Universität Marburg

Newsletter Physics 12/25

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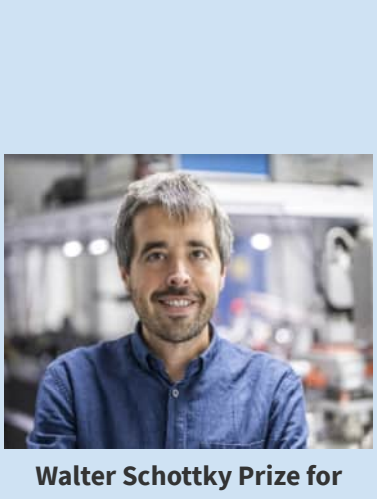
News from the Department

New Meet-the-Prof video with Nadine Leisgang

The PR team has continued the "Meet the Prof" series with Prof. Nadine Leisgang, who just recently joined the Physics Department. What fascinates her about her research? How does she want to structure her lectures? What does she like to do in her free time? Watch the video to find our more about Nadine and her plans. The interview was conducted by Christien Off with Oliver Rehn behind the camera.

Das PR-Team hat die Reihe „Meet the Prof" mit Prof. Nadine Leisgang fortgesetzt, die erst kürzlich zum Fachbereich Physik gestoßen ist. Was fasziniert sie an ihrer Forschung? Wie möchte sie ihre Vorlesungen gestalten? Was macht sie gerne in ihrer Freizeit? Sehen Sie sich das Video an, um mehr über Nadine und ihre Pläne zu erfahren. Das Interview wurde von Christien Off geführt, mit Oliver Rehn hinter der Kamera.

Interview



Emmy Noether funding for the Quantum Optoelectronics Group

Prof. Nadine Leisgang has successfully acquired research funding through the Emmy Noether Programme of the German Research Foundation (DFG). The project aims to establish an independent research group dedicated to the control and manipulation of excitonic phenomena in atomically thin semiconductors. Two-dimensional materials, such as transition metal dichalcogenides, offer a unique platform for investigating light–matter interactions at the quantum level. By combining nanofabrication with optical and electrical measurement techniques, the group explores new quantum phenomena in van der Waals heterostructures and develops building blocks for future optoelectronic and quantum technologies. The project is funded for six years. The group welcomes motivated students who are interested in contributing to ongoing researchprojects.

Prof. Nadine Leisgang konnte erfolgreich Forschungsmittel im Emmy-Noether-Programm der Deutschen Forschungsgemeinschaft (DFG) einwerben. Das Projekt zielt darauf ab, eine unabhängige Forschungsgruppe aufzubauen, die sich mit der Kontrolle und Manipulation exzitonischer Phänomene in atomar dünnen Halbleitern beschäftigt. Zweidimensionale Materialien wie Übergangsmetall-Dichalkogenide bieten eine einzigartige Plattform zur Untersuchung von Licht-Materie-Wechselwirkungen auf der Quantenskala. Durch die Kombination von Nanofabrikation mit optischen und elektrischen Messmethoden erforscht die Gruppe neuartige Quantenphänomene in van-der-Waals-Heterostrukturen und entwickelt Bausteine für zukünftige optoelektronische und Quantentechnologien. Die Förderung läuft über sechs Jahre. Die Gruppe freut sich über motivierte Studierende, die an aktuellen Forschungsprojekten mitwirken möchten.

Walter Schottky Prize for Marcel Reutzel

The German Physical Society (DPG) has awarded Prof. Marcel Reutzel the prestigious Walter Schottky Prize. He receives the award for his outstanding work in the field of solid state research. The award honors his work on ultrafast processes in quantum materials, in particular the observation of Floquet states in graphene using ultrafast momentum-resolved microscopy.

Die Deutsche Physikalische Gesellschaft (DPG) hat Prof. Marcel Reutzel mit dem renommierten Walter-Schottky-Preis ausgezeichnet. Prof. Reutzel erhält die Ehrung für seine herausragenden Arbeiten auf dem Gebiet der Festkörperforschung. Die Auszeichnung würdigt seine Arbeiten zu ultraschnellen Prozessen in Quanten-materialien, insbesondere die Beobachtung von Floquet-Zuständen in Graphen mittels ultraschneller Impuls-mikroskopie.

