National Science Day

Date: 13th March, 2026

Abstracts of Talks and Posters

School of Physical Sciences, IIT Mandi

Indian Institute of Technology Mandi

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National Science Day 2026 Schedule

13 March, A1 NKN

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Talk 1: Superfluid analogue of cosmological out-of-equilibrium dynamics: The story of a false vacuum

Sivasankar (ud23002@students.iitmandi.ac.in)
Indian Institute of Technology Mandi, 175005, Himachal Pradesh, India

Abstract: The relaxation of a quantum field from a metastable state (false vacuum) to a stable one (true vacuum), also known as false vacuum decay, is a fundamental problem in quantum field theory and cosmology [1, 2]. We study this phenomenon using a two-dimensional interacting and coherently coupled Bose-Bose mixture, a platform that has already been employed experimentally to investigate false vacuum decay in one dimension [3]. In such a mixture, it is possible to define an effective magnetization that acts as a quantum field variable. Using the Stochastic Gross-Pitaevskii equation (SGPE), we prepare thermal equilibrium states in the false vacuum and extract decay rates from the magnetization dynamics. The decay rates show an exponential dependence on temperature, in line with the thermal theory of instantons. Since the SGPE is based on complex scalar fields, it also allows us to explore the behavior of the phase, which turns out to become dynamic during decay. Our results confirm the SGPE as an effective tool for studying coupled magnetization and phase dynamics and the associated instanton physics in ultracold quantum gases [4].

References:

1. S. Coleman, Phys. Rev. D 15, 2929 (1977).
2. C. G. Callan and S. Coleman, Phys. Rev. D 16, 1762 (1977).
3. A. Zenesini et al., Nat. Phys. 20, 558 (2024).
4. Sivasankar et al., arXiv:2602.03834 (2026).

Talk 2: Valence Band-satelite, temperature dependent magnetic and spectral study of alpha iron

Trishu Verma (ud23001@students.iitmandi.ac.in)
Indian Institute of Technology Mandi, 175005, Himachal Pradesh, India

Abstract: We investigate the influence of correlations and plasmonic excitation on valence band-satellite of α-Fe, along with magnetic and spectral properties as function of temperature. Coulomb interaction parameters are obtained by systematically employing various schemes in constrained random phase approximation (cRPA). This study identifies the presence of valence band satellite in Fe at $\sim$6 eV binding energy supported by (i) substantial incoherent spectral weight in the valence band spectra obtained from Density Functional Theory plus Dynamical Mean Field Theory (DFT+DMFT) and (ii) plasmonic excitations in the frequency range $\sim$6-8 eV suggested by G0 W0 calculations. We note presence of significant contribution of temperature-dependent Pauli-spin susceptibility indicating competing degree of itinerancy, e.g., state shows a strong temperature driven non-Fermi-liquid behavior emerging near T_c. Our results reveal a high-temperature orbital-selective loss of coherence eventually leads to a orbital selective collapse of magnetization at T_c , suggesting a ferromagnetic phase characterized by strong correlation- and temperature dependent spectral features.

Talk 3: Flocking through the active nematics

Abhishek Sharma (d22027@students.iitmandi.ac.in)
Indian Institute of Technology Mandi, 175005, Himachal Pradesh, India

Abstract: We investigate the collective behavior of motile rods immersed in a monolayer of apolar rods confined between vertically vibrating plates using numerical simulations. We uncover an antidiffusive instability whereby motile rods segregate from the apolar medium and form flocks whose size increases with the medium concentration. Remarkably, enhanced segregation leads to a reduction of the global polar order. The flock structure is strongly influenced by the anisotropy of the medium rods. For small aspect ratios, the flocks are elongated perpendicular to the mean direction of motion, whereas for larger aspect ratios they elongate along the direction of motility. We rationalize the emergence of segregation-induced disorder using a minimal mean-field model.

