Prize Talk PV I Sun 18:45 HSZ 01

Die STAR TREK Physik: Warum die Enterprise nur 158 Kilo wiegt und andere galaktische Erkenntnisse — •Metin Tolan — TU Dortmund — Träger des Robert-Wichard-Pohl-Preises

Wie genau nehmen es die Macher von Star Trek eigentlich mit Physik und Technik? Erstaunlich genau! Schließlich rechnet der grünblütige Spock in Windeseile aus, dass genau 1.771.551 puschelige Tribbles in den Laderaum der Enterprise passen. Bedeutet diese Zahl etwas, oder ist sie einfach nur so dahingeschrieben? Wir werden sehen, dass alle Zahlen bei Star Trek eine Bedeutung haben und man überraschend viel wirklich aus den Angaben der Serie ausrechnen kann - bis hin zum Gewicht der Enterprise.

Plenary Talk PV II Mon 8:30 HSZ 01

Operating quantum states in single magnetic molecules — •Wolfgang Wernsdorfer — PHI and INT, Karlsruhe Institute of Technology, Germany

The endeavour of quantum electronics is driven by one of the most ambitious technological goals of today's scientists: the realization of an operational quantum computer. We start to address this goal by the new research field of molecular quantum spintronics, which combines the concepts of spintronics, molecular electronics and quantum computing [1]. The building blocks are magnetic molecules, i.e. well-defined spin qubits. Various research groups are currently developing low-temperature scanning tunnelling microscopes to manipulate spins in single molecules, while others are working on molecular devices (such as molecular spin-transistors, spin valves and filters, and carbon-nanotubebased devices) to read and manipulate the spin state and perform basic quantum operations. We will first discuss this - still largely unexplored - field and then summarize our first results [2-7]. Finally, we will discuss the new challenges of the field and the requirements to achieve them.

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[2] M. Urdampilleta, et al., Nature Mater., 2011, 10, 502.
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[7] M. Ganzhorn, et al., Nature Comm., 2016, 7, 11443.

Prize Talk PV III Mon 13:15 HSZ 01

Random matrix theory and growing interfaces in one dimension — •Herbert Spohn — Technical University Munich — Laureate of the Max-Planck-Medal

In 1986 Kardar, Parisi, and Zhang proposed a stochastic evolution equation for interface growth. Adding fourteen years, and more, unexpected connections to quantum integrability were discovered in the context of the 1+1 dimensional KPZ equation. My presentation will cover background material, experimental validation, and applications to non-integrable classical and quantum chains.

Lunch Talk PV IV Mon 13:15 HSZ 02

From the physics lab to production: Organic photovoltaics as a fascinating field for industry scientists — •Karsten Walzer — Heliatek GmbH, Treidlerstraße 3, D-01139 Dresden

Using the example of Heliatek GmbH, I will discuss possible career pathways in the young field of organic semiconductor industry. Heliatek is a technology pioneer in organic photovoltaics (OPV), which has been spun-off 10 years ago from two universities: TU Dresden and University of Ulm. Today, Heliatek is an Organic Photovoltaic company, integrating the complete value chain from material synthesis and research, to the point of roll to roll production, product development and commercialization. The OPV foils with the brand name HeliaFilm are ideal for building integrated photovoltaics, the next growing market in PV. We will take a closer look into the challenges that we had to face going from lab to fab, and in parallel look at the outcomes of different examples of research, development and production. The knowledge transfer from academia to industry will be discussed, as well as the chances for cooperation between industry with academic and non-academic partners.

Plenary Talk PV V Mon 14:00 HSZ 01

Electric Field Control of Magnetism — •Ramamoorthy Ramesh — University of California, Berkeley

Complex perovskite oxides exhibit a rich spectrum of functional responses, including magnetism, ferroelectricity, highly correlated electron behavior, superconductivity, etc. The basic materials physics of such materials provide the ideal playground for interdisciplinary scientific exploration. Over the past decade we have been exploring the science of such materials (for example, colossal magnetoresistance, ferroelectricity, etc) in thin film form by creating epitaxial heterostructures and nanostructures. Among the large number of materials systems, there exists a small set of materials which exhibit multiple order parameters; these are known as multiferroics. Using our work in the field of ferroelectric(FE) and ferromagnetic oxides as the background, we are now exploring such materials, as epitaxial thin films as well as nanostructures. We have been able to demonstrate electric field control of both antiferromagnetism and ferromagnetism at room temperature. Current work is focused on ultralow energy (1 attoJoule/operation) electric field manipulation of magnetism. We are also exploring artificially designed multiferroics. In this talk, I will describe our progress to date on this exciting possibility.

