling relations for its frequency (ω) and temperature (T) dependence in accordance with Fermi-liquid theory. In the thermal relaxation regime, $1/\tau \propto (\hbar\omega)^2 + (p\pi k_B T)^2$ with p = 2, and ω/T scaling applies. Many-body electronic structure calculations using dynamical mean-field theory confirm the low-energy Fermi-liquid scaling, and provide quantitative understanding of the deviations from Fermi-liquid behavior at higher energy and temperature. In this regime, evidence for electron-like 'resilient' quasiparticle excitations with a scattering rate deviating from Landau's Fermi-liquid form is presented.
16:00		***Coffee Break***

Time	ID	**MaNEP II** *Chair: Alberto Morpurgo, Uni Genève*
16:30	**111**	**Charge Stripes and Spin Density Waves, $La_{1.8}Sr_{0.2}NiO_{4+\delta}$** *Paul Freeman, EPFL SB ICMP LQM, 1015 Lausanne* *Sean Giblin, Cardiff University, School of Astronomy and Physics, Queens Building, The Parade, Cardiff CF243AA, UK* *Dharmalingam Prabhakaran, Department of Physics, University of Oxford, Clarendon Laboratory, Parks Road, Oxford OX1 3PU, UK* *Oksana Zaharko, LNS, PSI, WHGA/144, 5232 Villigen PSI* *Karel Prokes, HZB, Glienicker Straße 100, DE-14109 Berlin* Since the discovery of charge-stripe order in a cuprate, the role of the charge-stripes in cuprate superconductivity has been under intense debate [1]. Despite near three decades of research the structure of magnetic correlations still remains controversial, with charge-stripes, spin density waves or spiral structures possibilities [2]. But we do not know the magnetic structure of charge-stripe order. We present a combined µSR and neutron diffraction study of a model charge-stripe material $La_{2-x}Sr_xNiO_{4+\delta}$, that shows the spin density wave nature of the magnetic order, and discuss implications of this study with regards to the cuprates. [1] J. M. Tranquada et al. Nature (London) **375** (1995) 561. [2] N. B. Christensen et. al., Phys. Rev. Lett. **98** (2007) 197003, A. T. Savici et. al., Phys. Rev. B **66** (2002) 014524. O. P. Sushkov, Phys. Rev. B **79** (2009) 174519.
16:45	**112**	**Comprehensive study of the spin-charge interplay in antiferromagnetic $La_{2-x}Sr_xCuO_4$** *Elia Razzoli [1], Gil Drachuck [2], Amit Keren [2], Amit Kanigel [2], Galina Bazalitski [2], Christof Niedermayer [3], Ming Shi [4]* *[1] Département de physique, Université de Fribourg, Ch. du Musée 3, 1700 Fribourg* *[2] Department of Physics, Technion, Israel Institute of Technology, IL-32000 Haifa* *[3] Laboratory for Neutron Scattering, Paul Scherrer Institute, 5232 Villigen PSI* *[4] Swiss Light Source, Paul Scherrer Institute, 5232 Villigen PSI* The interplay between the pseudogap and magnetism in the cuprates remains vague. Here we investigate the newly discovered nodal gap in the cuprates using three experimental techniques applied to one $La_{2-x}Sr_xCuO_4$ single-crystal (x=1.92%). We perform ARPES measurements as a function of temperature and find a nodal gap below 45 K. Muon-spin rotation measurements ensure that the sample is indeed antiferromagnetic with a doping close, but below, the spin-glass phase boundary. Finally, our elastic neutron scattering measurements show that the nodal gap opens well below the commensurate ordering, very close to the incommensurate spin density wave ordering temperature.
17:00	**113**	**Magnetic Proximity effect in $La_{2-x}Sr_xCuO_4/La_{2/3}Ca_{1/3}MnO_3$ superlattices** *Saikat Das [1], Miguel Angel Uribe Laverde [1], Kaushik Sen [1], Ivan Marozau [1], Maria Varela [2], Neven Biskup [2], Yuri Khaydukov [3], Olaf Soltwedel [3], Thomas Keller [3], Cinthia Piamonteze [4], Peter Nagel [5], Stefan Schuppler [5], Michael Merz [5], Christian Bernhard [1]* *[1] University of Fribourg, Chemin du Musée 3, 1700 Fribourg* *[2] Universidad Complutense de Madrid, Avda. Complutense s/n, ES-28040 Madrid* *[3] Max-Planck-Institut für Festkörperforschung, Heisenbergstraße 1, DE-70569 Stuttgart* *[4] Paul Scherrer Institute, SLS, 5232 Villigen PSI* *[5] Institut für Festkörperphysik, KIT, DE-76021 Karlsruhe* Artificial superlattices (SL) comprised of cuprate superconductors and manganites enable us to study the interaction between the competing superconducting and ferromagnetic orders. For this purpose, we have recently developed high quality $La_{2-x}Sr_xCuO_4/La_{2/3}Ca_{1/3}MnO_3$ superlattices [1]. $La_{2-x}Sr_xCuO_4$ offers the unique opportunity to vary the hole doping via the Sr concentration and to study its effect on the magnetic proximity effect [2],[3]. We shall present an overview of the structural, magnetic and superconducting properties of these superlattices. In addition first results from polarized neutron reflectometry, XMCD and XLD measurements on the magnetic proximity effect in such superlattices will be shown. [1] S. Das et al, accepted in Phys. Rev. B, http://arxiv.org/abs/1402.6258 [2] J. Chakhalian et al, Nat. Phys. 2, 244-248 (2006) [3] D. K. Satapathy et al, Phys. Rev. Lett. 108, 197201 (2012).