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Lukas Wagner receives Research Fellowship by WE Heraeus Foundation

Lukas Wagner was awarded a Research Fellowship by the Wilhelm and Else Heraeus Foundation for outstanding researchers in the early stages of their careers. Each German university and research institution was able to nominate one researcher from the field of physics. Five fellowships were awarded. The funds, amounting to 100,000 €, are freely available for research activities. The award ceremony took place on November 6 at the Berlin-Brandenburg Academy of Sciences and Humanities in Berlin.

Lukas Wagner wurde mit einem Research Fellowship der Wilhelm und Else Heraeus-Stiftung für herausragende Forschende im frühen Karrierestadium ausgezeichnet. Für die Teilnahme konnte jede deutsche Universität und Forschungseinrichtung eine*n Nachwuchsforscher*in aus dem Bereich Physik nominieren. Es wurden fünf Fellowships vergeben. Die Mittel in Höhe von 100.000 Euro stehen im Rahmen der Forschungstätigkeit zur freien Verfügung. Die Preisverleihung fand am 6.11.2025 in der Berlin-Brandenburgischen Akademie der Wissenschaften in Berlin statt.

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New Humboldt Fellow at the department (AG Koch)

Yasith Amarasinghe has received a scholarship from the Alexander von Humboldt foundation. He will start in November 2025 in the AG Koch's Semiconductor Photonics group and will stay for two years as postdoc. His topic is "3D orientation-independent high-gain passive transceiver antennas for the THz region" .

Yasith Amarasinghe hat ein Stipendium der Alexander von Humboldt-Stiftung erhalten. Er wird im November 2025 in der Gruppe „Halbleiterphotonik" von Prof. Koch beginnen und zwei Jahre lang als Postdoktorand tätig sein. Sein Thema lautet „3D-orientierungsunabhängige passive Transceiver-Antennen mit hoher Verstärkung für den THz-Bereich".

Dominik Muth: new doctor at the departement (AG Gerhard)

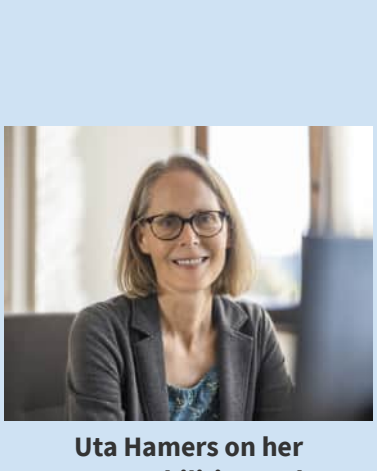
Dominik Muth completed his PhD in September 2025 in the Semiconductor Spectroscopy group headed by Prof. Marina Gerhard. In his thesis, he focused on time-resolved photoluminescence measurements on organic semiconductor materials in order to investigate characteristic photophysical processes occuring on ultrashort time scales. Among other topics, he studied population dynamics and exciton transport in acenes. He showed that crystal quality and temperature significantly influence singlet fission in tetracene and identified the dissociation of the correlated triplet pair state as a crucial temperature-activated process. His research contributes to the understanding and future optimization of the cooperative transport process in SF materials for technical applications.

Dominik Muth schloss im September 2025 seine Promotion in der Arbeitsgruppe Halbleiterspektroskopie unter der Leitung von Prof. Marina Gerhard ab. In seiner Arbeit konzentrierte er sich auf zeitaufgelöste Photolumineszenz-messungen an organischen Halbleitermaterialien, um charakteristische photophysikalische Prozesse zu erforschen, die auf ultrakurzen Zeitskalen ablaufen. Unter anderem beschäftigte er sich mit den Populations-dynamiken und dem Exziton-Transport in Acenen. Er zeigte, dass die Kristallqualität und die Temperatur den Singulett-Zerfall in Tetracen signifikant beeinflussen und identifizierte die Dissoziation des korrelierten Triplett-Paars als entscheidenden temperaturaktivierten Prozess. Seine Forschung leistet einen Beitrag zum Verständnis und zur zukünftigen Optimierung des kooperativen Transport-prozesses in SF-Materialien für technische Anwendungen.

Successful NOEKS conference in Marburg

The 17th International Conference on Nonlinear Optics and Excitation Kinetics in Semiconductors (NOEKS) took place from Sept 8th to 12th September at the Physics Department. It attracted around 80 participants. There were lively discussions on semiconductor optics, particularly on 2D materials. The conference took place in the large physics lecture hall, and the conference dinner was held at Marburg castle. Conference Chairs were Prof. Koch and Prof. Castro-Camus. Prof. Malic was the Programm chair.

