Plenarvortrag PV I Mo 12:00 RW 1

Dunkle Materie — •Laura Baudis — University of Zurich, Zurich, Switzerland

Das Universum ist nur zu einem kleinen Teil direkt sichtbar. Ein grosser Teil besteht aus Materie, die weder im Sichtbaren, noch im UV-, Gamma-, Infrarot- oder Mikrowellenbereich strahlt. Aus Messungen der Rotationskurven von Galaxien, der Masse von Galaxienhaufen, der Verteilung der grossräumigen Strukturen, des kosmischen Mikrowellenhintegrundes und der Expansionsrate des Universum wissen wir, dass die sichtbare Materie, aus der Galaxien, Sonnen, Planeten und Menschen bestehen, etwa 4% des Gesamtinhaltes des Universum bildet. Der Rest ist "dunkel", und kann bisher nur indirekt, also über die Gravitationswechselwirkung enthüllt werden. Die dunkle Materie kann aus massereichen, noch unbekannten Teilchen bestehen, die in einer frühen Phase des Universums entstanden sind. Nach solchen Teilchen wird weltweit mit immer empfindlicheren Detektoren fieberhaft gesucht. Das Ziel ist, diese Teilchen über die elastische Streuung an Atomkernen eines terrestrischen Detektors, und über ihre Umwandlung in bekannten Teilchen in der Sonne, im galaktischen Zentrum und im Halo der Milchstrasse nachzuweisen. Nach einer Einführung in das Gebiet der dunklen Materie wird der gegenwärtige Stand der Forschung vorgestellt, mit besonderem Akzent auf die zur Zeit empfindlichsten Experimente und einem Ausblick in die Zukunft: welche Empfindlichkeiten werden benötigt, um die dunkle Materie Teilchen nachzuweisen, und was werden wir über das Universum lernen?

Plenarvortrag PV II Di 8:45 RW 1

Baryon Spectroscopy using CBELSA/TAPS at ELSA and the CLAS Spectrometer at Jefferson Laboratory — •Volker Crede — Florida State University, Tallahassee, FL 32306 USA

Nucleons are complex systems of confined quarks and gluons and exhibit the characteristic spectra of excited states. In particular, highly-excited states are sensitive to the details of quark confinement, which is only poorly understood within QCD. This is the non-perturbative regime of QCD and it is one of the key issues in hadronic physics to identify the corresponding relevant degrees of freedom and the effective forces between them. In recent years, lattice-QCD has made significant progress toward understanding the spectra of hadrons. On the experimental side, high-energy electrons and photons are a remarkably clean probe of hadronic matter. Laboratories worldwide have accumulated data for such investigations, resulting in a number of surprising discoveries and contributing to our understanding of the nucleon, its underlying quark structure, and the dynamics of the strong interaction. Current experimental efforts utilize highly-polarized frozen-spin (butanol) targets and deuterium targets in combination with polarized photon beams. These are important steps toward so-called complete experiments that will allow us to unambiguously determine the scattering amplitudes in the underlying reactions and to identify resonance contributions. In my talk, I will give an overview of the excited baryon program at ELSA using the CBELSA/TAPS experiment and at Jefferson Laboratory using the CLAS spectrometer. In particular, I will discuss recent results from the (double-)polarization experiments.

Hauptvortrag PV III Di 9:30 RW 1

Recent Results from the COMPASS Experiment — •Frank Nerling for the COMPASS-Collaboration — Physikalisches Institut, Universität Freiburg

The COMPASS experiment at the CERN SPS investigates the structure and spectrum of hadrons by scattering high energetic hadrons and polarized muons off various fixed targets. During the years 2002-2007, COMPASS focused on nucleon spin physics using 160 GeV/c polarised μ^+ beams on polarised deuteron and proton targets, including measurements of the gluon contribution to the nucleon spin using longitudinal target polarisation as well as studies of transverse spin effects in the nucleon on a transversely polarised target. One major goal of the physics programme using hadron beams is the search for new states, in particular the search for J^{PC} exotic states and glueballs. COMPASS measures not only charged but also neutral final-state particles, allowing for investigation of new objects in different reactions and decay channels. In addition COMPASS can measure low-energy QCD constants like, e.g. the electromagnetic polarisability of the pion. Apart from a few days pilot run data taken in 2004 with a 190 GeV/c π^- beam on a Pb target, showing a significant spin-exotic $J^{PC} = 1^{-+}$ resonance at around 1660 MeV/c^2, COMPASS collected high statistics with negative and positive 190 GeV/c hadron beams on a proton (H_2) and nuclear (Ni, Pb) targets in 2008 and 2009. We give a selected overview of the newest results and discuss the status of various ongoing analyses.