Plenary Talk PV VI Mon 14:00 HSZ 02

The Emergence and Evolution of Life Beyond Physics — •Stuart Kauffman — Biochemistry and Biophysics, University of Pennsylvania; The Institute for Systems Biology, Seattle

The emergence and evolution of life is based on physics but is beyond physics. Evolution is an historical process arising from the non-ergodicity of the universe above the level of atoms. Most complex things will never exist. Human hearts exist. Prebiotic chemistry saw the evolution of many organic molecules in complex reaction networks, and the formation of low energy structures such as membranes. Theory and experiments suggest that from this, the spontaneous emergence of self reproducing molecular systems could arise and evolve. Such *collectively autocatalytic systems* cyclically link non-equilibrium processes whose constrained release of energy constitutes *work*, to construct the same constraints on those non-equilibrium processes. Cells do work to construct the boundary conditions that give the constrained releases of energy by which work they construct themselves.

Such systems are living, and can propagate their organization with heritable variations, so can be subject to natural selection. In this evolution, these proto-organisms emerge unprestatably, and afford novel niches enabling, not causing, further types of proto-organisms to emerge. With this, unprestatable new functions arise. The ever-changing phase space of evolution includes these functionalities. Since we cannot prestate these ever new functionalities, we can write no laws of motion for this evolution, which is therefore entailed by no laws at all, and thus not reducible to physics. Beyond entailing law, the evolving biosphere literally constructs itself and is the most complex system we know in the universe.

Evening Talk PV VII Mon 20:00 HSZ 01

Magnetresonanz-Tomografie in Echtzeit — •Jens Frahm — Biomedizinische NMR Forschungs GmbH am Max-Planck-Institut für biophysikalische Chemie 37070 Göttingen

Die Magnetresonanz-Tomografie (MRT) zählt zu den wichtigsten bildgebenden Verfahren der medizinischen Diagnostik mit weltweit etwa 100 Millionen Untersuchungen im Jahr. Sie zeichnet sich durch eine nichtinvasive Darstellung der weichen Gewebe und eine hohe Empfindlichkeit gegenüber krankhaften Veränderungen aus. Die Patienten müssen jedoch bei der Untersuchung stillhalten und dynamische Vorgänge sind bisher nicht direkt messbar. Der Vortrag wird fundamentale Fortschritte vorstellen, die mittels Echtzeit-MRT einen völlig neuen Zugang zu bewegten Organen und physiologischen Prozessen ermöglichen. Filmaufnahmen mit bis zu 100 Bildern pro Sekunde eröffnen den direkten Blick auf das schlagende Herz ohne Synchronisation mit dem Elektrokardiogramm, der Blutfluss in den Gefäßen lässt sich unmittelbar verfolgen und Sprech- oder Schluckvorgänge werden erstmalig in voller Dynamik darstellbar. Der Vortrag wird die technische Lösung beschreiben, viele Beispiele aus dem Körper zeigen und einen Blick in die Zukunft werfen.

Plenary Talk PV VIII Tue 8:30 HSZ 01

Surface and tip-Enhanced Raman spectroscopy: From single molecule spectroscopy to angstrom-scale spatial resolution and femtosecond time resolution — •Richard Van Duyne — Northwestern University, Evanston, Illinois, USA

Four decades on, surface-enhanced Raman spectroscopy (SERS) continues to be a vibrant field of research that is growing (approximately) exponentially in scope and applicability while pushing at the ultimate limits of sensitivity spatial resolution, and time resolution. This Plenary Lecture will discuss three aspects of our recent research in SERS

and tip-enhanced Raman spectroscopy (TERS). First, some new experimental results on single molecule SERS, the distance dependence of SERS, deep-ultraviolet SERS, and the magnitude of the chemical enhancement mechanism. Second, some highlights of our recent work in ultrahigh vacuum (UHV)-TERS will be presented culminating in the demonstration of angstrom-scale spatial resolution. Finally, I will conclude with an update on our progress in electrochemical TERS and, if time permits, I will conclude with a discussion of our efforts toward SERS with femtosecond time resolution.

