THE ATHENS INSTITUTE FOR EDUCATION AND RESEARCH

Abstract Book

9th Annual International Conference on Physics
19-22 July 2021, Athens, Greece

Edited by
Gregory T. Papanikos

2021

Abstracts
9th Annual International Conference on Physics
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Preface

This book includes the abstracts of all the papers presented at the *9th Annual International Conference on Physics* (19-22 July 2021), organized by the Athens Institute for Education and Research (ATINER).

A full conference program can be found before the relevant abstracts. In accordance with ATINER's Publication Policy, the papers presented during this conference will be considered for inclusion in one of ATINER's many publications.

The purpose of this abstract book is to provide members of ATINER and other academics around the world with a resource through which to discover colleagues and additional research relevant to their own work. This purpose is in congruence with the overall mission of the association. ATINER 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 to exchange ideas on their research and consider the future developments of their fields of study.

It is our hope that through ATINER's conferences and publications, Athens will become a place where academics and researchers from all over the world regularly meet to discuss the developments of their discipline and present their work. Since 1995, ATINER has organized more than 400 international conferences and has published nearly 200 books. Academically, the institute is organized into 6 divisions and 37 units. Each unit organizes at least one annual conference and undertakes various small and large research projects.

For each of these events, the involvement of multiple parties is crucial. I would like to thank all the participants, the members of the organizing and academic committees, and most importantly the administration staff of ATINER for putting this conference and its subsequent publications together. Specific individuals are listed on the following page.

Gregory T. Papanikos
President

9th Annual International Conference on Physics, 19-22 July 2021, Athens, Greece

Organizing & Scientific Committee

All ATINER's conferences are organized by the Academic Council. This conference has been organized with the assistance of the following academic members of ATINER, who contributed by reviewing the submitted abstracts and papers.

1. Gregory T. Papanikos, President, ATINER & Honorary Professor, University of Stirling, U.K.
2. Bala Maheswaran, Head, Electrical Engineering Unit, ATINER & Professor, Northeastern University, USA.
3. Ethel Petrou, Academic Member, ATINER & Professor, SUNY Erie, State University of New York, USA.
4. Ellene Tratras Contis, Head, Chemistry Unit, ATINER & Professor of Chemistry, Eastern Michigan University, USA.
5. Nikos Mourtos, Head, Mechanical Engineering Unit, ATINER & Professor, San Jose State University USA.

FINAL CONFERENCE PROGRAM
9th Annual International Conference on Physics, 19-22 July 2021, Athens, Greece

PROGRAM

Monday 19 July 2021

10.00-10.30
Registration

10.30-11.00
Opening and Welcoming Remarks:

- **Gregory T. Papanikos**, President, ATINER.
- **Bala Maheswaran**, Head, Electrical Engineering Unit, ATINER & Professor, Northeastern University, USA.
- **Ellene Tratras Contis**, Head, Chemistry Unit, ATINER & Professor of Chemistry, Eastern Michigan University, USA.

11:00-11:30
Mihail Calalb, Associate Professor, Tiraspol State University, Moldova.
Title: *The Constructive Principle of Learning by Being in Physics Teaching.*

11:30-12:00
Andrzej Molak, Professor, University of Silesia, Poland.
Title: *Disorder Influence on Electrical Relaxation in Perovskite Ceramics.*

12:00-12:30
Itzhak Orion, Professor & Head, Ben Gurion University of the Negev, Israel.
Jonathan Walg, PhD Student, Ben Gurion University of the Negev, Israel.
Title: *Radioactive Decay Rate Changes Affected by the Neutrino.*

12:30-13:00
Rudina Osmanaj, Lecturer University of Tirana, Albania.
Title: *QCDLAB2, A Learning Tool for Students in Lattice QCD.*

13:00-13:30
Liudmyla Kozak, Associate Professor, Taras Shevchenko National University of Kyiv, Ukraine.
Title: *Variations of Plasma Parameters During Substorms.*

13:30-15:00 Lunch

15:00-15:30
Branimir Lela, Associate Professor, University of Split, Croatia.
Title: *Production of Open-Cell Foams out of Aluminium Chips.*

15:30-16:00
Yu Xiao, PhD Student, University of Paris, France.
Title: *Versatile Design of Multifunctional Microgels from Molecular, Nano- and Microscale Building Blocks for Biomedical Applications.*

16:00-16:30
Dimitris Argyropoulos, Professor, North Carolina State University, USA.
Title: *Overcoming & Modulating Gelation Events in Lignin Toward Carbon Fiber Formation.*

16:30-17:00
Ellene Tratras Contis, Head, Chemistry Unit, ATINER & Professor of Chemistry, Eastern Michigan University, USA.
Title: *Sustaining Solutions in Undergraduate STEM Education.*

