Book of abstracts

FNSNF
Swiss National Science Foundation
The National Centres of Competence in Research (NCCR) are a research instrument of the Swiss National Science Foundation

Monday, 10 October 2016
Session 1: Strong field effects
09h10 – 10h20

Keynote: Time-Domain Quantum Physics of Electrons (
LEITENSTORFER Alfred (University of Konstanz)

Experiments exploring subcycle quantum phenomena triggered by infrared electric fields are presented. Applying amplitudes in the MV/cm range results in a highly conducting state of vanadium dioxide due to generation of electron-hole pairs by interband tunneling. Beyond 5 MV/cm, Wannier-Stark localization occurs in the band semiconductor GaAs. Recently, we succeeded in carrier-envelope phase control of single-electron tunneling over the spatial gap of a plasmonic nanoantenna.

Ultrafast Structure Switching through Nonlinear Phononics
JURASCHEK Dominik Maximilian[1], SPALDIN Nicola Ann[1]; FECHNER Michael[1]
[1] ETH Zurich

We describe an ultrafast coherent control of the transient structural distortion arising from nonlinear phononics in ErFeO3. Using DFT calculations we model the response of the system to a pulsed laser excitation. We find that the trilinear coupling of two orthogonal infrared phonons to a Raman phonon causes a switchable transient lattice distortion. Since this effect is determined by the symmetry of the system we propose that it is a universal feature of orthorhombic and tetragonal perovskites.

Time-resolved XUV photoemission: a new clue for understanding the ultrafast dynamics in copper oxides
CILENTO Federico (Elettra - Sincrotrone Trieste), GIANNETTI Claudio (Università Cattolica Brescia)

We use time-resolved ARPES with HHG probe to measure both the dynamics of quasiparticles over the entire Brillouin Zone of the Bi2212 compound and the dynamics of the Mott excitations involving the O 2p states lying 1.5 eV below the Fermi level. The dynamics of these high-energy excitations show a clear connection with the electron dynamics at the antinodes of the Fermi surface. This finding provides a novel ingredient for the theories of high-temperature superconductivity in copper oxides.

Monday, 10 October 2016
Session 2: Strongly correlated electrons
11h00 – 12h20

Keynote: Nonequilibrium Dynamics of Strongly Correlated Electron Systems
IMADA Masatoshi[1], IDO Kota[1]
[1] University of Tokyo

We first discuss a variational method developed for strongly correlated systems out of equilibrium[1]. The method is based on the time-dependent variational principe and is regarded as an extension of variational Monte Carlo methods for the equilibrium ground state. We present benchmark tests for the acuuracy and efficiency of the method. Then the application to the possible superconductivity in the nonequilibrium transient states are discussed.

[1] K. Ido et al.,Phys.Rev.B 92,245106(2015).

Ultrafast evolution of the model Mott-Hubbard compound V2O3
LANTZ Gabriel (ETH Zurich)

We have investigated the model Mott-Hubbard material Cr-doped V2O3 using state of the art pump-probe techniques, namely, angle resolved photoelectron spectroscopy, optical reflectivity, and X-ray diffraction. We were able to unequivocally disentangle the electronic and the lattice response. The comparative study of these transient responses shows the formation of a non-thermal phase, where both the electronic structure and the lattice structure are modified.

Hund's exchange out of equilibrium
STRAND Hugo[1], WERNER Philipp [1], ECKSTEIN, Martin[2]
[1] University of Fribourg
[2] University of Hamburg, Center for Free-Electron Laser Science

We study the canonical model for strongly correlated Hund's metals, the two band Hubbard model with local density-density and Hund's exchange interaction. Using real-time dynamical mean-field theory and a first- and second-order strong coupling expansion impurity solver we find novel dynamical features as compared to the single band model. We study the Mott insulator at half-filling and the strong influence of multiplet-crossings on the relaxation dynamics after an excitation pulse.