Vom 8. bis 12. September 2025 fand die 17. Internationale Konferenz über Nichtlineare Optik und Anregungskinetik in Halbleitern (NOEKS) am Physikalischen Institut statt. Rund 80 Teilnehmerinnen und Teilnehmer nahmen teil. Es gab angeregte Diskussionen über Halbleiteroptik, insbesondere über zweidimensionale Übergangsmetalldichalkogenide (2D-TMDCs). Die Konferenz wurde im großen Hörsaal der Physik abgehalten, das anschließende Abendessen fand auf Schloss Marburg statt. Die Konferenzleitung hatten Prof. Koch und Prof. Castro-Camus inne, Prof. Malic war Programmleiter.



High-quality MINT-teacher training

From 7 to 9 November, the 12th Federal Conference "Schule MIT Wissenschaft" (School WITH Science) took place at the Department of Physics and in the Chemikum, a nationwide unique training course for teachers of MINT subjects. The event was co-organised by the MIT Club of Germany e. V., the association of German and Germany-based graduates of the Massachusetts Institute of Technology (MIT). The event was attended by 112 teachers from all 16 federal states to exchange ideas with leading scientists and gain new inspiration for their teaching.

Vom 7.-9. November fand am Fachbereich Physik und im Chemikum die 12. Bundeskonferenz "Schule MIT Wissenschaft" statt, eine bundesweit einmalige Fortbildung für Lehrkräfte der MINT-Fächer. Mitveranstalter war der MIT Club of Germany e. V., die Vereinigung der deutschen und in Deutschland lebenden Absolvent*innen des Massachusetts Institute of Technology (MIT). An der Veranstaltung nahmen 112 Lehrkräfte aus allen 16 Bundesländern teil, um sich mit führenden Wissenschaftler*innen auszutauschen und neue Impulse für ihren Unterricht zu erhalten.

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Uta Hamers on her responsabilities at the department

At the end of 2024, the administrative economic units were integrated into the deans' offices without much preparation, after the handling of business trips and personnel administration had been taken over by the HR department. As part of this restructuring, management positions were established in the deans' offices of all faculties—a process that was largely completed by the summer of 2025. At the Department of Physics, this was relatively easy, as I had started my position as departmental officer in April 2024, and my role could be smoothly converted into that of a managing director. My duties in the dean's office range from financial controlling and strategic development of the department to a wide variety of tasks in the Office of Academic Affairs. Additionally, I serve as the safety officer, including responsibility for radiation protection, as well as the construction representative, making me the primary contact for all safety and construction-related matters, acting as a liaison to Division IV – Facility Management and Engineering. Overall, the tasks are very diverse and still exciting and interesting. I never get bored! What is most crucial for me as managing director of the dean's office, however, is the excellent support from Renate Schmid as dean's assistant, as well as from Katharina Brandl (and Stefanie Kramer, Elke Waschk until January 2026) in administrative operations.

Ende 2024 wurden die Wirtschaftsverwaltungen ohne große Vorbereitung in die Dekanate eingegliedert, nachdem die Bearbeitung von Dienstreisen und die Personalsachbearbeitung von der Personalabteilung übernommen worden waren. Im Zuge dieser Umstrukturierung wurden an allen Fachbereichen Dekanatgeschäftsführungen eingerichtet, ein Prozess der bis Sommer 2025 weitgehend abgeschlossen war. Am Fachbereich Physik war das relativ einfach, da ich im April 2024 neu als Fachbereichsreferentin eingestellt worden war und meine Position problemlos in die einer Geschäftsführerin umgewandelt werden konnte. Meine Tätigkeiten im Dekanat erstecken sich von Controlling der Finanzen, strategischer Entwicklung des Fachbereichs bis zu ganz unterschiedlichen Aufgaben im Studiendekanat. Zusätzlich bin ich Sicherheitsreferentin und hierbei auch für den Strahlenschutz zuständig sowie Baubeauftragte und damit erste Ansprechpartnerin für alle Sicherheits- und Bauangelegenheiten mit Schnittstellenfunktion zum Dezernat IV –Gebäudemanagement und Technik. Insgesamt sind die Aufgaben sehr vielfältig, immer noch spannend und interessant. Langweilig wird es mir nie! Ganz entscheidend für mich als Dekanatgeschäftsführerin ist aber die sehr gute Unterstützung durch Renate Schmid als Dekanatsassistenz sowie durch Katharina Brandl (und Stefanie Kramer, Elke Waschk noch bis Januar 2026) in der Wirtschaftsverwaltung.

