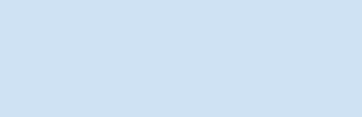


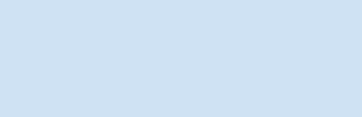
News from the Department



Physics colloquium in the winter term

The program for the physics colloquium in the winter term is fixed: The talks will have a general character and will be given by leading researchers in research and industry. We will have talks about quantum computers, most accurate picometer mirrors from Carl Zeiss, organic electronics, machine learning etc. We would like to welcome everybody, in particular students and non-science majors. The colloquium will be held on Wednesdays 3:30-4:30pm in the big lecture hall in Renthof 5. After the colloquium, we will offer coffee and delicious Klingelhöfer cake giving you the opportunity to meet our speakers. The students will again have the opportunity to get credit points for a key qualification.

[read more](#)



Student Research Center Mittelessen

The newly opened Student Research Center Mittelessen in Marburg offers space for students to conduct their own research projects and experimental investigations, contact with natural scientists and numerous ideas for engaging with STEM subjects. Hesse's Minister of Science Doris Fuchs and Minister of Education Prof. Dr. Alexander Lorz came to Marburg as guests for the opening ceremony. The ministries for the opening of the purpose-built rooms at the Department of Physics. Around 60 representatives from schools and educational institutions in Central Hesse used the opening as an opportunity to get to know what is on offer. Among other things, the center offers workshops on topics such as astrophysics, biological-chemical water investigation, electronics, artificial intelligence, radioactivity and robotics, which teach the basics of working in the natural sciences and ways to work on research questions. The Central Hesse Student Research Center will be open for free research school days from 2 to 6 pm on Wednesdays from October 4, 2023.

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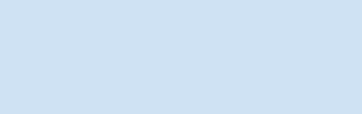


Best Dissertation Award (AG Volz)

Shamail Ahmed has received the Best Dissertation of the Year Award in the Mathematics and Natural Sciences category from Philipps-Universität Marburg. He completed his Ph.D. under the guidance of Prof. Volz. In his doctoral thesis entitled "Characterization of Ni-rich Lithium-ion Battery Layered Cathode Material using Scanning Transmission Electron Microscopy" he successfully identified and tracked the evolution of critical material defects that limit the lifespan of Ni-rich cathode active materials commonly used in contemporary Lithium-ion batteries. Furthermore, through the utilization of advanced computational simulations and aberration-corrected Transmission Electron Microscopy, he managed to visualize lithium and oxygen ions. This achievement enabled him to monitor the formation of a defective phase that hinders the practical application of energy-dense cathode active materials in lithium-ion batteries. His work paves the way for atomic-scale characterization and comprehension of energy storage, with the ultimate goal of enhancement.

[read more](#)

Shamail Ahmed hat den Preis für die beste Dissertation des Jahres in der Kategorie "Mathematik und Naturwissenschaften" von der Philipps-Universität Marburg erhalten. Er schloss seine Promotion unter der Leitung von Prof. Volz ab. In seiner Doktorarbeit mit dem Titel "Characterization of Ni-rich Lithium-ion Battery Layered Cathode Material using Scanning Transmission Electron Microscopy" identifizierte und verfolgte er erfolgreich die Entwicklung kritischer Materialdefekte, die die Lebensdauer von Ni-reichen aktiven Kathodenmaterialien begrenzen, die üblicherweise in modernen Lithium-Ionen-Batterien verwendet werden. Darüber hinaus gelang es ihm durch den Einsatz fortschrittlicher rechnerischer Bildsimulationen und aberrationskorrigierter Transmissionselektronenmikroskopie, Lithium- und Sauerstoffionen sichtbar zu machen. Dadurch konnte er die Bildung einer defekten Phase beobachten, die die praktische Anwendung dieses energiereichen aktiven Kathodenmaterials in Lithium-Ionen-Batterien behindert. Seine Arbeit ebnet den Weg für die Charakterisierung und das Verständnis der Energiespeicherung auf atomarer Ebene mit dem letztendlichen Ziel, diese zu verbessern.



