Onsdag 9/8

Chair: Anders Tranberg

13.30 Jörn Kersten: Curing Sterile Neutrino Dark Matter with a Dark Force

We propose a novel mechanism to generate sterile neutrinos ν_s in the early Universe, by converting ordinary neutrinos ν_a in scattering processes $\nu_s\nu_a\to\nu_s\nu_s$. After initial production by oscillations, this leads to an exponential growth in the ν_s abundance. We show that such a production regime naturally occurs for self-interacting ν_s, and that this opens up significant new parameter space where ν_s make up all of the observed dark matter.

13.50 Magdalena Eriksson: Stochastic inflation and its effective noise amplitude

During cosmological inflation, quantum field fluctuations undergo a quantum-to-classical transition on scales larger than the Hubble horizon. The stochastic inflation formalism is an effective theory for the physics of the super-Hubble wavelength parts of quantum scalar fields in (near-)de Sitter geometries. In this framework, the non-linear dynamics of the long-wavelength quantum fluctuations may be phrased in terms of an effective classical, but stochastic evolution equation. The stochastic noise represents short-wavelength modes which continually redshift into the long-wavelength domain during the inflationary expansion. Long-wavelength observables can then be computed from a corresponding Fokker-Planck equation. Interestingly, results for the late-time correlation functions using the stochastic approach has been favourably compared to perturbation theory at leading order in the infrared. The stochastic approach has also been shown to reproduce some non-perturbative results (e.g. a dynamical mass), which has made it a popular alternative to the more comprehensive field theoretical resummation methods adapted to expanding spacetimes. Nevertheless, the field-theoretical embedding of the stochastic approach, and its range of validity compared to the other QFT methods, is still not fully understood. In this talk I will review how an effective stochastic description can emerge from first-principles QFT in an expanding background, and I will highlight the key approximations and assumptions that are required to achieve this.

14.10 Vegard Undheim: Gravitational wave science arrives at Stavanger

The University of Stavanger has recently joined LIGO, which is the topic of this talk! I will cover some basics about what LIGO and gravitational waves are, as well as what I do to contribute.

14.30 Alexander Rothkopf: Machine-learning assisted complex Langevin real-time simulations

In this talk I present recent progress in stabilising and significantly extending the range of validity for direct real-time simulations of strongly correlated quantum systems in the complex Langevin framework. Our approach takes inspiration from the reinforcement learning paradigm of machine learning to learn optimal modifications of the stochastic complex Langevin dynamics, which achieve correct convergence at more than 3 times the current record for naive complex Langevin in the literature.

14.50 Konrad Tywoniuk: Exploring the Equilibration Time of the QGP with Jet Quenching

Heavy-ion collisions produce a quark-gluon plasma that undergoes rapid expansion and cooling, which presents a challenge for calculating jet quenching observables. Current approaches rely on analytical results for static cases, introducing theoretical uncertainties and biases in our understanding of the pre-equilibrated medium.

To address this issue, we employ analytical resummation schemes to incorporate multiple scattering in a class of expanding backgrounds. By introducing a new length scale related to the equilibration time of the QGP, we investigate the range of validity of Bethe-Heitler emissions, LPM interference effects, and higher-twist contributions to the emitted gluon spectrum. We also discuss methods to mitigate the non-local nature of the emission spectrum.

Our analysis shows that strong jet quenching is only possible when the equilibration time of the medium is longer than its mean free path, highlighting the importance of medium modifications of jets in the earliest stages of heavy-ion collisions.

By accounting for the expansion of the medium, our approach reduces the uncertainties in model predictions for jet quenching observables, providing insights into the nature of the pre-equilibrated medium. This work lays the foundation for further investigations into the dynamics of the QGP and the interplay between jets and the expanding medium.

15.10 Alexandre Falcao: Universality of jet energy loss in the quark-gluon plasma using Bayesian inference

Data from a wide range of jet observables measured in heavy ion collisions provide a comprehensive picture of jet modification by the resulting quark-gluon plasma. In this way, the medium-modified jets act as a perturbative probe that allows us to infer the properties of the medium. However, their interpretation is often limited by the assumptions of specific quenching models, and it remains a challenge to establish model-independent statements about the universality of different jet quenching observables.

In this work, we address this issue by proposing a treatment that is agnostic to the details of the jet-medium interactions and relies only on the universality of quark and gluon quenching in different jet observables. We use Bayesian inference to constrain the parameterisation of the energy loss of quark- and gluon-initiated jets in a data-driven manner. This constraint is primarily performed using the inclusive jet pT spectrum, for which the quark/gluon fraction varies across rapidity. We then predict the observed jet asymmetry in di-jet and boson-jet measurements, providing evidence for the universality of quenching effects.

