Newsletter Physics 10/21

We are back from the summer break and hope that you enjoy our first autumn newsletter.

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News from the Department

Jan Christoph Goldschmidt is new W3 professor

Jan Christoph Goldschmidt has accepted the offer for a professor position at the Department of Physics and will start his new group "Physics of solar energy conversion" in November 2021. We interviewed him about his future plans in Marburg, things and decisions he is most proud about, work-life balance and much more. "I want to design solar cells based on novel semiconductor materials". "I could have started working for a consulting company, but I decided to do PhD in physics about novel photovoltaic technologies". "During my interview in Marburg, I just had the feeling that it fits very well." Read the full interview below (in German).

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Two successful Loewe projects

Two projects in the new "LOEWE-Exploration" funding line of the state of Hesse are going to the Department of Physics with the total funding amount of about 500.000€. Both projects focus on microplastics, which are an increasing environmental problem.
In one project by Prof. Dr. Marina Gerhard, a new spectroscopic detection method for microplastics will be developed. In the second project of Prof. Dr. Peter Lenz and Prof. Dr. Martin Koch the origin of microplastics in the river Lahn is investigated. In addition, a numerical model for the simulation of microplastic material flows is being developed.

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SFB 1083 international conference

Interfaces between solids play a decisive role in modern materials sciences and their technological applications. International Conference "Internal Interfaces 2021", organized to take place at Schloß Rheinfels situated in the lovely Rhinevalley (designated a UNESCO cultural heritage site in 2002) will provide an expert forum for the discussion of recent progress as well as of experimental and theoretical challenges in basic research of solid/solid interfaces. The conference will include invited talks, contributed talks and posters in a single-session format. Due to the COVID pandemic, the conference will be held in a hybrid format (on site and online).

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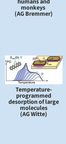
MINT summer school for girls

The Physics Department has recently participated in the "MINT summer school for girls". In this event, several female students from schools in Hessen have visited the science faculties in Marburg including the Physics Department. Guided by Luise Rost, Caroline Schreiber, Zoe Laufenberg and Tobias Breuer ,the students have performed experiments from the field of electronics and optics to introduce them into study experiences in physics courses. The event was very successful, since all participants had fun throughout the day and stated that their impressions have increased their interest in physics and improved their expectations towards studying physics.



Physics collection part of exhibition

The Physics Collection has contributed to the exhibition "Spuren lesen: Objekte erzählen. Marburger Universitätsammlungen digital". This exhibition was opened on the occasion of the diamnual collection conference "Digitales Kuratieren", September 15-17, 2021. In the rooms of the University Library, one could find objects from the university collections. The online exhibition will be hosted by the "Deutsche Digitale Bibliothek".

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November election of gender equality officers

In November, we will elect the gender equality officers for the term 12/2021 - 12/2023 at the department's annual general women meeting. At the moment, we are a team of four women, who are committed to optimise the situation of gender equality at the department. For the next term, we are looking for female physicists - students are very welcome - to join and collaborate with an input of time at your own choice. If you are interested, you are welcome to write an email for more information.

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PhD Defense Jonas Zimmermann

Jonas Zimmermann from the Surface Physics group has finished his PhD on "Charge-Transfer Dynamics at the Interface of Two-Dimensional Materials". He designed and built a novel second-harmonic imaging microscope for the systematic study of charge carrier dynamics in transition metal dichalcogenide heterostructures. Due to the excellent time resolution this setup provides he was able to resolve differences in the dynamics for different stacking configurations of MoS_2/WSe_2 heterostructures.

PhD Defense Christian Kriso

Christian Kriso from the Semiconductor Photonics Group successfully completed his PhD on "Investigating self-mode-locking in VECSELs: Nonlinear lensing and frequency-modulated combs". In his thesis, he studied whether the intrinsic nonlinearity of the VECSEL gain chip can be exploited to achieve ultrashort pulse or frequency-comb generation. Starting in October, he will join the Centre for Nanoscience and Nanotechnology (C2N) in Palaiseau close to Paris as a Postdoc to work on polariton physics and quantum optics.

New benches

We have new benches in the garden of Renthof 7! Fortunately, the sunny autumn weather still allows to use these nice wooden benches. Enjoy it!

Research Highlights

Engineering of printable and air-stable silver electrodes (AG Witte)

Deposition of F_4TCNQ and F_6TCNNQ leads to intercalation of silver into the molecular films. Careful heating of such intermixed multilayers enables the preparation of defined, charge transfer stabilized contact primer monolayers. This concept is translated to printable silver electrodes, enabling the application of air-stable, high work function substrates, which form sharp interfaces subsequently deposited p-type organic semiconductors. The work of AG Witte was published in Advanced Functional Materials.

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Ultrafast charge-transfer dynamics in twisted TMDC heterostructures (AG Höfer)

In TMDC heterostructures, photoexcited charge carriers can separate into different layers through ultrafast charge transfer. Since the coupling within these structures depends considerably on the layer stacking, a strong influence of the interlayer twist on charge transfer has been expected. In collaboration with the groups of T. Korn (Rostock) and C. Schüller (Regensburg), Gerson Mette and his team have employed second-harmonic imaging microscopy to investigate the ultrafast charge-carrier dynamics across MoS_2/WSe_2 heterostructure interfaces for different stacking configurations. The ultrafast electron transfer from WSe_2 to MoS_2 is found to depend considerably on the stacking angle. The transfer time is reduced from 85 fs down to 12 fs when going from a larger rotational mismatch towards 2H-stacking. The work was published in ACS Nano.

