2014

Physics Abstracts

Second Annual International Conference on **Physics**, 21-24 July 2014, Athens, Greece

Edited by Gregory T. Papanikos

THE ATHENS INSTITUTE FOR EDUCATION AND RESEARCH

2nd Annual International Conference on Physics

21-24 July 2014, Athens, Greece

Edited by Gregory T. Papanikos

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TABLE OF CONTENTS

(In Alphabetical Order by Author's Family name)

Preface

This abstract book includes all the abstracts of the papers presented at the *2nd Annual International Conference on Physics, 21-24 July 2014*, organized by the Athens Institute for Education and Research. In total there were 21 papers and 24 presenters, coming from 16 different countries (Brazil, Bulgaria, Canada, France, Georgia, Germany, India, Israel, Japan, Russia, Singapore, Slovakia, South Africa, Sweden, Turkey, USA). The conference was organized into six sessions that included areas such as Wave Propagation/Optics, Nuclear Physics, Materials/Devices, Cosmology/Relativity/Astronomy and other related fields. As it is the publication policy of the Institute, the papers presented in this conference will be considered for publication in one of the books of ATINER.

The Institute was established in 1995 as an independent academic organization with the mission to become a forum where academics and researchers from all over the world could meet in Athens and exchange ideas on their research and consider the future developments of their fields of study. Our mission is to make ATHENS a place where academics and researchers from all over the world meet to discuss the developments of their discipline and present their work. To serve this purpose, conferences are organized along the lines of well established and well defined scientific disciplines. In addition, interdisciplinary conferences are also organized because they serve the mission statement of the Institute. Since 1995, ATINER has organized more than 150 international conferences and has published over 100 books. Academically, the Institute is organized into six research divisions and twenty-seven research units. Each research unit organizes at least one annual conference and undertakes various small and large research projects.

I would like to thank all the participants, the members of the organizing and academic committee and most importantly the administration staff of ATINER for putting this conference together.

Gregory T. Papanikos
President

FINAL CONFERENCE PROGRAM
2nd Annual International Conference on Physics, 21-24 July 2014, Athens, Greece

PROGRAM

Conference Venue: Titania Hotel (52 Panepistimiou Avenue)

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10. Dr. Stella B. Bondi, Associate Professor, Old Dominion University, USA.
11. Dr. Arthur Pantelides, Director of Engineering, Sumitomo Machinery Corporation of America, USA.
12. Dr. Igor Gurevich, Senior Researcher, HETNET Consulting Company, Russia.

Administration

Fani Balaska, Stavroula Kiritsi, Eirini Lentzou, Konstantinos Manolidis, Katerina Maraki, Celia Sakka, Konstantinos Spiropoulos & Ioanna Trafali

C O N F E R E N C E P R O G R A M

(The time for each session includes at least 10 minutes coffee break)

Monday 21 July 2014

08:30-09:20 Registration

09:20-09:30 Welcome and Opening Remarks

- Dr. Gregory T. Papanikos, President, ATINER.
- Dr. George Poulos, Vice-President of Research, ATINER & Emeritus Professor, University of South Africa, South Africa.
- Dr. Ethel Petrou, Professor and Chair, Department of Physics, Erie Community College-South, State University of New York, USA & Academic Member, ATINER.

09:30-11:00 Session I: Materials/Devices I

Chair: George Poulos, Vice-President of Research, ATINER & Emeritus Professor, University of South Africa, South Africa.

1. Boris Sedunov, Professor, Russian New University, Russia. The Physics of Clusters in Real Gases.
2. Hiroyuki Kagami, Associate Professor, Nagoya College, Japan. An Improvement of the Impact of the Marangoni Effect on the Polymer Thin Film Thickness Profile after Drying Polymer Solution Coated on a Flat Substrate through Temperature, Evaporation and Concentration Management During Drying.

11:00-12:30 Session II: Wave Propagation/Optics

Chair: Ian Lazarus, Senior Lecturer, Durban University of Technology, South Africa

1. Guram Adamashvili, Head, Technical University of Georgia, Georgia. Vector Solitons of Self-Induced Transparency in Semiconductor Quantum Dot Waveguides.
2. *Nuri Unal, Professor, Akdeniz University, Turkey. Coherent States for Coupled Oscillators.
3. Christoph Schultheiss, Project Leader, Karlsruhe Institute of Technology, Germany. Momentum and Energy of a Mass Consisting of Confined Photons and Resulting Quantum Mechanic Implications.

12:30-13:30 Lunch

13:30-15:00 Session III: Cosmology/Relativity/Astronomy

Chair: *Nuri Unal, Professor, Akdeniz University, Turkey.

1. Valery Vasiliev, Professor, Russian Academy of Sciences, Russia. On the Solution of Spherically Symmetric Problem for a Solid Sphere in General Relativity. (Monday, 21 of July).
2. Shubhen Biswas, Physics Teacher, G.P.S.H.S. School, India. Quantum to Cosmological Phenomena in Gravity Induced Electromagnetism.
3. Eugene Trunkovsky, Scientific Researcher, M.V.Lomonosov Moscow State University, Russia. On Direct Measurements of the Angular Sizes of Stars by Lunar Occultation Observations.
4. Ian Lazarus, Senior Lecturer, Durban University of Technology, South Africa, Ramesh Bharuthram, DVC Academic, University of the Western Cape, South Africa, Suleman Moolla, Senior Lecturer, University of KwaZulu-Natal, South Africa, Satyavir Singh, Professor, Indian Institute of Geomagnetism, India & Gurbax Lakhina, Professor, Indian Institute of Geomagnetism, India. Nonlinear Electrostatic Solitary Waves in Electron-Positron Plasmas.

