HIPSTARS 2022 - Workshop on Heavy Ion Physics and Compact Stars

Report of Contributions

https://indico.global/e/13353

Contribution ID: **1** Type: **Talk**

Phi meson properties in nuclear matter from dilepton and K+K- decays in a transport approach

Tuesday 25 October 2022 11:35 (25 minutes)

The status of recent theoretical research related to the behavior of the ϕ meson in nuclear matter is reviewed, focusing on observables that will be measured at the J-PARC E16 experiment, including dilepton and K^+K^- decay modes and their angular distributions. The relation of these observables to fundamental properties of the strong interaction and nuclear matter, such as chiral symmetry, its partial restauration in nuclear matter, in-medium Lorentz symmetry violation and the resultant modification of hadronic dispersion relations, are also discussed.

Author: GUBLER, Philipp (JAEA)

Presenter: GUBLER, Philipp (JAEA)

Session Classification: Contribution talks

Contribution ID: **2** Type: **Talk**

Exploring jet transport coefficients by elastic scattering in the strongly interacting quark-gluon plasma

Tuesday 25 October 2022 10:50 (25 minutes)

We study the interaction of leading jet partons in a strongly interacting quark-gluon plasma (sQGP) medium based on the effective dynamical quasi-particle model (DQPM). The DQPM describes the non-perturbative nature of the sQGP at finite temperature T and baryon chemical potential μ_B based on a propagator representation of massive off-shell partons (quarks and gluons) whose properties (characterized by spectral functions with T, μ_B dependent masses and widths) are adjusted to reproduce the lQCD EoS for the QGP in thermodynamic equilibrium. We present the results for the jet transport coefficients, i.e. the transverse momentum transfer squared per unit length $\hat{q}$ as well as the energy loss per unit length $\Delta E = dE/dx$, in the QGP and investigate their dependence on the temperature T and baryon chemical potential μ_B as well as on jet properties such as the leading jet parton momentum, mass, flavor, and the choice of the strong coupling constant. In this first study only elastic scattering processes of a leading jet parton with the sQGP partons are explored discarding presently the radiative processes (such as gluon Bremsstrahlung). We present a comparison of our results for the elastic energy loss in the sQGP medium with the pQCD results obtained by the BAMPS and LBT models as well as with other theoretical approaches such as lattice QCD and the LO-HTL and also with estimates of $\hat{q}/T^3$ by the color string percolation model (CSPM) and the JET and JETSCAPE Collaborations based on a comparison of hydrodynamical calculations with experimental heavy-ion data.

Authors: GRISHMANOVSKII, Ilia (ITP, Frankfurt); SONG, Taesoo; SOLOVEVA, Olga (Goethe University Frankfurt); GREINER, Carsten (University of Frankfurt); BRATKOVSKAYA, Elena

Presenter: GRISHMANOVSKII, Ilia (ITP, Frankfurt)

Session Classification: Contribution talks

Contribution ID: **3** Type: **Talk**

Effects of the magnetic field on gravitational waves from spheroidal strange stars

Friday 28 October 2022 10:55 (25 minutes)

The macroscopic structure of magnetized strange stars is deformed due to the anisotropy in the pressures as a consequence of the magnetic field. In this work, we study implication of the magnetic field deformation in gravitational waves emission from strange stars.

Authors: Dr PÉREZ MARTÍNEZ, Aurora (ICIMAF/University of Salamanca); Dr MANREZA PARET, Daryel (University of Havana); Ms LÓPEZ PÉREZ, Samantha (ICIMAF)

Presenter: Ms LÓPEZ PÉREZ, Samantha (ICIMAF)

Session Classification: Contribution talks

Contribution ID: **4** Type: **Talk**

Mechanisms for deuteron production in HICs with PHQMD transport approach

Tuesday 25 October 2022 10:25 (25 minutes)

The Parton-Hadron-Quantum-Molecular Dynamics (PHQMD) is a microscopic transport approach designed to describe the dynamical formation of clusters in HICs [1]. Within this framework we discuss the production of deuterons by two different mechanisms. The first one is the 'kinetic' formation of deuterons by inelastic $NNN \to Nd$ and $\pi NN \to \pi d$ scattering processes which we implement by means of the covariant rate formalism [2]. Moreover, we investigate within these reactions the inclusion of finite-size effects modeled on the deuteron quantum wave function.
The second mechanism accounts for the formation of deuteron by the 'potential' interaction among nucleons. To recognize those baryons which gather together into clusters, we employ the Minimum-Spanning-Tree (MST) algorithm which looks for correlations of nucleons in coordinate space during the PHQMD evolution of the expanding matter [3]. Finally, we show that the combination of the two mechanisms provides a good description of the available experimental measurements in a large HICs energy range.

