HK 20: Physik mit schweren Ionen

Zeit: Dienstag 8:30–10:30 Raum: 2E

Gruppenbericht HK 20.1 Di 8:30 2E

N/Z Dependence of projectile fragmentation — •Wolfgang Trautmann for the ALADiN2000-Collaboration — GSI Darmstadt, Germany

The N/Z dependence of projectile fragmentation at relativistic energies has been studied in a recent experiment at the GSI laboratory with the ALADiN forward spectrometer coupled to the LAND neutron detector. Besides a primary beam of ^{124}Sn, also secondary beams of ^{124}La and ^{107}Sn delivered by the FRS fragment separator have been used in order to extend the range of isotopic compositions of the produced spectator sources.

The presently ongoing analyses of the measured isotope yields focus on isoscaling and its relation to the symmetry-energy term used for the fragment description at freeze-out and on the derivation of freeze-out temperatures which are found to be independent of the isotopic composition of the studied systems. The latter result is of particular interest because it favours a concept of phase-space driven expansion over that of a Coulomb-driven expansion[1] derived from the predictions of finite-temperature Hartree-Fock calculations.

[1] J.B. Natowitz et al., Phys. Rev. C 65 (2002) 034618

HK 20.2 Di 9:00 2E

Low-density nuclear symmetry energy in heavy ion collisions — •Hermann Wolter[1], Maria Colonna[2], Massimo Di Toro[2], and Joseph Rizzo[3] — [1]Universität München, Garching, Germany — [2]LNS-INFN, Catania, Italy — [3]Univ. di Firenze, Florence, Italy

The density dependence of the nuclear symmetry energy has received great interest recently, because of its role in the structure of exotic nuclei and in astrophysical processes. Heavy ion collisions provide an important way to obtain information about this in the laboratory, via interpretation of experimental data with stochastic transport simulations. In this report we investigate the symmetry energy below normal density, which is probed in collisions around the Fermi energy regime. We review our work on several nucleon and fragment observables with respect to their sensitivity to the symmetry energy. In central collisions ratios of emitted nucleon and light fragment yields are investigated, where we increase the sensitivity by using shifted double ratios. In peripheral collisions we study isospin transport between collision partners of different asymmetry in terms of the total kinetic energy loss to isolate symmetry energy effects. We also identify the ratio of the asymmetry of a neck fragment relative to that of the residues as a very sensitive observable. However, comparison with existing experimental data still does not yield a coherent picture of the isovector equation-of-state. Experiments with radioactive beams of greater asymmetry should increase the sensitivity.

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HK 20.3 Di 9:15 2E

Spallation reactions of ^{238}U and ^{56}Fe on deuterium, measured in inverse kinematics at the FRagment Separator at GSI — •M.Valentina Ricciardi and Strahinja Lukic for the CHARMS-Collaboration — GSI, Darmstadt, Germany

In 1996, at GSI, Darmstadt, a European collaboration started a long experimental program, devoted to reaching a full comprehension of spallation reactions. The experiments were performed in inverse kinematics, shooting nuclei with high kinetic energy on thin liquid ^{1,2}H targets. The nuclei escape the target strongly focussed in forward direction. Thanks to the high resolving power of the magnetic spectrometer (FRS) every nuclide can be unambiguously identified, its production cross section determined, and its velocity distribution measured with high precision. Five different nuclei (U, Pb, Au, Xe, Fe) impinging on two targets (hydrogen, deuterium) in the energy range 0.2-1.5A GeV were measured.

In this contribution, we will present the experimental data from two reactions recently analysed, ^{238}U+^{2}H at 1A GeV and ^{56}Fe+^{2}H at 0.5A GeV, and compare them with ^{238}U+^{1}H at 1A GeV and ^{56}Fe+^{1}H at 1A GeV. The experimental cases offer two different scenarios: one, where the target mass is doubled, the other where the target mass is doubled and at the same time the beam velocity is reduced to half the value. It will be discussed how the total energy introduced in the systems is a good ordering parameter for the study of the following deexcitation stage.

