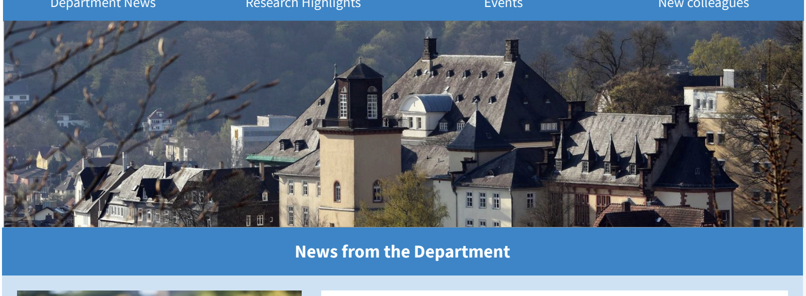
Universität Marburg

Newsletter Physics 03/26

Department News | Research Highlights | Events | New colleagues



News from the Department

Lukas Wagner: New group leader at our department.

Lukas Wagner started leading an independent research group. His group "Sustainably Scalable Perovskite Photovoltaics" (superPV) has the goal to carry out solar cell research on the nanometer scale for an energy transition on the terawatt level. The three key research areas are the optimization of printable perovskite solar cells with carbon-based electrodes, in operando characterization methods during accelerated ageing, and sustainability assessments. Supported by a "NanoMatFutur" grant funded by the Federal Ministry of Research, Technology and Space (BMFT), as well as a research fellowship by the WE Heraeus Foundation, they will set up equipment for solar cell fabrication and characterization in the already well-equipped mar.quest PeroLab (Lahnberge). The group welcomes students who want to gain experiences in a broad scope of topics such as sustainability studies, solar cell optimization, materials functionalization, measurement technology and method development, automization, AI-based data evaluation, and semiconductor simulation.

Lukas Wagner hat die Leitung einer unabhängigen Forschungsgruppe übernommen. Seine Gruppe „Nachhaltig Skalierbare Perowskit-Photovoltaik" hat sich zum Ziel gesetzt, Solarzellenforschung im Nanometerbereich für eine Energiewende im Terawattmaßstab zu betreiben. Die drei Forschungsschwerpunkte liegen auf der Optimierung druckbarer Perowskit-Solarzellen mit kohlenstoffbasierten Elektroden, in-operando-Charakterisierungsmethoden während beschleunigter Alterung und Nachhaltigkeitsbewertungen. Unterstützt durch eine „NanoMatFutur"-Förderung des Bundesministeriums für Forschung, Technologie und Raumfahrt (BMFT) sowie ein Research Fellowship der WE Heraeus Stiftung werden im bereits gut ausgestatteten mar.quest PeroLab (Lahnberge) Geräte für die Herstellung und Charakterisierung von Solarzellen implementiert. Die Gruppe begrüßt Studierende, die Erfahrungen in einem breiten Spektrum von Themen wie Nachhaltigkeitsstudien, Solarzellenoptimierung, Materialfunktionalisierung, Messtechnik- und Methodenentwicklung, Automatisierung, KI-basierte Datenauswertung und Halbleitersimulation sammeln möchten.

New Meet-the-Prof video with Stefan Wippermann

The PR team has continued the "Meet the Prof" series with Prof. Dr. Stefan Wippermann. Watch the video to find our what the motivation behind Stefan's research is, what he thinks about Marburg, and what hobbies he has. The interview was conducted by Christien Off with Oliver Rehn behind the camera.

Das PR-Team hat die Reihe „Meet the Prof" mit Prof. Dr. Stefan Wippermann. Im Video erfahrt ihr, was die Motivation hinter Stefans Forschung ist, was er über Marburg denkt und welche Hobbys er hat. Das Interview wurde von Christien Off geführt, mit Oliver Rehn hinter der Kamera.