Talk 4: Probing Underlying Event Activity through Spherocity and multiplicity activity event classifier

Anuraag Rathore (d23022@students.iitmandi.ac.in)
Indian Institute of Technology Mandi, 175005, Himachal Pradesh, India

Abstract: This study investigates the intricate relationship between transverse spherocity (S_0) and the relative transverse multiplicity activity event classifier (R_T) in proton-proton collisions at the Large Hadron Collider (LHC) with a center-of-mass energy of 13 TeV. Through a detailed analysis across different spherocity regions, we examine various observables to understand underlying event dynamics in high-energy particle collisions. We have used the PYTHIA 8 Monte-Carlo (MC) with a different implementation of color reconnection and rope hadronization models to demonstrate the proton-proton collision data at $\sqrt{s} = 13$ TeV. The sensitivity to the multi-partonic interaction is studied using a new differential approach to understand the underlying event and jetty-like domain. Furthermore, the baryon-to-meson production ratio and the average transverse momentum (p_T) are evaluated across R_T for selected spherocity classes, revealing significant dependencies on the event topology. These measurements offer insight into the complex nature of strange particle production and underlying event structure in high-energy collisions, with implications in quantum chromodynamics (QCD) studies. Experimental confirmation of these results is feasible using ALICE Run 3 data which will provide more insight into the soft physics in the transverse region which is useful to understand the small system dynamics.

References:

1. A. Rathore, et al. Phys. Rev. D 112 (2025) 11, 116021
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3. T. Martin, et al. Eur. Phys. J. C 76 (2016) 5, 299

Talk 5: Inter-Cluster Coulombic Decay: A novel pathway for remote spectroscopic events

Hari Varma (hari@iitmandi.ac.in)
Indian Institute of Technology Mandi, 175005, Himachal Pradesh, India

Abstract: Fullerenes are carbon networks that form hollow cage-like structures capable of encapsulating atoms, molecules, or clusters. The resulting systems are known as endohedral fullerenes [1]. They serve as nanoscale laboratories for exploring intriguing aspects of light–matter interactions. The interaction of XUV radiation with fullerene leads to the formation of collective electronic oscillations, known as plasmons. In an endohedral systems the plasmon finds an alternate decay path through the ionisation channels of the species inside, apart from the intrinsic fullerene continuum channels. This non-local decay path is known as resonant intercluster Coulombic decay (R-ICD). This talk introduces the ICD process and presents our recent prediction of the R-ICD mechanism, with $Na_{20}@C_{240}$ serving as a prototype system [2].

References:

1. Endohedral Fullerenes, Popov A A et al., Chem. Rev. 113 5989–6113 (2013)
2. Plasmonic resonant intercluster coulombic decay, Shaik R. et al., Phys. Rev. Lett. 130, 233201(2023).

Talk 6: Ultrafast Charge Separation Dynamics in Quasi-2D Perovskites for Improved Photocurrent Performance

Soumya Halder (soumyahalder231@gmail.com)
Indian Institute of Technology Mandi, 175005, Himachal Pradesh, India

Abstract: Quasi-two-dimensional (quasi-2D) metal halide perovskites exhibit complex phase heterogeneity that strongly influences their light-matter interactions and charge transport properties. However, the mechanisms governing charge transfer between different phases remain unclear. In this work, we investigate fluorinated multilayered $(4\text{-FBA})_2(\text{MA})_{n-1}\text{Pb}_n\text{I}_{3n+1}$ films (nominally $n = 3$) using femtosecond transient absorption spectroscopy. The films naturally form a heterogeneous stack of $n = 1, 2, 3$, and bulk-like phases along the growth direction. Ultraviolet photoelectron spectroscopy measurements, supported by density functional theory calculations, reveal a type-II band alignment between the small-n phases and the bulk domains. This staggered band structure drives efficient electron–hole separation through both direct and sequential transfer pathways. Electrons preferentially migrate into bulk domains, while holes accumulate in small-n layers, extending even to the $n = 1$ phase-an observation rarely reported previously. Importantly, the nearly symmetric transfer times of electrons and holes enable balanced and spatially efficient carrier separation. Global target analysis of the transient absorption data quantitatively confirms this carrier transfer mechanism. Finally, diode devices fabricated from these films exhibit enhanced photocurrent, directly linking interphase charge separation to improved device performance. Overall, this study provides new insights into interphase carrier dynamics in fluorinated quasi-2D perovskites and demonstrates how engineered band alignment can enable efficient directional charge separation for high-performance photovoltaic and optoelectronic applications.

