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Radial Distribution Functions of ZnO Rocksalt and Zinc Blend Types a Molecular Dynamics Computation

Y Chergui
Badji Mokhtar University, Sidi Ammar, Algeria

Parallal Molecular Dynamics and DL_POLY_4 software are used to analyze the pair correlation functions of ZnO rocksalt and zinc blend structures under different pressures and temperatures. Our system is formed from 5832 atoms of ZnO for rocksalt and zinc blend , the interatomic interactions are modeled by Coulomb-Buckingham Potential for short and long-range, the range of temperature is 300-3000K and for pressure is 0-100GPa. In this work we use radial distribution function to canculate the value of chemical bonds of Zn-Zn, Zn-O, and O-O under previous conditions of pressure and temperature. Although no more data under previous conditions our results are in the vicinity of available experimental and theoretical information. This work is very important in nanoscale of time and space and in different sectors of industry.

Key words: ZnO, pressure, temperature, energy, simulation, MD

Biography

Yahia CHERGUI is an assistant Professor in Electrical & Electronics Engineering Institute, Boumerdes Algeria. He has completed his PhD from Badji Mokhtar University in Annaba, Algeria. He did all his PhD work in Cardiff University in UK. His research field is Physics(condensed matter, and soft matter simulation by molecular dynamics). He has many published articles and international conferences. He has been serving as a referee with condensed matter journal (IOP), Energy journal (Elsevier), and American Journal of Modern Physics.

y.chergui@univ-boumerdes.dz

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Stability of magnetized astroclouds with extreme fugacity effects

Pralay Kumar Karmakar
Tezpur University, India

We describe the atypical evolutionary dynamics of the Dust-Acoustic Wave (DAW) and Dust-Coulomb Wave (DCW) stabilities in self-gravitating magnetized viscoelastic spherical dusty astroclouds. It is analysed on the astrophysical fluid scales of space and time, which are, indeed, relevant for initializing bounded structure formation via the non-local gravito-electrostatic coupling mechanism. It consists of the inertial dust grains with variable electric charge alongside the non-thermal electrons and ions in a generalized correlative hydrodynamic charter. A restricted spherical wave analysis over the perturbed cloud yields a unique generalized quadratic dispersion relation with plasma-dependent multi-parametric coefficients. The triggered fluctuations are free from the viscoelasticity effects in the weakly coupled limit (WCL) against the strongly coupled limit (SCL). The electron population density, dust charge, and magnetic field act as stabilizing and accelerating agencies to the fluctuations. The ion population density and non-thermality parameter show destabilizing and decelerating effects. The cloud size shows a unique stabilizing feature in the ultra-low frequency domain. It is seen that both DAW and DCW are dispersive in the short-wavelength (acoustic) regime; but, non-dispersive in the long-wavelength (gravitational) regime. Also, the new distinctive WCL-SCL scenarios specifically investigated here are explicitly compared, pictorially explained, and illustratively discussed. The semi-analytic findings show correlative consistencies in light of the real astronomic circumstances towards triggering the formation mechanism of astrostructure creation and progressive evolution widely.

Biography

Pralay Kumar Karmakar has completed his PhD from Centre of Plasma Physics – Institute for Plasma Research (CPP-IPR), Guwahati, Assam, India. The award has been conferred to him by Gauhati University, Guwahati, Assam, India. He has joined Tezpur University as Assistant Professor in the Department of Physics, Tezpur University, Tezpur, Assam, India. He is now Associate Professor in the same department of the University. He is interested in diversified emerging research areas, such as Astrophysical plasmas, Cosmic fluid dynamic, Stability analysis of complex media, Nonlinear dynamics, etc. Six scholars have already earned PhD degrees under his academic supervision so far. More than 100 students have successfully completed UG-PG projects under his guidance. Besides, he has published more than 100 research articles, 13 book chapters, etc. He has long been serving as an editorial board member and reviewer for diverse high-rated global research journals, and so forth.