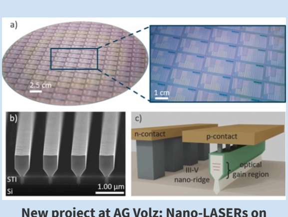
Interview

New Meet-the-Prof video with Mark Vogelsberger

The PR team has added another "Meet the Prof" video with Prof. Dr. Mark Vogelsberger, who just recently joined the Physics Department. What fascinates him about his research? How does he want to structure his lectures? What does she like to do in his free time? Watch the video to find our more about Mark and his 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. Dr. Mark Vogelsberger fortgesetzt, der seit kurzem zum Fachbereich Physik gehört. Was fasziniert ihn an seiner Forschung? Wie möchte er seine Vorlesungen gestalten? Was macht er gerne in seiner Freizeit? Sehen Sie sich das Video an, um mehr über Mark und seine Pläne zu erfahren. Das Interview führte Christien Off, Oliver Rehn stand hinter der Kamera.

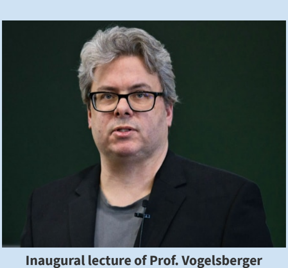
Interview



New project at AG Volz: Nano-LASERs on silicon for next-generation photonics

Silicon (Si) photonics is a key technology for solving future challenges caused by rising data traffic. It enables the miniaturization and mass production of optical systems by leveraging the mature complementary metal-oxide semiconductor (CMOS) process technology. However, the lack of a cost-effective and Si-compatible light source remains the primary obstacle to further expand Si photonics into high-volume applications, such as chip-to-chip optical interconnects in machine learning systems, fiber-to-the-X, or optical sensing applications. The integration of III-V devices or layers to Si using a hybrid or heterogeneous approach increases already functionalities and reduces costs. However, these concepts are complex due to the mechanical layer transfer and high alignment requirements. The monolithic deposition of III-V materials directly onto Si substrates would be the ultimate path towards lucrative Si photonics applications, but it faces challenges due to the different lattice properties of III-V and Si. The AG Volz has paired up with Imec, the world´s leading independent semiconductor research hub, in Leuven, Belgium, and with the Phtotonics group at the Unversity of Ghent, Belgium, to demonstrate nano-ridge lasers emitting at 1300 nm fully processed in a CMOS fab on 300 mm Si substrates. The research is financed by the DFG (German Research Foundation) in a collaborative project with its Flemish counterpart FWO .

Silizium (Si)-Photonik ist eine Schlüsseltechnologie zur Bewältigung künftiger Herausforderungen aufgrund des steigenden Datenverkehrs. Sie ermöglicht die Miniaturisierung und Massenproduktion optischer Systeme durch Nutzung der ausgereiften CMOS-Prozesstechnologie (Complementary Metal-Oxide Semiconductor). Das Fehlen einer kostengünstigen und Si-kompatiblen Lichtquelle bleibt jedoch das Haupthindernis für die weitere Ausweitung der Si-Photonik auf Anwendungen mit hohem Volumen, wie z. B. Chip-zu-Chip-optische Verbindungen in maschinellen Lernsystemen, Fiber-to-the-X oder optische Sensoranwendungen. Die Integration von III-V-Bauelementen oder -Schichten in Si unter Verwendung eines hybriden oder heterogenen Ansatzes erhöht bereits die Funktionalität und senkt die Kosten. Diese Konzepte sind jedoch aufgrund des mechanischen Schichttransfers und der hohen Anforderungen an die Ausrichtung komplex. Die monolithische Abscheidung von III-V-Materialien direkt auf Si-Substraten wäre der ultimative Weg zu lukrativen Si-Photonik-Anwendungen, steht jedoch aufgrund der unterschiedlichen Gitterkonstanten von III-V und Si vor Herausforderungen. Die AG Volz hat sich mit Imec, dem weltweit führenden unabhängigen Halbleiterforschungszentrum in Leuven, Belgien, und mit der Phtotonics-Gruppe an der Universität Gent, Belgien, zusammengetan, um Nano-Ridge-Laser mit einer Emissionswellenlänge von 1300 nm zu demonstrieren, die vollständig in einer CMOS-Fabrik auf 300-mm-Si-Substraten verarbeitet wurden. Die Forschung wird von der DFG (Deutsche Forschungsgemeinschaft) in einem Kooperationsprojekt mit ihrem flämischen Pendant FWO finanziert.



