Workshop for young scientists with research interests focused on physics at FAIR

Sunday 21 September 2014 - Sunday 28 September 2014

Vietri sul Mare

Book of abstracts

93 - Higher Moments of Net-proton, Net-charge Multiplicity Distributions at RHIC

Talks - Monday 22 September 2014 09:15

Presenter: Dr. LUO, Xiaofeng (Central China Normal University)

Experimental confirmation of the QCD critical point is an excellent test of QCD theory in the non-perturbative region and a milestone of exploring the QCD phase diagram. It is one of the main goals of the RHIC Beam Energy Scan (BES) program. Due to the high sensitivity to the correlation length [1] of the dynamical system and directly connected to the susceptibilities in theoretical calculations, for example, the Lattice Gauge Theory (LGT) calculations [2], higher moments of multiplicity distributions have been applied to search for the QCD critical point in the heavy-ion collision experiment.

In this talk, we will present the recently published experimental results of net-proton and net-charge [3] from RHIC BES data. We will discuss the deviations of the data from Poisson, binomial baselines as well as the implications. In addition, the results from HRG, AMPT and UrQMD model will be compared with the experimental results.

[1] M. A. Stephanov, Phys. Rev. Lett. 102, 032301 (2009); Phys. Rev. Lett. 107,
052301 (2011); C. Athanasiou, et al., Phys. Rev. D 82, 074008 (2010).
[2] S. Gupta, X. Luo, B. Mohanty, H. G. Ritter, N. Xu, Science 332, 1525 (2011);
F. Karsch and K. Redlich, Phys. Lett. B 695, 136 (2011); A. Bazavov et al., Phys. Rev. Lett.,109, 192302 2012); S. Borsanyi et al., Phys. Rev. Lett.111, 062005 (2013).
[3] STAR Collaboration, Phys. Rev. Lett. 112, 032302 (2014).

43 - Determination of freeze-out conditions from fluctuations in the Hadron Resonance Gas model

Talks - Monday 22 September 2014 10:00

Presenter: Mr. ALBA, Paolo Giuseppe (University of Turin and INFN)

Fluctuations of conserved charges measured in Heavy-Ion Collisions (HICs) received increasing attention in recent years, because they are good candidates to explore the phase diagram of QCD matter. During last year, net-electric charge and net-proton moments of multiplicities measured at RHIC have been published by the STAR collaboration, for a range of collision energies which spans a region of the phase diagram at finite chemical potential. In my talk I will present a new freeze-out curve obtained using the Hadron Resonance Gas (HRG) model approach to fit these experimental data. The HRG model is modified in order to have a realistic description of the HICs: kinematic cuts, resonance feed-down and resonance regeneration are taken into account. Our result is in agreement with preliminary studies by the ALICE collaboration, and is supported by recent lattice analysis of the same quantities.

59 - Cooper-Frye negative contributions and thermalization at FAIR energies

Talks - Monday 22 September 2014 11:00

Presenter: OLIINYCHENKO, Dmytro (Frankfurt Institute for Advanced Studies, Bogolyubov Institue of Theoretical Physics, Kiev)

Hydrodynamics is successfully applied as a theoretical model for the dynamics of heavy ion collisions at high collision energies reached at RHIC and the LHC. However, the applicability for collisions at lower beam energies remains unclear. Known limitations are both physical, such as possible lack of thermalization, large mean free path or large fluctuations, and technical, such as negative Cooper-Frye contributions. In this talk I will address the question: “What is the lowest collision energy, at which hydro-based approaches are still applicable?”
The question of hydrodynamics applicability cannot be answered within hydrodynamics itself. In order to investigate it we consider Au-Au collisions at energies Elab = 10-160 A GeV within a coarse-grained UrQMD approach. The energy-momentum tensor is calculated as a function of space and time to explore the degree of local equilibration of the system. In addition, UrQMD and viscous hydrodynamics are initialized in the same way and the resulting $T^{\mu \nu}$ during the space-time evolution is compared to quantify deviations from a hydrodynamic treatment.
At the end of the fluid-dynamical evolution particles are generated on the transition hypersurface according to the Cooper-Frye formula. This description suffers from the so-called negative contributions – particles flying from outside back to the fluid-dynamical region. By comparing the negative contributions in a coarse-grained transport approach to the ones obtained in a hydro-like treatment, the importance of the backstreaming effect of particles is assessed. We demonstrate, that the lower collision energy – the larger the negative Cooper-Frye contributions are. In our calculation they reach 12% at central 10 AGeV collisions for pions at midrapidity.

63 - Adaptive triggering for scintillation signals

Talks - Monday 22 September 2014 11:30

Presenter: Dr. VESIC, Jelena (Jozef Stefan Institute, Ljubljana, Slovenia)

Scintillation detectors will be an important part of detection systems in FAIR. In order to extract maximum information from the scintillation pulses, improved signal processing is required. Due to the stochastic nature of the pulse creation in a scintillation detector the output pulses are not all of the same shape but rather 'noised' with statistical fluctuations on the pulse tails, which may produce false triggers. The current state of the art in solving this kind of problems is either introducing a deadtime after each pulse which makes the detector inefficient at higher count rates or raising the trigger threshold above the fluctuactions level which, on the other side, lowers the dynamic range of the detector. In order to meet the ever growing demand for high precision/efficient experiments the solutions to these limitations are highly desirable. We propose a new method, the adaptive triggering for scintillation signals. In our method, the trigger is raised by a finite value and for a finite amount of time after each pulse. The method was first tested on simple simulated signals. Consequently, based on the simulation results, the optimal triggering parameters were obtained. Using these parameters, adaptive triggering was then tested with a NaI(Tl) detector in an intense Cs-137 gamma-ray field. The results show that this method significantly extends the useful energy range on the low energy side of the spectrum which is crucial if the desired information is present there.

62 - Multiplicity fluctuations and flow at the quark-hadron phase transition in a fluid dynamical model

Talks - Monday 22 September 2014 17:00

Presenter: Dr. HEROLD, Christoph (Suranaree University of Technology)

The region of large net-baryon densities in the QCD phase diagram is expected to exhibit a first-order phase transition. Experimentally, its study will be one of the primary objectives for the upcoming FAIR accelerator. We model the transition between quarks and hadrons in a heavy-ion collision using a fluid which is coupled to the explicit dynamics of the chiral order parameter. This allows us to investigate signals stemming from the nonequilibrium evolution during the expansion of the hot plasma. Special emphasis is put on the buildup of flow as a result of spinodal decomposition at the first-order phase transition in comparison to a crossover or a critical point. Moreover, we present an event-by-event analysis of baryon number fluctuations which have long since been claimed to be sensitive to a critical point.