Hauptvortrag PV IV Di 10:00 RW 1

Finite Volume Methods for Hadron Resonances — •Michael Döring — Helmholtz-Institut für Strahlen- und Kernphysik, Universität Bonn, D-53115 Bonn

With the rapid progress of Lattice QCD, the spectrum of excited states starts to become into reach. This allows, for the first time, for an ab-initio test of the resonance spectrum. The extraction and analysis of resonances is a challenge due to lattice artefacts such as the finite lattice volume. As will be discussed, hadronic calculations in the framework of effective field theory are the only tool to connect lattice QCD results to the infinite volume, i.e. the physical limit. Such calculations can be used to predict lattice spectra, estimate their required accuracy, or in case data are available, to analyze them. In addition, changing the boundary conditions of the problem allows for a direct access to many resonances as will be discussed for some of the most interesting excited states, such as the $f_0(980)$, the $\Lambda(1405)$ and the broad scalar resonances.

Plenarvortrag PV V Di 11:00 RW 1

Quark-Gluon Plasma at the LHC — •Silvia Masciocchi — GSI, Darmstadt, Germany

After two years of very successful operation with lead beams at the LHC, the characterization of the Quark-Gluon Plasma, the deconfined state of matter produced now at unprecedented high-energy collisions of heavy ions, comprises many exciting results. I will discuss results for global observables which describe properties of the hot fireball, the study of energy loss in the medium for both light and heavy flavors, as well as heavy quarkonia. There are interesting news from the description of initial state fluctuations, and the modification of jets in the dense QGP. In addition, the comparison with previous results from heavy-ion collisions at lower energies helps the understanding of the matter believed to be existing few microseconds after the big bang. Finally, the LHC plans a significant increase of the collision rate for 2018-9. This opens fascinating perspectives of new physics reaches, extending the potential of the present experiments. I give a brief look into these exciting plans.

Hauptvortrag PV VI Di 11:45 RW 1

The QCD Phase Diagram: Results and Perspectives — •Jan M. Pawlowski — Universität Heidelberg, Heidelberg, Germany

I review the progress made in recent years with functional continuum methods in our understanding of the QCD phase diagram and its application to heavy ion collisions and astrophysics. Within this approach QCD correlation functions of quarks, gluon and hadrons are computed non-perturbatively from first principles. The approach has been used complementary as well as in combination with lattice computations, a particular strength being its applicability to the chiral limit and at finite density. In the past decades this has led to a plethora of quantitative as well as qualitative results for the hadronic mass spectrum, the confinement-deconfinement and the chiral phase transition, the role of fluctuations (non-Gaussianities) and the dynamics of QCD far from equilibrium.

In the present talk I will mainly concentrate on the phase structure of QCD at vanishing and finite temperature and density, including the effects of strong (chromo-) magnetic and electric fields such as present in heavy ion collisions. Specifically results are discussed for the order parameters of confinement-deconfinement and chiral phase transitions, the nature of these transitions and their interrelation, as well as the thermodynamics of QCD. The talk concludes with a discussion of the further prospects for our understanding of the phase structure of QCD.

Hauptvortrag PV VII Di 12:15 RW 1

Entropy Creation in Heavy Ion Collisions — •Andreas Schäfer — University of Regensburg, 93040 Regensburg, Germany

Extremely rapid isotopization and thermalization in Heavy Ion Collisions are crucial to deduce information on the QCD phase diagram from such reactions. Whether it occurs and in which respect (ideal thermalization being only an asymptotic limit for infinitely long times) is, therefore, one of the most important questions in this field. At the same time for theory it is an truly challenging question. QCD is time-reversal invariant such that information should be conserved and there should not be any entropy production prior to the experimental measurement process which occurs only long after the reaction is over. To the extend that AdS/CFT duality holds thermalization is equivalent to black-hole formation and the sketched problem is identical to the famous information problem in black-hole physics, where the consensus shifted in recent years towards the believe that information is conserved (implying that no entropy is produced) but that it is contained in quantum mechanical phases which cannot be accessed experimentally. We analyzed the problem of entropy production in high-energy heavy ion collisions with various approaches which all led to comparable conclusions: If the unavoidable coarse-graining imposed for any subsequent measurement by the uncertainty principle is taken into account, thermalization happens indeed on very short time scales (supported by BMBF).