[1] J. Aichelin, E. Bratkovskaya, A. Le Fèvre, V. Kireyeu, V. Kolesnikov, Y. Leifels, V. Voronyuk and G. Coci, "Parton-hadron-quantum-molecular dynamics: A novel microscopic n -body transport approach for heavy-ion collisions, dynamical cluster formation, and hypernuclei production", Phys. Rev. C 101 (2020) no.4, 044905.

[2] W. Cassing, "Anti-baryon production in hot and dense nuclear matter", Nucl. Phys. A 700, 618-646 (2002).

[3] S. Gläßel, V. Kireyeu, V. Voronyuk, J. Aichelin, C. Blume, E. Bratkovskaya, G. Coci, V. Kolesnikov and M. Winn, "Cluster and hypercluster production in relativistic heavy-ion collisions within the parton-hadron-quantum-molecular-dynamics approach", Phys. Rev. C 105 (2022) no.1, 014908.

Authors: BLUME, Christoph (Goethe University Frankfurt (DE)); BRATKOVSKAYA, Elena; COCI, Gabriele (HFHF & Goethe University, Frankfurt); AICHELIN, Joerg (SUBATECH); GLÄSSEL, Susanne; KOLESNIKOV, Vadim; VORONYUK, Vadim; KIREYEU, Viktar (Joint Institute for Nuclear Research (RU))

Presenter: COCI, Gabriele (HFHF & Goethe University, Frankfurt)

Session Classification: Contribution talks

Contribution ID: **5** Type: **Talk**

Dynamics of the QGP phase at finite baryon density

Tuesday 25 October 2022 10:00 (25 minutes)

We present equilibrium as well as out-of-equilibrium properties of the strongly interacting QGP medium under extreme conditions of high temperature T and high baryon densities or baryon chemical potentials μ_B within a kinetic approach. We will explore first the thermodynamic and transport properties of the QGP close to equilibrium in the framework of effective models with $N_f = 3$ active quark flavours such as the Polyakov extended Nambu-Jona Lasinio (PNJL) [1] and dynamical quasiparticle model with the CEP (DQPM-CP) [2], and compare the results.
Furthermore, out-of equilibrium properties of the QGP medium and in particular, the effect of a μ_B - dependence of thermodynamic and transport properties of the QGP are studied within the Parton-Hadron-String-Dynamics (PHSD) transport approach [3,4].
The PHSD covers the full evolution of the system during HICs, including the partonic phase as well as the phase transition between the hadronic and partonic phases, where the microscopic properties of quarks and gluons are described by the DQPM.
The DQPM interprets the EoS in terms of dynamical degrees of freedom and allows evaluating the cross sections of the corresponding elastic and inelastic reactions, which are essential for the transport evolution.
The microscopic properties of partonic quasiparticles and their differential cross sections depend not only on the temperature T but also on the chemical potential μ_B explicitly in these studies.

We find that bulk observables and flow coefficients for strange hadrons as well as for antiprotons are more sensitive to the properties of the QGP, in particular to the μ_B - dependence of QGP interactions.

[1] O. Soloveva, D. Fuseau, J. Aichelin and E. Bratkovskaya,
Phys. Rev. C 103 (2021) no.5, 054901

[2] O. Soloveva, J. Aichelin and E. Bratkovskaya,
Phys. Rev. D 105 (2022) no.5, 054011

[3] W. Cassing and E.L. Bratkovskaya,
Nucl. Phys. A 831 (2009), 215-242

[4] P. Moreau, O. Soloveva, L. Oliva, T. Song, W. Cassing and E. Bratkovskaya,
Phys. Rev. C 100 (2019) no.1, 014911

Authors: BRATKOVSKAYA, Elena (GSI, Darmstadt); GRISHMANOVSKII, Ilia (ITP, Frankfurt); AICHELIN, Joerg (SUBATECH); OLIVA, Lucia (Università di Catania, INFN Catania); SOLOVEVA, Olga (Goethe University Frankfurt); Dr MOREAU, Pierre (Duke University); SONG, Taesoo; VORONYUK, Vadim; KIREYEU, Viktar (Joint Institute for Nuclear Research (RU))

Presenter: SOLOVEVA, Olga (Goethe University Frankfurt)

Session Classification: Contribution talks

Contribution ID: **6** Type: **Talk**

On the propagation of photons in rotating neutron stars including quantum and gravitational effects.