17:00-17:30
Bala Maheswaran, Head, Electrical Engineering Unit, ATINER & Professor, Northeastern University, USA.
Title: *Innovations Activities in Engineering Education.*

Tuesday 20 July 2021

11:00-11:30
Lukanda Kalobo, Senior Lecturer, Central University of Technology, Free State, South Africa.
Title: *Students' Understanding of Outliers in the Context of Boxplot and Scatter Plot.*

11:30-12:00
Xiaoya Yu, Director of Comprehensive Curriculum, Beijing Institute of Education, China.
Title: *From Maker to Stem-Progressive Analysis of Computing Course Teaching.*

12:00-12:30
Eckehard Mueller, Professor, Bochum University of Applied Sciences, Germany.
Title: *X-Ray Diffraction with the New Cos-a-Method to Determine (Residual) Stresses.*

12:30-13:00
Miltiades Elliotis, Scientific Collaborator, University of Cyprus, Cyprus.
Title: *Numerical Estimation of a Mode III Fracture Mechanics Parameter for Three-Dimensional Elliptic Boundary Value Problems with a Crack Singularity.*

13:00-13:30
Christoph Friedrich, Professor, University of Siegen, Germany.
Title: *Enhanced Preload stability of Modern Bolted Joints.*

13:30-14:00
Ali H. Tarrad, Professor, Université de Lorraine, CNRS, LEMTA, France.
Title*: A Waste Energy Recovery Management for Electricity Generation from Two Temperature Grades of Energy Sources in Subcritical Organic Rankine Systems.*

14:00-14:30 Lunch

14:30-15:05
Presentation canceled due to unavailability of the presenter

15:00-15:30
Joon Yang, Graduate Student, San Jose State University, USA.

Title: *Cubesat: Low Cost COTS Cubesat Orbit Determination Solutions for Prototype Propulsion Experiments.*

15:30-16:00
Jose Magallanes, Advisor, San Jose State University, USA.
Katrina Heil, Team Member, San Jose State University, USA.
Title: *San Jose State Altitude Cycling Balloon.*

16:00-16:30
Presentation canceled due to unavailability of the presenter

16:30-17:00
Miles Vranas, Mechanical Engineer, Monte Vista Robotics Team, USA.
Nikos Mourtos, Head, Mechanical Engineering Unit, ATINER & Professor, San Jose State University USA.
Title: *Compact Shaft-Rotating Swerve Drive with Prong Structure for Highly-Maneuverable and Agile Robots.*

Dimitris Argyropoulos
Professor, North Carolina State University, USA

Overcoming & Modulating Gelation Events in Lignin toward Carbon Fiber Formation

Mihail Calalb
Associate Professor, Tiraspol State University, Moldova

The Constructive Principle of Learning by Being in Physics Teaching

The article starts from the basic idea that there is no understanding without reflection, which in its turn, can be encouraged by creating in classroom the premises for conversation, discussion, and analysis. As a result, the logic chain Conversation - Reflection - Understanding should be present in any physics lesson. Considering this, the article examines the school physics lab as an example of constructivist learning environment and analyzes several didactic approaches as inquiry-based learning, problem-based learning, project-based learning, case studies, and just in time teaching from constructivist point of view. The author enumerates the basic principles for the organization of school physics lab in a constructivist manner: opportunities for students' own thinking, students identify solution through verbalization of the problem, teacher knows a priori concepts of students, achieve students' interest through students' effort. The concept of "big scientific ideas" is in the core of this organization.

More and more researchers and teachers realise that school does not belong to entertainment industry and student centered education hides actually the central role of the teacher. In this context, the evolution of educational paradigms from "learning by doing" and "learning by understanding" to the new concept, developed by the author – "learning by being" is described in the form of three-step ladder of paradigms. This evolution reflects the main problem educational systems from various countries face. Namely, low motivation and interest showed by the majority of school students for getting involved into the educational process. In this way, the higher is students' involvement degree into class activities, the more successful is that strategy**.** Learning by being means the students are intrinsically motivated and have the ownership on cognitive goals. In order to achieve learning by being, several methods based on mutual and immediate feedback with proven high impact on academic achievement of students should be used simultaneously: knowledge of learning objectives, anchoring new material into the student's conscious and subconscious, fostering metacognition, recurrent use of information, guided self-scaffolding. All these approaches are inherent to *Learning by being* and strongly correlate with Visible Teaching and Learning principles. Along with the term of *learning by being*, the author also

proposes the term of *guided self-scaffolding*. Both terms tend to accentuate high level of student's intrinsic motivation.

Based on the results of the Visible Teaching and Learning theory, the impact factors on academic achievement of students are analysed for the case of several constructivist strategies which put the accent on student's learning effort and are focused in this way on achieving learning by being. In addition, the article gives a structured analysis of student' and teacher' roles within learning by being approach.