pkk@tezu.ernet.in

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SYSTEMIC LOGIC IN THEORETICAL ASTROPHYSICS

Igor S. Makarov
Reform Science Center

New method, systemic intuition [1], has enabled us to discover the following: (1) there are two fundamental particles – virtual electron (electrino) and virtual positron (positrino) - with no physical properties; their interaction gives birth to virtual positronium characterized by energy; positroniums exchange photons and acquire states, called composiums, with complex energy;(2) ether, the primary physical medium described by correlation function, consists of composiums; (3) ether generates mesons and neutrons; cosmic rays and microwave background are the proper radiations of ether; experimental data on cosmic rays enabled us to evaluate characteristics of ether and dimensions of some particles; mean radius of real electron proved to be about 0.01 fm; (4) in respect to ether excitation, neutron is linear system with continuously distributed parameters consistent spatially with ether; because of its time-space contradiction it transforms into H-atom; (5) H-atom is linear system with lumped parameters consistent in time with ether; H-atom consists of three quarks implementing collective interaction of virtual particles inside the atom and its photon exchange with ether; quarks are described by real symmetric matrices; agents of those processes correspond to gluons; (6) essence of nuclear interaction is conservation of energy by alternate transformation of electric energy to magnetic one and vice versa, atom of deuterium (D-atom) being its fundamental case; (7) H-atom and neutron can roughly be modeled by electric RC- and LR-circuits respectively; for exact representation it is necessary to take into account minor magnetic properties of H-atom and electric properties of neutron; D-atom is modeled by electric LCR-circuit, He-atom by T-shape low-pass filter; all above electric parameters are evaluated; (8) the pulse response of H-atom model follows closely correlation function of ether in high-energy region; the cut-off energy region of ether spectrum, 10^8.5 eV, is formed by atoms of helium and other elements; (9) nuclear structure evolves by shells, D-atom being its basic element; there are seven shells: He-shell (2-shell), octahedral shell (8-shell), icosahedral shell (18-shell), double-icosahedral shell (36-shell) and three inverse shells of 18, 8 and 2 D-atoms; additional neutrons perform inter-shell interaction; electron shells are integral components of nuclear structure; (10) every nuclear shell can be modeled by electric LCR-network, so that the whole atom can be represented by matrix of impedances; atom with atomic number m consists of m D-atoms, is represented by network with m degrees of freedom and, when excited, emits m-neutrinos; (11) stellar medium simulates conditions of ether, so that the atoms produced in it become different models of ether, achieving their perfection in the U-atom; its structure being actually the realization and exposition of the implicit structure of H-atom.1. Igor S. Makarov. A Theory of Ether, Particles and Atoms. Second Edition. Open University Press. Manchester, UK, 2010. Order: ISBN-13: 9781441478412. Online: http://kvisit.com/S2uuZAQ

Keywords: ether, origin of matter, particle physics, nuclear structure.

Biography

Igor Stepanovich Makarov (b. August 18, 1935. Moscow USSR). I graduated with honor from the Moscow Institute of Communications and Broadcasting (1958). Then followed the Post-graduate Course of the same institute, with a dissertation in magnetic recording and the degree of Candidate of Science in Communications Engineering (1965). In 1964-1984, I worked as Senior Engineer and Senior Researcher at the Moscow Institute of Radio. Late in the 60s, I started my own independent research in Systems Theory and Theoretical Physics. During 1984-1992 I made several short reports on the existence of ether. In 1992 I immigrated in Israel. Looking for the proper conditions for my research, I have since traveled much across Europe, living for two years in Canada and gradually making progress with the research. During the period of 1996-2005, I published four articles in the Indian Journal of Theoretical Physics (Calcutta) on the theory of ether and its particles. In 2005-2006 in Israel, I prepared two drafts on the nuclear structure of atoms. The whole research, titled “A Theory of Ether, Particles and Atoms” (subtitled “The Reform of Modern Physics”) was published first privately in England (July 2007) and then, after numerous corrections, professionally, in Israel and USA.

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Heat exchangers technology and applications in heat exchanger engineering

Abdeen Omer
Energy Research Institute (ERI), UK

Over the years, all parts of a commercial refrigerator, such as the compressor, heat exchangers, refrigerant, and packaging, have been improved considerably due to the extensive research and development efforts carried out by academia and industry. However, the achieved and anticipated improvement in conventional refrigeration technology are incremental since this technology is already nearing its fundamentals limit of energy efficiency is described is 'magnetic refrigeration' which is an evolving cooling technology. The word 'green' designates more than a colour. It is a way of life, one that is becoming more and more common throughout the world. An interesting topic on 'sustainable technologies for a greener world' details about what each technology is and how it achieves green goals. Recently, conventional chillers using absorption technology consume energy for hot water generator but absorption chillers carry no energy saving. With the aim of providing a single point solution for this dual purpose application, a product is launched but can provide simultaneous chilling and heating using its vapour absorption technology with 40% saving in heating energy. Using energy efficiency and managing customer energy use has become an integral and valuable exercise. The reason for this is green technology helps to sustain life on earth. This not only applies to humans but to plants, animals and the rest of the ecosystem. Energy prices and consumption will always be on an upward trajectory. In fact, energy costs have steadily risen over last decade and are expected to carry on doing so as consumption grows. Refrigerants such as hydrochloroflurocarbons (HCFCs) are present in the ground source heat pump (GSHP) systems and can pose a threat to the environment through being toxic, flammable or having a high global warming potential.

