AIM Summer School 2022

30.05 – 03.06.2022

K6 Seminarhotel

Kirschallee 6, 38820 Halberstadt

Organizers

Dan Bosworth , Felix Bourier, Cesar Cabrera Cordova,
Irene Fernandez-Cuesta, Susanna Gevorgyan, Dominik Höing,
Alessandra Picchiotti, Matthew Robinson, Philipp Wessels-Staarmann,
Jutta Voigtmann, Tamme Wollweber, all CUI administration personnell

CLUSTER OF EXCELLENCE
CUI: ADVANCED
IMAGING OF MATTER

Universität Hamburg
DER FORSCHUNG | DER LEHRE | DER BILDUNG

mpsd
Max-Planck-Institut für
Struktur und Dynamik der Materie

DESY.

European XFEL

Timetable

Monday, 30 of May

8:00	**Boarding on bus in Hamburg central station**		
8:00–12:00	**travel / arrival / checking at the hotels**		
12:30–14:00	**Lunch**		
14:00–16:00	**Welcome game**		
16:00–16:15	CT	**Meny Menashes**	Novel quantum simulator based on an ultracold Strontium gas
16:15–16:30	CT	**Daniel Bosworth**	State transfer protocols using a dragged impurity
16:30–16:45	CT	**Hamid Ahmadi Rashtabadi**	Generation of frequency tunable ultraviolet pulses for steering and imaging of photoreaction dynamics
16:45–17:00	CT	**Julian Fiedler**	A velocity map imaging and ion microscopy unit for ultracold atoms
17:00–17:15	CT	**Felix Klein**	Pulsed Optomechanics in a quantum hybrid system
17:15–17:30	CT	**Jannik Lübke**	Control of bio-nanoparticles with electrical fields
17:30–17:45	PO	**Poster Slam**	
18:30–19:30	**Dinner**		
19:30–20:30	**Poster session**		

Tuesday, 31 of May

08:00–09:00	**Breakfast**		
9:00–10:30	PT	**Henrike Müller-Werkmeister** Potsdam University	Structural Dynamics in Complex Molecular Systems – Why do you still need ultrafast laser spectroscopy if you can use an XFEL?
10:30–11:00	**Coffee**		
11:00–12:30	PT	**Henrike Müller-Werkmeister** Potsdam University	Structural Dynamics in Complex Molecular Systems – Why do you still need ultrafast laser spectroscopy if you can use an XFEL?
12:30–14:00	**Lunch**		
14:00–16:00	**Mentoring session**		

CT: CUI members Talks, IS: Invited Speaker, PT: Plenary talks, PO: Poster Slam

16:00–18:00	IS	**Vladimir Airapetian** NASA	Prebiotic Chemistry of the Hadean Earth Under the Young Active Sun (zoom event)
18:00–18:30	PO	**Poster Slam**	
18:30–19:30		**Dinner**	
19:30–20:30		**Poster session**	

Wednesday, 1st of June

08:00–09:00		**Breakfast**	
9:00–10:30	PT	**Giulio Cerullo** Politecnico di Milano	Snapshots of primary photoinduced events in biomolecules by tunable few-optical-cycle pulses
10:30–11:00		**Coffee**	
11:00–12:30	PT	**Giulio Cerullo** Politecnico di Milano	Snapshots of primary photoinduced events in biomolecules by tunable few-optical-cycle pulses
12:30–14:00		**Lunch**	
14:00–18:30		**Free afternoon**	
18:30–19:30		**Dinner**	
19:30–20:30		**CUIans' quiz**	

Thursday, 2nd of June

08:00–09:00		**Breakfast**	
9:00–10:30	PT	**Alexandre Dauphin** IFCO	Generating and Detecting Topological Insulators in Quantum Simulators
10:30–11:00		**Coffee**	
11:00–12:30	PT	**Alexandre Dauphin** IFCO	Generating and Detecting Topological Insulators in Quantum Simulators
12:30–14:00		**Lunch**	
14:00–16:00	IS	**Eileen Schwanold** CUI-AIM	Diversity and Science
16:00–16:15	CT	**Joseph Adelinia**	Ultrafast Transport Probe of Light-Induced Superconductivity
16:15–16:30	CT	**Jannis Neuhaus-Steinmetz**	Complex magnetic ground states and topological electronic phases of atomic spin chains on superconductors
16:30–16:45	CT	**Benoît Richard**	Interactivity and animations for scientific visualization