17:15	**114**	**Controlling the near-surface superfluid density in underdoped $YBa_2Cu_3O_{6+x}$ by photo-illumination** *Evelyn Stilp [1], Andreas Suter [2], Thomas Prokscha [2], Zaher Salman [2], Elvezio Morenzoni [2], Hugo Keller [1], Patrick Pahlke [3], Ruben Hühne [3], Christian Bernhard [4], Jordan Baglo [5], Ruixing Liang [5], Walter Hardy [5], Doug Bonn [5], Robert Kiefl [5]* *[1] Physik-Institut der Universität Zürich, Winterthurerstrasse 190, 8057 Zürich* *[2] Laboratory for Muon Spin Spectroscopy, Paul Scherrer Institut, 5232 Villigen PSI* *[3] Institute for Metallic Materials, IFW Dresden, Helmholtzstraße 20, DE-01069 Dresden* *[4] Department of Physics, University of Fribourg, Chemin du Musée 3, 1700 Fribourg* *[5] Department of Physics and Astronomy, University of British Columbia, 2355 East Mall, Vancouver, BC, V6T 1Z4, Canada* In classical superconductors illumination with pulsed laser light causes transient pair breaking and weakens superconductivity. Surprisingly, in $YBa_2Cu_3O_{6+x}$ (YBCO) long term illumination increases the charge carrier density, leading to photo persistent conductivity at low temperatures ($T < 250$ K). Photo-doping enhances the superconducting transition temperature T_c, particularly in underdoped YBCO. In our study modifications in the Meissner screening profile caused by photo illumination were directly investigated using low-energy muon spin rotation. We found that illumination of underdoped YBCO with visible light increases the near-surface superfluid density and that the photo-persistent changes are strongly anisotropic in YBCO ortho-VIII single crystals.
17:30	**115**	**Connection between high energy spin excitations and degree of electron correlations in $Ba(Fe_{1-x}Co_x)_2As_2$ superconductors** *Yaobo Huang [1], Jonathan Pelliciari [1], Valentina Bisogni [1], Paul Olalde Velasco [1], Kejin Zhou [2], Marcus Dantz [1], Genfu Chen [3], Vladimir Strokov [1], Hong Ding [3], Thorsten Schmitt [1]* *[1] Swiss Light Source, Paul Scherrer Institute, 5232 Villigen PSI* *[2] Diamond Light Source, Harwell Science and Innovation Campus, Oxfordshire, OX11 0DE, Didcot, UK* *[3] Institute of Physics, Chinese Academy of Sciences, P.O.Box 603, CN-100190 Beijing* We probed the high energy spin-excitations (HESEs) in under, nearly optimal and over electron-doped (e-ded) $BaFe_{2-x}Co_xAs_2$ (BFCA) with Fe-L_3 edge RIXS. Our result show well-defined SEs dispersing up to 200 meV persisting into the SC phase, similar as found in hole-doped superconductor $Ba_{0.6}K_{0.4}Fe_2As_2$ (BKFA) [K. J. Zhou, et. al., Nat.Commun **4** 1470] thereby demonstrating the existence of an universal correlated spin state responsible for the spin fluctuations in these materials. HESEs in BFCA are nearly independent of *e-d*ing, in contrast to BKFA that softened relative to parent $BaFe_2As_2$. This indicates that e-ding $BaFe_2As_2$ does not affect significantly the HESEs, which is consistent with the lower degree of electron correlations of *e-d*ed iron pnictides [M. S. Liu, et.al., Nat.Phys **8** 376].
17:45	**116**	**Unconventional superfluidity in a two-leg fermionic ladder** *Shun Uchino [1], Akiyuki Tokuno [2], Thierry Giamarchi [1]* *[1] DPMC-MaNEP, University of Geneva, 24 Quai Ernest-Ansermet, 1211 Geneva* *[2] College de France, 11 place Marcelin Berthelot, FR-75005 Paris* We show that a novel unconventional superfluid triggered by a spin-orbit coupling is realized in a repulsively interacting fermionic ladder system. A competition between spin singlet and triplet pairings occurs due to the breaking of inversion symmetry. We show that both superfluid orders decay algebraically with the same exponent except for special coupling constants for which a dominant superfluid is determined solely by the spin-orbit coupling. We also discuss a realization of the superfluid in cold atoms.

18:00	**117**	**Geometry and bandstructure dependence of topological edge and domain wall states of a chiral p-wave superconductor** *Adrien Bouhon, Manfred Sigrist* *Institute for Theoretical Physics, ETH Zürich, Wolfgang-Pauli-Str. 27, 8093 Zürich* Motivated by Sr_2RuO_4 edge and domain wall quasiparticle states are analyzed based on the self-consistent solution of the Bogolyubov-de Gennes equations for a topological chiral p-wave superconductor. A tight-binding model of a square lattice for the dominant gamma band is used to elucidate the relation between band structure, topology and geometry of the defects. Within the same symmetry class states with different Chern numbers can occur. We discuss the characteristics of the tunneling spectrum for their edge states. Ref: A. Bouhon, PhD Thesis, Electronic properties of domain walls in Sr_2RuO_4, ETH Zürich, Januay 2014.
18:15		***Postersession and Apéro***
20:15		***Public Lecture***

ID	MaNEP Poster
121	**Structure and magnetic interactions in $Ba_{3-x}Sr_xCr_2O_8$** *Henrik Grundmann [1], Andreas Schilling [1], Marisa Medarde [2], Denis Sheptyakov [3]* *[1] Physik-Institut, Universität Zürich, Winterthurerstrasse 190, 8057 Zürich* *[2] Laboratory for Development and Methods, Paul Scherrer Institut, 5232 Villigen PSI* *[3] Laboratory for Neutron Scattering, Paul Scherrer Institut, 5232 Villigen PSI* We have recently reported on a non-linear tuning of the magnetic interaction constant J_0 in the spin dimer system $Ba_{3-x}Sr_xCr_2O_8$ by varying the Sr content x. We now show that this peculiar behavior of J_0 can be explained by changes in the crystal structure, probed with neutron powder diffraction. Performing theoretical calculations based on those structural details, we could well reproduce the change of J_0 by taking into account a structural transition due to the Jahn-Teller active Cr^{5+}-ions. This transition, lifting the magnetic frustration in the system, is heavily influenced by disorder arising from partially exchanging Ba with Sr.
122	**Spectroscopy evidences for true Landau Fermi quasiparticles in LSCO** *Claudia Giuseppina Fatuzzo [1], Yasmine Sassa [2], Martin Månsson [3], Stephane Pailhès [4], Thomas Claesson [5], Oliver J. Lipsocombe [6], Stephen M. Hayden [6], Luc Patthey [7], Ming Shi [7], Marco Grioni [8], Henrik M. Rønnow [1], Joël Mésot [3], Oscar Tjernberg [5], Johan Chang [1]* *[1] Laboratory of Quantum Magnetism, EPFL SB ICMP LQM, 1015 Lausanne* *[2] Laboratory for Solid State Physics, ETH Zürich, 8092 Zürich* *[3] Laboratory for Neutron Scattering, Paul Scherrer Institute, 5232 Villigen PSI* *[4] Inst. Lumière Matière, Université de Lyon 1, Bât. Kastler, 10 rue Ada Byron, FR-69622 Villeurbanne CEDEX* *[5] Materials Physics, KTH Royal Institute of Technology, SE-100 44 Stockholm* *[6] H.H. Wills Physics Laboratory, University of Bristol, Tyndall Avenue, Bristol, BS8 1TL, UK* *[7] Swiss Light Source, Paul Scherrer Institute, 5232 Villigen PSI* *[8] Laboratoire de Spectroscopie Électronique, EPFL SB ICMP Station 3, 1015 Lausanne* Improving our knowledge of the normal state of high-temperature cuprate superconductors is believed to represent an important, and maybe necessary, step to advance in our understanding of their unconventional superconducting state. In this talk we present an angle resolved photoemission spectroscopy of an overdoped cuprate system ($La_{1.77}Sr_{0.23}CuO_4$) [1,2]. We will show how the nodal low-energy excitations are consistent with true Landau Fermi quasiparticles [1]. Furthermore, we will show how the quasiparticle description of the excitations breaks down both for high energies and in spectra recorded in the anti-nodal region [2]. [1] C. G. Fatuzzo et al., submitted [2] J. Chang et al., Nature Communications, 4, 2559 (2013)

123 180° domain wall evolution in $PbTiO_3/SrTiO_3$ superlattices under an applied external field

Stephanie Fernandez-Pena [1], Pavlo Zubko [2], Céline Lichtensteiger [1], Jean-Marc Triscone [1]
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Understanding ferroelectricity in ultrathin films is important from the fundamental and technological points of view. At these thicknesses, electrostatics plays a key role and often leads to the formation of 180° domains which dominate their functional properties. Superlattice (SL) structures combining ferroelectrics and dielectrics, where domains form a regular pattern that can be probed using X-ray diffraction, are ideal for studying their response to applied fields. Reciprocal space maps reveal domain satellites up to third order around the main SL peak. Our detailed study maps their evolution under applied fields and the piezoelectric response of the SL.

