International WORKSHOP on "Emerging trends in High Energy and Condensed matter Physics"

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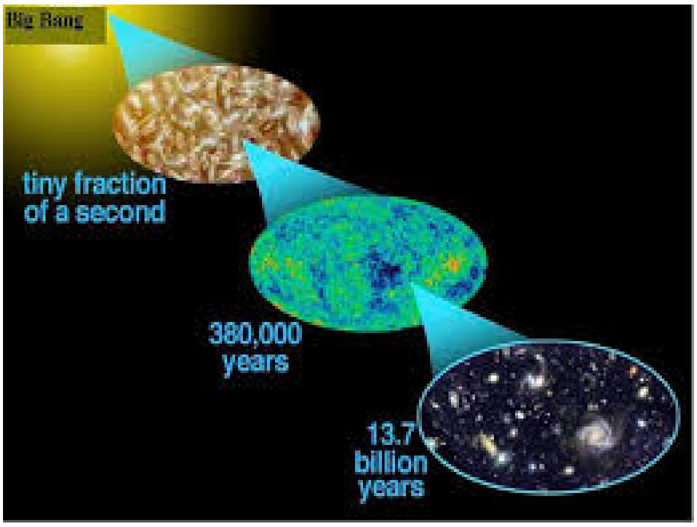

Book of Abstracts

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”Leptons from HF decays : Measurements and Inferences”

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In this talk I shall be covering on the selected results from LHC and RHIC. I shall be covering spectra and correlations (flow) and also nuclear modification factor. I shall be discussing quarkonia flow in further detail. Due to the larger mass of the bottomonium states compared to the charmonium ones,the measurement of bottomonia production in proton-nucleus collisions allows a study of CNM effects in a differentkinematic regime, therefore complementing the J/Psi studies[1].For smaller systems like p+A and p+p we have less deeply bound bottomonia states and thus a comparatively larger chance to escape. This means that more states become measurable, which is a positive feature. On the other hand,it also means that the escape mechanism which underlies the anisotropic flow of bottomonia may become largely ineffective, in particular for the Upsilon(1S). Accordingly,the measurement of a sizable flow for Upsilon(1S) in small systems[1] would probably hint at the importance of initial-state correlations. Hence understanding small systems becomes very important and such studies will be also stressed and presented.[1] D. Das and N. Dutta, Int. J. Mod. Phys. A 33, no. 16, 1850092 (2018)

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Exploring axial U (1) restoration in a modified 2+1 flavor Polyakov quark meson model

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Exploring axial U (1) restoration in a modified 2+1 flavor Polyakov
quark meson model
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Topic(s): Strongly-interacting matter at finite temperature
Abstract: We report on the U A (1) symmetry restoration resulting due to temperature dependence of
the coefficient c(T) for the Kobayashi-Maskawa-’t Hooft determinant (KMT) term in a modified 2+1 flavor

Polyakov loop quark meson model having fermionic vacuum correction term (PQMVT). Temperature depen-
dence of KMT coupling c(T) drives the non-strange condensate melting to significantly smaller temperatures
in comparison to the constant c case. Further due to c(T), m η 0 decreases from its vacuum value by 220 MeV
near T=176 MeV after the chiral transition (T c χ = 154.9 MeV). This is similar to the η 0 in-medium mass
drop of at least 200 MeV as reported by Csorgo and Vertesi in Ref [Csorgo, Vertesi], as an experimental
signature of the effective restoration of U A (1) symmetry. The pseudoscalar mixing angle θ p achieves anti-
ideal mixing in the influence of c(T). The η meson becomes light quark system (η N S) at T=176 MeV and
changes its identity with η 0 meson which becomes strange quark system (η S). The degenerated temperature
variations of σ, π meson masses merges with the temperature variations of the masses of degenerated a 0 , η
mesons near 275 MeV. It means that for c(T) when m σ = 400 MeV, the U A (1) restoration takes place at
1.75 T c χ =275 MeV.

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Dualities in three color and two color QCD phase diagram

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Dualities in three color and two color QCD phase diagram

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GW190814 secondary component as Neutron star with Hadron-Quark phase transition.