Keywords: Absorption cycles, environment, heat pumps, refrigeration cycles, thermodynamic

Biography

Abdeen Mustafa Omer (BSc, MSc, PhD) is an Associate Researcher at Energy Research Institute (ERI). He obtained both his PhD degree in the Built Environment and Master of Philosophy degree in Renewable Energy Technologies from the University of Nottingham. He is qualified Mechanical Engineer with a proven track record within the water industry and renewable energy technologies. He has been graduated from University of El Menoufia, Egypt, BSc in Mechanical Engineering. His previous experience involved being a member of the research team at the National Council for Research/Energy Research Institute in Sudan and working director of research and development for National Water Equipment Manufacturing Co. Ltd., Sudan. He has been listed in the book WHO'S WHO in the World 2005, 2006, 2007 and 2010. He has published over 300 papers in peer-reviewed journals, 200 review articles, 7 books and 150 chapters in books.

abdeenomer2@yahoo.co.uk

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Interaction of high-energy density synchrotron radiation with functional oxides and their X-ray nanopatterning

Marco Truccato
University of Torino, and INFN, Italy

Material damage related to heavy X-ray irradiation has become increasingly important with the recent development of nanofocused hard X-ray beams. Recently, the possibility has emerged to exploit this damage in order to locally modify in a controlled way the structural and electronic properties of materials. In the case of superconducting oxides like Bi2Sr2CaCu2O8+δ (Bi-2212) and YBa2Cu3O7-δ (Y-123), photon damage has been used to fabricate devices based on their intrinsic Josephson junction structure. Photon fluxes of the order of 1010-1011 ph s-1 have been used over areas about 50 × 50 nm2 to draw the desired pattern in pristine single crystals.[1, 2] Experimental evidences indicate oxygen loss from the crystals and the appearance of grain boundaries during the fabrication, whose misalignment increases with the irradiation dose.[3, 4] Our method has been demonstrated also in TiO2. We have shown the possibility of locally increasing the electrical conductivity upon irradiation, and of guiding the electroforming process needed for the fabrication of memristive devices. These modifications are most probably related to a local increase in the concentration of oxygen vacancies.[5] Corresponding computer simulations have been performed at room temperature and at a cryogenic temperature (8 K). The deposited energy density has been evaluated via Monte Carlo simulations considering the avalanche of relaxation processes induced by the beam. Then, heat propagation has been calculated by means of temperature-dependent finite element models. These simulations have taken into account the pulsed time pattern of the synchrotron beam. Results reveal temperature spikes corresponding to the synchrotron pulses. The temperature locally increases by tens of degrees, with a stronger effect at 8K because of the lower heat capacity at low temperature. These results indicate that rapid thermal dilation and contraction cycles occur, most probably with corresponding shock waves induced by the extreme temperature gradients (109 K m-1) and heating rates (1012 K s-1).

Biography

Marco Truccato is Professor at the Physics Department of University of Torino, Italy, where he teaches Solid State Physics and Physics of Superconductors. His almost 30-year long research activity in material science has encompassed many topics like diamond, semiconducting oxides, and superconducting oxides. He has been leading about 10 research projects at the local, regional, national and European level. In the past 10 years he has focused especially on the interaction between synchrotron radiation nanoprobes and matter - including living matter - taking part in about 20 experiments at the European Synchrotron Radiation Facility (ESRF) in Grenoble, France. He is also responsible for the Metal-Jet X-ray laboratory of the University of Torino. As of January 2022, he has published 65 papers and received over 570 citations.

