

## Newsletter Physics 11/22

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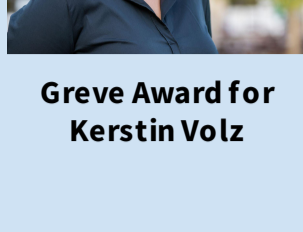
New colleagues



If you have difficulties reading the newsletter, you can download it by clicking the "download pdf" button or on the department homepage (under events).

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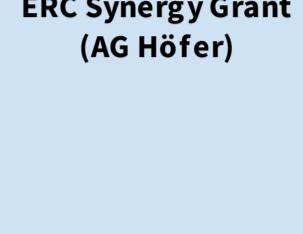
### News from the Department



#### Greve Award for Kerstin Volz

Many congratulations to Prof. Dr. Kerstin Volz, who will receive the 2022 Greve Prize from the German National Academy of Sciences Leopoldina together with Prof. Jürgen Janek (JLU Giessen) for their fundamental insights into rechargeable batteries. The newly established prize, which is worth 250,000 euros, is donated by the Helmut and Hannelore Greve Foundation for Science, Development and Culture. This year's prize honours outstanding research into the scientific foundations of sustainable energy supply. Kerstin Volz' research is key in understanding, how batteries, solar cells and devices for green hydrogen production work and helps to improve the underlying materials.

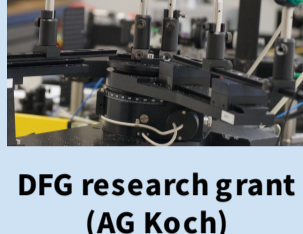
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#### ERC Synergy Grant (AG Höfer)

The European Research Council (ERC) awarded a Synergy Grant of 11.3 million Euros to the project "Photoemission Orbital Cinematography: An ultrafast wave function lab" in short "Orbital Cinema" to Ulrich Höfer, Rupert Huber (Regensburg), Peter Puschnig (Graz), and Stefan Tautz (FZ Jülich, coordinator). The new research project is to a large extent based on the successfully combination of photoemission orbital tomography with laser-pump-probe techniques by Robert Wallauer and coworkers [Science 371, 1056 (2021)]. This work, funded by the collaborative research center SFB 1083 demonstrated for the first time that orbital images can be traced on ultrafast time scales. The central goal of Orbital Cinema is to reach sub-cycle time resolution in orbital videography and to actively shape and functionalize molecular orbitals with lightwaves. For this purpose, a new experiment with attosecond time resolution will be set up jointly by Rupert Huber and Ulrich Höfer at the Regensburg Center for Ultrafast Nanoscopy (RUN).

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#### DFG research grant (AG Koch)

The DFG Research Unit Meteracom will receive another three years of funding. The research group of Prof. Martin Koch is involved with the subproject on "Characterization of propagation channels". Metrology at THz frequencies is still in its infancy. As of today it only covers detector calibration to characterization of ultrafast devices and the measurement uncertainty analysis of different spectrometer types available at THz frequencies. Meteracom addresses the grand challenge of metrology in THz communication measurements.

[read more](#)



#### Science Award for David Engel

David Engel was awarded with the IHK Wissenschaftspreis 2021 for his dissertation "Phase Dynamics in Human Visuomotor Control - Health & Disease", which he wrote in the Neurophysics group under supervision of Prof. Bremmer. In his thesis, he investigated how the visual percept of (self-)motion influences balance and postural control in humans, and how this is affected by neurodegenerative diseases like Parkinson's. He developed a mobile and cost-effective setup consisting of a virtual reality headset, a force platform, and a video-based motion tracking system, which he used to simulate visual perturbations while simultaneously tracking participants' postural responses. His findings along with the newly introduced setup hold the potential to facilitate discovery of biomarkers that are indicative of neurological disease, which could provide the means for an early diagnosis and improve the quality of life of those affected. The IHK Wissenschaftspreis is a biennial award honoring outstanding scientific achievements which combine innovative theoretical discoveries with potential industrial applications.