Friday 28 October 2022 11:40 (25 minutes)

Observational evidence indicates that there is a difference between the times of arrival at terrestrial detectors of electromagnetic radiation of different frequencies from space. This delay time has been observed for photons from cosmic rays, galaxies, neutron stars and even black holes. The origin of this delay is due to dispersion of the wave on his journey to Earth, caused by quantum contributions in the presence of the interstellar plasma and effects of space-time curvature. The objective of this work is to estimate the time delay of photons in an external magnetic field and apply the results to an astrophysical scenario: the magnetosphere of neutron stars. For their study the contribution of the medium analyzing the propagation of photons perpendicular to the magnetic field. We start from quantum electrodynamics considering radiative corrections, the photon polarization operator, in the one loop approximation. From this one, the dispersion equations of the polarization modes are solved in terms of analytical functions. Also, we employ a model to describe the pulsar's magnetosphere; composed by matter (electron-positron charged plasma) and a toroidal magnetic field. We obtain a general result valid in a wide range of energies and fields considering only the degenerate gas limit. We also include the effects of space-time curvature that modify the trajectory of light and add an extra time delay.

Authors: ROMERO JORGE, Adrian William (ICIMAF); PEREZ MARTINEZ, Aurora (ICIMAF); RODRÍGUEZ QUERTS, Elizabeth (ICIMAF)

Presenter: ROMERO JORGE, Adrian William (ICIMAF)

Session Classification: Contribution talks

Contribution ID: **7** Type: **Talk**

Bose-Einstein Condensation of a magnetized gas of charged scalar bosons revisited

Friday 28 October 2022 10:30 (25 minutes)

Charged scalar bosons may naturally form in the interior of neutron stars due to the pairing of protons with antiparallel spins. Although the concentration of proton pairs is small with respect to that of neutrons or neutron pairs, they might still have a relevant role in the macrophysics of these compact objects, especially in connection to their response to the strong magnetic fields of neutron stars. In this work, we study the effects of a uniform and constant magnetic field on the Bose-Einstein Condensation (BEC) of a magnetized gas of charged scalar bosons. The condensation of relativistic magnetized charged bosons is discussed usually in the weak (WF) or strong (SF) field regimes separately. In the WF limit, the gas undergoes a usual transition to the BEC, and the critical temperature depends on the magnetic field. In the SF regime, all the particles are confined to the lowest Landau level, making the system effectively one-dimensional. Since one-dimensional Bose gases do not exhibit BEC, it has been debated whether or not a magnetized scalar gas condenses. Indeed, in the SF regime, a critical temperature cannot be defined, but it can be shown that there exists an interval of temperatures along which the bosons start to concentrate around the ground state, indicating the occurrence of a diffuse phase transition. Here we review these limits and develop a low-temperature analysis suitable for any field that allows us to observe how the gas evolves from one regime to the other.

Authors: QUINTERO, Gretel; PÉREZ MARTÍNEZ, Aurora (ICIMAF/University of Salamanca); PEREZ ROJAS, Hugo Celso (Unknown)

Presenter: QUINTERO, Gretel

Session Classification: Contribution talks

Contribution ID: **8** Type: **Talk**

Compact stars and magnetic fields

Thursday 27 October 2022 10:00 (30 minutes)

I will review some fundamental aspects about the origin and evolution of magnetic fields in compact objects. From flux conservation in supernova collapse to dynamo models. I will also expose the main difficulties to explain the intense magnetic field measured in magnetars. Finally, I will relate this phenomenology to the magnetic fields observed in heavy ion collisions.