Prize Talk PV IX Tue 13:15 HSZ 01

Topological Insulators : a New State of Matter — •Laurens W. Molenkamp — Physikalisches Institut (EP 3), Universität Würzburg, Am Hubland, 97074 Würzburg, Germany — Laureate of the Stern-Gerlach-Medal

Topological insulators are a novel class of materials that exhibit a novel state of matter: while the inside (bulk) of the materials are electrically insulating, their surface is metallic. This effect occurs because the band structure of the materials is topologically different (in a mathematical sense) from the outside world. This talk describes our discovery of this type of behavior while studying the charge transport properties of MBE-grown layers of the narrow-gap semiconductor HgTe. As a more recent development, we describe how in these layers, a supercurrent is induced by contacting with Nb electrodes. AC investigations show strong evidence for the presence of a gapless Andreev mode in our junctions, a so-called Majorana mode.

Lunch Talk PV X Tue 13:15 HSZ 02

Als Physiker in einem Maschinenbau-Unternehmen — •Monika Mattern-Klosson — Leybold GmbH, Köln

Der Maschinenbau ist ein Branche, die heute ganz überwiegend von Ingenieuren dominiert wird. Dennoch gibt es spannende Tätigkeitsfelder, die für Physiker interessant sind und gute berufliche Perspektiven bieten. Am Beispiel der Leybold GmbH als Hersteller von Vakuumtechnik wird beleuchtet, welche Stärken Physiker in den Berufsalltag einbringen und welche Karrieremöglichkeiten es gibt. Außerdem wird dargestellt, welche Qualifikationen für den Berufserfolg relevant sind und welche zunächst unerwarteten Herausforderungen gemeistert werden wollen.

Prize Talk PV XI Tue 13:15 HSZ 03

Mikroelektronische Systeme zur Erzeugung und Charakterisierung eines Hochvakuums — •Moritz Kopetzki — Hochschule für angewandte Wissenschaften München — KETEK GmbH, München — Träger des Georg-Simon-Ohm Preises

Verkapselte mikroelektronische Systeme mit stabilem Hochvakuum eröffnen vielversprechende Anwendungsmöglichkeiten, z.B. neuartige Feldemissions-Elektronenquellen für mobile Röntgen-Fluoreszenz-Analyse-Geräte. In ein TO-Gehäuse der Firma KETEK wurden ein an der OTH Regensburg entwickeltes Mikro-Pirani-Vakuummeter (MPV) und eine an der Polytechnischen Universität Breslau entwickelte Mikro-Ionen-Getter-Pumpe (MIGP) integriert und das Modul mittels Vakuumlötverschluss verkapselt. Der Druck wurde mittels des MPV unabhängig von der Umgebungstemperatur und störenden thermischen Einflüssen, die durch den Betrieb der MIGP verursacht werden, ermittelt. Dies wurde durch die Verwendung eines MPVs mit Referenzwiderstand, einer zum Betrieb dieses MPVs entwickelten Schaltung und eines Druckberechnungsmodells erreicht. Die Druckauflösungsgrenze wurde mittels Kalibration des MPVs zu $5 \cdot 10^{-5}\,mbar$ bestimmt. Die MIGP ist die derzeit weltweit einzig verfügbare miniaturisierte Hochvakuumpumpe und basiert auf einer Gasentladung und der Bindung dabei entstehender Ionen (Restgasteilchen) in/an der Oberfläche. Die MIGP wurde mittels eines Hochspannungsmessplatzes mit und ohne Strombegrenzung betrieben und deren Auswirkungen auf i) den minimal erreichbaren Druck, ii) die dafür notwendige Abpumpzeit, iii) die Art der Entladung und iv) die Abhängigkeit des Ionenstroms vom Druck untersucht.

