PHYSICAL SOCIETY (EPS)

BOOK OF ABSTRACTS

THIRTEENTH NATIONAL CONFERENCE

February 15 & 16, 2019

VENUE:

Adama Science and Technology University

Adama, Ethiopia

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Compiled by:
Dr. Belayneh Mesfin

President's Message

It gives me great pleasure in welcoming all members of the Ethiopian Physical Society to the 13th Annual Conference organized in collaboration with Adama Science and Technology University, Adama. For those of you, who are joining the Society for the first time we have special appreciation. From those of you are regularly attending we could learn how much we profit from the gathering. As we all know, behind all technological development physics knowledge is there, and hence physicists are the missionaries. Our effort which may not look visible is absolutely behind and part of scientific advancement. Therefore, we are hopeful of our society and the world to gear further. The Ethiopian Physical Society is doing its best for the integrity of its members relationship which is one of its mission. Lastly, I wish you all participants a credible enjoyment from different levels of knowledge during your stay.

Dr. Deribie Hirpo
Secretary

Dr. Chernet Amente
President of EPS

Dr. Gelana Amente
Vice President

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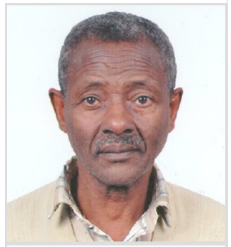

Dr. Mulugeta Bekele
Public Relations

A Computational Study of Water Hydrogen Bond Networks around Amino Acids

Shinie Shewangizaw

Department of Physics, College of Natural and Computational Science, Haramaya University, Haramaya, Ethiopia

Abstract

The statics and dynamical properties of directed water hydrogen bond networks connecting candidate donor (NH^{+3}) and acceptor (COO^{-}) groups is examined for the three amino acids alanine, isoleucine and glycine. There is a small difference between isoleucine and the other amino acids in the network distribution at 300 K. This is likely because of the longer side chain in isoleucine compared to the others. The relaxation time for dipole-dipole reorientation is looked around amino acids. As a collective dynamical properties of the water around amino acids, the scrambling time of the water wire and the water wire 'switches' is looked between the donor and acceptor.

Technology of Home Made Nitrogen Gas Laser for Laboratory Use

Tesfaye Mamo and A.V. Gholap

Department of Physics, Addis Ababa University, Addis Ababa, Ethiopia

Abstract

We try to address the issues of designing and fabricating nitrogen gas laser using locally available materials. The skills learned by the students during their training can have an impact on self and national development and we expect that it will boost the self confidence. Transversely excited nitrogen gas laser has been designed at atmospheric pressure. The laser uses self triggering for its operation. The laser emits ultra violet radiation at 337.1 nm with a peak power of 163 kW or more with a pulse repetition rate of 5 to 100 pps. The variation of power with gas pressure, applied discharge voltage to the capacitance and the capacitance is also described. The availability of materials needed to construct this laser and the ability to use this laser with the use of different kinds of dyes makes this laser as a source of broad spectrum laser. Since a simple single unit laser, such as He-Ne laser is very expensive, and purchase of different lasers for different wavelength out put will be unpractical in the case of our universities. But this simple laser can solve the above problems. Moreover, students will learn a lot with the construction of this laser.

Friday - February 15, 2019		
08:30 – 09:30 AM	**Conference Registration**	
09:15 AM	President of the university invites guest of honor	ASTU President
09:30 AM	Opening Remarks by the Guest of honor	Guest
09:45 AM	Welcoming Remarks by EPS President	Chernet Amente
Morning Session I – Chairman: Dr. Mulugeta Bekele		
10:00 AM	Setting Strategy for Organizational Visibility of Ethiopian Physical Society	Alemu Kebede
10:40 AM	The Role of Physics and Technology in Society	Prof. P. Singh
11:00 – 11:30 AM:	**Poster Presentation (Titles:** Please, see Page 4)	
Morning Session II – Chairman: Dr. Gelana Amente		
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11:50 AM	Entropy Entanglement in Different Types of Non-Markovian Three-Level Systems	Tamirat Abebe
12:10 AM	Relativistic Multipole Expansion of Electric Potential	Nebiyu Gemechu
12:30 – 02:00 PM	Lunch Break	
Afternoon Session I – Chairman: Dr. Tamirat Abebe		
02:00 PM	Effect of Side Chains on Intra and inter Molecular interaction of Terthiophene-Isoindigo Copolymers	Newayemedhin Tegegne
02:20 PM	Electronic Properties for 2H and 1T MoS2 Phases: Semiconducting to Metallic	Abera Mebrahtu
02:40 PM	Deep Red-Emission $EuSi_2O_2N_2$ Phosphor for White-Light-Emitting Diode	Gemechu Deressa
03:00 PM	Structural, Morphological, Impedance and Electrochemical Studies of Layered $LiNi_{1/3}Co_{1/3}Mn_{1/3}O_2$ Cathode Material for Lithium Ion Batteries	Tewodros Aregai
03:20 PM	Relativistic Disk Accreting Black Hole of Gamma-Ray Bursts Engine	Feyiso Sado
03:40 – 04:00 PM	Tea Break	
Afternoon Session II – Chairman: Dr. Habte Dulla		
04:00 PM	Evaluating the Role of Indian Ocean Dipole on Seasonal Rainfall Performance Over Ethiopia	Kedir Kemal
04:20 PM	Hierarchical Modeling and Forecasting Daily Extreme Temperature	Abdu Mohammed
04:40 PM	Electronic structure and nearly room-temperature ferromagnetism in V-doped monolayer and bilayer MoS2: using density functional theory	Sintayehu Mekonnen

