Plenary Talk PV I Mon 8:30 H1

Merging light with nanoparticles: artificial molecules, photocatalysis, cancer therapy, and solar steam — •Naomi J. Halas — ECE Department, Rice University, Houston, USA

Metallic nanoparticles, used since antiquity to impart intense and vibrant color into materials, have more recently become a central tool in the nanoscale manipulation of light. This interest has led to a virtual explosion of new types of metal-based nanoparticles and nanostructures of various shapes and compositions, and has given rise to new strategies to harvest, control, and manipulate light based on metallic nanostructures and their properties. As one begins to assemble metallic nanoparticles into useful building blocks, a striking parallel between the plasmons- the collective electronic oscillations- of these structures and wave functions of simple quantum systems is universally observed. Plasmon hybridization, the electromagnetic analog of molecular orbital theory, enables us to envision these structures as "artificial molecules". These nanoscale principles apply as we move from noble metals to more sustainable materials, such as Aluminum or carbon, that also support plasmon resonances. The inherently large optical absorption and scattering cross sections of these materials enable strong light-matter interactions and new functionalities: hot electron generation for photo-activated processes, and strong photothermal effects that can be used successfully for cancer therapy. Just as the principles of optics span a universe of applications, we find that the same photothermal effects responsible for nanoparticle-based cancer therapy can also be exploited for generating steam without the need to boil water. This effect provides a direct method for harnessing sunlight to drive physicochemical processes, such as distillation, without the need for conventional power sources.

Prize Talk PV II Mon 13:15 H15

Diffractive imaging from multiple near-field diffraction intensities — •Lars Lötgering — Institute for X-Optics, RheinAhrCampus Remagen - Joseph-Rovan-Allee 2, 53424 Remagen, Germany — Laureate of the Georg-Simon-Ohm-Prize

Throughout the past decade the optics community witnessed the development of various diffractive imaging modalities that recover microscopic information from diffraction data without the use of focusing refractive or diffractive lenses. Here we present a diffractive imaging method that utilizes correlation in near-field diffraction patterns to provide data redundancy from which object information is extracted. An increase in resolution is achieved by means of a cross-correlation based image registration procedure which enlarges the effective numerical aperture of the experimental setup. No a priori knowledge or scanning of the object is necessary as opposed to coherent diffractive imaging or ptychography.

Special Talk PV III Mon 13:15 H2

Perspectives in Scientific Communication: Publishing in Transition — •Alexander Grossmann — HTWK Leipzig and ScienceOpen

How will scientific publishing develop in the 21st century? How can the network generation foster academic discourse and interaction between researchers? Do we still need scholarly journals in the future to communicate about research? Over the last decades topics such as journal impact factor, academic fraud, non-transparent peer review and serial crisis have more and more dominated the discussion. However the digital revolution has already begun to change the rules. New topics such as article-level metrics, post-publication peer review and Open Access have emerged. Open Access is becoming publicly mandated in the US and EU, encouraging researchers to submit their work to open servers or subject repositories such as arXiv. Open or post-publication peer review are a new buzz words to use crowd-sourcing to evaluate scientific research more openly. It is therefore essential not only for early career scientists to have a good overview of the changing publishing landscape. Moreover researchers have to explore the ways in which the speed and network character of the internet breaks down old categories of scholarly publishing and creates new ways of communicating scientific results.

Plenary Talk PV IV Mon 14:00 H1

Recent Advances and Opportunities in Electron Microscopy of Materials — •Ulrich Dahmen — National Center for Electron Microscopy, Molecular Foundry, Berkeley, USA

The development of aberration correction for electron microscopy has greatly increased our ability to characterize materials at the atomic scale. The current resolution limit of 0.5Å is now available in a number of advanced instruments around the world. First achieved in 2009 under the TEAM project, this advance has enabled remarkable new science and opened extraordinary opportunities for development and discovery. After briefly describing some of the underlying new technologies such as electron-optical elements, stages, software and detectors, their impact on materials characterization will be highlighted with examples of recent applications at NCEM. These will include tomography, mechanisms and dynamics, observation of beam-sensitive materials, liquid cell microscopy, and high-precision measurement of atomic positions at interfaces in materials. Such observations will be placed in context by highlighting important historical developments and breakthroughs. Looking beyond the current state of the art, this talk will also outline some important opportunities for further developments and innovation in electron microscopy.