124 Subcritical switching dynamics and humidity effects in nanoscale studies of ferroelectric domain growth

Cédric Blaser, Patrycja Paruch, DPMC, Université de Genève, 24 Quai Ernest-Ansermet, 1211 Genève

Using biased scanning probe microscopy tips we studied ferroelectric polarization switching in c-axis oriented epitaxial $Pb(Zr_{0.2}Ti_{0.8})O_3$ thin films. We map out the detailed dependence of domain size, not only on tip bias and writing time, but also on relative humidity, which strongly enhances domain growth. For long, low voltage pulses, we observe nucleation-limited switching determined by local activation thresholds. With very short, high voltage pulses, we also probe the initial stages of switching, limited by growth. We identify a surprisingly long relaxation time (~100 ms) for the subcritical nucleus in this regime.

125 From order to randomness: a one-dimensional journey to disorder

Toni Shiroka [1], Federico Eggenschwiler [1], Marek Pikulski [1], Matthias Thede [1], Andrey Zheludev [1], Hans-Rudolf Ott [1], Joel Mésot [2]
[1] Laboratorium für Festkörperphysik, ETH Zürich, Otto-Stern-Weg 1, 8093 Zürich
[2] Paul Scherrer Institut, 5232 Villigen PSI

Although Heisenberg spin-1/2 chain materials have been extensively studied over the years, not much is known about their behaviour in the presence of disorder. By considering $BaCu_2Si_2O_7$, a typical 1D model compound, we could obtain a series of systems with different degrees of bond disorder by systematically replacing Si with Ge, hence re-modulating the Cu^{2+} exchange interactions. Magnetometry measurements combined with local magnetic-resonance studies allowed us to follow the evolution of the disorder-related properties from $BaCu_2Si_2O_7$ to the maximally disordered $BaCu_2SiGeO_7$, with intermediate disorder steps. Our results open the way towards a more rigorous understanding of the role and significance of disorder in low-dimensional systems.

126 Second-order response theory of radio-frequency spectroscopy, the "ARPES" of cold atoms

Christophe Berthod, Thierry Giamarchi
DPMC, University of Geneva, 24 quai Ernest-Ansermet, 1211 Genève 4

We present a theory of the radio-frequency (rf) spectroscopy of cold-atom gases, based on second-order response. This theory goes beyond the golden-rule approach, by taking into account the time dependence of the rf conversion, which sets the energy resolution. For a non-interacting final state, the rf intensity depends on the atomic spectral function, as well as the time envelope of the rf pulse. The energy resolution and the inhomogeneities deform the line shape of the rf signal with respect to the clean atomic spectra. Final-state effects can be studied in this formalism. We show that the effects of inhomogeneities can be minimized, taking advantage of interactions in the final state.

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Electron-hole asymmetry in WS_2 probed through scanning photocurrent microscopy

Nicolas Ubrig [1], Sanghyun Jo [1,2], Alberto F. Morpurgo [1,2], Alexey B. Kuzmenko [1,2], Helmuth Berger [3]
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[2] GAP, Université de Genève, Quai Ernest Ansermet 24, 1211 Genève
[3] Institut de Physique de la Matière Condendée, EPFL, 1015 Lausanne

We perform scanning photocurrent microscopy on WS_2-based ambipolar ionic liquid-gated field effect transistors. Both in the electron- and the hole-doping regimes, the photocurrent decays exponentially as a function of the distance between electrical contacts and the illumination spot. This allows us to compare the value and the doping dependence of the diffusion length of the minority electrons and holes on the same sample. Interestingly, the diffusion length of the minority electrons is several times larger than the one of the minority holes at the same doping concentration, which points to a strong intrinsic electron-hole asymmetry.

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Magnetic and Superconducting Ground State of delta-doped LSCO Superlattices

Andreas Suter [1], Gennady Logvenov [2], Alexander Boris [2], Zaher Salman [1], Evelyn Stilp [3], Thomas Prokscha [1], Elvezio Morenzoni [1]
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In cuprate superconductors, especially $La_{2-x}Sr_xCuO_4$ (LSCO), cation disorder has a strong impact on the electronic properties. One route to reduce disorder are tailored materials which can be grown by Molecular Beam Epitaxy. Here we will present a LE-μSR study on so called delta-doped LCO superlattices (d-LCO(N)) where each N's [LaO-LaO-CuO_2] block is replaced by [SrO-LaO-CuO_2] which is the solely source of doping. All these SLs show superconductivity. We will show that the close proximity of the antiferromagnetic and superconducting ground state in d-LCO(N) is leading to a non-trivial interplay between the two orders.

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Dispersive magnetic excitations in parent and Co doped NaFeAs iron superconductors

Jonathan Pelliciari [1], Yaobo Huang [1], Valentina Bisogni [1], Paul Olalde Velasco [1], Marcus Dantz [1], Changqing Jin [2], Thorsten Schmitt [1]
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[2] Beijing National Lab. for Condensed Matter Physics, Chinese Academy of Sciences, CN-100190 Beijing

We present our recent high resolution Fe L_3 RIXS study of parent and Co doped NaFeAs superconductors. Spectral shape decomposition reveals that dispersive magnetic excitations are present in our measurements for all doping levels. The extracted high-energy magnetic dispersion curves do not show softening of the energy scale, in contrast to RIXS experiments on hole-doped iron pnictides [1]. The lineshape of the magnetic peaks are discussed in detail in order to elucidate their behavior as a function of momentum. We discuss our data in comparison to inelastic neutron scattering studies on similar compounds [2].