Saturday - February 16, 2019		
Morning Session – Chairman: Dr. Tesgera Bedasa		
09:00 AM	Synthesis and Luminescence Properties of Sol-Gel Auto-Combustion Driven Mg_2SnO_4 Nanophosphor	Moges Tsega
09:20 AM	First principles study of structural, electronic and elastic properties of the tetragonal $SnTiO_3$ and $PbTiO_3$ ferroelectric perovskites	Shiferaw Gadisa
09:40 AM	Collisional Radiative Model of Laser Produced Emission Spectroscopy of Cu Plasmas	G.A. Wubetu
10:00 AM	Charge Transport Properties in Disordered Organic Semiconductors: Monte Carlo Simulation	Seyfan Kelil
10:20 AM	Effect of substrate on structural, optical and morphological properties of CdS thin films synthesized by solution growth technique	Tizazu Abza
10:40 AM	Disorder-Induced Superconductor-Insulator Transition	Zeleke Deressa
11:00 AM	Structural and Electronic Properties SiC Nanotubes Doped with Transition Elements and Different Semiconductors	Abebe Tadesse
11:20 – 11:40 AM	**Tea Break**	
Titles of Articles for Poster Presentations		
During Tea Breaks (Feb. 15 – 16, 2019)	Self-Association of Bioactive compounds of Coffee Beans and Their Hetero-association with Drugs	Abebe Belay
	Variations in ionospheric current systems from SWARM satellite constellation observations during March and June 2015 severe storms	Habtamu Marew
	First principle study on the electronic structure of FeSe under pressure	Mesfin Asfaw
	Edge detection and depth estimation method using first order magnetic derivatives	Yahya Ali
	A Study of γ- Ray Attenuation in AgCl – Determination of Thermo-physical Properties & Photon Interaction Parameters	A.S. Madhusudhan
	Technology of Home Made Nitrogen Gas Laser for Laboratory Use	Tesfaye Mamo
	A Computational Study of Water Hydrogen Bond Networks around Amino Acids	Shinie Shewangizaw
	Designing thermally actuated bimorph as energy harvester	Satyam Bhuyan
11:40 AM – 12:40 PM	**Business Session – Chairman:** Dr. Deribie Hirpo	
• EPS annual activity and audit report • Regular annual meeting of EPS's members		
12:40 PM – 02:30 PM	**Lunch Break**	
6:30 PM	**Reception - Closing Session**	

A Study of γ-Ray Attenuation in AgCl – Determination of Thermo-physical Properties & Photon Interaction Parameters

A.S. Madhusudhan Rao[1] and P. Kalyani[2]

[1]Department of Physics, Adama Science and Technology University, Ethiopia
[2]Department of Mathematics, Adama Science and Technology University, Ethiopia

Abstract

In the present study γ- ray attenuation and narrow collimated beam transmission methods have been employed. Mass attenuation coefficients (μ_m) of AgCl (pellet) have been determined at different γ-energies viz. (0.0595 MeV), (0.662 MeV), (1.173 MeV & 1.332 MeV), respectively, and compared with the values of X-Com, values calculated by Mixture rule. The variation of linear attenuation coefficient (μ_l) and thermo-physical properties of Silver Chloride (AgCl) have been determined as a function of temperature in the temperature range 300 K - 700 K. The experimental data obtained has been fitted into second degree polynomials. Coefficient of temperature dependence of density and coefficient of volume thermal expansion of the compound are evaluated. Variation of linear attenuation coefficient and density of the ionic crystal with temperature have been reported for first time. Variation of thermal expansion with the temperature has been compared with results in the literature. Total atomic cross-section (σ_t), electronic cross-section (σ_e), effective atomic number (Z_{eff}), electron density (N_{eff}) and photon mean free-path (λ) of the AgCl are evaluated using experimental, calculated and X-Com values of μ_m, and are reported for the first time.