82 - The Parallel Cellular Automaton track finder for the CBM experiment

Talks - Monday 22 September 2014 17:30

Presenter: Ms. AKISHINA, Valentina (Frankfurt University)

The CBM experiment at FAIR is being designed to study heavy-ion collisions at extremely high interaction rates. The event selection has to be done online and requires full event topology reconstruction, therefore fast and efficient reconstruction algorithms are needed.
The Cellular Automaton track finder is fast and robust and thereby will be used for the online and offline track reconstruction. In order to fully utilise the processing power provided by modern computer architectures parallelism is to be implemented for the reconstruction.
The CA track finder was fully parallelised inside the event. Since the CBM beam will have no bunch structure, but continuous, the reconstruction of time slices rather than events is needed. Thus, the parallel version of the algorithm was optimised for reconstruction of groups of minimum bias events packed in slices.
The parallel version of the algorithm shows the same efficiency as a single core one and achieves a speed up of about 10 while parallelising between 10 Intel Xeon physical cores with a hyper-threading.

65 - Electromagnetic calorimeter concept for the HADES spectrometer

Talks - Monday 22 September 2014 18:00

Presenter: Mr. SVOBODA, Ondrej (Nuclear Physics Institute, Academy of Sciences of the Czech Republic)

The HADES spectrometer currently operating on the beam of SIS18 accelerator in GSI will be moved to a new position in the CBM/HADES cave of the future FAIR complex. Electromagnetic calorimeter (ECAL) will enable the HADES@FAIR experiment to measure data on neutral meson production in heavy ion collisions at the energy range of 2-10 A GeV on the beam of the new accelerator SIS100@FAIR. Calorimeter will be based on 978 massive lead glass modules read out by photomultipliers and a novel front-end electronics. Layout of the ECAL detector will be presented.
Secondary gamma beam with energies ranging from 81 MeV up to 1399 MeV from MAMI-C Mainz facility was used to verify selected technical solutions. Relative energy resolution was measured using modules with three different types of photomultipliers. Two types of developed front-end electronics as well as energy leakage between neighboring modules under parallel and declined gamma beams were studied in detail.

71 - Radial modes of oscillations of magnetized compact hybrid stars

Talks - Monday 22 September 2014 18:30

Presenter: Mr. NIHAR RANJAN PANDA, Nihar (Institute of Physics)

The nuclear equation of state (EOS) at high density is still an unresolved issue though many theoretical and experimental efforts have been made in the last five decades. It is believed that compact stars such as neutron stars (NS) consist of hadronic and strange quark or color superconducting matter. Stars having a quark core surrounded by hadronic matter, may be considered as hybrid stars (HS). In the HS, there is a phase transition from hadronic to quark matter and a possible region is mixed phase of hadrons and quarks. The mixed phase is well proportionate of both the hadron and quark phases.
A huge magnetic field is predicted in core as well as on surface of the neutron star. We investigate the influence of strong magnetic field on EOS of relativistic high density cold hadronic matter in beta equilibrium and also of quark matter. For hadronic matter, EOS we have considered modified chiral sigma model in a relativistic mean field approach and for quark matter EOS, we have used MIT bag model, assuming density dependent bag pressure. Then we incorporated density dependent strong magnetic field in both EOS. We have also constructed an intermediate mixed phase assuming Glendenning conjecture [K K Mohanta et al. PRAMANA journal of physics,82,2014, 797-807]. Finally, we have verified the occurrence of phase transition and mixed phase from the unique behaviour of distribution radial modes of oscillation vs gravitational mass[P K Sahu et al. The Astrophysical Journal, 566, L89 L92, (2002)]. We found that there is a significant effect of magnetic field on the EOS of both the phases, as a result the value of maximum mass and radial modes of oscillation get significantly modified. I will display the details of these effects in my presentation.

76 - Theory Challenges for CBM

Talks - Tuesday 23 September 2014 09:15

Presenter: Dr. STEINHEIMER, Jan (FIAS)

I will discuss challenges and open questions for the thoeretical description of systems created at the CBM experiment at FAIR.
In particular I will focus on issues for hadronic bulk observables
which can be adressed by transport models.
Of particular interest is the possible phase transition of QCD expected to occur at the FAIR beam energy range. I will discuss what progress has been made and still needs to be done, regarding transport models and effective equations of state, to formulate clear signals for the observation of this phase transition.

69 - Overview of the Silicon Tracking System for the CBM experiment

Talks - Tuesday 23 September 2014 10:00

Presenter: LARIONOV, Pavel (Goethe-Universität Frankfurt(UFfm-IKP))

The CBM experiment at FAIR will explore the QCD phase diagram in the region of high net baryonic densities and moderate temperatures by colliding heavy ions at beam energies up to 45 GeV/nucleon. The physics program includes the study of the equation-of-state of nuclear matter in mentioned region of the phase diagram and the search for the de-confinement and chiral phase transition, and the critical endpoint. The Silicon Tracking System (STS) is the core tracking detector of the experiment, it is designed to provide track reconstruction and momentum determination of charged particles produced in beam-target interactions at very high hit rates (up to 10 MHz) and high multiplicity. It will be located downstream the target inside a 1T dipole magnet to achieve momentum resolution of 1%. The STS consists of 8 stations assembled out of 300 um thick silicon microstrip sensors providing material budget of 1% X0. The sensors will be read out through multi-line micro-cables with fast self-triggered electronics for the online track reconstruction.
The current status of the system development will be presented including recent developments of the components, simulations of the performance of the detector and latest in-beam test results.