16:45–17:00	CT	**Mukhtar Singh**	UV and Mid-IR Photo-induced Dissociation of Solvated (Bio)Molecular Complexes
17:00–17:15	CT	**Marvin Skiba**	Probing the fate of hybrid nanoparticles in cellular environment
17:15–17:30	CT	**Jim Skulte**	Cavity-induced p-band condensation in a dark state
17:30–17:45	CT	**Niklas Witt**	Coherence and pairing fluctuations in strongly correlated superconductors
18:00–18:30	PO	**Poster Slam**	
18:30–19:30	**Dinner**		
19:30–20:30	**Poster session**		

Friday, 3rd of June

08:00–09:00	**Breakfast**		
9:00–10:30	IS	**Enrico Patrono** CAS	The role of Neuroscience in brain-based lifelong learning, and its potential cross-disciplinary
10:30–11:00	**Coffee**		
11:00–12:30	IS	**Enrico Patrono** CAS	The role of Neuroscience in brain-based lifelong learning, and its potential cross-disciplinary
12:30–14:00	**Lunch**		
14:00–15:00	**Closing remarks**		
15:00–18:00	**Return to Hamburg by bus**		

List of Abstracts – Talks

Monday, 30 of May

16:00

Novel quantum simulator based on an ultracold Strontium gas

Meny Menashes CT

Quantum gases have been an active field of research in the last two decades, imitating many physical systems. One such setup is a novel quantum simulation platform based on Strontium atoms with single-particle and spin detection, and short cycle times below one second. By developing new cooling and detection techniques, a new regime for quantum simulation based on neutral atoms will be reached opening fascinating opportunities for experiments. In my talk, I will explain our methods and approaches to constructing a quantum degenerate gas and what we aim to study by measuring the states of the atoms.

16:20

State transfer protocols using a dragged impurity

Daniel Bosworth CT

We propose state transfer protocols to prepare a one-dimensional gas of trapped bosons in both pure and mixed excited states of the trap. This is achieved by dragging a charged impurity through the gas, which breaks the system's parity symmetry and thus leads to avoided crossings between neighbouring single-particle states. We exploit these avoided crossings in order to transfer the state dynamically from the ground state up to a desired excited state or mixture thereof. This serves as a basis for future studies on quench dynamics of excited bose gases.

16:40

Generation of frequency tunable ultraviolet pulses for steering and imaging of photoreaction dynamics

Hamid Ahmadi Rashtabadi CT

Frequency tunable resonant dispersive waves are generated in a compact cascaded hollow-core fiber setup pumped by a Ti:sapphire laser. The UV pulses with a Fourier limit of 1.3 fs are effective tools for observing and controlling extremely fast electronic dynamics in molecules.

17:00

A velocity map imaging and ion microscopy unit for ultracold atoms

Julian Fiedler CT

Ultrashort laser pulses provide pathways for manipulating atomic quantum gases on femtosecond timescales. By focusing a single femtosecondblaser pulse onto a Bose-Einstein condensate (BEC), a controlled number of charge carriers can be created, forming hybrid systems ranging from few ion-atoms-, to complex many body systems. To study such systems, we built a new coincidence detection unit, consisting of an electron velocity map imaging spectrometer and an ion microscope, that provides the spectral and spatial distribution with very high resolution. By measuring the ions and electrons simultaneously, we will get a detailed picture of the ionization process and subsequent dynamics.

17:20

Pulsed Optomechanics in a quantum hybrid system

Felix Klein CT

Pulsed Optomechanical experiments have recieved growing interest in recent years as they pave the way for backaction-evading measurement schemes of nanomechanical oscillators. Using light pulses with a fractional length of the oscillators period, it can be prepared in a quantummechanical, squeezed state while having access to its mechanical quadratures via pulsed state tomography. Here we present first steps of implementing such a pulsed experiment with a nanomechanical oscillator in a fiber fabry pérot cavity and discuss an experimental apporach for hybridization of such a system using electromagnetically induced transparency.