Edge detection and depth estimation method using first order magnetic derivatives.

Yahya Ali

Department of Physics, Addis Ababa University, Addis Ababa, Ethiopia

Abstract

Interpretation of potential field data for subsurface investigation can be qualitative or quantitative. Looking/Identifying contrasts or trends from profile or contoured maps are the qualitative approaches. Whereas quantifying source extents of anomalies/ contrasts are important steps in the quantitative interpretation of potential field data. Several approaches for edge detection and source depth estimation are developed. In this paper, tilt-angle and its horizontal derivatives will be discussed and field cases applied to determine edge and depth of magnetic anomalies at Megado area, Borena, Oromia will be presented. The tilt angle is a generalized definition for a local phase computed as the arctangent of ratio of the first vertical derivative to the first horizontal derivatives of the magnetic field. Methods of mapping edges and determining source depths and its advantage and pitfall of tilt angle method will be presented supported by case study at Megado.

List of Abstracts

CONTENTS

Setting Strategy for Organizational Visibility of the Ethiopian Physical Society

Alemu Kebede Hordofa

Department of Applied Physics, Adama Science and Technology University, Adama, Ethiopia

Abstract

The purpose of this paper is to address issues that would help strengthen the institutional capabilities of the Ethiopia Physical Society. It raises the importance of revising and restating the vision, mission, core values and objectives. The importance of setting strategy and identification of strategic partner institutions is also given due attention. The strategies set and the strategic issues raised are believed to be so important in fostering the institutional visibility to various stake holders, both domestic and international.

First principle study on the electronic structure of FeSe under pressure

H. Beyene, M. A. Afrassa, R. Muatu.

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mesfingn171@gmail.com

Abstract

In this work we have performed density functional theory(DFT) calculations as implemented in QUANTUM ESPRESSO code to study the how pressure influences on the electronic structure and the lattice dynamics properties of FeSe. All calculations were executed using the tetragonal lead-oxide or P4/nmm structure, with lattice parameters a and c, various volumes and c/a ratios. We reproduced the already accepted band structure of FeSe. . The effect of pressure on lattice parameter c is clearly seen. We found that superconducting transition temperature of FeSe (Tc) increases sensitively under pressure from 8k to 16.75K at P ≈2Kbar. We also found that the equilibrium configuration of FeSe in the tetrahedral structure to have a volume of 75.37 A^3 and 74.03 A^3 with c/a ratio of 1.487 and 1.489 respectively. Thus obtained results are comparable to the experimental value (c:a = 1.47[a.u], V = 78.219 A^3). The density's at the Fermi energy are slightly enhanced under pressure. Zero pressure values of DOS at EF are 2.69(state/cell/eV). At pressures corresponding to the maximum critical temperature, the density's equal to 3.54(state/cell/eV) (p≈2Kbar).

Variations in ionospheric current systems from SWARM satellite constellation observations during March and June 2015 severe storms

Habtamu Marew[1, 2], Melessew Nigussie[1]

[1]*Washera Geospace and Radar Science Research Laboratory, Bahir Dar University, Bahir Dar, Ethiopia*

[2]*Department of Physics, Debre Tabor University, Debre Tabor, Ethiopia*

Abstract

Characterizing the field aligned currents during geomagnetically disturbed days is the aim of this paper. Many works have been done to have a clear knowledge on field aligned (Birkeland currents), but recently launched Swarm-A, B, and C satellites enabled to see three-dimensional character of the current density at two low earth orbit altitudes (about 450km and 530km altitudes). Hence, we have analyzed quiet and storm day swarm data in the year 2015 and obtained a clear view on the global distribution of field aligned and radial current densities. The results depicted that strong currents flow over the high latitude regions during the assessed storm days and sometimes high current density gradient is observed between the lower satellite positions and the upper one. Extreme maximum currents are observed during the storm hours (up to 4 mA/m^2). Therefore, successive investigations are needed to have more understanding and a model for estimation and prediction.

Keywords: Birkland currents, current density, field aligned and radial currents.

The Role of Physics and Technology in Society

P. Singh

Department of Physics, Addis Ababa University, Addis Ababa, Ethiopia

Abstract

Physics is fundamental to our understanding of physical world around us. Technology drives inspiration from the advances, innovations and discoveries of physics. Physics assisted technology helps to improve the quality of life of the citizens/society. Some of the prominent achievements of the combined efforts of physics and technology will be recalled. Recent discovery of Graphene can lead to a scientific and technological revolution for the benefit of whole of humankind. With the discovery of topological insulators and superconductors and quantum Hall effects, the prospects of magnetic levitation and quantum computation will be highlighted.