Plenary Talk PV V Mon 14:00 H15

From patterns to function in living systems: dryland ecosystems as a case study — •Ehud Meron — Ben-Gurion University of the Negev, Beer-Sheva, Israel

Dryland landscapes show a variety of vegetation pattern-formation phenomena; banded vegetation on hill slopes and nearly hexagonal patterns of bare-soil gaps in grasslands ("fairy circles") are two striking examples. Vegetation pattern formation is a population-level mechanism to cope with water stress. It couples to other response mechanisms operating at lower and higher organization levels, such as phenotypic changes at the organism level and biodiversity changes at the community level, and plays a crucial role in understanding ecosystem response and ecosystem function in changing environments. In this talk I will present a platform of mathematical models for dryland ecosystems and describe some of the ecological questions we have studied using this platform. I will discuss the mechanisms that destabilize uniform vegetation and lead to periodic vegetation patterns, the variety of extended and localized patterns that can appear along a rainfall gradient, the impact of pattern formation on critical state transitions (regime shifts), pattern-induced species coexistence, and restoration of degraded landscapes as a spatial resonance problem. I will conclude with a discussion of two open problems, the coupling between pattern formation and biodiversity, and the reconciliation of human intervention and ecological integrity in disturbed ecosystems.
Reference: Ehud Meron, Nonlinear Physics of Ecosystems, CRC Press 2015.

Plenary Talk PV VI Tue 8:30 H1

Linking Individual to Collective Behavior in Complex Adaptive Networks — •Jorge M. Pacheco — Departamento de Matemática e Aplicações, Universidade do Minho, 4710 - 057 Braga, Portugal

A central problem in Physics is to understand how collective behavior results from a given two- or N- body fundamental interaction. Similarly, in a society, a central problem is to understand the link between individual social behavior and emergent collective phenomena (vaccination, epidemics, crowd behavior, diffusion of innovations, etc). Here I address this problem by letting individuals engage in pair-wise interactions by means of a well-defined social dilemma (a prisoners dilemma of cooperation). These individuals are embedded in a social network that is both complex and adaptive. Adaptation here allows individuals to manifest preferences and resolve conflicts of interest, reshaping the network accordingly. Exact Monte-Carlo simulations reveal the inadequacy of any of the tools developed to date (mostly in the realm of Physics) to predict the co-evolutionary dynamics of the population at large. I will present and discuss in detail an adaptive-network-sensitive observable that is capable of predicting the collective, population-wide dynamics, given prior knowledge of the fundamental rules that govern the social interaction between 2 individuals in a social network.

Prize Talk PV VII Tue 13:15 H1

Quantum Optics in Vacuum: The Casimir Effect — •Astrid Lambrecht — Laboratoire Kastler Brossel, CNRS, UPMC, ENS, Collège de France Campus Jussieu, 75005 Paris, France — Laureate of the Gentner-Kastler-Prize

The last 15 years have witnessed considerable changes in the topic of Casimir forces. Casimir physics has become an interdisciplinary research field gathering various fluctuation-induced phenomena. It unites today topics including quantum vacuum in cosmology, quantum and critical Casimir effects, the dynamical Casimir effect, atom-surface interactions in cold matter and Rydberg atoms and the role of van der

Waals forces in biological systems.

