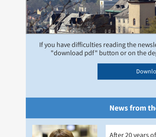
Newsletter Physics 11/21



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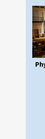
News from the Department



Gerson Mette says goodbye Marburg

After 20 years of studying, doing a PhD and being a researcher at the Department of Physics, Gerson Mette leaves Marburg behind to start a new position at ZEISS in Roßdorf. Here, he looks back at his time in Marburg: "I enjoyed the studies and the life in Marburg and never regretted the decision." "One of the best decisions was to join the research group of Ulrich Höfer." "The preparation of the SFB 1083 was a particularly intense and exciting time". Read the entire text below (in German).

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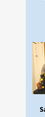

Physics Colloquium starts again

We are happy to announce the reinstatement of the Department colloquium that will take place on Thursdays at 5.15pm. The colloquium is a joint venture of the Department of Physics as a whole and the SFB 1083. Thanks to the feedback and suggestions by the members of the Department and the SFB, we now have a list of exciting upcoming talks (for the program see the link below). Importantly, the program includes also inaugural lectures (Antrittsvorlesungen) by Marina Gerhard, Ermin Malic and Jens Gädde. Unless otherwise noted, talks and lectures will be presented in a hybrid mode, i.e., in the lecture hall G+HS RH5 and via a web-conference tool that will be announced.

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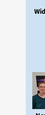

New image brochure of the SFB 1083

The SFB 1083 has recently updated its image brochure to feature the goals and the focus of the research center in the third funding period. The image brochure gives a general introduction to the research on internal interfaces and portraits the participating researchers mainly for interested students and for the general public. Information about the SFB for the upcoming funding periods as well as the current period can also be found in the brochure.

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Physik am Samstagmorgen starts again

Presenting physics in an exiciting way for a broad audience, supported by motivating experiments: This is the concept of our series "Physik am Samstagmorgen". Unfortunately, it had not been offered in winter 2020/2021 due to the pandemic. Yet, the organizer Tobias Breuer plans to restart it in 2021/2022. The details are not yet final, in particular the rules for presentations for a public audience are still unclear, but fortunately three motivated presenters have already agreed to participate. Further information will be distributed in this newsletter.

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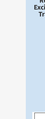
Poster prize for Maximilian Widemann (AG Volz)

Congratulations to Maximilian Widemann from the AG Volz for the poster prize he won at the Microscopy and Microanalysis Conference this year! His poster entitled "Decomposition Behavior of III/V Semiconductor Precursor Gases in a Closed Gas Cell In-Situ TEM Holder Observed by Mass Spectrometry" showed – for the first time – that a gas cell in a transmission electron microscope can be operated under realistic conditions to mimic growth in large reactors. With his experiment Max will be able to monitor growth processes of various materials and interfaces in-situ and at the atomic level. This will significantly advance our understanding on the relevant processes.



New public relation team for the department

In this term, a new team has been formed with the goal to improve the visibility of the Physics Department to the public, to other research institutions and in particular to school students who we would like to win for our department. Joseline Neuhaus, Samuel Brem and Ermin Malic will initiate a number of activities to reach this goal including image videos, presence in social media, regular events for schools and many more. If you have ideas/suggestions or would like to be part of these activities, let us know. Our email address is pr-physics@physik.uni-marburg.de.

Research Highlights

Formation of anti-phase boundaries in layered oxide cathodes (AG Volz)

If we aim at increasing the lifetime of batteries, which is in urgent need, we have to know each and every possible mechanism that makes batteries fail. Defects in battery materials play an essential role in the performance of a battery. We analyzed the role of a defect called Antiphase boundary (APB) in the cathode material of a typical modern-day lithium-ion battery (LIB) on the atomic level and tracked its behavior when the battery is operated. The formation, evolution, and conversion of APBs into a locally phase-make the cathode materials degrade prematurely, thus limiting the life of a LIB. As a consequence of our understanding of the formation and evolution of APBs, it will become easier to tweak the chemical composition of the material to avoid the formation and the subsequent growth of APBs. The work was published in Matter.

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Rapid exciton dynamics in MoS2 bilayers (AG Malic)

In a joint experiment-theory study with the groups of Elaine Li (University of Texas), Ulrike Woggon and Andreas Knorr (TU Berlin), AG Malic has revealed a much faster exciton dynamics in MoS2 bilayers compared to the monolayer case. This is traced back to an efficient intervalley exciton-phonon scattering involving momentum-dark exciton states. The combined experimental and theoretical studies unequivocally establish different microscopic mechanisms that determine exciton quantum dynamics in mono- and bilayers of 2D materials. Understanding exciton quantum dynamics provides critical guidance to the manipulation of spin-valley degrees of freedom in technologically promising 2D materials. Our work was published in Physical Review Letters.