Visiting professor Antonello Androne (AG Koch)

Dr. Antonello Andreone is a visiting professor from the University of Naples "Federico II", currently hosted by the research group of Prof. Martin Koch in the Physics Department. He will be in Marburg for approximately 1-2 years. His scientific background ranges from low-temperature physics (with a focus on superconductivity) to materials science and the design, fabrication, and characterization of high-frequency devices, such as resonators, filters, and metasurfaces, mainly for telecommunications applications. In recent years, his work has increasingly centered on THz science and technology, with particular attention to spectroscopy, innovative components, and emerging applications at the interface between photonics and materials research.

Dr. Antonello Andreone ist Gastprofessor der Universität Neapel „Federico II" und derzeit Mitglied der Forschungsgruppe von Prof. Martin Koch am Fachbereich Physik. Er wird etwa ein bis zwei Jahre in Marburg bleiben. Sein wissenschaftlicher Hintergrund reicht von der Tieftemperaturphysik (mit Schwerpunkt auf Supraleitung) über die Materialwissenschaften bis hin zum Entwurf, der Herstellung und der Charakterisierung von Hochfrequenzbauelementen wie Resonatoren, Filtern und Metasoberflächen, hauptsächlich für Telekommunikations-anwendungen. In den letzten Jahren hat sich seine Arbeit zunehmend auf die THz-Wissenschaft und -Technologie konzentriert, mit besonderem Augenmerk auf Spektroskopie, innovative Komponenten und neue Anwendungen an der Schnittstelle zwischen Photonik und Materialforschung.

Departmental Women's General Assembly on October 30, 2025

On 30 October, the Departmental Women's General Assembly took place. The meeting served as a forum for exchanging information on the situation of women in the Department of Physics and discussing ideas for gender equality activities. An important item on the agenda was the election of the Departmental Women's and Gender Equality Officer. In addition to long-standing members of the team, Maya Strobel and Renate Schmid, Carlotta Dohmann, Lea Obermüller and Annika Schneider ran for office. All five were unanimously elected as a team. We would like to thank Franziska Hüppe very much for her commitment as Women's and Equality Officer at the Department of Physics and wish her every success in completing her dissertation.

Am 30. Oktober fand die Fachbereichs Frauen-Vollversammlung statt. Die Sitzung diente dem Austausch von Informationen zur Situation von Frauen am Fachbereich Physik und der Diskussion von Ideen zu Gleichstellungsaktivitäten. Ein wichtiger TOP war die Wahl der Fachbereichs-Frauen- und Gleichstellungsbeauftragten. Neben den langjährigen Mitgliedern des Teams, Maya Strobel und Renate Schmid, kandidierten Carlotta Dohmann, Lea Obermüller und Annika Schneider für das Amt. Alle fünf wurden als Team einstimmig gewählt. Wir danken Franziska Hüppe ganz herzlich für ihr Engagement als Frauen- und Gleichstellungsbeauftragte am Fachbereich Physik und wünschen ihr viel Erfolg für die Fertigstellung ihrer Dissertation.

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More for female physics students

The "Mehr (für) Physikstudentinnen*" (More for Female Physics Students) project invited guests to its annual doctoral student presentation on 12 November. Maryam Raouph (Schrimpf research group), Lea Obermüller (Goldschmidt research group) and Eleonora Kraus (Malic research group) introduced themselves and their work. They were able to exchange experiences and goals, while students had the opportunity to ask questions about doctoral studies. The event was very informative and motivating.

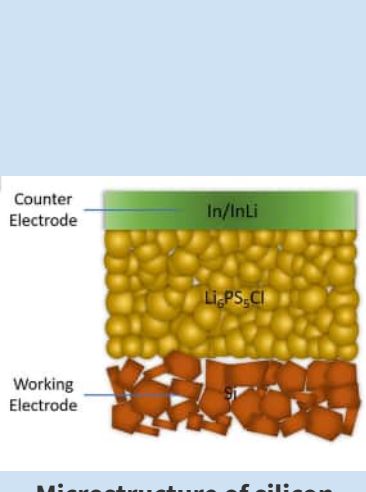
Das „Mehr (für) Physikstudentinnen*" Projekt hat am 12. November zur jährlichen Promovendinnenvorstellung eingeladen. Dort stellten Maryam Raouph (AG Schrimpf), Lea Obermüller (AG Goldschmidt) und Eleonora Kraus (AG Malic) sich und ihre Arbeit vor. Sie konnten sich untereinander über ihre Erfahrungen und Ziele austauschen, während Studierende Fragen zur Promotion stellen konnten. Die Veranstaltung war sehr informativ und motivierend.