Plenary Talk PV XII Tue 17:30 HSZ 01

Molecular semiconductors for LEDs and solar cells: designing around the Coulomb interaction — •Richard Friend — Cavendish Laboratory, University of Cambridge, UK

Pi-conjugated organic molecules and polymers now provide a set of well-performing semiconductors that support devices, including light-emitting diodes (LEDs) as used in smart-phone displays and lighting, field-effect transistors (FETs) and photovoltaic diodes (PVs). These are attractive materials to manufacture, particularly for large-area applications where they can be processed by direct printing, so that the cost of materials and processing can be very low. This practical success is made possible by breakthroughs in the understanding and engineering of the underlying semiconductor science. The physics of organic semiconductors is often controlled by large electron-hole Coulomb interactions and by large spin exchange energies. Management of excited state spin is fundamental for efficient LED and solar cells operation. I will discuss in particular recent progress in the control of emissive spin singlet excited states and non-emissive spin triplet excited states.

Plenary Talk PV XIII Wed 8:30 HSZ 01

Characterization of Biological Photoreceptors in Space and Time — •Peter Hegemann — Humboldt-Universität zu Berlin

Biological sensory photoreceptors are families of proteins that can be studied with unprecedented precision in space and time. Excited state dynamics, chromophore isomerization and electron transfer reactions, as well as inactivation processes are studied on rhodopsins with retinal chromophores or LOV and BLUF-proteins with flavin chromophores by UV/Vis, Raman and IR spectroscopy on fs to ps time scales. Proton transfer reactions, hydrogen-network changes and structural changes can nowadays also be studied on fs to second time scales, whereas ion transport or catalytic activities are monitored on microsecond to second scales by biochemical or electrical methods. By employment of these technologies in conjunction with protein engineering and theoretical calculations my group in collaboration with many colleagues has deciphered or at least enlightened the reaction mechanism of light-gated ion channels, light-driven pumps, and photo-activated guanylyl/adenolyl cyclases. These proteins are widely applied in the neurosciences for activation or deactivation of selected neurons in large neuronal networks as the animal brain (Optogenetics).

Prize Talk PV XIV Wed 13:15 HSZ 01

Functional domain walls in multiferroic oxides — •Dennis Meier — Department of Materials Science and Engineering, NTNU, Trondheim, Norway — Laureate of the Gustav-Hertz-Prize

Oxide materials exhibit a broad range of tunable phenomena, including magnetism, multiferroicity, and superconductivity. Oxide interfaces are particularly intriguing. The low local symmetry combined with the sensitivity to electrostatics and strain leads to unusual physical properties beyond the bulk properties. Recently, ferroelectric domain walls have attracted attention as a novel type of oxide interface. These walls are spatially mobile and can be created, moved, and erased on demand. The additional degree of flexibility enables domain walls to take an active role in future devices and hold a great potential as multifunctional 2D systems for nanoelectronics.

In my talk I will discuss unique features that occur at ferroelectric domain walls in multiferroic oxides. In the first part, I will address geometrically driven charged domain walls in hexagonal manganites and show how their local electronic properties can be optimized and controlled. In the second part, I will consider domain walls in spin-spiral multiferroics with strong magnetoelectric couplings and additional functionality that arises from the interplay of charge and spin degrees of freedom. The goal is to provide insight into the exotic and fascinating physics at domain walls in multiferroics and their great application potential for next-generation devices.