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INVESTIGATIONS OF ELECTRONIC AND OPTICAL PROPERTIES OF NITROGEN, COPPER, AND SULFUR DOPED TiO2

Haseeb Ahmad
Kohat University of Science and Technology (KUST), Pakistan

Recently, environmental pollution and energy crises are taking increasing attention from researchers. Doped TiO2 is widely used to deal with the environmental pollution and energy crises in an environmental friendly way. For the cleaning up of environmental pollution, the DFT based computations were implemented to examine impact of Cu, N and S doping on the electronic and optical properties of anatase TiO2. Cupper in anatase TiO2 decreased the band gap of unadulterated TiO2 from 2.17 eV to 1.85 eV by presenting Cu 3d locals over the valance band. Isolated N 2p state was introduced over the highest point of the valence which would annihilate the electron–hole sets and restrict the efficiency of N@TiO2. Sulfur doping decreased the band width of TiO2 to 1.89 eV. The codoping of Cu as well as S decreased the band gap of TiO2 to 1.86 eV. Tri-doping of Cu, N and S induced a synergistic effect restricting the gap to 1.80 eV. The creation of Cu 3d, N 2p and S 3p drastically reduced the band gap which would improve the light absorbing and photocatalytic activity of TiO2. The optical absorption coefficient depicts that CuNS@TiO2 display noticeable absorption among the developed models. Moreover, the suitable band structure of the tri-doped system would diminish the recombination sites. This would help in increasing the application spectrum of TiO2 in photo electrochemical applications.

Biography

Haseeb Ahmad Born in Lakki Marwat KPK Pakistan. Done His schooling and college from Lakki marwat after that he went to Bannu University of science and technology (BUST) for completing his sixteen year of education in Physics. He got admission in Kohat University of Science and Technology (KUST) for getting his MS degree. He is currently working in Material studio and Simulation Under the supervision of Dr Matiullah Khan (Associate professor) in the department of physics.

khanhaseebahmad98@gmail.com

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Pressure induced structural and topological phase transition in ternary compound LiAuBi

Anita Yadav
Indian Institute of Technology Ropar, India

The study of topological semimetals and insulators have become a keen interest in the field of solid-state physics which are known to possess properties that enhances the performance of a thermoelectric (TE) material1,2 In our study, we have performed detailed theoretical investigations of topological phases in non-centrosymmetric half Heusler compound LiAuBi upto a pressure of 30 GPa. It is found that the compound forms into a dynamically stable face centered cubic (FCC) lattice structure of space group 216 at ambient pressure. The presence of spin-orbit coupling results in the s-p band-inversion near the Fermi level and thus may be categorized as topological semi-metals. The compound is topologically non-trivial at ambient pressure, but undergoes a quantum phase transition to trivial topological phase at 23.4 GPa. However, the detailed investigations show a structural phase transition from FCC lattice (space group 216) to a honeycomb lattice (space group 194) at 13 GPa, which is also associated with a non-trivial to trivial topological phase transition.\ To understand its TE performance, transport properties are studied using Boltzmann transport theory, which show that the compound also carries appreciable thermoelectric properties at ambient pressure. The theoretical findings pave its path for practical applications in spintronics as well as thermoelectricity, therefore LiAuBi needs to be investigated experimentally.

Biography

Anita Yadav is a Ph.D. scholar at Departmnet of Physics, Indian Institute of Technology (IIT) Ropar, India. She works on first principles investigation of 2D and 3D ternary compounds for their electronic band structures, magnetic, and thermoelectric properties.

anita.yadav@iitrpr.ac.in

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Physics of Thermal and Mechanical Memory in Shape Memory Alloys

Osman Adiguzel
Firat University, Turkey

Shape memory alloys take place in class of smart materials with adaptive properties and stimulus response to the external changes. These alloys exhibit a peculiar property called shape memory effect. This phenomenon is initiated by thermal and mechanical treatments on cooling and stressing the material and performed thermally on heating and cooling after these treatments. Therefore, this behavior is called thermal memory or thermoelasticity. Low temperature phases of shape memory alloys are soft phases and deformed easily. The material keeps the deformed shape after releasing external forces, the deformation energy is stored in the materials, and releases on heating by recovering the original shape. These alloys exhibit another property, called superelasticity, which is performed in only mechanical manner, by stressing and releasing. Therefore, this behavior can be called mechanical memory. The alloys are stressed in parent phase region just over austenite finish temperature and recover the original shape simultaneous and instantly on releasing the external forces. These phenomena are result of crystallographic or structural transformations in the materials, called martensitic transformations, by which crystalline structure of the material change. Shape memory effect is governed by thermal and stress induced martensitic transformations. Thermal induced martensitic transformation occurs in <110> - type directions on {110} - type planes of austenite, by means of lattice invariant shear, on cooling along with lattice twinning and ordered parent phase structures turn into twinned martensite structures; these twinned structures turn into detwinned martensite structures by means of strain induced martensitic transformation with deformation in martensitic state. Superelasticity is also the result of stress-induced martensitic transformation, and parent austenite phase structures turn into the fully detwinned martensite with the stressing. Superelasticity exhibits ordinary elastic material behavior, but it is performed in non-linear way; loading and unloading paths are different at the stress-strain diagram, and hysteresis loop reveals energy dissipation. Copper based alloys exhibit this property in metastable β - phase region, which has bcc-based structures at high temperature parent phase field. Lattice invariant shears and twinning are not uniform in these alloys and give rise to the formation of unusual layered complex structures, like 3R, 9R or 18R structures depending on the stacking sequences, with lattice twinning. The unit cell and periodicity are completed through 18 layers in direction z, in case of 18R martensite, and unit cells are not periodic in short range in direction z. In the present contribution, x-ray diffraction and transmission electron microscopy studies were carried out on two copper based CuZnAl and CuAlMn alloys. X-ray diffraction profiles and electron diffraction patterns exhibit super lattice reflections inherited from parent phase due to the displacive character of martensitic transformation. Specimens of these alloys were aged at room temperature for a long term, and x-ray diffractograms taken during ageing show that diffraction angles and peak intensities changed. This result refers to redistribution of atoms in diffusive manner