Author: MANREZA, Daryel (Universidad de La Habana, Facultad de Física)

Presenter: MANREZA, Daryel (Universidad de La Habana, Facultad de Física)

Session Classification: Contribution talks

Contribution ID: **9** Type: **not specified**

Macroscopic Models for Magnetized Compact Stars

Thursday 27 October 2022 10:30 (25 minutes)

Compact stars (white dwarfs and neutron stars) possess strong magnetic fields that affect their micro and macrophysics. In recent years, several theoretical models of magnetized compact objects have been developed, considering different approximations and assumptions about the geometry and intensity of the stellar magnetic field. Such suppositions reflect on the resulting structure equations, i.e., the solutions of Einstein's field equations used to compute the star's observables. Consequently, many of these models differ in their predictions about the properties of magnetized compact objects. Our goal here is to explore to what extent the effects of the magnetic field on the observables depend on the model used to compute them. To do so, we first compare the predictions of several sets of structure equations, trying to get an insight into their differences. Later, we perform a deeper study for two macroscopic models of axisymmetric non-rotating stars under the action of a uniform and constant magnetic field. We computed the macroscopic properties of magnetized white dwarfs, strange stars, and Bose-Einstein condensate stars given by each of these two models and found that their predictions are consistent as long as they are used with the same equation of state, so that the influence of the magnetic field in the observables mainly depends on the microscopic description of the star. However, there are features that appear to be ruled by the geometry of the magnetic field and the approximations taken to obtain the structure equations. Hence, we propose some strategies to discern between both possibilities.

Authors: RODRIGUEZ, Adriel; Dr QUINTERO ANGULO, Gretel (University of Havana)

Presenters: RODRIGUEZ, Adriel; Dr QUINTERO ANGULO, Gretel (University of Havana)

Session Classification: Contribution talks

Contribution ID: **10** Type: **not specified**

Stability Analysis of Mixed Stars

Thursday 27 October 2022 12:05 (25 minutes)

An analysis of the parameter space that characterizes the possible limit of the collapse of a real scalar field with spherical symmetry coupled with matter in a linear way and under two types of constitutive equations (linear and polytropic) is carried out. The methodology for obtaining the solutions involves adjusting the relationships between the energy density of matter (fixed in advance) and the central value of the scalar field (searched) in such a way that the solution of the scalar field shows Yukawa potential-like behavior. This relationship is plotted for different values of the coupling constant. Then the different mass values are obtained and subjected to the necessary stability conditions. For the stability criteria, the weak energy condition and the fact that the total mass of the system increases with the growth of the energy density at the origin, among others, are used.

Author: GARCÍA, Carlos Manuel

Presenter: GARCÍA, Carlos Manuel

Session Classification: Contribution talks

Contribution ID: **11** Type: **Talk**

Deciphering flow at SIS energies: A look through the keyhole

Monday 24 October 2022 10:30 (25 minutes)

The elliptic flow of hadrons at SIS energies is negative due to immense shadowing from the spectators shielding the collision zone. In this talk it is discussed how this measured negative elliptic flow is created through the decoupling dynamics. In contrast to the final state observed flow, the flow of the whole system during the time evolution is found to be positive due to the early pressure gradient exerted by the Equation-of-State. A measurement of the elliptic flow of di-leptons is proposed as a method to determine the early Equation-of-State independently from the elliptic flow of protons and pions which is dominated by the shadowing effect. This poses the unique opportunity for the HADES and CBM collaborations to measure the Equation-of-State directly at 2-3 times nuclear saturation density.

Author: REICHERT, Tom

Presenter: REICHERT, Tom

Session Classification: Contribution talks

Contribution ID: **12** Type: **Talk**

Equation of state of photons propagating in magnetized vacuum.

Friday 28 October 2022 10:00 (30 minutes)

The photon propagation in a magnetized vacuum is described by non-linear electrodynamics. In this framework, the Energy momentum Tensor is obtained using the robust Euler-Hilbert method that allows getting physical quantities in particular the equation of state. The pressure becomes anisotropic and it is possible to define a pressure perpendicular and parallel to the magnetic field. The calculation is done for arbitrary values of the magnetic field 0<B/Bc<430 applicable for understanding Astrophysical phenomena but also to confirm QED predictions, using top-table experiments with pulsating lasers, or interpreting results as signals of new physics.

Author: Dr PEREZ MARTINEZ, Aurora (USAL)

Co-authors: Dr PEREZ-GARCIA, M Angeles (USAL); RODRIGUEZ QUERTS, Elizabeth (Instituto de Cibernética Matemática y Física ICIMAF)

Presenter: Dr PEREZ MARTINEZ, Aurora (USAL)

Session Classification: Contribution talks

Contribution ID: **13** Type: **Talk**

Scalar field mass estimation from the existence of Dynamical Gravastar

Friday 28 October 2022 12:05 (25 minutes)

A value for the mass of the scalar field is estimated from conjecturing the existence of Dynamic Gravastars as Black Hole candidates.
This mass is determined assuming that the mass of the DG corresponds with the intermediate mass gap, fixing around the values determined in GW190521 by the gravitational wave experiments Ligo-Virgo.