Tobias Breuer obtains a Teaching Award

Tobias Breuer, Head of the Physics Lab Courses ("Physikalische Praktika"), was awarded with the 2022 Teaching Award („Preis für hervorragende Lehre 2022“) by the Faculty of Medicine. The prize is awarded by the Fachschaft der Medizin. The award ceremony took place on 25 August during the Approval Ceremony of the medical students in the Alte Aula of the University of Marburg. As reason for choosing Tobias Breuer as award winner, the Fachschaft Medizin states: *With comprehensive teaching videos and improved experiments, Dr. Breuer sheds light on complex topics and guides us through his subject in our first year of study. In Physics Lab 2.0, he is in his element and keeps the students excited with old and new experiments. Whether optics, electronics or mechanics – with Dr. Breuer, you always have a clear view. Tobias Breuer expresses his gratitude for the award and the related recognition of his teaching efforts. In this context, he gratefully thanks all coworkers in the Physik-Praktikum and at the department for their support, especially with view on the extremely intensive phases during the peak of the Covid pandemic.*

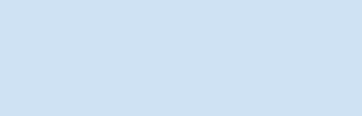
Tobias Breuer, Leiter der Physikalischen Praktika, wurde vom Fachbereich Medizin 2022 für die Physikalischen Praktika für Studierende der Medizin ausgezeichnet. Der Preis wird von der Fachschaft der Medizin verliehen. Die Preisübergabe fand am 25. August in der Approbationsfeier der Medizin-Studierenden in der Alten Aula der Universität Marburg statt. In der Begründung für die Auswahl von Tobias Breuer als Preisträger formuliert die Fachschaft: *„Mit verständlichen Lehrvideos und überarbeiteten Praktikumdurchführungen ist Dr. Breuer der facettenreichste Physik- und leitet uns im ersten Studienjahr durch sein Fach. Im Physikpraktikum 2.0 list er in seinen Versuchen unter Spannung. Ob Optik, Elektrik oder Mechanik – mit Dr. Breuer hat man stets den Durchblick.“* Tobias Breuer dankt für die Preisverleihung und die damit verbundene Anerkennung für die Lehrentzät und spricht in dem Zusammenhang auch seinen großen Dank an alle Mitarbeiter_innen im Praktikum und am Fachbereich für die Unterstützung aus, insbesondere mit Blick auf die äußerst intensiven Phasen in den Hochphasen der Pandemie.



Poster Award (AG Schrimpf)

Maryam Raouf was awarded one of three prizes for the best poster presentations at the international annual meeting of the German Astronomical Society in Berlin, September 11-15. In her presentation "Prospects of Plate Archive Photometric Calibration by GAIA SED fluxes" she discussed the use of the low resolution spectra of about 220 million stars from the latest GAIA data release DR3 for improving the photometric calibration of astronomical photographic plates widely used for observations in the 20th century. The German Astronomical Society began its annual meetings in 1863.

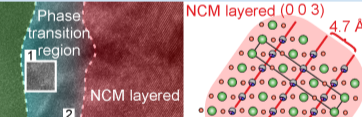
Maryam Raouf wurde mit einem der drei Preise für die besten Posterpräsentationen auf der internationalen Jahrestagung der Deutschen Astronomischen Gesellschaft in Berlin ausgezeichnet, 11.-15. September. In ihrem Vortrag "Prospects of Plate Archive Photometric Calibration by GAIA SED fluxes" diskutierte sie die Verwendung der niedrig aufgelösten Spektren von etwa 220 Millionen Sternen aus der neuesten GAIA-Datenausgabe DR3 zur Verbesserung der astronomischen Fotoplatten und die im 20. die im 20. Jahrhundert für Beobachtungen verwendet wurden. Die Deutsche Astronomische Gesellschaft begann ihre Jahrestagungen im Jahr 1863.



Large-scale equipment grant from DFG (AG Goldschmidt)

The DFG has approved the large-scale equipment application from AG Goldschmidt for a layer deposition facility for perovskite solar cells. With 565,000 euros, the DFG is supporting the procurement of several gloveboxes, a vapor deposition system, a sputtering system and a system for atomic layer deposition. These funds are supplemented by other funding sources. The facility is created with which perovskite-based tandem solar cells can be produced in different ways under particularly controlled conditions.