Considering two perfectly flat reflecting parallel plates at zero temperature, Casimir found in 1948 a simple universal expression for the quantum Casimir force. Since the late 1990s numerous experiments have tested precisely Casimir forces between plates and spheres, cylinders, nanostructured plates and atoms. At the same time the theory has been pushed intensively in order to take into account optical properties of the surfaces or particles used in experiments, finite temperature, the surface state and the experimental geometry, often very different from the ideal two plates situation.

The talk will present a quantum optical scattering approach to the theory of Casimir forces, which gives the electro-magnetic interaction between various objects (atoms, molecules, flat plates, nano-structured surfaces, nano spheres, etc) in a unified way. Some recent results on the quantum reflection of antihydrogen atoms on the Casimir potential above specifically designed matter slabs will also be given.

Prize Talk PV VIII Tue 13:15 H3

Energie und Klima: Cool Facts for a Hot Debate ? — •Christoph Buchal — Forschungszentrum Jülich und Universität zu Köln, D-52425 Jülich — Träger des Robert-Wichard-Pohl-Preises

Die gegenwärtige Diskussion um die Entwicklung des Klimas, um die energiebedingten Emissionen und um die Energiewende wird in der Öffentlichkeit, in den Medien und von der Politik mit großer Entschiedenheit, oft sogar mit unerbittlichem Sendungsbewusstsein geführt. Die gesicherte wissenschaftliche Faktenlage und die sehr komplexe globale Situation geraten dabei bisweilen aus dem Blick. Ein in zahlreichen Vorträgen praktizierter Ansatz zur Objektivierung der Diskussion mit Hilfe einer überzeugenden Hierarchie von Fakten wird vorgestellt. Auf diese Weise soll ein angstfreier, quantitativer und pragmatischer Umgang mit den Problemen und Erfolgen der Energieversorgung gefördert werden.

Special Talk PV IX Tue 13:15 H2

The German Research Foundation – a short overview — •Cosima Schuster and Michael Mössle — Deutsche Forschungsgemeinschaft, Bonn

The German Research Foundation (DFG) is the central funding organization for basic research in Germany. As a self-governing organization for science and research it offers a broad spectrum of funding opportunities from individual grants to larger coordinated programs. The scientific review of proposals submitted to the DFG is an integral part of the funding process.The talk will give an overview about the decision-making processes and the financial framework. Thereby, the evaluation criteria for the review reports and the tasks of the review boards (Fachkollegien) will be discussed in detail.

In the second part, funding programs will be presented. Within its portfolio, DFG supports early career scientists at every phase of the scientific qualification by appropriate programs. In particular, the postdoctoral research fellowship for a stay abroad and the Emmy-Noether-program will be discussed.

Plenary Talk PV X Tue 17:45 H1

The puzzle of Self-Assembly and the Self-Assembly of Puzzles — •Daan Frenkel — Department of Chemistry, U. Cambridge, UK

A holy grail of nano-technology is the creation of truly complex, multi-component structures by self-assembly.

Most self-assembly has focused on the creation of 'structural complexity' - the assembly of complex structures, using only a small number of distinct building blocks.

In my talk, I will discuss 'Addressable Complexity': the creation of structures that contain hundreds or thousands of distinct building blocks that all have to find their place in a 3D structure, like pieces in a jig-saw puzzle.

Simple model calculations allow us to understand the factors that control successful self-assembly.

Plenary Talk PV XI Wed 8:30 H1

Topological Physics in HgTe-based Quantum Devices — •Laurens W. Molenkamp — Physikalisches Institut (EP3), Universität Würzburg

Suitably structured HgTe is a topological insulator in both 2- (a quantum well wider than some 6.3 nm) and 3 (an epilayer grown under tensile strain) dimensions. The material has favorable properties for quantum transport studies, i.e. a good mobility and a complete absence of bulk carriers, which allowed us to demonstrate variety of novel transport effects.

One aspect of these studies is topological superconductivity, which can be achieved by inducing superconductivity in the topological surface states of these materials. Special emphasis will be given to recent results on the ac Josephson effect. I will present data on Shapiro step behavior that is a very strong indication for the presence of a gapless Andreev mode in our Josephson junctions.