The long night of science

The Long Night of Science, organized by the biology, chemistry and physics student councils, took place on 21 November. In the packed lecture hall on the Lahnberge, we were able to learn a lot from lectures on biology, chemistry and physics and an experimental lecture. After Thor wie had some fun playing PowerPoint-Karaoke. Physics was represented with lectures by Prof. Vogelsberger (Simulated Universes) and Sarah Zajusch (Lights on - Cat's dead). .

Am 21.11. hat die Lange Nacht der Wissenschaft, organisiert von den Fachschaften der Biologie, Chemie und Physik, stattgefunden. Im voll besetzten Hörsaal auf den Lahnbergen konnten wir viel lernen bei Vorträgen aus der Biologie, Chemie und Physik und einem Experimentalvortrag. Danach gab es noch etwas Spaß beim PowerPoint-Karaoke. Die Physik war vertreten mit Vorträgen von Prof. Vogelsberger (Simulierte Universen) und Sarah Zajusch (Licht an - Katze tot).

Research Highlights



Hybrid excitons: Combining the best of two worlds? (AG Reutzel)

Faster, more efficient, and more versatile – these are the benchmarks for novel optoelectronic devices that hold the key to future energy and information technologies. Together with researchers from Göttingen, Berlin, and Graz, AG Reutzel could show how ultrafast energy transfer leads to the formation of a hybrid exciton at a 2D/organic heterointerface. At the interface of the two fundamentally different material systems, a new type of exciton is formed that combines the unique properties of both components. The hybrid exciton's wavefunction exist in several states at once: It can reside solely on one molecule, as well as extend across the interface, being partially in both the organic and the 2D semiconductor. This work is published in **Nature Physics**.

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Microstructure of silicon anodes in batteries (AG Volz)

Silicon offers great promise as a potential anode active material and the optimum alternative to lithium metal in all-solid-state lithium-ion batteries. However, its practical application is limited by severe volume expansion (≈300%) during lithiation, leading to cracking upon delithiation. In this study, AG Volz investigated the microstructural evolution of microcrystalline silicon electrodes in a solid-electrolyte-free environment using cryogenic scanning transmission electron microscopy (STEM) after electrochemical cycling. A controlled workflow prevents ambient exposure, and cryo-TEM ensures structural integrity. After the first lithiation, the electrode shows a heterogeneous mix of crystalline $Li_{15}Si_4$, various amorphous Li_xSi phases, and residual crystalline silicon. After the first delithiation, the silicon becomes largely amorphous, showing a heterogeneous texture with pronounced thread-like features and only traces of crystallinity. By the tenth delithiation, the bulk microstructure is far more uniform, with thread-like features largely eliminated and persisting only in small regions near grain boundaries. These results indicate that, although silicon begins in a crystalline state, a more homogeneous bulk silicon amorphous microstructure develops only after several cycles. Our findings highlight that stabilizing the microstructure and minimizing cracking during cycling requires not only optimization of electrode architecture but also careful selection of the silicon phase. This work is published in **Advanced Energy Materials**.

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Trion-engineered photo-transistors (AG Malic)

Multimodal device operations are essential to advancing the on-chip integration of 2D semiconductors in electronics, photonics, and quantum technology. Precise control over carrier dynamics, particularly exciton generation and transport, is crucial for fine-tuning the functionality of 2D heterostructure-based optoelectronic devices. However, traditional exciton engineering in 2D semiconductors is mainly restricted to artificially assembled vertical heterostructures with electrical or strain-induced confinements. In this joint experiment theory work involving the groups of Prasana Sahoo (Indian Institute of Technology), Saroj Dash (Chamers Unviersity of Technology, Sweden) and AG Malic, bilayer 2D $MoSe_2$-WSe_2 -$MoSe_2$ lateral heterostructures are utilized to achieve preferential exciton generation and manipulation without the need for external confinement. In lateral n-p-n field-effect transistor (FET) geometry, unique and nontrivial electro-optical properties are uncovered, including dynamic tuning of channel photoresponsivity from positive to negative. The multimodal operation of these 2D-FETs is achieved by adjusting electrical bias and the impinging photon energy, enabling precise control over the trion generation and transport. The findings pave the way for developing practical exciton-based transistors, sensors, multimodal optoelectronic components on-chip, and quantum technologies. This work is published in **Advanced Functional Materials.**