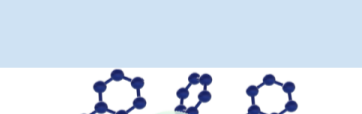
Die DFG hat den Großgeräteantrag von der AG Goldschmidt für eine Anlage zur Schichtabscheidung für Perowskit-Solarzellen bewilligt. Mit 565.000 Euro unterstützt die DFG die Beschaffung mehrerer Gloveboxen, einer Aufdampfanlage, einer Sputteranlage und einer Anlage für die Atomic Layer Deposition. Diese Mittel werden ergänzt durch andere Fördermittel und Berufungsmittel, so dass eine einzigartige Anlage entsteht, mit der unter besonders kontrollierten Bedingungen auf unterschiedliche Arten Perowskit-basierte Tandemsolarzellen hergestellt werden können.



DFG grant on polariton physics (AG Malic)

When 2D materials are integrated into an optical microcavities, their tightly-bound excitons can hybridize with cavity photons to form exciton polaritons. These quasiparticles inherit properties from their constituent parts, potentially combining the spatial coherence and long propagation lengths of photons with the tunability and nonlinearly of material-based excitations. The large oscillator strength of 2D excitons leads to a massive Rabi splitting, and the large binding energy allows for room-temperature polaritons. A microscopic understanding of polariton relaxation is essential for interpreting optical spectroscopy measurements, as well as understanding phenomena, such as Bose-Einstein condensation. The proposal "Optics, dynamics and transport of exciton polaritons in 2D materials" is awarded to AG Malic by the DFG. The grant runs over 2 years and will be carried out by Jamie Fitzgerald, a postdoctoral researcher in AG Malic.

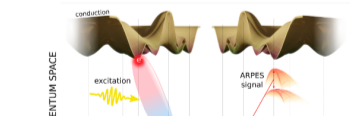
Wenn 2D-Materialien in optischen Mikrokanaliten integriert werden, können ihre fest gebundenen Exzitonen mit den Photonen des Hohlraums hybridisieren und Exziton-Polaritonen bilden. Diese Quasiteilchen erben die räumliche Kohärenz und die große Ausbreitungslänge von Photonen mit der Ausbreitungslänge von Exzitonen kombinieren. Diese Exziton-Polaritonen können durch die große Bindungsenergie ermöglicht die Polaritonen bei Raumtemperatur. Ein mikroskopisches Verständnis der Polaritonrelaxation ist für die Interpretation optischer Spektroskopiemessungen sowie für das Verständnis von Phänomenen wie der Bose-Einstein-Kondensation unerlässlich. Der Antrag "Optik, Dynamik und Transport von Exziton-Polaritonen in atomar dünnen Halbleitern" der AG Malic ist von der DFG bewilligt worden. Die Förderung läuft über 2 Jahre und wird von Jamie Fitzgerald, einem Postdoktoranden in der AG Malic durchgeführt.



Inventor's laboratory

The 34th Inventor Laboratory took place in Marburg from July 11th to 14th, which was organized by the Center for Chemistry in collaboration with Chemikum, the Philipps University of Marburg and the company Elkamet. This year, 235 top pupils from 85 schools in Hesse applied for the 16 places. The participants had the opportunity to carry out experiments on the topics of renewable energy and hydrogen for several days in the laboratories of the participating groups (Prof. Gerhard, Gottfried, Volz and Witte) and to get to know and use modern laboratory equipment. At the end, the pupil groups presented their results in a poster competition. The award and the related recognition of their teaching efforts. In this context, he gratefully thanks all coworkers in the Physik-Praktikum and at the department for their support, especially with view on the extremely intensive phases during the peak of the Covid pandemic.

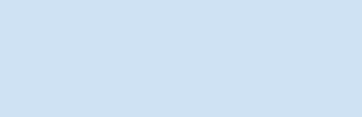
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Summer Party

During the summer semester, the student council invited the faculty to the annual summer party. With great weather, members from all student groups came together and there was grilling, chatting and fun. After a long hiatus, the Patmy Award for Outstanding Teaching was also finally awarded again to Josef Neuhäusl. Congratulations to Josef Neuhäusl! We are already looking forward to the next summer party at Renthof!