Abendvortrag PV VIII Di 19:30 RW 1

Raumfahrt – Eine Kulturaufgabe? — •Gerhard Thiele — Resident Fellow am European Space Policy Institute (ESPI) in Wien

Preisträgervortrag PV IX Mi 11:20 RW 1

Aspekte physikdidaktischer Forschung und Entwicklung — •Volkhard Nordmeier — Freie Universität Berlin — Träger des Robert-Wichard-Pohl-Preises

Die Bandbreite physikdidaktischer Forschungs- und Entwicklungsprojekte reicht von Vorhaben zur empirischen Bildungsforschung bis hin zur Entwicklung und Erprobung von Medien und Experimenten für den Einsatz in Schule und Hochschule. Im Vortrag sollen anhand konkreter Beispiele Einblicke in aktuelle Projekte gegeben werden, die diese unterschiedlichen Aspekte fachdidaktischer Forschungs- und Entwicklungsarbeit betreffen.

Der Vortrag soll aber auch dazu anregen, neu über den Stellenwert einer modernen fachbezogenen fachdidaktischen Forschung nachzudenken.

Preisträgervortrag PV X Mi 11:50 RW 1

Physik weckt Emotionen — •Christian Heilshorn — Gymnasium Raabeschule, Braunschweig — Träger des Georg-Kerschensteiner-Preises

Was können Lehrkäfte tun, um eine Begeisterung für das Fach Physik zu wecken und zu erhalten?

Diese Grundsatzfrage ist Leitlinie des Grundschulprojekts "Physik für helle Köpfe", das mittlerweile von über 80 weiterführenden Schulen in Niedersachsen durchgeführt wird.

Unsere Antwort: Das "Wecken" muss möglichst früh und altersgerecht geschehen. Kinder im Grundschulalter sind besonders spontan und wollen vieles ausprobieren. Es bieten sich zwei Ansätze, die ihnen dafür zahlreiche Möglichkeiten an die Hand zu geben vermögen:

Die Welt des Lichts ist in besonderer Weise geeignet. Allein schon durch vielfältige Experimente mit ebenen Spiegeln erspielen sich die Kinder physikalische Zusammenhänge. Durch ihre natürliche Motivation, ihre Alltagserfahrungen zu überprüfen und zu erforschen, werden sie zu Entdeckern: Ihre Neugier generiert immer wieder neue Experimente.

Eine besondere Nähe zum Kerncurriculum für Grundschulen liefert das Akustik-Angebot "Strom macht Musik", welches im Sachunterricht des 4. Jahrgangs angesiedelt ist.

Das Projekt lebt nicht von den betreuenden Lehrkräften, sondern insbesondere mit den Betreuerinnen und Betreuern der Sek I. Am Gymnasium Raabeschule zeichnen sich diese durch ihre hohe Motivation und kommunikative Kompetenz aus. Hochmotivierte und engagierte "Lehrkräfte" - eine wichtige Erfahrung für die spätere Berufsfindung?

Plenarvortrag PV XI Mi 8:45 RW 1

Spectroscopy of Gravity with Ultra-Cold Neutrons — •Hartmut Abele — Atominstitut - Technische Universität Wien, Stadionallee 2, 1020 Vienna, Austria

This talk is about a test of gravitation at small distances by quantum interference. The method is based on a new spectroscopy technique, devoid of electromagnetic coupling. The quantum bouncing ball allows us to observe transitions between gravitational quantum states, when a Schrödinger-wave packet of an ultra-cold neutron couples to the modulation of a hard surface. The technique is related to Rabi spectroscopy usually used in atom optics, and the experiment has the potential to test the equivalence principle and Newton's gravity law at the micron scale, because Newtonian gravity and hypothetical fifth forces evolve with different phase information. Such forces can be mediated from gauge bosons propagating in a higher dimensional space and this experiment can therefore test speculations on large extra dimensions of sub-millimetre size of space-time or the origin of the cosmological constant in the universe, where effects are predicted in the interesting range of this experiment and might give a signal in an improved setup.