21:00–23:00 Greek Night and Dinner (Details during registration)

Tuesday 22 July 2014

09:00-11:00 Session V: Education
Chair: Dr. George Poulos, Vice-President of Research, ATINER & Emeritus Professor, University of South Africa, South Africa

1. Bruno Goncalves, Professor, Federal Institute of Education, Brazil & Mario Dias, Student, Federal Institute of Education, Brazil. Simple Giant Pendulum: Qualitative and Quantitative Study.
2. Ramzi Suleiman, Professor, University of Haifa, Israel. On the Possibility of a New Physics.
3. Peter Chudinov, Associate Professor, Perm State Agricultural Academy, Russia. Approximate Analytical Description of the Projectile Motion with a Quadratic Drag Force.
4. *Mark Paetkau, Senior Lecturer, Thompson Rivers University, Canada, Dan Bissonnette, Lecturer, Thompson Rivers University, Canada & Colin Taylor, Lecturer, Thompson Rivers University, Canada. Using Simulations to Help Prepare Students for the Lab.
5. Meng Ho Tan, Teaching Assistant, National University of Singapore, Singapore, Chammika Udalagama, Lecturer, National University of Singapore, Singapore, Teng Jar Tan, Laboratory Officer, National University of Singapore, Singapore & Geok Quee Lim, Laboratory Officer, National University of Singapore, Singapore. Do, See, Think and Learn.

11:00-12:30 Session VI: Nuclear Physics
Chair: *Mark Paetkau, Senior Lecturer, Thompson Rivers University, Canada

1. Ali Al-Adili, Researcher, Uppsala University, Sweden, Stephan Pomp, Uppsala University, Sweden, Franz-Josef Hambsch, Institute for Reference Materials and Measurements, Belgium & Stephan Oberstedt, Institute for Reference Materials and Measurements, Belgium. The Effect of Neutron Emission on Measured Mass Yields.
2. Eduardo S. Moura, Ph.D. Student, University of Wisconsin-Madison, USA, *Maria Elisa C. M. Rostelato, Senior Technologist Researcher, Nuclear and Energy Research Institute, Brazil, Larry A. DeWerd, Professor and Director, University of Wisconsin, USA & Carlos A. Zeituni, Technologist Researcher, Nuclear and Energy Research Institute, Brazil. Experimental Measurements in Brachytherapy Based in Heterogeneous Media
3. Bernard Schaeffer, Retired, France. Electromagnetic Interactions in an Atomic Nucleus.

12:30

-13:30 Lunch

13:30-15:00 Session VII: Materials/Devices II
Chair: Ethel Petrou, Professor and Chair, Department of Physics, Erie Community College-South, State University of New York, USA & Academic Member, ATINER.

1. Yesim Gucbilmez, Associate Professor, Anadolu University, Turkey, Ibrahim Calis, R&D Engineer, Betareks, Turkey & Adife Seyda Yargic, Research Assistant, Bilecik Seyh Edibali University, Turkey. Optimization of Ethyl Acetate Production Using Palladium Incorporated MCM-41 and MCM-48 Type Mesoporous Nano-Structured Catalysts.
2. Nataliya Kazantseva, Senior Research Scientist, Institute of Metal Physics Ural Division of RAS, Russia. Materials for High-Speed Transport Systems.
3. Darina Bachvarova, Post Doc, Shumen University, Bulgaria, Spasova Kornelia, Post Doctoral, Shumen University, Bulgaria, P. Petkova & P. Vasilev. Optical Properties of LiNbO3: Ru in the VIS Spectral Region.
4. Jozef Hraska, Professor, Slovak University of Technology, Slovakia, Peter Hartman, Ph.D. Student, Slovak University of Technology, Slovakia & Paulina Sujanova, Ph.D. Student, Slovak University of Technology, Slovakia. Circadian Characteristics of Special Glazing.

17:30-20:30 Urban Walk (Details during registration)

21:00-22:00 Dinner (Details during registration)

Wednesday 23 July 2014
Cruise: (Details during registration)

Thursday 24 July 2014
Delphi Visit: (Details during registration)

Guram Adamashvili
Professor, Technical University of Georgia, Georgia

Vector Solitons of Self-Induced Transparency in Semiconductor Quantum Dot Waveguides