Inaugural lecture of Prof. Vogelsberger

On February 4, Prof. Vogelsberger delivered his inaugural lecture, "Understanding the Universe with Cosmological Simulations," in the large lecture hall at Renthof 5. He was appointed W3 Professor of Astrophysics to the Department of Physics on April 1, 2025. The Astrophysics Research Group does not use telescopes but instead conducts cosmological simulations that model a specific part of the universe. Numerical models are designed on computers, which then perform calculations to determine how galaxies or structures in the universe develop. This makes it possible to better understand galaxy formation and structure development and ultimately compare these with observations. However, the computer remains the primary tool used in the research .

Am 4. Februar hielt Prof. Vogelsberger seine Antrittsvorlesung „Das Universum verstehen mit kosmologischen Simulationen" im Großen Hörsaal, Renthof 5. Am 01.04.2025 wurde er als W3-Professor für Astrophysik an den Fachbereich Physik berufen. Die AG Astrophysik arbeitet nicht mit dem Teleskop, sondern führt kosmologische Simulationen durch, die einen gewissen Teil des Universums simulieren. Es werden numerische Modelle am Computer entworfen und dieser führt dann Berechnungen durch, wie sich Galaxien oder Strukturen im Universum entwickeln. Damit ist es möglich, die Galaxienentstehung und die Strukturbildung besser nachzuvollziehen und dies letztendlich mit den Beobachtungen zu vergleichen; das hauptsächliche Arbeitsgerät bleibt aber der Computer.

Excursion to DESY in Hamburg

At the beginning of December, 24 female students of physics, mathematics and computer science immersed themselves in the world of large-scale research. The three-day excursion organised by the project "Mehr (für) Physikstudentinnen*" (More (for) Female Physics Students) took them directly to the German Electron Synchrotron (DESY) in Hamburg. Other highlights included a presentation on black holes at the planetarium, discussions with scientists and, in particular, the opportunity to strengthen ties with each other. The participants' conclusion was clear: inspiring, motivating and a good platform for networking.

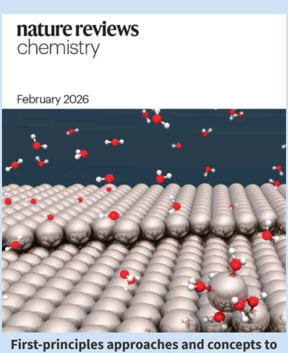
Anfang Dezember tauchten 24 Studentinnen* der Physik, Mathematik und Informatik in die Welt der Großforschung ein. Die dreitägige Exkursion des Projekts „Mehr (für) Physikstudentinnen*" führte direkt zum Deutschen Elektronen-Synchrotron (DESY) nach Hamburg. Weitere Highlights waren die Vorstellung über Schwarze Löcher im Planetarium, der Austausch mit Wissenschaftler*innen und besonders das Kontaktestärken untereinander. Das Fazit der Teilnehmerinnen* war eindeutig: Inspirierend, motivierend und eine gute Plattform zum Netzwerken.

"Marburg-WG" project

Following our casting campaign at the end of last year, we received numerous video applications from students from a wide range of disciplines via Instagram. In January 2026, we continued with online interviews to get to know a selection of candidates personally. Eight of them were finally invited to a workshop day at the physics department. A selection committee with representatives from the university accompanied the process and finally chose four students who will now move into the newly renovated shared flat from March to April. The future flatmates are looking forward to meeting you all. You can look forward to the project officially starting in mid-April – we will keep you up to date.

Nach unserer Casting-Kampagne Ende letzten Jahres haben uns über Instagram zahlreiche Videobewerbungen von Studierenden aus ganz unterschiedlichen Fachrichtungen erreicht. Im Januar 2026 ging es mit Online-Interviews weiter, um eine Auswahl an Kandidat*innen persönlich kennenzulernen. Acht von ihnen wurden schließlich zu einem Workshop-Tag auf dem Fachbereichsgelände der Physik eingeladen. Eine Auswahlkommission mit Vertreter*innen der Universität begleitete den Prozess und entschied sich final für vier Studierende, die von März bis April nun in das frisch renovierte WG-Haus einziehen. Die künftigen WG-Bewohner*innen freuen sich, Sie alle kennenzulernen. Sie dürfen gespannt sein, ab Mitte April startet das Projekt offiziell – wir halten Sie auf dem Laufenden.