75 - Prospects for thermal dilepton rates from lattice QCD

Talks - Tuesday 23 September 2014 11:00

Presenter: FRANCIS, Anthony (GSI, Darmstadt)

We discuss the prospects of computing thermal dilepton rates from first principles lattice QCD. The focus lies in the determination of the meson vector-vector current spectral function in the low mass region. We review and compare recent results from continuum-extrapolated, quenched calculations, as well as dynamical two-flavor setups.
Additionally we update our two-flavor dynamical analysis to include newly generated ensembles using Wilson-Clover fermions at pion masses of 270MeV and spatial (box) lengths of 3.1fm. These lattice setups cover a temperature range of 170MeV to 340MeV, with the pseudocritical temperature at roughly 200MeV. Also large vacuum ensembles are available, enabling a comparison to the experimentally observed spectral function extracted from electron-positron annihilation to hadrons. At finite temperature, we discuss the electrical conductivity across the phase transition and the signs of the dissociation of the ρ particle.

44 - Higher order fluctuations of strangeness and flavor hierarchy

Talks - Tuesday 23 September 2014 11:30

Presenter: Dr. MANTOVANI SARTI, Valentina (University of Turin-INFN Turin)

Fluctuations of conserved charges, such as electric charge, baryon number and
strangeness, are proving to be a promising and useful tool to
investigate the deconfinement phase transition of QCD and recently also the freeze-out dynamics in heavy-ion collisions (HICs).

Lattice QCD calculations involving higher order susceptibilities have shown some first indications that a flavour hierarchy in the deconfinement process
between strange and light quarks might occur.
Moreover, theoretical models based on statistical and thermal properties
of particles produced during the collision show that the freeze-out temperature for strange mesons and baryons seems to be higher than the one associated to protons and pions.

The analysis of higher order moments of strange particle distributions measured in HICs might provide more insight into this issue. Preliminary results on the moments of net-charged kaons have been
presented by the STAR collaboration for several collision energies, as part of the RHIC beam energy scan program. Besides, particle ratios involving strange mesons and baryons are available at both STAR and ALICE experiment.
We present results for higher order fluctuations of strangeness within the Hadron Resonance Gas (HRG) model including resonance feed-down corrections and kinematic cuts.
We compare our results to the STAR data of net-kaon cumulants and extract their freeze-out temperature as a function of the collision energy. This result is compared to the independent freeze-out temperature estimate from
the evaluation of particle ratios at STAR and ALICE center-of-mass energies.

Moreover, in order to constrain even more the range of the freeze-out temperature, we suggest the study of higher order moments for specific subsets of strange particles. The analysis of higher order fluctuations of strangeness for such subsets could be performed in the future at HIC facilities and lead to more precise estimates of the freeze-out parameters.

81 - Photon emission within the quark meson model

Talks - Tuesday 23 September 2014 17:00

Presenter: Mr. WUNDERLICH, Falk (HZDR and TU Dresden)

Certain aspects of the behavior of strongly interacting matter can be understood in terms of effective models. Among such models is the quark meson model. With a suitable choice of parameters and field content the phase diagram exhibits a 1st order phase transition that terminates in a critical point at nonzero chemical potential.
We apply a method developed by Carter and extended to the quark meson model by Mocsy et al. to calculate thermodynamic quantities and the masses of the dynamic fields in a self consistent manner. The sensitivity of these observables as well as the position of the critical point to the field fluctuations is discussed.
Adding an electromagnetic sector to the model the photon emissivity is computed to leading order to elucidate whether peculiarities appear near the critical point.

51 - Charged Kaon- and φ-reconstruction in Au+Au-collisions at 1.23 AGeV

Talks - Tuesday 23 September 2014 17:30

Presenter: Mrs. SCHULDES, Heidi (IKF, Goethe-Universität)

In Au+Au-collisions at 1.23 AGeV, the complete strangeness production
is below its nucleon-nucleon threshold. In baryon dominated matter K+ and K− exhibit different properties, because K- can be resonantly absorbed by nucleons. Although strangeness exchange reactions have been proposed to be the dominant channel for K− production below threshold, the production yield could also be explained in Ar+KCl-reactions at 1.76 AGeV based on a statistical hadronization model fit to the measured particle yields. To take care for strangeness conservation, strangeness is calculated canonically within Rc, and therefore the ratio of φ/K− is predicted to rise with decreasing beam energies and hence the feed-down of φ-mesons to Kaons becomes more important.
In April and May 2012, 7.3 billion Au(1.23 GeV per nucleon)+Au collisions have been recorded by the HADES detector. In this contribution, we present results of the charged kaon and φ-meson production and test the above discussed prediction.

50 - V0 Reconstruction in Au+Au-Collisions at 1.23 AGeV with HADES

Talks - Tuesday 23 September 2014 18:00

Presenter: Mr. SCHEIB, Timo (Uni Frankfurt)

In heavy ion collisions at beam energies of 1-2 AGeV, strangeness production can be observed below its elementary production threshold. In April and May 2012, 7.3 billion Au(1.23 GeV per nucleon)+Au collisions have been recorded by the HADES detector, installed at the Helmholtzzentrum fuer Schwerionenforschung (GSI) in Darmstadt, Germany. In this collision system the weakly decaying strange hadrons K0s and Λ were measured and can be reconstructed. In order to draw conclusions on strangeness production mechanisms in heavy ion collisions the yields can be compared to non-strange particle production, i.e. charged pions.

In this contribution preliminary particle spectra of Λ hyperons and K0s mesons measured in these collisions are presented.

55 - Backtracking algorithm for lepton recontruction with HADES

Talks - Tuesday 23 September 2014 18:30

Presenter: Mr. SELLHEIM, Patrick (Goethe-Universität Frankfurt)

The HADES (High Acceptance Di-Electron Spectrometer) at the GSI
Helmholtzzentrum für Schwerionenforschung investigates dilepton and
strangeness production in elementary and heavy-ion collisions. In
April - May 2012 HADES recorded 7 billion Au+Au events at a beam
energy of 1.23 GeV/u with the highest multiplicities measured so far.
The track reconstruction and particle identification in the high track density environment are challenging.
Most important detector component for lepton identification is a Ring
Imaging Cherenkov detector. Its main purpose is the separation of
electrons and positrons from large background of charged pions produced in heavy-ion collisions. In order to improve lepton identification a new backtracking algorithm was developed.
In this contribution we will show the results of a new backtracking
algorithm compared to the currently applied method for −/+ identification. Efficiency and purity of a reconstructed −/+ sample will be discussed as well.
Supported by BMBF (05P12RFGHJ), Helmholtz Alliance EMMI,
HIC for FAIR, HGS-HIRe and H-QM.