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GW190814 secondary component as Neutron star with
Hadron-Quark phase transition.
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The recently observed gravitational wave event GW190814 has a secondary component with a mass in the range 2.50-2.67M , which lies in the mass gap region raising the question as whether it is a supermassive neutron stars or a light black hole. In this context, I study the properties of the Neutron star(NS) with Hadrons along with a Phase transition to Quark matter. The NS properties are calculated using the density-dependent relativistic mean-field model (DD-RMF) for the hadronic matter . The Quark matter is studied by employing

the Vector-Enhanced Bag model (vBag). The phase transition properties of the mixed Equation of State (EoS) are studied using both Maxwell and Gibbs mechanisms. The maximum mass of neutron star with the used DD-RMF parameter sets is found to be around 2.55M for pure hadronic phase and around 2M for hadron-quark mixed phase using both Gibbs and Maxwell construction. The tidal deformability for the hybrid EoS at 1.4M , Λ 1.4 , remains unchanged from the pure hadronic EoS with Maxwell construction, but decreases with the increasing neutron star mass for Gibbs construction. Thus while the pure hadron matter EoS satisfies the mass constraint from recently observed GW190814 data, the star matter properties for the hadron-quark phase transition satisfy the constraints from the recent observations GW170817. Therefore, we cannot exclude the possibility of the secondary object in GW190814 as a neutron star composed of hadrons and quarks.

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Neutrinos: Dirac or Majorana

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Abstract
Neutrinos: Dirac or Majorana
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To understand the origin of small neutrino mass, a question arises whether neutrinos are Dirac or Majorana particles? This is one of the most fundamental problems of the modern day neutrino physics. For this, we are considering bottom up approach i.e. to go for phenomenological models which are in tune with the latest precise data. Texture specific mass matrices have been phenomenologicaly analyzed for both Dirac and Majorana neutrinos. If neutrinos are Majorana particles, neutrinoless double beta decay would occur. We outline here how the present knowledge of mixing angles and mixing matrix elements could help to determine the nature of neutrinos. Along with this, several quantities such as neutrinoless double beta decay ⟨mee⟩, Jarlskog's rephasing invariant parameter in the leptonic sector Jl and the corresponding Dirac like CP violating phase have been calculated.

Keywords

Texture specific mass matrices, Dirac and Majorana Neutrinos, Neutrinoless double beta deacy , CP violation

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Tracker Equation For Cosmological Tracking Solutions

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Tracker Equation For Cosmological Tracking Solutions
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ABSTRCT
The energy content of the universe may be supplemented by quintessence as a slowly- rolling scalar field. The understanding of tracker fields enables us to avoid the initial condition i.e. at the early age of the universe, match for the scalar and matter field which is very sensitive for the present observed ratio of their energy density nearly same today, as first one has very slow decreasing energy density than the last one. Quintessence [1] is considered to be missing energy component required to supplement the baryonic and matter density to achieve the critical density. [2, 3] This energy component has negative pressure with dynamical character and distributed in-homogeneously with slow time evolution. A form of quintessence called tracker fields has been introduced which avoids the coincidence problem [4]. We have calculated tracker function other than [5] and looking for its implication.

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Particle Production and Semiclassical Validity in Two-mode Squeezed Vacuum state of an Oscillatory Quantize Scalar Field in FRW Universe

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Abstract
An approximate solution to the semiclassical Einstein equation is obtained in two-mode squeezed vacuum (TMSV (|ξ 2 >)) state formalism perturbatively and is found to obey the same power-law expansion as that of classical Einstein equation. However, the semiclassical gravity shows a significant difference that the Hubble constant does not oscillate, in contrast with the oscillatory behavior observed in classical gravity, for a specific choice of squeezing angle. This coherently oscillating scalar field in the TMSV state suffers from the phenomenon of nonclassical particle creation due to the quantum fluctuation of the scalar field in the expanding background cosmology. We also analyzed the validity of the semiclassical theory in TMSV state and finally examined the nonclassicality of the above state in the oscillatory phase of a massive scalar field.
Keywords: Scalar Field, Two-mode Squeezed Vacuum State, FRW Universe, Semiclassical Approximation to gravity, quantum fluctuation, particle creation.