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#### Poster award of the SFB Summer School

At the end of September, a summer school on the topic "Prospects and Challenges of Hybrid Interfaces in TMDC and Organic Systems" organized by the SFB 1083 took place in Eitorf (near Cologne). In addition to lectures from national and international experts in this field of research, there was ample opportunity to deepen the topics through lively discussions in small groups with the experts. The more than 45 student participants also had the opportunity to present their own work in a poster session. The contributions by Sarah Zajusch (Dark Exciton Formation Dynamics in TMDC Monolayers) and Daniel Bischof (Controlling Molecular Orientation and Optical Properties in Hexafluoropentacene Thin Films) were recognized as the best posters and received a dinner voucher as a prize.



#### Interview with Renate Schmid

In our series of interviews with key people in our department, Josefine Neuhaus met with Renate Schmid, the secretary in the dean's office. You may know her name from the mails concerning the "Brandmeldeanlage" or the "Fachbereichsratsitzung", but "collecting and distributing information" is only part of her job. Read about how she came to Marburg, her view as a non-physicist on the department, gender equality and ethics.

[Interview](#)



#### Physik am Samstagmorgen

We are very happy to announce that our popular lecture series "Physik am Samstagmorgen" will start again this winter and it will take place in presence. In four lectures (given by Tobias Breuer, Jan Goldschmidt, Ermin Malic & Robert Wallauer, and Marina Gerhard) exciting effects related to everyday phenomena will be presented. The lectures are taught for everyone interested in physics. Pre-knowledge or even a graduation in physics is not necessary, as the presentations will be easy to understand for everyone and will be supported by vivid experiments. In this term, the lectures will be about different aspects of light: the nature of light, light conversion to electrical energy in solar cells, theoretical modelling of light absorption in ultra-thin novel material systems and light as a precise sensor for material investigations. The first lecture will be held on November 12th by Tobias Breuer and will be about "The three magical properties of light and the "magic monitor". Due to the universities' measures to reduce energy consumption, the lectures will not be offered at the Renthof campus but instead typically in the Audimax in Biegenstr. 10. All presentations are given in German language. We are looking forward to welcome everyone of you as well as your family, friends and neighbours!

[Info Page](#)



#### Florian Gebhard - our new Dean

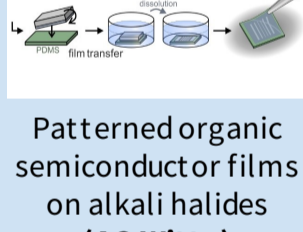
Florian Gebhard took office as Dean of the Physics Department on October 1, 2022. The picture shows the handover of the "baton", which is represented in our department by a large key. We wish Florian Gebhard all the best for his term of office.



#### Retirement of Carmen Schweetz

Carmen Schweetz received her retirement certificate from Vice President Prof. Pankuweit. She was thanked for her many years of service in the department and in various committees of the university. Her pragmatic way of working, her enthusiasm and her decisiveness were explicitly pointed out. She will not leave the department completely, but will remain with us on a part-time basis for the next year in order to train her successor.

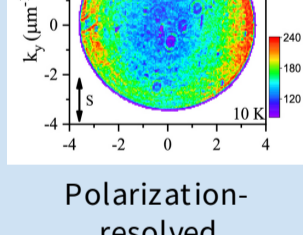
### Research Highlights



#### Patterned organic semiconductor films on alkali halides (AG Witte)

A key problem in organic electronics remains the lateral patterning and structuring of organic films for device applications since photolithography is not applicable. The AG Witte has developed a new approach to control the molecular orientation and patterning organic semiconductor films by first creating F-centers (halide vacancies) on KCl surfaces through electron irradiation and utilize the additional electrostatic stabilization of interfacial seed molecules. In a joint experiment-theory study with the group of Jerome Cornil in Mons (Belgium), the microscopic mechanism and the film energetics could be identified. In addition, it is demonstrated patterned organic films. In a joint experiment-theory study with the group of Christian Schneider (Oldenburg), AG Malic explored the interplay of excitonic physics and phenomena arising from the commonly utilized encapsulation procedure on the optical properties of 2D materials. In our study, we probe MoSe<sub>2</sub> monolayers which are prepared in both a suspended, as well as an encapsulated manner. We show that the hBN encapsulation significantly enhances the linear polarization of exciton PL emission at large emission angles. This degree of linear polarization of excitons can increase up to 17 % in the hBN encapsulated samples, which is connected to the optical anisotropy of the hBN layers. This work was published by Optica.