Keywords: Thermoelasticity, superelasticity, shape memory effect, martensitic transformation, lattice twinning, detwinning.

Biography

Adiguzel graduated from Department of Physics, Ankara University, Turkey in 1974 and received PhD- degree from Dicle University, Diyarbakir-Turkey. He studied at Surrey University, Guildford, UK, as a post-doctoral research scientist in 1986-1987, and studied on shape memory alloys. He worked as research assistant, 1975-80, at Dicle University and shifted to Firat University, Elazig, Turkey in 1980. He became professor in 1996, and he has already been working as professor. He published over 80 papers in international and national journals; He joined over 120 conferences and symposia in international and national level as participant, invited speaker or keynote speaker with contributions of oral or poster. He served the program chair or conference chair/co-chair in some of these activities. In particular, he joined in last seven years (2014 - 2020) over 80 conferences as Keynote Speaker and Conference Co-Chair organized by different companies. He supervised 5 PhD- theses and 3 M.Sc.- theses. Dr. Adiguzel served his directorate of Graduate School of Natural and Applied Sciences, Firat University, in 1999-2004. He received a certificate awarded to him and his experimental group in recognition of significant contribution of 2 patterns to the Powder Diffraction File – Release 2000. The ICDD (International Centre for Diffraction Data) also appreciates cooperation of his group and interest in Powder Diffraction File.

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Stereolithographic Additive Manufacturing of Photonic Crystal with Dielectric Patterns for Electromagnetic Wave Modulation

Soshu Kirihara
Osaka University, Japan

In stereolithographic additive manufacturing (STL-AM), 2-D cross sections were created through photo polymerization by UV laser drawing on spread resin paste including nanoparticles, and 3-D models were sterically printed by layer lamination. The lithography system has been developed to obtain bulky ceramic components with functional geometries. An automatic collimeter was newly equipped with the laser scanner to adjust beam diameter. Fine or coarse beams could realize high resolution or wide area drawings, respectively. As the row material of the 3-D printing, nanometer sized metal and ceramic particles were dispersed into acrylic liquid resins at about 60 % in volume fraction. These materials were mixed and deformed to obtained thixotropic slurry. The resin paste was spread on a glass substrate at 50 µm in layer thickness by a mechanically moved knife edge. An ultraviolet laser beam of 355 nm in wavelength was adjusted at 50 µm in variable diameter and scanned on the spread resin surface. Irradiation power was changed automatically for enough solidification depth for layer bonding. The composite precursors including nanoparticles were dewaxed and sintered in the air atmosphere. In recent investigations, ultraviolet laser lithographic additive manufacturing (UVL-AM) was newly developed as a direct forming process of fine metal or ceramic components. As an additive manufacturing technique, 2-D cross sections were created through dewaxing and sintering by UV laser drawing, and 3-D components were sterically printed by layer laminations with interlayer joining. Though the computer aided smart manufacturing, design and evaluation (Smart MADE), practical materials components were fabricated to modulate energy and material transfers in potential fields between human societies and natural environments as active contributions to Sustainable Development to Goals (SDGs).