In conclusions is underlined that conceptual understanding in school physics lab, which is inseparable from learning by being, is achieved through the overlapping of several strategies with high impact factor on academic achievement. Parallel use or the overlapping of several teaching and learning techniques gives a synergistic effect.

Miltiades Elliotis
Scientific Collaborator, University of Cyprus, Cyprus

Numerical Estimation of a Mode III Fracture Mechanics Parameter for Three-Dimensional Elliptic Boundary Value Problems with a Crack Singularity

In this study two spatial problems of solid bodies (steel bolds) with a surface crack singularity (V-notch) are examined. These are problems in the domain of linear elastic fracture Mechanics which are reduced to Laplace equation problems by considering a Lamé potential. The boundary singularity is numerically treated by first determining the general solution of the governing equation, in the vicinity of the surface crack and by expressing it as an asymptotic expansion, the coefficients of which are approximated by polynomials. The remaining numerical steps are followed according to the singular function boundary integral method (SFBIM), which in the literature is known as one of the so-called Trefftz methods. Very fast convergence and very high accuracy are observed in implementing the method to solve a general 3-D model problem of a solid body having a cross section in the form of an ellipse and a specific spatial model problem of a steel rivet, which connects metal members of a structure. In fact, the CPU time and the numerical error recorded with this numerical technique are significantly smaller than those achieved with the finite element method (FEM) which was used to solve the same problems. The calculated value of Mode III fracture Mechanics parameter (FMP) indicates that there is no danger of crack propagation. Thus, the extension of the method to this category of problems is quite interesting since it involves a novel application of this algorithm in fracture Mechanics, a domain in which the method demonstrates its capability to treat problems with crack discontinuities and provide results more efficiently (less computing effort and greater accuracy) than the classical FEM with grid refinement. This advantage of the SFBIM can be exploited for research or design purposes, in several fields of applied Mechanics, by implementing its algorithm with subroutines embedded in engineering packages and aiming to make them more efficient in solving specific problems.

Christoph Friedrich
Professor, University of Siegen, Germany
&
Tobias Held
Scientific Assistant, University of Siegen, Germany

Enhanced Preload Stability of Modern Bolted Joints

The design of screw joints is very important for fastened components to ensure reliable transmission of mechanical or thermal loads between components. Suitable fastener choice and proper design are required for increasing product performance while reducing size-, weight- and cost ratios.

A fastening system is basically characterized by component geometry and materials. Robust clamping of components depends on time dependent clamp force, which can be represented by bolt´s preload change.

In any fastening system preload loss takes place. The contribution shows, why (seating, load plastification, creeping). Furthermore, the loss may not be too large to provide suitable behaviour, e.g., higher tightening preload from better tightening cannot be utilized, if most of the advantage is compensated by preload loss.

Important influences are clamped materials, tightening level (from assembly method) and type of thread engagement. For various combinations measurements of preload loss over time are shown (think on long-time-measurements, which are necessary, so the results are nowhere else to see). The paper shows also, how the measurement is done.

The outcome of all the combinations is that preload loss significantly exceeds the estimations of existing guidelines, e.g., VDI 2230. The reason is, that in time of development of the guidelines mainly steel components have been used and preloading was moderate. So, the conclusion is to extend the calculation with a better and more flexible approach for today's requirements. Also this will be shown.

Overall, the contribution combines explaining mechanisms for preload loss, results from measurements for analysis as well as calculation for prediction in advance to extend guidelines.

This leads to our assessment that the contribution is of strong interest for all, who are working with bolted joints at innovative components – because then they are facing these questions.

Lukanda Kalobo
Senior Lecturer, Central University of Technology, Free State, South Africa

Students' Understanding of Outliers in the Context of Boxplot and Scatter Plot

Identifying and dealing with outliers is one of the most important phases of data cleansing. By identifying and analysing outliers, users can either gain insight into abnormal patterns or purge the data of errors. It is common to consider boxplot and scatter plot in the identification of outliers. While these two procedures are useful for respectively determining univariate or bivariate data, it should be used cautiously, as understanding the characteristics of outliers is more important in identifying it. This article shows how, with appropriate guidance students can understand and identify outliers by using a boxplot or scatter plot. The purposive sample consisted of 35 university students who were enrolled in their first year course on Mathematics Education. For an hour, the students solved problems whose solutions required them to understand and identify univariate and bivariate outliers by using a boxplot and scatter plot. Upon quantitatively and qualitatively analysing the data, the students' statistical misunderstandings have been spotted, and classified in groups. Suggestion on how to confront these misunderstandings has been projected. We recommend that educators consider these statistical misinterpretations as they determine whether, how, and when to identify outliers using a boxplot or scatter plot.