Entropy Entanglement in Different Types of non-Markovian Three-Level Systems

Tamirat Abebe

Department of Physics, Jimma University, Jimma, Ethiopia

Abstract

In this paper, we solve the non-Markovian master equation to study the dynamics of different types of three-level atomic systems interacting with bosonic Lorentzian reservoirs at zero temperature. Von Neumann entropy (S) is used to show the evolution of the degree of entanglement of the subsystems. We show that entropy of the system monotonically increases in time for any fixed value of the parameter p in all kinds of atoms. Our calculations show that a Λ-type atom has the greatest degree of entropy when compared with Ξ and V-type atoms. The results presented are also compared with some recently published reports.

Keywords: Non-Markovian; Lorentzian reservoir; Von Neumann entropy.

Self-Association of Bioactive compounds of Coffee Beans and Their Hetero-association with Drugs

Abebe Belay

Department of Physics, Adama Scence and Technology University, Adama, Ethiopia

Email-abebebelay96@gmail.com

Abstract

In this research, it is intended to investigate the self-association bioactive compounds (caffeine, caffeic and 5-caffeoylquinic acids) of coffee bean and their hetero-association with genotoxic aromatic drugs (erhidium bromide). The absorption spectrum for the self-association and hetero-association were analyzed by dimer and modified Benesi-Hildebrand model respectively. The analysis leads to determine the equilibrium constants, molar extinction coefficients of monomer, dimer molecules and molecular structures of the complex. Knowledge of the equilibrium constants for self-association and hetero-association enable us to calculate the relative contents of the compounds and the hetero-complex formed in the mixed solutions. In addition, Investigation the self-association and hetero-association of the biologically active compounds of coffee bean also useful; to propose the structures of the complexes which have great applications in the area of pharmaceutical and food companies, biochemistry and biophysics.

Key words: Self-association, hionetero-associat, drugs, bioactive compounds of coffee beans

Effect of substrate on structural, optical and morphological properties of CdS thin films synthesized by solution growth technique

Tizazu Abza

Department of Physics, Hawassa University, Hawassa, Ethiopia

Abstract

In this work cadmium sulfide (CdS) thin films were deposited on glass, zinc sulfide (ZnS) and cobalt sulfide (CoS) substrates using the chemical bath deposition technique. The influence of substrate on structural, morphological, compositional and optical properties of the films was investigated. The powder X -ray diffraction (XRD) result showed that CdS thin film grown on glass substrate has a cubic structure with a single peak along (111) plane. CdS thin film grown on cubic ZnS substrate has amorphous structure. The XRD pattern of CdS thin films synthesized on the mixed phase of hexagonal and face centered cubic CoS confirmed the co-existence of hexagonal and cubic CdS phases with cubic phase dominant over that of the hexagonal phase. The scanning electron microscopy (SEM) micrograph of CdS films deposited on glass substrate revealed spherical grains of size 125 nm uniformly covering the substrate without pinholes and cracks. Grain size as large as 800 nm with distinct grain boundaries was observed when ZnS was used as a substrate, however some pinholes appeared on the surface. The SEM micrograph of CdS thin film deposited on CoS coated glass showed clearly visible spherical surface grains of size 450 nm on flat and compact background accompanied by few cracks. The energy dispersive X-ray spectra of CdS films deposited on glass, ZnS and CoS substrate confirmed the presence of Cd and S in all films. The band gaps of the CdS thin films deposited on glass, ZnS and CoS substrates were 2.5, 2.3 and 2.2 eV as it was obtained from UV-VIS optical analysis.

Keywords: Cadmium Sulfide, Substrate, Crystal Structure, Surface Morphology, Optical Bandgap

Relativistic Multipole Expansion of Electric Potential

Nebiyu Gemechu

Department of Physics, Jimma University, Jimma, Ethiopia

Abstract

Using relativistic multipole expansion, the multipole moments of the electric potential of a charged system moving at constant velocity with respect to a stationary observer are determined. A system of discrete point charges and a charged plate of uniform surface charge density are considered for analysis. For relativistic considerations, two reference frames: namely S and S' have been chosen. S', which contains the charged system, is moving with constant velocity relative to frame S, which contains stationary observer. For easy comparison, both multipole expansions are expressed in terms of the coordinates of the S' frame. The two observers in S and S', in general calculate different expressions of multipole expansion for the same charged system because of Lorentz contraction effect. The monopole, dipole and quadrupole terms of the potential evaluated by the observer in S are time dependent showing that there are also magnetic effects which, however, are not observed by an observer in S'. Surprisingly, an observer in S calculates **non-zero** magnetic monopole.