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Polariton transport in 2D semiconductors (AG Malic)

Exciton transport in 2D semiconductors holds promise for room temperature, ultracompact optoelectronic devices, but it is limited by short propagation distances. Hybridization of excitons with cavity photons to form exciton-polaritons can enhance the propagation by orders of magnitude, enabling a coherent, ballistic transport. However, a microscopic understanding of the role of phonons is still lacking, particularly regarding their influence on the crossover from the ballistic to the diffusive polariton transport regime. In this work, AG Malic investigated the spatiotemporal polariton dynamics in MoSe2 monolayers at moderate to high temperatures, explicitly including the phonon-mediated coupling to the intervalley exciton reservoir. We identify three distinct transport regimes: (i) an initial subpicosecond ballistic-like regime characterized by a phonon-induced velocity renormalization, (ii) a transient, few-picosecond superdiffusive regime characterized by strongly enhanced diffusion, and (iii) a slower, exciton-limited diffusion following thermalization. The gained microscopic insights will trigger and guide future experimental studies on the phonon-mediated polariton transport in atomically thin semiconductors. This work is published in **Science Advances.**

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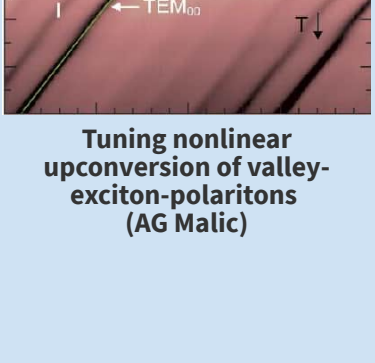
press release



Tuning nonlinear upconversion of valley-exciton-polaritons (AG Malic)

Controlling exciton relaxation and energy conversion pathways via their coupling to photonic modes is a central task in cavity-mediated quantum materials research. In this context, the light-matter hybridization in optical cavities can lead to intriguing effects, such as modified carrier transport, enhancement of optical quantum yield, and control of chemical reaction pathways. In this joint experiment-theory collaboration with Christian Schneider (University of Oldenburg) and AG Malic, we investigated the impact of the strong light-matter coupling regime on energy conversion, both in relaxation and upconversion schemes, by utilizing a strongly charged $MoSe_2$ monolayer embedded in a spectrally tunable open-access cavity. We find that the charge carrier gas yields a significantly modified photoluminescence response of cavity exciton-polaritons, dominated by an intra-cavity like pump scheme. In addition, upconversion luminescence emerges from a population transfer from fermionic trions to bosonic exciton-polaritons. Due to the availability of multiple optical modes in the tunable open cavity, it seamlessly meets the cavity-enhanced double resonance condition required for an efficient upconversion. The latter can be actively tuned via the cavity length in-situ, displaying nonlinear scaling in intensity and fingerprints of the valley polarization. This suggests mechanisms that include both trion-trion Auger scattering and phonon absorption as its underlying microscopic origin. This work is published in **Nature Communications.**

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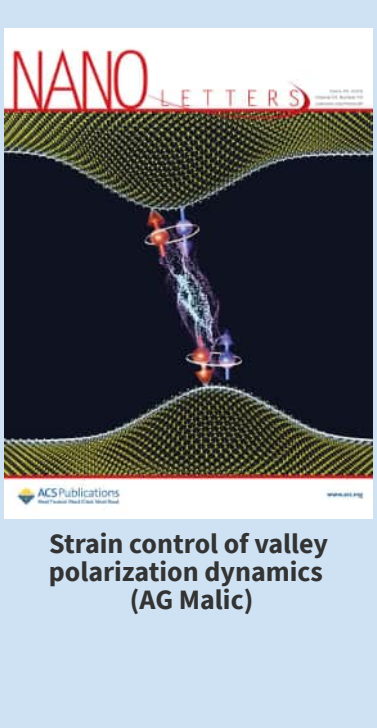

Strain control of valley polarization dynamics (AG Malic)