Monday, 10 October 2016
Session 3: XFEL Science
14h00 – 15h35

Keynote: Correlation enhanced electron-phonon interaction in FeSe – Combined results from tr-XRD and tr-ARPES
SHEN Zhi-Xun (Stanford University)

SwissFEL: New FEL Source for Hard and Soft X-rays
ABELA Rafael[1], PATTHEY Luc[1]
[1] *Paul Scherrer Institut)*

SwissFEL facility will be in operation in 2017 and produce 20 fsec pulses of coherent x-rays in the range of 250 eV to 12.4 KeV, with extremely high peak brightness. These characteristics will provide opportunities for new experiments in chemistry, solid state physics, biochemistry and materials science. After a brief status report, the presentation will be focus on novel applications with an emphasis on the photonics part of the project.

Ultrafast demagnetization dynamics in TbMnO3
ABREU Elsa[1], BOTHSCHAFTER Elisabeth[2], KUBACKA, Teresa[1], RETTIG, Laurenz[2], PORER Michael[2], PARCHENKO Sergii[2], DORNES, Christian[1], MANZ, Sebastian[1] ,KOOHPAYEH, S. M.[3], DHESI, Sarnjeet[4], JOHNSON Steven[1], STAUB Urs[2]
[1] *ETH Zurich*
[2] *Paul Scherrer Institut*
[3] *Johns Hopkins University*
[4] *Diamond Light Source*

TbMnO3 is a well-studied low temperature multiferroic. Below 41K it orders antiferromagnetically. Below 27K the magnetic order changes to cycloidal and a ferroelectric polarization arises.We present our results on photoinduced demagnetization dynamics in TbMnO3. The magnetic order is tracked via the (0 q 0) reflections using resonant X-ray diffraction at the Mn L2 edge. The timescales and pathways of the transition between the multiferroic and the high temperature phase will be discussed.

Monday, 10 October 2016
Session 4: Nonequilibrium dynamics/phase transitions
16h10 – 17h10

Keynote: Electric breakdown near first order Mott transitions

FABRIZIO Michele[1], CAPONE Massimo[1], AMARICCI Adriano[1], MAZZA Giacomo[2]
[1] SISSA
[2] Centre de Physique Theorique, Ecole Polytechnique

Physical Mott transitions are often first order with broad hysteresis loops, which entails extended insulator-metal coexistence. In such a circumstance, an electric field may drive metallic the insulator by nucleating the more polarisable metastable metal. Recent experiments on narrow gap Mott insulators can indeed be interpreted as a field driven stabilisation of a formerly metastable metal phase. In this talk I will uncover this scenario in a very simple toy model for a d-d Mott insulator.

Nonequilibrium electron dynamics: Formation of the quasiparticle peak

SAYYAD Sharareh[1], ECKSTEIN Martin[2]
[1] Max Planck Institute for the Structure and Dynamics of Matter
[2] University of Hamburg, Center for Free-Electron Laser Science

We characterize how the narrow quasiparticle band of the one-band Hubbard model forms out of a bad metallic state in a time-dependent metal-insulator transition. Our results exhibit a nontrivial electronic timescale which is much longer than the width of the quasiparticle peak itself. We will present that this timescale is dominated by the spinon equilibrium physics, where it's bandwidth has a nonmonotonous temperature dependence.

Monday, 10 October 2016
Poster Session
17h10 – 19h00

ESB Instrument at SwissFEL: Femtosecond Pump-Probe Diffraction and Scattering in Condensed Matter
RITTMANN Jochen (Paul Scherrer Institut)

Molecular wave packet dynamics observed by FEL X-ray absorption spectroscopy
LEMKE Henrik(Paul Scherrer Institut)

Laser-induced elements specific magnetization dynamics in multiferroic CoCr2O4
PARCHENKO Sergii (Paul Scherrer Institut)

Femtosecond structural dynamics associated with charge and orbital order in the single-layer manganite Pr0.5Ca1.5MnO4
PORER Michael (Paul Scherrer Institut)

Dynamics of the insulator-to-metal transition in NdNiO_3
ESPOSITO Vincent[1], RETTIG Laurenz[1], INGOLD Gerhard[1], HUBER T.[2], HUBER L.[2], JOHNSON STEVEN[2], STAUB Urs[1], BEAUD Paul[1]
[1]Paul Scherrer Institut
[2]ETH Zürich