46 - The PANDA Experiment

Talks - Wednesday 24 September 2014 09:15

Presenter: Mr. KLIEMT, Ralf (GSI, Darmstadt)

The PANDA (anti-Proton ANnihiliation at DArmstadt) experiment will be a multi-purpose apparatus at the future Facility for Antiproton and Ion Research (FAIR) at Darmstadt. Anti-proton induced reactions with 1.5 to 15 GeV/c beam momentum at high luminosities of up to 2*10^32/(s*cm^2) will be investigated. Exclusive detection of whole events with almost 4pi acceptance and high precision are needed for the broad physics program. The focus lies on studying the strong interaction in the charm region, by charmonium, open-charm and baryon spectroscopy, and includes the search for glueballs, hybrids and other exotics, hypernuclear physics, nucleon structure studies as well as in-medium modifications of hadrons.

78 - Meson spectroscopy in a study of the Bethe-Salpeter equation

Talks - Wednesday 24 September 2014 10:00

Presenter: KUBRAK, Stanislav (Justus-Liebig-University)

We calculate the spectrum of light mesons, charmonium and bottomonium,
for total momenta J=0..3 in the Dyson-Schwinger/Bethe-Salpeter approach to QCD, using the rainbow-ladder approximation in combination with an effective interaction.
We find two new states in the nnbar and ssbar channels for J=3--, with masses 1528(184) MeV and 1752(94) MeV respectively, that compare well with the experimental values of 1688 MeV and 1854 MeV. The underlying reasons for agreement in some states, and discrepancy in others, are discussed and quantified. The impact of the shape of the effective interaction on the fine splitting of excited states in the charmonium spectra is discussed in detail.

60 - Tau Vector and Axial Vector Spectral Functions in the Extended Linear Sigma Model

Talks - Wednesday 24 September 2014 11:00

Presenter: Ms. HABERSETZER, Anja (Institut für Theoretische Physik, Goethe-Universität Frankfurt)

Low energy resonances appear as final states of the processes that are produced in proton-proton collisions. Thus, in order to analyse the results that will be obtained by the PANDA experiment, it is necessary to control the low energy sector of hadron spectroscopy. The extended Linear Sigma Model (eLSM) describes scalar, pseudoscalar, vector and axial-vector meson resonances, the glueball, and the tetraquark, as well as baryons, on the basis of a Lagrangian that is invariant under global chiral symmetry transformations and dilatation. In addition, for \(N_F=2\), we have now included the electroweak interaction on the basis of a local \(SU(2)_L\times U(1)_Y\) symmetry. Thus we have all components available to compute the coherent amplitudes that yield the vector and axial-vector spectral functions of the weak \(\tau\)-decay with intermediate \(a_1\) and \(\rho\) resonances. We find that within the framework of the eLSM the assumption that the \(\rho\) and \(a_1\) meson resonances are quarkonia and chiral partners is valid. We will also see that the obtained weak spectral functions give a nice illustration of Vector Meson Dominance in the weak sector of meson vacuum phenomenology.

48 - Phenomenology of (open and hidden) charmed meson in a chiral symmetric model.

Talks - Wednesday 24 September 2014 11:30

Presenter: Ms. ESHRAIM, Walaa (JW Goethe University)

We present a U(4)r × U(4)l chiral symmetric model, which includes scalar and pseudoscalar mesons as well as vector and axial-vector mesons. We compute charmed mesons masses, weak decay constants, and strong decay widths of (open and hidden) charmed mesons. Moreover, we calculate the decay width of a pseudoscalar ground state charmonium c into a pseudoscalar glueball and the decay widths of a scalar charmonium χc0 into the scalar glueball. The precise description of the decays of open charmed states is important for the CBM experiment at FAIR, while the description of hidden charmed states and the pseudoscalar glueball is vital for the PANDA experiment at the upcoming FAIR facility. In the end, we study the mixing of axial- and pseudo-vector charmed mesons.

92 - BES III results and overview

Talks - Wednesday 24 September 2014 12:00

Presenter: Dr. HU, Jifeng (Universita degli Studi di Torino)

In this talk, I will present the recent BESIII results on hadron spectroscopy. BESIII has accumulated a large data example of electron-positron annihilations at the energies ranging from 3GeV to 4.6GeV. BESIII is a general-purpose spectrometer and provide excellent performance in particle detection in the energy range of interest. This talk covers the most recent physics outputs at BESIII, including the bayronic spectroscopy, the XYZ states, and the light meson spectroscopy.

84 - TRIGA-SPEC: Status of the MATS and LaSpec prototype systems for the FAIR facility

Talks - Wednesday 24 September 2014 17:00

Presenter: Mr. BEYER, Thomas (Max-Planck-Institut für Kernphysik, Heidelberg); Mr. RENISCH, Dennis (Institut für Kernchemie, JGU Mainz)

The TRIGA-SPEC facility at the TRIGA research reactor at the University of Mainz is dedicated to high-precision measurements of ground-state properties of neutron-rich radionuclides far from stability. TRIGA-SPEC consists of the Penning-trap mass spectrometer TRIGA-TRAP and the collinear laser spectroscopy setup TRIGA-LASER. The measurements provide access to nuclear binding energies, Q-values, charge radii, nuclear spins and moments. The collection of such data allows testing the predictive power of mass models, supports astrophysical calculations on the rapid neutron-capture process, and extends our knowledge of deformation and nuclear structure. The nuclides of interest are produced by thermal neutron-induced fission of a 235U or 249Cf target inside the research reactor TRIGA Mainz. The extraction and preparation of the nuclides of interest for both experimental branches will be achieved by an aerosol gas-jet based system, a surface or plasma ionizer, and a radiofrequency quadrupole for accumulation and emittance reduction. TRIGA-TRAP and TRIGA-LASER serve as test setups for the MATS (precise Measurements on very short-lived nuclei using an Advanced Trapping System for highly-charged ions) and LaSpec (Laser Spectroscopy on short-lived nuclei) experiments, respectively, at the low-energy branch of the future FAIR facility. The current status of the TRIGA-SPEC facility and recent technical developments improving the efficiency of both branches will be presented.