HK 20.4 Di 9:30 2E

Production of fragments with finite strangeness in heavy-ion collisions within a BUU+SMM combined model — •Theodoros Gaitanos, Horst Lenske, and Ulrich Mosel — Institut für Theoretische Physik, Universität Gießen

Hypernucleus production in high energy collisions with rare isotop and antiproton beams will be one of the major projects under investigation in the new experimental facilities at GSI (HypHI and PANDA collaborations, respectively). Such investigations will be important in understanding the interaction between hyperons and nucleons, which can be accessed so far mainly from studies on hypernuclei. We have developed a hybrid model, consisting of a dynamical part (modelled by a covariant transport equation of a Boltzmann-type (GiBUU)) and a statistical part (modelled by a statistical multifragmentation model (SMM)). The GiBUU+SMM model has been applied to heavy-ion collisions at *SIS/GSI* energies by analyzing the results in terms of fragment formation with and without strangess degrees of freedom. It turns out that the hybrid approach reproduces well experimental data on spectator fragmentation at low beam energies, which motivates its application to nuclear collisions at higher beam energies in studying hypernucleus formation. In particular, we present results for the production probabilities of Λ-hypernuclei for different H- and He-isotops near and *beyond* the stability region. We thus make predictions for the future HypHI experiment.

Work supported by BMBF.

HK 20.5 Di 9:45 2E

Friction in abrasion — •Ville Föhr, Strahinja Lukic, Antoine Bacquias, Daniela Henzlova, Vladimir Henzl, Aleksandra Kelic, Maria Valentina Ricciardi, and Karl-Heinz Schmidt for the CHARMS-Collaboration — GSI, Darmstadt, Germany

Peripheral heavy-ion collisions at relativistic energies can be seen as a sudden cut-off of the projectile and target overlap zone. The non-overlapping zone, the so-called spectator region, is subjected to friction which is observed as a slowing down of the velocities of the projectile spectators. With the high-resolution magnetic spectrometer FRS we were able to determine the production cross sections of the fully identified fragments and to measure their velocities in the reaction ^{136}Xe (1 A GeV) + Pb. From this information we determined the impact parameter of the reaction from which they emerged. This method is based on the measured cross sections from which the impact parameter can be determined through Glauber calculation. Velocities of the projectile spectators are presented as a function of impact parameter with direct comparison to the predictions of theoretical models.

HK 20.6 Di 10:00 2E

Fragment formation in low energy proton-induced reactions within a hybrid BUU+SMM approach — •Theodoros Gaitanos, Horst Lenske, and Ulrich Mosel — Institut für Theoretische Physik, Universität Gießen

The formation of fragments in proton-induced reactions at low relativistic energies is investigated within a combination of a covariant dynamical transport model of a Boltzmann type (GiBUU) and a statistical approach (SMM). The GiBUU model describes the dynamics of the pre-equilibrium stage leading an intermediate configuration, which is characterized by the mass and charge numbers and the excitation energy. The excited system finally undergoes statistical fragmentation according to the SMM model. We discuss in detail the reliability and possible limitations of such a hybrid model by comparing our results with a wide compilation of experimental data. It turns out that the hybrid model reproduces appropriate well not only the general experimental trends (mass and charge distributions of the yields and kinetic energies of nuclides), but also the characteristics of individual nuclides produced in such reactions. Thus it is straightforward to extend this model to heavy ion collisions at high relativistic energies. The fragment formation in the more complex situation of a nucleus-nucleus collision including the production of hypernuclei has been also studied and the results will be presented in a separated contribution.

Work supported by BMBF.

HK 20.7 Di 10:15 2E

Performance of TOF wall for positively charged particles for HypHI experiment — •Olga Borodina for the HypHI-Collaboration — GSI Darmstadt, Germany

The HypHI project aims to study hypernuclei at extreme isospins and to measure directly hypernuclear magnetic moments for the first time. The first experiment aims to demonstrate the feasibility of hypernuclear spectroscopy with heavy ion beams by producing and identifying hydrogen and helium hypernuclei with a Li beam at 2 A GeV impinged on a ^{12}C target. The most promising signals of hypernuclei in the experiment is the existence of a secondary decay vertex well behind the target, which can be identified via measurements of π^- channels of the mesonic decay of hypernuclei of interest. Three layers of scintillating fiber detectors mounted in front of a large dipole magnet, ALADiN, will be used for tracking particles to reconstruct secondary decay vertices. Behind ALADiN there are two Time Of Flight (TOF) walls which can also measure positions of registered particles. One of the TOF walls so called the ALADiN TOF walls already exists and will be used to measure π^-, and the other TOF wall, TOF+, for positively charged particles is under construction. Prototypes of TOF+ wall have been already tested with cosmic rays and light beam fragments produced by ^{58}Ni and ^{12}C beams impinged on a carbon target. In the presentation, the performance of the TOF+ wall will be discussed. The expected result in the Phase 0 experiment by taking the result of the prototype study into account will be also discussed with Monte Carlo simulations.