Talk 7: Constraining Lorentz Violation using 21cm and CMB Cross Correlations

Bhuwan Joshi (di2207@students.iitmandi.ac.in)
Indian Institute of Technology Mandi, 175005, Himachal Pradesh, India

Abstract: Lorentz symmetry is a fundamental pillar of modern Physics, yet high-energy theories often predict its violation. One potential signature of such a violation is cosmic birefringence — rotation of the polarization plane of photons due to Chern-Simons coupling in Maxwell's electrodynamics. This rotation angle, aka birefringence angle, depends upon the distance travelled by the photon and is thus different for CMB and 21cm photons. While the rotation angle in CMB, i.e., $\alpha_{\rm CMB}$, has been tightly constrained by CMB experiments, the potential of the 21cm cosmological signal to constrain this parameter, as well as constrain $\alpha_{\rm 21cm}$, remains largely unexplored. In this work, we provide constraints on both these angles by cross-correlating 21cm and CMB signals. Using the Fisher matrix formalism, we give our forecasts for 21cm experiments, including SKA, HIRAX, and PUMA, & Planck like CMB experiment. We find that best constraints $\sigma_{\alpha_{\rm CMB}} \sim 4.4^\circ$ and $\sigma_{\alpha_{\rm 21cm}} \sim 100^\circ$ are found using $C_\ell^{T_{21}B_{\rm CMB}}$ and $C_\ell^{T_{21}B_{21}}$ respectively. Since birefringence hasn't yet been detected in 21cm, we choose the fiducial value $\alpha_{\rm 21cm}^{\rm fid} = 0$ assuming the null hypothesis.

Talk 8: Coexistence of strong spin fluctuations and partial ordering in a buckled honeycomb lattice system $Nd_2Te_4O_{11}$

Manshi Rani (ud22006@students.iitmandi.ac.in)
Indian Institute of Technology Mandi, 175005, Himachal Pradesh, India

Abstract: Frustration-driven quantum fluctuations, along with spin-orbit coupling and crystal electric field can give rise to exotic magnetic phenomena in rare-earth-based quantum magnets. We have investigated the magnetic ground state of $Nd_2Te_4O_{11}$ through thermodynamic and muon spin relaxation (μSR) experiments. It crystallises in a monoclinic crystal structure, where magnetic ions are decorated on a distorted honeycomb lattice, without any disorder between their constituent atoms. Magnetization and heat capacity studies consistently indicate the formation of the Jeff = 1/2 state of Nd^{3+} ions. These findings are further supported by point-charge-based calculations, which indicate substantial energy separation between the ground state and the first excited state ($\sim$9.5 meV). Thus, it confirms that at low temperature, magnetic properties are solely dependent on the ground state Kramers doublet, leading to a low-energy Jeff = 1/2 state in $Nd_2Te_4O_{11}$. In zero field, this compound exhibits the signature of static magnetic ordering below TN $\sim$ 0.45 K, which is suppressed under applied magnetic field $\geq$ 30 kOe. In contrast, μSR results reveal the presence of persistent and strong spin fluctuations down to 50 mK. This compound can be a potential candidate to explore quantum magnetism in honeycomb geometry.