Lunch Talk PV XV Wed 13:15 HSZ 02

Physics Crossing Boundaries: From Nanoscience to Bio and IT Spin-Off Companies and a New Open-Access Journal — •Richard Palmer — Editor-in-Chief, Advances in Physics: X, Taylor & Francis Group, Milton Park, Oxford OX14 4RN, UK

Physics lies at the intellectual heart of science and technology, but some of its greatest achievements derive from crossing over traditional boundaries. To be a little poetic, it is a fertile tree which bears a multitude of fruits. In this talk I will share some experiences of translating my basic physics research, specifically nanoscale physics, into a variety of advanced technology sectors - early stage cancer detection, semiconductor device fabrication, novel catalyst production - via the creation of spin-off companies and international licensing. I will also talk about the creation of a new, open access journal, Advances in Physics: X (launched 2016, but related to the Philosophical Magazine, published since 1798), whose aims are to demonstrate the connectivity of Physics, i.e. the intellectual relationships between one branch of Physics and another, and the pervasiveness of Physics, that is, the influence of Physics across (hence the *X*) the boundaries into other disciplines, including chemistry, materials science, engineering, biol-

ogy and medicine. Thus the journal seeks to promote the centrality of Physics and physical measurement, defending the discipline and revealing both its richness and its impact.

Plenary Talk PV XVI Wed 14:00 HSZ 01

Networks powered by quantum entanglement: from the first loophole-free Bell test to a quantum Internet — •Ronald Hanson — QuTech and Kavli Institute of Nanoscience, Delft University of Technology

Entanglement - the property that particles can share a single quantum state - is arguably the most counterintuitive yet potentially most powerful element of quantum physics. Future quantum networks may harness the unique features of entanglement in a range of exciting applications, such as quantum computation and simulation, secure communication, enhanced metrology for astronomy and time-keeping as well as fundamental tests of nature. To fulfill these promises, a strong worldwide effort is ongoing to gain precise control over multi-particle nodes and to wire them up using quantum-photonic channels. Diamond spins associated with NV centers are promising building blocks for such a network as they combine a coherent electron-optical interface [1] (similar to that of trapped atomic qubits) with a local register of robust and well-controlled nuclear spin qubits [2].

Here I will introduce the field of quantum networks and present an overview of the latest progress, including the first loophole-free violation of Bell s inequalities [3,4] and the first primitive network experiments on a pair on spatially separated two-qubit nodes.

Plenary Talk PV XVII Wed 14:00 HSZ 02

The Statistical Mechanics of Active Matter — •Michael Cates — DAMTP, University of Cambridge, Wilberforce Road, Cambridge CB3 0WA, UK

In active matter, the local dynamics of individual particles is maintained far from equilibrium by a continuous conversion of fuel into motion. Examples include swimming bacteria and a class of synthetic colloidal swimmers in which a fuel bath and/or light field maintains self-propulsion. Such systems can show new forms of collective behaviour arising from the absence of microscopic Time Reversal Symmetry (TRS). An example is the motility-induced phase separation (MIPS) into dense and dilute phases for swimmers whose only interaction is a hard-core repulsion. (This contrasts with equilibrium systems which only phase-separate when attractions are present). In cases where swimming is light-activated, these collective effects might be exploitable in the directed assembly of swimming colloids into functional microfluidic devices.

I will discuss the above phenomena, and then describe how the physics of broken TRS can be incorporated into stochastic field theories of the Cahn-Hilliard type. An important question is whether the entropy production of individual particles survives coarse-graining, or whether it ceases to have any important effects at large length scales, so that the system is equivalent to an equilibrium one with shifted parameters (e.g., an effective attraction in the case of MIPS). This is a difficult question: I will describe some first steps towards answering it.

Prize Talk PV XVIII Wed 15:00 HSZ 04

Magnon transport in spin textures — •Helmut Schultheiss — Helmholtz-Zentrum Dresden-Rossendorf, Institute of Ion Beam Physics and Materials Research, Bautzner Landstrasse 400, 01328 Dresden, Germany — Laureate of the Walter-Schottky-Prize

One of the grand challenges in cutting edge quantum and condensed matter physics is to harness the spin degree of electrons for information technologies. While spintronics, based on charge transport by spin polarized electrons, made its leap in data storage by providing extremely sensitive detectors in magnetic hard-drives, it turned out to be challenging to transport spin information without great losses. With magnonics a visionary concept emerged: Utilize magnons - the excitation quanta of the spin system in magnetically ordered materials - as carriers for information. Magnons are waves of the electrons* spin precessional motion. They propagate without charge transport and its associated Ohmic losses, paving the way for a substantial reduction of energy consumption in devices. In this presentation, I will present our recent highlights on magnon propagation and manipulation in non-collinear spin textures. In particular, I will outline how magnons can be steered in magnetic microstructures by locally generated magnetic fields [1] and how magnetic domain walls serve as magnon nanochannels [2].