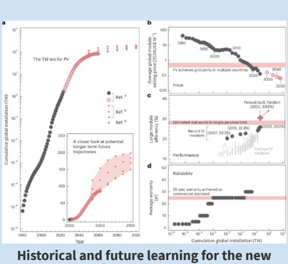
Research Highlights



First-principles approaches and concepts to simulate electrochemical interfaces (AG Wippermann)

Ab initio techniques have revolutionized the way theory helps practitioners to explore mechanisms governing reactions or properties, and develop new strategies for materials discovery and design. Nevertheless, their application to electrochemical systems remains limited, due to challenges electronic structure calculations face in achieving realistic descriptions of electrified solid–liquid interfaces, including potential and pH control or free energies of barrier configurations. The extension of the scope of simulations to achieve potential control, inherent to electrochemical experiments, is just emerging. In this Review, we discuss approaches to describing electrified interfaces between solid electrodes and liquid electrolytes in realistic environments. By exchanging energy, electronic charge and ions with their environment, electrochemical interfaces are thermodynamically open systems. Additionally, large electrostatic potential and field fluctuations occur on timescales and length scales relevant to chemical reactions. We discuss the key challenges for incorporating these features into ab initio simulations to facilitate broader community use and provide a new level of realism when exploring fundamental electrochemistry from first principles. This work is published in **Nature Reviews Chemistry** and highlighted **on the Cover** of the february issue.

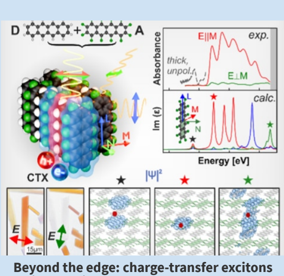
read more



Historical and future learning for the new era of multi-terawatt photovoltaics (AG Goldschmidt)

Solar photovoltaics (PV) is entering a new era of multi-terawatt deployment, with 2 TW already in service and more than 75 TW predicted in many scenarios by 2050. This next era has been enabled by over five decades of cumulative advances in PV module cost reduction, performance and reliability. The current scale of deployment also introduces new needs, opportunities and challenges. In this Perspective we frame a path forwards based on learning, broadly defined as a combination of expansion of knowledge and advances through research and development, experience and collaboration. We discuss historical topics where learning has driven PV deployment until now, and emerging areas that are required to sustain high levels of future deployment. We expect progress to continue in terms of module price, performance and reliability, driven by advances in PV cell and module design, the emergence of tandem devices and increased focus on extending module lifetimes. Large-scale deployment also means large-scale sustainability and responsibility. We therefore posit that additional metrics, such as the impact on global CO_2 emissions, resource consumption and design for reuse and recycling, will become increasingly important to the PV industry and provide opportunities for further learning. The work was published in **Nature Energy**.

read more

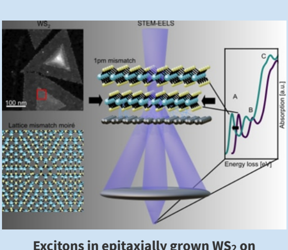


Beyond the edge: charge-transfer excitons in organic donor-acceptor cocrystals (AG Witte)

Charge-transfer excitons (CTX) are considered key intermediates for charge separation in organic solar cells, but their microscopic nature is still poorly understood, because most studies use disordered mixtures or simplified quantum mechanical models for their description. In a joint experimental-theoretical study by the Witte research group together with the group of Prof. Cocchi (Uni Jena), the properties of such CTX in highly ordered molecular donor-acceptor cocrystals for the class of acenes-perfluoroacenes were microscopically investigated. A crucial prerequisite was the fabrication of ultrathin, phase-pure single crystals that enabled detailed polarization-resolved absorption measurements over a large energy range extending from the visible to the UV. The experiments were complemented by state-of-the-art first-principles calculations using density functional and many-body perturbation theory and revealed excellent agreement with the experimental findings. The study shows, in particular, that CTX states are not limited to a single low-energy excitation at the absorption edge, but occur across a broad spectral range. The higher-energy optical transitions exhibit considerable oscillator strength and a pronounced polarization that can be classified using a molecular coordinate system and thereby challenge several widespread interpretations found in literature. This work is published in **Advanced Functional Materials** and opens the door for future microscopic studies on the dynamics of charge separation in solar cells.