Hauptvortrag PV XII Mi 9:30 RW 1

Newest results on pygmy resonances in atomic nuclei — •Andreas Zilges — Institut für Kernphysik, Universität zu Köln

The Pygmy Dipole Resonance (PDR), a concentration of electric dipole strength in atomic nuclei at rather low excitation energies, has recently been the subject of numerous experimental and theoretical studies. Complementary experiments with electromagnetic and hadronic probes and state-of-the-art theoretical approaches have led to a differentiated view of this elementary excitation mode in nuclei. The present status will be reviewed and future experiments to resolve the remaining open questions will be discussed.

Supported by the DFG (ZI 510/4-1 and SFB 634).

Hauptvortrag PV XIII Mi 10:00 RW 1

New modes of low-energy excitations — •Nadia Tsoneva[1,2] and Horst Lenske[1] — [1]Institut für Theoretische Physik, Universität Gießen — [2]INRNE, BAS, Sofia, Bulgaria

Studies of electromagnetic response functions along isotopic and isotonic chains led to the surprising observation of new low-energy modes of nuclear excitations. They are carrying features which are very distinct from the surface vibrations and the giant resonances known from stable nuclei close to the N=Z line. Meanwhile, there are clear indications that these new modes are specific signals of nuclear skin oscillations which become visible in transition densities and currents. A theoretical method based on density functional theory and multiphonon approach is presented for investigations of nuclear excitations with different multipolarities and energies in stable and exotic nuclei. The relation of low-energy modes to neutron or proton skins is systematically investigated for isotonic and isotopic chains. Our studies of dipole and quadrupole response functions and the corresponding transition densities indicate new pygmy dipole and quadrupole modes. Also, the presence of skins is found to affect M1 strength distributions in nuclei. The results are compared to experimental data. The information on pygmy resonances reveals new aspects on the isospin dynamics of the nucleus with important astrophysical consequences. In this connection, cross sections in ^{86}Kr(γ, n) reaction are studied in order to probe the s-process branching at ^{85}Kr. The investigations contribute to the understanding of neutron-capture processes and the synthesis of heavy neutron-rich elements. Supported by BMBF project 06GI9109.

Plenarvortrag PV XIV Do 8:45 RW 1

Neutron-rich matter in the laboratory and the cosmos — •Achim Schwenk — TU Darmstadt/EMMI, Darmstadt, Germany

This talk will given an overview of strongly interacting matter at neutron-rich extremes and highlight the impact of three-body forces for neutron-rich nuclei and for matter in astrophysical environments.

Hauptvortrag PV XV Do 9:30 RW 1

Präzisionsmassenmessungen an ISOLTRAP für Kernstruktur- und Astrophysik — •Susanne Kreim für die ISOLTRAP Kollaboration-Kollaboration — CERN, Genf — Max-Planck-Institut für Kernphysik, Heidelberg

Penningfallen-Massenmessungen liefern u.a. für neutronenreiche Kerne schwerer als Blei hochpräzise Massenwerte, die uns Aufschluss über die Kernstruktur und Nukleosyntheseprozesse in dieser Region geben. Von besonderem Interesse ist hier der schnelle Neutroneneinfangprozess (r-Prozess). Änderungen in der Bindungsenergie, welche aus der Bestimmung der Masse extrahiert werden kann, geben Information über die im Kern wirkenden Kräfte. Mit dieser Motivation wurden Hochpräzisionsmassenmessungen an langen Isotopenketten von Rn, Fr und Ra mit ISOLTRAP durchgeführt, die im Vortrag mit theoretischen Vorhersagen verglichen werden.