[1] Zhou et al, NatComm., 4, 1470 (2013)
[2] Wang et al, NatComm., 4, 2874(2013)

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Unconventional Superconductivity by Fermi Surface Mismatch: A Diagrammatic Monte Carlo Study

Jan Gukelberger [1], Evgeny Kozik [2], Lode Pollet [3], Kris Van Houcke [4], Nikolay Prokof'ev [5], Boris Svistunov [5], Matthias Troyer [1]
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[2] Physics Department, King's College, London WC2R 2LS, United Kingdom
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[5] Department of Physics, University of Massachusetts, Amherst, MA 01003-4525, United States

The conventional BCS pairing mechanism for s-wave superconductivity relies on spin rotation symmetry ensuring coinciding Fermi surfaces for both spin species. We study attractively interacting fermions on a square lattice where this symmetry is broken by imposing either a spin imbalance or a spin-dependent hopping anisotropy. The resulting Fermi surface mismatch disfavours conventional superconductivity making room for new kinds of order such as inhomogeneous or triplet superconductivity. We present unbiased numeric results for the low temperature phase diagrams of these models obtained with Diagrammatic Monte Carlo, a new technique for correlated fermionic systems based on sampling Feynman diagrammatic series directly in the thermodynamic limit.

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Structural and Antiferromagnetic Domains in Undoped $YBa_2Cu_3O_6$

Bálint Náfrádi [1], Thomas Keller [2], Frederic Hardy [3], Christoph Meingast [3], Andreas Erb [4], Bernhard Keimer [2]
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[2] Max-Planck-Institut für Festkörperforschung, Heisenbergstrasse 1, DE-70569 Stuttgart
[3] Institute of Solid State Physics, Karlsruhe Institute of Technology, Hermann-v.-Helmholtz-Platz 1, DE-76021 Karlsruhe
[4] Walther-Meißner-Institut für Tieftemperaturforschung, Walther-Meißner-Straße 8, DE-85748 Garching

We have used high resolution neutron Larmor diffraction (LD) and dilatometry to confirm a long-standing proposal about small lattice distortions in undoped $YBa_2Cu_3O_6$. We find that below T_N, orthorhombic domains are induced by magnetostriction resulting from antiferromagnetic domains. Although the orthorhombicity $b/a-1=2.6\cdot10^{-6}$ is too small to be detected by conventional diffraction techniques, it is responsible for a large anisotropy of the magneto-resistance in the ab-plane with d-wave symmetry. Additionally we took advantage of LD to determine the average size of the antiferromagnetic domains. LD thus is a generic method for the study of antiferromagnetic domains and related magneto-elastic effects.

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Spontaneously magnetized Tomonaga-Luttinger liquid in frustrated quantum antiferromagnets

Shunsuke Furuya, Thierry Giamarchi
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Spontaneous symmetry breaking and Nambu-Goldstone bosons (NGB) going with it are fundamental for a wide range of physical systems. NGB which governs low-energy physics is affected by dimensionality. In 1D quantum antiferromagnet, although the true long-range antiferromagnetic order is absent, we can consider a counterpart of the NGB of the antiferromagnetic order, that is, the Tomonaga-Luttinger liquid (TLL). Here TLL is related to the short-range antiferromagnetic order and described by a critical relativistic field theory. This nature of TLL is consistent with a general statement of NGB in higher dimensions that the NGB originating from the antiferromagnetic (ferromagnetic) order has a relativistic (non-relativistic) dispersion relation.

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Tuning the static spin-stripe phase and superconductivity in $La_{2-x}Ba_xCuO4$ (x = 1/8) by hydrostatic pressure

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Magnetization and muon spin rotation experiments were performed in $La_{2-x}Ba_xCuO_4$ (x = 1/8) as a function of hydrostatic pressure up to p ~ 2.2 GPa. It was found that the magnetic volume fraction of the static stripe phase strongly decreases linearly with pressure, while the superconducting volume fraction increases by the same amount. This demonstrates competition between bulk superconductivity and static magnetic order in the stripe phase of $La_{1.875}Ba_{0.125}CuO_4$ and that these phenomena occur in mutually exclusive spatial regions.

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Electronic structure of quasicrystalline Al-Ni-Co near Fermi level by soft X-ray ARPES.

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Fermi surface (FS) contours and valence band (VB) dispersion near Fermi level of 10-fold Al-Ni-Co were measured at different photon energies hv by means of Soft-X-Ray ARPES. Clear linear dichroism observed in valence band confirmed that the Fermi states are formed by symmetric dispersive Al 3sp states hybridized with Co and Ni d-states. The observed FS contours were quite sharp, thus unveiling the delocalized character and sharp k definition of the valence states.

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Nanostructuring the $LaAlO_3/SrTiO_3$ interface

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Under proper growth conditions, a two-dimensional electron gas (2DEG) can be formed at the interface between $LaAlO_3$ and $SrTiO_3$, if the $LaAlO_3$ thickness is at least 4 unit cells [1]. Here, we investigate two techniques that were shown to further confine this 2DEG in the lateral direction [2,3]. The first one is electron beam lithography which allows the realization of nanostructures down to 500 nm in width. The second one makes use of an atomic force microscopy probe to locally apply a strong electric field to the interface. In systems with only 3 unit cells of $LaAlO_3$, this induces a reversible metal-insulator transition that can be used to design nanostructures.

[1] S. Thiel, et al., Science 313, 1942 (2006)
[2] D. Stornaiuolo, et al., APL 101, 222601 (2012)
[3] C. Cen, et al., Nat Mater 7, 298 (2008)

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Structural and electronic properties of $La_{1-x}Sr_xTiO_3$ thin films

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$LaTiO_3$ is a structurally distorted Mott-Hubbard insulator. Gradual substitution of the lanthanum by strontium accesses an intriguing phase diagram, $La_{1-x}Sr_xTiO_3$. The end material, $SrTiO_3$, is an undistorted band insulator but, for $0.05 < x < 0.95$, metallic behaviour is observed [1]. We explore the $La_{1-x}Sr_xTiO_3$ system in epitaxial thin films, grown by pulsed laser deposition. To understand the onset of electronic correlations close to the Mott-Hubbard state, the electronic properties and structural distortion across this phase diagram are being investigated. The latter being achieved through new techniques utilising synchrotron radiation [2]. The interplay between the structure, the electrical transport and the electronic correlations in $La_{1-x}Sr_xTiO_3$ is being studied.

[1] Y. Tokura et al, Phys. Rev. Lett., 70, 2126 (1993).
[2] S. J. May et al, Phys. Rev. B, 82, 014110 (2010).

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Synthesis of $Nb_2Pd_xS_6$ superconductors by chemical vapor transport method

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$Nb_2Pd_{0.81}S_5$ was recently discovered to exhibit superconductivity up to high critical field (μ_0H_{c2} ~37 T) [1]. Here we report the synthesis and superconductivity of $Nb_2Pd_xS_6$ fibers with various Pd-contents. These materials have been synthesized by chemical vapor transport either with or without iodine as transport agent. Samples prepared at 900° C with iodine have a larger diameter, up to dozens of micrometers, while that prepared at 800° C without iodine have smaller diameter, 0.1-5 µm. All samples are superconducting, with a Pd-dependent T_c ranging from 6.5 K to 8 K. T_c is maximized by lowering x and increasing the processing temperature.