A theory of an optical vector pulsing soliton of self-induced transparency for a TM-mode propagating in a planar semiconductor waveguide sandwiched between two dielectric media is developed. A transition layer between the waveguide and one of the connected media is described using a model of a two-dimensional gas of inhomogeneously broadened semiconductor quantum dots. The energetic spectrum of the quantum dots can be considered as a quasi-equidistant three-level system in a cascade configuration under off-resonant excitation. A nonlinear coherent interaction of an optical pulse with the ensemble of quantum dots in the presence of single-excitonic and biexcitonic transitions is governed by the Maxwell-Liouville equations. By using the perturbative reduction method, the system of the Maxwell-Liouville equations is reduced to the two-component coupled nonlinear Schrödinger equations. It is shown that the phase modulation changes significantly the pulse parameters. The shape of the optical two-component vector pulsing soliton with the sum and difference of the frequencies in the region of the carrier frequency is presented. Explicit analytical expressions for the optical vector pulsing soliton are obtained with realistic parameters which can be reached in current experiments. Both components of the vector pulsing soliton are bright solitons (bright-bright soliton pair). In the special case the vector pulsing soliton can be reduced to the one-component pulsing soliton (breather) solution of the Maxwell-Bloch equations and these nonlinear waves have different profiles and they are 0π pulses of self-induced transparency.

Ali Al-Adili
Researcher, Uppsala University, Sweden
Stephan Pomp
Uppsala University, Sweden
Franz-Josef Hambsch
Institute for Reference Materials and Measurements - European Commission - Joint Research Centre, Belgium
&
Stephan Oberstedt
Institute for Reference Materials and Measurements - European Commission - Joint Research Centre, Belgium

The Effect of Neutron Emission on Measured Mass Yields

Prompt-neutrons are important to take into account when measuring fission yields via the so-called 2E-technique. The energies of both fission fragments are measured to determine the mass distributions by employing the conservation of momentum and mass. The amount of emitted neutrons per fragment, $\nu(A)$, has to be estimated in each fission event. One has also to consider the increase of $\nu(A)$ as a function of excitation energy. This happens when measuring at higher incident neutron energies. However it is not fully understood whether the increase in $\nu(A)$ as a function of En is mass dependent. This issue is still under debate, both theoretically and experimentally, but experiments on ^{237}Np(n,f) and ^{235}U(n,f) showed that the extra neutrons are emitted from the heavy fragments, pre-dominantly. On the contrary, many works assumes an overall higher neutron multiplicity for all fragments. In this paper we studied the impact of a mass-dependent increase in $\nu(A)$ on the fission mass yields and their energy distributions. We show that this choice can be significant on the measured observables and some corrections are eventually needed on some earlier literature studies. The post-neutron emission mass yield distribution revealed changes between 10 and 30 %. This may have important consequences on the various reactor applications in which mass yields are used at higher excitation energies. Further experimental studies of $\nu(A)$ are essential and in particular, how $\nu(A)$ changes as a function of incident neutron energy. Until then, some fission yields in the data libraries could be affected if they were calculated based on wrong assumption on the neutron emission.

Darina Bachvarova
Post Doc, Shumen University, Bulgaria
Spasova Kornelia
Post Doc, Shumen University, Bulgaria
P. Petkova
&
P. Vasilev

Optical Properties of $LiNbO_3$: Ru in the VIS Spectral Region

The absorption spectra of $LiNbO_3$: Ru single crystals are measured in the visible spectral region at room temperature. The two absorption maxima are clearly expressed around 370 nm and 530 nm. The investigated samples are grown with four different concentrations of ruthenium. The energies of the electron transitions in Ru are calculated. The role of the spin-orbit interaction and Jahn-Teller effect is evaluated also.

Shubhen Biswas
Physics Teacher, G.P.S.H.S.School, India

Quantum to Cosmological Phenomena in Gravity Induced Electromagnetism

The basic aim of this work is an effort to explain Gravity Induced Electromagnetism with physical perceptions in Quantum to Cosmological Phenomena. Introduction to the manifestation of electromagnetism owes to the dynamic mass in terms of weak-field approximation in General Relativistic approach. The possible outcome regarding this approach is Theory of Dynamic Gravitational Electromagnetism (TDGEM) for the physical perceptions in Quantum to Cosmological phenomena.

On the basis of the reference [1] it has been shown that for a moving mass particle there corresponds a dynamic change in extra potential at the observation point or the space-time metric in General Relativistic approach. It is postulated that the changing potential will be transformed into electromagnetic field. In a four dimensional space - time continuum the electromagnetic field tensors are constructed with the help of velocity dependent extra potential. Thus, TDGEM is consistent with dimensions and as well as Maxwell's equations. With the help of these relations, excluding the ion core dynamo theory, origin of terrestrial magnetic field is explained to a good extent.

With respect to reference [2] it is considered that the elementary particle is made up of self bound lump of relativistic photonic masses. A treatment of the dynamic variable of TDGEM as the quantum mechanical observable allowed measuring the quantized charges and spinning magnetic moment of the elementary particles. The results are very much with the agreement of recent experimental data of electrons and quarks (Leptons).

In reference [3] a theory on gravity induced electromagnetic field for accelerated mass has been presented as an extension of the TDGEM. It is also shown that an accelerating particle of finite mass can radiate electromagnetic energy like the accelerated charge particle.

One of the biggest enigma regarding energy flow ~10^47 joules in a matter of seconds for Gamma Ray Bursts are explained over references[4&5] the theoretical consequence of electromagnetic radiation from decelerated mass due to bounce at the end of gravitational collapse in on self for massive stealer objects or at their merger. Here in the theoretical consideration neither deceleration at the collapse nor the rotation itself can produce jets.