Encoding and manipulating digital information in quantum degrees of freedom is one of the major challenges of today's science and technology. The valley indices of excitons in transition metal dichalcogenides (TMDs) are well-suited to address this challenge. In this joint experiment-theory collaboration between Kiril Bolotin (FU Berlin) an AG Malic, we demonstrate a new class of strain-tunable, valley-polarized hybrid excitons in monolayer TMDs, comprising a pair of energy-resonant intra- and intervalley excitons. These states combine the advantages of bright intravalley excitons, where the valley index directly couples to light polarization, and dark intervalley excitons, characterized by low depolarization rates. We demonstrate that the hybridized state of dark KK' intervalley and defect-localized excitons exhibits a degree of circular polarization of emitted photons that is three times higher than that of the constituent species. Moreover, a bright KK intravalley and a dark KQ exciton form a coherently coupled hybrid state under energetic resonance, with their valley depolarization dynamics slowed down a hundredfold. Overall, these valley-polarized hybrid excitons with strain-tunable valley character emerge as prime candidates for valleytronic applications in future quantum and information technology. This work is published in **Nano Letters and selected for the Cover Page.**

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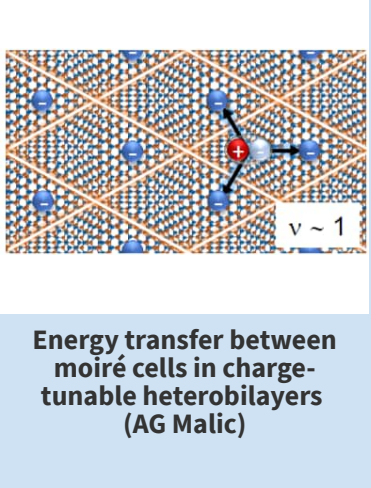

Energy transfer between moiré cells in charge-tunable heterobilayers (AG Malic)

Moiré superlattices in van-der-Waals heterostructures offer a versatile platform for exploring emergent quantum phenomena. In type-I MoSe2-WS2 moiré superlattices, the large lattice mismatch ensures robustness of the moiré period against twist-angle disorder. The excitonic ground state is formed by moiré-trapped MoSe2 intralayer excitons. However, a key challenge is the controlled transfer of excitonic energy across moiré sites. In this joint work between Christian Schüller (University of Regensburg) and AG Malic, we investigated gate-controlled phonon-assisted resonant energy transfer (RET) as a means to transfer excitonic energy between moiré cells. By harnessing the interplay between resonantly excited moiré excitonic complexes and single or few phonons, energy transfer pathways can be modulated via the charging state of moiré cells. We discuss two potential RET mechanisms: phonon-assisted resonant tunneling and Försterlike dipole-dipole transfer. Our findings highlight the potential of this approach for excitonic circuits and nanoscale energy transport, paving the way for future applications in quantum technologies. This work was published in **npj 2D Materials**.

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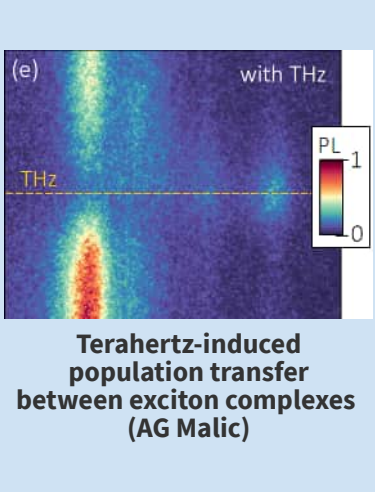

Terahertz-induced population transfer between exciton complexes (AG Malic)

Two-dimensional van der Waals semiconductors feature a variety of stable Coulomb-bound electron-hole complexes, which determine the optical response of the materials and serve as primary carriers of energy and spin-valley encoded information. Importantly, transitions between different excitonic states are found in the terahertz spectral range, motivating the use of strong THz radiation for their manipulation on ultrafast timescales. In this work, we apply this technique to efficiently transfer populations within the manifold of excitonic complexes in monolayer WSe2, combining pulsed optical injection with a perturbation induced by a THz free-electron laser source. Monitoring time-resolved photoluminescence, we show conversion between different Coulomb-bound species across biexcitonic and excitonic regimes. Depending on the lattice temperature, these processes involve both short-lived bright and long-lived dark states. Combining experimental findings with theory support, we outline possible dissociation and formation pathways of charged excitons and biexcitons induced by the THz radiation. Finally, we demonstrate access to the formation dynamics of charged biexcitons under controlled conditions of thermalized populations of their constituents, avoiding complications of excess energies that otherwise occur after nonresonant optical excitation. This work was published in **Physical Review B** and was selected as **Editors' Suggestion.**