read more

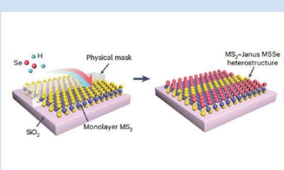
press release



Excitons in epitaxially grown WS_2 on graphene: A nanometer-resolved electron energy loss spectroscopy and DFT study (AG Volz, AG Wippermann)

Atomically thin WS_2 on graphene is a highly promising platform for future exciton-based optoelectronic devices. Together with our collaborators from AIXTRON SE and the group of Martin Esmann from the University of Oldenburg, the team of Kerstin Volz characterized epitaxial WS_2/graphene heterostructures grown by Metal Organic Chemical Vapor Deposition by Scanning Transmission Electron Microscopy (STEM). Using nanometer-resolved monochromated Electron Energy Loss Spectroscopy (EELS) that is applied in the STEM, we compare monolayer, bilayer and multilayer WS_2 on graphene and find a systematic redshift of the A and B excitons, as well as higher-energy features, with increasing layer number. High-resolution STEM imaging and quantitative atom-position analysis reveal a lattice-mismatch moiré of about 1 pm between the lower WS_2 layer, which is tightly aligned to the graphene, and the more relaxed upper layer. We show that this minute mismatch produces long-wavelength stacking modulations across the bilayer region, which we can reproduce with image simulations of an appropriately strained bilayer supercell. Theoretical modeling is carried out within our group together with Stefan Wippermann using *ab initio* calculations, which demonstrate that an unstrained WS_2 bilayer would show a slight exciton blueshift due to enhanced dielectric screening. When we include the experimentally observed lattice mismatch, the resulting band-gap reduction overcompensates this effect and yields the redshift of the A and higher-energy excitons seen in our spectra. Our results show that picometer-scale epitaxial strain can affect the optical properties and thus yield insights how to engineer excitons in wafer-scale WS_2/graphene heterostructures. This work has been published in **ACS Nano.**

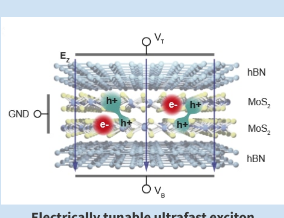
read more



Contemporary challenges in van der Waals 2D semiconductors (AG Malic)

Van der Waals (vdW) layered semiconductors have emerged as a unique class of quantum materials distinguished from their bulk counterparts by reduced dielectric screening, strong Coulomb interactions, large exciton binding energies, strong spin− orbit coupling, and pronounced thickness-dependent band structures. These fundamental attributes have enabled the exploration of exotic many-body physics and a broad spectrum of device applications, ranging from field-effect transistors and ferroelectric switches to optoelectronics, magnetic semiconductors, neuromorphic computing, and energy harvesting systems. Despite remarkable advances, critical challenges remain in the controlled synthesis of high-quality crystals, formation of low-resistance contacts, integration of stable and scalable gate dielectrics, and reliable device performance at the wafer scale. In this mega-review, we provide a comprehensive overview of contemporary challenges and future opportunities in vdW-layered semiconductors, structured across nine themes: growth and heterostructures of transition metal dichalcogenides, Ohmic contacts, emerging gate dielectrics, high-performance low-power field-effect transistors (FETs), diluted magnetic semiconductors, plasmonics and exciton propagation, hot-carrier solar cells, bioinspired neuromorphic computing, and electrocatalytic/photocatalytic energy conversion. By consolidating fundamental insights and device-level perspectives, this review aims to chart a roadmap for advancing vdW semiconductors from laboratory-scale discoveries to transformative technologies in electronics, optoelectronics, spintronics, and sustainable energy systems. This work is published in **ACS Nano**.