Liudmyla Kozak
Associate Professor, Taras Shevchenko National University of Kyiv, Ukraine
Bohdan Petrenko
Taras Shevchenko National University of Kyiv, Ukraine
Elena Krongerg
Max Plank Institute, Germany
&
Elena Grigorenko
Russian Space Research Institute, Russia

Variations of Plasma Parameters during Substorms

A chain of events accompanying appearance of a substorm in Earth ionosphere and magnetosphere is considered. Features of geomagnetic pulsations and mechanism of their generation are indicated. Measurements of magnetic field fluctuations from ferro-probe magnetometers (sample rate 22.4 Hz), and also the data on temperature, velocity, and density of electrons, and different types of ions from the experiment PEACE and CIS-CODIF (sample rate 0.125–0.25 Hz) of space mission Cluster-2 have been analyzed. It was obtained that during the initiation of substorm, which was accompanied by dipolarization (sharp change of magnetic field configuration from the elongated to the tail force lines to more dipole structure) one can observe changing the plasma parameters. In particular it was registered the changes of concentration, significant increase of temperature, and increasing fluctuations of the velocity components with the increase of z-component. The time shift of heating protons and oxygen ions, and also density changing was detected. During the substorm electron density exceeds in order one of helium ions, and almost in two orders one of oxygen ions; Alfven velocity is near 470 km/s, and parameter β characterizing the ratio of thermal pressure to magnetic one exceeds a unity. Using wavelet analysis the comparison of wave characteristics for different pressures was carried out. The pressure of magnetic field, and also dynamic and thermal pressure for different types of particles was considered. In fluctuations of the magnetic field pressure, thermal pressure of electrons and protons the Pc5 and powerful Pc4 pulsations (45–150 s), and also direct and inverse cascades was observed. At this the direct cascades point to the decay of larger structures, as a result of which one could observe the transfer from lower to higher frequencies, and on the contrary the reverse cascades are characterized by the transfer from higher to lower frequencies, and by the presence of

merging (self-organization) of small structures into larger ones. The obtained results point to significant role of kinetic effects in the complex chain of processes in Earth magnetosphere in the period of explosive phase of substorm.

Branimir Lela
Associate Professor, University of Split, Croatia
Sonja Jozić
Associate Professor, University of Split, Croatia
Jure Krolo
Postdoctoral Student, University of Split, Croatia
Ivana Dumanić
Research Assistant, University of Split, Croatia
&
Karla Grgić
Research Assistant, University of Split, Croatia

Production of Open-Cell Foams out of Aluminium Chips

Metal foams are type of materials whose properties depend on the structure and size of porosity, so the main task of this research is to examine the effect of porosity and processing parameters of open cell aluminium foams on their properties. In order to achieve the task, experiments were carried out in which quantity and size of space holder material were taken as variables influencing the final quality of metal foams. Sintering was carried on for three of six samples. As a quality indicator compressive strength, energy absorption capability, density, microhardness and electrical conductivity were taken into consideration. Aluminium alloy chips were utilized as a based material for foam production. This way aluminium waste in the form of chips could be recycled without melting process.

Jose Magallanes
Advisor, San Jose State University, USA
Katrina Heil
Team Member, San Jose State University, USA
Diego Castillo
Team Member, San Jose State University, USA
Eric Hon
Team Member, San Jose State University, USA
Tyler Neca
Team Member, San Jose State University, USA
Periklis Papadopoulos
Professor, San Jose State University, USA
&
Aysha Rehman
Instructional Student Assistant, San Jose State University, USA

San Jose State Altitude Cycling Balloon

Phosphine has recently been discovered as a constituent element of the Venusian atmosphere. The existence of phosphine on Venus has sparked great interest in the scientific community. Further study of Venus began to be explored. One of the methods of studying Venus was an Altitude Cycling Balloon. Altitude cycling balloons are an alternative planetary exploration technology that allow for extensive aerial missions to study atmospheric conditions at various altitudes selected by the user. The operating altitude of an Altitude Cycling Balloon is much lower than traditional CubeSats which allows for different portions of the atmosphere to be analyzed. Though Altitude Cycling Balloons were originally designed by Thin Red Line Aerospace, the San Jose State Altitude Cycling Balloon differs in the fact that it will be a modular design that provides flexibility for a variety of mission requirements. The entire system consists of segmented balloons that are connected in a vertical formation with helium being used to inflate the balloons. Attached below the balloons are interconnected housing sections where electronics, a power supply, and the mechanical compression mechanism are housed. The mechanical compression mechanism consists of a stepper motor with a Kevlar cord attached to the top balloon. Upon user input, the stepper motor rotates resulting in the balloon compressing or expanding. This action results in a change of density inside of the balloon vehicle thus resulting in the vehicle ascending or descending. The Balloon is made modular by designing rings that allow balloons to be added or removed depending on the

application. This allows for both large and small-scale missions to take place without having to design and replace the entire system, realistically allowing for the balloon to be reusable and applicable to different projects under one user. The current design also allows for a more cost-effective system which increases the accessibility to a tool that was previously out of reach for many students. The sensor information is gathered through an Arduino using the I2C protocol wirelessly via an XBEE S2C. Devices that work with the I2C protocol are very accessible and easy to use. This allows anyone to use the basic design of the San Jose State Altitude Cycling Balloon and attach any I2C compatible device needed for their mission requirements and conduct their task.

