# HK 29: Schwerionenkollisionen und QCD Phasen

Zeit: Dienstag 14:00–16:00 Raum: HSZ-201

**Gruppenbericht** HK 29.1 Di 14:00 HSZ-201

**J/$\psi$ production in Pb–Pb collisions at $\sqrt{s_{\rm NN}} = 2.76$ TeV measured with ALICE at the LHC** — •Jens Wiechula for the ALICE-Collaboration — Physikalisches Institut, Eberhard Karls Universität Tübingen

Charmonium production has been proposed as an important probe to study the phase of deconfined quarks and gluons (QGP) produced in ultra-relativistic heavy-ion collisions. Due to their large mass, charm quark production can only happen in the initial parton interactions, so that they participate in the whole collision evolution. More than 25 years ago it was predicted that $J/\psi$ production, due to colour screening mechanisms in the QGP phase, should be suppressed in ultra-relativistic heavy-ion collisions in comparison to the yield in pp collisions scaled by the number of binary nucleon-nucleon interactions. This effect has indeed been observed, first at the SPS and later by the RHIC experiments. At LHC energies, however, the large abundance of produced charm quarks allows for studying other $J/\psi$ production mechanisms via (re)combination of $c$ and $\bar{c}$ quarks.

ALICE is the dedicated heavy-ion experiment at the LHC. $J/\psi$ production is measured at mid- and forward rapidity in the di-electron and di-muon decay channel, respectively. In both rapidity intervals the acceptance reaches down to $p_{\rm T} = 0$, being unique among the LHC experiments. Results on the nuclear modification factor ($R_{\rm AA}$) will be presented. A differential analysis as a function of transverse momentum, rapidity and collision centrality has been performed. The results will be discussed and compared to various theoretical calculations.

HK 29.2 Di 14:30 HSZ-201

**J/$\psi$-Hadron Correlations in Proton-Proton Collisions and J/$\psi$ in Proton-Lead Collisions with the Central Barrel of ALICE at the LHC** — •Michael Winn for the ALICE-Collaboration — Physikalisches Institut, Universität Heidelberg

The description of J/$\psi$ production in proton-proton (pp) and in proton-nucleus (pA) collisions remains challenging for theory based on perturbative QCD and factorization. Furthermore, the investigation of J/$\psi$ in pp and pA collisions represents an important reference for heavy-ion collisions, where the behaviour of charmonium is seen as a key observable for deconfinement. In this context, in addition to cross section and polarization measurements, azimuthal J/$\psi$-hadron correlations provide further information constraining the responsible mechanisms at work.

The central-barrel detectors of ALICE ($|\eta| < 0.9$) are well suited to detect J/$\psi$ in its dielectron decay channel and the associated charged tracks in the same event with full azimuthal coverage. First results of azimuthal J/$\psi$-hadron correlations in pp collisions at a center-of-mass energy of 7 TeV will be shown. Finally, the potential of ALICE for J/$\psi$ measurements in proton-lead collisions with the central barrel will be discussed.

HK 29.3 Di 14:45 HSZ-201

**Perspectives of $\psi'$ and $\chi_c$ measurements in ALICE** — •Steffen Weber for the ALICE-Collaboration — TU Darmstadt, Institut für Kernphysik, Darmstadt, Germany

ALICE is a dedicated heavy-ion experiment at the LHC at CERN. The LHC can deliver proton and heavy-ion beams with center-of-mass-energies up to $\sqrt{s} = 14$ TeV for protons and $\sqrt{s_{NN}} = 5.5$ TeV for heavy ions.

At such high energies, $c\bar{c}$-pairs are abundantly produced. They can either form open charm hadrons or quarkonia. The latter are important probes of the hot medium created in heavy-ion collisions. Different models predict either suppression [1] or enhancement [2] of charmonia production in a quark-gluon-phase. Measurements of $\psi'$ and $\chi_c$ states would allow to distinguish different production mechanisms.

We present perspectives for $\psi'$ and $\chi_c$ measurements in ALICE. We will especially highlight these measurements in connection with the ALICE upgrade plans [3].

[1] T. Matsui and H. Satz, Phys. Lett. B 178, (1986)
[2] P. Braun-Munzinger and J. Stachel, arXiv:0901.2500 [nucl-th], (2009)
[3] L. Musa et al., CERN-LHCC-2012-012, (2012)

HK 29.4 Di 15:00 HSZ-201

**Electron Trigger with the ALICE TRD** — •Uwe Westerhoff for the ALICE-Collaboration — WWU Münster

Electrons are an important probe to investigate the properties of pp, p-Pb and Pb-Pb collisions.