17:40

Control of bio-nanoparticles with electrical fields

Jannik Lübke CT

During Single-Particle Imaging (SPI) experiments at free-electronblaser facilities, aerosolized nanoparticles are successively exposed to intensenx-rays, which diffract and are recorded as snapshots of individual molecules. After collecting many of these snapshots, the molecular (3d-) structure can be retrieved. This method relies on identical particles and controlled sample delivery. Here I present our experimental approach for optimized SPI experiments.

18:00–18:30 — posterslam

The slides from the poster slam will be added to the present booklet during the conference PO

- Emanuele Rossi: Non-linear X-ray spectroscopy as a tool for studying ultrafast chemical reactions
- Sani Harouna-Mayer: 3D pair distribution function of textured Pt
- Huan Zaho: Femtosecond Dynamics of Ag29 Nanoclusters Probed by Time-Resolved UV-Vis Spectroscopy
- Benoît Richard: Exploiting the full information contained in multi-coincidence measurements from X-ray induced Coulomb explosion
- Hamid Ahmadi Rashtabadi: Generation of frequency tunable ultraviolet pulses for steering and imaging of photoreaction dynamics
- Daniel Bosworth: TBC
- Fabian Scheiba: Parametric waveform synthesis for soft-X rays and attosecond science
- Mei Bai: Theory of dissipative EXAFS
- Daniel Lengle: Cation Exchange on Single Nanowires
- Sunil Kumar Mahato: Thin Film based Quantum Emitters
- Jan Lukas Dresselhaus: Multilayer Laue lenses for hard X-Rays
- Matteo Vandelli: Quantum embedding in dual space for multi-orbital electronic systems
- Joseph Adelinia: Ultrafast Transport Probe of Light-Induced Superconductivity
- Philip Lenz: Nanoconfinement: changing the properties of water in nanopores
- Michael Lau: Spin Wave Driven Skyrmions on a Micromagnetic Lattice
- Mario Großmann: TBA
- Kai-Fu Wong: Petahertz Optical Sampling of Nanoplasmonic Fields
- Tatiana Bezriadina: Theoretical description of x-ray absorption by laser-driven electronic systems
- Giovanni De Vecchi: Probing Light-Induced Superconductors with Ultrafast Magnetometry

Tuesday, 31 of May

9:00–10:30 and 11:00–12:30

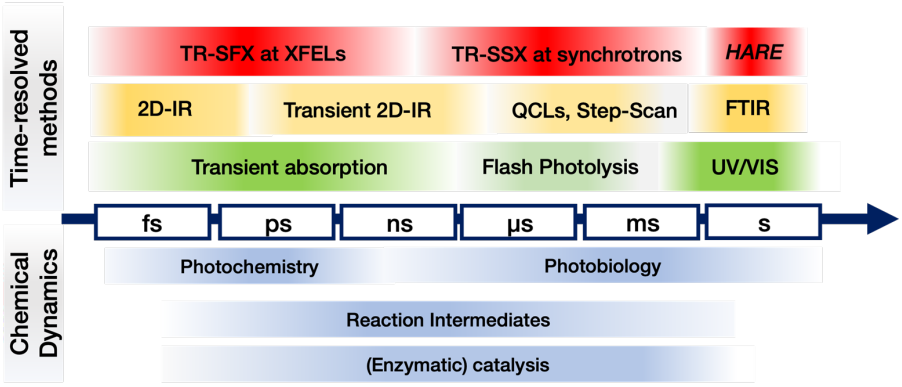
Structural Dynamics in Complex Molecular Systems – Why do you still need ultrafast laser spectroscopy if you can use an XFEL?