Authors: FONTANELLA, Duvier (ICIMAF); CABO MONTES DE OCA, Alejandro (ICIMAF)

Presenter: FONTANELLA, Duvier (ICIMAF)

Session Classification: Contribution talks

Contribution ID: **14** Type: **Talk**

Using machine-learning to explore hadron collisions

Tuesday 25 October 2022 12:00 (30 minutes)

In this talk, we explain how machine-learning techniques (in particular, neural networks) can be applied to reconstruct the parton kinematics. We use as a reference process the production of pion+photon in hadron collisions, although the methodology can be easily extrapolated to any process. Besides reproducing results available in the literature, we provide a practical strategy to estimate the error associated with the reconstruction. These tools could be implemented in heavy ion collisions, in order to shed light to the laws governing the microscopic behaviour of Nature.

Author: SBORLINI, German (Universidad de Salamanca)

Presenter: SBORLINI, German (Universidad de Salamanca)

Session Classification: Contribution talks

Contribution ID: **15** Type: **Talk**

CLASS code for numerical cosmological computations

Thursday 27 October 2022 11:40 (25 minutes)

We describe the use of the numerical code CLASS (Cosmic Linear Anisotropy Solving System) by Julien Lesgourgues. Our main objective is to know the capabilities of this code to use it in the calculation of inflationary models of the early universe in the framework of the Lee-Wick theory. In this talk we will give an introduction of the main features of this numerical code.

Presenter: CASTILLO, Amanda (Facultad de Física, Universidad de La Habana, Cuba)

Session Classification: Contribution talks

Contribution ID: **16** Type: **Talk**

Equations of state of neutron stars using CompOSE

Thursday 27 October 2022 10:55 (25 minutes)

We review the use of the CompOSE database of equations of state (EoS) of neutron stars. Our goal is to use several EoS to study the maximum mass of neutron stars and try to prove in the mass gap (lack of objects in the interval from 2 to 5 solar masses). We will present how to use the code and how to extract the relevant parameters.

Presenter: MARTINEZ, Achely (Facultad de Física, Universidad de La Habana, Cuba)

Session Classification: Contribution talks

Contribution ID: **17** Type: **Talk**

Correcting the B_A coalescence factor at GSI-HADES and RHIC-BES energies

Monday 24 October 2022 10:55 (25 minutes)

We investigate the coalescence factors B_2 and B_3 at low collision energies ($\sqrt{s_{\rm NN}} < 6$ GeV) with special focus on the HADES and RHIC-BES experiments. It is shown that, in order to properly interpret the coalescence factors B_A, two important corrections are necessary: I) B_2 has to be calculated using the proton $\times$ neutron yields in the denominator, instead of the square of the proton yield, and II) the primordial proton (neutron) densities have to be used for the normalization and not the final state (free) protons (neutrons). Both effects lead to a drastic reduction of B_2 and B_3 at low energies. This reduction decreases the discrepancy between the volumes extracted from HBT measurements and the volumes extracted from the coalescence factor ($V \propto 1/B_2$). While at HADES and low RHIC-BES energies these corrections are substantial, they become irrelevant above $\sqrt{s_{\rm NN}} > 6$ GeV. The proposed correction method is model independent and is only based on the measurement of protons, clusters and charged pions.

Author: Mr KITTIRATPATTANA, Apiwit (Institut für Theoretische Physik, Goethe Universität Frankfurt, Max-von-Laue-Strasse 1, 60438 Frankfurt am Main, Germany)

Presenter: Mr KITTIRATPATTANA, Apiwit (Institut für Theoretische Physik, Goethe Universität Frankfurt, Max-von-Laue-Strasse 1, 60438 Frankfurt am Main, Germany)

Session Classification: Contribution talks

Contribution ID: **18** Type: **not specified**

Microscopic description of beta decay rates of r process nuclei

Monday 24 October 2022 11:40 (25 minutes)

TBA

Author: ALVEAR TERRERO, Diana (TU-Darmstadt/Helmholtz Research Academy Hesse for FAIR (HFHF), Germany & ICIMAF, Cuba)

Presenter: ALVEAR TERRERO, Diana (TU-Darmstadt/Helmholtz Research Academy Hesse for FAIR (HFHF), Germany & ICIMAF, Cuba)