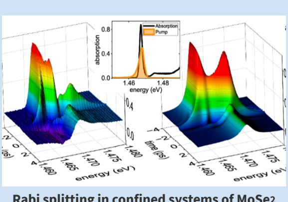
read more



Electrically tunable ultrafast exciton dynamics in 2D materials (AG Malic)

Extended efforts have been devoted to the study of strongly-interacting excitons and their dynamics, towards macroscopic quantum states of matter such as Bose-Einstein condensates of excitons and polaritons. Momentum-direct layer-hybridized excitons in transition metal dichalcogenides have attracted considerable attention due to their high oscillator strength and dipolar nature. However, the tunability of their interactions and dynamics remains unexplored. Here, we achieve an unprecedented control over the nonlinear properties of dipolar layer-hybridized excitons in an electrically gated van der Waals homobilayer monitored by transient optical spectroscopy. In this joint experiment-theory study invovling the groups of A. Kis (EPFL, Lausanne), G. Cerullo (CNR-IFN, Milano), and AG Malic, we apply a vertical electric field to reveal strong Coulomb interactions of dipolar hybrid excitons. We find opposite density-dependent energy shifts of the two main hybrid species based on their dipolar orientation, together with a strongly enhanced optical saturation of their absorption. Furthermore, by electrically tuning the interlayer tunneling between the hybridized carriers, we significantly extend the formation time of hybrid excitons, while simultaneously increasing their decay times. Our findings have implications for the search on quantum blockade and condensation of excitons and dipolaritons in two-dimensional materials. This work is published in **Nature Communications**.

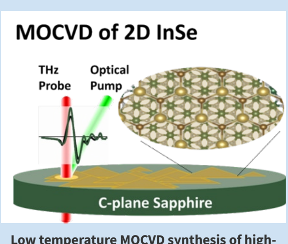
read more



Rabi splitting in confined systems of $MoSe_2$ monolayers and (Ga,In) As quantum wells (AG Volz)

Rabi splitting is a defining signature of strong light-matter interaction, emerging when a two-level system is resonantly driven by an optical field, resulting in a spectral doublet separated by the Rabi energy. In solid-state systems, Rabi splitting occurs at exciton resonances, where it is shaped by many-body interactions intrinsic to the material. In this work, we investigate the Rabi splitting dynamics in two paradigmatic two-dimensional semiconductors: a hBN-encapsulated $MoSe_2$ monolayer and a (Ga,In)As multiple quantum well structure. In $MoSe_2$, strong Coulomb interactions dominate over light-matter coupling, while in the quantum wells, both interactions are of comparable strength. While both systems exhibit clear Rabi splitting under resonant excitation, their behavior diverges under increased excitation strength. $MoSe_2$ displays sublinear Rabi splitting due to excitonic correlations, whereas (Ga,In)As quantum wells reveal additional spectral resonances and coherent optical gain, indicating a transition beyond the simple two-level regime. These contrasting behaviors are quantitatively captured by a unified microscopic many-body theory based on Heisenberg equations of motion and an exciton expansion. Our findings elucidate the impact of many-body interactions on coherent exciton dynamics and establish a framework for tailoring strong-field optical responses in two-dimensional materials. This work is published in **Nature Communications**.

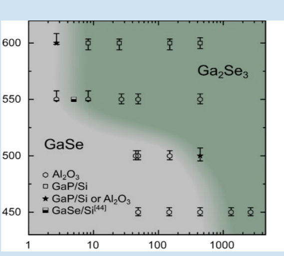
read more



Low temperature MOCVD synthesis of high-mobility 2D InSe (AG Volz, AG Witte)

2D indium selenide (InSe) is a layered semiconductor with high electron mobility and a tunable band gap ranging from 1.25 eV in the bulk to 2.8 eV in the monolayer limit. However, growing phase-pure InSe remains challenging due to the complex indium–selenium (In–Se) phase diagram. This complexity and the sensitivity of chemical precursors to growth conditions make it difficult to control which In–Se phase forms during synthesis during, e.g., metal-organic chemical vapor deposition (MOCVD). MOCVD is considered the most promising approach for growing InSe, as it enables wafer-scale, uniform, and controllable deposition—key requirements for device integration. In this work, AG Volz together with AG Witte and AG Chatterjee present a systematic investigation of InSe synthesis on c-plane sapphire substrates at low temperatures. By varying Se/In precursor ratio and growth temperature, they create a phase diagram that covers In-rich, equal stoichiometric, and Se-rich In_xSe_y phases. Raman spectroscopy and atomic force microscopy, supported by energy dispersive X-ray spectroscopy and scanning transmission electron microscopy, reveal formation conditions of 2D InSe. The epitaxial alignment is verified by in-plane X-ray diffraction. Samples grown under optimized conditions exhibit a strong optical absorption in the visible range and especially a comparably high electron mobility, underlining the potential of the MOCVD-grown material for future applications. This work is published in **Small.**

