HK 64: Instrumentation

Zeit: Freitag 14:00–16:15 Raum: P 2

Gruppenbericht HK 64.1 Fr 14:00 P 2

First Online Test of the Cryogenic Stopping Cell for the Super-FRS at the FRS Ion Catcher at GSI — •Timo Dickel for the FRS Ion Catcher-Collaboration — Justus-Liebig-Universität Gießen — GSI, Darmstadt

At the FRS, GSI, exotic nuclei can be produced and separated. After production and separation of the nuclei of interest, they are slowed down from relativistic energies and are thermalized to a few eV with a cryogenic gas-filled stopping cell. To achive high stopping efficiencies, the cryogenic stopping cell is operated at highest densities (5 mg/cm^2). This is possible due to the use of a fine structured RF carpet (4 electrodes per mm). After extraction from the cryogenic stopping cell the ions are guided through an RF quadrupole system to a multiple-reflection time-of-flight mass spectrometer (MR-TOF-MS). The MR-TOF-MS is used for high precision mass measurements ($\delta m/m \approx 10^{-7}$), to remove isobaric contaminants from the ions of interest and as a broadband mass spectrometer to investigate and optimize the operation of the stopping cell and the range bunching. Results from the first online test of the FRS-Ion-Catcher, such as the highly efficient stopping and extraction of ^{223}Th, will be shown.

HK 64.2 Fr 14:30 P 2

Simulations of the new cryogenic gas filled stopping cell for the low energy branch of the Super-FRS at FAIR — •Moritz Pascal Reiter[1], Timo Dickel[1,2], Wolfgang Plass[1,2], Hans Geisel[1,2], Daniel Schäfer[1], and Christoph Scheidenberger[1,2] for the FRS Ion Catcher-Collaboration — [1]Justus-Liebig-University, Giessen — [2]GSI, Darmstadt

At the low energy branch of the Super-FRS at FAIR exotic nuclei will be produced at relativistic energies, slowed down, thermalized and provided as a low energy beam to high precision experiments. The ions are stopped in a cryogenic stopping cell in high density helium gas.

In order to guide the development of the new cryogenic stopping cell and to study the performance of the new techniques used, numerical simulations of the stopping cell have been performed. A parameter study of the RF carpet has been done and optimized working parameters for the stopping cell have been found. The simulation results show good agreement with the first offline and online experiments of the cryogenic stopping cell obtained at the FRS Ion Catcher at GSI. For the first time cryogenic operation of a stopping cell with a radio frequency carpet and hitherto unreached helium densities have been demonstrated.

HK 64.3 Fr 14:45 P 2

Commissioning of the Cryogenic Buffer-Gas Stopping Cell at SHIPTRAP* — •Christian Droese[1], Klaus Blaum[2], Michael Block[3], Sergey Eliseev[2], Frank Herfurth[3], Mustapha Laatiaoui[4,5], Felix Lautenschläger[4], Enrique Minaya Ramirez[6], Lutz Schweikhard[1], and Peter Thirolf[5] — [1]Ernst-Moritz-Arndt-Universität Greifswald — [2]Max-Planck-Institut für Kernphysik Heidelberg — [3]GSI Helmholtzzentrum für Schwerionenforschung Darmstadt — [4]Technische Universität Darmstadt — [5]Ludwig-Maximilians-Universität München — [6]Helmholtz-Institut Mainz

The Penning-trap spectrometer SHIPTRAP (M. Block et al., Eur. Phys. J. D 45 (2007) 39) is employed to perform high-precision mass measurements of exotic nuclides, in particular above fermium. In recent experiments the masses of 252-254No and 255,256Lr were measured directly for the first time in a Penning trap (M. Block et al., Nature 463 (2010) 785). For mass measurements of heavier elements, it is crucial to further increase the overall efficiency of the setup which is mainly limited by the stopping efficiency of the fusion evaporation products in the SHIPTRAP gas cell. Therefore, a second generation gas cell with increased stopping volume was designed. In addition, the operation at cryogenic temperatures leads to a larger gas density at a lower pressure and an improved cleanliness of the helium buffer gas. With the new gas cell an increase of the overall efficiency by up to a factor of 5 is expected. The first results of the commissioning will be presented.
*Supported by BMBF (06ML9148) and GSI (LMTHIR1012).