Biography

Soshu Kirihara is a doctor of engineering and a professor of Joining and Welding Research Institute (JWRI), Osaka University, Japan. In his main investigation “Materials Tectonics” for environmental improvements of “Geotechnology”, multi-dimensional structures were successfully fabricated to modulate energy and materials flows effectively. Ceramic and metal components were fabricated directly by smart additive manufacturing, design and evaluation (Smart MADE) using high power ultraviolet laser lithography. Original stereolithography systems were developed, and new start-up company “SK-Fine” was established through academic-industrial collaboration.

kirihara@jwri.osaka-u.ac.jp

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Development of Corrosion-Resistant S. G. Iron

Sudipta Sen
Dept. of Metallurgical and Materials Engg, NIT Rourkela, India

The spheroidal graphite (S.G) iron which is also known as ductile or nodular iron is the most useful alloy belonging to the Cast Iron family. Ever since its discovery in 1948, its application in engineering industries is increasing day by day. The very recent development is the application of S. G. Iron as a cask material for the transport of spent nuclear fuels. These casks are often kept in sea water at a depth of around 30 meter (from the sea-level). This is done to prevent scattering of radiation into the environment even if the container fails to serve its purpose due to some reason or other. Obviously in such cases the cask-material has to be highly corrosion-resistant. It has been found that best corrosion resistance can be obtained by intercritical annealing that results in DMS (Dual Matrix Structure i.e., Ferrite + Martensite). The corrosion-resistance can also be improved by alloying with Ni, Cu and Cr.

Biography

Sudipta Sen is a professor of Metallurgical and Materials Engineering, working in Department of Metallurgical and Materials Engineering, National Institute of Technology Rourkela, Sundargarh, Odisha, India - 769008.

ssen@nitrkl.ac.in

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Stereolithographic Additive Manufacturing of Photonic Crystal with Dielectric Patterns for Electromagnetic Wave Modulation

Yoritaka Iwata
Kansai University, Japan

Neutrino is known to be a candidate of the Majorana particle. Neutrinoless double beta decay (Fig. 1) is a weak process which takes place only when neutrinos can be identified with anti-neutrinos. In this sense the observation of neutrinoless double beta decay is to confirm the Majorana property of neutrinos. Neutrinos are usually considered to be left-handed in the standard model (SM) of elementary particle physics, while anti-neutrinos to be right-handed. If neutrinos are actually Mojorana particles, there should be a mixing or replacement between left-handed and right-handed particles. In this context left-right symmetric model [1] suggests that there are three additional mechanisms of weak boson exchanges to the standard mechanism (WL-WL exchange) exchanging left handed weak bosons; indeed, the λ mechanism (WL-WR exchange), η mechanism (WLWR mixing), and heavy neutrino exchange mechanism (WR-WR exchange). The study of neutrinoless double beta decay is carried out for evaluating the Majorana neutrinomass, quantitatively clarifying the lepton number violation, and showing the Majorana property of neutrinos.Although the neutrinoless double beta decay has been well studied with respect to the standard mechanism, neutrinoless double beta decay study including the right-handed weak boson has been started only several years ago. In this paper much attention is paid to the calculation of nuclear matrix elements of the neutrinoless double beta with respect to the standard mechanism, λ mechanism, and η mechanism. The nuclear matrix element plays a role of connecting the neutrino effective mass with the half-life of neutrinoless double beta decay. where Cm, CN, Cλ , Cη , CmN and on are obtained by calculating nuclear matrix elements, ηm, ηN and ηλ and ηη are associated with the effective mass of neutrino, and ??/??? means the half-life. In conclusion the values of nuclear matrix elements of Fermi, Gamow-Teller and tensor types are presented based on interacting shell model calculation (ISM, for short) [4,5]. Bounds on Majorana neutrino mass and lepton number violating parameters are also derived. Here it is remarkable that the neutrinoless double beta decay is a beyond-the-SM process showing the violation of lepton numbers.

Biography

Yoritaka Iwata is an associate professor at the Faculty of Chemistry, Materials and Bioengineering, Kansai University, Osaka, Japan. He received his B.Eng. from Osaka University, M.Eng. from Osaka University, Ph.D. in mathematics from Osaka University, Japan under the supervision of Professors K. Uosaki and A. Yagi, Ph.D. in physics from The University of Tokyo, Japan under the supervision of Professor T. Otsuka. Dr. Iwata has chaired or co-chaired several internationaworkshops and is serving as a reviewer board member of mathemtics journal ”Axioms”, and a review editor of physics journal “Frontiers in Physics” and “Frontiers in Astronomy and Space Sciences”. His research interest is in functional analysis, operator theory, Numerical analysis, and mathematical physics including soliton theory, quantum physics/information.

iwata_phys@08.alumni.u-tokyo.ac.jp

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