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Non-classical exciton propagation in 2D materials (AG Malic)

In a collaboration with A. Chernikov (TU Dresden) und M. Glazov (Ioffe Institute, Russia), AG Malic has gained new microscopic insights into non-classical exciton transport at low temperatures in WSe2 monolayers. Monitoring phonon-assisted recombination of dark states, we find a highly unusual exciton diffusion. We observe a pronounced decrease of the diffusion coefficient with increasing temperature. This behavior corresponds neither to well-known regimes of semiclassical free-particle transport nor to the thermally activated hopping in systems with strong localization. Its origin is discussed in the framework of both microscopic and semi-phenomenological analytical models illustrating the observed characteristics of non-classical propagation. The work was published in Physical Review Letters (with Editor's Suggestion).

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Proattentive processing of visually guided self-motion in humans and monkeys (AG Bremmer)

When we move through the environment (e.g. while driving or walking), our brain constantly has to keep track of where we are heading. Only this allows us to adjust our movement in order to stay on track or navigate around obstacles. In an interdisciplinary EEG study, researchers from the Neurophysics Group found that visual heading direction is processed within the first 120 ms of a movement or following a heading change. This demonstrates, for the first time, that the information about where we are moving is analyzed by our brains even before we consciously perceive it. The work was published in Progress in Neurobiology.

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Temperature-programmed desorption of large molecules (AG Witte)

The formation of molecular nanostructures is determined by the interplay of intermolecular and molecule-substrate interactions. However, these interactions are experimentally hardly accessible. In a collaboration between the groups of Gregor Witte and Michael Gottfried, temperature-programmed desorption (TPD) was used to quantify these interactions for pentacene films adsorbed on gold. The combination of a quantitative analysis of coverage-dependent TPD traces with Kelvin probe and STM data allows to distinguish different contributions to the net intermolecular repulsion, and provides new insights into the relation of thin film structure and surface dynamics at elevated temperatures. The work was published in Nanoscale.

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Direct measurement of excitonic wavefunction (AG Malic)

While optical signatures of excitons in 2D materials have been studied extensively, experimental access to the excitonic wave function itself has been elusive. In a joint study including E. Erosterfer (FHI Berlin), A. Rubio (MPI Hamburg), A. Knorr (TU Berlin) and AG Malic, multidimensional photoemission spectroscopy was combined with microscopic theory to present a momentum-, energy- and time-resolved perspective on excitons in WSe2. By tuning the excitation wavelength, we determine the energy-momentum signature of bright exciton formation and its difference from conventional single-particle excited states. The multidimensional data allows to retrieve fundamental exciton properties (such as the binding energy) and to reconstruct the real-space excitonic wave function via Fourier transform. The work was published in Natural Sciences.

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Perfluorinated Acenes: Crystalline Structure Prediction, Selective Growth and Optoelectronic Properties (AG Witte)

The emerging field of organic electronics has stimulated extensive research for a better understanding of molecular materials and the search for new molecular semiconductors and fluorophores. Since optoelectronic properties of molecular solids also depend crucially on molecular packing motifs, it is not sufficient to only consider single-molecule properties, but also to gain precise knowledge of the crystalline phases to understand structure–property-relationships. AG Witte analyzed and compared structural and optoelectronic properties of perfluorinated acenes ranging from perfluoronaphthalene to perfluoropentacene, while this has been possible before only for selected acenes. In particular they demonstrated for the case of PFT that the different packing motifs occurring in the various phases have a strong influence on the photoluminescence spectra. The work was published in the Journal of Physical Chemistry C.

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Events

Group seminar Ultrafast Quantum Dynamics Group

12 November 1:00 pm:
Mikhail Glazov (Ioffe Institute, Russia)
Nonclassical electron and exciton transport in 2D crystals

26 November 1:00 pm:
Bernhard Urbaszek (CNRS Toulouse, France)
Atomically thin semiconductors for photonics and spintronics

zoom link

New Colleagues

Joshua Thompson

I recently started working as a Post Doc for the Ultrafast Quantum Dynamic group, following my PhD at the University of Bath and Post Doc at Chalmers University of Technology. I like all things 2D, having worked on the electronic, optical and excitonic properties of graphene and TMDs. My work with Ermin Malic will expand on this and branch into new research areas such as organic molecules. I love music, video games and of course Manchester United.

Prof. Mark Vogelsberger (MIT, USA) has obtained the offer to fill the W3 professor position "Theorie komplexer Systeme" in our department.

Salvatore Mannana and **Oers Legeza** have finished their guest professor position in our department and return to Göttingen and Budapest, respectively.

Share your good news.

Your newsletter team: Carina Hawaley, Maya Ströbel, and Ermin Malic

Send us an e-mail with a short text and a nice foto to newsfb13@physik.uni-marburg.de

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