Hot QCD Matter 2025 (Series 3)

Report of Contributions

Contribution ID: **2** Type: **Poster**

When Stars Collapse in Silence: Magnetar-Black Hole Variability Under the Veil of Dark Matter

Thursday 4 September 2025 16:50 (10 minutes)

Magnetars, a rare class of neutron stars, are known for their ultra-strong magnetic fields and high-energy emission variability. Their origin, evolution, and interactions especially with black holes present unique challenges to astrophysical models. This study investigates the dynamic behavior of magnetar–black hole systems, focusing on how hidden dark matter, either distributed in their local environment or potentially influencing the black hole's properties during formation, could affect their observable characteristics. Two possibilities are considered: that black holes may be embedded in dense dark matter environments, or that they themselves may be composed of or formed from dark matter.

Using Universe Sandbox and MATLAB, combined with real observational datasets from known pulsars and compact object surveys, the research models how dark matter might amplify magnetic field decay, alter accretion patterns, and modulate high-energy emissions. Particular attention is given to variability patterns that could mimic or interfere with traditional variable stars used in distance measurement.

These anomalous signatures, if unaccounted for, may lead to biases in interpreting time-domain data from surveys such as Gaia, LSST, and TESS. This work underscores the need to include exotic compact object behavior especially those influenced by dark components of the universe when refining stellar population models and cosmic distance indicators.
By bridging compact object astrophysics with large-scale survey interpretation, this study opens a potential new avenue for identifying dark matter's indirect effects on stellar systems and deepening our understanding of high-energy cosmic evolution.
Keywords: Dark matter interactions, Black hole–magnetar merger, Simulation-based modelling, Compact object astrophysics.

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Presenter: GANDHI, Anmol (Independent Researcher)

Session Classification: Poster Session

Contribution ID: **3** Type: **Oral**

Transport coefficients of anisotropic quark matter

Friday 5 September 2025 15:00 (15 minutes)

We investigate the transport properties of quark matter under conditions of momentum anisotropy using the Polyakov chiral quark mean-field (PCQMF) model. Momentum anisotropy naturally arises in systems out of equilibrium, such as the early stages of relativistic heavy-ion collisions or the interior of compact stars. Understanding the impact of such anisotropy on transport coefficients is essential for accurately describing the evolution of these systems. We focus on calculating the shear viscosity and electrical conductivity, which are crucial for characterizing the dissipative dynamics of the medium. The PCQMF model, incorporating features of chiral symmetry breaking, confinement, and the Polyakov loop, is employed to evaluate these viscous coefficients at finite temperature and chemical potential.

Authors: Mr SINGH, Dhananjay (National Institute of Technology Jalandhar); KUMAR, Arvind (Dr B R Ambedkar National Institute of Technology Jalandhar India)

Presenter: Mr SINGH, Dhananjay (National Institute of Technology Jalandhar)

Session Classification: Parallel Session

Contribution ID: **5** Type: **Oral**

Sensitivity of Multi-Particle Azimuthal Correlations and Rapidity-Even Dipolar flow to α-Clustering in $^{16}\mathrm{O} + {}^{16}\mathrm{O}$ Collisions at $\sqrt{s_{NN}} = 200$ GeV

Thursday 4 September 2025 14:40 (20 minutes)

We examine symmetric and asymmetric cumulants as well as rapidity-even dipolar flow in ^{16}O+^{16}O collisions at $\sqrt{s_{NN}} = 200$˜GeV to explore α-clustering phenomena in light nuclei within the viscous relativistic hydrodynamics framework. Imprints of α-clustering manifest in the anisotropic flow coefficients and their correlations—particularly in observables involving elliptic-triangular flow correlations. Our results indicate that the final-state symmetric and asymmetric cumulants—especially $\mathrm{NSC}(2,3)$ and $\mathrm{NAC}_{2,1}(2,3)$—are sensitive to the initial nuclear geometry. Moreover, our results reveal a significant difference in rapidity-even dipolar flow, v_1^{even}, between α-clustered and Woods–Saxon configurations in high-multiplicity events. These results highlight the crucial influence of nuclear structure on heavy-ion collision dynamics and offer observables to differentiate nuclear geometries, especially in ultra-central collisions.

Authors: Mr SHAFI, Kaiser (Indian Institute of Science Education and Research, Berhampur); CHATTERJEE, Sandeep (IISER, Berhampur)

Presenter: Mr SHAFI, Kaiser (Indian Institute of Science Education and Research, Berhampur)

Session Classification: Parallel Session

Contribution ID: **6** Type: **Oral**

Exploring Radial and Directed Flow as Probes of QGP Properties Across Energies

Saturday 6 September 2025 09:50 (20 minutes)

Over the past 15 years, elliptic and triangular flow coefficients (v_2, v_3) have been extensively studied in heavy-ion collisions to gain insight into the collective behavior and transport properties of the quark-gluon plasma (QGP). However, in recent years, increasing attention has been directed toward the radial and directed flow coefficients (v_0, v_1), which have emerged as valuable probes of the QGP medium. In this talk, I will present our recent work on the study of v_0 and v_1 across a wide range of collision energies, from the LHC to RHIC. The radial flow coefficient v_0, now measured in several experiments, is currently a topic of active discussion as a probe of the collective behaviour of the medium. In addition, directed flow v_1—especially for identified particles—along with the observed splitting between baryons and antibaryons, and between positively and negatively charged hadrons, serves as a sensitive probe of conserved charge dynamics, their diffusion, electromagnetic fields, and the medium's electrical conductivity. I will discuss our hydrodynamic model results for v_0 and its significance as well as the detailed investigation of v_1 for identified hadrons, emphasizing its relevance in the Beam Energy Scan (BES) program phenomenology. In particular, I will highlight the role of baryon diffusion in shaping directed flow and present our recent findings on how baryon diffusion and electrical conductivity influence the splitting of v_1 among hadron species with identical mass but different conserved charges.

Author: Mr PARIDA, Tribhuban (IISER Berhampur)

Presenter: Mr PARIDA, Tribhuban (IISER Berhampur)

Session Classification: Plenary Session

Contribution ID: **7** Type: **Oral**

Impact of D meson loop on J/ψ mass shift in nuclear medium

Friday 5 September 2025 16:00 (15 minutes)

We explore the in-medium modification of the J/ψ meson mass in symmetric nuclear matter at zero and finite temperatures using an effective Lagrangian combined with a QCD sum-rule approach. The J/ψ self-energy is evaluated via the DD, D^*D, and D^*D^* meson loops, with medium effects incorporated through D and D^* meson masses computed in the hadronic chiral SU(3) model and QCD sum rules. Results are compared with previous studies and may contribute to a better understanding of forthcoming data from heavy-ion collision experiments of the FAIR project, such as CBM and PANDA.

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Presenter: KAUR, Manpreet (Dr. B R Ambedkar National Institute of Technology Jalandhar (144008), Punjab, India)

Session Classification: Parallel Session

Contribution ID: **8** Type: **Oral**

Probing conserved charge dynamics via HBT interferometry in relativistic heavy-ion collisions

Thursday 4 September 2025 15:00 (15 minutes)

The quark-gluon plasma (QGP), a transient state of deconfined quarks and gluons governed by quantum chromodynamics (QCD), existed microseconds after the Big Bang and can be recreated in ultra-relativistic heavy-ion collision experiments. Probing its properties requires a detailed understanding of the spatio-temporal structure of the particle-emitting sources at the time of freeze-out. In this study, we utilize Hanbury Brown–Twiss (HBT) interferometry to calculate the HBT correlation functions and extract the three-dimensional HBT radii for various identical particle pairs, providing insights into the source geometry and emission duration. For our analysis, we employed a hybrid framework combining viscous hydrodynamics with hadronic transport, along with a Monte Carlo Glauber-based initial condition generator, to simulate the collision dynamics and evolution of the QGP medium, incorporating different QCD conserved charges, particularly baryon number. Our analysis lays the foundation for exploring the particle emission surfaces via meson–baryon–antibaryon splitting in the HBT radii, which may provide unique access to the underlying freeze-out dynamics and, ultimately, to the initial conditions of the system.

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Presenter: MUKHERJEE, ARKADIP (Indian Institute of Science Education and Research (IISER) Berhampur)

Session Classification: Parallel Session

Contribution ID: **9** Type: **Poster**

Impact of Spin on Quark Wigner Distributions

Thursday 4 September 2025 16:40 (10 minutes)

We study how the spin of quarks and the target affects the shape of Wigner distributions in the transverse impact parameter space ($\vec{b}_\perp$), which is conjugate to the transverse momentum transfer $D_\perp = \frac{\Delta_\perp}{1-\xi^2}$, within the framework of a light-front dressed quark model. This study considers the effect of nonzero longitudinal momentum transfer, called skewness, defined as $\xi = \frac{\Delta^+}{2P^+}$. By looking at different combinations of quark and target spin, we find that certain patterns like dipoles and quadrupoles, appear due to spin and orbital motion. These patterns become more noticeable as skewness increases, causing changes in how the quark is spread out in space. This shows that spin plays an important role in the 3D structure of hadrons. Our results provide deeper insight into the role of spin in shaping the multidimensional structure of hadrons and establish a link between polarization effects and partonic spatial correlations in non-forward regimes.

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Presenter: JANA, SUJIT (SVNIT)

Session Classification: Poster Session

Contribution ID: **10** Type: **Oral**

Performance studies of GEM detectors for future heavy ion experiment

Friday 5 September 2025 15:15 (15 minutes)

Gas Electron Multiplier (GEM) detectors are widely used in high-energy physics experiments because of their high rate handling capability and outstanding position resolution. In the Muon Chamber (MuCh) of the future Compressed Baryonic Matter (CBM) experiment, detector efficiency is a key performance parameter.
This study focuses on the behavior of different GEM detectors under prolonged irradiation using a radioactive source. Gain and energy resolution are also studied. Different behavior in performance is observed at the start of operation and after the conditioning effect. The charge-up in the Kapton of GEM foil is also studied along with the stability in performance. The details of the experimental setup, methodology, and results will be presented.

Author: Mr MANDAL, SUBIR (Bose Institute)

Co-authors: Dr GOPE, Somen (Bose Institute); Ms GHOSH, Srotoshi (Presidency University and Bose Institute); Prof. DAS, Supriya (Bose Institute); Dr BISWAS, Saikat (Bose Institute)

Presenter: Mr MANDAL, SUBIR (Bose Institute)

Session Classification: Parallel Session

Contribution ID: **11** Type: **Oral**

Aspects of spin hydrodynamic frameworks in QCD medium

Saturday 6 September 2025 14:40 (20 minutes)

The quark-gluon plasma (QGP) produced in relativistic heavy-ion collision experiments exhibits collective behavior that can be effectively described using a relativistic hydrodynamic framework. In recent years, the experimental observation of spin polarization in various hadrons has opened a new avenue for probing the non-trivial vortical structure of the QGP medium. This has motivated the development of a consistent theoretical framework of relativistic spin hydrodynamics, which incorporates spin degrees of freedom into the hydrodynamic descriptions. Such a framework is essential for performing dynamical simulations of spin polarization phenomena. Spin hydrodynamics is formulated based on the conservation of total energy, linear momentum, and total angular momentum—including both orbital and spin contributions. In this talk, I will discuss various theoretical aspects of dissipative spin hydrodynamic frameworks, including approaches based on relativistic kinetic theory, entropy current analysis, etc. I will highlight several important features of spin hydrodynamics, such as pseudo-gauge dependence, spin transport coefficients, gradient ordering of spin-related variables, analytical solutions, etc.