Henrike Müller-Werkmeister

PT

University of Potsdam, Institute for Chemistry, Physical Chemistry, Karl-Liebknecht-Str. 24-25, 14476 Potsdam - Golm henrike.mueller-werkmeister@uni-potsdam.de, www.uni-potsdam.de/usd

Experimental tools to investigate structural dynamics in complex molecules such as proteins are rapidly emerging, driving by technical innovations, including XFELs. Most of these structural dynamics techniques share the same principle of the pump-probe approach, triggering a molecular process with a pump pulse (often fs laser) and, after a defined time delay, probing the system in question with a) another laser pulse (in case of optical spectroscopy), b) an X-Ray pulse (in case of time-resolved serial crystallography (TR-SX) and others) or e.g. c) an electron pulse (in case of ultrafast electron diffraction). While time-resolved serial crystallography can provide full



temporal and spatial resolution down to atomic resolution, still a lot of attention needs to be paid to the optical trigger and potential laser-induced damages. Furthermore, as beamtime is very sparse, experiments need to be prepared optimally. This includes determination of the best excitation conditions and a detailed study of the structural dynamics with optical spectroscopies. Here, transient infrared spectroscopy and multidimensional infrared spectroscopy (2D IR) are highly important tools, as infrared spectroscopy is inherently structure-sensitive and can be applied for studies of proteins in solution.

I will provide an overview on different structural dynamics experiments, with a focus on protein dynamics and review the basics of femtosecond time-resolved spectroscopy in the UV/Vis and IR as complementary tools. Overall, a full tool-box to study ultrafast structural dynamics of both small and complex molecules, both in solution and the solid state, is available now and can be applied to fully understand molecular function.

16:00 – 18:00

Prebiotic Chemistry of the Hadean Earth Under the Young Active Sun

Vladimir Airapetian IS

NASA Goddard Space Flight Center and American University, DC, USA

Is life unique to Earth or a common phenomenon in the Solar System and the Universe? This fundamental question is among the greatest puzzles of modern science. Earth's evident long-term habitability makes it a key data point for understanding the formation of habitable worlds in the Universe. Earth could be a special outlier, or it could be a typical rocky planet. Understanding the conditions that allowed for the emergence of life on early Earth, and whether other inner planets in our Solar System possibly also supported habitable conditions early in their histories but failed to sustain them due to their unique evolutionary trajectories, is a promising way to address these questions. For this, we need to know how the basic requirements for life as we know it such as liquid water, organic compounds and persistent external energy fluxes promoted the emergence and complexification of biological systems on early Earth and how they were impacted by planetary and solar properties. The early Solar System was a chaotic place, likely subject to frequent large impacts as well as the violently changing energetic ionizing radiation flux from the young Sun. In this talk, I will describe our observationally constrained state-of-the-art theoretical models of the corona, the wind and transient events from the young Sun at the time when life arose on Earth and discuss the impact of solar X-ray, Extreme UV and particle fluxes associated with superflares on our planet. Specifically, I will use these constrained energy fluxes to describe our recent atmospheric chemistry models impacted by energetic particles from the young Sun and formation and precipitation of biologically relevant molecules including hydrogen cyanide and formaldehyde to the Earth's surface. I will then highlight our recent results of laboratory experiments of irradiation of mildly reduced gas mixture irradiated by high energy protons with the fluxes consistent with our theoretical models and their implications to the formation of complex molecules on the Hadean Earth.

18:00–18:30 — posterslam

The slides from the poster slam will be added to the present booklet during the conference PO

- Matthew Robinson: Experimentally unravelling the ultrafast dynamics of thermal-energy chemical reactions
- André Becker: Non-Equilibrium Dynamics of Few Trapped Fermions
- Marty Rogers: Photocage Design for Time-Resolved Crystallography
- Niels Breckwoldt: Utilising charge state distributions for calibration of intense XFEL pulses with Bayesian optimisation
- Shivani Kesarwani: Synthesis and Characterization of Gold Nanoparticles
- Felix Gerken: Bethe ansatz for open quantum spin chains
- Alessandra Picchiotti: Single-particle DNA detection using microfluidic chips and the LADOM technique
- Marcel Herber: Hierarchical Assembly of 2D Nanomaterials into Hetero-Layered Structures
- Felix Klein: I will prepare a talk
- Jakob Butlewski: Pump asymmetry compensation in a quantum hybrid system
- Alexandra Mozdzen: Two-Dimensional Bose Gas with Tuneable Interaction Strength
- Jette Heyer: Many to few: From ultracold plasma to atom-ion hybrid systems
- Ioannis Ioannidis: Manipulating Majorana Modes in Magnetic Atomic Chains
- Niklas Witt: See field "Plenary talk"
- Artur Feld: Functionalization strategies for semiconductor nanoparticles
- Jannik Lübke: Control of bio-nanoparticles with electrical fields
- Alexander Wolff: Foundations for Squeezed-Light-Enhanced Mass Photometry
- Jingxuan He: Cold and controlled beams of nanoparticles and bio-macromolecules