Talk 9: Oscillations and Emergent spatio-temporal dynamics: Active matter, Electrochemical and Chemical systems

Tanushree Roy (tanushreeroy@iitmandi.ac.in)

Indian Institute of Technology Mandi, 175005, Himachal Pradesh, India

Abstract: Oscillations are among the most fundamental dynamical behaviors observed in physical systems. Oscillatory dynamics span a wide range of phenomena, from mechanical pendulums and electrical circuits to chemical and electrochemical reactions, as well as active matter systems. Understanding the mechanisms responsible for these oscillations is essential for uncovering universal principles governing self-organization in driven systems. In this talk, we discuss the emergence of diverse spatio-temporal dynamics and patterns arising from oscillatory instabilities in different systems, including self-propelled oscillators, electrochemical oscillators, and chemical oscillators. These studies provide insight into the fundamental physics of driven matter and reveal how oscillations and collective dynamics emerge across different length scales and environments. Such investigations have important implications for the design of stimuli-responsive materials, the development of synthetic active matter, and the control of complex dynamical states in different environments.

Talk 10: Bulk reconstruction in 2D multihorizon black hole

Rhitaparna Pal (dodonpal99@gmail.com)
Indian Institute of Technology Mandi, 175005, Himachal Pradesh, India

Abstract: The goal of the bulk reconstruction program is to construct boundary representations of fields in asymptotically Anti-de Sitter spacetimes. we extend the program by computing the boundary representation of massless fields in an Achucarro-Ortiz black hole spacetime. We obtain analytic expressions for smearing functions in both the exterior and interior of the black hole.

Talk 11: Investigation of electronic and structural properties Near phase transitions

Sharshad K (d22026@students.iitmandi.ac.in)
Indian Institute of Technology Mandi, 175005, Himachal Pradesh, India

Abstract: We investigate classical and quantum phase transitions as well as the electronic, magnetic, and structural properties around the phase transitions of perovskite manganites, such as $SrRu_{1-x}Mn_xO_3$ (SRMO) and $La_{1-x}Sr_xMnO_3$ (LSMO). These materials exhibit rich electronic and magnetic properties due to strong correlations between charge spin and lattice degrees of freedom. The results highlight the roles of Mn-Mn and Ru-Mn interactions in governing the resistivity and magnetic ordering. LSMO shows characteristics associated with various exchange interactions affecting magnetic ordering, while SRMO displays enhanced disorder and competing magnetic interactions leading to modified transport behavior. These findings offer clues about the tunability of correlated oxides and their potential for spintronic and functional oxide applications.

Talk 12: Structural Studies of Fullerenes and its Derivatives through Elastic Electron Scattering (EES)

Kartik Madan (DI21001@students.iitmandi.ac.in)
Indian Institute of Technology Mandi, 175005, Himachal Pradesh, India

Abstract: Using electrons as probe to study molecules is an approach widely used by researchers around the globe. Here we would be extracting the geometric information of the fullerene C_{240} and carbon onion $C_{60}@C_{240}$, using the differential cross section (DCS) studies of the electron scattering. Modelling the interaction potential depicting the target fullerenes and their derivatives are done with the help of extensively used annular square well (ASW) and the density functional theory (DFT) within the jellium approximation. The scattering amplitude for EES as suggested by the first Born's approximation involves the radial potential used to describe the scattering interaction along with the momentum transfer term Δ, expressed as $2k\sin(\theta/2)$, where θ is the angle of scattering. The DCS is expressed as the conjugate squared of the scattering amplitude. It has the geometries of the target molecules as the functions of sines and cosines which could be extracted with the help of Fourier transforms of the DCS. Thus exploring the boundaries of electron spectroscopy, as DCS can be calculated experimentally and theoretical analysis of DCS would enable us to look into the peculiar geometries of the target molecules. Such techniques have already been used in theoretical photoionization studies. The theoretical models have been able to produce the structural properties of the target molecules so far.

Talk 13: Improved Sensitivity to the $H \to Z\gamma \to \ell^+\ell^-\gamma$ Process at the LHC Using Machine Learning and novel kinematic observables

Manisha Rana (d23021@students.iitmandi.ac.in)
Indian Institute of Technology Mandi, 175005, Himachal Pradesh, India