88 - PRIOR - Proton Microscope for FAIR

Talks - Wednesday 24 September 2014 17:30

Presenter: SHESTOV, Lev (GSI, TUD, EMMI, Darmstadt)

High energy proton microscopy (HEPM) is an emerging diagnostic technique which provides unique capabilities in penetrating radiography including the combination of high spatial resolution and accuracy of density reconstruction inside volumes and in situ environments. Since the proton beam is composed of charged particles, the beam may be focused with magnetic lenses to form images of the object far away from the interaction region. Therefore HEPM makes possible quantitative measurements of material densities under extreme conditions of temperature and pressure, providing this way an ideal probe for the high energy density physics research at FAIR.

Recently the PRIOR (Proton Microscope for FAIR) facility has been constructed and successfully commissioned at GSI by an international team of scientists from GSI, IPCP, ITEP, LANL and TUD using a 4.5 GeV proton beam from the SIS-18 synchrotron. PRIOR will allow for a significant step forward in spatial resolution (10 - 20 μm). At FAIR, PRIOR will be one of the key experiments of the HEDgeHOB collaboration. It will take full advantage of the intense 10 GeV proton beam from the SIS-100 synchrotron in order to further increase the spatial and temporal resolution of the dynamic density measurements. The current status of the PRIOR project will be discussed along with the results of the recent static and dynamic experiments.

61 - Theoretical approaches to dilepton production: What can we learn about in-medium effects from model calculations?

Talks - Wednesday 24 September 2014 18:00

Presenter: Mr. ENDRES, Stephan (Frankfurt Institute for Advanced Studies / University of Frankfurt)

Low-mass dilepton pairs from heavy-ion collisions are considered good probes for chiral symmetry restoration and the in-medium properties of vector mesons. However, the complexity of the different contributing sources is a challenge for theory; a satisfying description of dilepton production in heavy-ion collisions covering all energy ranges from SIS to LHC is yet to be found. Transport approaches (e.g. UrQMD and GiBUU) are successfully used to obtain a realistic microscopic description of the collision dynamics. However, such microscopic models usually do not include any in-medium effects and are limited to hadronic degrees of freedom. We present an alternative approach that uses coarse-grained output from transport calculations to extract local thermodynamic properties and determine thermal dilepton emission rates by application of in-medium spectral functions. A big advantage of this approach is the ability to cover all collision energies and the whole space-time evolution in a unified description. We analyze the results of our transport and coarse-graining calculations and compare them to experimental data. Special focus is set on recent HADES results and the future CBM experiment. Both approaches show that the baryonic coupling of the rho meson is crucial for the understanding of dilepton spectra, especially at high baryon densities as at SIS or FAIR energies.

66 - Charmonium suppression in a baryon rich quark-gluon plasma

Talks - Wednesday 24 September 2014 18:30

Presenter: Mr. BHADURI, Partha Pratim (Variable Energy Cyclotron Centre)

We have investigated the survival probability of different charmonium states, in a high baryon density parton plasma, expected to be produced in nuclear collisions at FAIR. Charmonia are assumed undergo complete dissociation by color screening, if the in-medium Debye radius becomes comparable to the spatial size of the corresponding bound state. Results indicate a non-trivial dependence of the suppression pattern on the plasma evolution dynamics. A much larger magnitude of suppression is foreseen induced by cold nuclear matter compared to that due to plasma screening.

53 - Non-conventional mesons at the PANDA experiment

Talks - Thursday 25 September 2014 09:15

Presenter: Dr. GIACOSA, Francesco (Frankfurt Uni)

One of the main goals of the PANDA experiment is the search of non-conventional quark-antiquark states, such as glueballs, hybrids and tetraquark and/or also molecular states. The energy region between 2.5-5 GeV is especially interesting because it is expected to locate many non-conventional mesons and will be carefully investigated by the PANDA experiment. In the talk I review the present theoretical knowledge about the spectroscopy of these states and I will discuss how the PANDA experiment will influence our understanding of them.

58 - Reconstruction of π^0 and η mesons via conversion method in Au+Au at 1.23AGeV with HADES

Talks - Thursday 25 September 2014 10:00

Presenter: Mrs. BEHNKE, Claudia (Institut fuer Kernphysik, Goethe-Universitaet, Frankfurt, Germany)

Lepton pairs emerging from decays of virtual photons represent promising probes of matter under extreme conditions. In the energy domain of 1 - 2 GeV per nucleon, the HADES experiment at GSI Helmholtzzentrum fuer Schwerionenforschung in Darmstadt studies di-electrons and strangeness production in various reactions, i.e. collisions of pions, protons, deuterons and heavy-ions with nuclei. An accurate determination of the medium radiation depends on a precise knowledge of the underlying hadronic cocktail composed of various sources contributing to the net spectra. Therefore, a measurement of the neutral meson yields together with the dileptons is crucial. In this contribution, the capability of HADES to detect e^-e^+ pairs from conversions of real photons will be demonstrated. We will present results from a two-photon analysis of Au+Au collisions at 1.23 GeV/u providing information on neutral π^0 and η mesons. Supported by BMBF (06FY9100I and 06FY7114), HIC for FAIR, EMMI, GSI, HGS-Hire and H-QM

80 - The g-factor of highly-charged ions – stress test for the Standard Model and access to the atomic mass of the electron

Talks - Thursday 25 September 2014 11:00

Presenter: Dr. STURM, Sven (Max-Planck Institut für Kernphysik)

The ultra-precise measurement of the g-factor of highly-charged ions provides a unique possibility to probe the validity of the Standard Model under extreme conditions. The bound electron is exposed to electric fields of up to 10^16 V/m, yielding a high sensitivity for higher-order contributions and hypothetical physics beyond the Standard Model.

We have determined the g-factor of hydrogen- and lithiumlike silicon by measuring the Larmor- and cyclotron frequencies of single ions in a Penning trap with previously unprecedented precision. The comparison of these values with the prediction of theory yields the most stringent test of quantum electrodynamics and relativistic inter-electron interaction in strong fields.

Furthermore, the developed techniques open an access to fundamental constants. Recently, we have determined the atomic mass of the electron with a relative uncertainty of 30 ppt, more than an order of magnitude better than the current CODATA literature value. This result enables future ultra-high precision tests of the Standard Model, e.g. the determination of the fine-structure constant and bound-state QED tests.