HK 64.4 Fr 15:00 P 2

Detection systems for forward emitted fluorescence photons from relativistic ion beams at storage rings — D. Anielski[1], Ch. Geppert[2,3], V. Hannen[1], R. Jöhren[1], T. Kühl[3], M. Lochmann[2,3], R. Lopéz Coto[1], •J. Mader[1], W. Nörtershäuser[2,3], H.-W. Ortjohann[1], R. Sánchez[3], Ch. Weinheimer[1], and D. Winters[3] — [1]Institut für Kernphysik, Universität Münster — [2]Institut für Kernchemie, Universität Mainz — [3]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt

Laser spectroscopy experiments with highly charged ions (HCI) enable very precise tests of QED in extremly strong electromagnetic fields by comparing hyperfine transitions in H- and Li-like heavy ions of the same isotope. In ^{209}Bi^{80+} the transition wavelength lies in a challenging infrared region, i.e. $\lambda_0 \approx 1555$ nm. When the ions are stored at high velocities ($\beta \approx 0.71$) at the ESR at GSI the wavelength of forward emitted photons is Doppler shifted to $\lambda \approx 640$ nm which makes them detectable with standard PMTs. The difficulty is to efficiently collect those photons without disturbing the ion beam. For this purpose, a movable parabolic mirror system with a central slit for the beam has been developed at the university of Münster and will be presented in this talk. The system has been used in the successful measurement of the hyperfine transition in Li-like Bismuth during the LIBELLE experiment. Based on this experience a detection system for forward emitted photons at XUV wavelength will be constructed and used in fine structure measurements with Be-like Krypton at ESR.
This work is supported by BMBF under contract number 06MS9152I.

HK 64.5 Fr 15:15 P 2

Performance Improvement of a Time-of-Flight detector and Longer Observation of Circulating Ions for IMS at FRS-ESR — •Marcel Diwisch[1], Natalia Kuzminchuk[1], Samuel Ayet[2], Timo Dickel[1,2], Hans Geissel[1,2], Ronja Knöbel[1,2], Wolfgang Plass[1,2], Christoph Scheidenberger[1,2], Baohua Sun[1,2], and Helmut Weick[2] for the FRS-ESR-Collaboration — [1]Justus-Liebig-Universität Gießen — [2]GSI, Darmstadt

Mass measurements of short-lived exotic nuclei can be performed using Isochronous Mass Spectrometry at the FRS-ESR facility at GSI. The mass values are obtained from the revolution time measurements using a time-of-flight detector. Ions passing the detector release secondary electrons from a thin carbon foil which are guided to micro channel plate (MCP) detectors by electric and magnetic fields. The time accuracy as well as the rate capability of the TOF detector are crucial parameters for the performance of IMS. Simulations showed that by increasing the kinetic transport energy of the secondary electrons from the foil to the MCPs the time accuracy of the detector can be improved. In measurements with a modified detector with higher kinetic transport energies the timing performance of the detector was improved by 50%. Additionally MCPs with a smaller pore size to improve the rate capability and a thinner carbon foil to reduce the energy loss in the foil were installed in the TOF detector. In an online experiment with uranium fission fragments a 10 times higher turn number of the ions could be observed than in former experiments.

HK 64.6 Fr 15:30 P 2

Aufbau und Inbetriebnahme eines Paarspektrometers zur Überwachung des hochenergetischen Photonenstrahls an MAMI — •Peter Merkel für die A2-Kollaboration — Institut für Kernphysik, Universität Mainz, Mainz, Germany

Am Crystal-Ball (CB) Experiment am Elektronenstrahl-Beschleuniger MAMI in Mainz werden Nukleonen und weitere Hadronen mittels eines reellen Photonenstrahls untersucht. Mit der neuen Beschleunigerstufe, MAMI-C, steht ein intensiver polarisierter Strahl mit einer Energie von bis zu 1,604 GeV zur Verfügung. Dieser erzeugt durch Bremsstrahlung und dem Glasgow Tagging-Spektrometer einen energiemarkierten Photonenstrahl. Ein hermetisches Detektorsystem, bestehend aus dem CB/TAPS-Kalorimeter und weiteren Detektoren, welche eine Teilchenidentifikation und Spurrekonstruktion erlauben, weist Vielkörper-Endzustände exklusiv nach. Auf Grund des polarisierten Elektronenstrahls ist die Erzeugung sowohl transversal polarisierter Photonen als auch longitudinal polarisierter kohärenter Photonen möglich.