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[2] K. Wagner, et al., Nature Nanotech. 11, 432 (2016).

Plenary Talk PV XIX Thu 8:30 HSZ 01

Model systems in heterogeneous catalysis at the atomic level — •Hans-Joachim Freund — Fritz-Haber-Institut der Max-Planck-Gesellschaft, Faradayweg 4-6, 14195 Berlin, Germany

Thin single crystalline oxide films (1) comprize perfect supports to grow nanoparticles of metals and other catalytically relevant materials. The model systems thus created can be thoroughly investigated with respect to structure and/or chemical activity applying techniques of surface science under ultrahigh vacuum conditions as well as the traditional techniques applied in catalysis to study chemical kinetics under ambient conditions. It is possible to image active sites at the metal nanoparticles, oxide interface and relate this directly to variations in the electronic structure. While oxide films are prepared as single crystalline films in order to clearly report on structure-reactivity relationships, we have demonstrated for the case of a silica film that, both its crystalline as well as vitreous structure could be atomically resolved opening avenues to investigate heterogenized homogeneous catalysts, which are often based on amorphous silica supports.

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Prize Talk PV XX Thu 13:15 HSZ 01

Exotic Spin-Orbital Order in Transition Metal Oxides — •Andrzej M. Oles — Marian Smoluchowski Institute of Physics, Jagiellonian University, prof. S. Łojasiewicza 11, Krakow, Poland — Max Planck Institute for Solid State Research, Stuttgart, Germany — Laureate of the Smoluchowski-Warburg-Prize

Strong Coulomb interactions in transition metal oxides suppress charge fluctuations and lead to spin-orbital entanglement in superexchange which has numerous consequences for magnetic and optical properties of Mott insulators [1]. Here we consider: (i) nematic order in the 2D compass model at finite temperature [2]; (ii) entanglement spectra controlling quantum phase transitions [3]; (iii) charge defects in doped $Y_{1-x}Ca_xVO_3$ with robust spin-orbital order and soft kinetic gap within the defect band [4]; (iv) orbital dilution for d^3 (Mn^{4+}, Cr^{3+}) impurities in $(Ca,Sr)_2RuO_4$, and (v) charge dilution due to hole-doublon pairs for d^2 doping. We show that orbital dilution (iv) modifies locally or even globally spin-orbital order [5]. For charge dilution (v) intersite excitations on the d^4-d^2 hybrid bonds generate $T_i^+T_j^+$ terms responsible for enhanced quantum fluctuations. Our findings are expected to be of importance for future experimental and theoretical studies of correlated Mott insulators with impurities.

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Lunch Talk PV XXI Thu 13:15 HSZ 02

Berufsbild Physiker(in) ausserhalb universitärer und industrieller Forschung — •Udo Weigelt — Grünecker Patent- und Rechtsanwälte PartG mbB, München

Es wird ein Überblick über die Möglichkeiten für Physiker(innen) ausserhalb der universitärer und industriellen Forschung gegeben. Ein Schwerpunkt werden hierbei die Möglichkeiten für Physiker(innen) im gewerblichen Rechtschutz sein.

Prize Talk PV XXII Thu 13:15 HSZ 03

Controlling Light Fields with Mie-Resonant Dielectric Metasurfaces — •Isabelle Staude — Friedrich Schiller University, Jena, Germany — Laureate of the Hertha-Sponer-Prize

High-refractive-index dielectric nanoresonators can support strong multipolar Mie-type resonances while exhibiting very low absorption losses at optical frequencies. Using the capabilities of modern nanotechnology, these resonances can be tuned by the size, shape, material composition, and environment of the nanoresonators. Thus, carefully designed dielectric nanoresonatos can be employed as building blocks of resonant metasurfaces with tailored linear and nonlinear optical properties. This talk will review our recent advances in light-field control with dielectric metasurfaces using silicon nanodisks as nanoresonators. It will focus on metasurfaces designed to impose a spatially variant phase shift onto an incident light field, thereby providing control over

its wave front. Based on the simultaneous excitation of electric and optically-induced magnetic dipole resonances, the nanoresonators can be tailored to emulate the behavior of the forward-propagating elementary wavelets known from Huygens' principle. This concept allows for the experimental realization of metasurfaces with high transmittance efficiency, full phase coverage, and a polarization insensititve response at telecom frequencies. Various examples of wavefront control will be discussed, including beam shaping and holographic imaging.