87 - Materials research with energetic ion beams: Basic aspects and nanotechnology

Talks - Thursday 25 September 2014 11:45

Presenter: BENDER, Markus (GSI, Darmstadt)

When solids are exposed to energetic ions (MeV-GeV), their physical and chemical structure can severely be modified. The change is governed by ultrafast dynamical processes starting from the deposition of large energy densities, electronic excitation and ionization processes, and finally damage creation in the atomic lattice system. Each projectile creates a cylindrical track with a few nanometers in diameter and up to many µm in length. Of particular interest are material degradation and modification processes under multiple extreme conditions. The coupling of extreme energy depositions with high pressure and high temperature can dramatically modify phase transformation pathways leading to interesting insights and applications in the field of materials- and geosciences.
At present, a dedicated irradiation facility at UNILAC provides different in-situ and on-line techniques to monitor damage formation. This includes sophisticated analytical methods such as high resolution microscopy and X-ray diffraction for the investigation of beam-induced surface and bulk modifications. In addition, optical spectroscopy, thermal imaging and residual gas analysis are applied. The irradiation experiments can be performed under various gas atmospheres and under cryogenic to elevated temperature.

49 - Studies of exotic nuclei: state-of-the-art experimental tools and techniques

Talks - Friday 26 September 2014 09:15

Presenter: Dr. PASCHALIS, Stefanos (Technical University of Darmstadt)

A topical review on the experimental physics for NUSTAR experiments at FAIR. State-of-the-art experimental devices for nuclear physics studies, such as the R3B setup and the AGATA/GRETINA gamma-ray energy-tracking arrays, will be presented and the kind of experiments possible with them will be discussed.

67 - Study of the unbound 13Be and the future of p2p reactions at FAIR

Talks - Friday 26 September 2014 10:00

Presenter: Mr. RIBEIRO, Guillermo (CSIC-IEM)

The field of nuclear physics is interested in the understanding of the properties of nuclei in and beyond the drip-line, especially the last decade the interest in research on halo and non-bound nuclei has been growing fast [1, 2].

This contribution is about a study of the unbound system 13Be produced from a 14B (p, 2p) reaction at high energy. The experiment was performed in complete kinematics using the R3B setup in Cave C at GSI.

A primary beam of 40Ar at energy 490 MeV/u was let to impinge on a Beryllium target producing a mixed beam, which was separated in the fragment separator (FRS) before reaching the reaction target and the detection setup. As incoming nuclei the 14B was selected and after a p2p knockout reaction on CH2, the products of the unbound nuclei of interest 13Be was selected in the detector set-up .

The isotope 13Be has a half-life in the order of 10-21 s, not allowing us to detect it directly, forcing us to look for the 12Be+n system. The invariant mass technique is used in the analysis in order to reconstruct the relative energy of the 12Be+n system. The reconstructed excitation spectra combined with the measurement of the gamma emitted from the excited 12Be fragments permits us to extract information about the 13Be structure.

In this contribution these results will be explained together with a comparison to the latest published data, [3, 4], in order to reach a conclusion about the shell structure of 13Be.

For the future R3B experiments at FAIR a new calorimeter, CALIFA, optimized for (p, 2p) reaction is being constructed [5]. For the front end-cap of CALIFA a demonstrator CEPA4 [6] is currently being tested. The main results and the future applications of the new detection technique used in the framework of probing unbound nuclei will be discussed.

1) H. Simon, Phys., Scr. T 152, 014024 (2013).
2) T. Baumann et al., Rep. Prog. Phys.75, 036301(2012).
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91 - Investigation of the prompt gamma ray emission for online monitoring in ion therapy

Talks - Friday 26 September 2014 11:00

Presenter: Mr. STEINSCHADEN, Dominik (Stefan Meyer Institute for Subatomic Physics, Austrian Academy of Science)

This talk deals with the investigation of the characteristics of prompt gamma ray emission in radiotherapy with carbon ions. The aim of this investigation was to study the principle of using the prompt gamma rays, created by nuclear reactions of the incident therapy beam with the irradiated tissue, to determine the position of the Bragg peak during the medical treatment. Developing a system for online monitoring in ion therapy with the required accuracy is an important step for the utilization of modern acceleration facilities for medical purpose.

The studies were carried out by Monte Carlo simulations in the framework of the simulation environment GATE(GEANT4 Application for Tomographic Emission) realized on the computer cluster of the Vienna General Hospital. In the course of these investigations some production parameters of prompt gamma rays like the emission rate, energy and direction were determined as a function of the primary carbon ion energy and the penetration depth in a water target. A possible connection between these parameters and the position of the Bragg peak and the dose delivery was checked. An energy range for produced gamma-rays can be detected in which the production rate of the photons shows a significant drop right after the Bragg peak. Additional the detection of prompt photons outside of the irradiated material was simulated. Using the results of the photon production and the virtual geometry a response function of the virtual detector was acquired which allows linking the photon detection with the photon production and the depth of the Bragg peak. New simulation results show that the accuracy of the recalculation can be raised by distinguishing between photons created directly in the beam line and photons created outside by fraction products.

89 - Hard X-Ray Polarimetry using Double-Sided Segmented Solid-State Detectors as Compton Polarimeters

Talks - Friday 26 September 2014 11:30

Presenter: Dr. WEBER, Günter (HI-Jena)

Studies of the polarization of hard x-rays emitted in energetic heavy-ion atom collisions provide detailed information of the collision dynamics as well as of the atomic structure at high-Z [1]. Moreover, hard x-ray polarimetry also opens a route for polarization diagnosis of spin-polarized ion and electron beams as are discussed for future PNC experiments at FAIR [2]. However, due to the lack of efficient polarimeters previous studies of the radiation stemming from highly-charged ions were mainly restricted to measurements of the spectral and angular distribution. Owing to recent progress in the development of highly segmented solid-state detectors, a novel type of polarimeter for the hard x-ray regime has become available. Applied as Compton polarimeters, two-dimensional position-sensitive x-ray detectors now allow for precise and efficient measurements of photon linear polarization properties in the energy region between 70 and a few 100 keV [3,4,5]. An overview on recent measurements performed at the ESR storage ring at GSI [6,7,8], the polarized electron source SPIN at TU Darmstadt [9] and the PETRA III synchrotron at DESY will be presented. Also future experimental possibilities at the HESR of the FAIR facility will be discussed.