Effect of Side Chains on Intra- and Inter-Molecular Interaction of Terthiophene-Isoindigo Copolymers

Newayemedhin Tegegne,[1] Zelalem Abdissa[2], Wendimagegn Mammo[2], and Heinrich Schowoerer[3]

[1]Department of Physics, Debre Berhan University, Ethiopia.
[2]Department of Chemistry, Addis Ababa University, Ethiopia
[3]Max Planck Institute for Structural Dynamics, Hamburg, Germany

Abstract

Two tethiophene-isoindigo copolymers were succesfully designed and synthesized. The band gap of the copolymers was less than 1.7 eV. We found intramolecular charge transfers in both copolymers. The intramolecular charge transfer were generated in a time scale of 13 ps for a long side chain. This time was shortened to 4.5 ps as the alkyl side chains were shorter by 4 methyl units. The shorter side chains foster intramolecular charge transfer state by almost 3 fold. The exciton life time was also found to be shorter with increasing the length of the side chains. An exciton-exciton annihilation started at one order lower exciton density with the shorter side chained copolymer. The efficient exciton diffusion is due to better interchain interaction in the copolymer backbone when the side chains are shorter.

Disorder-Induced Superconductor-Insulator Transition

Zeleke Deressa

Department of Physics, Addis Ababa University, Addis Ababa, Ethiopia

Abstract

In this work, we are interested to know the effect of disorder on the superconducting state of two dimensional thin films because most of the experimentally observed high temperature superconductors are two dimensional and expected to come with some degrees of disorder (1). We investigated the effect of disorder on the superconducting state of two dimensional thin films using the repulsive Bose-Hubbard model which was established for tightly bound hard-core bosons (2). The relationship between superconducting order parameter and disorder strength was found analytically by using temperature dependent double time Green's function formalism. The results of our calculations revealed that disorder (randomness in an on-site potential energy) enhances scattering of Cooper pairs and destroys superconductivity. We have also determined the critical value of disorder corresponding to the transition point of SIT. Below this critical value of disorder, the system acts as a superconductor, a system with zero electrical resistance. Above the critical value it acts as an insulator, a system with infinite electric resistance. This is a fascinating result because a direct transition from state of the infinite conductivity to the opposite extreme of infinite resistivity is unexpected in the theory of condensed matter physics.

Keywords: Disordered superconductors, hard-core bosons, Bose-Hubbard model, superconductor-insulator transition, two-body interaction, disorder strength

Effect of substrate on structural, optical and morphological properties of CdS thin films synthesized by solution growth technique

Tizazu Abza

Department of Physics, Hawassa University, Hawassa, Ethiopia

Abstract

In this work cadmium sulfide (CdS) thin films were deposited on glass, zinc sulfide (ZnS) and cobalt sulfide (CoS) substrates using the chemical bath deposition technique. The influence of substrate on structural, morphological, compositional and optical properties of the films was investigated. The powder X -ray diffraction (XRD) result showed that CdS thin film grown on glass substrate has a cubic structure with a single peak along (111) plane. CdS thin film grown on cubic ZnS substrate has amorphous structure. The XRD pattern of CdS thin films synthesized on the mixed phase of hexagonal and face centered cubic CoS confirmed the co-existence of hexagonal and cubic CdS phases with cubic phase dominant over that of the hexagonal phase. The scanning electron microscopy (SEM) micrograph of CdS films deposited on glass substrate revealed spherical grains of size 125 nm uniformly covering the substrate without pinholes and cracks. Grain size as large as 800 nm with distinct grain boundaries was observed when ZnS was used as a substrate, however some pinholes appeared on the surface. The SEM micrograph of CdS thin film deposited on CoS coated glass showed clearly visible spherical surface grains of size 450 nm on flat and compact background accompanied by few cracks. The energy dispersive X-ray spectra of CdS films deposited on glass, ZnS and CoS substrate confirmed the presence of Cd and S in all films. The band gaps of the CdS thin films deposited on glass, ZnS and CoS substrates were 2.5, 2.3 and 2.2 eV as it was obtained from UV-VIS optical analysis.

Keywords: Cadmium Sulfide, Substrate, Crystal Structure, Surface Morphology, Optical Bandgap

Electronic Properties for 2H and 1T MoS2 Phases: Semiconducting to Metallic

Abera Mebrahtu

Department of Physics, Axum University, Ethiopia

Abstract

In this work, we are reporting the change of semiconducting MoS2 to a metallic properties by simply changing geometry of constituent atoms based on first principles electronic structure calculations using quantum espresso code. Shifting the position of one S atom in the structure of MoS2 completely alters the electronic structure. While 2H phase, where the Sulfur atoms are directly above each other is semiconducting, the 1T phase where one of the Sulfur atoms is shifted is metallic. This change can be invoked through temperature, electrostatic gating, stress, strain and doping.