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Presenter: DAS, ARPAN (Birla Institute of Technology And Science Pilani, Pilani Campus)

Session Classification: Plenary Session

Contribution ID: **12** Type: **Oral**

Electric, thermal and thermoelectric response of a hot pion gas in a time dependent background magnetic field

Friday 5 September 2025 15:15 (15 minutes)

The prime focus of the work is to determine the electric, thermal and thermoelectric transport coefficients of a hot pion gas in the presence of time-dependent background magnetic fields. The thermoelectric effect is analyzed by examining the magneto-Seebeck and Nernst coefficients in the hot pionic medium under such conditions. Furthermore, the phenomenologically relevant elliptic flow coefficient, linked to the Knudsen number, is examined. The analysis reveals the significant impact of both the strength and time dependence of the magnetic field on the transport coefficients of the pionic medium. The results are analyzed in contrast to those obtained under a constant magnetic field.

Authors: KUMAR, Ankit (Indian Institute of Technology Gandhinagar); Dr K K, Gowthama (Indian Institute of Technology Bombay); DAS, Sadhna; CHANDRA, Vinod

Presenter: KUMAR, Ankit (Indian Institute of Technology Gandhinagar)

Session Classification: Parallel Session

Contribution ID: **13** Type: **Oral**

Surface tension calculation of QGP under one loop correction at finite chemical potential

The surface tension under one loop correction at finite chemical potential is calculated. Due to the effect of the chemical potential in this one loop correction, the formation of stable bubble/droplet is obtained with the value of quark and gluon parametrization in the range of gamma_{q} = 1/8 and 24 gamma_{q} less than and equal to gamma_{g} less tahn and equal to 30 gamma_{q}. It implies that the fluid
dynamics of the quark, anti-quark and gluon exist with the stable and
unstable droplets depending on the different quark and gluon parameter
values. Such phenomenological parameters can induce the droplet forma-
tion of QGP and it may stabilize the droplet depending on their values and form smaller droplets with the inclusion the chemical potential.
Due to the smaller in the size of droplet, it enhances in the stability of surface tension calculation. So the surface tension is
improved with the effect of chemical potential and enhance to give the evidence of existence of QGP.

Author: Prof. SOMORENDRO SINGH, Shougaijam (University of Delhi, Delhi, India)

Presenter: Prof. SOMORENDRO SINGH, Shougaijam (University of Delhi, Delhi, India)

Session Classification: Plenary Session

Contribution ID: **14** Type: **Oral**

Neutron star equation of state from the Bayesian analysis

Friday 5 September 2025 14:40 (20 minutes)

We constrain the nuclear matter equation of state within the relativistic mean field model by including the isoscalar-vector and isovector-vector coupling term at a fundamental level using the Bayesian analysis. We used the nuclear saturation properties and recent astrophysical observations to constrain the dense matter equation of state. We obtained about 20000 sets of equations of states out of sampling about 60 million sets of equations of states. All 20000 equations of state satisfy nuclear matter saturation properties at saturation densities and produce high mass neutron stars. In our findings, we find that the non-zero value of the scalar-vector and isovector-vector coupling parameter and the negative value of the sigma meson self-coupling stiffen the equation of state. Our sets of equations of state produce neutron stars of mass larger than 2.5 $M_{\odot}$ to include the recent gravitational waves observation GW190419.

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Presenter: Dr KUMAR, Deepak (Institute of Physics)

Session Classification: Parallel Session

Contribution ID: **15** Type: **Poster**

Coalescence Like Sum Rules from Hydrodynamics

Thursday 4 September 2025 16:50 (10 minutes)

Hadronization in ultra-relativistic heavy-ion collision (UHIC) experiments can be effectively described by the quark coalescence mechanism. Within this framework, sum rules for flow coefficients naturally emerge, wherein the flow harmonic v_n of a hadron is expressed as the sum of the corresponding v_n of its constituent quarks. The application of these sum rules requires the consideration of number-of-constituent-quark (NCQ) scaling.
In this work, we test the validity of these sum rules using hadrons generated from a hydrodynamic model at $\sqrt{s_{NN}} = 200\ GeV$. Despite not employing quark coalescence for hadronization in Hydro framework—instead utilizing the Cooper-Frye freezeout formalism, we observe that the sum rule behavior is still reproduced. To understand this within the hydrodynamic context, an expression for the v_2 is derived from the Cooper-Frye formalism. Using this expression, we relate the elliptic flow v_2 of one hadron to the v_2 of two other hadrons. The relative contributions are found to depend on the masses of the hadrons involved. We find that although these weight coefficients differ from those obtained via the quark coalescence mechanism, the sum rules remain valid in both approaches. A comparative analysis reveals that the agreement improves at high p_T , consistent with expectations.

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Co-authors: CHATTERJEE, Sandeep (IISER, Berhampur); Mr PARIDA, Tribhuban (IISER Berhampur)

Presenter: Ms PRIYA (Indian Institute of Science Education and Research, Berhampur)

Session Classification: Poster Session

Contribution ID: **16** Type: **Oral**

Extracting the baryon diffusion coefficient of the hot and dense strongly interacting matter with Bayesian method

Thursday 4 September 2025 15:15 (15 minutes)

In a recent study, it was proposed that the rapidity odd directed flow splitting of proton and anti-proton observed in relativistic heavy ion collisions can be explained by incorporating the baryon diffusion effect into the hydrodynamic evolution of the strongly interacting matter created in heavy-ion collisions. However, extracting this coefficient from hydrodynamic simulations is a computationally intensive and numerically challenging task. To address this, we employ a statistically robust and sophisticated Bayesian analysis framework to estimate the baryon diffusion coefficient from hydro-simulated data by calibrating the model parameters against STAR experimental data at \sqrt{s_{NN}} = 19.6 GeV.

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Presenter: PANDAY, Aradhana (IISER Berhampur)

Session Classification: Parallel Session

Contribution ID: **17** Type: **Poster**

Mass bounds for fully bottom tetraquark from Regge phenomenology driven inequalities

Thursday 4 September 2025 16:40 (10 minutes)

We present a study of the mass spectrum of fully bottom ($bb\bar{b}\bar{b}$) tetraquark states using a Regge phenomenology-based approach. Interpreting these tetraquarks as diquark–antidiquark bound systems, we employ quasi-linear Regge trajectories in the (J, M^2) plane to examine their mass behavior. Within this framework, we establish linear and quadratic mass inequalities that impose constraints on the ground-state masses without relying on specific interaction models. This method offers a straightforward and effective way to estimate mass bounds and yields results compatible with other theoretical predictions. Our findings may support experimental efforts to identify such states and help clarify their quantum numbers, contributing to the broader understanding of exotic hadronic structures in Quantum Chromodynamics.

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Co-author: Dr RAI, Ajay Kumar (Sardar vallabhbhai National Institute of Technology-Surat)

Presenter: PATEL, Vandan (Sardar Vallabhbhai National Institute of Technology Surat, Gujarat, India)

Session Classification: Poster Session

Contribution ID: **19** Type: **Oral**

Probing the initial state and evolution of isobaric systems in relativistic nuclear collisions

Friday 5 September 2025 16:00 (15 minutes)

We investigate isobaric collisions (Ru+Ru and Zr+Zr) at RHIC to study how nuclear structure influences the initial conditions and the subsequent evolution of the quark-gluon plasma (QGP). Though identical in mass number, the nuclei differ in proton number and structure, Ru is expected to have a quadrupole deformation, while Zr exhibits octupole features. These differences result in distinct initial energy density distributions and spatial eccentricities, which manifest into qualitative and quantitative differences in the final-state observables such as anisotropic flow coefficients.

Electromagnetic probes, particularly thermal photons, offer direct access to the early stages of the medium evolution. Photons are emitted throughout the lifetime of the system and largely unaffected by final state interactions. Thus, they are considered as highly sensitive to investigate the initial geometry. A comparative analysis of electromagnetic and hadronic observables in isobaric collisions can thus provide critical insights into the initial conditions, QGP dynamics, and the influence of nuclear structure on the dynamics of heavy-ion collisions.

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Co-author: CHATTERJEE, Rupa

Presenter: PAUL, Amit (Variable Energy Cyclotron Centre (VECC), Kolkata)

Session Classification: Parallel Session

Contribution ID: **23** Type: **Oral**

Higher-order thermoelectric effects in hot and dense interacting hadron gas in the presence of a magnetic field

Thursday 4 September 2025 15:45 (15 minutes)

From low-energy semiconductor devices to strongly interacting hadronic matter, the thermoelectric coefficients encode deep information about the system's dynamics in response to non-zero gradients. What makes thermoelectricity truly beautiful is its dual nature: it is both the window into the microscopic dynamics of constituents of matter and a bridge to macroscopic energy conversion, where heat is transformed into electrical power and vice versa. The hot and dense hadronic medium produced in relativistic heavy-ion collisions at RHIC and LHC energies provides a unique platform to study thermoelectric transport phenomena because of its charged and neutral constituents, namely baryons and mesons. In the presence of temperature gradients and nonzero baryon chemical potential, the medium exhibits anisotropic thermoelectric responses under an external magnetic field[1]. Using the relativistic Boltzmann transport equation within the relaxation time approximation, we investigate the thermoelectric properties of an interacting hadron gas in different frameworks of the hadron resonance gas model. A particular focus is placed on the estimation of Thomson coefficients, which arise due to the temperature dependence of the Seebeck coefficients. For the first time, we estimate the longitudinal Thomson, magneto-Thomson, and transverse Thomson coefficients in the hot hadronic medium. The magneto-Thomson and transverse Thomson coefficients originate in the medium due to the temperature dependence of magneto-Seebeck and Nernst coefficients in the presence of a magnetic field[2]. The study of such higher-order thermoelectric coefficients enriches the broader understanding of nonequilibrium transport in strongly interacting systems, revealing complex coupling mechanisms between charge carriers and thermal gradients in the context of heavy-ion collisions.

[1] K. Singh, K. K. Pradhan, D. Sahu and R. Sahoo, Phys. Rev. D 111, 074033 (2025)
[2] K. Singh, K. K. Pradhan and R. Sahoo, [arXiv:2506.22086 [hep-ph]]

Author: SINGH, Kamaljeet (Indian Institute of Technology Indore (IN))

Co-authors: Mr PRADHAN, Kshitish Kumar (Indian Institute of Technology Indore); Dr SAHU, Dushmanta (Indian Institute of Technology Indore); Prof. SAHOO, Raghunath (Indian Institute of Technology Indore)

Presenter: SINGH, Kamaljeet (Indian Institute of Technology Indore (IN))

Session Classification: Parallel Session

Contribution ID: **24** Type: **Poster**

Thermalization and Transport Phenomena in Oxygen-Oxygen Collisions at √(s_NN)=7 TeV: A Color String Percolation Model Approach

Thursday 4 September 2025 17:00 (10 minutes)

The investigation of the QCD phase transition and the Quark-Gluon Plasma (QGP) formation in high-energy nuclear collisions continues to be a central focus in modern nuclear physics. While traditionally associated with heavy-ion collisions, recent studies suggest that QGP-like droplets may also emerge in high-multiplicity proton-proton (pp) events. Motivated by these findings, the present study investigates Oxygen-Oxygen (O+O) collisions at √(s_NN)=7 TeV, a promising and upcoming system at the Large Hadron Collider (LHC). Because of the nuclear stability and doubly magic configuration, oxygen-16 is considered an ideal probe for studying QCD-related phenomena in small systems. In this study, we employ the Color String Percolation Model (CSPM) to analyze thermodynamic observables from O+O events simulated using the A Multi-Phase Transport (AMPT) model. We extracted several key thermodynamic and transport parameters, including the initial percolation temperature (T(ξ)), energy density (ε), the shear viscosity to entropy density ratio (η/s), etc. These observables provide critical insight into the evolution of medium and collective behavior in small collision systems. The results are benchmarked against Lattice QCD (LQCD) predictions using nuclear density profiles such as Woods-Saxon and harmonic oscillator. The role of α-clustering in oxygen nuclei is also investigated for its influence on collective behavior. This study offers new insights into QGP-like behavior and thermalization in small systems, strengthening the role of CSPM in interpreting the dynamics of hot QCD matter at LHC energies.