Bala Maheswaran
Head, Electrical Engineering Unit, ATINER & Professor, Northeastern University, USA

Innovations Activities in Engineering Education

We try to reform engineering education by moving away from the boundaries of traditional classroom-based methods to project-based, concept-based, team-based, skill- and knowledge-integrated approaches using real-world situations. Experiential learning motivates students to grasp the concept and gain knowledge in the subject. It also helps them to use their skill for innovative outcomes. Experiential-based learning is an interesting concept and is in practice at several institutions. There will always be different opinions on the impact of these activities on learning. In the presentation, we will show theme based innovative experiential learning approaches and their outcomes. This idea includes sample students' papers and projects published at peer-reviewed proceedings, and several learning activities used as a part of the experiential education. We will also present prototypical course requirements, such as, project ideas, proposals for projects, designing, building prototypes, and projects reports. This presentation will be beneficial to other educators to style their own experiential learning approaches.

Andrzej Molak
Professor, University of Silesia, Poland

Disorder Influence on Electrical Relaxation in Perovskite Ceramics

Disorder introduced to crystal lattice structure influenced electrical features of studied ceramics. Compounds containing bismuth manganite (BMO) ceramics were prepared. Electrical features of BMO, Fe-doped BMO self-composite, $Pb(ZrTi)O_3$-BMO composite (PZT-BMO), BM-PT ceramics, and epoxy-glue/BMO composite were chosen for studies of electrical relaxation processes. Ceramics were obtained by standard high-temperature sintering. Broadband dielectric spectroscopy tests were conducted in 80-800 K range. BMO was formerly considered as multiferroic material. It shows ferromagnetic ordering in low temperatures. Ferroelectric ordering depends on technology conditions and the sintered BMO exhibited paraelectric order. It exhibited high magnitude electric permittivity related to thermal generation of charge carriers. BMO formed structural self-composite, which consisted of $Bi_{12}MnO_{20}$ and $BiMn_2O_5$ phase. Activation energy, E_a, varied from 0.14 to 0.40 eV, that corresponded to valence band formed by O 2p states hybridized with Mn 3d states and occurrence of oxygen vacancies, V_O. Electrical transport was attributed to small polaron hopping. Manganese ions, which changed their valence state because of hopping of electrons, enabled reorientation of dipols. Estimation of density of states in vicinity of Fermi energy for BMO and BM-PT ceramics was performed. Occurrence of charge transfer between Mn^{3+} and Mn^{4+} states was confirmed with Mossbauer spectroscopy test. Two electrical relaxation processes were determined. They corresponded to structural disorder and charge transfer between the Mn^{k+} ions. PZT-BMO cramics were studied to check influence of Mn originated dipols on the PZT ferroelectric phase PZT. BMO addition to PZT shifted and diffused the discontinuous ferroelectric-paraelectric phase transition. When BMO content was high enough, relaxor behaviour was induced due to increased number of dipoles. In an opposite approach, small amount of ferroelectric lead titanate (PT) was added to BMO and multi-phase compound was formed. BMO-PT permittivity included contributions from conducivity and relaxation processes. Inter-diffusion of Bi, Mn, Pb, and Ti atoms was deduced. Such disorder influenced relaxation processes and shortened relaxation times. Applied hydrostatic pressure induced simultaneous effects. Shortening of relaxation times was attributed to stress-strain effects,

which were caused by external hydrostatic pressure and by stress field generated by different ionic radii of replaced ions. These Mn based compounds exhibited marked dielectric losses, which ought to be depressed. Therefore, an epoxy-glue/BMO composite was produced. This composite also exhibited relaxation processes. One was attributed to polaron hopping in Mn-Ti-Zr sublattice. The other was attributed to misfit stresses formed at ceramic grain – epoxy glue interfaces. This composite exhibited losses by 2-3 orders lower in comparison to BMO ceramics. Therefore, features of ceramics-epoxy polymer composites provide perspectives for applications.