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CALCULATING LEPTONIC CP INVARIANCE FOR FRAMPTON-GLASHOW AND YANAGIDA (FGY) MODEL

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In the present paper, I revisit the relationship between the weak basis invariants (WB) related to CP violation responsible for leptogenesis and CP violation relevant at low energy. To this end, for all the four experimental viable cases pertaining to Frampton-Glashow and Yanagida (FGY) model, I reconstruct the WB invariants in terms of left-handed Majorana neutrino mass matrix elements,

and thus finding the necessary and sufficient condition for CP invariance at high energy. Further for all the viable cases, I have shown the explicit dependence of WB invariants on Dirac type and Majorana type CP violating phases. In the end, I discuss the implication of such interrelationships on leptogenesis.

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A Quest for Unique Texture in Quark Mass Matrices

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A Quest for Unique Texture in Quark Mass Matrices
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Abstract: We start with the most general quark mass matrices within the framework of Standard Model and apply the ideas of 'naturalness' and 'weak basis transformations' within the texture zero approach. Our analysis leads us to an interesting conclusion, viz. a particular texture four zero structure seems to be the unique viable option for explaining the present quark mixing data.

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Mass Matrices And Sterile Neutrinos : an Overview

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Mass Matrices And Sterile Neutrinos : an Overview

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Neutrino oscillation experiments have provided solid evidence that, in contrast to the prediction of the Standard Model (SM), neutrinos are massive and that their flavors change during propagation.Despite the victorious accomplishment of solar, atmospheric, reactor and accelerator neutrino experiments, there are experimental anomalies that cannot be explained within the standard three active neutrino framework. In particular, the possible presence of sterile neutrinos points towards non-standard neutrino physics. The issue of the LSND and MiniBooNE results has been around for some time, and is frequently interpreted as a hint towards the presence of one or two sterile neutrino states. To solve sterile neutrino problem, there can be so many approaches like hybrid textures, zero determinant, zero trace, seesaw mechanism, radiative mechanism but particularly we emphasize our work by using texture specific mass matrices. We prepare an overview of all the examination that hints beyond standard model. A brief summary of the past, present and future neutrino experiments are also presented.

Keywords: Neutrino oscillations, anomalies, sterile neutrinos, hybrid texture, texture specific mass matrices.

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Information loss problem and possible solutions

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The Information loss problem has engaged physicists over a long time now with varied points of view whethër information is lost when it enters the black holes or otherwise. Recent Proposals of AMPS, EP=EPR and other proposals are attempt to address the problem with renewed view points which conflate or complement some of earlier solutions. In this talk attempt would be made to address how the problem has evolved historically and logically and possible pointers towards its resolutions

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Thermal Model Calculations for Hot and Dense Hadronic Matter Using Van der Waals Type Equation of State

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We have provided a modified grand canonical ensemble formulation for a multi-component hadronic resonance gas system. We have considered the attractive as well as repulsive interaction among the constituent baryons (antibaryons) and obtained a van der Waals type equation of state. Using this formulation we have calculated several relative hadronic yields as well as nucleon (antinucleon) densities in the system. This approach is thermodynamically consistent. It is found that the particle ratios get significantly modified in the case of van der Waals interactions for a baryon rich system. In this approach the repulsive force is assumed to exist between pairs of two baryons and pairs of two antibaryons, while it is purely attractive between a baryon-antibaryon pair. The values of attractive and repulsive parameters have been obtained from the previous studies which are required to reproduce the ground state properties of nuclear matter. We have also studied the effect of the variation of these parameters on our results.