Wednesday, 1st of June

9:00–10:30 and 11:00–12:30

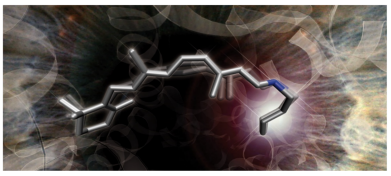
Snapshots of primary photoinduced events in biomolecules by tunable few-optical-cycle pulses

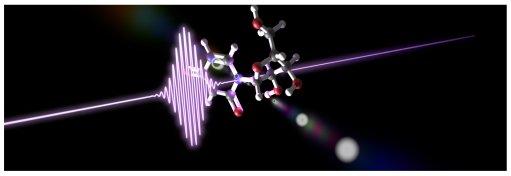
Giulio Cerullo

PT

Dipartimento di Fisica, Politecnico di Milano, Piazza L. da Vinci 32, 20133 Milano, Italy

Many light-induced processes in biomolecules, such as energy relaxation, energy/charge transfer and conformational changes, occur on ultrafast timescales, ranging from 10-14 to 10-13 s. The speed of such elementary processes is intimately linked to their efficiency, making ultrafast optical spectroscopy an invaluable tool for their investigation [1]. Pump-probe and the emerging multi-dimensional spectroscopies require short pulses, in order to observe fast dynamics, and broad frequency tunability, to excite a system on resonance and probe optical transitions occurring at different frequencies. Optical parametric amplifiers are ideal tools for such experiments, because they provide frequency tunability and support broad gain bandwidths, enabling the generation of pulses with duration down to a few optical cycles and tunability from the IR to the UV [2].





In this seminar I will introduce the principles of ultrafast optical spectroscopy (Introductory Lecture) and give examples of its application to the study of important photoinduced processes (Contemporary Science Lecture), such as energy/charge transfer in natural and artificial light-harvesting complexes [3], the isomerization of rhodopsin which triggers the primary event of vision [4] and conical intersection events underlying photoprotective mechanisms of DNA [5, 6]. 0.2

1 M. Maiuri et al., J. Am. Chem. Soc. 142, 3 (2020).
2 C. Manzoni and G. Cerullo, J. Opt. 18, 103501 (2016).
3 S.M. Falke et al., Science 344, 1001 (2014).
4 D. Polli et al., Nature 467, 440 (2010).
5 R. Borrego-Varillas et al., J. Am. Chem. Soc. 140, 16087 (2018).
6 R. Borrego-Varillas et al., Nat. Commun. 12, 7285 (2021).

Thursday, 2nd of June

9:00–10:30 and 11:00–12:30

Generating and Detecting Topological Insulators in Quantum Simulators

Alexandre Dauphin

IFCO

PT

Topological insulators are exotic phases of matter. While insulating in their bulk, they present conducting surface states protected by the topology of the system. Their description requires a global order parameter, an integer called topological invariant and, therefore, their characterization escapes the Ginzburg-Landau theory of phases of matter. Such a quantized invariant makes these materials very robust against local perturbations such as disorder or interactions. A very famous application of this robustness appears in the measurement of the transverse conductivity of the integer quantum Hall effect. The latter provides a new standard for the resistance and is now a key ingredient of the recent revision to the SI system of units.

Quantum simulators open another avenue for the study of the properties of topological insulators. In the 80s, Feynman proposed to simulate the dynamics of complex quantum systems with another quantum system in a very controllable environment. Quantum simulators can be realized in diverse physical systems such as ultracold atoms or molecules, or photonic devices. It is then possible to engineer the dynamics to mimic the desired materials. In this lecture, I will discuss how one can simulate topological insulators in cold atom and photonic simulators. I will also discuss different strategies to measure the topological invariant. Finally, I will show some experimental implementations of the theoretical schemes.