Deep Red-Emission $EuSi_2O_2N_2$ Phosphor for White-Light -Emitting Diode

Gemechu Deressa[1] and Jong Su Kim[2]

[1]Program of Chemistry, School of Applied Natural Science, Adama Science and Technology University, Adama, Ethiopia
[2]Department of Display Science and Engineering, Pukyong National University, Busan, Republic of Korea

Abstract

New deep red-emitting $EuSi_2O_2N_2$ phosphor excited by InGaN-based blue light was synthesized to generate White-Light-Emitting Diode. The powder phosphor was obtained through the solid- state reaction method at 1300□ in a reducing atmosphere (5% H_2 and 95% N_2). The $EuSi_2O_2N_2$ phosphor showed the broad red emission with 680 nm peak and 150nm half width, which was attributed to 5d-4f transition of Eu^{2+} ion. Its excitation spectrum showed it can be efficiently excited from 430 nm to 500nm blue light which couples well with the emission of blue LEDs. The $EuSi_2O_2N_2$ phosphor had high CRI .It is suggested that the red phosphor can be useful for white-light-emitting-diode.

Keywords: *Deep red-emitting, $EuSi_2O_2N_2$ phosphor, White-Light-Emitting Diode, InGaN-blue light*

Charge Transport Properties in Disordered Organic Semiconductors: Monte Carlo Simulation

Seyfan Kelil and Lemi Demeyu

Department of Physics, Addis Ababa University, Addis Ababa, Ethiopia.

Abstract

We present a Kinetic Monte Carlo (KMC) simulations to study the dependence of charge density and electric field on carrier mobility in a disordered organic semiconductor material using a lattice model. The density of states (DOSs) of the system is considered to be a Gaussian. Our simulations reveal that for a more disordered system the carrier mobility is increasing with charge density and lattice sizes of material at lower charge density; In contrast, for lower disordered material the carrier mobility is constant with charge density and lattice sizes at lower charge density. In addition, at the charge density, $r > 10^{16}$ cm^{-3} the carrier mobility increases with charge density and lattice sizes of disordered organic semiconducting materials for different disorders; whereas at higher disordered organic material the carrier mobility is strongly dependent on the charge density. The effect of the disorder parameter $s' = s/(k_BT)$ on the carrier mobility is more pronounced than the charge density at lower charge density. On the other hand, I observed the effect of electric field on the carrier mobility in disordered organic semiconducting materials for different localization length and disorder of a material.

Collisional Radiative Model of Laser Produced Emission Spectroscopy of Cu Plasmas

G.A. Wubetu[1], T. J. Kelly[4], P. Hayden[2], H. Fiedorowicz[3], W. Skrzeczanowski[3], and J.T. Costello[2]

[1]Bahir Dar University, College of Science, Department of Physics, Ethiopia.
[2]National Centre for Plasmas Science and Technology and School of Physical Science, Dublin City University, Glasnevin, Dublin, Republic of Ireland.
[3] Institute of Optoelectronic, Military University of Technology, Warsaw, Poland.
[4]School of Mathematics & Physical Sciences, University of Hull, Hull, UK

Abstract

Polarization resolved emission spectroscopy (PRES) from a laser-produced copper plasma has been studied for a variety of background pressures. The discrete line emission of both copper neutral particles was found to be significantly less polarized than the nearby continuum. We used traditional laser produced plasma diagnostics to measure the electron densities and temperatures. These parameters were then used to seed a collisional-radiative model in order to determine the dominant recombination processes present in the plasma that contribute to the partial polarization of the emission. As the recombination radiation (RR) rate is larger than the free-free rate, the anisotropic continuum polarisation emission is as the results from the transfer of the anisotropy of the electron velocity distribution function (EVDF) and hence the directed motion of electrons into partially polarised recombination radiation plasmas.

Structural, Morphological, Impedance and electrochemical Studies of Layered $LiNi_{1/3}Co_{1/3}Mn_{1/3}O_2$ Cathode Material for Lithium Ion Batteries

Tewodros Aregai

Department of Physics, College of Natural and Computational Sciences, Aksum University, Ethiopia