Ultrafast photochemistry and photobiology at SwissFEL's Experimental Station A
MILNE Christopher (Paul Scherrer Institut)

Photo-induced gap closure in an excitonic insulator
GOLEZ Denis[1], MOR Selene[4], MONNEY Claude[3], STAEHLER Julia[4], ECKSTEIN Martin[2], WERNER Philipp[1]
[1] University of Fribourg
[2] University of Hamburg, Center for Free-Electron Laser Science
[3] University of Zurich
[4] Fritz Haber Institute

Coherent lock-in at the A1g optical phonon frequency of FeSe/SrTiO3
GERBER S.[1,2], YANG S.-L.[1,3], ZHU D.[4], SOIFER H.[1], SOBOTA J. A.[1,5], REBEC S.[1,3], LEE J. J.[1,3], JIA T.[1,3], MORITZ B.[1], JIA C.[1], GAUTHIER A.[1,3], LI Y.[1], LEUENBERGER D.[1], ZHANG Y.[6], CHAIX L.[1], LI W.[1], JANG H.[7], LEE J.-S.[7], YI M.[8], DAKOVSKI G. L.[4], SONG S.[4], GLOWINA J. M.[4], NELSON S.[4], KIM K. W.[9], CHUANG Y.-D.[5], HUSSAIN Z.[5], KAO C.-C.[10], MOORE R. G.[1], DEVERAUX T. P.[1,] LEE W.-S.[1], KIRCHMANN P. S.[1], SHEN Z.-X.[1,3]
[1]Stanford Institute for Materials and Energy Sciences, SLAC National Accelerator Laboratory and Stanford University.
[2]SwissFEL and Laboratory for Micro & Nanotechnology, Paul Scherrer Institut.
[3]Geballe Laboratory for Advanced Materials, Stanford University.
[4]Linac Coherent Light Source, SLAC National Accelerator Laboratory.
[5]Advanced Light Source, Lawrence Berkeley National Laboratory.
[6]International Center for Quantum Materials, Peking University.
[7]Stanford Synchrotron Radiation Lightsource, SLAC National Accelerator Laboratory.
[8]Department of Physics, University of California Berkeley.
[9]Department of Physics, Chungbuk National University.
[10]SLAC National Accelerator Laboratory.

Nonequilibrium dynamics of the Holstein model in normal states and superconducting states
MURAKAMI Y.[1], TSUJI N.[1], AOKI H.[1], WERNER P.[1]
[1]University of Fribourg

Coherent structural dynamics of an ultrafast CDW-to-metal transition

HUBER T.[1], NEUGEBAUER M.J.[1], MARIAGER, S.O.[2], FERRER A.[1,2], GRÜBEL S.[2], JOHNSON J.[2], LÜBCKE A.[2,5], SAVOINI M.[1], HUBER L.[1], KUBACKA T.[1], DORNES C.[1], ABREU E.[1], KUBLI M.[1], BOTHSCHAFTER E.[2], RETTIG L.[2], RITTMANN J.[2], ESPOSITO V.[2], DOMINKO D.[3], SCHÄFER H.[3], LAULHE C. [6,7], RAVY S.[6], BEAUD P.[2], INGOLD G.[2], DEMSAR J.[3], JOHNSON S.L.[1]

[1]Institute for Quantum Electronics, Physics Department, ETH Zurich

[2]Swiss Light Sources, Paul Scherrer Institut

[3]Physics Department, Universität Konstanz

[4]Institute of Physics, Johannes Gutenberg-Universität Mainz

[5]Laboratoire de Spectropscopie Ultrarapide, EPFL

[6]Sychnrotron SOLEIL

[7]Université Paris-Sud

Tuesday, 11 October 2016
Session 5: Systems with strong electron-phonon coupling
09h00 – 10h20

Keynote: Understanding complex materials using non-equilibrium spectroscopy: What can theory tell us?
KEMPER Alexander (North Carolina State University)