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Session Classification: Poster Session

Contribution ID: **25** Type: **Oral**

Pseudorapidity Density Distribution of Charged Particles and System Size in Heavy-Ion Collision

Thursday 4 September 2025 15:15 (15 minutes)

In heavy-ion collisions, the pseudorapidity density distribution of charged particles is a fundamental observable that encodes important information about the collision dynamics. In this study, we analyze the pseudorapidity distributions of charged particles from Au+Au collisions at center-of-mass energies ranging from $\sqrt{s_{NN}} = 19.6$ GeV to 200 GeV (RHIC energies), and Pb+Pb collisions at $\sqrt{s_{NN}} = 2.76$ TeV and 5.02 TeV (LHC energies). To better capture the asymmetries and energy-dependent shape evolution in the pseudorapidity distributions, we propose a fitting function that extends the traditional Gaussian form by incorporating an error function modulation. This function consists of a sum of two symmetric Gaussians, each modified by an energy-dependent error function characterized by the parameter λ. The λ parameter shows a scaling behaviour with collision energy that resembles the inverse of the baryon chemical potential ($1/\mu_B$), suggesting a connection with baryon stopping. We interpret the overlap of these modified Gaussians in pseudorapidity space as an indicator of source overlap and use it to estimate the effective system size. This overlap area exhibits an energy dependence similar to that of the baryon chemical potential μ_B. The estimated size shows good agreement with values obtained from femtoscopic analyses and hydrodynamic model predictions.

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Presenter: NEERAJ (Indian Institute of Technology Mandi - IIT-Mandi (IN))

Session Classification: Parallel Session

Contribution ID: **26** Type: **Oral**

Phase transitions in a rotating hadron resonance gas

Thursday 4 September 2025 14:40 (20 minutes)

In addition to the magnetic field, a huge amount of vorticity is expected to be produced in non-central heavy-ion collisions at TeV energies. This vorticity or rotation (ω) can affect the evolution of the system and, hence, the phase diagram of the QCD matter, which is one of the important research areas for both the theoretical and experimental high-energy physics community. In this work, we study the effect of rotation on the phase diagram of hadronic matter. We find that rotation plays a role similar to baryochemical potential (μ_B) on the thermodynamic properties of hadron gas. The rotation adds a new kind of chemical potential called rotational chemical potential. Therefore, the phase transition can occur not only in the $T-\mu_B$ plane but also in the $T-\omega$ plane. We use an interacting hadron resonance gas model with van der Waals kind of attractive and repulsive interaction among the hadrons. We observe a liquid-gas phase transition under the effect of rotation, even at zero baryochemical potential. Moreover, we estimate the higher-order rotational susceptibilities and their ratios to study how the system responds to a small angular velocity. These results allow us to reinvestigate the QCD matter properties under the effect of rotation and study the phase diagram in the $T-\mu_B-\omega$ plane.

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Presenter: PRADHAN, Kshitish Kumar (IIT Indore)

Session Classification: Parallel Session

Contribution ID: **27** Type: **Oral**

Properties of strange mesons in dense resonance matter

Friday 5 September 2025 09:30 (20 minutes)

Exploring the in-medium properties of different mesons such as their masses and decay width may play a significant role in understanding the related experimental observables. In this work we focus on the modifications in the properties of pseudoscalar K and vector ϕ mesons in the dense hadronic medium using the chiral SU(3) hadronic mean field model. We consider the hadronic medium consisting of nucleons, hyperons and decuplet baryons at finite density and temperature. In the chiral SU(3) model, the properties of baryons are modified through the exchange of scalar fields σ, ζ and δ and vector fields ω, ρ and ϕ. We evaluate the in-medium masses and optical potentials of K mesons at finite baryon density and temperature. Considering the in-medium masses of K mesons as input, masses and decay width of ϕ mesons are evaluated using the effective Lagrangian approach through the $\phi K \bar{K}$ interactions at one-loop level. Finite temperature of the resonance matter is found to impact significantly the in-medium masses of different mesons.

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Session Classification: Plenary Session

Contribution ID: **28** Type: **Oral**

Mass Predictions for Ω_{bc} and $\Omega^{'}_{bc}$ Baryons in a Quark–Diquark Rotating String Picture

Friday 5 September 2025 15:45 (15 minutes)

We present a detailed study of the mass spectra of the bottom–charm baryons (Ω_{bc} and $\Omega^{'}_{bc}$) within a quark–diquark rotating string framework. This model treats each Ω_{bc} and $\Omega^{'}_{bc}$ baryon as a b–c diquark core bound to a strange quark via a relativistic rotating string (flux tube), and it includes spin-dependent interactions to capture fine spectral details. Using this approach, we compute the masses of the ground and the excited states of the Ω_{bc} and $\Omega^{'}_{bc}$ baryons. The predicted masses for the ground-state Ω_{bc} and $\Omega^{'}_{bc}$ show close agreement with previous theoretical estimates, lending credibility to the approach. Furthermore, we provide predictions for a broad range of radially and orbitally excited Ω_{bc} and $\Omega^{'}_{bc}$ states. These theoretical predictions serve as valuable benchmarks for ongoing experimental efforts, offering a crucial reference point for guiding their potential observation.

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Presenter: JAKHAD, Pooja

Session Classification: Parallel Session

Contribution ID: **29** Type: **Oral**

Phenomenological investigation of conventional and non-conventional hadrons

Friday 5 September 2025 09:50 (20 minutes)

Quantum Chromodynamics (QCD), the fundamental theory governing the strong interaction, remains a important area of study due to the ongoing challenges in fully understanding its internal dynamics, even after extensive research. Hadron spectroscopy, a specialized field within particle physics, focuses on exploring the spectrum of hadrons. This field seeks to uncover the intrinsic properties and interactions of hadrons by analyzing attributes such as their masses, spin, parities, and other quantum numbers. Due to the vast amount of data recently reported by various world-wide experimental collaborations, the spectroscopic study of hadronic states and their decay properties has been of keen interest of hadron physics. Here, the hadronic properties of baryons, mesons and exotic particles will be discussed

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Presenter: Dr RAI, Ajay Kumar (Sardar vallabhbhai National Institute of Technology-Surat)

Session Classification: Plenary Session

Contribution ID: **30** Type: **Poster**

Investigation of the Mass Spectra of Singly Charmed Pentaquarks

Thursday 4 September 2025 17:20 (10 minutes)

In this study, we calculate the mass spectra of singly charmed pentaquark states using the hypercentral constituent quark model (HCQM). The pentaquark is treated as a bound system consisting of two diquarks and an antiquark, with their interactions described by a potential that includes both a linear confining term and a Coulomb term. To account for the fine structure of the mass spectra, spin-dependent interactions specifically spin–spin, spin–orbit, and tensor terms are incorporated. We systematically analyze the spin-parity quantum numbers of the predicted states and compare our results with available experimental data and other theoretical approaches. This work provides valuable insight into the internal structure of exotic hadrons and supports ongoing efforts to better understand singly charmed pentaquark systems.

Author: RATHOD, Hardik (Sardar Vallabhbhai National Institute of Technology)

Co-author: Dr RAI, Ajay Kumar (Sardar vallabhbhai National Institute of Technology-Surat)

Presenter: RATHOD, Hardik (Sardar Vallabhbhai National Institute of Technology)

Session Classification: Poster Session

Contribution ID: **31** Type: **Poster**

Mass Spectra of Cascade Bottom–Charm Baryons (Ξ_{bc}, Ξ'_{bc}) in a Relativistic Flux Tube Model

Thursday 4 September 2025 17:10 (10 minutes)

Using the relativistic flux tube model with spin effects, we present an investigation of the mass spectra of the Ξ_{bc} and Ξ'_{bc} baryons. This quark–diquark approach treats each baryon as a (bc) diquark bound to a light quark by a rotating string-like flux tube, incorporating spin dependent interactions. Our predicted masses for the ground-state Ξ_{bc} and Ξ'_{bc} align closely with earlier theoretical estimates, lending confidence to the model's reliability. Additionally, we provide comprehensive predictions for radially and orbitally excited states across the spectrum. These theoretical results offer crucial guidance for ongoing and future experimental searches (e.g., at the LHC), aiding in the identification of Ξ_{bc} and Ξ'_{bc} baryons signals within complex collision data. As no bottom–charm baryon has been observed yet, our findings establish a timely baseline for guiding potential discoveries in this sector.

Author: Mr PRAJAPATI, V.G. (Sardar Vallabhbhai National Institute Of Technology)

Co-authors: JAKHAD, Pooja; Dr RAI, Ajay Kumar (Sardar vallabhbhai National Institute of Technology-Surat)

Presenter: Mr PRAJAPATI, V.G. (Sardar Vallabhbhai National Institute Of Technology)

Session Classification: Poster Session

Contribution ID: **32** Type: **Oral**

Heavy quark potential in the presence of momentum anisotropy at finite magnetic field

Friday 5 September 2025 14:40 (20 minutes)

The study explores how heavy quarkonia behave in a hot quark-gluon plasma (QGP) that is both magnetized and exhibits finite momentum anisotropy. The concept of inverse magnetic catalysis is considered, which impacts the Debye screening mass altered by the magnetic field, and in turn affects the effective quark masses. Our findings show that both the momentum anisotropy and inverse magnetic catalysis significantly influence the thermal decay rates and dissociation temperatures of heavy quarkonia.

Author: Dr NILIMA, Indrani (Banaras Hindu University)

Co-author: Prof. SINGH, B. K. (Department of Physics, Institute of Science, Banaras Hindu University (BHU), Varanasi 221005, India andDiscipline of Natural Sciences, PDPM Indian Institute of Information Technology Design and Manufacturing, Jabalpur 482005, India)

Presenter: Dr NILIMA, Indrani (Banaras Hindu University)

Session Classification: Parallel Session

Contribution ID: **33** Type: **Poster**

Meson Mass Modifications in Hot and Dense QCD Matter via a Complex Heavy-Quark Potential

Thursday 4 September 2025 17:00 (10 minutes)

We present a method to determine the masses of heavy quarkonium mesons modified by medium effects at finite temperature and density by solving the radial Schrödinger equation with a complex heavy-quark potential derived from an improved Gauss law model. This potential incorporates medium screening through a temperature- and density-dependent Debye mass parameter, featuring a real part that accounts for Debye screening and an imaginary part describing in-medium decay processes. By extracting the binding energies from the numerical solutions and adding the constituent quark masses, we compute temperature- and density-dependent meson masses. The approach reproduces known vacuum meson masses at zero temperature and predicts consistent mass shifts in the medium, providing a reliable framework for studying in-medium meson mass modifications.

Author: YADAV, DIPESH (SVNIT)

Co-authors: Dr RAI, Ajay Kumar (Sardar vallabhbhai National Institute of Technology-Surat); LODHA, Chetan

Presenter: YADAV, DIPESH (SVNIT)

Session Classification: Poster Session

Contribution ID: **34** Type: **Poster**

Two-body nonleptonic decays of D, Ds, B and Bs mesons in the factorization approach: Theoretical predictions for heavy-ion physics applications

Thursday 4 September 2025 16:50 (10 minutes)

Heavy flavor mesons serve as crucial probes of the Quark-Gluon Plasma (QGP) in heavy-ion collisions at RHIC and LHC facilities. Precise theoretical predictions of their decay properties in vacuum are essential baseline measurements for understanding medium modifications in hot QCD matter. Using the factorisation approach, this work presents a comprehensive study of two-body nonleptonic decays of D, Ds, B, and Bs mesons. We calculated branching fractions for 100 decay channels, employing relativistic quark model form factors and mass values of parent particles with Hydrogen-like and Gaussian-like wavefunctions as input. Our results demonstrate good agreement with PDG data and existing theoretical predictions for most channels, validating the factorization framework's effectiveness. The Gaussian wavefunction approach shows particular promise, with branching fraction predictions aligning well with experimental values like PDG. Discrepancies in some channels reflect known limitations of the factorization approximation and highlight the importance of final-state interactions. Our results provide important theoretical benchmarks for collision data and guiding future advancements in computational modelling within the field of QCD matter.