14:00–16:00

Diversity and Science

Eileen Schwanold

Organizational and Social Psychologist, Diversity Officer at CUI Diversity and Science

IS

In recent years, diversity has grown to become quite the buzzword with increased visibility in the mainstream media. Companies use it as a means to sell their products better, radio stations pride themselves in offering more musical diversity and many TV formats make an extra effort to be “more diverse”. This surely makes it harder to grasp what “diversity” and “diversity management” were initially meant to achieve as concepts for the management of organizations and social groups. In this talk, we will have a look at the roots of the concept and ask ourselves what diversity really means for the scientific system. Is it worth striving for - and if so, how can we effectively work towards it? The presentation will provide a conceptual introduction, insights into current practices of diversity management in science as well as plenty of room for questions and exchange on the topic.

16:00

Ultrafast Transport Probe of Light-Induced Superconductivity

Joseph Adelinia CT

The observation of superconducting-like optical features in driven K3C60 far above the critical temperature has opened up a new pathway to increase the superconducting Tc. In light of this discovery, it is important to explore further characteristics of the non-equilibrium state, such as a Meissner effect and critical current behaviour. We combine MBE thin-film growth with on-chip ultrafast transport techniques to measure the transient electronic response of K3C60 after optical excitation. This technique can serve as an ultrafast voltmeter to observe changes in the electrical conductivity of the sample on a picosecond timescale. Further still, our measurement geometry allows us to search for nonlinearities related to a critical current which could be associated with superconductivity.

16:20

Complex magnetic ground states and topological electronic phases of atomic spin chains on superconductors

Jannis Neuhaus-Steinmetz CT

Understanding the magnetic properties of atomic chains and nanoscopic wires on superconductors is an essential cornerstone on the road towards controlling and constructing topological matter. Yet, even in the simplest models of suspended chains, the classes of available magnetic ground states remain debated. Ferromagnetic (FM), antiferromagnetic (AFM), and spiral configurations have been suggested and experimentally detected, while additionally non-coplanar and complex collinear phases have been conjectured. Here, we resolve a recent controversy by determining the magnetic ground states of chains of magnetic atoms in proximity to a superconductor with Monte-Carlo methods, which employ the initial tight-binding model directly without further simplifications. We confirm the existence of FM, AFM and spiral ground states, and identify additional more complex ground states. We topologically classify the electronic structures, and investigate the stability of the magnetic states against increasing superconductivity. In addition, we introduce a computationally efficient alternative for approximating the magnetic ground state with an effective Heisenberg model, which we demonstrate by using our previous results as a benchmark for this new method.

16:40

Interactivity and animations for scientific visualization

Benoît Richard CT

The ability to interact with your data is invaluable to build an intuition about it. Learning to build a (possible interactive) animation, however has a steep learning curve. In this talk, I propose to cover some key (and confusing) concepts used across animation libraries, with the goal to give a headstart to anyone interested in adding interactivity to their project.

17:00

UV and Mid-IR Photo-induced Dissociation of Solvated (Bio)Molecular Complexes

Mukhtar Singh CT

We present the ultrafast imaging of UV and thermal energy chemical dynamics of micro-solvated (bio)molecular complexes probed with strong field techniques. We are interested in Hydrogen bonded aggregates of molecules or chromophores with solvent molecules, which are important model systems for the interactions between proteins and their solvent environment. We produced a pure sample of the molecule of interest in the gas phase by using a combination of a molecular beam and the electrostatic deflector. To study the photo induced dynamics, we set up an UV-IR pump-probe experiment, in which a 267 nm beam was used to excite the system. To ionise the system we use a 1.3 μm beam. We determined the time-dependent appearance of the different reaction products and disentangled which ultrafast processes occur. Next step is to use a mid-IR pump beam for the excitation and the same 1.3 μm ionising beam to study thermal excitation in bio molecular complexes. In future experiments will use laser-induced electron diffraction (LIED) to probe the induced dynamics in order to obtain structural information about the system with atomic resolution.