Nonlinear electron-phonon coupling in doped manganites
ESPOSITO Vincent[1],MANKOWSKY Roman[2], Dr. FECHNER Michael[3], BEAUD Paul[1], STAUB Urs[1], FOERST Michael[2], LEMKE Henrik Till[1], CHOLLET Matthieu[4], GLOWNIA James[4]
[1] Paul Scherrer Institut
[2] (Max-Planck Institute for the Structure and Dynamics of Matter
[3] ETH Zurich
[4] SLAC

The charge and structural dynamics following large amplitude excitation of a lattice mode in a charge and orbitally ordered manganite are probed with resonant x-ray diffraction at the LCLS free electron laser. Combining these experimental results with ab initio calculations, the charge order and the associated insulator-to-metal transition is found to be driven by nonlinear electron-phonon coupling, highlighting a new avenue of nonlinear phonon control.

Nonequilibrium DMFT study of coherent dynamics in strongly coupled phonon-mediated superconductors
MURAKAMI Yuta[1], AOKI Hideo[2], TSUJI Naoto[3], WERNER, Philipp[1]
[1] University of Fribourg
[2] Electronics and Photonics Research Institute, Advanced Industrial Science and Technology
[3] RIKEN Center for Emergent Matter Science (CEMS)

We study collective modes in strongly coupled phonon-mediated superconductors with the nonequilibrium dynamical mean-field theory. We reveal the relation between the energy of the amplitude Higgs mode and the SC gap, and a crossover in the damping law of the mode depending on the temperature, which is in contrast to the previous BCS studies. We also show emergence of the second amplitude mode originating from the phonon dynamics, which hybridizes with the Higgs mode to extend its lifetime.

Tuesday, 11 October 2016
Session 6: Magnetization dynamics: spin-lattice phenomena
11h00 – 12h20

Keynote: THz-driven Ultrafast Spin-Lattice Scattering In Metallic Ferromagnets
BONETTI Stefano (Stockholm University)

We used strong THz fields to excite magnetization dynamics in thin film metallic ferromagnets. We observed ultrafast demagnetization caused by the spin-lattice depolarization of the THz-induced spin current. THz conductivity measurements point towards the influence of lattice disorder as the driving force for demagnetization, but many details remain not understood. I will give an outlook of the opportunities offered by THz and x-ray FELs towards a deeper understanding of ultrafast magnetism.

Ultrafast phonon-driven quenching of magnetic order
MAEHRLEIN Sebastian[1],RADU Ilie[2], MALDONADO Pablo[3], PAARMANN Alexander [1], GENSCH, Michael[4], KALASHNIKOVA Alexandra M.[5], PISAREV, Roman V.[5], WOLF Martin[1], OPPENEER Peter M.[3], Dr. KAMPFRATH Tobias[1]
[1] Fritz Haber Institute of the Max Planck Society
[2] Max-Born Institute, Berlin, Germany
[3] Uppsala University
[4] Helmholtz-Zentrum Dresden-Rossendorf
[5] Ioffe Physical Technical Institute, Russian Academy of Sciences

We use intense THz pulses to resonantly excite TO optical phonons in an insulating ferrimagnet and study the response of the magnetic order on time scales from fs to ms. Since electron orbital degrees of freedom are frozen out here, our approach probes spin-phonon coupling in a highly specific way. We observe an unexpectedly fast quenching of the magnetic order on time scales of 1 ps. Our results reveal strongly driven lattice modes as a novel and efficient pathway to manipulate magnetic order.