Author: PARMAR, Manakkumar (Sardar Vallabhbhai National Institute of Technology, Surat)

Co-authors: LODHA, Chetan; Dr RAI, Ajay Kumar (Sardar vallabhbhai National Institute of Technology-Surat)

Presenter: PARMAR, Manakkumar (Sardar Vallabhbhai National Institute of Technology, Surat)

Session Classification: Poster Session

Contribution ID: **35** Type: **Oral**

Experimental overview of light-nuclei production in high energy collisions

Saturday 6 September 2025 12:10 (20 minutes)

Light (anti-)nuclei and hypernuclei are loosely bound objects whose production in high-energy collisions provides a unique window into the late-stage dynamics of the system. Their formation is typically described either through coalescence of nucleons at kinetic freeze-out or via thermal production at chemical freeze-out, and comparisons between these scenarios remain a subject of active investigation. Key observables include transverse-momentum spectra, integrated yields, compound light nuclei ratios (e.g., \(d/p\), \(t/p\), \({}^3\mathrm{He}/p\)), coalescence parameters (\(B_2\), \(B_3\)), and collective flow coefficients measured across a wide range of collision energies and systems. Recent precision measurements by the STAR and ALICE collaborations across RHIC Beam Energy Scan II and LHC Run 2/3 provide critical data to test these models, with implications for QCD phase structure and the role of baryon density.

In this talk, I will present a comprehensive overview of the experimental status of light-nuclei production, focusing on recent results from STAR and ALICE collaborations. I will summarize the measured observables, discuss their systematic behavior with energy, centrality, and multiplicity, and compare the data to expectations from various theoretical frameworks. These studies help constrain hadronization mechanisms and freeze-out conditions while also providing benchmarks for transport and statistical models across a wide energy range.

Author: Mr SHARMA, Rishabh (Indian Institute of Science Education and Research (IISER) Tirupati)

Presenter: Mr SHARMA, Rishabh (Indian Institute of Science Education and Research (IISER) Tirupati)

Session Classification: Plenary Session

Contribution ID: **36** Type: **Oral**

Transition magnetic moments of the baryons in hot and dense matter

Friday 5 September 2025 10:10 (20 minutes)

The investigation of in-medium transition magnetic moments between spin-3/2 and spin-1/2 baryons offers a powerful tool to explore the modifications in hadronic properties under extreme conditions, such as those which exist within neutron stars and heavy-ion collisions. In the current work, we have studied the electromagnetic transition magnetic moments for baryonic decays of the type \(Bˆ*{3/2} \rightarrow B{1/2} + \gamma \), incorporating the effects of a hot and dense nuclear medium. The effective masses of quarks and baryons in the hot and dense nuclear medium are obtained self-consistently within the framework of chiral SU(3) quark mean field model, which accounts not only for spontaneous chiral symmetry breaking but also for the influence of scalar and vector meson fields. The magnetic moments of the constituent quarks, adjusted to reflect in-medium effective masses, are then used within the SU(4) constituent quark model to compute the modified transition magnetic moments. Our results show a significant impact on the transition moments with the changes in the density and temperature of the medium, showing the significant deviations from their vacuum values. These findings provide valuable insights into the structure of baryons in dense matter and are relevant for understanding electromagnetic processes in astrophysical and heavy-ion collision environments.

Authors: KUMAR, Arvind (Dr B R Ambedkar National Institute of Technology Jalandhar); DUTT, Dr Suneel; DAHIYA, Harleen (Dr. B R Ambedkar National Institute of Technology, Jalandhar)

Presenter: DUTT, Dr Suneel

Session Classification: Plenary Session

Contribution ID: **37** Type: **Oral**

Gain and Ion Backflow Analysis in a Proposed Triple GEM Geometry Using ANSYS and Garfield^{++}

Thursday 4 September 2025 16:00 (15 minutes)

The Gas Electron Multiplier (GEM) is a prominent class of Micro Pattern Gaseous Detectors (MPGDs), widely used in high-energy physics experiments, medical imaging, and radiation monitoring due to their excellent spatial resolution, high rate capability, and robustness against discharges. A GEM foil typically consists of a thin polyamide layer coated with copper on both sides, with a high density of microscopic holes. When a voltage is applied across the foil, strong electric fields inside the holes enable gas multiplication of electrons. To achieve higher gain, three GEM foils are often cascaded in series, forming a triple GEM configuration. However, performance is highly sensitive to hole geometry, foil structure, and applied voltages, motivating ongoing research into design optimizations.
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In this study, we explore the performance of a newly proposed GEM geometry aimed at improving gain and reducing ion backflow, two critical parameters in the optimization of gaseous detectors. Initially, a detailed simulation was carried out for a single GEM structure featuring a novel conical hole design, where a single conical hole replaces the conventional double-conical hole. Additionally, the thickness of the lower copper layer was increased to make the foil more stable to handle and to suppress the excess flow of ions to the drift region. The results from this single GEM configuration demonstrated a significant enhancement in effective gain along with a noticeable suppression in ion backflow compared to the standard geometry. Encouraged by these findings, we have extended the study to a full triple GEM detector setup, implementing the same proposed geometry across all three GEM layers. The results are very promising for the triple GEM configuration, demonstrating significant improvements in gain and ion backflow suppression. These findings are of valuable significance for future GEM upgrades.

Author: RANA, Sachin (Tata Inst. of Fundamental Research (IN))

Co-authors: K. MONDAL, Md. (Indian Institute of Technology Mandi); ANGIRAS, Poojan (Indian Institute of Technology Mandi); Dr SARKAR, A (Indian Institute of Technology Mandi)

Presenter: RANA, Sachin (Tata Inst. of Fundamental Research (IN))

Session Classification: Parallel Session

Contribution ID: **38** Type: **Poster**

The Diquark-Antidiquark Picture of Kaon-like Resonances

Thursday 4 September 2025 16:40 (10 minutes)

Motivated by the discovery of several kaon-like states observed at BESIII and LHCb, this study explores S, P and D wave tetraquark states with quark contents $ss\bar{s}\bar{q}$ and $sq\bar{q}\bar{q}$ using potential-based phenomenology. The tetraquarks are modeled as diquark-antidiquark systems in $[\bar{3}]_c \otimes [3]_c$ and $[6]_c \otimes [\bar{6}]_c$ color configurations. A comparison with experimentally observed states is provided to enhance our understanding of light-light tetraquark systems with non-homogeneous quark compositions.

Authors: LODHA, Chetan; Dr RAI, Ajay Kumar (Sardar vallabhbhai National Institute of Technology-Surat)

Presenter: LODHA, Chetan

Session Classification: Poster Session

Contribution ID: **39** Type: **Oral**

2-D mode expansion of the transverse phase space

Saturday 6 September 2025 09:30 (20 minutes)

Traditionally, the phase space of produced particles in relativistic heavy ion collisions has been studied in terms of Fourier basis that decompose the azimuthal distribution giving rise to the well known flow coefficients. However, very little has been done in the radial direction to analyse the transverse momentum dependence beyond simple 'eye estimation'. We introduce a systematic 2-D decomposition to study both the radial as well as the azimuthal phase space dependency in terms of Fourier-Bessel basis. This introduces a class of observables that enable us to extract novel information of the phase space distribution which form the basic building blocks using which all other observables may be constructed systematically. We will take up a few applications of this novel Fourier-Bessel decomposition to illustrate its utility.

Authors: Mr SHAFI, Kaiser (Indian Institute of Science Education and Research, Berhampur); Mr PARIDA, Tribhuban (IISER Berhampur); CHATTERJEE, Sandeep (IISER, Berhampur)

Presenter: CHATTERJEE, Sandeep (IISER, Berhampur)

Session Classification: Plenary Session

Contribution ID: **40** Type: **Oral**

Validity of relativistic hydrodynamics beyond local equilibrium

Friday 5 September 2025 14:40 (20 minutes)

By constructing a formal solution to the moment equations of the Boltzmann equation within the relaxation time approximation, we identify the key step that allows relativistic hydrodynamics to capture non-gradient corrections: the elevation of anisotropies to independent dynamical fields with their own evolution equations. This highlights a conceptual distinction between the gradient expansion and relativistic hydrodynamics. While the gradient expansion is valid only in the vicinity of local thermal equilibrium, the introduction of dynamical anisotropies inadvertently capture "non-hydrodynamic"corrections, as their evolution equations can closely approximate the exact dynamical equations by rescaling the transport coefficients. Therefore, relativistic hydrodynamics emerges as more than just a near-equilibrium theory.

Author: Mr GANGADHARAN, Reghukrishnan (NISER)

Presenter: Mr GANGADHARAN, Reghukrishnan (NISER)

Session Classification: Parallel Session

Contribution ID: **41** Type: **Oral**

Quarkonium and Thermodynamical Properties in a Baryon-Rich Anisotropic Medium of QGP

Saturday 6 September 2025 17:05 (20 minutes)

We investigate the in-medium properties of heavy quarkonia by studying the medium modified heavy-quark potential in a hot and dense QCD medium under finite baryonic chemical potential (μb) and anisotropy (ξ). The real and imaginary components of the potential are computed using a static gluon propagator within the quasiparticle model framework. The real part is employed to solve the Schrödinger equation for binding energy and mass spectra, while the imaginary part provides the thermal width. Dissociation temperature is determined using thermal width criteria. Additionally, thermodynamic properties of the QGP, such as pressure, energy density, and speed of sound, are calculated. Our study offers insight into quarkonia behavior and QGP properties in a more realistic anisotropic and baryon-rich environment.

Keywords: -Quark-Gluon Plasma (QGP), Anisotropy (ξ), Baryonic Chemical Potential (μb), Medium Modified Cornell Potential, Quasi-particle Debye mass.

Author: Dr AGOTIYA, Vineet Kumar (Central University of Jharkhand, Ranchi, India)

Co-authors: Mr LAL, Manohar (Central University of Jharkhand, Ranchi, India); Mr SOLANKI, Siddhartha (Central University of Jharkhand, Ranchi, India); Mr SHARMA, Rishabh (Central University of Jharkhand, Ranchi, India)

Presenter: Dr AGOTIYA, Vineet Kumar (Central University of Jharkhand, Ranchi, India)

Session Classification: Plenary Session

Contribution ID: **42** Type: **Poster**

Effect of viscosity on jet thermalization in hot QCD plasma.

Thursday 4 September 2025 17:00 (10 minutes)

We perform numerical investigations in the framework of QCD kinetic theory to examine the energy and angular characteristics of high energetic parton, acting as representative for a jet formed in heavy-ion collisions. The parton traverses through Quark-Gluon Plasma (QGP), enabling us to analyze the behavior of the medium. The parton's energy loss, arising from medium-induced radiation, is computed using the first-order opacity expansion. The calculation takes into account the impact of viscosity in a dynamically screened medium exhibiting boost-invariant longitudinal expansion. The numerical analysis includes Grad's 14-moment approach and the Chapman-Enskog-like technique within the framework of relativistic dissipative hydrodynamics. We study the effects of viscous modification on the expanding medium as well as single particle phase space distribution of the hard parton, which eventually modifies the jet cone angle. The results also highlight the crucial role of jet cone size on jet quenching observables.