Abstract: The Drell–Yan (Z/γ^*) processes have a significantly large cross section at LHC energy. They are one of the prominent backgrounds in many physics analyses, and their di-lepton ($\ell^+\ell^-$) final state plays an important role in many resonant signal regions. By using Monte Carlo simulated data, the study aims to improve the $Z/\gamma* \to \ell^+\ell^-$ background's discrimination and suppression from the $H \to Z\gamma \to \ell^+\ell^-\gamma$ signal at $\sqrt{s} = 13$ TeV. This study presents correlated observables that are prompted by physics and are obtained from the two-dimensional (P_H, $\theta_Z\gamma$) plane. These observables maintain excellent signal efficiency while improving signal-background separation by encoding variations in angular and momentum information. We introduce a Boosted Decision Tree (XGBoost) classifier for multivariate analysis (MVA). The classifier obtains quantifiable performance gains by adding more correlated observables that are motivated by physics. Both the electron and muon channels show a notable improvement in the area under the ROC curve (AUC), indicating the usefulness of the enlarged feature set. Additionally, the signal-to-background ratio is increased to 2.1% for the electron channel and 3.4% for the muon channel near the Higgs mass by optimizing background rejection using the (P_H, $\theta_Z\gamma$) plane. This study shows that sensitivity and robust background rejection can be enhanced by combining interpretable multivariate approaches with kinematic correlations. The method is adaptable and easily applicable to a variety of analyses, such as resonant searches, unusual Higgs decays, and investigations outside of the Standard Model.

Talk 14: Geodesics, One-Point Functions and Black Hole Perturbations

Arundhati Goldar (d21086@students.iitmandi.ac.in)
Indian Institute of Technology Mandi, 175005, Himachal Pradesh, India

Abstract: Holographic black holes exhibit a striking relation between thermal boundary one-point functions and bulk geodesic lengths. In the large conformal-dimension limit, the one-point function of a primary operator is given by the exponential of the geodesic length from its boundary insertion point to the horizon. We test the robustness of this relation under perturbations by considering an arbitrary radial deformation of an Euclidean BTZ black hole and working to first order in the perturbation. We find that the relation remains robust: the corrected one-point function at large conformal dimension is still governed by an exponent proportional to the modified boundary-to-horizon geodesic length. The result is established using WKB and saddle-point methods, with the validity of the WKB approximation justified by exact analyses.

Talk 15: Investigating ultra-thin 4H-SiC AC-LGADs for superior radiation-hard timing applications

Jaideep Kalani (d23018@students.iitmandi.ac.in)
Indian Institute of Technology Mandi, 175005, Himachal Pradesh, India

Abstract: Low Gain Avalanche Diodes (LGADs) are promising particle detectors for timing resolution better than 50 ps in high radiation and high pile-up environments, in future particle collider experiments with increaded luminosity. In this work we study ultra thin n-in-p LGAD structures below 50 μm using WeightField2 and validate the simulations with irradiation measurements from an FBK wafer, finding good agreement for both unirradiated and neutron irradiated cases. Device performance is evaluated under HL-LHC conditions including lifetime integrated fluence of order 10^{14} $n_{eq}cm^{-2}$ at 243 K, accounting for radiation damage, gain reduction, and lattice defects. A 20 μm sensor shows the best timing performance. Extending the study to Silicon, Diamond, and 4H-SiC, we find 4H-SiC to be the most promising material, providing higher gain for the same geometry and better charge collection and timing retention up to 50×10^{14} $n_{eq}cm^{-2}$. Time resolution below 25 ps is achieved for a 20 μm 4H-SiC device. We further present detailed TCAD simulations of 4H-SiC LGADs with multiple JTE edge termination and deep p+ guard implants, comparing thicknesses and analyzing electric field profiles, breakdown behavior, and gain stability before and after irradiation. These results provide practical design guidelines to improve breakdown robustness, extend detector lifetime, and optimize timing precision for HL-LHC and future collider experiments.