The Ultrafast Einstein-de Haas Effect
DORNES Christian[1], JOHNSON Steven[1,] BOTHSCHAFTER Elisabeth[2], SAVOINI Matteo[1], ACREMANN Yves1, KUBLI Martin[2], LEMKE Henrik Till[2], PORER Michael[2], VAZ Carlos[2], ZHU Diling[3,] SONG, Sanghoon[4], GLOWNIA James[4], STAUB Urs[2], WINDSOR Yoav William[2], RETTIG Laurenz[2], RAMAKRISHNAN Mahesh[2], BUZZI Michele[2], ESPOSIT, Vincent[2]
[1] ETH Zurich
[2] Paul Scherrer Institut
[3] SLAC

The original Einstein-de Haas experiment confirmed the appearance of a mechanical torque on an iron rod upon changes of its magnetisation, as required by conservation of angular momentum. Today, the microscopic mechanism behind ultrafast demagnetisation is hotly debated. We present a fs-XRD measurement of a laser-induced transverse strain wave in a magnetised iron film. Its origin is identified as angular momentum transfer from the electronic spin system to the lattice during demagnetisation.

Tuesday, 11 October 2016
Session 7: Cooperative phenomena
14h00 – 15h20

Keynote: Transient correlated electron dynamics with multi degrees of freedom

ISHIHARA Sumio[1], ONO Atsushi[1], HASHIMOTO Hiroshi[1]
[1] *Department of Physics, Tohoku University*

Recent our studies in the photoinduced transient electron dynamics in correlated electron systems with multi degrees of freedom are reviewed. 1) Photo-excited charge dynamics of interacting charge-frustrated systems are studied in an interacting electron model on a two dimensional triangular lattice coupled with the lattice vibrations. 2) The dynamical localization phenomena in low dimensional correlated electron system are studied by the numerical simulation method.

Disentangling Lattice and Magnetic Dynamics in Antiferromagnetic EuTe

SCHICK Daniel[1], TRABANT Christoph[1], PONTIUS Niko[1], SCHÜSSLER-LANGEHEINE Christian[1], SPRINGHOLZ Gunther[2], FÖHLISCH Alexander[1]
[1] *Helmholtz-Zentrum Berlin*
[2] *Johannes Kepler Universität Linz*

The semiconductor EuTe is a prototypical antiferromagnet at temperatrues below 12K. We use resonant magnetic X-ray scattering to directly follow the magnetic order in EuTe after photoexcitation on a sub-picosecond up to microsecond timescale. By designing the sample structure on the nanoscale we can realize distinctive excitation scenarios between electronic, phononic and thermal stimuli of the antiferromagnetic EuTe which allows for disentangling these contributions on an ultrafast timescale.

Magnetic switching by spin-phonon coupling

ESPOSITO Vincent[1], MANKOWSKY Roman[2], FECHNER Michael[3], BEAUD Paul[1], STAUB Urs[1], FÖRST Michael[2], LEMKE Henrik Till[1], CHOLLET Matthieu[4], GLOWNIA James[4]
[1] *Paul Scherrer Institut*
[2] *Max-Planck Institute for the Structure and Dynamics of Matter*
[3] *ETH Zurich*
[4] *SLAC*

The charge and structural dynamics following large amplitude excitation of a lattice mode in a charge and orbitally ordered manganite are probed with resonant x-ray diffraction at the LCLS free electron laser. Combining these experimental results with ab initio calculations, the charge order and the associated insulator-to-metal transition is found to be driven by nonlinear electron-phonon coupling, highlighting a new avenue of nonlinear phonon control.

Tuesday, 11 October 2016
Session 8: Photodoping
16h00 – 17h20

Itinerant and localized magnetization dynamics in antiferromagnetic Ho

RETTIG Laurenz[1], DORNES Christian[2], THIELEMANN-KÜHN Nele[3], PONTIUS Niko[3], ZABEL Hartmut[4], SCHLAGEL D.I.[5], LOGRASSO, T.a.[6], CHOLLET Matthieu[7], ROBERT Aymeric[7], SIKORSKI Marcin[7], SONG Sanghoon[7], GLOWNIA, James M.[7], SCHÜßLER-LANGEHEINE Christian[3], JOHNSON Steven[2], STAUB Urs[8]
[1] *Fritz-Haber-Institut der MPG*
[2] *ETH Zurich*
[3] *Helmholtz-Zentrum Berlin*
[4] *Ruhr-Universität Bochum*
[5] *Ames Laboratory*
[6] *Iowa State University*
[7] *SLAC*
[8] *Paul Scherrer Institut*

The magnetic properties of rare-earth metals strongly depend on the interplay of the itinerant d and localized f electron magnetic moments. We investigate that interaction by studying the ultrafast magnetization dynamic in the metallic antiferromagnet Ho using time-resolved resonant x-ray diffraction at the Ho L3 absorption edge. The equivalent demagnetization timescales found for both subsystems demonstrate strong intra-atomic exchange coupling.