Author: RODRIGUES, Sally

Co-author: Dr SARKAR, Sreemoyee (MPSTME)

Presenter: RODRIGUES, Sally

Session Classification: Poster Session

Contribution ID: **43** Type: **Poster**

Numerical Relativistic Magnetohydrodynamics and Related study in Heavy Ion Collisions

Thursday 4 September 2025 17:10 (10 minutes)

Relativistic heavy-ion collisions generate a deconfined state of nuclear matter known as the quark-gluon plasma (QGP), along with extremely strong magnetic fields (~10^{18}–10^{19} Gauss) in non-central events. These fields can significantly modify the transport properties of the QGP, such as its conductivity and viscosity. In this work, we numerically investigate the QGP evolution using the framework of Relativistic Magnetohydrodynamics (RMHD), employing the RHLLE scheme—an approximate Riemann solver—for solving the RMHD equations. Our simulations are benchmarked against standard test problems like the Balsara shock tube and include event-by-event fluctuating initial conditions to capture realistic geometry and field inhomogeneities.

Author: SENGUPTA, Krishanu (National Institute of Science Education and Research)

Presenter: SENGUPTA, Krishanu (National Institute of Science Education and Research)

Session Classification: Poster Session

Contribution ID: **44** Type: **Oral**

Investigation of Breakdown and Timing Performance in Post-Irradiated Multiple JTE-Guarded 4H-SiC LGADs Using TCAD

Thursday 4 September 2025 15:30 (15 minutes)

Low Gain Avalanche Detectors (LGADs) based on 4H-Silicon Carbide (SiC) are promising for fast timing applications in high radiation environments, offering advantages over traditional Si LGADs due to their superior material properties. A key challenge remains the design of robust edge termination that maintains high breakdown and stable gain after heavy irradiation. In this work, we present detailed TCAD simulations for 4H-SiC LGAD structure using multiple Junction Termination Extensions (JTEs) with deep p+ guard implants, comparing different sensor thicknesses. The electric field profiles, charge collection, and timing resolution before and after irradiation are evaluated. In addition, we simulate thermal annealing cycles and quantify their effect on defect removal and field recovery. The results of this study provide design guidance and post-irradiation treatment to maximize SiC-LGAD lifetime and timing precision for HL-LHC or future collider experiments.

Author: Mr KALANI, Jaideep (IIT Mandi)

Co-authors: Mr CHAUHAN, Arnav (IIT Mandi); Mr PALNI, Prabhakar (IIT Mandi); Mr MAHAJAN, Ridham (IIT Mandi)

Presenter: Mr KALANI, Jaideep (IIT Mandi)

Session Classification: Parallel Session

Contribution ID: **45** Type: **Oral**

Heavy Flavor Jet Quenching in Pb–Pb Collisions Using JETSCAPE Framework

Thursday 4 September 2025 15:45 (15 minutes)

We investigate the quenching of b-jets and c-jets in Pb–Pb collisions at $\sqrt{s_{NN}} = 5.02$ TeV using the JETSCAPE framework, incorporating multiple parton energy loss models including MATTER, LBT, and AdS/CFT. These models collectively capture both the perturbative and non-perturbative stages of in-medium jet evolution, enabling a comprehensive study of mass- and flavor-dependent jet quenching phenomena. We compute the nuclear modification factors (R_{AA}) for b-jets, c-jets, and inclusive jets, and analyze the double ratios $R_{AA}^{\mathrm{b-jet}}/R_{AA}^{\mathrm{inclusive}}$ and $R_{AA}^{\mathrm{c-jet}}/R_{AA}^{\mathrm{inclusive}}$ to isolate the impact of quark mass on energy loss. Furthermore, we perform a jet radius-dependent analysis to probe energy transport beyond the jet cone and modifications to jet substructure. Our results are compared to recent ATLAS measurements, providing key insights into the role of jet mass, and medium response in the quark-gluon plasma.

Author: Ms PRIYADARSHINI, Manaswini (Indian Institute of Technology Mandi (IN))

Co-authors: RATHORE, Anuraag (Indian Institute of Technology Mandi - IIT-Mandi (IN)); Mr KALANI, Jaideep (Indian Institute of Technology Mandi (IN)); PALNI, Prabhakar (Indian Institute of Technology Mandi (IN))

Presenter: Ms PRIYADARSHINI, Manaswini (Indian Institute of Technology Mandi (IN))

Session Classification: Parallel Session

Contribution ID: **46** Type: **Poster**

Probing Dissipative Dynamics of Hybrid Stars through r-mode Oscillations

Thursday 4 September 2025 17:20 (10 minutes)

We study the damping of r-mode oscillations in hybrid stars, focusing on bulk viscosity as the dominant dissipative mechanism. In the hybrid star the mixed phase emerges due to a first-order phase transition between hadronic and quark matter at high baryon densities, and is treated as a distinct region with its own transport properties. Bulk viscosity is computed by incorporating non-equilibrium weak interaction processes (such as direct Urca) in both the hadronic and quark Phases. Our analysis reveals that the mixed phase exhibits resonant peaks in bulk viscosity at low temperatures in the range $\sim 1.5 \times 10^7\,\mathrm{K} - 3 \times 10^7\,\mathrm{K}$, whereas the peak shows at $T \sim 5 \times 10^7\,\mathrm{K}$ for pure hadronic phase and at $T \sim 1 \times 10^7\,\mathrm{K}$ for quark phase .The increase in bulk viscosity within the mixed phase raises the critical rotation frequency (Ω/Ω_0), particularly in the temperature range $T \sim 10^6 - 10^8\,\mathrm{K}$, where r-mode instabilities are usually active. The mixed phase bulk viscosity moderately shifts r-mode instability window towards lower temperature, which may have consequences for the spin evolution of neutron stars and gravitational wave.

Author: ZALA, KHUSHBU

Co-author: Dr SARKAR, Sreemoyee (MPSTME)

Presenter: ZALA, KHUSHBU

Session Classification: Poster Session

Contribution ID: **47** Type: **Oral**

Quarkonium potential in QCD medium with momentum dependent relaxation time

Friday 5 September 2025 15:30 (15 minutes)

In this work, we studied the in-medium behavior of quarkonia (charmonium) in a hot QCD medium using a modified kinetic theory framework that includes momentum-dependent relaxation times. The longitudinal gluon self-energy and Debye screening mass are computed within the one-loop hard thermal loop approximation, incorporating non-equilibrium corrections. We analyze how the quarkonium potential, binding energy, and thermal width are affected by the momentum dependence of the relaxation time. Our results show significant deviations from the standard relaxation time approximation, highlighting the importance of non-equilibrium effects in modeling quarkonia suppression in heavy-ion collisions.

Author: SINGH, Sunny Kumar (Indian Institute of Technology Gandhinagar)

Co-authors: KURIAN, Manu (McGill University); GHOSH, Ritesh (Saha Institute of Nuclear Physics); Mr BHADURY, Samapan (Jagiellonian University)

Presenter: SINGH, Sunny Kumar (Indian Institute of Technology Gandhinagar)

Session Classification: Parallel Session

Contribution ID: **48** Type: **Oral**

Kinematic Discriminants of Double Parton Scattering in Vector Boson Final States at LHC

Thursday 4 September 2025 15:00 (15 minutes)

Double parton scattering (DPS) processes provide a way to study the multi-parton interactions and spatial and momentum correlations within the hadrons. While traditional DPS studies use simple models like the "pocket formula", recent QCD-based approaches with parton splittings and correlations offer a more dynamic view. This study analyzes DPS at the LHC, focusing on same-sign WW, WZ, and ZZ final states by combining theoretical predictions and Monte Carlo simulations. Using DPS simulation with double parton distributions (dPDFs) and angular-ordered parton evolution, we explore various observables such as inter-lepton azimuthal separation, transverse momentum imbalance, and rapidity gaps across different kinematic regimes, comparing them with results from traditional Monte Carlo generators like PYTHIA and HERWIG. We also assess the importance of quark flavor decomposition and parton flavor correlations, which are not well-constrained in current LHC data. This study seeks to identify unique DPS signatures beyond cross-section measurements which could be useful for future experimental analyses to better understand multi-parton interactions at the LHC.

Author: RATHORE, Anuraag (Indian Institute of Technology Mandi - IIT-Mandi (IN))

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Presenter: RATHORE, Anuraag (Indian Institute of Technology Mandi - IIT-Mandi (IN))

Session Classification: Parallel Session

Contribution ID: **49** Type: **Oral**

Cold nuclear matter effects on charmonium production in RHIC and LHC energy domain

Friday 5 September 2025 15:00 (15 minutes)

Charmonia ($c\bar{c}$) states are believed to undergo considerable suppression, if quark-gluon plasma (QGP) is formed in relativistic heavy-ion collisions. However, a precise identification of the "anomalous" suppression pattern and its interpretation as a signature of color deconfinement demands a detailed understanding of charmonium production and suppression in proton-nucleus ($p + A$) collisions and its scaled-up contribution to nucleus-nucleus ($A + A$) collisions. In such collisions charmonium production is affected due to the presence of several different effects of different physical origin, inside the target nucleus for $p + A$ and inside the target as well as projectile nucleus for the $A + A$ system, collectively known as cold nuclear matter (CNM) effects. Interplay of various CNM effects ultimately result in an increase in resonance production cross section less than linearly with the number of binary collisions. The origin and degree of different physical processes causing charmonium suppression in normal nuclear matter would depend on the underlying collision energy and the kinematic window of the particular measurement.

In the foreseen contribution we plan to make a detailed evaluation of the different CNM effects, namely initial state parton energy loss, nuclear shadowing and final state energy loss of the nascent $c\bar{c}$ pairs in their pre-resonance stage by analyzing the available data on J/ψ production in $p+A$ and $A + A$ collisions as available from the experiments carried out at DESY, RHIC and LHC accelerator facilities. Extrapolating the observed pattern, we will give predictions for the expected level of J/ψ suppression due to confined nuclear matter, in the recently recorded $O + O$ and $Ne + Ne$ collisions at the LHC.

Author: GIRI, Sourav Kanti (Department of Atomic Energy (IN))

Co-author: Dr BHADURI, Partha Pratim (Variable Energy Cyclotron Centre)

Presenter: GIRI, Sourav Kanti (Department of Atomic Energy (IN))

Session Classification: Parallel Session

Contribution ID: **50** Type: **Oral**

Recent results on two particle correlation measurements at LHC energy

Friday 5 September 2025 15:30 (15 minutes)

Recent results from collisions of small systems (e.g. pp, p-Pb) have revealed QGP-like signatures challenging our present understanding about the conditions required to form a Quark-Gluon Plasma (QGP) [1]. Notably, long-range azimuthal correlations, also known as the "ridge", suggest the presence of collective behavior —a hallmark of QGP —even when only a few nucleons are involved in the interaction [2]. Two-particle correlation measurements have played a pivotal role in revealing this collectivity [3].

In this presentation, we will focus on recent results from jet-like two-particle correlation measurements in collisions of small systems. By examining angular correlations between high-p_T particle pairs, we aim to probe the extent to which medium-induced modifications —such as suppression or broadening of the away-side peak—might occur. These are key signatures of jet quenching, a phenomenon widely observed in heavy-ion collisions and considered strong evidence for the presence of a dense, interacting QGP. The absence or presence of such effects in small systems remains an open question and related studies will be presented in this talk.

Reference:

1. Exploring QGP signature in small system: Insights from ALICE in p–Pb and pp collisions. https://doi.org/10.1051/epjconf/202431400039
2. First observation of ultra-long-range azimuthal correlations in low multiplicity pp and p-Pb collisions at the LHC. https://doi.org/10.48550/arXiv.2504.02359
3. Ridges in p-A (and pp) collisions. https://doi.org/10.48550/arXiv.1901.00747

Author: HALDAR, Mintu (Bose Institute (IN))

Co-author: Dr PRASAD, Sidharth Kumar (Bose Institute)

Presenter: HALDAR, Mintu (Bose Institute (IN))

Session Classification: Parallel Session

Contribution ID: **51** Type: **Oral**

Spin alignment of vector mesons in relativistic heavy-ion collisions

Thursday 4 September 2025 15:30 (15 minutes)

The ALICE collaborations at the LHC and the STAR collaboration at RHIC have observed the spin alignment of various vector mesons such as ϕ, K^{*0}, J/ψ, and Υ (1S) in heavy-ion collisions. This spin alignment can be induced by the formation of a vorticity field during these collisions. In addition to the vorticity field, the magnetic field and momentum-space anisotropies in the medium are also expected to contribute to the spin alignment of vector mesons. In the current study, we explore the spin alignment of various vector mesons in the presence of vorticity, magnetic field, and anisotropies present in the QGP medium. The spin alignment of vector mesons is characterized in terms of the spin density matrix. Our findings predict how the diagonal and off-diagonal elements of the spin density matrix are sensitive to medium temperature, rotation, magnetic field, and medium anisotropy. In our investigations, we obtained a non-zero value of the off-diagonal matrix elements, which signifies the presence of local spin-alignment and quantum decoherence effect in the system. Further, we propose that a spin-dependent dissociation mechanism could be used as a possible probe for deconfined hot QCD matter through spin-alignment observables.