Growing HgTe under compressive strain opens up yet another line a research - the material is readily turned into a topological (Weyl) semimetal, exhibiting clear signs of the Adler-Bell-Jackiw anomaly in its magnetoresistance.

Prize Talk PV XII Wed 13:15 H1

Topological Spin Textures in Chiral Magnets — •Christian Pfleiderer — Physik-Department, Technische Universität München, D-85748 Garching, Germany — Laureate of the Max-Born-Prize

Present day limitations of information technology based on magnetic materials may be traced to the notion that all magnetic materials known until recently display topologically trivial forms of long-range magnetic order. A new form of magnetic order composed of topologically non-trivial spin solitons driven by chiral spin interactions, widely referred to as skyrmion lattices in recognition of seminal theoretical contributions of British nuclear physicist Tony Skyrme, display several exceptional properties that offer unexpected new perspectives for the study of magnetic order and the challenges encountered in information technology. In particular, the non-zero topological winding number per magnetic unit cell implies enhanced stability, very efficient coupling to the conduction electrons in metallic systems by virtue of Berry phases, and very weak pinning by defects. Taken together these pave the way to sizeable spin transfer torque effects at ultra-low current densities. I will review the status of the research on skyrmions and related topological spin solitons in bulk compounds and thin films, focussing on similarities and differences with conventional magnetic materials.

Prize Talk PV XIII Wed 13:15 H15

Spontaneous symmetry breaking out of equilibrium: Kibble-Zurek mechanism in colloidal monolayers — •Peter Keim[1,2], Sven Deutschländer[1], Georg Maret[1], and Patrick Dillmann[1] — [1]University of Konstanz, Germany — [2]Laureate of the Gustav-Hertz-Prize

The Kibble-Zurek mechanism (KZM) describes the evolution of defects and domains when a system is forced through a phase transition with spontaneously broken symmetry. It is used to describe transitions on such different scales like the Higgs field in the early universe shortly after the Big Bang [1] or condensed matter systems like quenched quantum fluids [2]. Cooling at a finite rate, a domain structure naturally arises for a system with continuous phase transition. Due to critical slowing down, the system has to fall out of equilibrium in the vicinity of the transition for any non-zero cooling rate; at this so called fall out time, a fingerprint of critical fluctuations is taken. Within this picture, we investigate the non-equilibrium dynamics in a soft-matter analogue, a two-dimensional ensemble of colloidal particles which in equilibrium obeys the Kosterlitz-Thouless-Halperin-Nelson-Young melting scenario (KTHNY-theory). We show that the frozen-out length scale follows the prediction as function of the quench rate, if Kibble-Zurek mechanism is adopted to the KTHNY universality [3].

[1] T. Kibble, J. Phys. Math. Gen. **9** 1387 (1976) [2] W. Zurek, Nature **317** 505 (1985) [3] S. Deutschländer, P. Dillmann, G. Maret, P. Keim, Proc. Natl. Acad. Sci. **112** 6925 (2015)

Discussion PV XIV Wed 13:15 H2

A career in science: Should I stay or should I go? — •Martin Wolf — Fritz-Haber-Institut der MPG, Faradayweg 4-6, 14195 Berlin

Many younger scientists are highly motivated and love to tackle scientific problems. However, they are often unsure whether they should take the risk to stay in science and pursue a scientific career. In particular, the German science system is often regarded as being less transparent regarding possible career pathways and the criteria to be fulfilled to successfully obtain a permanent position in academia or other research institutions. This public discussion at the DPG spring meeting will not provide you with any "safe recipe" for how to make such a career. However, examples will be presented by several individuals, who made their career in the German science system and who will formulate what they believe to be important for that process. After this panel style discussion the floor is open for questions and statements by the audience.

