Plenarvortrag PV I Mo 11:15 Audimax

Neutron-rich nuclei: recent in-beam gamma spectroscopy results from the RIBF — •Alexandre Obertelli — IKP, TU Darmstadt, Germany

Neutron-rich nuclear systems reveal particular phenomena such as shell evolution, halos and neutron skins. Large efforts are being made worldwide to reach the most neutron-rich nuclei and investigate how their structure differ from stable ones, leading to stringent tests for the predictive power of state-of-the art nuclear structure models.

In this talk, results from a three-year gamma-spectroscopy campaign at the Radioactive Isotope Beam Factory (RIBF) of RIKEN in Japan, today's most powerful accelerator to produce neutron-rich nuclei, will be presented with a focus on the nuclear structure at and nearby 78Ni.

Plenarvortrag PV II Mo 12:00 Audimax

Demystifying the Quark-Gluon Plasma — •Ante Bilandzic — Physik-Department, Technische Universität München, James-Franck-Str. 1, 85748 Garching bei München, Germany

The primary objective of heavy-ion program at ultrarelativistic colliders is to explore the properties of a new state of matter, the Quark-Gluon Plasma (QGP), in which quarks and gluons move freely over distances that are large in comparison to the typical size of a hadron. Anisotropic flow, which measures the momentum anisotropy of final-state particles, is sensitive on the one hand to the initial density and to the initial geometry fluctuations of the overlap region, and on the other hand to the transport properties of the QGP.

In this talk an overview of anisotropic flow results so far in heavy-ion physics at Large Hadron Collider (both in Run 1 and Run 2) will be presented. Results in small collision systems (proton-proton and proton-lead) at various collision energies will be discussed as well in order to determine the onset of QGP formation, as a function of system size and energy. The technical aspects and foreseen improvements of multiparticle correlations, which are at the moment the primary analysis techniques used in anisotropic flow measurements, will be outlined. Discussion on other environments in which QGP can be produced, like for instance the core of neutron stars, will conclude the talk.

Plenarvortrag PV III Di 9:00 Audimax

Accelerator Challenges of FAIR Phase 0 — •Mei Bai, Ralph Baer, Christina Dimopoulo, Peter Gerhard, Lars Groening, Ralph Hollinger, Andreas Kraemer, Frank Herfurth, David Ondreka, Stephan Reimann, Marcus Schwickert, Mariusz Sapinski, Markus Steck, Sergy Litevinov, Jens Stadlmann, Peter Spiller, Klaus Tinschert, and Udo Weineich — Planckstrasse 1, Darmstadt

After two years shutdown, the GSI accelerators and the latest addition of storage ring CRYRING, will be back into operation in 2018 as the FAIR phase 0 with the goal to fulfill the needs of GSI/FAIR scientific community and the needs of FAIR accelerators and detector development. Even though GSI has been well known of a variety of ions beams ranging from proton up to uranium for the research in multi scientific areas such as nuclear physics, astrophysics, biophysics, material science, the upcoming beam time in 2018 faces a number of challenges in recommissioning its existing circular accelerators with brand new control system and significant upgrade of beam instrumentations, as well as in rising failures of dated components and systems. As the work horse for the past two decades, the cycling synchrotron SIS18 has been undergoing a set of upgrade measures for fulfilling future FAIR operation, among which many measures will also be commissioned during the upcoming beam time. This paper presents the highlights of the challenges such as re-establish the high intensity heavy ion operation as well as parallel operation mode for serving multi users. The status of preparation including commissioning results will also be reported.

Plenarvortrag PV IV Di 9:45 Audimax

Beta-detected NMR: radionuclides as probes in biophysics and biochemistry — •Magdalena Kowalska — ISOLDE, CERN, Geneva, Switzerland

In chemistry and biochemistry nuclear magnetic resonance (NMR) is currently the most versatile and powerful spectroscopic technique for characterization of molecular structure and dynamics in solution. However, one drawback of the method is its low sensitivity, leading to relatively large amounts of sample, posing constraints on the systems that may be explored.

Beta-detected NMR is an extremely sensitive type of NMR, which makes use of radioactive nuclei. It has been used very successfully in nuclear physics, where it allows determining with high precision magnetic and quadrupole moments of many exotic nuclei.

Our CERN-ISOLDE project aims at applying beta-NMR for the first time to liquid samples, allowing to study the interaction of different metal ions with biomolecules, such as proteins or nucleic acids. This technique, which relies on the anisotropic emission of beta-particles in the decay of spin-polarized nuclei allows reaching the ultimate limit in sensitivity. In addition, the spins are hyperpolarized using lasers, which results in polarizations of 10-100%. The combination of these two features gives over 10 orders of magnitude more sensitivity than conventional NMR.

This talk will cover the principles of the technique, the ISOLDE setup, and first biological studies and results.