Author: SAHOO, Bhagyarathi (Indian Institute of Technology Indore (IN))

Co-authors: Dr SINGH, Captain R. (IIT Indore); SAHOO, Raghunath (Indian Institute of Technology Indore (IN))

Presenter: SAHOO, Bhagyarathi (Indian Institute of Technology Indore (IN))

Session Classification: Parallel Session

Contribution ID: **52** Type: **Oral**

Impact of external magnetic field on magnetic moment of Ξ baryon resonances

Friday 5 September 2025 15:45 (15 minutes)

The effective masses and magnetic moments of baryons are crucial for probing their internal structure and deepening our understanding of non-perturbative QCD. Hence, exploring the impact of external magnetic field in such nuclear matter is of key interest. In the present work, we have used the effective field theories to calculate the total magnetic moment of Ξ baryon resonances. The chiral SU(3) quark mean field model is used to calculate the in-medium masses of quarks and thus of baryons and using them within the SU(4) chiral constituent quark model we find the effective magnetic moment of Ξ baryon resonances. In previous studies, there have been precise experimental measurements of magnetic moment of Ξ baryon resonances. However, studies aimed at probing the impact of external magnetic fields have not yet been undertaken within this framework. We have examined the impact of external magnetic fields on the Ξ baryon resonances while incorporating the effect of other factors such as baryonic density and temperature. Calculation of the magnetic moments include the the contributions of the valence, sea and orbital angular moment individually realized through the chiral constituent quark model. The present findings throw new insights into the internal quark structure of the baryons. In our study, we have found significant variation in the values of magnetic moment observed as a function of baryonic density and temperature.

Author: DASTIDAR, Utsa

Co-authors: DUTT, Dr Suneel; KUMAR, Arvind (Dr B R Ambedkar National Institute of Technology Jalandhar India); DAHIYA, Harleen

Presenter: DASTIDAR, Utsa

Session Classification: Parallel Session

Contribution ID: **53** Type: **Oral**

Signatures of local acceleration of quark-gluon plasma in the dilepton production

Friday 5 September 2025 12:30 (20 minutes)

Dilepton emissions represent a key probe for characterising the Quark-Gluon Plasma (QGP). A central role in computing dilepton yields is played by the imaginary part of the electromagnetic current-current correlation, or equivalently, of the photon polarisation tensor [1]. In this work, we investigate the influence of local acceleration on dilepton production. We compute this quantity in a thermal medium subject to acceleration. We assume the acceleration is sufficiently small so that it can be treated as a perturbation. We employ the thermal Dirac propagator in an accelerated frame, recently formulated within the imaginary-time formalism in [2]. Using a small acceleration expansion, we evaluate the imaginary part of the photon polarization tensor. Our perturbative results are then compared with the case of vanishing acceleration, allowing us to clearly isolate and identify the effects introduced by local acceleration.

Keywords: Dilepton production rate, Accelerated medium, Quark gluon plasma.

References:
[1] L. D. McLerran and T. Toimela, Phys. Rev. D 31, 545 (1985).
[2] V. E. Ambruş and M. N. Chernodub, Phys. Lett. B 855, 138757 (2024).

Author: BANDYOPADHYAY, Aritra

Presenter: BANDYOPADHYAY, Aritra

Session Classification: Plenary Session

Contribution ID: **54** Type: **Oral**

The spectra and the anisotropic flow of dileptons from a magnetized QCD matter

Saturday 6 September 2025 15:00 (20 minutes)

Inspired by a recent observation of enhancement in the dilepton rate from a magnetized QCD medium [1], we utilize a hydrodynamic model framework to incorporate the impact of the space-time evolution of the system on such properties [2]. In particular, we investigate the transverse momentum (p_T) spectra and even flow harmonics such as v_2 and v_4 with a focus on the impacts of the strength and lifetime of the magnetic field. We find that there is an enhancement in the p_T spectra in the presence of the external field, which grows with its strength. Another interesting observation is the existence of nonzero flow harmonics in the presence of even a very weak magnetic field. Such observations allow one to consider dileptons as a strong candidate for use as a magnetometer for a hot and magnetised QGP.

1. Phys. Rev. D 106, 056021 (2022)
2. Panda et al [In preparation]

Authors: PANDA, Ankit Kumar (IIT Bhilai); Dr DAS, Aritra (Department of Physics and Astronomy, Iowa State University, Ames, Iowa, 50011, USA); Dr DASH, Ashutosh (Institute for Theoretical Physics, Goethe University, Max-von-Laue-Str.1, D-60438 Frankfurt am Main, Germany); Dr BANDYOPADHYAY, Aritra (Department of Physics, West University of Timişoara, Bd. Vasile Pˆarvan 4, Timişoara 300223, Romania); Dr CHOWDHURY, Aminul Islam (Center for Astrophysics and Cosmology, University of Nova Gorica, Vipavska 13, SI-5000 Nova Gorica, Slovenia)

Presenter: PANDA, Ankit Kumar (IIT Bhilai)

Session Classification: Plenary Session

Contribution ID: **55** Type: **Oral**

Can Charmonium be a Probe for QGP in Small Collision Systems?

Saturday 6 September 2025 16:00 (20 minutes)

Inspired by recent observations, we attempt to investigate the existence of a QGP-like medium in $p-p$ collisions. The $p-p$ being a small collision system implies comparable transverse and longitudinal
dimensions, leading to rapid cooling of the medium. Consequently, it changes the dynamics of charmonium states, which is highly unlike the charmonium dynamics in heavy-ion collisions. We use second-order viscous hydrodynamics to obtain the medium evolution. As charmonium traverses through the medium, the relative velocity between charmonium and medium induces the relativistic Doppler shift, leading to an effective temperature for charmonium. The implicit temperature of the particle
depends on its velocity and the medium's thermal velocity. Here, we show how particle velocity (v_Q) or transverse momentum (p_T) influences the suppression and regeneration of the charmonium in the
medium. The present study incorporates the QGP-induced suppression effects, such as collisional damping, gluonic dissociation, and regeneration mechanisms. Additionally, we observe that the temperature evolution is fast enough in $p-p$ collisions to induce rapid changes in the Hamiltonian of the system, causing the transition from J/ψ to ψ(2S) state. This transition between charmonium states is obtained by considering the non-adiabatic framework for evolving charmonium states. These combined effects explore the charmonium yield modification in $p-p$ collisions at $\sqrt{s}$ = 13 TeV. The present study reexamines the validity of charmonium dynamics as a potential probe for QGP investigation in small collision systems.

Author: Mr SINGH, Captain Rituraj

Co-authors: Dr BAGCHI, Partha; SAHOO, Raghunath (Indian Institute of Technology Indore (IN)); Prof. ALAM, Jan-e (Murshidabad University, Berhampore, Murshidabad-742101, India)

Presenter: Mr SINGH, Captain Rituraj

Session Classification: Plenary Session

Contribution ID: **57** Type: **Oral**

Transport coefficients of compressed baryonic matter at finite magnetic field

Friday 5 September 2025 16:00 (15 minutes)

The chiral model is among the effective QCD models that provide non-perturbative estimates in the intermediate density regime inaccessible to LQCD and pQCD. Within this model, increasing density or chemical potential leads to a reduction of the quark condensate and constituent quark mass, ultimately restoring chiral symmetry [1]. This work aims to provide a kinetic theory based, non-pQCD estimation of the transport coefficients −particularly shear viscosity −in presence of a finite magnetic field using the condensate dependent constituent quark mass. Strong magnetic fields lead to Landau quantization of perpendicular momenta which in turn affect the transport coefficients. This is particularly significant in the light of upcoming experimental facilities of Compressed Baryonic Matter (CBM) experiment at FAIR, Germany and Nuclotron-based Ion Collider fAcility (NICA) in Russia which are set to explore high baryon density regions of the QCD phase diagram.

References

[1] D.R.J. Marattukalam, A. Dwibedi, S. De, S. Ghosh, Possibility of quantum Hall effect in dense quark matter environments: A chiral model approach, 2024, arXiv:2410.22890.

Authors: MARATTUKALAM, Dani Rose J (Indian Institute of Technology Bhilai); DWIBEDI, ASHUTOSH; Dr DE, Sourodeep; Dr GHOSH, Sabyasachi

Presenter: MARATTUKALAM, Dani Rose J (Indian Institute of Technology Bhilai)

Session Classification: Parallel Session

Contribution ID: **58** Type: **Oral**

Probing Dynamical Electrical Conductivity via Dilepton Emission: A Kinetic theory approach

Friday 5 September 2025 15:15 (15 minutes)

Dileptons have long been recognized as a clean and penetrating probe of the Quark-Gluon Plasma (QGP) formed in high-energy heavy-ion collisions. In this work, we study the thermal dilepton spectra and their elliptic flow by analyzing the dynamical conductivity that enters the dilepton production rate. This conductivity is extracted from the trace of the spectral function, derived using relativistic kinetic theory with the collision kernel modeled via the Relaxation Time Approximation (RTA).

For the first time, we derive an analytical expression for the dilepton production rate that explicitly depends on the relaxation time. This rate is then integrated over the full spacetime volume of the QGP evolution, using the temperature and velocity profiles obtained from realistic MUSIC hydrodynamic simulations.

Authors: Dr PANDA, Ankit (IIT Bhilai); Mr DWIBEDI, Ashutosh (IIT Bhilai); Dr GHOSH, Sabyasachi (IIT Bhilai); Dr ROY, Victor (NISER)

Presenter: Mr DWIBEDI, Ashutosh (IIT Bhilai)

Session Classification: Parallel Session

Contribution ID: **59** Type: **Poster**

Modelling transport properties of compressed baryonic matter

Thursday 4 September 2025 17:20 (10 minutes)

We present a comparative study of key transport coefficients—electrical conductivity (σ), thermal conductivity (κ), shear viscosity (η), and the Lorenz number ($\kappa/\sigma T$) by using different models: Hadron Resonance Gas (HRG) model, the Nambu–Jona-Lasinio (NJL) model, and effective chiral model. By examining their dependence on temperature and net baryon density, our results capture the evolution of transport behavior across hadronic and partonic regimes. This comparative framework enhances the understanding of QCD matter over a wide range of energy scales and provides a useful baseline for interpreting heavy-ion collision experiments.

Authors: RAI, Anand (IIT BHILAI); MARATTUKALAM, Dani Rose J (Indian Institute of Technology Bhilai); MURMU, Prasanta; DWIBEDI, ASHUTOSH; SHARMA , Rishabh (Central University Of Jharkhand Ranchi); Dr GHOSH, Sabyasachi

Presenter: RAI, Anand (IIT BHILAI)

Session Classification: Poster Session

Contribution ID: **60** Type: **Oral**

Polarization and magnetic field in heavy ion collisions

Thursday 4 September 2025 10:35 (20 minutes)

We investigate the rotational Brownian motion of heavy quarks in a QCD medium, focusing on its connection to the polarization of open heavy-flavor hadrons. Our analysis indicates that the transverse momentum dependence of heavy-quark polarization can serve as a distinctive probe of the intense initial magnetic field generated in off-central relativistic heavy-ion collisions. Furthermore, we propose a novel application of this strong magnetic field produced in relativistic heavy-ion collision physics.