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NJL Model and QCD phase transition

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Quantum Chromodynamics (QCD) Matter Under Nambu-
Jona–Lasinio (NJL) Model and Phase Transition Temperature
Quantum Chromodynamics (QCD) is one of the fundamental and ultimate theory of strong interactions. It describes the interaction of quarks through their colour quantum numbers

called colour charges. The mediating particles are gluons which are called gauge bosons with spin-zero particles and are massless. QCD deals with two extreme forms of matter in two phases. One heated to trillion degrees called QCD quenched and other maintained at zero temperature labelled as QCD vacuum. Low energy QCD deals with systems of light quarks where energy and momentum scales are smaller than 1 GeV mass energy gap observed in hadron spectrum. Right after the Big Bang, quarks and leptons were mass-less. When the temperature of the universe dropped below 100 GeV, the spontaneous breaking of the electroweak symmetry resulted in Higgs particles condensing in the vacuum, this "Higgs mechanism" gave mass to leptons and quarks. With further cooling, once the temperature dropped below 100 MeV, the quarks and gluons became confined in protons and neutrons. The QCD vacuum was modified by the spontaneous breaking of chiral symmetry giving the u (up) and d (down) quarks in the nucleon an "effective" mass of some 300 MeV. This constituent mass of the quarks is different from their current mass. The Higgs mechanism is only responsible for ~2% of the mass of the nucleon, QCD dynamically generates the remaining 98% of the mass of ordinary matter. At low energy scale which is also relevant for conventional nuclear physics, QCD exhibits two important features. One is called the color confinement and other is approximate chiral symmetry and its spontaneous breaking. In case of physical quark masses neither chiral condensate vanishes nor chiral susceptibility diverges at the pseudo-critical temperature. In spite of this these quantities retain a reminiscent behaviour of them corresponding to one in the chiral limit. In particular the chiral susceptibility has a peaked structure as a function of temperature and it is customary to define critical temperature as the temperature for which susceptibility reaches its peak.
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PhD in Theoretical High Energy Nuclear Physics

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Bulk viscosity near QCD phase transition and spontaneous symmetry breaking effect

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Bulk viscosity near QCD phase transition and spontaneous
symmetry breaking effect
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2,3
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1
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Abstract
We evaluate the effect of spontaneous symmetry breaking on the transport properties of strongly interacting fermionic matter near QCD phase transition. We develop a field theoretical model using dynamic quasi-particle description for fermions which are allowed to interact with Nambu-Goldstone modes via Yukawa type coupling. We solve this model at Wilson-Fisher fixed point and evaluate perturbative expression for bulk and shear viscosity of this medium. To analyze the behaviour of these transport coefficients near QCD phase transition region we use scaling analysis. It is found that Nambu-Goldstone modes can result in singular behaviour of bulk viscosity to entropy ratio ζ/s in the Z(2) universality class.

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Magnetotransport and magnetocaloric effect in Gd3In

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The electrical transport and magnetic properties of the rare-earth based binary intermetallic compound Gd3In are reported. The sample has tetragonal crystal structure with space group P4/mmm. At TC = 190 K, the sample orders ferromagnetically, however, a recentrant antiferromagnetic-like state is observed below TN = 100 K where a sharp drop in magnetization is observed. Clear signature of meta-magnetic transition is present in the isothermal variation of magnetization for an applied field of HC= 11.5 kOe at 2 K. Due to the presence of field induced transition, we have calculated the magneto-caloric effect (MCE) around the magnetic transitions using our magnetization data, which turns out to be quite eventful. MCE, expressed in terms of change in entropy (⊠S) due to the change in magnetic field (⊠), is found to be negative around TC with a maximum value of ⊠S= -5.3 Jkg-1K-1 for H = 50 kOe. On the other hand, it is positive up to H = 10 kOe around TN, and turns negative for higher values of H with a maximum value of ⊠S = -2.6 Jkg-1K-1. This is clearly due to the metamagnetic transition observed around 11.5 kOe. In the temperature variation of electrical resistivity, we observe clear signatures of magnetic transitions occurring at TC and TN, and the sample shows negative magnetoresistance throughout the temperature range (6-300 K) with a value of -12% at around 90 K for H = 50 kOe.