Plenary Talk PV XV Wed 14:00 H1

Taming Molecules in Hybrid Nanosystems — •Jürgen P. Rabe — Department of Physics, Humboldt-Universität zu Berlin, Germany

Single molecules are precisely defined quantum objects, whose properties depend strongly on their immediate environment. Therefore hybrid nanosystems provide powerful means to control them. On the other hand, structure-property relationships of molecules in nanosystems are a key to understanding their function in biological systems and also to develop multi-functional artificial nanosystems. Here we report on the control over and with chain molecules and monoatomically thin crystals, i.e. quasi 1- and 2-dimensional macromolecules, which are highly flexible in solution while their conformation and their corresponding properties can be well defined in hybrid nanosystems. We have developed tools and platforms to correlate structure and dynamics in such systems with their properties. This includes ordered self-assembled monomolecular layers on an inert solid substrate, which can be used, e.g., to manipulate single macromolecules with scanning probes and light [1], a soft slit-pore from graphene and a solid substrate for ultrathin fluid films, which may serve as a nanoscopic test tube [2], and organic-inorganic hybrids based self-assembled molecular nanotubes with interesting opto-electronic and energy transfer properties [3]. [1] C.-L. Lee, T. Liebig, S. Hecht, D. Bléger, J.P. Rabe, ACS Nano 8 (2014) 11987. [2] N. Severin, J. Gienger, V. Scenev, P. Lange, I.M. Sokolov, J.P. Rabe, Nano Lett. 15 (2015) 1171. [3] Y. Qiao, F. Polzer, H. Kirmse, E. Steeg, S. Kühn, S. Friede, S. Kirstein, J.P. Rabe. ACS Nano 9 (2015) 1552.

Plenary Talk PV XVI Wed 14:00 H15

Antiferromagnetic spintronics — •Tomas Jungwirth — Institute of Physics ASCR, Cukrovarnicka 10, 162 00 Praha 6, Czech Republic and School of Physics and Astronomy, University of Nottingham, Nottingham NG7 2RD, UK

Interesting and useless - this was the common perception of antiferromagnets expressed explicitly, e.g., in the 1970 Nobel lecture of Louis Néel. Connecting to this traditional notion we can define antiferromagnetic spintronics as a field that makes antiferromagnets useful and spintronics more interesting. We will give an overview of this emerging field whose aim is to complement or replace ferromagnets in active components of memory, logic, or other spintronic devices. Antiferromagnetic materials are magnetic inside, however, the direction of their ordered microscopic moments alternates between individual atomic sites. The resulting zero net magnetic moment implies that if information was stored in antiferromagnets it would be invisible to common magnetic probes, insensitive to disturbing magnetic fields, and the antiferromagnetic element would not affect magnetically its neighbors no matter how densely the elements were arranged in a device. The intrinsic high frequencies of antiferromagnetic dynamics represent another property that makes antiferromagnets attractive alternatives to ferromagnets. Among the outstanding questions is how to efficiently manipulate and detect magnetic states of an antiferromagnet. In the lecture we will focus on electrical reading and writing of information, combined with robust storage, that has be recently realized in antiferromagnetic memories via relativistic quantum mechanics phenomena.

Evening Talk PV XVII Wed 18:00 H1

Max-von-Laue-Lecture: Nuclear Energy: Practical Realities and Significant Challenges — •Allison Macfarlane — George Washington University, Washington, USA

Nuclear energy tends to be a polarizing subject: you are either for it or against it. Putting debates aside, in 2016, there are practical realities associated with nuclear power: many countries use it (even Germany, though it will be phased out), many seem to want to acquire it (even though it is a 60-year-old technology), and all that have or will have it must develop a responsible way of managing its wastes. In this post-Fukushima environment, can nuclear power continue to be used safely? Given the threats of terror attacks, can it be used securely? Can "new entrants," countries that want to acquire nuclear power, do so safely? And can we develop a technically sound and politically acceptable solution to the waste problem? All of these areas must be addressed to ensure public health and safety.