Author: JAISWAL, Amaresh

Presenter: JAISWAL, Amaresh

Session Classification: Plenary Session

Contribution ID: **67** Type: **Oral**

Measurement of light (anti)nuclei production in jets with ALICE

Friday 5 September 2025 11:50 (20 minutes)

The mechanism responsible for (anti)nuclei production in ultrarelativistic hadronic collisions remains a subject of active scientific debate. Two leading frameworks, the statistical hadronisation model and the coalescence model, are commonly employed to interpret experimental data. In the coalescence scenario, multi-baryon states are produced when baryons that are close in phase space at kinetic freeze-out coalesce. Since jets emit nucleons in a highly collimated fashion, the restricted phase space is expected to favour the formation of nuclear states via coalescence within jets, resulting in an enhanced yield compared to the underlying event. In this contribution, measurements of the coalescence parameter B_2, which quantifies the likelihood of deuteron formation, are presented for both in-jet and out-of-jet regions in pp and p–Pb collisions. These results provide important new insights into nuclei production mechanisms in small collision systems, and are compared to theoretical predictions from the coalescence model.

Author: Dr KHUNTIA, ARVIND (INFN BOLOGNA)

Presenter: Dr KHUNTIA, ARVIND (INFN BOLOGNA)

Session Classification: Plenary Session

Contribution ID: **68** Type: **Oral**

Di-muon measuements with CBM experimet at FAIR

Thursday 4 September 2025 12:10 (20 minutes)

Collision of heavy nuclei at relativistic energies provide a unique opportunity to study the behavior of strongly interacting matter under extreme conditions of temperature and density. Till date such collisions are only known way for laboratory investigation of a possible phase transition from hadronic matter to a plasma of de-confined quarks and gluons as well as the restoration of the chiral symmetry which is spontaneously broken in the hadronic world. While the ultra-relativistic heavy-ion collisions at RHIC and LHC probes the QCD medium at high temperatures and small baryo-chemical potentials, QCD phase diagram is relatively less explored in the regime of large baryon densities. Theoretical calculations based on QCD inspired models suggest a potentially rich phase structure in the high density region including the emergence of a first-order transition along with a second-order critical endpoint. Heavy-ion collisions at lower collision energies offer unique opportunities for systematic studies of this regime.

With beam kinetic energies in the range 2 - 11 A GeV, the Compressed Baryonic Matter (CBM) experiment at FAIR, aims to probe the QCD phase diagram in the range 500 < \mu_B < 800 MeV. Production of lepton pairs has been identified as a unique tool to determine the temperature and life time of the high baryon density fireball created in these collisions. In additions dileptons provide direct information about hadron spectral functions, in particular the ρ-meson and its mixing with the chiral partner a1 , sensitive to chiral symmetry restoration. In this talk we will present a brief overview of the physics opportunities and challenges of the foreseen di-muon measurements, in the FAIR energy domain.

Author: Dr BHADURI, Partha Pratim (Variable Energy Cyclotron Centre, Kolkata)

Presenter: Dr BHADURI, Partha Pratim (Variable Energy Cyclotron Centre, Kolkata)

Session Classification: Plenary Session

Contribution ID: **69** Type: **Oral**

Radial flow via $v_0(p_{\mathrm{T}})$ in heavy-ion collisions at LHC energies

Saturday 6 September 2025 10:10 (20 minutes)

The transverse momentum dependent observable $v_0(p_{\mathrm{T}})$ has recently emerged as a novel probe of radial expansion in high-energy heavy-ion collisions. Using Pb−Pb collision data at $\sqrt{s_{\mathrm{NN}}} = 5.02$ TeV recorded with the ALICE detector, measurements of $v_0(p_{\mathrm{T}})$ for pions, kaons, and protons are performed across a broad range of collision centralities. A pseudorapidity gap technique is employed to suppress short-range nonflow correlations and isolate collective dynamics. The results reveal clear mass ordering at low p_T and baryon-meson separation at higher p_{T}, reflecting hydrodynamic expansion and hadronization via quark recombination. Comparative modeling with a blast-wave framework, including event-by-event fluctuations of radial flow velocity and freeze-out temperature, shows consistency with parameters extracted from transverse momentum spectra. Moreover, the sensitivity of $v_0(p_{\mathrm{T}})$ to bulk-viscosity effects and the underlying equation of state highlights its potential as a complementary observable for constraining the transport properties and freeze-out dynamics of the quark−gluon plasma.

Author: Ms SAHA, Swati (National Institute of Science Education and Research (NISER))

Presenter: Ms SAHA, Swati (National Institute of Science Education and Research (NISER))

Session Classification: Plenary Session

Contribution ID: **71** Type: **Oral**

Experimental overview of jet measurements at LHC

Saturday 6 September 2025 11:50 (20 minutes)

Jet is a collimated shower of particles produced from the fragmentation of high energetic partons in high energy collisions. Jet measurements provide a testing ground of the pQCD calculations while in heavy-ion collisions they help to probe the medium. In this talk I will focus on the recent results of jet measurements at LHC. The recent interesting results from small collision systems will also be highlighted.

Author: Dr PRASAD, Sidharth Kumar (Bose Institute)

Presenter: Dr PRASAD, Sidharth Kumar (Bose Institute)

Session Classification: Plenary Session

Contribution ID: **72** Type: **Oral**

Probing light-flavour particle production in small collision system through event topology with ALICE

Saturday 6 September 2025 12:30 (20 minutes)

Recent measurements in high-multiplicity pp and p−Pb collisions at the LHC have shown that small systems exhibit similar phenomena traditionally associated with heavy-ion collisions, such as strangeness enhancement, finite radial-flow and azimuthal anisotropy. These effects challenge the notion that such systems can be modelled as incoherent superpositions of parton-parton scatterings, as commonly assumed in Monte Carlo generators like Pythia. This study explores light-flavour hadron and resonance production as a function of event topology, particularly transverse spherocity, which classifies events as either isotropic (soft-dominated) or jet-like (hard-dominated). In addition, charged particle yields are investigated in different azimuthal regions relative to the leading particle, allowing subtraction of underlying event contributions and isolation of jet-like signals. The analysis includes multi-differential measurements of light flavour particles as a function of multiplicity and event topology in pp collisions at $\sqrt{s} = 13$ TeV. These results provide valuable insight into the role of final-state effects and medium-like behaviour in small systems. Comparisons with state-of-the-art QCD-inspired event generators help identify deficiencies in current modelling approaches. This study aims to establish topological selections as powerful tools for disentangling competing particle production mechanisms in small collision systems.

Author: Dr RATH, Rutuparna (GSI Darmstadt)

Presenter: Dr RATH, Rutuparna (GSI Darmstadt)

Session Classification: Plenary Session

Contribution ID: **73** Type: **Oral**

Construction of the Facility for Antiproton and Ion Research (FAIR) in Germany and Indian contribution

Thursday 4 September 2025 11:30 (20 minutes)

India is a founder-member country to participate in the construction of international multipurpose accelerator facility called the Facility for Antiproton and Ion Research (FAIR) at Darmstadt, Germany. Bose Institute, Kolkata, has been designated as the Indian shareholder of the FAIR GmbH and the nodal Indian Institution for managing the FAIR programme from India.

Indian participation in FAIR is twofold. Firstly, the advancement of knowledge in astrophysics, high-energy physics, nuclear physics, plasma physics and biophysics through the participation of Indian researchers, engineers and students of Institutes and Universities across the country in various experiments planned at FAIR. In addition to this, India is also contributing high-tech equipment as in-kind supplies to FAIR.

Our active involvement in overseeing the designing, manufacturing and supply of in-kind items e.g. power converters, vacuum chamber, beam stoppers, IT cable etc. for accelerator and coordinate participation of Indian scientists in the experiments including detector development, physics simulation, experimental data analysis at FAIR under the project entitled "India's participation in the construction of Facility for Antiproton and Ion Research (FAIR) at Darmstadt, Germany", turning this mission into reality.

India is participating in the NUSTAR and CBM experiments at FAIR and in particular Bose Institute is involved in the Compressed Baryonic Matter (CBM) experiment, to study and characterize the matter created in the relativistic nucleus-nucleus collisions at low energy and moderate to high baryon density.

In this talk the details of FAIR facility and the experiments at FAIR will be presented.

Author: Dr BISWAS, Saikat (Bose Institute)

Presenter: Dr BISWAS, Saikat (Bose Institute)

Session Classification: Plenary Session

Contribution ID: **74** Type: **Oral**

Quarkonia production in Run 3 using ALICE at the LHC

Friday 5 September 2025 12:10 (20 minutes)

The measurement of quarkonium production is a powerful tool for investigating both perturbative and non-perturbative aspects of quantum chromodynamics (QCD) in proton-proton (pp) collisions, as well as the properties of the quark-gluon plasma (QGP) in heavy-ion collisions. Quarkonia are golden probes of the QGP evolution, with their yields influenced by suppression and (re)generation of initially uncorrelated charm quarks.

In pp collisions, charmonia, such as J/ψ and ψ(2S), are produced through a process that can be factorized into initial hard parton scattering (described by perturbative QCD) and subsequent non-perturbative bound-state formation. Precise measurements of their production cross sections and ratios (e.g., ψ(2S)-to-J/ψ) provide critical tests of theoretical models and serve as benchmarks for studies in nuclear collisions. The newly installed Muon Forward Tracker (MFT) enables the ALICE experiment to separate prompt and non-prompt J/ψ at forward rapidity ($2.5 < y < 4.0$) for the first time, complementing midrapidity ($|y| < 0.9$) capabilities. These measurements serve as essential references for heavy-ion studies while testing expectations of QCD-based models.

From the start of Run 3 at the LHC, ALICE has collected large data samples of \pp and \PbPb collisions at $\sqrt{s} = 13.6$ and $\sqrt{s_{\rm NN}} = 5.36$ TeV, respectively, achieving unprecedented precision in quarkonium studies. This contribution presents preliminary Run 3 results, including measurements of $\psi(2S)$-to-J/ψ ratio in pp and Pb$-$Pb collisions, inclusive J/ψ cross sections in pp collisions, elliptic flow ($v_2^{{\rm J}/\psi}$ and $v_2^{\Upsilon(1S)}$), and prompt/non-prompt J/ψ separation at mid and forward rapidities. Additionally, performance studies of the exotic X(3872) state will be discussed. These measurements significantly advance our understanding of heavy-quark production and QGP properties.

Author: Dr THAKUR, Dhananjaya (INFN Sezione di Torino)

Presenter: Dr THAKUR, Dhananjaya (INFN Sezione di Torino)

Session Classification: Plenary Session

Contribution ID: **75** Type: **Oral**

Nuclei formation in pp and heavy-ion collisions at the LHC: Insight into the production mechanisms using novel tools

Thursday 4 September 2025 12:30 (20 minutes)

A hot topic at the Large Hadron Collider (LHC) is the production of anti-nuclei. In ultra high-energy collisions, nuclei with very low binding energies are not expected to survive the dense and hot final state environment. The traditional view of nuclei production has been that antinuclei form via coalescence after the hot environment has dissipated. However, statistical thermal models, where hadrons are produced from a fireball at thermal equilibrium, can also describe the relative abundances of light nuclei in pp and heavy-ion collisions at the LHC. In this talk, latest measurements on nuclei in pp and heavy-ion collisions at the LHC will be discussed. The deuteron and anti-deuteron production will be investigated to test the microscopic mechanism of their production, which is still under debate. In particular, using a realistic coalescence model for deuteron production, the deuteron-antiproton (antideuteron-proton) balance functions as a function of multiplicity and transverse momentum selection for pp collisions will be presented. This will be compared with balance functions obtained using the statistical-thermal FIST package. Finally, the possibility to differentiate between the two production mechanism will be discussed.