References:

1. J. Kalani, et al. JINST 21 (2026) P02037
2. Cartiglia N., et al. Nucl. Instrum. Meth. A 979 (2020)164383
3. G. D'Amen, et al. JINST 17 (2022) C08007

Poster 1: Probing the Interstellar Medium of NGC 7380: Toward a Determination of the Gas-to-Dust Ratio

Pryanshu Basur, Neelam Panwar (ARIES), Krishna Parattu (v24049@students.iitmandi.ac.in)
Indian Institute of Technology Mandi, 175005, Himachal Pradesh, India

Abstract NGC 7380 is a young open cluster that is a great laboratory to study the effect of stellar feedback on the natal ISM. Massive stars in these clusters affect their environment in deep ways, and one of the fundamental parameters to understand such a process is the gas-to-dust ratio (GDR). The GDR is thought to be tracking a typical value in the ISM, but it differs vastly in star-forming clouds because of local physical processes such as stellar winds, radiation pressure, and cloud dispersal. In this study, we are conducting a multi-wavelength analysis to derive the GDR across NGC 7380. Molecular gas content is traced through CO observations obtained from the Purple Mountain Observatory, which serve as a proxy for molecular hydrogen. The dust component and its distribution are mapped using a near-infrared colour excess method applied to a stellar catalogue constructed from 2MASS and UKIRT data. This work will deliver the first spatially resolved map of the gas-to-dust ratio in NGC 7380. By quantifying the mean GDR and exploring its variations across the cluster, we provide new constraints on molecular cloud dispersal and the physical state of the ISM in this active star-forming region. Based on the WD01 model, we report aGDR of 85±2 from 12CO and 122±4 from 13CO. resulting in an average GDR of 104 for the region.

Poster 2: Driven Evolution from Short-Range Ferromagnetic Clusters to Glassy State in $TbCoC_2$

Manisha (d23019@students.iitmandi.ac.in)

Indian Institute of Technology Mandi, 175005, Himachal Pradesh, India

Abstract We investigate the magnetic properties of a rare-earth based dicarbide $TbCoC_2$ that crystallizes in a non – centrosymmetric orthorhombic structure. DC susceptibility confirms the presence of high temperature transition followed by a ferromagnetic (FM) transition at 28 K. Below this FM transition, significant drop in moment and a bifurcation between zero field cooled and field cooled curve suggests towards the presence of disordered magnetic state. A combined DC and AC susceptibility study indicate that the high temperature transition can be attributed to the dynamical short-range FM cluster state in paramagnetic matrix. The dynamic magnetization studies provide the evidence of cluster glass state below FM transition.

Poster 3: Study of magnetic and structural behaviour of Cr-doped $Ca_{0.7}Sr_{0.3}RuO_3$

Pankaj Verma and Bindu Radhamany (d23024@students.iitmandi.ac.in)
Indian Institute of Technology Mandi, 175005, Himachal Pradesh, India

Abstract $SrRuO_3$ is an infinite-layer Ruddlesden-Popper series compound. Ca-doped $SrRuO_3$ shows the smeared quantum phase transition from ferromagnetic to paramagnetic behavior (2). The smeared quantum phase transition could be due to the disorder induced in the system, as the Ca is doped on the Sr site. We synthesized the compound $Ca_{0.7}Sr_{0.3}Ru_{1-x}Cr_xO_3$ ($x = 0, 0.05, 0.1$) by using the solid-state method, and XRD measurements were done using a 9 kW Rigaku SmartLab X-ray diffractometer with Cu Kα radiation in the Bragg-Brentano focusing geometry. $Sr_{0.3}\,Ca_{0.7}\,Ru_{1-z}\,Cr_z\,O_3$ ($z = 0, 0.05, 0.1$) shows that all the compounds stabilize in the orthorhombic phase at room temperature; a decrement in the unit cell volume is observed with an increase in Cr doping. In the temperature-dependent DC susceptibility measurement, it clearly shows that the transition temperature increased with Cr doping. The increment in Tc could be due to the increment in the magnetic moment or exchange interaction or both. Magnetization (M) vs. external magnetic field (H) suggests that all compounds are ferromagnetic and coercivity increased with Cr doping. Curie-Weiss fitting suggests the increase of ferromagnetic interaction with Cr doping. To relate the observed magnetic behavior with theory, we did the DFT for spin polarized (FM phase and A-type, C-type, and G-type) on $Ca_{0.75}Sr_{0.25}RuO_3$ using the lattice parameters of $Ca_{0.7}Sr_{0.3}RuO_3$, and thus we calculated the magnetic exchange constant (J)(3).