Peter Chudinov
Associate Professor, Perm State Agricultural Academy, Russia

Approximate Analytical Description of the Projectile Motion with a Quadratic Drag Force

The problem of the motion of a projectile thrown at an angle to the horizon, has a long history and is one of those tasks that started the dynamics as a science. The number of works devoted to this task is immense. It is a constituent of many introductory courses of physics. This task arouses interest of authors as before. With zero air drag force, the analytic solution is well known. The trajectory of the projectile is a parabola. In situations of practical interest, such as throwing a ball with the occurrence of the impact of the medium the quadratic resistance law is usually used. In that case the problem probably does not have an exact analytic solution and therefore in most scientific publications it is solved numerically. Analytic approaches to the solution of the problem are not sufficiently advanced. Meanwhile, analytical solutions are very convenient for a straightforward adaptation to applied problems and are especially useful for a qualitative analysis. Therefore the attempts are being continued to construct analytical solutions (even approximate) for this problem. That is why the description of the projectile motion with a simple approximate analytical formulas under the quadratic air resistance is of great methodological interest. Lately these formulas have been obtained by the author of this abstract. These formulas allow us to obtain a complete analytical description of the problem. This description includes:

-analytical formulas for determining the basic eight parameters of projectile motion. The four parameters correspond to the top of the trajectory, four – to the point of drop. There are formulas for the maximum height of ascent of the projectile, motion time, the velocity at the trajectory apex,flight range, the time of ascent, the abscissa of the trajectory apex, impact angle with respect to the horizontaland the final velocity;

- analytical formulas for the six basic functional dependences of the problem, including the trajectory equation in Cartesian coordinates;
- the determination of the optimum angle of throwing, providing the greatest range;
- constructing the envelope of a family of trajectories of the projectile;
- finding the vertical asymptote of projectile motion.

All these characteristics are determined directly from the initial conditions of projectile motion the initial velocity and angle of throwing. In the absence of air resistance, all these relations turn into well-known formulas of the theory of the parabolic motion of the projectile. The proposed analytical solution differs from other solutions by simplicityofformulas, ease of use and high accuracy (relative error isabout 1-2 %). The motion of a baseball is presented as an example.We introduce the dimensionless parameter p, which is the ratio of air resistance to the weight of the projectile at the start of the movement. Calculations show that these formulas are applicable for $0 \le p \le 1.5$. A slight complication in formulas extends the applicability to the range $0 \le p \le 4$. This approach enables us to simplify the qualitative study of the projectile motion, taking into account air resistance. It is notable that the numerical values of the sought-for quantities are determined with high accuracy. The proposed formulas make it possible to carry out a complete analytical investigation of the motion of a projectile in a medium with the resistance in the way it is done for the case of no drag.

Bruno Goncalves
Professor, Federal Institute of Education, Brazil
&
Mario Dias
Student, Federal Institute of Education, Brazil

Simple Giant Pendulum: Qualitative and Quantitative Study

A simple pendulum is constituted by a suspended body on the end of an inextensible and massless string, when it is displaced sideways from its resting equilibrium position due to the fact that the mechanical energy store of the system, switching between forms of potential energy and kinetic energy.

The simple pendulum is a common object of study among students and it is easily assembled. It can be used in both disciplines of high school subjects as the basic cycle of undergraduate courses in the exact sciences areas. In a simple experiment whose purpose is to get the value of local gravity, it can teach students various concepts related to laboratorial practice.

For this reason, it is necessary to check if the experiment done in the classroom has, in fact, reliable accuracy. Therefore, the experiment was done with different string lengths to check if their variation influences the accuracy of the value obtained for gravity.

The most often technical problem found to perform the experiment in the classroom is the difficulty to measure the oscillation period of pendulum. In the giant pendulum, the difficult found by the group was mounting the same. For these reasons, the group aimed to resolve all technical difficulties performing several measures, in order to obtain a better statistical treat.

For this, it has established a partnership with fire Department of Minas Gerais to obtain measurements with very large value of L and to compare them with the experiment done in the classroom, doing the necessary statistical treatment. As physics is an experimental science, we set up an apparatus to verify our hypothesis.

Finally, it can be seen that as the length of the pendulum increases the accuracy of gravity acceleration measurement is also increased. And through this experiment can also be shown that the coefficient of dragging can be ignored in the small pendulum when it is repeated the several times.

Yesim Gucbilmez
Associate Professor, Anadolu University, Turkey
Ibrahim Calis
R&D Engineer, Betareks, Turkey
&
Adife Seyda Yargic
Research Assistant, Bilecik Seyh Edibali University, Turkey

Optimization of Ethyl Acetate Production Using Palladium Incorporated MCM-41 and MCM-48 Type Mesoporous Nano-Structured Catalysts

In the content of this study, mesoporous, nano-structured and silica based Pd-MCM-41 and Pd-MCM-48 type catalysts were produced by the direct hydrothermal synthesis (DHS) and wet impregnation (IMP) methods. The as-synthesized catalysts contained 1%, 3% and 5% palladium by weight in solution. XRD, chemical sorption, nitrogen physisorption, SEM and EDS analyses were carried out to characterize the catalysts.