Furthermore, we examine the extracted Casimir scaling of jet quenching and the role of resolution effects in constraining the early, perturbative jet evolution using these data-driven methods. This study provides a new perspective on the universality of jet quenching in heavy ion collisions, free from the assumptions of specific models.

Torsdag 10/8

Chair: Bjarne Stugu

10.20 Ida Storehaug: Beauty measurements via non-prompt J/ψ in ALICE

The ALICE detector was designed to investigate the quark-gluon plasma (QGP), a deconfined phase of strongly interacting matter which can be formed in heavy-ion collisions. Heavy quarks, such as charm and beauty, are produced in the hard partonic scatterings at the early stage of the collision, prior to QGP formation, and could thus experience energy loss, transport, thermalisation and hadronisation during the QGP phase. These in-medium effects are quantified with the nuclear modification factor ($R_{\rm AA}$), defined as the particle production yield in heavy-ion collisions normalized to that in pp collisions at the same energy, and scaled by the number of binary nucleon-nucleon collisions.

Among the hard probes, charmonium states, an in particular the J/ψ, have been extensively studied down to zero $p_{\rm T}$ in ALICE. Non-prompt J/ψ, being the product of weak decay of beauty hadrons, is a background to the prompt J/ψ, directly produced from charm quarks. However, non-prompt J/ψ production is interesting in its own right. Since it is a proxy for the b-quark production, non-prompt J/ψ can probe the mass dependence of the heavy-quark in-medium energy loss mechanism.

In this contribution, a review of the non-prompt J/ψ $R_{\rm AA}$ results will be presented, as a function of $p_{\rm T}$ and centrality. The signal is reconstructed in the dielectron decay channel at midrapidity ($|y|<0.9$) down to $p_{\rm T}=1.5 \text{ GeV/c}$ and identified via secondary vertices of beauty hadrons, displaced from the primary interaction vertex. Presented results are obtained by analyzing data from Pb–Pb collisions collected at $\sqrt{s_{\rm NN}}$= 5.02 TeV during the LHC Run 2. Comparison to models and prospects for Run 3 will also be presented.

10.40 Anastasia Merzlaya: Open charm measurements at SPS energies in the NA61/SHINE

The study of open charm meson production provides an important tool for detailed investigations of the properties of hot and dense matter formed in nucleus-nucleus collisions. In particular, charm meson data is of vivid interest in the context of the phase-transition between confined hadronic matter and the quark-gluon plasma.

The NA61/SHINE experiment is in the unique position of measuring the D^0 mesons production (via it's $D^0 \rightarrow \pi^{+} + K^{-}$ decay channel) in heavy-ion collisions at SPS energies. The first observation was recently done in Xe+La and Pb+Pb collisions at 150A GeV/c with new Vertex Detector setup which improved special resolution in the target region. Also, NA61/SHINE plans a systematic measurements of open charm production in Pb+Pb collisions in the period 2022-2024 after the major detector upgrade conducted during LS2 which increased data taking rate by order of magnitude.

11.00 Alex Nielsen: Gravitational waves with ground-based detectors of the LVK collaborations

In this short overview I will highlight what has been achieved so far in the field of gravitational wave astronomy, focusing on the LIGO, Virgo, KAGRA detectors. I will also discuss what to expect from the future, including the current observing run and present some of the public tools that can be used to follow along.

Chair: Håvard Helstrup

13.00 Annual meeting of Section for Subatomic physics and astrophysics
13.20 Discussion on Nordic nuclear physics meetings
14.10 Who is who in Nuclear physics in Norway

Would it be possible for the subatomic physics topical group at the NFS to organize a dedicated “Who is Who” in nuclear physics session, in which one representative from each academic institution (+ each dedicated center e.g. NORCC, NNRC and potentially IFE) gives a 5-7 minutes flash talk on their activities and involved researchers? Since most actors should be present at the meeting it would only require a small extra effort for them to prepare such a short presentation.

Fredag 11/8

Chair: Sunniva Siem

10.00 Vetle Wegner Ingeberg: The OSCAR Gamma Detector Array

The OSCAR array is the world largest array of LaBr3:Ce gamma-ray detectors. LaBr3:Ce is a scintillation material that not only has a high efficiency, but also high energy resolution and fast response time. This means that these detectors are extremely versatile and can be used in a large variety of use cases. In this presentation I will present the OSCAR array, its capabilities, and a number of real world use cases.