Eckehard Mueller
Professor, Bochum University of Applied Sciences, Germany

X-Ray Diffraction with the New Cos-a-Method to Determine (Residual) Stresses

For many years, the sin2ψ-method has been established to determine residual stresses by X-ray diffraction. With upcoming of new area detector for X-rays, a full Debye-Scherrer ring can be detected at same time. Having residual stresses in a component the Debye-Scherrer ring shifts a little bit and is also a little bit deformed. Out of these two facts the normal stress and the shear stress can be calculated. This method is called cos-α-method. By making four measurements in different direction the whole matrix can be determined in a minimum of time. For 2 mm aperture the measuring time (X-ray on) is 5 to 10 seconds for steel. Looking to variations of the intensity on the ring, it can be seen if there are texture and coarse grain. The cos-α-method is fully compatible with the sin2ψ-method but giving more information in one measurement. It is also easy to measure at big components like driving shafts for railways, roller bearing for cranes, etc. because the device is relatively small. Also, retained austenite can be measured with this new equipment coming from the company pulstec in Japan and is called μ-X360s. The intensity of both different rings is compared to calculate the amount of retained austenite. An overview can be given, and new results can be presented.

Itzhak Orion
Professor & Head, Ben Gurion University of the Negev, Israel
&
Jonathan Walg
PhD Student, Ben Gurion University of the Negev, Israel

Radioactive Decay Rate Changes Affected by the Neutrino

We demonstrated radioactive decay rates change in response to solar flare events using Am-241 and Rn-222 radiation measurements, in our previous studies. The objective of the current study was to examine whether the count-rate changes occur due to neutrino interaction with nuclides. We constructed two separate gamma radiation detection systems that were operated nearby medical proton cyclotrons: NaI(Tl) detector gamma radiation in front of an Am-241 radioactive source; and NaI(Tl) detector in front of a Rn-222 radioactive source. The Am-241 system subsequently responded after fifteen days to several cyclotron operations, due to the neutrino emission. Double cyclotrons operations, yielding intense neutrino emissions, led to the Rn-222 system responses after shorter periods – around ten hours. The radioactive decay rates decrease response was validated as an effect of neutrino emission by a controlled emitter. Hence, solar neutrino flux rise is the cause of the observed radioactive decay rate changes.

Rudina Osmanaj
Lecturer University of Tirana, Albania
Klaudio Peqini
Lecturer University of Tirana, Albania
&
Dafina Hyka
Lecturer University of Tirana, Albania

QCDLAB2, A Learning Tool for Students in Lattice QCD

Introducing LatticeQCD and its techniques to students is often quite challenging. In this paper we use a special package named QCDLAB2 as an educational tool for lattice QCD algorithms and hadron spectroscopy. The tool, a collection of MATLAB functions, is based on a "short-code" and a "minutes-run-time" algorithmic design philosophy. Another helping feature of it, is the ability to make substantial changes in a few seconds. For these reasons, we have used this package to introduce LQCD to students and learn basic calculations. We have calculated the quark propagators and light hadron spectrum, for two different fermions actions and different gauge coupling constants. The students can make their own changes and try different situations, in order to better understand what happens. Using QCDLAB2, as a learning tool, LatticeQCD seems to be less difficult and challenging to understand.

Ali H. Tarrad
Professor, University of Lorraine, CNRS, LEMTA, France

A Waste Energy Recovery Management for Electricity Generation from Two Temperature Grades of Energy Sources in Subcritical Organic Rankine Systems

The waste energy represents one of the most important issues for economic utilization and management of energy in modern industrial fields. This article outlines a scheme to utilize two different source temperature levels fall within the envelope of higher than 200°C zone. Two regenerative organic Rankine cycles (RORC) were implemented to construct a compound regenerative organic Rankine cycle (CRORC) to improve the energy management of the sources. These two mini-cycles were integrated throughout an intermediate economizer circuit to extract a certain amount of energy from the high-temperature level mini-cycle. R-123 was circulated in the high-temperature cycle due to its high critical temperature at evaporation and condensation temperatures of 160°C and 50°C respectively. R-123, R-21, and the hydrocarbon R-600 were used as working fluids for the low-temperature cycle at evaporation and condensation temperatures of 130°C and 35°C respectively. The R-123 fluid in the high-temperature mini-cycle was superheated to 170-240°C whereas the fluid in the low-temperature level was superheated to 180°C. The results showed that the independent system (IRORC) requires more energy recovery amount than that of the compound system by a maximum of 2% to achieve the same net power output. This corresponds to the enhancement of 2% for the system net thermal efficiency of the compound (CRORC) system when compared to the independent (IRORC) one. The compound (CRORC) system revealed a net thermal efficiency in the range of 14% and 15.6% for the test conditions. The mini-cycle net thermal efficiency of the low-temperature in the compound system was enhanced by the range of 2.5-5% when compared to that of the independent arrangement. R-123/R-123 and R-123/R-21 systems exhibited higher net thermal efficiencies than that of the R-123/R-600 one by 3% and 2% respectively. Increasing of the superheat degree of the high-temperature mini-cycle from 10°C to 80°C for the compound system has improved the thermal efficiency by 7.6-7.9 for the examined fluid pairs and operating conditions.