Bei der Produktion longitudinaler Photonen mit einem Diamant als Radiator werden diese nur in einen sehr kleinen Winkel emittiert. Des Weiteren entsteht ein übliches Bremstrahlungsspektrum transversal polarisierter Photonen. Um die Rate der kohärenten Strahlung zu erhöhen wird der Strahl stark kollimiert.

Mein Vortrag beschreibt den Aufbau eines Paarspektrometers, um parallel zum laufenden Strahlbetrieb das Bremsstrahlungsspektrum direkt im Photonenstrahl zu messen. Dadurch wird es möglich den Anteil der linear polarisierten kohärenten Photonen online zu bestimmen.

HK 64.7 Fr 15:45 P 2

Status des Endpunkttaggers an MAMI-C — •Patrik Ott für die A2-Kollaboration — Institut für Kernphysik, Universität Mainz, Mainz, Germany

Am Crystal-Ball (CB) Experiment am Elektronenstrahl-Beschleuniger MAMI in Mainz werden Nukleonen und weitere Hadronen mittels eines reellen Photonenstrahls untersucht. Mit der neuen Beschleunigerstufe, MAMI-C, steht ein intensiver polarisierter Strahl mit einer Energie von bis zu 1,604 GeV zur Verfügung. Dieser erzeugt durch Bremsstrahlung und dem Glasgow Tagging-Spektrometer einen energiemarkierten Photonenstrahl. Ein hermetisches Detektorsystem, bestehend aus dem CB/TAPS-Kalorimeter und weiteren Detektoren, welche eine Teilchenidentifikation und Spurrekonstruktion erlauben, weist Vielkörper-Endzustände exklusiv nach.

Mein Vortrag beschreibt den Aufbau eines neuen Tagging-Systems zur Untersuchung der Reaktion $\gamma p \rightarrow \eta' p$, deren Schwellenenergie bei 1,447 GeV liegt. Das bisherige Tagging-Spektrometer vermag Photonen bis 1,492 GeV zu markieren. Das neue Spektrometer wird den Energiebereich bis zur maximalen Strahlenergie von 1,594 GeV erweitern. Dadurch wird es möglich sein die Statistik um den Faktor acht zu erhöhen.

Das Design und der Einbau des Spektrometer-Magnet ist abgeschlossen. In diesem Vortrag gehe ich hauptsächlich auf das Detektorarray, bestehend aus 50 Szintilatoren, ein. Zum Abschluss stelle ich einige vorläufige Ergebnisse dar.

HK 64.8 Fr 16:00 P 2

Correlated prompt fission γ-ray data measurements — •Stephan Oberstedt[1], Robert Billnert[1,2], and Andreas Oberstedt[2] — [1]European Commission, Joint Research Centre, IRMM, 2440 Geel, Belgium — [2]Fundamental Fysik - Chalmers Tekniska Högskola, 41296 Göteborg, Sweden

The OECD-NEA has published in its recent high priority data request list a demand for new and precise data on prompt fission γ-ray emission for the standard actinide isotopes ^{235}U and ^{239}Pu in view of their importance for the development of future nuclear fission applications and for a responsible handling of nuclear waste during an a-priori assessment of the fission-fragments' heat production and toxicity. Prompt fission γ-rays, together with prompt neutrons, represent very powerful probes of the nuclear fission process near the scission point. They provide information to better understand how the total excitation energy available in the fissioning system gets transferred to intrinsic excitation in the fragments. Prompt fission γ-rays should preferably be known as a function of fission-fragment mass and excitation energy, but existing experimental data date back to the early 1970s for the above mentioned isotopes. We have performed a detailed feasibility study on novel lanthanum-halide and cerium-bromide detectors with a particular focus on their corresponding time and energy resolution, essential parameters to arrive at a set-up with high detection efficiency in conjunction with a high neutron/γ-ray separation power. New prompt fission γ-ray spectra from the reactions ^{252}Cf(SF) and ^{235}U(n$_{th}$, f) will be presented.