Author: TRIPATHY, Sushanta (CERN)

Presenter: TRIPATHY, Sushanta (CERN)

Session Classification: Plenary Session

Contribution ID: **77** Type: **Oral**

Wigner Distribution and Orbital Angular Momentum of Quarks

Saturday 6 September 2025 15:20 (20 minutes)

Wigner distributions offer a multidimensional phase–space representation of quarks, simultaneously encoding spatial and momentum correlations. They form a natural bridge between generalized parton distributions (GPDs) and transverse–momentum–dependent distributions (TMDs), providing direct access to quark orbital angular momentum (OAM). In this talk, I will present the light-front formulation of quark Wigner distributions and discuss their relation to canonical and kinetic OAM through generalized transverse–momentum–dependent distributions (GTMDs). Model predictions, polarization-dependent correlations, and recent progress in lattice QCD extractions will be highlighted. These results shed light on the quark contributions to the nucleon spin and deepen our understanding of the three-dimensional structure of hadrons.

Author: Dr OJHA, Vikash Kumar (Sardar Vallabhbhai National Institute of Technology)

Presenter: Dr OJHA, Vikash Kumar (Sardar Vallabhbhai National Institute of Technology)

Session Classification: Plenary Session

Contribution ID: **80** Type: **Oral**

Thermoelectric power in graphene and quark–gluon plasma systems

Friday 5 September 2025 15:30 (15 minutes)

The thermoelectric power or Seebeck coefficient of graphene and quark gluon plasma (QGP) produced in the relativistic heavy ion collision experiment exhibits significant deviation compared to the conventional Mott relation. This deviation highlights the unique transport properties and strongly interacting quantum fluid behaviors of both the graphene and QGP cases. Near the charge neutrality point, the Seebeck coefficient approaches the hydrodynamic limit, showing an enhanced value at high temperatures. In this study, we investigate the Seebeck coefficient of a clean graphene monolayer using a kinetic theory-based relaxation time approximation (RTA) calculation, incorporating the fluid-like collective dynamics of charge carriers. By assuming an energy-independent relaxation time, we demonstrate that the Seebeck coefficient derived from a quasiparticle description of the electron-hole plasma with linear dispersion provides a good agreement with experimental observations. Similarly, for QGP, we observe the thermoelectric power by using the kinetic theory-based RTA calculation. The comparative study of graphene and QGP thus provides deep insights into the transport characteristics for high-energy physics and nanoscale thermoelectrics.

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Win, T. Z., Aung, C. W., Khandal, G., & Ghosh, S. (2025). Wiedemann–Franz law violation domain for graphene and nonrelativistic systems. International Journal of Modern Physics B, 2550182.

Author: Mrs NAYAK, Subhalaxmi (IIT BHILAI)

Co-authors: Dr DEY, Jayanta (JINR,DUBNA,RUSSIA); Dr GHOSH, Sabyasachi (IIT BHILAI); Dr VEMPATI, Sesha (IIT BHILAI)

Presenter: Mrs NAYAK, Subhalaxmi (IIT BHILAI)

Session Classification: Parallel Session

Contribution ID: **81** Type: **Oral**

Wiedemann-Franz law Violation in Graphene and Quark Matter

Friday 5 September 2025 15:00 (15 minutes)

The Wiedemann-Franz (WF) law states that the ratio of electrical and thermal conductivity, multiplied by temperature, remains constant in conventional metals- an outcome well-explained by Fermi gas and Fermi liquid theory[1]. However, this law breaks down in many-body systems. Notably, quark or hadronic matter produced in high-energy nuclear collisions at RHIC and LHC does not obey the WF law[2, 3]. These systems exist in regimes characterized by temperatures and baryon chemical potentials on the order of MeV to GeV. In contrast, condensed matter systems operate in much lower energy scales, typically in the meV to eV range. While traditional metals with Fermi energies around 2–10 eV conform to the WF law, materials like graphene can exhibit its violation by reducing the Fermi energy through controlled doping[4, 5]. Using Boltzmann transport theory, we investigate the thermal and electrical conductivities in both graphene and ultra-relativistic quark matter. Our findings reveal a clear violation of the Wiedemann-Franz law in both domains, despite their vastly different energy scales.

Author: Ms WIN, Thandar Zaw (Indian Institute of Technology Bhilai)

Co-authors: Mr DWIBEDI, Ashutosh (Indian Institute of Technology Bhilai); Dr AUNG, Cho Win (Indian Institute of Technology Bhilai); Mr KHANDAL, Gaurav (Indian Institute of Technology Bhilai); Dr GHOSH, Sabyasachi (Indian Institute of Technology Bhilai); Mrs NAYAK, Subhalaxmi (Indian Institute of Technology Bhilai)

Presenter: Ms WIN, Thandar Zaw (Indian Institute of Technology Bhilai)

Session Classification: Parallel Session

Contribution ID: **82** Type: **Poster**

Heavy quark relaxation time from the effective QCD potential

Thursday 4 September 2025 17:10 (10 minutes)

In this work, we investigate the scattering cross section for heavy quark using the Dual QCD potential within the framework of the Born approximation. The scattering cross section is presented as a function of momentum. This study is further extended to calculate the relaxation time and analyze its dependence on temperature.

Authors: Mr MURMU, Prasanta (Indian Institute of Technology Bhilai); Dr PUNETHA, Garima; Dr BANDYOPADHYAY, Aritra; Dr GHOSH, Sabyasachi (Indian Institute of Technology Bhilai)

Presenter: Mr MURMU, Prasanta (Indian Institute of Technology Bhilai)

Session Classification: Poster Session

Contribution ID: **87** Type: **Oral**

Simulations of stochastic fluid dynamics near a critical point

Saturday 6 September 2025 10:30 (20 minutes)

We present numerical simulations of stochastic fluid dynamics with a conserved charge coupled to the momentum density of the fluid. This theory is known as model H, and it is expected to describe universal dynamics in the vicinity of a possible critical endpoint in the QCD phase diagram. We verify dynamical scaling, extract the scaling exponent z, and compute the renormalization of shear viscosity. In a finite system, we observe a crossover between the mean field value z = 4 and the true critical exponent $z \sim 3$. We show that this crossover is sensitive to the values of the correlation length and the renormalized shear viscosity.

Author: CHATTOPADHYAY, Chandrodoy (PRL, Ahmedabad)

Co-authors: OTT, Josh (Massachusetts Institute of Technology, USA); Prof. SCHAEFER, Thomas (North Carolina State University, USA); Prof. SKOKOV, Vladimir (North Carolina State University, USA)

Presenter: CHATTOPADHYAY, Chandrodoy (PRL, Ahmedabad)

Session Classification: Plenary Session

Contribution ID: **88** Type: **Oral**

Thermodynamics of strongly magnetized dense quark matter from hard dense loop perturbation theory

Saturday 6 September 2025 15:40 (20 minutes)

In this work we discuss the hard dense loop perturbation theory approach for studying the thermodynamics of strongly magnetized dense quark matter. The study has been confined to one loop self-energy of quarks and gluons respectively, for calculating the free energy of the system. Thermodynamic quantities such as pressure, magnetization, second-order quark number susceptibility, and speed of sound have been computed, and their behavior with chemical potential and magnetic field has been studied. It is found that the speed of sound approaches the speed of light at extremely high densities. The results may be helpful for studying extremely magnetized and dense objects such as neutron stars and magnetars.

Author: Mr SATAPATHY, Sarthak (BJB College)

Co-authors: Mr KHAN, Salman Ahamad (Department of Physics, Integral University, Lucknow—226026, India); Mr RANA, Sumit (School of Physics, Beijing Institute of Technology, Beijing 102488, China)

Presenter: Mr SATAPATHY, Sarthak (BJB College)

Session Classification: Plenary Session

Contribution ID: **91** Type: **Oral**

Exploring the origin of collective phenomena in small collision systems at the LHC

Friday 5 September 2025 11:30 (20 minutes)

The observation of collective-like behaviors in pp and p–Pb collisions at LHC energies has sparked debate about the similarities between the dynamics of small systems and heavy-ion collisions. In this talk, our latest published results are presented, showing baryon-meson v2 grouping (within 1 sigma) and significant splitting (approximately 5 sigma) at intermediate pT in high-multiplicity p–Pb and pp collisions, similar to those observed in heavy-ion collisions. The Hydro-Coal-Frag model, which incorporates partonic flow and quark coalescence, best describes the data, while alternative models fail to reproduce the pattern, providing strong evidence of a collectively flowing partonic medium in high-multiplicity pp and p–Pb collisions. The key question of how far down in system size the dynamics of small systems and heavy-ion physics remain similar is also investigated. The observed baryon-meson grouping and splitting, down to lower multiplicities (Nch ˜ 25), suggest that partonic collectivity may persist even in smaller systems. Additionally, our newly published results on ultra-long-range two-particle correlations, |Deltaeta|> 5.0(6.5), extending down to or below minimum bias multiplicity in pp and p–Pb collisions, explore the limits of collective medium formation in small systems.

Author: Prof. SARKAR, Debojit (IIT Bombay)

Presenter: Prof. SARKAR, Debojit (IIT Bombay)

Session Classification: Plenary Session

Contribution ID: **92** Type: **Oral**

In-medium jet modification in Quark Gluon Plasma produced in heavy-ion collisions at RHIC

Thursday 4 September 2025 11:50 (20 minutes)

In this talk, I will discuss in-medium jet modifications observed in heavy-ion collisions at the STAR experiment. I will also present upcoming measurements and their underlying physics at this conference.

Author: SAHOO, Nihar Ranjan

Presenter: SAHOO, Nihar Ranjan

Session Classification: Plenary Session

Contribution ID: **94** Type: **Oral**

Analytical solutions of hydrodynamics and their applications

We present analytical solutions of relativistic hydrodynamics for systems with cylindrical symmetry, incorporating boost-invariant longitudinal expansion and Hubble-like transverse flow. We also discuss an analytical solution for a spherically expanding system with Hubble-like symmetry. For both cases, we calculate hadron transverse momentum spectra on a constant-temperature freeze-out hypersurface. The resulting spectra can be directly compared with experimental data corresponding to cylindrical and spherical fireball geometries, respectively. Furthermore, we outline a solution corresponding to a non-boost-invariant scenario, which is particularly relevant in the low-energy collision regime.

Author: BISWAS, Deeptak (National Institute of Science Education and Research (NISER))

Presenter: BISWAS, Deeptak (National Institute of Science Education and Research (NISER))

Session Classification: Plenary Session

Contribution ID: **95** Type: **Oral**

Initial state effect on the hadron production in small systems at LHC

This work explores the effect of the geometry of the nucleus in the p-^{16}O, ^{16}O-^{16}O and ^{20}Ne-^{20}Ne collisions at LHC energies with the PYTHIA Monte Carlo event generator in Angantyr framework. Angantyr models heavy-ion collisions as a superposition of independent nucleon-nucleon (NN) collisions, without incorporating collective effects. We construct tetrahedral structure of ^{16}O and bi-pyramidal structure of ^{20}Ne composed of four α-clusters and five α-clusters, respectively. We compare their collision dynamics against those generated using Woods-Saxon nuclear density distribution. The results are further compared for different orientations of the ^{20}Ne nuclei, including tip-tip, body-body, body-tip, and random orientations of the bi-pyramidal structure. The results show that the geometric arrangement of α-clusters in the ^{16}O and ^{20}Ne nucleus significantly influence the particle production at the freeze-out boundary there-by affecting the multiplicity and mean transverse momentum, $\langle p_T \rangle$, of the produced hadrons. These results highlight the sensitivity of final state observables to the nuclear structure and orientation of colliding nuclei, providing insights into the dynamics of small collision systems, even in non-hydrodynamic framework.

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