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73 - Chiral dynamics and peripheral partons in the nucleon

Talks - Friday 26 September 2014 17:00

Presenter: GRANADOS, Carlos (Uppsala University)

We introduce transverse densities in the study of parton dynamics in the proton's peripheral region. We calculate these densities using Chiral perturbation theory (ChPT) and parametrize the long distance structure of the nucleon in a model independent framework in which we identify chiral (b~O(M_pi^(−1))) and molecular (b~O(M_N^2/(M_pi^(3)))) parametrical regions. Through the light cone formulation of the nucleon's electromagnetic current in ChPT, one calculates transverse densities from local products of light cone wave functions of a pion-nucleon system. These products are understood as 2-dimensional parton distributions and as such are universal in processes that probe the nucleon's periphery. This universality and also that of the corresponding transverse density can be tested and used in phenomenological studies of reactions such as high energy proton-nucleon/nucleus collisions and in electron proton scattering as well as in low Q^2 extraction of baryonic form factors.

72 - Lattice study of hybrid static potentials

Talks - Friday 26 September 2014 17:30

Presenter: Mr. WOLF, Philipp (Johann Wolfgang Goethe-Universität Frankfurt am Main)

Hybrid static potentials are computed using lattice gauge theory with particular focus on small quark-antiquark separations. The resulting potentials are used to estimate masses of hybrid mesons.

47 - Chiral phase transition and critical endpoint in the vectormeson extended linear sigma model

Talks - Friday 26 September 2014 18:00

Presenter: Dr. KOVACS, Peter (Wigner RCP)

We investigate the effects of (axial)vector mesons on the chiral phase transition in the framework of an SU(3), (axial)vector meson extended linear sigma model with additional constituent quarks and Polyakov loops. We determine the parameters of the Lagrangian at zero temperature in a hybrid approach, where we treat the mesons at tree-level, while the constituent quarks at 1-loop level. We assume two nonzero scalar condensates and determine their temperature and baryochemical potential dependence according to the hybrid 1-loop level equations of states. We determine whether there is a critical endpoint of the phase boundary in the baryochemical potential - temperature plane. We also investigate the changes of the tree-level scalar/vector meson masses in the hot and dense medium.

77 - Feasibility studies for the Forward Spectrometer

Talks - Friday 26 September 2014 18:30

Presenter: Mr. BIERNAT, Jacek (Jagiellonian University)

The Forward Spectrometer developed for the PANDA detector will consist of many different detection systems allowing for a precise track reconstruction and particle identification. A feasibility studies done for the forward spectrometer will be presented. In the first part results of the simulations will be shown with the focus on studies of particle occupancies of the tracking stations. In next importance of the Forward tracker for the reconstruction of the DDbar decays will be shown on example of the reconstruction of Ψ(4040) state. Finally, results from tests of the prototype straw-tube tracking chambers, obtained at Forschungzentrum Juelich will be discussed.

90 - A Primer on Nucleosynthesis

Talks - Saturday 27 September 2014 09:15

Presenter: Dr. MUMPOWER, Matthew (University of Notre Dame)

Where do the atoms in your body come from? This question can be answered by invoking ideas from nuclear, particle, and astro physics. The field of nucleosynthesis combines these disciplines by studying processes in nature that create nuclei from pre-existing nucleons or from other nuclei. In this talk I discuss basic concepts of nuclear reactions and astrophysical environments. I provide an overview of the different nucleosynthesis processes observed thus far. From the big bang to supernova explosions each event creates different sectors of isotopes found on the periodic table. Studying the outcome of nucleosynthesis events can teach us not only about astrophysical scenarios but offer great insight into the various epochs of the universe.

54 - Investigating 8B structure for astrophysical applications

Talks - Saturday 27 September 2014 10:00

Presenter: Ms. HENNINGER, Katharine (Gesellschaft fur Schwerionenforschung mbH, Plankstrasse 1, 64291 Darmstadt)

We investigate the structure of proton-rich isotope 8B in the Fermionic Molecular Dynamics (FMD) formalism. The structure of 8B is important for stellar nucleosynthetic reaction rates in the pp chain and for determining the high-energy solar neutrino flux. 8B is difficult to access experimentally, making microscopic calculations especially valuable for determination of associated reaction rates. Clustering plays an important role in the structure of 8B, and FMD is especially well-suited for modelling clustering. For a multiconfiguration treatment we construct the many-body Hilbert space from antisymmetrised angular-momentum projected 8-particle states that are minimised in energy under constraints like matter-, proton- and neutron-radius or quadrupole moments, and add 7Be+p clusters. Our current results suggest a prolate 8B; with a tendancy towards formation of a proton halo.

52 - Phase structure of three and four flavor QCD

Talks - Saturday 27 September 2014 11:00

Presenter: Mr. WELZBACHER, Christian A. (JLU Giessen)

We investigate the phase structure of QCD at finite temperature and light-quark chemical potential. We improve upon earlier results for Nf=2+1 dynamical quark flavors and investigate the ef fects of charm quarks in an extension to Nf=2+1+1. We determine the quark condensate and the Polyakov loop potential using solutions of a coupled set of (truncated) Dyson-Schwinger-equations for the quark and gluon propagators of Landau gauge QCD. At zero chemical potential we fi nd excellent agreement with results from lattice-QCD. With input fi xed from physical observables we find only a very small influence of the charm quark onto the resulting phase diagram at finite chemical potential. We discuss the location of the emerging critical end-point and compare with expectations from lattice gauge theory.

70 - Lattice investigation of tetraquark candidates with two very heavy quarks

Talks - Saturday 27 September 2014 11:30

Presenter: Mr. WAGENBACH, Björn (Johann Wolfgang Goethe-Universität Frankfurt am Main)

We report on an investigation of tetraquark candidates with two very heavy quarks. These two quarks are treated in the static limit, while the other two are dynamical u, d, s or c twisted mass quarks. Different isospin, spin and parity quantum numbers are considered. The relation to systems of four dynamical quarks is discussed.

68 - Antibaryon-nucleus bound states

Talks - Saturday 27 September 2014 14:30

Presenter: Ms. HRTANKOVA, Jaroslava (Nuclear Physics Institute, Rez, Czech Republic)

Antibaryon-nucleus bound states

J. Hrtankova, J. Mares
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The study of the antibaryon-nucleus interaction is an interesting issue as it provides valuable information about the behavior of the antibaryon ($\bar{B}$) in nuclear medium, the in-medium $\bar{B}N$ interaction as well as nuclear dynamics. The possibility of the existence of $\bar{B}$-nucleus bound states - and antiproton states in particular - has attracted much interest in recent years in view of future activities at FAIR [1-5].