17:20

Probing the fate of hybrid nanoparticles in cellular environment

Marvin Skiba CT

Metal nanoparticles are intensively studied in different research areas including nanomedicine. For stabilization and functionalization the nanoparticles are coated with molecules, ligands, which are often based on polymers. In many biological fluids, proteins quickly adsorb to the nanoparticles' surface upon exposure, forming a so-called protein corona. This can critically change their behavior, e.g. cellular uptake, cytotoxicity or the intended specific binding to receptors (targeting). Therefore, it is of utmost importance to understand the formation and fate of the protein corona as detailed as possible. We want to study the fate of the individual parts – the metal core, the polymeric coating and the protein corona upon entering living cells. In this talk, x-ray fluorescence imaging (XFI) data obtained at synchrotron sources will be presented. It will be discussed how elemental colocalization inside mammalian cells can help to understand the fate of nanoparticles in cells. As a perspective, complementary future experiments using different techniques like high-resolution mass spectrometry imaging will be presented.

17:40

Cavity-induced p-band condensation in a dark state

Jim Skulte CT

We experimentally realize a dark state in the p-band of an ultracold quantum gas coupled to a high-finesse cavity. We show that this dark state can be understood as a condensate in the p-band, which due to its parity symmetry does not couple to the cavity mode. We further show experimentally by band mapping measurements and theoretically by solving the equations for the full atom-cavity system and a minimal model, that cavity interactions transfer the atoms into a dark state in the p-band making the state very long lived and robust.

18:00

Coherence and pairing fluctuations in strongly correlated superconductors

Niklas Witt CT

We present a microscopic dynamical mean-field based theory to the macroscopic properties of correlated superconductors. We illustrate with the example of alkali doped fullerides (A3C60) how proximity of superconducting and Mott localized states impact superconducting coherence, pairing fluctuations, and critical temperature.

18:00–18:30 — posterslam

The slides from the poster slam will be added to the present booklet during the conference PO

- Michaela Schneeberger: Nonequilibrium aqueous solvation around nascent halogen atoms
- Jim Skulte: Cavity-induced p-band condensation in a dark state
- Zeki Zeybek: Many Body Physics with Rydberg atom Arrays
- Agnes Weimer: Size- and Shape-Controlled Iron Oxide Nanocrystal Formation
- Rukan Nasri: Interfacing DNA with ultrashort Lasers
- Marvin Skiba: TBA
- Cassian Plorin: TBA
- Sergei Riabchuk: Generation and temporal characterization of few-femtosecond UV pulses for time-resolved studies
- Cesar Cabrera: The Cesium quantum gas microscope
- Julian Fiedler: A velocity map imaging and ion microscopy unit for ultracold atoms
- Donika Imeri: Quantum Network based on Silicon Vacancy Centers in Diamond
- Susanna Gevorgyan: Structural dynamics of biosynthesized nanoparticles and prospects in Proteomics
- Dominik Höing: Hot Electron Dynamics in Plasmonic Gold Nanoparticles
- Nicolas Heimann: TBA
- Anna Zehle: TBA
- Thies Plassmann: A novel quantum simulation platform based on an ultracold strontium gas

Friday, 3rd of June

9:00–10:30 and 11:00–12:30

The role of Neuroscience in brain-based lifelong learning, and its potential cross-disciplinary

Enrico Patrono IS

Laboratory of Neurophysiology of Memory, Czech Academy of Sciences, Prague, Czech Republic

The human brain is capable of continuous learning over a lifespan. The learned knowledge is retained, fine-tuned, and reused to perform new tasks. Neuroscience studies the mental processes involved in learning through the brain. It is a science that combines several fields of the biological and psychological realms to understand the abilities of neurons and neural circuits. Eric Kandel described the understanding of the biological basis of learning, memory, and consciousness as the "epic challenge" of the last two centuries. However, only in the last 70-80 years, Neuroscience becomes a significant field of study, understanding the complexity of neuronal communication and its role in human behaviors, thanks to the steep technical development. Recent technologies allowed us to observe how neural cells communicate and interact and understand the orchestral role of neuronal communications in the brain, subserving human behaviors. The recent advancements and technical development in Neuroscience brought the researchers to the point that bio-physiological knowledge is not enough to cover the broader challenges that the brain complexity face continuously. One example is the current involvement of computer programming skills and expertise in computational neuroscience and neuro-genetics. Furthermore, the recent development of optogenetics - a neuroscience method that allows for mechanical activation of neurons by light flashes – induced a vigorous drive towards the realm of physics and optics. Finally, it is possible to hypothesize that Neuroscience is a scientific field of study that can open a cross-disciplinary endeavor with many other research fields.