Im Sommersemester hat die Fachschaft den Fachbereich zum jährlichen Sommerfest eingeladen. Bei tollem Wetter kamen Mitglieder aus allen Statusgruppen zusammen und es wurde gegrillt, gesquatscht und endlich wieder der Patmy-Preis für herausragende Lehre vergeben. Herzlichen Glückwunsch an Josef Neuhäusl! Wir freuen uns schon auf das nächste Sommerfest am Renthof!



Experiments in physics practical course

In the physics practical courses, various experiments are offered to give students a clear understanding of physics topics and also to train experimental and evaluation skills such as the plotting of data, the comparison with reference data sets and the statistical evaluation of correlations. In the coming newsletters, we would like to present some examples of such experiments to give interested readers an insight into our experimental portfolio. In the current newsletter, we present the experiment "Fundamentals of X-Ray Radiation".

In den Physik-Praktika werden diverse Versuche angeboten, um den Studierenden physikalische Themen anschaulich näherzubringen und zudem Experimentier- und Auswertungskompetenzen auszubilden. Diese beispielsweise das Auftragen von Daten in einem gleich mit Referenzdatensätzen und die graphische Auswertung von Zusammenhängen. In den kommenden Newslettern möchten wir einige Beispiele für solche Experimente vorstellen, um interessierten Lesern und Leserinnen einen Einblick in unser Experimentierangebot zu geben. Im aktuellen Newsletter stellen wir das Experiment "Grundlagen der Röntgenstrahlung" vor.

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Excitons in organic materials: revisiting old insights with new insights (AG Witte)

The concept of excitons that was originally developed for inorganic materials also applies to organic materials without consideration of peculiar differences in the characteristics of optical excitations in these systems. To accurately capture the nature of excitons in organic materials, the groups of Prof. Witte and Prof. Cocchi (Oldenburg) carried out a combined experiment-theory study for the case of the prototypical organic molecule tetracene and perfluorotetracene. The groups performed detailed optical spectroscopy measurements in various states of matter, including isolated molecules in solution, poly- and single-crystalline samples, and even a melt, and complemented the results with modern state-of-the-art first-principles calculations based on density functional theory and many-body perturbation theory, which are summarized in a topical review. The employed methodologies offer unprecedented insights into the optical response of the systems, allowing them to clarify the single-particle character of the excitations in isolated molecules and the collective nature of the electron-hole pairs in the aggregated phases. The analysis shows in particular that quantum-mechanical interactions between the molecules are required to form an exciton, while semi-classical models accounting only for electrostatic couplings between the optically excited molecules and their environment are unable to reproduce their effects. This work is published in **Electronic Structure**.

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Energy transfer in organic/TMD hybrids (AG Malic/Witte/Gebhard)

Blayers of transition metal dichalcogenides are characterized by long-lived, spatially separated interlayer excitons. Provided strong interlayer tunneling, hybrid exciton states consisting of interlayer and interlayer excitons can be formed. Here, electrons and holes are in a superposition of both layers. Although crucial for optoelectronic applications, hybrid excitons are usually optically inactive and have therefore not yet been directly observed. Yet, based on microscopic and material-specific theory performed in AG Malic and collaboration with the Stephan Mathias (Göttingen), we show that time- and angle-resolved photoemission spectroscopy (ARPES) is a direct technique to visualize these hybrid excitons. Concretely, we predict a characteristic double-peak signal arising from the hybridized hole in the MoS₂ homobilayer. The relative intensity is proportional to the quantum mixture of the two hybrid valence bands at the Γ-point. Our study provides a concrete recipe for how to directly visualize hybrid excitons and how to distinguish them from the usually observed regular excitonic signatures. This work is published in **ACS Photonics**.

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Sequential order dependent dark-exciton modulation (AG Malic)

In this joint experiment-theory collaboration between Young Hee Lee (Sungkyunkwan University, South Korea) and AG Malic, we report the emergence of dark-excitons in TMD heterostructures with a representative stacking sequence. The feature stems from band nonlocalization and is distinct from those of typical neutral excitons or trions, regardless of materials, substrates, and even homogeneous bilayers, which is further confirmed by scanning tunneling spectroscopy. To understand the unusual scattering coefficients of a representative excitonic Elliot formula by imposing strain exclusively on the top layer that could be a consequence of the stacking process. We further find that the intensity ratio of dark and bright excitons in the same layer is inversely proportional to the laser power, and not to the incident light intensity. This can be a metric for engineering the intensity of dark excitons in TMD heterostructures, which could be