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Sustaining Solutions in Undergraduate STEM Education

Science, Technology, Engineering and Mathematics (STEM) programs that attract and sustain student interest feature learning that is experiential, investigative, hands-on, personally significant to both students and faculty, connected to other inquiries, and suggestive of practical application to students' lives. Such learning flourishes in a community in which faculty are committed equally to teaching, to maintaining their own intellectual vitality, and to partnering with students in learning, and in which institutional support for such a community exists. The CSIE (Creative Scientific Inquiry Experience) Program at Eastern Michigan University (EMU) is involved in retaining and increasing the number of STEM graduates by including faculty professional development, student connectedness to the sciences and mathematics through academic service-learning, and curricular reform. In this presentation we report on the success of the CSIE program, including course development, student engagement, student success, especially among underserved students, and sustainability. This work is important because it offers insight into the development, sustainability, and scalability into faculty-driven STEM education reform spanning 15 years.

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Compact Shaft-Rotating Swerve Drive with Prong Structure for Highly-Maneuverable and Agile Robots

In our current society, robots are becoming increasingly important. Although many robots are stationary, for example robotic arms, moving robots are of particular interest for many applications. Applications of moving robots today include combating COVID-19 in hospitals, transporting goods in and across warehouses and distribution centers, and moving equipment and instrumentation in space, to name a few. Mobile robots are often required to maneuver rapidly in tight spaces. The best way to achieve this is through a modular assembly called Swerve Drive, which is a driven wheel that can pivot 360 degrees. Three or more modules can be placed at the corners of the robot, allowing high levels of maneuverability, such as, for example, spinning while following a path in any direction. This paper presents the design of a Swerve Drive module, which improves the current state-of-the-art. The proposed Swerve Drive module has similar properties to current designs available in the market in four out of six metrics defined in this work, while it does significantly better in the other two metrics, making this design the new state-of-the-art.

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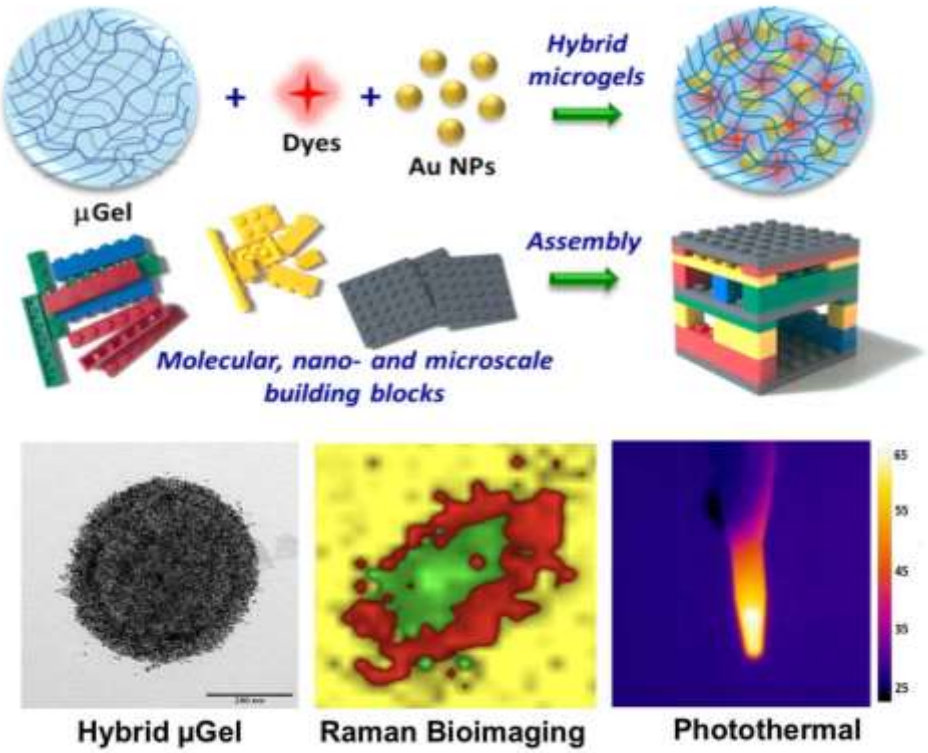
Versatile Design of Multifunctional Microgels from Molecular, Nano- and Microscale Building Blocks for Biomedical Applications