Außerdem kann die in diesem Massenbereich stattfindende Kernspaltung zur Erklärung für ein Wiederaufleben des r-Prozess gereichen. Mit den sechs neuen, jüngst gemessenen Massen von Ra und Fr Isotopen können Betazerfallsenergien berechnet und deren Auswirkung auf den r-Prozess-Pfad untersucht werden. Es wird außerdem erwartet, dass die kürzlich am ISOLTRAP-Experiment bestimmte Masse und Halbwertszeit von Zn-82 eine große Auswirkung auf den r-Prozess um den Abschluss der Neutronenschale N=50 haben wird.

Hauptvortrag PV XVI Do 10:00 RW 1

Laserspektroskopie an relativistischen 209-Bi82+ und 209-Bi80+ Ionen am Speicherring ESR der GSI — •Christopher Geppert[1,2], Matthias Lochmann[1], Rodolfo Sanchez[1,2], Michael Hammen[1], Nadja Frömmgen[1], Elisa Will[1], Benjamin Botermann[1], Zoran Andjelkovic[1], Raphael Jöhren[3], Jonas Mader[3], Volker Hannen[3], Christian Weinheimer[3], Danyal Winters[2,4], Thomas Kühl[2], Yuri Litvinov[2], Thomas Stöhlker[2,4], Andreas Dax[5], Michael Bussmann[6], Weiqiang Wen[7], Richard Thompson[8] und Wilfried Nörtershäuser[1,2] — [1]Institut für Kernchemie, Universität Mainz — [2]GSI Helmholtzzentrum, Darmstadt — [3]Institut für Kernphysik, Universität Münster — [4]Physikalisches Institut, Universität Heidelberg — [5]Department of Physics, University Tokyo — [6]Helmholtz-Zentrum Dresden-Rossendorf — [7]IMP Lanzhou — [8]Imperial College, London

Die genaue Bestimmung der Hyperfeinstrukturaufspaltung (HFS) von hochgeladenen Ionen erlaubt im Abgleich mit theoretischen Berechnungen einen Test der QED. Die Messung an schweren und hochgeladenen Ionen erlaubt einen Test der QED in starken Feldern.

Im Rahmen der LIBELLE (E083)-Kollaboration am Helmholtzzentrum für Schwerionenforschung (GSI) wurden hierzu wasserstoff- und lithium-ähnliches Bismut bei Geschwindigkeiten von ß=0.7 im Speicherring ESR gespeichert und mittels Laserspektroskopie untersucht. Nach 12-jähriger Suche wurde nun erstmals der verbotene HFS-Übergang im lithium-ähnlichen Bismut gefunden.

Plenarvortrag PV XVII Do 11:00 RW 1

The FAIR Accelerator Complex: Challenges and Prospects — •Oliver Kester[1], Weinrich Udo[1], Spiller Peter[1], Eickhoff Hartmut[1], Krämer Dieter[2], Steck Markus[1], Groening Lars[1], Kollmus Holger[1], Knie Klaus[1], Jacoby Wolfgang[2], Hagenbuck Frank[1], Prasuhn Dieter[3], Maier Rudolf[3], and Winkler Martin[1] — [1]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany — [2]FAIR GmbH, Darmstadt, Germany — [3]Forschungszentrum Jülich, Jülich, Deutschland

The Facility for Antiproton and Ion Reserach - FAIR- is a new, unique international accelerator complex dedicated to the research with antiprotons and ions. FAIR employs heavy ion synchrotrons which will accelerate heavy ion beam with unprecedented intensities in order to generate intense secondary beams. These beams of rare isotopes or antiprotons will be collected and cooled for precision experiments. FAIR relies therefore on accelerator systems employing cutting edge technologies in magnet design, cryogenics, rf-cavities, beam cooling, beam instrumentation and extreme high vacuum etc. The challenges and prospects of this unique system are adressed and discussed.

Hauptvortrag PV XVIII Do 11:45 RW 1

Perspectives of QPACE and iDataCool — •Tilo Wettig — Department of Physics, University of Regensburg, 93040 Regensburg, Germany

I will review two recent high-performance computing projects that provide substantial compute power for lattice QCD at low cost while also addressing the growing concern about energy consumption of supercomputers. Both projects were done in close collaboration with IBM Germany. QPACE is a massively parallel machine based on the PowerXCell 8i processor, an enhanced version of the Cell processor used in the PlayStation 3. We developed a custom FPGA-based network that allows for efficient communication between nearest-neighbor nodes. QPACE was number 1 on the Green 500 list and thus the most energy-efficient supercomputer in the world in 2009 and 2010. iDataCool is a standard Linux cluster for which a hot-water cooling system was developed which allows for reuse of the waste heat generated by the computer. The concepts developed within iDataCool are implemented in the SuperMUC petascale machine to be installed at LRZ. I will also discuss how the lessons learned in our projects influence the design of future supercomputers aimed at exascale performance.