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Study of Spin Polarization, Fermi Surface, Band Structure and Thermophysical Properties of Sc 2 ZrSi Inverse Heusler

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Study of Spin Polarization, Fermi Surface, Band Structure and
Thermophysical Properties of Sc 2 ZrSi Inverse Heusler

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Abstract
The origin of half-metallicity, spin behavior, thermoelectrics and thermodynamics of inverse full-Heusler Sc 2 ZrSi alloy are explored using the by density functional theory. The structural characterization using the calculation of ground state energy confirm the XA-type structure of Heusler having similarity with Hg 2 CuTi-type structure that has F-43m space group symmetries.Band structure and occupation of density of states at the Fermi level determine its semiconducting nature and an indirect band gap of 0.52 eV.Semi-classical Boltzmann transport theory is used to determine various thermoelectric coefficients to infer about its capability for waste heat recovery systems.The Seebeck coefficient and electrical conductivity measurements also convey semiconducting band structure over all chemical potentials.The thermoelectric efficiency measured through zT calculation with a value of 0.5 at 1200 K, convey the material can be used as thermoelectric material.The thermodynamics using Debye temperature, specific heat and thermal expansion coefficient define low anharmonicity and low lattice thermal conductivity of the material. The overall thermophysical assets suggest the material has a potential stand for spintronics and thermoelectric applications.

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Band gap engineering of barium stannate (BaSnO3) perovskite oxide by Mn-doping: Theory and experiment

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Band gap engineering of barium titanate ($BaSnO_3$) perovskite oxide by Mn-doping: Theory and experiment

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ABSTRACT
Nanocrystalline $BaSn_{1-x}Mn_xO_3$ (x = 0.0 - 0.3) nanostructures were synthesized by solid state reaction route. Heavy Mn-doping upto 30% in powdered $BaSnO_3$ is accomplished to investigate the optical properties, electronic structure and magnetic properties of the synthesized samples. From XRD analysis and Transmission electron micrographs (TEM), nanoscale cubic structures are observed within (~50 nm) dimensions. Band gap transition from 3.2 eV in pure $BaSnO_3$ to 2.6 eV in Mn-doped samples is coherent with DFT calculations. So, an ultraviolet active material is reduced to absorb the visible light via band gap engineering as achieved by proportional Mn-doping in the parent material. An increase in Mn-content leads to the decrease in band gap of parent material up to certain limits (20% doping only). The origin of these reduced values can be argued from the unpaired Mn-3d5 electronic states which induces the defect states below the conduction band minima near the Fermi level. The more, defect states present in a sample, the smaller will be its band gap. However, after certain doping (optimal 20% in present case), the distortion effects in the crystal structure does not allow further alteration of the band gap but induce magnetism only.

Keywords: $BaSnO_3$; Nanoparticles, XRD, Transition metals, Optical properties

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Fano factor & Conductivity in the confined region of the potential well

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Transport properties in the confied region of the potential well have been calculated. It has been shown here that edge states or surface states occur in this particluar system. Tight binding Green function along with Bloch's theorem used here to calculate the transport properties. Transmission occurs in the form of plateus and shows the metallic behavior. Fano factor has been calculated in this system. Conductivity is also calculated for this particular system

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Polymer Nanocomposite Electrolyte Films For Energy Storage/Conversion devices

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The conducting polymer nanocomposite electrolytes free standing thin films are used in technologically interesting due to the wide variety of applications Such as ; batteries, solar cell , electrochemical sensors and supercapacitors etc [1-2]. The conducting polymer nanocomposite electrolytes thin films have been prepared by standard solution cast technique. The prepared free standing films were characterized by different tool of characterizations technique such as EIS, FTIR, and SEM. The basic requirement of polymer nanocomposite electrolyte films are high ionic conductivity is approx.of order 10
-2 to 10-4 S/cm-1 .FTIR spectroscopy is an important technique for the analysis of bond formation in the polymer structure, since it provides information about the complexation of blend polymer with sodium ion and interaction in the prepared films [3-4]. The surface morphology of polymer nanocomposite electrolyte films by scanning electron microscopy (SEM). The cyclic Voltammetry of polymer nanocomposite electrolytes films were calculated by electrochemical stability window (ESW) by using an electrochemical analyzer.

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Recent Advances and Challenges in Compton Scattering from Heavier Metals

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As Compton scattering is a powerful technique for the determination of electronic structure of materials, with the advent of high resolution in spectrometers, in the past two decades. Several measurements on single crystal materials have been carried out to determine electron momentum distribution using this technique. In this paper, I present a review of such studies on heavier metals and emphasis is made towards the challenges encountered.
Key words: Compton scattering, Electron momentum distribution, Heavy metals, High resolution, Single Crystals