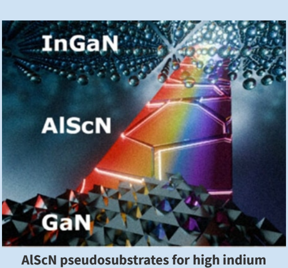
read more



MOCVD growth of covalent and 2D Ga_xSe_y: A phase validation and characterization (AG Volz, AG Gerhard)

Two-dimensional materials such as GaSe have gained significant attention due to their thickness-dependent electronic properties and suitability for visible-range optoelectronics. The related phase Ga_2Se_3 also features a direct bandgap and an excellent lattice match to silicon, making it highly relevant for silicon-integrated photonics. Here, AG Volz together with the groups of Marina Gerhard and Stephan Reitzenstein (TU Berlin) demonstrate wafer-scale MOCVD growth of Ga_xSe_y using DiPSe, TTBGa, and TEGa. By systematically varying the growth temperature (450–600 °C) and the selenium-to-gallium ratio, a phase diagram was established that enables targeted synthesis of phase-pure GaSe or Ga_2Se_3. Raman spectroscopy verifies the corresponding phase formation. Mass spectrometry of DiPSe further reveals that the temperature-dependent decomposition of the selenium precursor—and thus the effective Se/Ga ratio at the wafer surface—governs the transition between both phases. Optical spectroscopy confirms direct transitions at 1.34 eV (Ga_2Se_3) and 1.89 eV (multilayer GaSe), demonstrating their optoelectronic activity. The study was published in **npj 2D Materials and Applications.**

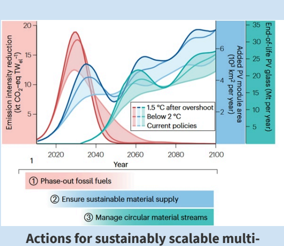
read more



AlScN pseudosubstrates for high indium content InGaN alloy epitaxy (AG Volz)

Nitride-based semiconductors are vital for efficient optoelectronic devices in the ultraviolet to green spectral range. However, producing red-emitting InGaN micro-LEDs is challenging due to lattice mismatch with traditional GaN substrates. This mismatch causes strain relaxation, compositional gradients, and defects in high-indium-content InGaN films. These issues severely limit device efficiency, and the potential of alternative substrates to address these challenges is not fully explored. In this work, which is published in ACS Applied Materials and Interfaces, we show that $Al_{1-x}Sc_xN$ pseudosubstrates with adjustable lattice parameters greatly improve lattice matching of InGaN. Using plasma-assisted molecular beam epitaxy, we grow 120 nm-thick, phase-pure $Al_{1-x}Sc_xN$ layers ($0.1 < x_{Sc} < 0.2$). This enables high-quality deposition of $In_{0.28}Ga_{0.72}N$ layers and a uniform indium distribution compared to growth directly on GaN. AlScN-supported films exhibit no compositional pulling effect common for conventional substrates. This uniformity is confirmed by room-temperature photoluminescence, showing a narrow emission at 538 nm. Our results demonstrate that AlScN pseudosubstrates are promising for future integrated red micro-LED devices. This work was published in **ACS Applied Materials & Interfaces**.

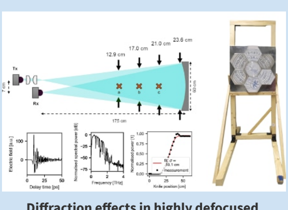
read more



Actions for sustainably scalable multi-terawatt photovoltaics (AG Wagner & AG Goldschmidt)

How can solar energy be sustainability scaled to terawatt level? An international team lead by Lukas Wagner and Jan Christoph Goldschmidt assessed this question, identifying three key phases for sustainability development of the solar industry in the 21st century: rapid capacity increase for a decarbonization of the energy system, ensuring sustainable material supply, and achieving materials circularity. These challenges can be addressed by novel technologies like perovskite multijunction solar cells, as long as the technology development follows sustainability guidelines outlined in the paper. The work was published in **Nature Reviews Clean Technology**.