Abstract

Layered structure $LiNi_{1/3}Co_{1/3}Mn_{1/3}O_2$ has been synthesized by the solid state reaction method and the structural, morphological, impedance and electrochemical studies of the synthesized cathode materials were investigated. The TG curve shows significant weight loss (17.8%) between the temperatures 310°C and 570°C. From X-ray diffraction analysis, the compound possesses a typical α-$NaFeO_2$ layered structure with R3m space group. The SEM morphology shows a very fine surface morphology and the grain sizes are found to be between 1 μm to 2 μm. The EDS spectrum confirms the presence of Ni, Co, Mn and O in $LiNi_{1/3}Co_{1/3}Mn_{1/3}O_2$ cathode materials. Two distinct peaks are observed in each FT-IR spectrum of different wavelength regions. The impedance, AC Conductivity and dielectric studies of $LiNi_{1/3}Co_{1/3}Mn_{1/3}O_2$ are carried out as function of frequency in the frequency range 50 Hz - 1 MHz at different temperatures (303.15 K to 393.15 K) and the results are presented in detail. The electrochemical experimental data is collected at voltage range between 2.7 to 4.6 V at charge/discharge rates of 0.1C. The 1st, 2nd, 3rd and 5th cycle charge and discharge capacity values of $LiNi_{1/3}Co_{1/3}Mn_{1/3}O_2$ are 195/186, 192/181, 180/169.7 and 172.3/160.5 mAh/g and the Columbic efficiencies are 95.4%, 94.3%, 94.2% and 93.2% respectively. From the study, we conclude that the $LiNi_{1/3}Co_{1/3}Mn_{1/3}O_2$ cathode material is a promising next-generation cathode material for lithium-ion batteries.

Keywords: *Layered structure, $LiNi_{1/3}Co_{1/3}Mn_{1/3}O_2$, structural, electrochemical*

Relativistic disk accreting black hole of Gamma-Ray Bursts engine

Feyiso Sado

Department of Physics, Addis Ababa University, Addis Ababa, Ethiopia

Abstract

The observed properties of Gamma-Ray Bursts such as rapid variability of X-ray light curve and large energies strongly signature the compact binary disk accretion system. Our work particularly highlights the extremely rotating, disk accreting black holes as physical source of the flares variability and X-ray afterglow plateaus. We investigate the compact binary mergers (neutron star - neutron star and neutron star onto black hole) and gravitational core collapse of super massive star, where in both cases hyper-accreting Kerr hole is formed. The core collapse in a powerful gravitational field explained as a potential source for the radiated flux of hard X-rays spectrum. We described the evolution of rapidly rotating, accreting BH in general relativity and the relativistic accretion flow in resistive MHD for viscous radiation. We compute the structure of accretion disk, the accretion luminosity of the dynamical evolution of inner accretion disk and precisely determine their radiation spectra, and compare to observational data of X-ray satellites. Finally, we obtained the resulting disk radiation basically explained as the X-ray luminosity of the central source, such as LMC X-1 and GRO J1655-40. These results are interestingly consistent with observational data of galactic X-ray source binary systems such as X-ray luminosities of Cyg X-1, NGC, Seyfert, M87 which are powerful emitters in X-ray and gamma-ray wavebands of the observed X-ray variability with typical luminosity and the measured high frequency gamma ray employed to high energy observation.

Keywords: Relativistic accretion disk – gamma rays: bursts – radiation: X-ray luminosity

First principles study of structural, electronic and elastic properties of the tetragonal $SnTiO_3$ and $PbTiO_3$ ferroelectric perovskites

Shiferaw Gadisa

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Abstract

Ferroelectric perovskite ABO_3 materials have much attention recently due to their multi-functional properties and can be used in wide range of applications such as ferroelectric random access memory (Fe RAM), high dielectric capacitance, optoelectronic devices and sensor. Furthermore, environmental considerations are driving research to discover new materials which are lead and bismuth-free, yet with out reducing ferroelectric performance. The study includes optimization of structural parameters, bulk modulus of Murnaghan E(V) curve, electronic band structure, and density of states (DOS) of $SnTiO_3$ and $PbTiO_3$ perovskites in tetragonal phase are simulated using plane wave basis, by use of norm-conserving pseudo-potential method in the framework of density functional theory (DFT), with the generalized gradient approximation (GGA) of Perdue BurkeErnzerhof (PBE) used for the exchange-correlation functional as implemented in quantum espresso open source package. Moreover, the elastic properties such as elastic constants, Poisson's ratio, Young's modulus, anisotropy factor, and shear modulus are obtained for both compounds. All computed and simulated values of the study are compared with previous available experimental and theoretical data.

Keywords: $SnTiO_3$, $PbTiO_3$, electronic properties, elastic constants, PP-PW, Applications

Synthesis and Luminescence Properties of Sol-Gel Auto-Combustion Driven Mg_2SnO_4 Nanophosphor

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Abstract

Nanocrystalline Mg_2SnO_4 nanophosphor was synthesized by a facile sol-gel auto-combustion method calcined 800 °C for 1 h. The X-ray diffraction pattern showed that the nanopowder has a cubic inverse spinel polycrystalline structure with an average crystallite size of about 20 nm. The photoluminescence spectra were measured at 84-300 K, and the broad emission band was obtained in the wavelength range of 400-500 nm. Photoluminescence at 120 K showed the highest emission band centered around 414 nm. The thermoluminescence (TL) glow curve showed an increase in TL peak intensity with UV irradiation time due to the increasing number of inherent traps created by UV irradiation. The maximum TL intensity was found for 30 min UV exposure. Activation energies of the trapping centers were found between 0.39 eV and 0.48 eV. The frequency factor of the main glow-peak was also evaluated in the $3.03\times 10^6 - 4.26 \times 10^7$ s^{-1} range for UV irradiated phosphor. The decrease in activation energy and frequency factor with increasing UV exposure time may attribute to the decrease in trap depth. The calculated trap parameters related to the glow peak show this phosphor may be useful in radiation dosimetry applications.