[1] Zhang, Q.; Li, G.; Rhodes, D.; Kiswandhi, A.; Besara, T.; Zeng, B.; Sun, J.; Siegrist, T.; Johannes, M. D.; Balicas, L. Sci. Rep. 3 (2013) 1446.

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Towards reversible control of domain wall conduction in $Pb(Zr_{0.2}Ti_{0.8})O_3$ thin films

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Electrical conduction at domain walls in insulating (multi)ferroics [1] makes these intrinsically nanoscale features potentially useful as devices in nanoelectronics applications [2]. Here, using a combination of piezoresponse force microscopy and local conductance mapping we demonstrate that by tuning the oxygen vacancy distribution (shown to modulate conduction [3]), we can reversibly switch between conducting and insulating behavior at 180° domain walls in $Pb(Zr_{0.2}Ti_{0.8})O_3$ thin films. To explain these observations, we propose a mechanism based on changes in electrostatic and chemical boundary conditions, reversible upon repeated cycling between ultrahigh vacuum thermal annealing and ambient exposure.

[1] Seidel et al., Nat. Mat. 8, 229 (2009)
[2] Catalan et al., Rev. Mod. Phys. 84

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Probing the metal-insulator transition in nickelates using soft x-ray absorption spectroscopy

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[2] Helmholtz-Zentrum-Berlin für Materialien und Energie, Albert-Einstein-Strasse 15, DE-12489 Berlin
[3] Université de Versailles St-Quentin en Yvelines/CNRS, 45 avenue des Etats-Unis, FR-78035 Versailles
[4] Peter Grünberg Institut, Forschungszentrum Jülich and JARA, DE-52425 Jülich

We show that in the low temperature insulating state a clear multiplet structure gives rise to two peaks at the Ni-L_3 edge x-ray absorption spectrum of $SmNiO_3$ thin films. The energy splitting between these peaks is reduced only upon crossing the metal-insulator transition. We analyze films with varying strain-engineered metal-insulator transition temperatures and elucidate the separate effects of strain and temperature in the absorption spectra. We conclude that the strain-induced modulation of the transition temperature is likely driven by changes in the electron bandwidth.

F. Y. Bruno et al, APL 104,021920(2014). F.Y. Bruno et al. PRB 88,195108(2013).

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Magnetotransport studies of gated $LaAlO_3/SrTiO_3$ interfaces

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The two-dimensional electron gas between $LaAlO_3$ and $SrTiO_3$ exhibits spectacular physics phenomena including superconductivity and a large spin-orbit coupling. Both the superconducting ground state and the spin-orbit interaction are tunable by an electric field effect using the $SrTiO_3$ substrate as a back gate dielectric. We report magnetotransport properties of top- and back-gated $LaAlO_3/SrTiO_3$ heterostructures by using the $LaAlO_3$ film and $SrTiO_3$ substrate as top and back gate insulators. This dual approach allows large tunabilities in the carrier density and magnetoresistance to be obtained. We investigate the consequences of the different gating geometries on the electronic properties of $LaAlO_3/SrTiO_3$ interfaces.

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Strain-induced metal-insulator transitions in d^1 perovskites within DFT+DMFT

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We assess the effect of epitaxial strain on the electronic properties of the Mott insulator $LaTiO_3$ and correlated metal $SrVO_3$ using DFT + DMFT approach. We find that $LaTiO_3$ undergoes an insulator-to-metal transition under a compressive strain of about -2 %, consistent with recent experimental observations [1]. We show that this transition is driven mainly by strain-induced changes in the crystal-field splitting between the Ti t_{2g} orbitals. We demonstrate that a clear distinction between strain and interface effects is necessary for the understanding of emerging properties in oxide heterostructures.

[1] Wong et al., Phys. Rev. B **81**, 161101 (2010)

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Charge density waves in Cu_xTiSe_2

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The interplay between charge density waves and superconductivity has been a long standing puzzle in a range of superconducting materials, especially those whose electronic systems exhibit reduced dimensionalities. The transition metal dichalcogenide $TiSe_2$ is an appealing material to contribute to this debate. Indeed, it does exhibit a CDW phase that is giving way to superconductivity upon Cu intercalation with a maximum T_c of 4.15K [1]. Here we present an STM study at 77K revealing the appearance of charge stripes with increasing Cu content in Cu_xTiSe_2 ($x<0.08$).

[1] E. Morosan et al., Nature Physics, **2**, 544 (2006)

144	**New light on the sub-gap peaks seen by STM in $YBa_2Cu_3O_{7-\delta}$**

Jens Bruér [1], Ivan Maggio-Aprile [1], Nathan Jenkins [1], Christophe Berthod [1], Øystein Fischer [1], Zoran Ristic [2], Christoph Renner [1]
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We present Scanning Tunneling Microscopy and Spectroscopy (STM/STS) studies on the high temperature cuprate superconductor $YBa_2Cu_3O_{7-\delta}$. Our key finding is that sub-gap states, which earlier were seen as sharp features only when tunneling into a vortex core, are indeed observed in zero field tunneling spectra as well. Our new data show these in-gap states to be present everywhere consistently, in spectra both with and without well-defined coherence peaks. This fact suggests that these features - by the way also seen in BSSCO - have a more general origin and are not specific signatures of the vortex core.

145	**Impurity driven magnetically ordered ground states in quasi-one-dimensional quantum magnets $SrCuO_2$ and Sr_2CuO_3**

Surjeet Singh [1], Koushik Karmakar [1], Markos Skoulatos [2], Bertrand Roessli [2], Uwe Stuhr [2], Amy Poole [2], Christian Rüegg [2]
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We present studies on quasi one-dimensional S = ½ Heisenberg antiferromagnets $SrCuO_2$ and Sr_2CuO_3 doped with magnetic impurities. We show that doping with Co induces a large magnetic anisotropy and a transition to an ordered state near $T_p \approx 5$ K in $SrCuO_2$ [1] and $T \approx 11$ K in Sr_2CuO_3. In line with these observations, the spectra measured by inelastic neutron scattering indicate gapless low-energy spin excitations in Co-doped crystals of $SrCuO_2$. These results are in stark contrast with the reports of a pseudo-gap opening below 80 K in the spin excitation spectrum of Ni doped $SrCuO_2$ [3].