Keynote: Probing the local charge and spin dynamics in correlated materials via the coupling with high-energy electronic excitations

GIANNETTI Claudio (Università Cattolica del Sacro Cuore)

Ultrafast non-equilibrium techniques are emerging as a unique tool to investigate the interplay between the physics of the high-energy excitations and the emergence of low-energy orders, such as superconductivity, charge-order (CO) and frustrated magnetism in correlated materials. Here, I will tackle two paradigmatic systems, i.e., the copper oxides and the honeycomb iridates, in which the dynamics of high energy-excitations provides new insights into the emergent low-energy physics.

Dynamics of screening: an EDMFT+GW perspective

GOLEZ Denis[1], ECKSTEIN Martin[2], WERNER Philipp[1]
[1] *University of Fribourg*
[2] *University of Hamburg, Center for Free-Electron Laser Science*

We will present a study of the dynamical phase transition out of an excitonic insulator phase after photo-excitation using a time-dependent GW method. We identify dynamical phase transition points marked by a slowdown in the relaxation. The transfer of kinetic energy from the photoexcited carriers to the exciton condensate is shown to be the main mechanism for the gap melting. In the last part we will explain how the optical excitation can even transiently enhance the order parameter.

Wednesday, 12 October 2016
Session 9: CDW systems and band structure effects
09h00 – 10h20

Keynote: A multitude of hidden orders created in nonequilibrium transition

MIHAILOVIC Dragan[1], VASKIIVSKYI Igor[2], GERASIMENKO Yaroslav[2], MERTELJ Tomaz[2], RAVNIK Jan[2]
[1] Jozef Stefan Institute
[2] JSI

Femtosecond pulse induced charge ordering studied by low-temperature 4-probe STM reveals a multitude of hidden states with different long range order, from a commensurate polaronic crystal order to a new type of polaron glass. The dynamical properties of these states are shown to be distinctly different, as revealed by the relaxation properties on intermediate timescales, while the photoinduced transition from one long range ordered state to another is shown to proceed within a few femtoseconds.

Coupling of electronic excitations to boson modes in complex materials analyzed by femtosecond tr-ARPES

BOVENSIEPEN Uwe (University Duisburg-Essen)

Pump-probe experiments using femtosecond laser pulses offer by now almost routine means to analyse optical excitations and their relaxation dynamics in the time domain. In this talk experiments using time- and angle-resolved photoemission spectroscopy on the charge density wave materials RTe_3, TaS_2 and the high temperature superconductor BSCCO will be presented. It will be shown that electronic or bosonic excitations can be clearly distinguished complementing established static spectroscopy.

Transient band gap enhancement in the excitonic insulator phase of Ta2NiSe5 upon photoexcitation

MONNEY Claude[1], MOR Selene[2], STÄHLER Julia[2], WERNER Philipp[3], ECKSTEIN Martin[4], HERZOG Marc[2], GOLEZ Denis[3],
MIZOKAWA Takashi[5], HIDENORI Takagi[6], NOHARA Minoru[7], KATAYAMA Naoyuki[8]
[1] University of Zurich
[2] Fritz-Haber-Institut, Berlin
[3] University of Fribourg
[4] University of Hamburg, Center for Free-Electron Laser Science
[5] University of Waseda, Tokyo
[6](University of Tokyo, Tokyo)
[7] Okayama University, Okayama
[8] University of Nagoya, Nagoya

By using time- and angle-resolved photoemission spectroscopy, we show that the band gap of the semiconductor Ta2NiSe5 can be transiently increased on the sub-picosecond timescale with an ultrashort infrared laser pulse. We attribute this effect to the excitonic insulator phase taking place in this material at low temperature. Our result suggests that for a few hundreds of femtoseconds, an out-of-equilibrium phase takes place upon photoexcitation in which the exciton condensate is enhanced.