The 3% palladium loaded catalysts 3%-Pd-MCM-41-DHS, 3%-Pd-MCM-41-IMP, 3%-Pd-MCM-48-DHS and 3%-Pd-MCM-48-IMP catalysts were tested in the one pot gas phase oxidation of ethanol to ethyl acetate in a tubular fixed bed reactor inserted into a tubular furnace and loaded with 0.2 mg catalyst. Helium was used as the diluent gas and the total volumetric flow rate of the feed stream was 50 ml/min. The amount of EtOH vaporized in a heated chamber maintained at 30^{o}C was calculated using the Antoine Equation. The EtOH vapor was swept using the inert helium gas and combined with oxygen. The molar O_2/EtOH ratio was changed in the range of 0.5-1.0 with 0.1 increments and the reaction temperature was changed in the range of 100-250^{o}C. The connecting lines were heated to 120^{o}C using heating tapes to prevent possible condensations and the product distributions were obtained using an online connected mass spectrometer.

The optimum ethyl acetate yield was obtained with the 3%Pd-MCM-41-DHS catalyst at 150^{o}C at an O_2/EtOH molar ratio of 0.9 as 46.7%. This was a very remarkable result since the highest yield obtained in the literature for the same reaction was 35% at 150^{o}C with an O_2/EtOH molar ratio of 3.0 using Pd-HPA-SiO_2 type catalysts. Hence, a new catalytic pathway can be proposed for the gas phase one pot oxidative synthesis of ethyl acetate using the results of the present study.

Jozef Hraska
Professor, Slovak University of Technology, Slovakia
Peter Hartman
Ph.D. Student, Slovak University of Technology, Slovakia
&
Paulina Sujanova
Ph.D. Student, Slovak University of Technology, Slovakia

Circadian Characteristics of Special Glazing

The window provides most of the natural daylight income into indoor environment. Last decades brought, that light, especially natural daylight covers more response on human, than only visual ability. The light properties in long-term inhabited environment can seriously influent the health state and wellbeing of occupants. The non-visual impact on human reflects on maintaining of our circadian rhythms, including sleep cycles, metabolism, core temperature and mostly of biological processes in our body. Also Sick Building Syndrome (SBS) is still frequented issue. Inappropriate lighting in the indoor environment is assumed to be one of the reasons of sick building syndrome occurrence. The parameters of indoor light climate may be influenced with selection of window glazing. The presented paper deals with a two way evaluation of spectral characteristics of band of special window panes. The scale of samples includes various tinted glasses, low emissivity window panes and other modern window glazing. Firstly, the spectral transmittance of samples is measured with spectrophotometer. The outputs are classified in terms of their visual and photobiological response. Second part includes measurement, where some of selected samples are used as windows in our experimental models. All of the models represent same sized single office room in the scale of 1:5 with one window. One of the models is considered as reference model equipped with single clear glass. The internal surfaces of all models are in spectrally neutral color. All other models have window equipped with sample of chosen special glazing. The light condition used for this longer–term observation covers natural daylight. In the models are located the measure devices able to record visual response and also non-visual impact of light parameters inside the models. The results of these measurements will be evaluated on the basis of the latest advances in non-visual effects of light on human health and wellbeing. This observation may provide more complex point of view on evaluation and selection of glazing intended for the use as window glazing in long-term occupied spaces.

Hiroyuki Kagami
Associate Professor, Nagoya College, Japan

An Improvement of the Impact of the Marangoni Effect on the Polymer Thin Film Thickness Profile after Drying Polymer Solution Coated on a Flat Substrate through Temperature, Evaporation and Concentration Management during Drying

Drying process of polymer solution coated on a flat substrate is important in various industrial applications supposing resist coating process in semiconductor engineering process. Then we have proposed and modified a model of drying process of polymer solution coated on a flat substrate for flat polymer film fabrication. And we have clarified dependence of distribution of polymer molecules on a flat substrate after drying on a various parameters based on analysis of many numerical simulations of the model. Then we applied the model to thickness control of a thin film after drying through thermal, evaporative and concentration management. As a result, thickness control of a thin film after drying in the drying process can be achieved to some extent through adding evaporative, thermal and concentration operations artificially and instantaneously depending on solute's concentration distribution on the substrate during drying.

On the other hand, in case of the modified model to which the Marangoni effect is added, we see that solute on upper gas-liquid interface is attracted more strongly to the edge due to Marangoni effect and as a result the edge's elevation of the thin film after drying is enlarged through numerical simulation of the model.

In this study, we apply the above-mentioned thermal, evaporative and concentration management to the modified model to which the Marangoni effect is added. As a result, we see that the edge's elevation of the thin film after drying due to the Marangoni effect can be also improved through the appropriate thermal, evaporative and concentration management.

Now it may be difficult that minute control like this is realized experimentally. But it is important that we offer theoretically a method of minute control of the thickness profile after drying because it may be realized in the future.