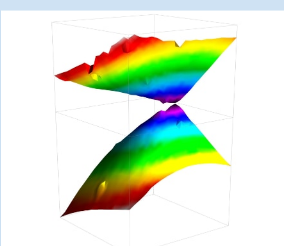
read more



Diffraction effects in highly defocused THz beams (AG Koch)

In the quest to supply the ever-growing demand for increased data rate and user numbers, telecommunication channels move to further and further increasing carrier frequencies. The sixth-generation technology of wireless communication (6G) will employ frequencies ranging into the terahertz (THz) range. As available transmitter powers are typically quite low, the main focus is on tight-beam communication instead of omnidirectional antennas common at lower frequencies. Now in this scenario of high frequency and relatively large beams, the Fresnel formalism from optics can be employed to model beam propagation and partial blockage by objects with features close to the wavelength of THz radiation. In a joint work between the research groups of Martin Koch (Philipps-University Marburg), Enrique Castro-Camus (CIO, León, Mexico) and Daniel Mittleman (Brown University, USA) under the umbrella of the Meteracom project, the applicability of Fresnel diffraction theory has been tested experimentally. By using THz Time-Domain Spectroscopy and a large, faceted mirror manufactured in house between the mechanical workshop and AG Koch in Marburg, the diffraction effects of objects in the beam could be investigated over a large frequency range and compared to theory. This recent work is published in **Optics Express**.

read more



Spin Resonance without a spin: A microwave analog (AG Stöckmann)

In a microwave network with a so-called symplectic symmetry all states appear as Kramers doublets which may be interpreted as spin-up and spin-down states of an effective spin 1/2. A change of the geometry lifts the degeneracy thus mimicking a Zeeman effect. The figure shows the eigenvalues of one doublet in dependence of two bond lengths acting as effective magnetic fields, exhibiting a characteristic double-cone structure. In a next step a microwave analog of nuclear magnetic resonance has been realized. The main challenge had been the need to vary one bond length with frequencies up to some ten MHz to simulate a radio-frequency field. This achievement enables studies of time-dependent systems so far beeing inaccessible. This is the last experimental work of the Arbeitsgruppe Quantenchaos which had been terminated two years ago. Hans-Jürgen Stöckmann thanks the Department of Physics for supporting his research for so many years after his official retirement 2010. This work was published in **Physical Review E.**

read more

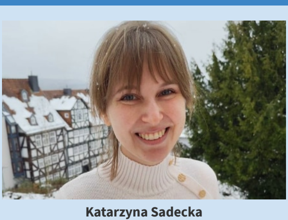
Events

Physik am Samstagmorgen
14 March, 11.00 am
Big lecture hall, Renthof 5

Mindful Physics – What physics and psychology have in common.

Speaker: Dr. Tobias Breuer. The lecture is in german.

New colleagues



Katarzyna Sadecka (AG Malic)

After completing my PhD in theoretical physics at Wrocław University of Science and Technology, Poland, in close collaboration with the University of Ottawa, Canada, I recently joined Philipps-Universität Marburg as a postdoctoral researcher in the Ultrafast Quantum Dynamics group led by Prof. Ermin Malic. My PhD research focused on the electronic and optical properties of two-dimensional materials, in particular transition metal dichalcogenides and bilayer graphene. In Marburg, I am extending this expertise to two-dimensional semiconducting magnets, such as CrSBr, focusing on optical excitations and how magnetic order influences their dynamics and the light-matter interaction. In my free time, I enjoy reading, photography, and exploring new places.

Rutvik Raviya (AG Volz)

I recently joined the Structure and Technology Research Lab as a PhD student. Following my Master's thesis in the same group, where I studied lithium-based solid-state battery materials with a focus on investigating interfacial degradation in cathode-solid electrolyte composites using transmission electron microscopy, I am now continuing this research to improve battery capability by understanding the structural changes at the nanoscale responsible for many of the performance issues. My goal is to develop safer, higher-energy batteries for large-scale applications, such as electric vehicles. In my free time, I enjoy traveling, hiking, and listening to music while exploring cultures and languages. I also like to relax by solving Sudoku, playing chess, or taking long walks.

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