Keywords: Mg_2SnO_4, Sol-gel, Luminescence, Phosphor

Evaluating the Role of Indian Ocean Dipole and Seasonal Rainfall Performance over Ethiopia

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Abstract

Inter-seasonal rainfall variability over the Ethiopia was investigated with respect to Indian Ocean Dipole (IOD) and Indo-Pacific (IOD-ENSO). For better understanding of the nature of IOD and El Niño/Southern Oscillation (ENSO) influences on short rains, it is important to check the amplitude variation particularly during the years when flood or drought happened. The impact of IOD and ENSO were well investigated with the help of statistical analysis method. Statistical correlation between the IOD index and the global sea level pressure anomalies demonstrates that loadings of opposite polarity occupy the western and the eastern parts of the Indian Ocean. Besides the simple correlation method and a partial correlation technique were also used to show exclusive relationship between two variables while excluding influence arising from another independent variable. In order to make in-depth analysis, we considered parts of the country where Belg and Kiremt are the main rainy seasons. During Bega season, the country also receives less mount of rainfall but often very unseasonal that disturb harvesting season. We found that during bega season, rainfall performance over the country is clearly influenced by Indian Ocean Dipole (IOD) and/or ENSO. In contrast, during March-May, there is no clear inter-relation exist between seasonal rainfall and SST pattern in the Indian Ocean. As the result, the short rainy season over the country is not linearly related with selected extreme event of IOD years. The association between El Niño and positive IOD phases is much stronger than the association between La Niña and negative IOD during September to November. In conclusion further analysis required to pinpoint how the formation of strong SST anomalies over Indian and Pacific Oceans to explain seasonal rainfall variability, which in turn improves localized climate prediction over the country.

Hierarchical Modeling and Forecasting Daily Extreme Temperature

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Abstract

We construct a year ahead future forecast model for daily maximum and minimum temperature. We apply the method constructed to six stations, located in the Lake Tana sub-basin, the source of the Blue Nile in mountainous northern and central Ethiopia. We consider the temperature time-series as an additive model comprised of trend, seasonal, other cyclic fluctuations and temporally correlated noise. The method is based on Bayesian hierarchical modeling. We model seasonal and other cyclic components as stationary and non-stationary processes using Gaussian Markov random field techniques. For inference, we use Markov chain Monte Carlo methods. Synthetic example cases are used to demonstrate the ability of the model to recover true model parameters and the applicability of it for multi-step forecasting. Data from 2005-2014 is used as a training data set, and the data during 2015 is used to test the one year ahead, i.e. 2015, forecast of the daily extreme temperatures against the actual data. We show that the model is able to describe the ten-year training data set dynamics adequately. Moreover, we show that the forecast can be used for long-term temperature prediction and validate the general predictive performance of the model using a rolling forecasting origin time-series cross-validation technique.

Keywords: Bayesian estimation, Forecast, Gaussian processes, Hierarchical model, MCMC, Temperature

Electronic structure and nearly room-temperature ferromagnetism in V-doped monolayer and bilayer MoS_2: using Density functional theory

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Abstract

The electronic structure, magnetic properties and ferromagnetic transition temperature (T_c) of Vandium (V) doped monolayer (ML) and bilayer (BL) MoS_2 are investigated using density function theory (DFT) plus on-site Hubbard potential correction (U). The results show that substitution of V dopant atom at the Mo sites are energetically favorable and magnetic interaction between two dopants in ML and BL MoS_2 oscillates from ferromagnetic (FM) to antiferromagnetic (AF) depending on atomic distance between dopants. Our result also shows that a pair of V dopants in deferent layers of BL MoS_2 interacts antiferromagnetically. Moreover, it is obtained that interlayer interaction in BL MoS_2 affects the magnetic interaction in V-doped BL MoS_2. The calculated ferromagnetic transition temperatures (Tc) value for impurity concentration of 12.5% and 22.22% are 242 and 285 K, respectively, for ML phase. However, for BL phase T_c values are 187 and 256 K for concentration of 6.25% and 11.11%, respectively, these values are closer to room-temperature. Our calculations indicate that, V-doped ML and BL MoS_2 are promising candidates for 2D dilute magnetic semiconductors for spintronics applications.

Keywords: Monolayer MoS_2; bilayer MoS_2; V doping; magnetic interaction.