[1] Karmakar et al. Crystal Growth and Design, (in press) DOI
[2] Sirker et al. Phys. Rev. Lett. **98**, 137205 (2007).
[3] Simutis et al . Phys. Rev. Lett. **111**, 067204 (2013)

146	**Probing low-energy excitations in the insulating iridates Sr_2IrO_4 and $Sr_3Ir_2O_7$ by Oxygen K-edge RIXS**

Paul Olalde-Velasco [1], Yaobo Huang [1], Valentina Bisogni [1], Jonathan Pelliciari [1], Marcus Dantz [1], Sara Fatale [2], James Vale [3], Desmond McMorrow [3], Marco Grioni [2], Johan Chang [2], Henrik Ronnow [2], Vladimir Strokov [1], Thorsten Schmitt [1]
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Resonant Inelastic X-ray Scattering (RIXS) can probe electronic and magnetic excitations in solids [1]. We measured the momentum dependent O K-edge RIXS response of insulating Sr_2IrO_4 [2] and $Sr_3Ir_2O_7$ [3]. The energy of the observed low-energy excitations below 300 meV corresponds to magnetic modes. Particularly at ~100 meV to single magnons previously observed by Ir L_3 RIXS [2,3]. This suggests a novel selection rule for magnetic excitations during the indirect RIXS process at the O K-edge that is induced by the strong Spin-Orbit coupling present in iridates.

[1] L. J. P Ament et al., Rev. Mod . Phys. **83**, 705 (2011).
[2] J. Kim et al., PRL. **108**, 177003 (2012).
[3] J. Kim et al., PRL. **109**, 157402

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Dynamical Spin-Spin Correlations for the Dimerized Spin-1/2 Chain at Finite Temperature

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[3] HISKP, Universität Bonn, Nussallee 14-16, DE-53115 Bonn

We present DMRG results at finite temperature for dynamical spin-spin correlations of a strongly dimerized spin-1/2 chain in a transverse magnetic field. The phase diagram of this model as a function of magnetic field contains three phases and two quantum critical points. We investigated the behavior of the system for a wide range of magnetic fields, and for temperatures ranging from very low ones to values of the order of the energy scale of the system. We discuss the characteristics features of the spectrum and possible comparison with neutron scattering results.

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Relaxation dynamics of a coherently split one-dimensional gas

Laura Foini, Thierry Giamarchi, DPMC, University of Geneva, Quai Ernest-Ansermet 24, 1211 Geneva

Non-equilibrium dynamics in isolated quantum systems represent, at present, a vivid research direction both theoretically and experimentally. Such interest is sustained by the progress in the field of cold atoms that allows to investigate the unitary dynamics of the system. I will review an experiment that has considered the splitting of a one-dimensional Bose gas into two coherent gases, where the properties of the system are probed by interference. While previous works have focused on the independent dynamics of the two systems after the splitting, in our study we take into account the effect of a finite tunneling coupling.

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Evidence of inequivalent nickel sites in rare-earth nickelates using spectroscopic ellipsometry

Julien Ruppen, Jérémie Theyssier, Raoul Scherwitzl, Marta Gibert, Sara Catalano, Oleg Peil, Jean-Marc Triscone, Antoine Georges, Dirk van der Marel
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We investigate the detailed evolution as a function of temperature of the electronic structure of $NdNiO_3$ films using optical spectroscopy, in particular spectroscopic ellipsometry in the range 0.5 meV to 5eV. The materials are thin films of $NdNiO_3$ on substrates with different lattice parameters, which we use to tune the lattice parameter of the $NdNiO_3$ films. Depending on the level of tuning we observe either a single phase transition in the temperature evolution of the optical spectra, or a double one when the material is tuned more deeply toward the insulator side of the phase diagram.

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Low temperature electrical transport anomalies in thermoelectric BiCuSeO oxychalcogenides

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We have shown that layered oxychalcogenide materials exhibit promising thermoelectric properties, with $ZT \approx 1.4$ around 650°C. These p-type materials, with parent compound BiCuSeO, crystallize in a 2D structure analogue to the iron-pnictides superconductors' one, with alternating intermetallic covalent layer and oxide, insulating layers. Their promising ZT values come mainly from their very low thermal conductivity values. BiCuChO compounds also exhibit interesting properties at low temperature. Thus, two anomalies in the resistivity curves have been observed, one for the undoped compound near 260 K and the other for the doped samples at very low temperature. Moreover, the substitution of the chalcogenide leads to a complex evolution of the properties.

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Quantitative determination of the band gaps in $MoTe_2$

Ignacio Gutiérrez Lezama, Maria Longobardi, Alberto Ubaldini, Enrico Giannini, Alexey Kuzmenko, Christoph Renner, Alberto Morpurgo
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We have performed ionic-liquid gating, scanning tunneling spectroscopy and optical transmission spectroscopy on nm- and/or micrometer-thick $MoTe_2$ flakes, extracted from the same crystal, to identify the band gaps present in bulk $MoTe_2$. We found that an indirect (0.88 eV) and a direct band gap (1.02 eV) coexist in this material. Given the similar magnitude of these gaps and the effect of quantum confinement on the band structure of transition metal dichalgogenides, the indirect band gap may become larger than the direct one in flakes thicker than a monolayer. Hence, bulk-like $MoTe_2$ may be a suitable candidate to realize light-emitting devices.

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New limiting mechanism for topologically frustrated Josephson junctions in Sr_2RuO_4

Sarah Etter [1], Manfred Sigrist [1], Hirono Kaneyasu [2], Matthias Ossadnik [1]
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[2] Department of Material Science, University of Hyogo, Kamigori, Hyogo 678-1297, Japan

We study a Josephson junction of cylindrical geometry between a conventional s-wave and a chiral p-wave superconductor. Such junctions appear naturally in eutectic Sr_2RuO_4-Ru. Depending on temperature, two different superconducting phases are realized at the interface. While one leads to a conventional Josephson effect, the other is topologically frustrated which profoundly changes its behavior due to the appearance of a spontaneous flux pattern involved in a pinning-depinning transition. We discuss in detail this new limiting mechanism for the critical current in the frustrated case and compare it to the conventional case. Our results are relevant to explain anomalous features observed in Pb/Ru/Sr_2RuO_4 junctions in recent experiments by Maeno et al.

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Electrical and optical investigations of transition metal dichalcogenides using ionic liquid gated transistors.

Davide Costanzo [1], Sanghyun Jo [1], Nicolas Ubrig [1], Helmuth Berger [2], Alexey B. Kuzmenko [1], Alberto F. Morpurgo [1]
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[2] Institut de Physique des Nanostructures, EPFL, 1015 Lausanne

We discuss our investigations of ionic-liquid gated transistors based on different transition metal dichalcogenides. Experiments on MoS_2 focus on mono-, bi-, and tri-layers with different stacking sequences (exfoliated from 2H-MoS_2 and 3R-MoS_2 crystals), and exploit the large gate capacitance to explore transport and optical processes (photoluminescence, electroluminescence and Raman) over a broad carrier density range. The work on WS_2 addresses low-temperature transport at very high carrier densities (10^{14} cm^{-2}). For holes, the magnetic field and temperature dependent resistance exhibits weak-antilocalization due to spin-orbit interaction. For electrons, an anomalous behaviour is seen, possibly due to the occurrence of superconductivity at lower temperature.