Nataliya Kazantseva
Senior Research Scientist, Institute of Metal Physics Ural Division of RAS, Russia

Materials for High-Speed Transport Systems

Titanium aluminides are promising perspective materials providing unique combination of physical and mechanical properties for high-speed transport system, like sport cars, racing cars, high-speed trains. This materials are characterized by good strength at temperatures up to 6500^{o}C (~600 MPa), but poor room-temperature plasticity (~1-2%). The latter property limits their commercial applications. The efforts aimed at the improvement of the plasticity of these alloys include both the design of new alloys and new methods of their production. A comparative study of the phase content, structure and mechanical properties of the different titanium aluminides is presented. We study the influence of the crystallization conditions on the microstructure and mechanical properties of the TiAl- and Ti_3Al- based alloys prepared by the special method of pulsed volume pressing (PVP) and the Ti_2AlNb-base alloys. The factors that responsible to the successful structure of TiAl-alloys with high mechanical properties were found. The cooling rate varying in the mold with different heat capacities (0.385 cal/g K for copper and 0.12 cal/g K for steel) substantially affects the grain size, the uniformity of its distribution and the lamella thickness. In the Ti3Al-base alloy high rate of cooling allows serve "soft" plates of β_0 phase. The mechanical properties and structure of the stable and metastable phases in the Ti_2AlNb-base alloys under severe plastic deformation (shock-wave loading and shear under pressure) were also studied.

Ian Lazarus
Senior Lecturer, Durban University of Technology, South Africa
Ramesh Bharuthram
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Suleman Moolla
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Satyavir Singh
Professor, Indian Institute of Geomagnetism, India
&
Gurbax Lakhina
Professor, Indian Institute of Geomagnetism, India

Nonlinear Electrostatic Solitary Waves in Electron-Positron Plasmas

The study of nonlinear effects in electron-positron plasmas is important since it is known that these plasmas exists in, active galactic nuclei, gamma-ray bursts (GRBs), white dwarfs and in laboratories. In these plasmas, there exists only one frequency scale, due to them having the same charge-to-mass ratio for each species. Hence they are different from their electron-ion counterparts and thus exhibit different wave phenomena. The generation of nonlinear electrostatic solitary waves (ESWs) similar to those observed in the broadband electrostatic noise (BEN) is explored in a magnetized four component two-temperature electron-positron plasma. The plasma consists of cool electrons and cool positrons with equal temperatures and having equal initial densities, and hot electrons and hot positrons with equal temperatures and equal initial densities. Fluid theory is used to derive a set of nonlinear equations for the ESWs. Wave propagation is taken in the x-direction at an angle θ to the external magnetic field, which is assumed to be in the x-z plane. The electric field structures are examined for various plasma parameters and are shown to yield sinusoidal, sawtooth and bipolar waveforms.

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Maria Elisa C. M. Rostelato
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Experimental Measurements in Brachytherapy Based in Heterogeneous Media

Brachytherapy is a radiotherapy modality used for cancer treatment. It consists of the insertion of radioactive sources inside or close to the anatomical volumes to be treated. These radioactive sources emit ionizing radiation that interacts (under specific probabilities) with the tissue and with the DNA chains, respectively. The main goal of the brachytherapy is to delivery a high and accurate dose at the tumor and spares the health tissues from undesired irradiation. These last decades makes the revival of the brachytherapy: The evolution of the image acquisitions, such as Computer Tomography (CT) and Magnetic Resonance Imaging (MRI), as well the methods to evaluated the intern organs motion were incorporated to brachytherapy in order to delivery three-dimensional (3D) and image-guided dose distributions and with the dose algorithms, incorporated at the Treatment Planning System (TPS), high spatial resolution and better dose distributions were achieved compared with conventional two-dimensional (2D) methods. Metrological measurements realized by primary and accredited laboratories also developed dosimeters to obtain accurate and precise experimental values of the dosimetric quantities that are included in these TPS calculations. Despite these progresses and improvements, TPS's based in dose to water distributions are still in use, due to the complexity of accurate measurements in equivalent tissues, e.g. bone, lung and glandular tissues. For certain anatomical regions, up to 15 % of difference between the planned dose and delivered dose arises when such algorithms are used. Some TPS's that account for the patient heterogeneities based in the densities obtained from the CT images were introduced recently, but the dose responses are only based in numerical techniques (probabilistic and deterministic methods) and it lacks in considering experimental methods to better estimative of the uncertainties in the process and for comparisons with TPS's profiles.

This paper will present the research and development of our group regarding with the approximation of experimental methods to measure the dose distribution in heterogeneous media in brachytherapy, using tissue equivalent materials. Discussions about the protocols used by dose the algorithms will be also presented. Finally, our results with high dose rate (HDR) Iridium-192 brachytherapy sources, the most common brachytherapy source, in heterogeneous media will be examined using different dosimeters.

Mark Paetkau
Senior Lecturer, Thompson Rivers University, Canada
Dan Bissonnette
Lecturer, Thompson Rivers University, Canada
&
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Using Simulations to Help Prepare Students for the Lab

Thompson Rivers University has been using online simulations to help students prepare for their first-year Physics labs. Online simulations have been developed allowing students to simulate the lab prior to the actual lab. The goal of these simulations is to effectively prepare students for the lab. To test whether the simulations are effective means of preparing students, we attempted to measure the "level-of-preparedness" of our students. Using our preparedness measure, we compare the preparedness for two forms of pre-lab exercises. A statistically significant change in "preparedness" is found with the use of online simulations. Several simulations will be presented as well as the details of the testing of level-of-preparedness in the students.