[read more](#)



#### Polarization-resolved photoluminescence in 2D materials (AG Malic)

The polarized photoluminescence from 2D materials is a frequently applied tool to scrutinize optical selection rules and valley physics, yet it is known to sensibly depend on a variety of internal and external material and sample properties. In a joint experiment-theory study with the group of Christian Schneider (Oldenburg), AG Malic explored the interplay of excitonic physics and phenomena arising from the commonly utilized encapsulation procedure on the optical properties of 2D materials. In our study, we probe MoSe<sub>2</sub> monolayers which are prepared in both a suspended, as well as an encapsulated manner. We show that the hBN encapsulation significantly enhances the linear polarization of exciton PL emission at large emission angles. This degree of linear polarization of excitons can increase up to 17 % in the hBN encapsulated samples, which is connected to the optical anisotropy of the hBN layers. This work was published by Optica.

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### Events



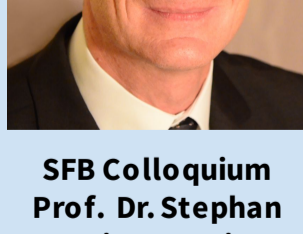
#### Seminar AG Malic / SFB Colloquium Prof. Kai-Qiang Lin

22. Nov, 1 pm, lecture room, Renthof 7

#### Prof. Dr. Kai-Qiang Lin (Department of Physics, University of Regensburg, Regensburg, Germany)

##### Excitonic multi-level system for quantum interference in transition metal dichalcogenide monolayers & bilayers

Monolayer transition-metal dichalcogenides (TMDCs) show a wealth of exciting physics. We present the existence of a new excitonic species, the high-lying exciton (HX), in transition metal dichalcogenide monolayers with almost twice the band-edge A-exciton energy and with a linewidth as narrow as that of band-edge excitons. The HX is populated through momentum-selective optical excitation in the K-valleys, and is identified experimentally in upconverted photoluminescence (UPL) and theoretically in *ab initio* GW-BSE calculations. The coincidence of such high-lying excitonic species at around twice the energy of band-edge excitons rationalize the efficient exciton-exciton annihilation in TMDC monolayers, and enables the excitonic quantum-interference phenomenon revealed in optical second-harmonic generation (SHG). We probe the excitonic temporal dynamics in such three-level system through time-resolved sum-frequency generation (SFG) and four-wave mixing (FWM). High-lying excitons in bilayer WSe<sub>2</sub> can be largely tuned by twisting and Stark effect, which gives control over the excitonic quantum interference and the corresponding optical nonlinearity.



#### SFB Colloquium Prof. Dr. Stephan Reitzenstein

30. Nov, 4:15 pm, small lecture room, Renthof 5

#### Prof. Dr. Stephan Reitzenstein (Institut für Festkörperphysik, Technische Universität Berlin, Berlin, Germany)

##### Development and deterministic nanofabrication of single quantum dot devices for applications in photonic quantum technologies

Photonic quantum devices are key building blocks for the implementation of quantum networks and for the realization of photonic quantum processors. Moreover, they allow one to explore exciting physics in the quantum regime of single emitters and single photons. Of particular interest are devices generating, routing, processing and detecting single photons which act as information carriers in the field of photonic quantum technologies. In this talk I present recent progress in the development and deterministic fabrication of high-performance single-photon sources (SPSs) and on-chip quantum circuits based on semiconductor quantum dots (QDs) and quantum dot molecules (QDMs). Here, QDs act as close-to-ideal photon emitters with high quantum efficiency and excellent quantum nature in terms of single-photon purity and photon indistinguishability. Using an advanced nanofabrication technology platform, namely in-situ electron beam lithography, we pre-select suitable QDs and integrate them with nm accuracy into photonic nanostructures such as circular Bragg gratings to enhance the brightness of the sources, to develop fiber-coupled stand-alone single-photon sources, and to enable the development of highly functional integrated quantum circuits. The talk gives an insight into the physics of such devices and discusses technological challenges, current limitations as well as perspectives of semiconductor QD based quantum devices.

### Share your good news

Your newsletter team: Carina Hlawaty and Ermin Malic

Send us an e-mail with a short text and a nice foto to [newsfb13@physik.uni-marburg.de](mailto:newsfb13@physik.uni-marburg.de)

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