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Polarization Resolved Optical Excitation of Charge-Transfer Excitons (AG Wilete)

Charge-transfer excitons (CTX) at organic donor/acceptor interfaces are considered important intermediates for charge separation in photovoltaic devices. In a collaboration between the groups of Gregor Witte and Caterina Cocchi (Oldenburg), the CTX state of the prototypical molecular donor/acceptor system pentacene:perfluoropentacene was investigated. While first-principles many-body calculations and solving the Bethe-Salpeter equation validate the experimental findings, analogous simulations performed on bimolecular clusters are unable to reproduce the CTX state. This is ascribed to the lack of long-range interactions and wave-function periodicity in these calculations and represents an important finding for the description of molecular donor/acceptor systems. The work was published in the Journal of Physical Chemistry Letters.

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Purely elastic linear instabilities in parallel shear flows (AG Eckhardt)

Many fluids from daily life, such as shampoo, belong to the class of viscoelastic fluids and can show chaotic motion despite the lack of inertia in form of purely elastic turbulence (PET). In this work, Martin Lellep from the AG Eckhardt introduced free-slip boundary conditions to parallel shear flows to circumvent numerical instabilities that hinder theoretical studies of PET in those systems. Surprisingly, they found both plane Couette and plane Poiseuille flows with free-slip boundary conditions to be linearly unstable. By performing a boundary condition homotopy from the free-slip to no-slip boundary conditions, it was demonstrated that the unstable modes are directly related to the least stable modes of the no-slip problem. This work was published in Journal of Fluid Mechanics.

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Upcoming Events

Colloquium Tobias Breuer 11. Nov, 5.15pm

Tobias Breuer (Philipps Universität Marburg)
Organik-Anorganik-und Organik-Organik-Grenzflächen – Strukturkonnelle und Grenzflächenkenntnis

Tobias Breuer presents an overview of his research results in the field of interfaces in organic-inorganic and organic-organic heterostructures. He will show that a combination of sample preparation, their structural characterization and spectroscopic analysis allows to tailor and investigate well-defined interfaces of various material systems. This allows the identification and exploration of specific interface-related effects such as intercalation, structural inheritance and chemical modification at the interface. Furthermore, the related consequences of these effects as well as strategies to control their intensity are discussed. The presentation will be held in German.

Seminar AG Malic Mikhail Glazov 12. Nov., 1pm

Mikhail Glazov (Ioffe Institute, Russia)
Nonclassical electron and exciton transport in 2D crystals

Two-dimensional (2D) semiconductor systems based on quantum wells have revolutionized modern electronics and optoelectronics. Recently, another class of stable 2D materials starting with graphene and transition metal dichalcogenides (TMDCs) such as MoS2 have revealed novel physics at the fundamental level offering unique functionalities relevant for future applications in 'valleytronics' and quantum technologies. Atomically thin TMDCs possess spectacular optical and transport properties. Strong Coulomb interaction binds electrons and holes in excitons: neutral quasi-particles with considerable binding energies. In this talk, Mikhail Glazov, an expert in the field of modelling of atomically thin materials, will present his recent results on non-classical aspects of exciton propagation in transition metal dichalcogenides. The talk will be digital and can be attended via the zoom link below.

zoom link

Colloquium Peter Hommelhoff 25. Nov., 5.15pm

Peter Hommelhoff (Universität Erlangen-Nürnberg)
Strongfield and ultrafast physics at graphene and graphene-based interfaces

When electrons in graphene are driven with intense laser fields, intraband currents and interband transitions may result. Intriguingly, these two processes can couple closely, leading to laser waveform-controlled excitations of currents. In this talk, we will show the underlying dynamics, which is based on coherent superposed Landau-Zener transitions and resulting in ultrafast turn-on times of currents (within 1 femtosecond). While this work refers to currents inside of graphene, we have also investigated how fast electrons can be transfered from the semimetal graphene into the wide bandgap semiconductor silicon carbide, a heterostructure representing a Schottky junction. We find that the charge transfer time can be as fast as 300 attoseconds. The last part of the talk will focus on experimentally disentangling virtual from real conduction band excitation, i.e., excitation alive during the presence of the laser pulse only from longlived excitations.

Seminar AG Malic Bernhard Urbaszek 26. Nov., 1pm

Bernhard Urbaszek (CNRS Toulouse, France)
Atomically thin semiconductors for photonics and spintronics

Atomic monolayers of transition metal dichalcogenides (TMDs) have remarkable properties for fundamental research and potential applications. They are semiconductors with a direct gap in the visible to near infrared region of the optical spectrum. Light-matter interaction is enhanced at specific exciton resonances with 20 % of the light absorbed per monolayer. Recent progress in fabrication allows approaching lifetime broadened optical transitions and in this regime TMD monolayers can in principle be tuned to 100 % reflectivity i.e, to be perfect mirrors. In addition, chiral optical selection rules allow for optical manipulation of the spin and valley index of electrons with polarized lasers, opening research opportunities in spintronics and valleytronics. In this talk, Bernhard Urbaszek will give a review of current understanding of optical properties of TMD monolayers and heterostructures and how they can be coupled to photonic structures.

zoom link

Share your good news.

Your newsletter team: Carina Hlawaty, Maya Strobel, and Ermin Malic

Send us an e-mail with a short text and a nice foto to newsfb1.lj@physik.uni-marburg.de

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