Evening Talk PV XVIII Wed 20:00 H1

Vorhersagen sind schwierig ... Möglichkeiten und Grenzen von Klimamodellen — •Jochem Marotzke — Max-Planck-Institut für Meteorologie, Bundesstr. 53, Hamburg

Besonders schwierig sind Vorhersagen über eine Zukunft jenseits des menschlichen Erfahrungshorizonts, und um solche handelt es sich, wenn wir den Klimawandel bis zum Ende des 21. Jahrhunderts betrachten. Wir müssen uns dabei auf höchst abstrakte Werkzeuge verlassen, nämlich auf Klimamodelle. Dieser Vortrag wird die Möglichkeiten und Grenzen von Klimamodellen ausloten: Worauf basieren sie? Können wir ihren Ergebnissen vertrauen, und wenn ja, warum? Gibt es fundamentale oder praktische Grenzen ihrer Vertrauenswürdigkeit? Die Antworten liegen in grundlegenden Aspekten der Physik.

Plenary Talk PV XIX Thu 8:30 H1

Many body methods for materials: current status and future developments — •Georg Kresse — University of Vienna, Faculty of Physics, Austria

The properties of all materials arise from the quantum mechanics of their constituent electrons in the field of the nuclei. The solution of the underlying many-electron Schrödinger equation is a non-polynomial hard problem, owing to the interplay of the electron-electron repulsion and the Pauli exclusion principle. The dominant computational method for describing materials has been density functional theory, although this approach involves uncontrolled approximations.

Methods based on an explicit ansatz for the many-electron wavefunction are potentially more accurate and systematically improvable. This talk discusses recent breakthroughs covering quantum chemistry methods as well as many body perturbation theory. Results for a hierarchy of techniques ranging from low order perturbational methods over coupled cluster techniques, up to configuration interaction quantum Monte Carlo are presented for a variety of solids. As for molecular systems, coupled cluster methods are found to be very accurate for weakly correlated electrons, however, the steep increase of the computational cost makes predictions for materials still very time-consuming. Simpler methods that recover the important ingredients of the many electron solution, such as the random phase approximation to the correlation energy, are discussed alongside illustrative examples for important materials. I finish with an outlook on the challenges lying on the road towards validated first principles predictions.

Prize Talk PV XX Thu 13:15 H1

Morphometrie materieller Strukturen — •Herbert Wagner — LMU Theoretische Physik, Theresienstr. 37, 80333 München — Träger der Max-Planck-Medaille

Die autonome räumliche Aggregation der Materie erzeugt eine Hierarchie struktureller Muster, die sich von molekularen bis hin zu kosmischen Skalen erstreckt. Eine quantitative Beschreibung der geometrischen Form und des topologischen Zusammenhangs dieser Muster ermöglicht wichtige Rückschlüsse auf deren Evolution. Die Integralgeometrie stellt hierzu eine vollständige Familie von skalenfreien Meßgrössen (Quermaße, Minkowski-Funktionale) bereit, die in mathematisch wohldefinierter Weise Information über räumliche Korrelationen beliebig hoher Ordnung enthalten.

Am Beispiel der in den letzten Jahrzehnten erstellten Galaxienkataloge (z.B. Sloan Digital Sky Survey) werden die Quermaße und ihre Anwendung anschaulich erläutert. Der morphometrische Vergleich mit Modellsimulationen stützt die Hypothese, wonach die Evolution des Universums in der gegenwärtigen Epoche von "Dunkler Materie" und "Dunkler Energie" dominiert wird.