Hauptvortrag PV XIX Do 12:15 RW 1

ELENA - an upgrade to the CERN Antiproton Decelerator — •Walter Oelert — IKP, Forschungszentrum Jülich, 52425 Jülich representing the ELENA team

During more than 10 years of regular operation, the AD has supplied a successful physics program with low-energy antiproton beams.

For the medium and long-term future, several options exist for upgrades and consolidation of the facility as well as for extension of the physics program.

This presentation will deal with the design, construction and impact of the Extra Low ENergy Antiproton ring (ELENA) which has been approved lately. ELENA is a compact ring for cooling and further deceleration of the 5.3 MeV antiprotons delivered by the AD. A significant increase (between one and two orders of magnitude) in the antiproton trapping efficiency by the experiments is expected due to the efficient deceleration and the compensation of the adiabatic increase of the beam emittances obtained by using an electron cooler. In addition, a second extraction channel is foreseen, opening the possibility for the installation of further experiments in the AD hall.

Plenarvortrag PV XX Fr 8:45 RW 1

Quarkonium spectroscopy from lattice QCD — •Georg M. von Hippel — Institut für Kernphysik, Johannes-Gutenberg-Universität Mainz, 55099 Mainz, Germany

Lattice simulations remain the only known method to obtain a priori information about the spectrum of Quantum Chromodynamics (QCD). Recent progress both in theoretical formulations and algorithms now allows for the extraction of reliable information on the excited-state spectra of quarkonium. I will discuss some of the theoretical issues involved and review recent lattice results on both charmonium and bottomonium spectra, in particular also taking into account recent progress regarding the bottomonium hyperfine structure within non-relativistic QCD.

Hauptvortrag PV XXI Fr 9:30 RW 1

Hybrid Transport Models — •Hannah Petersen — Duke University, Durham, North Carolina, USA

In this talk, I will review the success of hybrid approaches based on microscopic transport and hydrodynamics to describe the dynamical evolution of relativistic heavy ion collisions. The equation of state is an explicit input in fluid dynamic calculations and therefore hydrodynamics provides a framework that allows the treatment of the phase transition to the quark gluon plasma. In microscopic transport approaches the non-equilibrium evolution of the whole phase-space distribution is taken into account. I will discuss, how a combination of the advantages of both approaches can be used to get a more consistent picture of the dynamics of heavy ion reactions. I will present selected results over the whole energy range from RHIC and LHC to future FAIR energies to illuminate the potential of hybrid approaches and outline future challenges. Specifically, I am going to concentrate on the importance of event-by-event descriptions to understand initial state fluctuations in relativistic heavy ion collisions.

Hauptvortrag PV XXII Fr 10:00 RW 1

Strangeness in Hadrons — •Concettina Sfienti — Johannes Gutenberg-Universität Mainz

The challenges of nuclear science have nowadays broadened and extends from fundamental particles - quarks and gluons - to the most spectacular of cosmic events like supernova explosions. At the energies characteristic for nuclear binding the strength and complexity of QCD complicate the understanding of the nuclear phenomena in terms of fundamental degrees of freedom.

The properties of baryon many-body systems, which contain not only nucleons but also hyperons with strangeness, link closely to the underlying hyperon-nucleon interaction. The hyperon offers a selective probe of the hadronic many-body problem as it is not restricted by the Pauli principle. As the study of any complex system, the inclusion of an impurity and the study of its subsequent propagation provides us with a way to reveal configurations or states that can not be reached other ways.

The physics of strangeness in hadronic systems is a constantly developing field with a large variety of production reactions, making use of precision coincidence measurements. It brings up new, often unexpected, results, new challenges and open questions. High precision studies of light Lambda hypernuclei, spectroscopy of double lambda-lambda nuclei are examples of the outstanding challenges for hypernuclei research in the next decade.