This contribution reports on our recent calculations of $\bar{p}$ and $\bar{Y}$ ($Y = Λ, Σ, and Ξ) bound states in selected nuclei, performed within the relativistic mean-field (RMF) approach.

First, the G-parity motivated antibaryon-meson coupling constants were employed and possible deviations from the G-parity values were taken into account by introducing a scaling factor [2]. Various RMF models were used, including a model with density-dependent couplings, in order to study model dependence of the extrapolation of equation of state to higher densities. Our calculations confirmed
large polarization effects of the nuclear core caused by the presence of the antibaryon and revealed significant effect of the $\bar{B}$ self-interaction which was not considered in previous RMF calculations.

Next, we focused on the calculations of $\bar{p}$ nuclear bound states using a potential consistent with $\bar{p}$-atomic data [5]. The imaginary part of the phenomenological optical potential was introduced to describe absorption of the $\bar{p}$ in the nuclear medium and all relevant decay channels were included. The reduction of the phase space for the annihilation products for deeply bound
$\bar{p}$ states was taken into account while treating fully self-consistently energy and density dependencies of the corresponding suppression factors. As a result, the $\bar{p}$ absorption widths significantly decrease when the phase space suppression is considered.

References:

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64 - Non-perturbative relativistic calculations of electronic quantum dynamics in low-energy ion-atom collisions

Talks - Saturday 27 September 2014 15:00

Presenter: Dr. YURY, Kozhedub (Saint Petersburg State University)

Heavy-ion collisions play a very important role in studying of relativistic quantum dynamics of electrons in the presence of strong electromagnetic fields [J. Eichler and W. E. Meyerhof, Relativistic Atomic Collisions, (Academic Press, New York, 1995)]. What is more, if the total charge of the colliding nuclei is larger than the critical one, Z1 + Z2 > 173, such collisions can provide a unique tool for tests of quantum electrodynamic effects at the supercritical fields [W. Greiner, B. Mueller, J. Rafelski, Quantum Electrodynamics of Strong Fields, (Springer-Verlag, Berlin, 1985); Proceedings of the Memorial Symposium for Gerhard Soff, Ed.: W. Greiner and J. Reinhardt, (EP Systema, Budapest, 2005)]. In oder to investigate of these effects one have to be able to describe in details the relativistic quantum dynamics of electrons in low-energy ion-atom collisions. Realization of FAIR project and particular CRYRING at the present GSI SIS18/ESR facility will open novel and unique physics opportunities with large discovery potential for studying low-energy heavy ion-atom collisions.

In the work we present results of non-perturbative relativistic calculations of electronic quantum dynamics in low-energy ion-atom collisions. Method of calculations is based on the independent particle model, where the effective many-particle Hamiltonian is approximated by a sum of single-particle Hamiltonians reducing the electronic many-particle problem to a set of single-particle equations for all electrons in the collision system. Dirac-Kohn-Sham operator is taken as effective sigle-electron Hamiltonian. Solving of the effective single-particle equations is based on coupled-channel approach with atomic-like Dirac-Sturm-Fock orbitals, localized at the ions (atoms) [I.I. Tupitsyn et al., Phys. Rev. A 82 (2010) 042701; 85 (2012) 032712; Y.S. Kozhedub et al., Phys. Scr. T156 (2013) 014053.] Many-particle probabilities are calculated in terms of single-particle amplitudes employing the formalism of inclusive probabilities [H.J. Luedde and R.M. Dreizler, J. Phys. B 18 (1985) 107; P.Kuerpick, H.J.Luedde, Comput. Phys. Commun. 75 (1993) 127]. Calculations are performed for systems already studied experimentally and theoretically Ne--Ne^{9+}, Ar--S^{15+}, as well as for systems Xe--Xe$^{52+ - 54+}$, Xe—Bi^{83+}, which experimental research is planed at GSI in the nearest future. The role of relativistic and many-particles effects is analyzed.

74 - Bound-electron g-factor and fundamental constants

Talks - Saturday 27 September 2014 15:30

Presenter: Mr. GLAZOV, Dmitry (Saint Petersburg State University)

High-precision measurements of the g-factor of highly charged ions are among the physics topics of the FLAIR collaboration within the framework of FAIR. Simultaneous experimental and theoretical study of the g-factor of light hydrogen-like ions provided the best up-to-date determination of the electron mass [1]. First ppb-precision measurement for lithium-like system has been accomplished recently [2]. Experiments with heavy boron-like ions will lead to independent determination of the fine structure constant [3]. As an indispensable step towards this goal, the g-factor of boron-like argon is to be measured within the ARTEMIS experiment at GSI [4]. The correspondingly high accuracy of the theoretical values requires complex calculations within the framework of bound-state QED. The most recent results obtained by our group demonstrate perfect agreement between the theory and experiment at the level of 10^{-8} [5]. Presented are the recent developments on both experimental and theoretical sides as well as the plans for future.

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83 - Towards Proton Therapy and Radiography at FAIR

Talks - Saturday 27 September 2014 16:00

Presenter: PRALL, Matthias (GSI, Darmstadt)

Protons having energies in the GeV range have been proposed as an alternative to Bragg-peak hadron therapy. This strategy reduces lateral scattering and overcomes uncertainties of particle range and relative biological effectiveness. GeV protons could additionally be used for targeting in image guided stereotactic radiosurgery. We experimentally demonstrated the potential of GeV protons for imaging of biological samples using E=0.8 GeV protons and the pRad setup at Los Alamos National Laboratory (LANL). In this setup, a system of magnetic lenses creates a point-to-point mapping from object to detector. This mapping compensates image blur due to lateral scattering. The known transmission function T(x) allows to derive the areal density x of a measured object from a count rate. We produced 2-dim proton radiographs of PMMA test objects, biological samples, an anthropomorphic phantom and performed simple dosimetry. High resolution tomographic reconstructions were derived from the 2-dim proton radiographs.

The application of relativistic protons to diagnostic has shown promising results. Our experiment was performed within the framework of the PANTERA (Proton Therapy and Radiography) project.

In the future, the proton microscope PRIOR (Proton Microscope for FAIR) located in the FAIR facility (Darmstadt), will focus on optimizing the technique for imaging of lesions implanted in animals and couple the irradiation with standard radiotherapy.