10.20 Lauren Bell: Dipole Resonances in the Well-Deformed Even-even Samarium (^{152,154}Sm) Isotopes.

In this thesis, an investigation has been carried out in order to study resonances in the γ-ray strength function of two even-even samarium isotopes, namely ^{152}Sm and ^{154}Sm. Specifically, I have investigated two statistical properties, namely the nuclear level density (NLD) and the γ-ray strength function (γSF).

In 2018, an experiment was carried out at the Oslo Cyclotron Laboratory in which 15 and 16 MeV proton beams were irradiated on targets of ^{152}Sm and ^{154}Sm, respectively, allowing the study of the ^{152}Sm$(p,p'\gamma)^{152}$Sm and ^{154}Sm$(p,p'\gamma)^{154}$Sm reactions. I used the Oslo method was used to analyze these data sets to simultaneously extract the NLD and γSF. The extracted NLD and γSFs are plotted along with data obtained from (γ,n) reactions in order to distinguish several resonances which are seen in ^{152,154}Sm. These resonances are then each fitted with a Lorentzian in an attempt to describe the structures which are seen in the γSF.

In this work, a resonance compatible with the Scissors Mode, was found in both isotopes along with a possible spin-flip resonance in ^{154}Sm. Finally I estimated the strength of the Scissors Resonance, $B_{SR}(M1)$, for both ^{152}Sm and ^{154}Sm. These $B_{SR}(M1)$ values were compared with other available samarium isotopes and it was found that the values obtained from this work were in good agreement with other samarium data sets which had been analyzed with the Oslo method.

10.40 Johannes Sørby Heines: Measuring excited states of nuclei with the recoil distance Doppler-shift method

The internal structure of nuclei has a great influence on how they interact. We can gain insight into this structure by measuring the lifetimes of excited states. In an experiment at GANIL, a large array of neutron-rich nuclei with mass number around 100 were produced in a fusion-fission reaction, and their lifetimes were measured with the recoil distance Doppler-shift method. While this method is conceptually elegant, the analysis is far from straight forward. Commonly used techniques involve several intermediate steps, each of which adds uncertainty to the final result. We're working to extract the lifetime directly, using Markov chain Monte Carlo algorithms to take all the data into account without intermediate steps. This talk will give an overview of the experiment and present the status of our research.

11.00 Henrik Haug: Measurements of PFGs from 232Th with different angular

Prompt fission γ-rays (PFGs) hold a vast amount of information about the fission process. They have information on the energy and angular momentum of the fission products, and the competition between neutron and γ emission during fission fragment deexcitation [1]. In designing the next generation of nuclear reactors, there was a call for more precise measurements of PFGs quantities like total γ-energy and multiplicity, in order to get more accurate reactor simulations [2]. Investigating how changing the excitation energy and angular momentum of a fissioning nucleus will affect the PFGs will help improve our understanding of the fission process.

Measuring PFGs with different angular momentum of the fissoning nucleus has not been done before. We are going to measure the PFGs at the Oslo Cyclotron Laboratory. The combination of OSCAR, SiRi and fission detectors makes this a unique experimental set-up for studying PFGs as a function of excitation energy. With the reactions 232T h(p, p′f) and 232T h(α, α′f) we will induce different angular momentum J and energy for the fissioning nucleus. In this talk i will present preliminary results on γ-energy and multiplicities given by the Monte-Carlo based code FREYA.

References
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[2] G Rimpault, D Bernard, D Blanchet, C Vaglio-Gaudard, S Ravaux, and A Santamarina. Needs of accurate prompt and delayed -spectrum and multiplicity for nuclear reactor designs. Physics procedia, 31:3–12, 2012.

11.20 Kevin Ching Wei Li: Disentangling clustering phenomena in 12C and 16O

12C and 16O remain at the forefront of nuclear structure studies as they are the predicted sites for a wide range of interesting phenomena. Furthermore, 12C and 16O play a prominent role in helium burning—a crucial process in the stellar evolution for massive and AGB stars. The challenge of understanding the structures of 12C and 16O thus endures as a litmus test of our ability to not only theoretically model nuclei, but to also phenomenologically analyse/interpret data. This talk will present recent work which aims to disentangle broad, intertwined contributions to the excitation spectra of 12C and 16O, populated through inelastic scattering and transfer reactions.