Plenary Talk PV XXIII Thu 14:00 HSZ 01

Bottom-up fabrication of graphene nanoribbons: From molecules to devices — •Roman Fasel — Empa, Swiss Federal Laboratories for Materials Science and Technology, Überlandstrasse 129, 8600 Dübendorf, Switzerland

Graphene nanoribbons (GNRs) are promising candidates to overcome the low on/off-behaviour of graphene - a zero band gap semiconductor - while still preserving high charge carrier mobility that is essential for the fabrication of efficient field effect transistors. It has been shown that atomically precise GNRs can be fabricated by an on-surface synthesis approach [Nature 466, 470 (2010)]. This versatile method has been successfully applied to the fabrication of armchair GNRs (AGNRs) of different widths - and thus different band gaps - as well as more complicated structures like chevron GNRs or heterojunctions [Adv. Mater. 28, 6222 (2016)]. Most recently, it has also been extended to afford the fabrication of GNRs with zigzag edges (ZGNRs), which are predicted to exhibit spin-polarized edge states.

In a first part of this presentation, I will briefly review the on-surface synthesis approach to GNRs and discuss some recent additions to the family of GNRs including atomically precise 6-ZGNRs [Nature 531, 489 (2016)], GNRs with chiral or cove edges, as well as GNR heterostructures incorporating tunable quantum dots. In the second part, I will address some of the challenges related to the technological application of GNRs, in particular regarding GNR fabrication scalability and device fabrication. Recent results on GNR field effect transistors with high performance will be discussed.

Plenary Talk PV XXIV Thu 14:00 HSZ 02

Novel Phase Change Materials by Design: The Mystery of Resonance Bonding — •Matthias Wuttig — RWTH Aachen, I. Physikalisches Institut, Aachen, Germany — JARA-FIT Institute Green IT, Forschungszentrum Jülich GmbH and RWTH Aachen University, 52056 Aachen, Germany

Phase change media utilize a remarkable property portfolio including the ability to rapidly switch between the amorphous and crystalline state, which differ significantly in their properties. This material combination makes them very attractive for data storage applications in rewriteable optical and electronic data storage. This talk will discuss the unique material properties, which characterize phase change materials. In particular, it will be shown that only a rather small group of materials utilizes resonant bonding, a particular flavor of covalent bonding, which can explain many of the characteristic features of phase change materials. This insight is employed to predict systematic property trends and to explore the limits in stoichiometry for such memory applications. It will be demonstrated how this concept can be used to tailor the electrical and thermal conductivity of phase change materials. Yet, the discoveries presented here also force us to revisit the concept of resonant bonding and bring back a history of vivid scientific disputes about the nature of the chemical bond. Interesting enough, among the materials showing 'resonant bonding' are also well-known thermoelectrics as well as topological insulators.

Plenary Talk PV XXV Fri 8:30 HSZ 01

The European XFEL - Status and first commissioning results — •Hans Weise — DESY, Hamburg, Deutschland

The European X-ray Free-Electron Laser (XFEL) under construction in Hamburg, Northern Germany, aims at producing X-rays in the range from 260 eV up to 24 keV out of three undulators that can be operated simultaneously with up to 27,000 pulses per second. The FEL is driven by a 17.5 GeV superconducting linac. The linac is the worldwide largest installation based on superconducting radio-frequency acceleration. The design is using the so-called TESLA technology which was developed for the superconducting version of an international electron-positron linear collider. The Installation of this linac is now finished and commissioning was started. First lasing is expected for spring 2017. The contribution summarizes the status of the project. First results of the linac commissioning are given.