Prize Talk PV XXI Thu 13:15 H15

Microscopic view on ultrafast carrier dynamics in graphene — •Ermin Malic — Department of Physics, Chalmers University of Technology, Gothenburg, Sweden — Institut für Theoretische Physik, Technische Universität Berlin, Germany — Laureate of the Walter-Schottky-Prize

The continuing trend to miniaturization of devices in modern technology faces fundamental physical limits of applied materials. The search for novel structures with new functionalities has brought graphene, an atomically thin two-dimensional material, into the focus of current research. Its unique electronic properties exhibiting linear and gapless bands result in novel relaxation channels for electrons. In my talk, I will present the highlights of our recent research on the carrier dynamics in optically excited graphene. Performing microscopic time- and energy-resolved calculations in close collaboration with leading experimental groups, we have obtained novel insights into fundamentally intriguing and technologically promising ultrafast phenomena in graphene [1]. To give two examples, we have predicted (i) extremely efficient Auger scattering giving rise to a significant carrier multiplication - a many-particle effect that is promising for the design of highly efficient graphene-based photodetectors and (ii) the appearance of a

spectrally broad population inversion that can be exploited for the emission of coherent laser light even in the technologically challenging terahertz regime.

[1] Ermin Malic and Andreas Knorr, Graphene and Carbon Nanotubes: Ultrafast Relaxation Dynamics and Optics, Wiley-VCH (2013)

Special Talk PV XXII Thu 13:15 H2

What really matters - Einflussfaktoren auf den beruflichen Erfolg von Physikerinnen und Physikern — •Bettina Langfeldt — Helmut-Schmidt-Universität

Der Vortrag fokussiert auf ausgewählte Ergebnisse der vom Bundesministerium (BMBF) und dem Europäischen Sozialfonds (ESF) geförderten Studie "Geschlechterdisparitäten in Berufs- und Karriereverläufen von MathematikerInnen und PhysikerInnen innerhalb und außerhalb klassischer Beschäftigungsmodelle" mit Bezug auf den Wissenschaftsbereich als Tätigkeitsfeld. Im Mittelpunkt stehen Geschlechterdisparitäten in den Karriereverläufen von Physikerinnen und Physikern, die sich mit Bezug auf die individuellen sowie die organisationalen Einflussfaktoren ergeben. Folgende Fragestellungen sind dabei von besonderem Interesse: Zeigen sich hinsichtlich Karriereplanung, Aufstiegsorientierung und Nutzung unterschiedlicher Karrierestrategien bedeutende geschlechterbezogene Differenzen? Welche institutionellen Rahmenbedingungen üben den größten (geschlechterdifferenzierenden) Einfluss auf den Berufserfolg von Männern und Frauen in der Wissenschaft aus? Welche Gleichstellungsmaßnahmen existieren im akademischen Feld der Physik und wie werden diese von Physikerinnen und Physikern genutzt und beurteilt?

Plenary Talk PV XXIII Thu 14:00 H1

The future of computing — •Michelle Y Simmons — Centre of Excellence for Quantum Computation and Communication Technology, University of New South Wales, Sydney NSW 2052, Australia

Down-scaling has been the leading paradigm of the semiconductor industry since the invention of the first transistor in 1947. However miniaturization will soon reach the ultimate limit, set by the discreteness of matter, leading to intensified research in alternative approaches for creating logic devices. This talk will discuss the development of a radical new technology for creating atomic-scale devices which is opening a new frontier of research in electronics globally. We will introduce single atom transistors where we can measure both the charge and spin of individual dopants with unique capabilities in controlling the quantum world. To this end, we will discuss how we are now demonstrating atom by atom, the best way to build a quantum computer - a new type of computer that exploits the laws of physics at very small dimensions in order to provide an exponential speed up in computational processing power.