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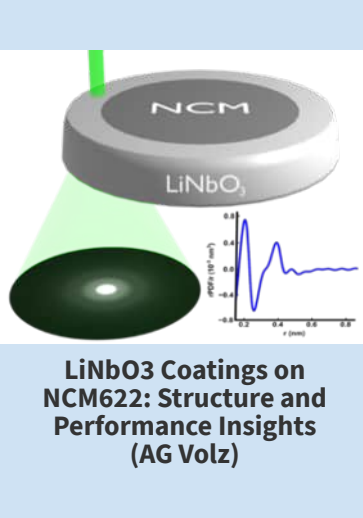

LiNbO3 Coatings on NCM622: Structure and Performance Insights (AG Volz)

Batteries with a solid instead of a liquid electrolyte promise increased safety and a higher energy density. However, a key challenge remains the optimization of the cathode/electrolyte interface, which often suffers from unwanted reactions that lead to rapid battery degradation. To itigate these effects, protective coatings such as lithium niobate ($LiNbO_3$) on cathode materials like $Li(NiCoMn)O_2$ (NCM) are being developed and optimized. In a collaboration led by the AG Volz, research groups from Marburg (structural analysis), Karlsruhe (synthesis and electrochemistry), and Darmstadt (theory) analyzed the structure and composition of $LiNbO_3$ coatings and correlated these characteristics to observed performance differences in batteries. The study revealed that only at a synthesis temperature of around 350 °C does $LiNbO_3$ form the desired amorphous structure, which enhances battery stability and performance. At higher or lower synthesis temperatures, different amorphous or crystalline structures form, exhibiting properties that accelerate battery degradation. These findings improve our understanding of how $LiNbO_3$ coatings protect the cathode surface and thereby contribute to the advancement and practical applicability of solid-state batteries. This work was published in **Advanced Materials Interfaces**.

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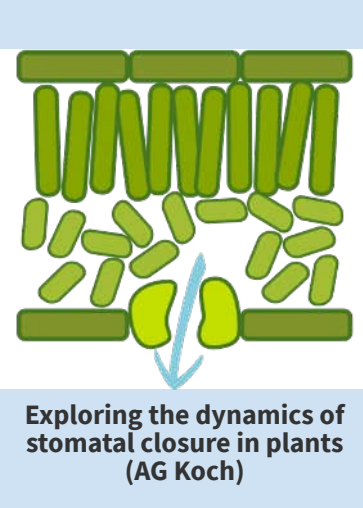

Exploring the dynamics of stomatal closure in plants (AG Koch)

In the process of photosynthesis, plants absorb carbon dioxide and release oxygen through small openings in their leaves (stomata). However, this process also results in the loss of water vapor which becomes problematic if there is not enough water available. Plants can therefore actively control the opening of these pores. The Koch research group has succeeded in continuously monitoring this regulation with the help of a self-developed measuring system: the absorption of terahertz radiation in the leaf can be used to determine the water content, and by comparing this with a mathematical model, conclusions can be drawn about the speed and efficiency of this regulation. This method could help improve the resilience of plants in times of accelerated climate change. This work was published in **Scientific Reports**.

read more

Events

Physics Christmas Party
12 December, 4.30 pm
Renthof 5

On 12 December, the Fachschaft hosts a Christmas party for everyone at the Physics Department. The party starts at 4:30pm on the 2nd floor of RH5, and we would like to ask everyone who comes to bring a small snack or drink to share, so please sign up on this list. There will be PowerPoint karaoke and lots of games, and we are also planning a little surprise for you**.**

sign up here

Introduction of research groups
21 January, 2.15 pm
Renthof 5

You are going to finish your studies soon and still do not know where to write your thesis? Come to our AG-Vorstellung on the 21 January 2026 in the large lecture hall in the Renthof 5, where you can learn what each research group at the department is doing. After a few short presentations you can get to know better each research group at a poster session and start building connections.

Share your good news

Your newsletter team: Carina Hlawaty, Oliver Rehn and Ermin Malic

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

write e-mail