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Density Matrix Renormalization Group for Cold Atoms

Michele Dolfi [1], Adrian Kantian [2], Bela Bauer [3], Matthias Troyer [1]
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[3] Microsoft Research, Station Q, University of California, 93106 Santa Barbara, USA

We push the DRMG method to challenging topics for the cold atom physics community. On one side we investigate characterize the nature of the ground state in coupled Hubbard ladders by studying long-range pairing correlation functions. For these systems the DMRG method requires a large number of renormalized states to capture the entanglement in the underlying ansatz. On the other side we study the heat introduced during the ramp up of the optical lattice potential on a cold cloud in a harmonic confinement. We employ the recent developed Multigrid DMRG technique, which allows the study of continuum models.

156	**Identifying the STS spectral features of high T_c cuprate superconductors** *Ivan Maggio-Aprile, Nathan Jenkins, Christophe Berthod, Alexandre Piriou, Jens Bruér, Christoph Renner, Øystein Fischer, DPMC-MaNEP - Université de Genève, 24 quai E.-Ansermet, 1211 Genève* Scanning tunnelling spectroscopy is known to be a powerful technique to probe in real space the local DOS of materials. What is a less known is that the tunneling spectra can be efficiently numerically modelled, allowing the extraction of a number of physical quantities which can be of particular importance towards a better understanding of the microscopic mechanisms of high temperature superconductivity (HTS). We present here accurate numerical modelling of HTS cuprate spectra, which allows us to identify and quantify a sharp van Hove singularity lying close to the Fermi level, or the coupling of the quasiparticles with a bosonic collective mode.
157	**A firmware-based direct-sampling NMR spectrometer** *Marek Pikulski [1], Toni Shiroka [1,2], Hans Rudolf Ott [1,2], Joël Mesot [1,2]* *[1] Laboratorium für Festkörperphysik, ETH Zürich, Otto-Stern-Weg 1, 8093 Zürich* *[2] Paul Scherrer Institut, 5232 Villigen PSI* Nuclear magnetic resonance (NMR) instrumention employed in condensed matter physics is typically built using analog radio-frequency components. The implementation of dedicated hardware implies high initial cost or significant construction efforts. By contrast, recently available high-performance radio-processor devices are capable of directly sampling and emitting signals in the NMR frequency range. They also provide field-programmable gate arrays (FPGAs), which can be used for time control and real-time data processing. We report the implementation of a novel type of NMR spectrometer employing these techniques and demonstrate its ability to meet the special demands of condensed matter NMR.
158	**Instantaneous growth of Bi nanolines on Si(001)** *Maria Longobardi, Renan Villarreal* *Department of Condensed Matter Physics, University of Geneva, 24 Quai Ensermet, 1211 Geneva* Bismuth (Bi) on Si(001) self-assembles into micrometer long, almost defect free nanolines. Their structure is explained by the Haiku model featuring a 5-7-5 reconstruction of the Si underneath the Bi chains. We found particular experimental conditions where they grow nearly instantaneously, even on slightly contaminated and poorly reconstructed Si(001) surfaces. This finding paves the way to grow nanolines on Si(001) with patterned electrical contacts for local transport measurements. It further confirms DFT modeling predicting the Haiku to be the ground state of Bi on Si(001). We present an STM and RHEED investigation of this fast Bi self-assembly.
159	**Interplay between microscopic decoherence and superconducting proximity effect in a graphene Andreev interferometer** *Sandra Šopic, Fabio Deon, Alberto Morpurgo* *Dép. de Physique de la Matière condensée, University of Geneva, 24 Quai Ernest Ansermet, 1211 Genève 4* We investigate the reentrance of the superconducting proximity effect in graphene Andreev interferometers. At high gate voltages the energy dependence conductance oscillations exhibits a scaling with conductance and Thouless energy of the normal region as expected theoretically. The scaling breaks down when the Fermi energy approaches the charge neutrality point. The phenomenon is a manifestation of single particle dephasing that limits the propagation of superconducting correlations away from the superconductor/graphene interface. Our work addresses the interplay between microscopic decoherence and superconductivity, and shows that graphene provides a useful experimental platform to probe unexplored phenomena in the superconducting proximity effect.
160	**Observation of insulating state at charge neutrality in suspended multilayer graphene** *Anya Grushina, Dong-Keun Ki, Alberto Morpurgo* *Universite de Genève, Quai Ernest Ansermet, 24, 1211 Genève* In suspended graphene, interaction-induced broken symmetry states near charge neutrality at zero magnetic field occur in Bernal-stacked bilayers and in ABC-stacked trilayers. The nature of these states, that are gapped as insulating, is not yet established. Here, we report on the third graphene system exhibiting a clear gapped insulating state at charge neutrality and B = 0 T. Quantum Hall and Raman measurements suggest that the system is either three or four layer thick and Bernal stacked. The gap size is approximately 2-3 meV, with a thermally activated conductance clearly visible at 4 K. A complete characterization of multi-terminal transport is presented.

161	**Tantalum as a metallic contact for nanolines on Si(001)** *Renan Villarreal, Maria Longobardi, Christoph Renner* *Department of Condensed Matter Physics, University of Geneva, quai Ernest-Ansermet 24, 1211 Genève* Electron-electron interactions and transport in 1D-systems remains to be a topic of fundamental interest. Today such systems exist, however, local transport measurements are challenging. Contacting atomic structures can be done by lithography and microscopy. Nonetheless, some 1D-systems require elevated temperatures (e.g. those growing on Si(001)-(2×1)), and standard contacting procedures are mostly unsuitable. Herein, lithography and mask deposition are used for tantalum (Ta), which was found to withstand high temperature processing [1]. On that account, we study the structural and electronic properties of Ta/Si(001), including the effect of exposure to very high temperature, using scanning probes. [1] A. W. Dunn et al., Appl. Phys. Lett. 71, 2937 (1997).
162	**Interplay of antiferromagnetic order, ferromagnetic interactions and Kondo physics in low doped cuprates** *Daniel Müller, Manfred Sigrist, Inst. for Theoretical Physics, ETH Zürich, Wolfgang-Pauli-Str. 27, 8093 Zürich* In their recent work Sawatzky et al. argued that the fundamental low energy quasi-particle are rather given by three-spin-polarons than Zhang-Rice singlets. They used an effective Hamiltonian of the cuprate three-band system by performing perturbation theory and solved the problem with exact diagonalization. We critically review the derivation of this effective Hamiltonian and analyze its phase diagram by using mean-field calculations including Gutzwiller factors. Since the effective Hamiltonian consists of both, antiferromagnetic and oxygen mediated ferromagnetic interactions between Cu-sites, a rich interplay of magnetic order and Kondo physics is expected and whose current status will be presented.
163	**Superconducting and normal state properties of a-WSi films** *Xiaofu Zhang, Julia Lonsky, Andreas Engel, Andreas Schilling* *Physik Institut, Universität Zürich, Winterthurerstrasse 190, 8057 Zürich* Amorphous films of WSi have been proposed as alternative material for superconducting-nanowire single-photon detectors (SNSPD) [1]. The knowledge of superconducting and normal state material properties is important for a better understanding of the outstanding single-photon detection reported for WSi-SNSPDs. We present a detailed analysis of magneto-conductivity measurements of a-WSi thin films of different composition and film thickness. The resulting material parameters will be compared with other detector materials (NbN, TaN,...). The applicability of a-WSi for x-ray sensitive SNSPD [2] will also be discussed. [1] B. Baek et al., Appl. Phys. Lett. 98, 251105 (2011). [2] A. Engel et al., Appl. Phys. Lett. 100, 062601 (2012).
164	**An STM/STS study of the metal-insulator transition in Nickelates** *Thomas Brecke Amundsen, Ivan Maggio-Aprile, Marta Gibert Gutierrez, Sara Catalano, Jean-Marc Triscone, Christoph Renner* *Department of Condensed Matter Physics, University of Geneva, Quai Ernst-Ansermet, 24, 1211 Geneva* We present a variable temperature STM/STS study of the metal insulator transition of $LaNiO_3$ (LNO) epitaxial thin films grown on $NdGaO_3$ (NGO) substrates. STM micrographs reveal stepped surfaces with a granular morphology. The grains, whose origin may be electronic or structural, have a diameter of a couple of tens of nanometers. We present spectroscopy maps and analyze the evolution of the local tunneling conductance spectra as the LNO sample is cooled through the metal insulator transition temperature of about 140 K.