Bernard Schaeffer
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Electromagnetic Interactions in an Atomic Nucleus

The one million times ratio between nuclear and chemical energies is generally attributed to a mysterious strong force, still unknown after one century of nuclear physics. It is now time to reconsider from the beginning the assumptions used, mainly the uncharged neutron and the orbital motion of the nucleons. Except for the long range Coulomb repulsion, the electric and magnetic Coulomb's forces between adjoining nucleons are generally assumed to be negligible in the atomic nucleus by the nuclear specialists. The Schrödinger equation with a centrifugal force as in the Bohr model of the atom is unable to predict the binding energy of a nucleus. In contrast, the attractive electric and repulsive magnetic Coulomb forces alone explain quantitatively the binding energies of hydrogen and helium isotopes. For the first time, with analytical formulas, the precision varies between 1 and 30 percent without fitting, adjustment, correction or estimation, proving the electromagnetic nature of the nuclear energy.

Nuclide	Formula	This paper	[8]	[7]	Experimental
^2H	$-\alpha m_p c^2 \sqrt{\frac{32}{27\lvert g_n g_p \rvert}}$	−0.8	−1.1	−0.8	−1.11
^3H	$-\alpha m_p c^2 \times \frac{32}{3\sqrt{3}\lvert g_n \rvert}$	−3.7		−2.9	−2.83
^3He	$B_{em}^{^3\mathrm{H}}/A \times \frac{\lvert g_n \rvert}{\lvert g_p \rvert}$	−2.54			−2.57
^4He	$-\alpha m_p c^2 \frac{64}{9\sqrt{2\lvert g_n g_p \rvert}}$	−7.4	−6.2		−7.07

Christoph Schultheiss
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Momentum and Energy of a Mass Consisting of Confined Photons and Resulting Quantum Mechanic Implications

The Higgs particle gives quarks their mass. Nevertheless, the mass of a proton is larger than the mass of the constituent quarks by a factor of nearly hundred. Obviously, the force that confines the quarks in the proton, namely the gluons, are accountable for the mass amplification effect. A one-dimensional model is presented in which the proton and its mass are simulated by a massless cavity which contains back- and forth-reflecting light-fast photons. The investigation starts with the demonstration that momentum conservation and Doppler shift are sufficient for solving the Compton kinematics. Consequently, Doppler– and energy equations as well as each combination of the three equations yield the same result. From a mathematical perspective, the Compton effect is therefore overdetermined and the question arises: why is that the case and does it matter? To answer this: the photon-particle-interaction is reduced to a free photon-confined photon interaction, for which changes in momentum are exclusively Doppler-based. This suggests that the energy conservation itself describes a "storing" of the colliding free photon in the cavity. It fuses with the confined photon and decays in spontaneous or delayed fashion by emission of a Doppler-shifted free photon. Delayed emissions lead to a "stop-and-go" motion of the cavity with fictitious velocity and fictitious kinetic energy in accordance with the quantum-mechanic de Broglie relation between momentum and wavelength. This kind of motion consumes no energy and overcomes potentials (i.e. gravitation) with minimum energy consumption. To simulate a massless cavity, the model requires the existence of a photon pool similar to the zero-point radiation described by Casimir (1948). This photon pool and a thermal fraction help to stabilize and conserve the cavity. Acceleration by means of a swarm of incident-free photons at a cavity triggers a series of phase mismatches with the confined photons which lead to a distortion of the pool distribution. It is expected that an attractive "stop-and-go"-displacement of probe masses behind the accelerated cavity takes place – an effect consistent with energy conservation.

These statements are based on a simple model and may not describe reality in detail. But they may give useful information about first-order

processes in the proton and may give links to understand quantum mechanic behavior.

Boris Sedunov
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The Physics of Clusters in Real Gases

The physics of real gases is interesting both for science and practice. For scientists it is important to move forward from the ideal gas model and to include in the thermal physics of gases the molecular interactions. The practitioners need in advanced models of real gases to predict with greater precision their practically valuable properties. The deeper we penetrate in molecular interactions the larger is influence of individual characteristics of gases. But the molecular interactions are shadowed by the thermal movements [1].

The report demonstrates the power of the original computer aided analysis [2] of precise experimental thermophysical data contained in modern databases, such as [3]. The analysis discovers the cluster structure of pure real gases, provides knowledge of their bond parameters, discovers the structural transition between different isomers of clusters, and opens new features of molecular interactions in gases.

The analysis is based on the new variable – the monomer fraction density D_m [4], which develops further the fugacity concept. The series expansion coefficients of thermophysical values by powers of D_m reflect the cluster fractions' properties and provide the knowledge of their equilibrium constants, bond energies and numbers of bound states. This approach helps also to understand better the structure and properties of supercritical fluids [5].