Plenary Talk PV XXIV Thu 14:00 H15

Single-Molecule Spectroscopy of Biomolecular Dynamics at the Nanoscale — •Ben Schuler — University of Zurich, Switzerland

Proteins are the most versatile constituents of the molecular machinery of life. Understanding their remarkable mechanisms of self-organization and their functional properties requires detailed knowledge of their structure and dynamics. Single-molecule spectroscopy provides an opportunity for investigating these properties on nanometer lengthscales and down to nanosecond timescales. By probing individual molecules, both structural and dynamic heterogeneity, which would be hidden in the ensemble average, can often be identified. Förster resonance energy transfer (FRET) combined with correlation spectroscopy, microfluidics, and the quantitative analysis of photon statistics enables us to probe distances, distance distributions, and both the equilibrium and non-equilibrium dynamics of biomolecules, even in complex environments, including live cells. A thorough understanding of the physics underlying biomolecular behavior is becoming accessible via the growing synergy of experiment with analytical theory and molecular simulations. I will present the basic conceptual and experimental ideas, and illustrate them with recent investigations of the dynamics, folding, assembly, and interactions of proteins in the context of their roles in living systems.

Evening Talk PV XXV Thu 17:30 H1

Lise-Meitner-Lecture: Ist Leben konstruierbar? — •Petra Schwille — Max-Planck-Institut für Biochemie, Am Klopferspitz 18, 82152 Martinsried

Obwohl uns die modernen Lebenswissenschaften und mit ihr die Biophysik täglich neue Informationen über die Moleküle und Wechselwirkungen liefern, die belebte Systeme ausmachen, können wir bis heute nicht sagen, mit welchen definierbaren Bestandteilen oder Eigenschaften die unbelebte Natur endet und die belebte beginnt. Einig ist man sich lediglich über den enormen Komplexitätsgrad des Lebens, der den anorganischer Systeme bei weitem übersteigt. Liegt der Schlüssel also in der Komplexität allein? Aber die Komplexität resultiert aus der fortwährenden Evolution, und die ersten Zellen, vor etwa 3 Milliarden Jahren, waren mutmaßlich sehr viel weniger komplex als selbst die einfachsten heutigen Organismen. Und so hoffnungslos ein Versuch wäre, „moderne" Zellen aus ihren Bestandteilen nachzubauen - die Konzeption einer „Urzelle" mit einem Minimum an Bauteilen und Funktionselementen scheint immerhin möglich, schließlich hat sie auch die Natur irgendwann hervorgebracht. Unser Ziel im Rahmen der Synthetischen Biologie ist es, lebende Systeme systematisch auf möglichst wenige fundamentale Funktionselemente herunter zu brechen, so dass diese Teilsysteme im Gegensatz zu den „natürlichen" Zellen überschaubar und in Gänze verstehbar sind. Hierbei sollen zunächst verschiedene essentielle Eigenschaften lebender Systeme, wie z.B. die Selbstreplikation, mit möglichst wenigen biologischen Funktionsmodulen wie Proteinen, Nukleinsäuren und Lipiden nachgebaut und quantitativ analysiert werden. Anhand des bakteriellen Zellteilungsapparats aus *E.coli* werde ich zeigen, dass wesentliche Selbstorganisations- und Musterbildungsphänomene am Beginn der Zellteilung mit verblüffend wenigen Komponenten im Reagenzglas reproduziert werden können.

Plenary Talk PV XXVI Fri 8:30 H1

Towards a Sustainable Energy System; the German Model — •Robert Schlögl — Fritz-Haber-Institut der Max-Planck-Gesellschaft, Berlin — Max-Planck-Institut für Chemische Energiekonversion, Mülheim a.d. Ruhr

The integration of fossil, biological and direct solar primary energy carriers into a system of sustainable, secure and affordable energy system for our human activities is a challenge for physics/chemistry as much as for societal considerations. The present status and the scale of the required transformations will be elucidated using the German energy system.

We derive from a systemic view onto this challenge[1] some critical achievements that have to be met by surface and interface science in order to arrive at the critical world scale solutions for interchanging free electrons and chemical bonds as energy carriers. The requirements for these achievements lead us back to rather old but unsolved fundamental questions in interface science.

[1]*R. Schlögl, Angew. Chem. Int. Ed. 2015, 54, 4436-4439.