References:

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2. Jaskirat Brar and R Bindu J. Phys.: Condens. Matter 36 (2024) 325503.

Poster 4: Constraining Step Feature Inflationary Models through Primordial Power Spectrum Signatures

Mridul Kumar (v24052@students.iitmandi.ac.in)
Indian Institute of Technology Mandi, 175005, Himachal Pradesh, India

Abstract Inflation is believed to have shaped the early Universe but small features in the inflationary potential can leave observable imprints in the primordial power spectrum. In this work, we study an inflationary model with a step-like feature in the potential and calculate the resulting power spectrum beyond the standard slow-roll approximation. The step introduces characteristic oscillations whose scale and strength depend on the model parameters. To understand how well these features can be tested, we apply Fisher analysis to constrain the parameters describing the step. This approach allows us to estimate how sensitively current and future observations can probe such deviations from the usual smooth inflationary dynamics. Our results show that even simple features in the inflationary potential can lead to measurable signatures further making them an interesting target for precision cosmological studies.

Poster 5: Inclusive and Diffractive jets photoproduction at HERA and EIC

Abhas Rathi (d25074@students.iitmandi.ac.in)
Indian Institute of Technology Mandi, 175005, Himachal Pradesh, India

Abstract Jet cross-section obtained from photoproduction studies has proven to aid in determination of the strong coupling constant, extraction of parton distribution functions and constraining the gluon density. This study aims to establish a validated simulation framework using Monte-Carlo event generator Pythia 8 to simulate inclusive-jet and diffractive dijet photoproduction events. The validation done against ZEUS 2012 inclusive jet and H1 2015 diffractive dijet experimental data reveals good agreement at low jet transverse energy ($E_T^{\text{jet}} < 30$ GeV) and forward pseudorapidity ($\eta^{\text{jet}} > 1$) and more than 50% agreement for observables such as such as $x_{\mathbb{P}}$, x_γ, $\Delta\eta$ and E_T^{jet} respectively. The impact of parton distribution function and multiparton interactions is also investigated which showed NNPDF2.3 NLO to give best fit while turning off MPI resulted in notable deviation. This validated framework is extended to make predictions for inclusive jet photoproduction at the Electron-Ion Collider across centre-of-mass energies of 28.6, 63.2 and 140.7 GeV and provide an initial baseline for photoproduction studies at the EIC.

References:

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Poster 6: On the prospect of constraining inflationary models based on de-Sitterization of Bianchi Cosmologies

Apurba Samanta (di2404@students.iitmandi.ac.in)
Indian Institute of Technology Mandi, 175005, Himachal Pradesh, India

Abstract The Cosmic No-Hair Conjecture, proposed by G.W. Gibbons and S.W. Hawking and partially proven for Bianchi models by R.M. Wald, states that solutions of Einstein's field equations with a positive cosmological constant asymptotically approach a de Sitter spacetime.In this work, we extend the analysis to all Bianchi types (Class A and Class B) with a scalar field in an inflationary framework. Under the slow-roll approximation and without specifying a particular form of the potential, we investigate whether anisotropic cosmological models generically evolve toward a de Sitter phase. We Calculate stronger constraints on the potential parameters beyond the standard slow-roll conditions ($\epsilon_V, \eta_V \ll 1$), thereby restricting viable cosmological models and narrowing the possible form of the fundamental inflationary potential.