Ramzi Suleiman
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On the Possibility of a New Physics

The present article describes and discusses the properties of a new relativity theory of moving bodies in inertial systems. The theory, termed Complete Relativity, departs from standard physics by abandoning the Lorentz Invariance Principle. It is shown that at high enough velocities, the theory's predictions are consistent with Quantum Mechanics, the Standard Model of elementary particles physics, and Standard Cosmology, while at low enough velocities it reduces to Newtonian mechanics. Several predictions of the theory, including the Planck Constant, the velocities of photons and neutrinos, and the content of the universe, are presented and compared with experimental results and cosmological observations.

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Do, See, Think and Learn

This article presents details of our experience and the student feedback of a successful strategy investigated to teach subtle physics concepts to non-physics students in the general education course 'How the Ocean Works'. The course aims at introducing the physical concepts related to oceanography to a class of undergraduates from various backgrounds, which is not physics. Two concepts central to understanding the ocean are (1) Archimedes' principle and (2) the Coriolis effect.

Due to subtleties of the concepts and the non-science background of the students it was necessary to develop an approach with as little technical details and mathematical derivations while still providing a substantial grasp of the principle. In addition, we also wanted to identify, discuss and rectify any misconceptions that a student may have.

To this end we adopted a 'seeing is believing' strategy that engaged the students in hands on activities so that they do, see, think and learn. This process used worksheets that were carefully prepared by us that re-utilized equipment typically found in a standard physics laboratory to prompt the students to connect and immerse themselves in active, collaborative learning. We share our experiences and the resulting student feedback.

Eugene Trunkovsky
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On Direct Measurements of the Angular Sizes of Stars by Lunar Occultation Observations

When the edge of the dark part of the lunar disk covers (occults) one or another star, at the movement of the Moon relatively stars in the sky, a diffraction effects arise, and as a result one can record a diffraction curve of stellar occultation. A typical duration of passing of the first Fresnel zone over line of sight of the observer for the light source having a very small angular diameter is of the order of 20 milliseconds (ms), therefore for a sufficiently detailed registration of changes of the light flux in the diffraction pattern it is necessary to record them with a time resolution of the order of 1 ms. For that one should have a photoelectric photometer which allows to record light flux from the investigated star with the mentioned time resolution. If the diffraction curve of the lunar occultation of a star is recorded then it is possible to do it's analysis in order to distinguish it from the diffraction curve corresponding to the occultation of a point light source (having a zero angular diameter), and thus to determine directly the angular size of the star under study. In case of close double star it is also possible to analyse the recorded occultation diffraction curve and to determine angular sizes of it, though in this case a model of the occultation process is more complex.

During about 30 years in the observatories of the Sternberg Astronomical Institute of Moscow State University a several tens of occultation diffraction curves of various stars have been recorded with a time resolution of 1 ms. When processing the data obtained the angular diameters of some stars have been determined directly, and in some other cases a close binarity of stars under study has been discovered, and the angular distances between their components and their luminosity ratios have been measured. Several examples of such results are presented.

Nuri Unal
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Coherent States for Coupled Oscillators

In this study, first, we find the normal coordinates of the coupled two harmonic oscillators with the time varying physical parameters: mass and coupling parameters and discuss the reduction of the system into two set of uncoupled time dependent harmonic oscillators. Second, we construct the coherent states for each oscillators and discuss the coherent states, probabilities and the uncertainities of each oscillator for some special cases. We derive the classical trajectories and time dependent discrete quantum states of coupled two oscillator systems.

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On the Solution of Spherically Symmetric Problem for a Solid Sphere in General Relativity

The paper is concerned with the spherically symmetric static problem of General Theory of Relativity (GTR) considered by K. Schwarzschild for a particular form of the line element in which the circumferential metric coefficient is equal to the radial coordinate r. The Schwarzschild solution specifies the metric tensor for the external and internal semi-Riemannian spaces induced by the gravitation of a perfect fluid sphere with constant density and includes the so-called gravitational radius r_g which is associated with the singular behavior of the solution. For the external space, the solution becomes singular if the sphere radius R reaches r_g which is referred to as the Black Hole event horizon. The solution for the internal space gives infinitely high fluid pressure at the center of the sphere with radius $R = 9/8r_g$ which is traditionally used for physical interpretation of the Black Hole existence. For a solid sphere, the solution has not been found.

The solution presented in the paper is based on the general form of the line element for spherically symmetric Riemannian space in which the circumferential metric coefficient $\rho(r)$ is an arbitrary function of the radial coordinate. As shown, the solution of the static problem exists for a class of functions $\rho(r)$ which cannot be found from GTR equations. The particular form of this function is determined under the condition according to which the gravitation, changing the Euclidean space to the Riemannian space inside the sphere, does not affect the sphere mass.

The solution for the external space obtained under this condition is not singular and exists if $R \geq R_g = 1.115r_g$. For the sphere with $R \prec R_g$, the solution becomes imaginary. For the internal space of the perfectly fluid sphere, the solution is not singular, and the pressure cannot be infinitely high. The obtained results are compared with the Schwarzschild solution.

To solve the problem for an elastic sphere, the GTR equations are supplemented with additional equations for stresses which are similar to compatibility equations of the theory of elasticity. These equations are derived under the condition according to which the Einstein transformation is valid for the space experiencing deformation. The solution obtained for a linear elastic isotropic sphere allows us to determine the stresses induces by the gravitation and is not singular.