One source of electrons are the semi-leptonic decays of heavy-flavour hadrons (open charm and beauty). The measurement of these hadrons can be used to test predictions of pertubative QCD. To get a sufficiently large sample of these particles at high transverse momenta, an electron trigger is required.

The J/$\psi$ is an important particle to study proton-proton collisions as well as to investigate the properties of the quark-gluon plasma created in lead-lead collisions. One option to measure this particle is via the decay channel J/$\psi \rightarrow e^+ e^-$. Due to the rather low mass of 3.1 GeV/$c^2$ of the J/$\psi$, an electron trigger with a low transverse momentum threshold is required.

The Transition Radiation Detector (TRD) of the ALICE experiment can provide these triggers. We will report on the mode of operation for the electron triggers and their performance in proton-proton collisions at $\sqrt{s} = 8$ TeV.

HK 29.5 Di 15:15 HSZ-201

**Can heavy quarkonia be used as thermometers in heavy-ion collisions?** — •Nicolas Borghini — Universität Bielefeld

Heavy quarkonia have long been proposed as probes of deconfinement in heavy-ion collisions, and more recently, they were put forward as thermometers of the created matter. I shall examine this claim in the view of our knowledge on the dynamics of the medium, and argue that quarkonia are far from constituting such a tool. Eventually, I shall present some options for describing heavy quark-antiquark pairs in a dynamically evolving environment.

HK 29.6 Di 15:30 HSZ-201

**Elliptic Flow of $J/\psi$ at Mid-Rapidity in Pb–Pb Collisions at $\sqrt{s_{NN}} = 2.76$ TeV with the ALICE experiment** — •Julian Book — Institut für Kernphysik, Goethe-Universität Frankfurt am Main

The investigation of the properties of strongly interacting matter under extreme conditions is the aim of the ALICE experiment. Quarkonia, i.e. bound states of heavy (charm or bottom) quarks such as the J/$\psi$, are expected to be produced in initial hard scattering processes in hadronic collisions. Thus they will provide insights into the earliest and hottest stages of nucleus-nucleus collisions where the formation of a Quark-Gluon Plasma is expected. The recent measurement of the $J/\psi$ production in Pb–Pb collisions performed by ALICE at the LHC clearly showed less suppression with respect to SPS and RHIC results. The study of azimuthal anisotropy of particle production gives information on the collective hydrodynamic expansion of the QGP. Therefore, the measurement of the elliptic flow of $J/\psi$ will help to understand the (re)generation mechanism and the degree of $J/\psi$ thermalisation in Pb–Pb collisions at LHC energies. We present the first look into the elliptic flow measurement of $J/\psi$ decaying into $e^+e^-$ obtained at mid-rapidity ($|y| < 0.9$) in semi-central collisions and discuss its impact together with the results for $J/\psi$ decaying into $\mu^+\mu^-$ measured at forward rapidities ($2.5 < y < 4.0$).

HK 29.7 Di 15:45 HSZ-201

**Heavy quarks in a (3+1) dimensional hybrid approach** — •Thomas Lang — Frankfurt Institute for Advanced Studies (FIAS), Ruth-Moufang-Straße 1, D-60438 Frankfurt — Institut für Theoretische Physik, Goethe-Universität Frankfurt, Max-von-Laue-Straße 1, D-60438 Frankfurt

We have implemented a Langevin approach for the transport of heavy quarks in the UrQMD hybrid model. Here two different sets of drag and diffusion coefficients are used, one based on a $T$-Matrix approach and one based on a resonance model. In case of the resonance model we have investigated the effects of different decoupling temperatures of the heavy quarks from the medium, ranging between 130 MeV and 180 MeV. We present calculations of the nuclear modification factor $R_{AA}$, as well as of the elliptic flow $v_2$ in Au+Au collisions at

$\sqrt{s_{NN}} = 200\,\text{GeV}$ and Pb+Pb collisions at $\sqrt{s_{NN}} = 2.76\,\text{TeV}$. In order to compare with data at RHIC and LHC we have implemented a Peterson fragmentation and a quark coalescence approach followed by the semileptonic decay of the D- and B-mesons to electrons. We find that our results strongly depend on the decoupling temperature and the hadronization mechanism. At a decoupling temperature of 130 MeV we reach a good agreement with the measurements at both, RHIC and LHC energies, simultaneously for the elliptic flow $v_2$ and the nuclear modification factor $R_{AA}$. We also make a prediction for the medium modification of charm quarks at FAIR energies.

Supported by the Hessian LOEWE initiative through the Helmholtz International Center for FAIR (HIC for FAIR), GSI, and HGS-HIRe.