Poster 7: Generating Needle Beam of Single photons with a Flat Multi-level diffractive lens

Jyotshna Bora (di2507@students.iitmandi.ac.in)
Indian Institute of Technology Mandi, 175005, Himachal Pradesh, India

Abstract An MDL(multi- level diffractive lens) is a special type of lens which has a diffraction engineered lens plane. The MDLs we use here are designed to give specific focal lengths, depth of focus and focusing spot-size; considering the focusing behaviour of classical light sources. In our experiments, we use the MDLs to study the focusing behaviour of a Single Photon source. The propagation of Single photons after passing through an MDL is studied using various spatial and axial data in the image plane. All the spatial photon records are taken by an ICCD. After axially stitching the image data taken at varying distances from lens plane, we obtain information about the optics of single photons. Single photon focusing is very important considering its ability to preserve spatial and temporal information with signal-idler correlations. Since MDL can focus the single photons upto an engineered extended distance, this experiments can prove very useful in various fields involving detector technologies.

Poster 8: Transport Properties of AM_4X_8 Type Tetrahedral Cluster Compounds

Aravind V Raj (d23219@students.iitmandi.ac.in)
Indian Institute of Technology Mandi, 175005, Himachal Pradesh, India

Abstract The family of lacunar spinel compounds AM_4X_8 (A = Ga, Ge; M = V, Nb, Ta; X = S, Se) are getting a major attention in the scientific community. The compound is having a noncentosymmetric cubical phase. It is pyroelectric and magnetically insulating which shows a structural transition and magnetic ordering at low temperatures. Here we are considering one member of the family GaV_4Se_8, having a Mott insulating ground state and shows properties like resistivity switching, pressure induced supercon- ductivity and topological Thermal Hall Effect (TTHE). The structural transition temperature at which the phase transition occurs is TS = 41K and magnetic ordering temperature TC = 17.5K. The magnetic field vs temperature plotting of the compound give rise to a new discovery of magnetic phase changes, which is cycloidal, skyrmion lattice and forced ferromagnetic phases in increasing magnetic field. The skyrmions are stable upto 2K and μ0H = 370mT. Pulsating voltage provided to the system generates an electric field effect which induces electronic phase change through breaking of the Mott insulating state to a metal like state and hence leading to the resistivity switching. Study of skyrmion lattice can help in gathering new ideas about the the topological phenomena of bosonic excitation in other systems. Resistive switching property of the system paves path in the development of Resistive Random Access Memory RRAM.

Poster 9: TBA

Rinkesh Panigrahi (d23189@students.iitmandi.ac.in)
Indian Institute of Technology Mandi, 175005, Himachal Pradesh, India

Abstract We consider scenarios where Jackiw-Teitelboim black holes are attached to baths whose temperatures can be manipulated externally. We consider the bath to be cooled continuously and numerically investigate the subsequent evolution of the generalized entropies of the black hole. Page curves corresponding to several different cooling profiles of the bath are obtained.

Poster 10: Improving Gain and Mitigating Ion Backflow in Triple-GEM Detectors via Structural Optimization

Sachin Rana (d23025@students.iitmandi.ac.in)
Indian Institute of Technology Mandi, 175005, Himachal Pradesh, India

Abstract Gas-based particle detectors are essential in modern nuclear physics and high-energy physics experiments. Micro-Pattern Gas Detectors (MPGDs) have gained significant attention due to their high spatial precision, reliable operational stability, and exceptional rate capability, among the numerous technologies that are currently available. The Gas Electron Multiplier (GEM) is a highly successful MPGD technology that is extensively utilized in numerous contemporary detector systems. The conventional GEM foil, which features a bi-conical perforation structure, does not always provide the most efficient detector performance, despite its widespread use. Exploring alternate geometrical configurations of GEM devices is critical for increasing detector performance and important operational properties. The objective of this study is to enhance gain performance and decrease ion backflow by examining modified GEM geometries. The investigation concentrates on the geometrical optimization of a triple-GEM detector configuration. The electric field maps that were generated using Mechanical APDL were subsequently imported into Garfield^{++}, which facilitated the charge transport processes within the detector in a detailed manner. We assessed the ion backflow behavior and electron multiplication (gain) for various geometrical configurations using this framework. The results of this study offer significant insights into the ways in which changes to the geometry of GEM foils can affect the performance of detectors. Optimization strategies of this nature can facilitate the advancement of gaseous detectors of the future, which will exhibit enhanced efficiency, reduced ion-related effects, and improved stability.