Session Classification: Contribution talks

Contribution ID: **19** Type: **Talk**

Heavy quark diffusion in the hot QCD matter

Monday 24 October 2022 12:05 (25 minutes)

The heavy quarks (HQs) are considered to be effective probes to study the evolution of the QGP. We study the dynamics of HQs in a hot QCD medium with a time-correlated noise, η. We have introduced the effect of memory through η and the dissipative force in the Generalized Langevin equation. We supposed that the time correlations of the colored noise decay exponentially with time, called the memory time, \tau. We have explored the effect of non-zero values of \tau on the nuclear modification factor, RAA, and transverse momentum broadening, \sigma_p of the HQs within the QGP medium. We will also discuss the diffusion of HQs in the pre-equilibrium phase, the Glasma phase, within the framework of the Wong equation and its impact on heavy quark RAA and v2.

Author: DAS, Santosh Kumar (School of Physical Science, Indian Institute of Technology Goa, India)

Presenter: DAS, Santosh Kumar (School of Physical Science, Indian Institute of Technology Goa, India)

Session Classification: Contribution talks

Contribution ID: **20** Type: **not specified**

Hydrodynamics, Thermalization & Entanglement from Spacetime Geometry

Monday 24 October 2022 12:30 (2 hours)

Ultracold gases, the quark-gluon-plasma generated in heavy-ion collisions, as well as black holes constitute isolated quantum systems. They all may start their time-evolution from an initial pure state while they may end up in a mixed final state having produced entropy, which seems like a paradox if time evolution is unitary and the system is isolated. This begs the question how entanglement evolves and how thermalization occurs within these systems. Is there a precise relation among these seemingly different systems? In fact, the answer is yes, holography (gauge/gravity correspondence) provides such a relation [1].
As two examples, we discuss first how heavy-ion collision data and numerical holographic model data indicate that hydrodynamics is a valid approximation even when the system is far away from equilibrium [2,3]. Second, we compute the entanglement entropy [4,5] for a strongly coupled quantum many body system in different states [6].

[1] Van Raamsdonk, Science 370 (2020) 6513, 198-202.
[2] Chesler and Yaffe, Phys.Rev.Lett. 102 (2009) 211601.
[3] Cartwright, Kaminski, Knipfer, arxiv.org/abs/2207.02875.
[4] Ryu and Takayanagi, Phys.Rev.Lett. 96 (2006) 181602.
[5] Hubeny et al., JHEP 07 (2007) 062.
[6] Cartwright and Kaminski, JHEP 01 (2022) 161.

Presenter: KAMINSKI, Matthias

Session Classification: School

Contribution ID: **22** Type: **not specified**

Work on student presentations

Monday 24 October 2022 14:30 (2 hours)

Presenter: BLEICHER, Marcus (Goethe University Frankfurt)

Session Classification: School

Contribution ID: **23** Type: **not specified**

Hadron physics

Tuesday 25 October 2022 14:30 (4 hours)

Presenter: NERLING, Frank (HFHF, GU Frankfurt & GSI Darmstadt)

Session Classification: School

Contribution ID: **24** Type: **not specified**

AGN Physics

Friday 28 October 2022 14:30 (2 hours)

The lecture contains the present status of AGN accretion disc physics and feedback processes from the gravitational radius scale up to the kilo-parsec scale demonstrating how feeding and feedback are working together. Recent results from black hole imaging with the Event Horizon Telescope and gravitational wave detection results will be discussed and prospects for future observations will be worked out.
The outline is as follows:
1.The basics
1.1 Definition
1.2.AGN signatures
1.3.AGN types
1.4.Seyfert unification through physical processes
2.Nuclear components
2.1 Black Hole signatures
2.2 The standard accretion disc
2.3.Deviations from the standard accretion disc
2.4.The Eddington limit
2.5.Accretion disc line physics
2.6.The efficiency limit
2.7.Models for X-ray variability
2.8.Black hole imaging as GR tests
3.Radiation transport
3.1 The transport equation for absorption and emission
3.2.Solving the radiation transport equation
3.3.Physical interpretation of the solution of the transport equation

Author: BOLLER, Thomas

Presenter: BOLLER, Thomas

Session Classification: School

Contribution ID: **25** Type: **not specified**

TBA

Thursday 27 October 2022 14:30 (4 hours)

Presenter: BLEICHER, Marcus (Goethe University Frankfurt)

Session Classification: School