Abendvortrag PV V Mi 20:00 HZO 40

Fusionsreaktionen – Die Energiequelle der Sonne und der Sterne auf der Erde nutzen — •Sibylle Günter — Max-Planck-Institut für Plasmaphysik, Garching

In gewissem Sinn ist Kernfusion die direkteste Nutzung der „Sonnenenergie“, denn ein Fusionskraftwerk soll – ähnlich wie die Sonne – Energie aus der Verschmelzung von Wasserstoffkernen gewinnen. Um eine ausreichende Anzahl von Fusionsreaktionen zu erzielen, müssen in einem künftigen Kraftwerk Temperaturen von ca. 200 Millionen Grad vorherrschen. Bei solch hohen Temperaturen bildet sich ein Plasma, ein Gas aus geladenen Teilchen. Plasmen können in Käfigen aus Magnetfeldern eingeschlossen werden, die auch für die nötige Wärmeisolierung sorgen. Im Laufe der Fusionsforschung haben sich zwei Konzepte für solche Magnetfeldkäfige herauskristallisiert: der Tokamak und der Stellarator. Das Tokamak-Konzept ist deutlich weiter entwickelt, aber während der Tokamak bisher in Pulsen betrieben wird, ist der Stellarator für den Dauerbetrieb geeignet. Das weltweit modernste Stellarator-Experiment ist unlängst am IPP in Greifswald in Betrieb gegangen. Es soll die prinzipielle Kraftwerkstauglichkeit von Stellaratoren testen, aber noch keine Fusionsenergie erzeugen. Der auf dem Tokamak-Konzept basierende ITER, der im südfranzösischen Cadarache gebaut wird, soll dagegen erstmals Energiegewinnung durch Fusion demonstrieren. Im Vortrag wird diskutiert, warum der Weg zur Kernfusion so lang ist, wo wir stehen und welche Probleme noch zu lösen sind. Im Gegensatz zu Spaltungskraftwerken beruhen Fusionskraftwerke nicht auf einer Kettenreaktion und eine Endlagerung von radioaktiven Abfällen ist nicht erforderlich. Aus diesem Grund bieten sich Fusionskraftwerke langfristig als Ersatz von bisherigen Spaltungskraftwerken an.

Plenarvortrag PV VI Do 9:00 Audimax

Neutron star mergers and the begin of multi-messenger astrophysics — •Stephan Rosswog — The Oskar Klein Centre, Department of Astronomy, Stockholm University, Stockholm, Sweden

Neutron star mergers had long been suspected to produce gravitational wave "chirps", gamma ray bursts and produce r-process elements. While overall convincing, all these conjectures were based on indirect arguments and none was proven directly. This changed on August 17, 2017: a gravitational wave signal from a merging neutron star binary was detected, closely followed by a short gamma-ray burst and week-long transients accross the electromagnetic spectrum coming from the radioactive decay of freshly synthesised r-process elements. In this talk I will give an overview over these recent developments.

Plenarvortrag PV VII Do 9:45 Audimax

An Improved Value of the Atomic Mass of the Proton — •Florian Köhler-Langes — Max-Planck-Institut für Kernphysik, Saupfercheckweg 1, 69117 Heidelberg, Germany

In combination with the neutron and the electron, the proton is one of the basic building blocks of atomic matter. The precise knowledge of its properties, e.g. its mass, is of utmost importance for tests of fundamental physics and the clarification of 3 to 4 sigma discrepancies between high-precision mass measurements of various light atoms.

Therefore, a new cryogenic five-fold Penning trap setup was constructed. The measurement principle is based on a phase-sensitive comparison of the proton's cyclotron frequency to that of a bare carbon nucleus. In order to measure both frequencies in the same electric and magnetic field configuration, both single ions are transported alternately into an ultra-harmonic Penning trap, consisting of seven cylindrical electrodes. Exactly the same electric field configuration for both ions with different charge/mass ratio requires two separate, precisely tuned axial resonators for non-destructive frequency detection.

At this conference, the new experimental setup will be introduced and the latest result on the atomic mass of the proton will be presented. This new value is 3 times more precise than the current literature value and reveals a disagreement of about 3 standard deviations to it [1]. Aiming for relative precisions of a few parts per trillion the next upgrade will be discussed.

[1] F. Heiße et al., Phys. Rev. Lett. 119, 033001 (2017)

Plenarvortrag PV VIII Fr 9:00 Audimax

Flow and fluctuations in high energy nuclear collisions — •Stefan Floerchinger — Institut für Theoretische Physik, Universität Heidelberg, Philosophenweg 16, 69120 Heidelberg

The QCD fluid produced by heavy ion collisions at RHIC or the LHC is subject to various fluctuations, for example in the energy density, fluid velocity, baryon number density or shear stress. Much can be learned from a detailed analysis of the origins, dynamical evolution and observable consequences of such perturbations in the fluid fields. I will give an introduction and overview for this field of research and highlight some parallels to cosmology where a similar analysis of fluctuations allows to constrain the properties of dark matter.

Plenarvortrag PV IX Fr 9:45 Audimax

COMPASS: Unravelling light-flavour QCD — •Jan Friedrich for the COMPASS-Collaboration — TU München

The multi-purpose spectrometer setup of the COMPASS collaboration at the CERN SPS is in service since more than 15 years for a broad physics programme that aims at the better understanding of strong interaction, which is theoretically described by QCD. Novel results range from soft reactions testing the chiral symmetry breaking of QCD, such as the chiral anomaly, challenge hadronic bound systems and their multi-particle decays using meson resonances, and finally allow to unravel the role of spin and internal dynamics of the quark-gluon structure in the nucleon at high energies.

Such results have been made possible by both advances in experimental techniques and analysis methods which allow precise measurements challenging theoretical concepts.

The very successful running of COMPASS invites for extending the programme beyond the year 2020, and recently proposed options for measuring missing pieces in the transversity distributions in the nucleon, as well as a measurement of the proton radius with high-energetic muons, will also be discussed.