165	**Infrared ellipsometry study of photo-induced charge carriers in bulk $SrTiO_3$ under mechanical stress** *Meghdad Yazdi, Benjamin Mallett, Channan Wang, Premysl Marsik, Christian Bernhard* *University of Fribourg, ch. du musee 3, 1700 Fribourg* We investigated the electronic properties of photo-induced charge carriers in $SrTiO_3$ using far- and mid-infrared ellipsometry. The charge carriers are induced by the illumination of the sample with white light where a considerable part of the spectrum exceeds the band gap of $SrTiO_3$ of 3.2 eV (~388 nm). In particular, the analysis of the so-called Berreman-mode in the mid-infrared allows us to determine both, the concentration and the mobility of these mobile charge carriers. We also studied the influence of mechanical stress that is applied to $SrTiO_3$ during and affects the structural domain state below the cubic-to-tetragonal structural phase transition at 105 K. Our optical data provide information about the interplay of this structural domain state and the photo-induced charge carriers.
166	**Spin-triplet Superconductivity in Artificial Hybrid Structures** *James Witt [1], Laura Heyderman [1], Gavin Burnell [2]* *[1] Paul Scherrer Institute, 5232 Villigen PSI* *[2] University of Leeds, School of Physics and Astronomy, E. C. Stoner Laboratory, Leeds, LS2 9JT, UK* Conventional superconductivity and ferromagnetism are considered to be antagonistic orders in bulk systems. When brought into contact however – in artificial hybrid structures – novel emergent effects are generated at the interface of the two systems. One such effect, which has attracted much recent attention, is the generation of an unconventional spin-triplet pairing which is less susceptible to the pair-breaking effects of magnetic scattering. Presented are recent investigations into the nature of this novel pairing mechanism and developments of experimental techniques aimed at directly probing the spin-triplet components.
167	**Probing the Stability of the Spin Liquid Phases in the Heisenberg-Kitaev Model using Tensor Network Algorithms** *Juan Osorio Iregui, Philippe Corboz, Matthias Troyer* *Institute for Theoretical Physics, ETH Zürich, Wolfgang-Pauli-Str 27, 8093 Zürich* We address questions regarding the survival of the Kitaev spin liquid phases in the Heisenberg-Kitaev model. Using iPEPS Ansatz wavefunctions we obtain the thermodynamic limit ground-state phase diagram of the Heisenberg-Kitaev model. To assess the validity of our ansatz wavefunctions we perform benchmarks against exact results for the Kitaev model and find very good agreement for reasonable values of the bond dimension D. We confirm the survival of both Kitaev spin liquid phases over a finite extent of the phase diagram and characterise the spin-liquid to ordered phase transitions.
168	**Time Domain THz Ellipsometry** *Premysl Marsik, Department of Physics, Uni Fribourg, Chemin du Musee 3, 1700 Fribourg* Ellipsometry is a widespread technique in the range from the deep ultraviolet to far infrared. The measurement of polarization of light reflected from the sample allows precise determination of real and imaginary part of dielectric function. In the terahertz range, time-domain transmission spectroscopy can access these quantities easily for transparent samples, but for opaque samples, ellipsometry brings benefit of self-normalization, which means that no reference sample is necessary. Using time-domain detection, 3 of 4 elements of Jones matrix can be measured with simple rotating analyzer and rotating polarizer configuration. Or, with addition of a reference measurement, one can directly access complex Fresnel's coefficients and therefore determine both dielectric permittivity and magnetic permeability. We are presently building a variable angle of incidence, time domain THz ellipsometer operating in range from 0.1 to 2 THz (3 - 60 cm^{-1}) in RAE mode with free standing wire-grid polarizers. Our ellipsometer is also equipped with optical cryostat for measurements at temperatures between 4 and 450 K. In our contribution we will present the actual state of the development.

169	**Substitution in $LiMF_4$: a playground of fundamental interactions** *Peter Babkevich, Henrik Rønnow, Julian Piatek, Bastien Dalla Piazza, Ivan Kovacevic* *EPFL LQM ICMP, 1015 Lausanne* Despite its fundamental nature, very few studies exist on purely dipolar-coupled magnetic systems. Well known examples include $LiHoF_4$ which is an excellent realisation of an Ising system while $LiErF_4$ and $LiYbF_4$ have been found to be XY. The family of compounds, $LiMF_4$, where M = Ho, Er, Yb, Tm, Gd, etc are intriguing to study fundamental interactions. The crystal field environment that the M ions experience play a crucial role in stabilising magnetism. Through careful analysis of inelastic neutron and susceptibility measurements we are able to explain and predict, in the mean-field approximation, the low-temperature phase diagrams of $LiMF_4$ compounds.
170	**Phase transitions in ternary intermetallic stannides** *Daniel Mazzone, PSI, WHGA 127, 5232 Villigen* The ternary intermetallic stannides $Ca_3Ir_4Sn_{13}$ and $Yb_3Rh_4Sn_{13}$ were studied. $Ca_3Ir_4Sn_{13}$ display a superconducting phase and a structural modulation with an onset at T* . Under increasing pressure T* decreases monotonically, while the superconducting transition temperature increases, and then decreases, in a dome like behavior. A QCP was postulated at the pressure where T* is suppressed to zero. The structural modulation of $Ca_3Ir_4Sn_{13}$ has been investigated by means of single crystal x-ray and neutron diffraction and inelastic neutron scattering experiments. The vortex lattice in the mixed state of $Yb_3Rh_4Sn_{13}$ has been investigated using SANS. Near H_{c1} we found a melting of the vortex lattice.