Wednesday, 12 October 2016
Session 10: Magnetization dynamics
11h00 – 12h20

Keynote: Manipulating magnetism by ultrafast control of the exchange interaction
MENTNIK Johan (Institute for Molecules and Materials, Radboud University)

Magnetic ordering originates from the exchange interaction, the strongest interaction between microscopic spins. In thermodynamic equilibrium this concept is well known and can often be conveniently described by the Heisenberg exchange Hamiltonian $H = -\sum_{i,j} J_{ij} S_i S_j$, where Jij is the exchange parameter and Si and Sj are spins at neighboring sites i,j of a lattice. However, much less is known about the validity of this concept under electronic nonequilibrium conditions such as generated by femtosecond laser excitation. Here we present recent theoretical advances [1,2] which demonstrate an ultrafast control of exchange interactions. Interestingly, we find that depending on the laser frequency and intensity an enhancement, reduction and even complete reversal of the sign of the exchange interaction can be achieved. Moreover, we show how such ultrafast control of the exchange interaction can be used to manipulate magnetic order. In addition to the excitation of high-frequency spin precession in canted antiferromagnets that has been recently observed in experiments [3], we argue that a change of sign of the exchange interaction causes an effective timereversal of the spin dynamics. Furthermore, we show that the modification of exchange interaction can even cause spin dynamics in collinear antiferromagnets, as has recently been observed experimentally [4,5]. In this case the excitation directly relies on the quantumcharacter of the spins and causes purely longitudinal oscillations of the antiferromagnetic order parameter on femtosecond timescales, determined by the exchange interaction alone [6]. Finally, we demonstrate that a laser-induced reduction of the exchange interaction causes an ultrafast cooling of the spin system on sub-picosecond time scales [7], which suggest a novel way to search for highly efficient magnetocaloric materials.

[1] J.H. Mentink and M. Eckstein, Phys. Rev. Lett. 113, 057201 (2014)
[2] J.H. Mentink, K. Balzer, M. Eckstein, Nat. Commun. 6, 6708 (2015)
[3] R.V. Mikhaylovskiy et al., Nat. Commun. 6, 8190 (2015)
[4] J. Zhao et al., Phys. Rev. Lett 93, 107203 (2004)
[5] D. Bossini et al., Nat. Commun. 7, 10645 (2016)
[6] D. Bossini et al., in preparation (2016)

Ultrafast energy and momentum resolved dynamics of magnetic correlations in photo-doped Mott insulator Sr2IrO4
DEAN Mark (Brookhaven National Laboratory)

This talk describes RIXS measurements of magnetic dynamics after photo-doping the Mott insulator Sr2IrO4. We find that the non-equilibrium state, 2 ps after the excitation, exhibits strongly suppressed long-range magnetic order, but hosts photo-carriers that induce strong, non-thermal magnetic correlations. These 2D in-plane Neel correlations recover within a few picoseconds, while the 3D long-range magnetic order restores on a fluence-dependent timescale of a few hundred picoseconds.

Ultrafast electronic, spin and lattice separation in LaCoO3
IZQUIERDO Manuel[1], YAROSLAVTSEV Alexander[1], CARLEY Robert[1], KAROLAK Michael[2], LICHTENSTEIN Alexander[3], SCHERZ Andreas[1], MOLODTSOV Serguei[1]
[1] European XFEL GmbH
[2] Theoretical Physics I, University of Würzburg
[3] University of Hamburg

The semiconductor to metal transition of LaCoO3 is investigated with all-optical and optical-soft x-ray experiments with femtosecond pulses. The combined analysis has evidenced that upon laser excitation the system is driven into a transient metallic state, in which the electronic, spin and lattice degrees of freedom are excited in different time scales. DFT++ calculations have shown that correlation-driven charge and spin fluctuations are relevant to understand phase transitions in LaCoO3.