The development of hybrid microgels based on the integration of inorganic nanoparticles into polymeric particles has stimulated worldwide efforts in recent years due to their promising biomedical applications as smart therapeutic system and bioimaging agents. In this talk, we describe an innovative modular strategy to obtain multifunctional smart hybrid particles based on the self-assembly of different building blocks (stimuli-responsive microgels, gold nanoparticles and fluorescent dyes) that could be compared to the assembly of lego® bricks (Figure 1). The final hybrid networks display thermo- and pH-sensitive behavior leading to a reversible shift of the Au NPs plasmon band in the 520-750 nm range. Moreover, the presence of gold nanoparticles (Au NPs) trapped within the polymer matrix results in a strong enhancement of the Raman signatures of the dyes. The nanohybrids thus act as surface-enhanced Raman spectroscopy (SERS) tags for bioimaging. The Au NPs trapped within the particles are also valuable light-to-heat plasmonic converters for biomedical

hyperthermia. Besides, the combination of both Au NPs and dyes offers added-value property for photoacoustic imaging. Such hybrid particles thus open promising prospects for a broad range of biomedical applications, including photoacoustic, fluorescence and Raman imaging as well as photothermal therapy.

Figure 1. (Top) *Smart Combination and Assembly of Polyanionic Microgels, Cationic Molecular Linkers (Fluorescent Dyes) and Negatively Charged Au NPs* (Bottom) *TEM Image of the Nanohybrids* (left), *Raman Image After Internalization Inside Fibroblast* (center) *and Photothermal Profile Under 808 nm Laser Irradiation* (right)



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Cubesat: Low Cost COTS Cubesat Orbit Determination Solutions for Prototype Propulsion Experiments

The space exploration industry is expanding now more than at any other time. Engineers and scientists are designing, testing, and launching new technologies into space at a high pace. A popular method of testing and demonstrating new space technologies has been through nanosatellites. CubeSats, in particular, have exhibited unique capabilities of demonstrating new technologies in space. They have a simple design, low production and maintenance costs, modular configuration, and can be easily launched as a secondary payload on most space missions due to their small mass and size.

The Technology Education Satellite (TechEdSat) program, led by NASA Ames and SJSU, has been launching CubeSats and testing new space technologies since 2012. Previous TechEd Satellites have been able to demonstrate the use of the Iridium communication network in space and effective de-orbiting capabilities using an exo-brake system. The next milestone of new space technology testing and demonstration for TechEd Sat, and most CubeSats, is propulsion systems.

Propulsion systems, usually cold gas thrusters, are imperative for attitude control, orbital maneuvers, and de-orbiting of the CubeSat. Cold gas thrusters offer simplicity, reliability, and affordability. They also eliminate numerous safety risks by not carrying out combustion or carrying hazardous materials. The tradeoff, however, is that they produce less thrust and are less mass efficient than other propulsion systems.

Nevertheless, a propulsion system needs to be paired with an attitude determination and control system to be effective. Since such

technologies are still mostly in testing phases, little to no flight heritage is available. This is where designing and testing a new simple, affordable, and effective CubeSat orbit determination system becomes important. SJSU is pioneering by testing and space-qualifying a new system that will be launched on the next TechEd Sat which will be used to demonstrate a new cold gas thruster propulsion technology.

The system includes a 3-axis MEMS inclinometer and a microcontroller. This system will be integrated as a companion module to interface the TechEdSat BUS with the propulsion system. The orbit determination system will be used to identify the position and orientation of the satellite by inertial measurements and tilt sensing output an angle of inclination of the CubeSat with respect to Earth's gravity. The propulsion system to be tested includes a resistojet module that heats up the expanded pressurized gas to increase thrust. Therefore, the orbit determination system will be particularly useful in identifying changes in orientation during similar maneuvers for cold and hot gas propulsion. Identifying such changes is important to quantify thrust and performance variances between cold and hot gas propulsion.

In order to space-qualify the orbit determination system, an extensive series of tests need to be carried out. Most importantly a vacuum test that could simulate the situation of operations in space and a rocket vibration test to simulate launch conditions. In addition, contingency measures should be put in order to increase redundancy and reduce the risks of a system-wide failure. While testing is continuing, both inclinometer and microcontroller have shown promising results in the initial vacuum chamber tests. Moreover, the orbit determination and propulsion systems are expected to be launched in Fall 2021 as part of the next TechEdSat deployment from the ISS.

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From Maker to Stem-Progressive Analysis of Computing Course Teaching

Computing Courses (Information technology science and technology courses) in primary and middle schools carry the educational goals of information literacy and scientific literacy of primary and middle school students. Maker education enters the campus to inject fresh blood into information technology courses and promote the reform of information technology courses, but it is easy to fall into the thinking set of small inventions and small creations or the whole class forms homogeneous single works similar to examples. The introduction of the educational concept of interdisciplinary integration of STEM and the way of project-based learning makes it possible to break through this dilemma. Taking the project of "Designing and Making intelligent manhole cover anti-drop device" as an example, this paper analyzes STEM education from task-driven maker education to project-oriented learning, providing an effective implementation approach for the advancement of information technology courses.