BOOK OF ABSTRACTS

XV. INTERNATIONAL CONFERENCE ON NUCLEAR STRUCTURE PROPERTIES

NSP2022

28–30 JUNE 2022
SCIENCE AND ART FACULTY
KIRIKKALE UNIVERSITY
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KIRIKKALE–2022

XV. INTERNATIONAL CONFERENCE ON NUCLEAR STRUCTURE PROPERTIES

We are pleased to organize the XV. International Conference on Nuclear Structure Properties, NSP2022 in Kırıkkale University, Kırıkkale, Türkiye on 28-30 June 2022.

Conference web page address: **http://nsp2022.kku.edu.tr**

The aim of this conference is to provide an opportunity for researchers from all over the world to present their research results and activities in Nuclear Physics and related subjects. The conference provides opportunities for the delegates to exchange new ideas and application experiences, establish research relations and find academic partners for future collaborations.

The last six previous conferences were held in Sakarya in 2015 (NSP2015), Sivas in 2016 (NSP2016), Karabük in 2017 (NSP2017), Trabzon in 2018 (NSP2018), Bitlis in 2019 (NSP2019) and Konya in 2021 (NSP2021). The abstract of accepted presentations (both oral and poster) will be published in the conference abstract book after the peer-review process.

Full papers presented as orals or posters will be published in the following review journals after their peer-review process.

1. MDPI - Symmetry | SCI-Expanded & an Open Access Journal - Special Issue
2. BEU Journal of Science (Bitlis Eren Üniversitesi Fen Bilimleri Dergisi) - Special Issue
3. Journal of Energy Systems
4. Electronic Letters on Science and Engineering
5. Cumhuriyet Science Journal
6. Sakarya University Journal of Science (SAUJS)
7. Journal of Science (Süleyman Demirel University Faculty of Arts and Science)
8. Journal of OKUFED (Osmaniye Korkut Ata University Faculty of Arts and Science)
9. Inspiring Technologies and Innovations (INOTECH)

We thank you to participate to XV. International Conference on Nuclear Structure Properties (NSP2022).

You well come to NSP2022.

Prof. Dr. Mahmut BÖYÜKATA

On the behalf of the organizing committee.

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INVITED SPEAKERS

Andrea VITTURI (National Institute for Nuclear Physics – INFN, Padova, Italy)
"The algebraic molecular model in ^{12}C and its application to the alpha + ^{12}C scattering: From densities and transition densities to optical potentials, nuclear form factors and cross sections"

Andrew BOSTON (Liverpool University, Liverpool, England)
"The AGATA spectrometer"

Dennis BONATSOS (Institute of Nuclear and Particle Physics, NCSR Demokritos, Greece)
"Islands of shape coexistence"

Francesco CAPPUZZELLO (Catania University, Catania, Italy)
"Heavy-ion induced direct reactions in view of the NUMEN project: a multichannel approach"

Hasan GUMUS (Ondokuz Mayıs University, Samsun, Türkiye)
"The concept of effective charge and electronic energy loss calculations for intermediate energy electrons and positrons"

Hatice DURAN YILDIZ (Institute of Technology Accelerator, Ankara University, Ankara, Türkiye)
"Beam dynamic studies at SRF accelerator system for free-electron laser and ATLAS experiment ADCoS duties at CERN"

Jameel-Un NABI (Wah University, Punjab, Pakistan)
"Updated status of key nuclei for presupernova evolution"

José M. ARIAS (Sevilla University, Sevilla, Spain)
"Quantum simulation of the Agassi Model in trapped ions"

Muhsin N. HARAKEH (Groningen University, Groningen, Netherlands)
"Nuclear compression modes from stable to exotic nuclei"

Sabin STOICA (International Centre for Advanced Training and Research in Physics (CIFRA), Romania, Bucharest, Romania)
"Challenges in the study of double-beta decay"

Sefa ERTURK (Niğde Ömer Halisdemir University, Niğde, Türkiye)
"Recent developments in SPECT and PET medical imaging systems"

Serdar UNLU (Burdur Mehmet Akif Ersoy University, Burdur, Türkiye)
"Allowed and forbidden contributions to two-neutrino double beta decay process"

Takehiko R. SAITO (High Energy Nuclear Physics Laboratory, RIKEN, Saitama, Japan)
"Solving puzzles of light hypernuclei by using heavy-ion beams, nuclear emulsions, and machine learning"

Valentin Olegovich NESTERENKO (Joint Institute for Nuclear Research, Dubna, Russia)
"Low-energy M1 states in deformed nuclei: spin scissors or spin-flip?"

Yu ZHANG (Liaoning Normal University, Dalian, China)
"Effects of single-particle on shape phase transitions in odd-even systems"

TOPICS

Nuclear Structure
Nuclear Reactions
Nuclear Astrophysics
Nuclear Models
Nuclear Scattering
Nuclear Energy
Nuclear Reactors
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ABSTRACTS OF INVITED PRESENTATIONS

The Algebraic Molecular Model in ^{12}C and its Application to the Alpha+^{12}C Scattering: From Densities and Transition Densities to Optical Potentials, Nuclear Form Factors and Cross Sections [$]

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Abstract:

The three-alpha algebraic molecular model is used in ^{12}C to construct densities and transition densities connecting low-lying states of the rotovibrational spectrum, first and foremost those belonging to the rotational bands based on the ground and the Hoyle states. These densities are then used as basic ingredients to calculate, besides electromagnetic transition probabilities, nuclear potentials and form factors to be used to describe elastic and inelastic alpha+^{12}C scattering processes. The calculations confirm the role played by nuclear inelastic processes as a basic tool for investigating nuclear structure properties, as complementary to electromagnetic probes. In this respect, our calculations give support to the use of algebraically-based molecular models in the description of cluster-like nuclei.

We have finally considered the possibility of moving from the equilateral configuration to an isosceles one. The consequent effects on the structure of the ground band, the nature of the excited bands and the values and selection rules of the electromagnetic transitions are discussed.

$ Work done in collaboration with J. Casal, L. Fortunato and E.G. Lanza.

The AGATA Spectrometer

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Abstract:

Each major technical advance in gamma-ray detection devices has resulted in significant new insights into nuclear science. Over the next 10-15 years, many new and enhanced nuclear physics facilities will become available in Europe. These are described in the 2017 NuPECC Long Range Plan (LRP) and include the major new facilities FAIR (Germany), SPES (Italy), SPIRAL2 (France) and HIE- ISOLDE (CERN), which present an unrivalled opportunity to study the properties of nuclei far from stability. Key to these studies is advanced experimental techniques, including high-precision and high-efficiency gamma-ray detection.

The Advanced Gamma Tracking Array (AGATA) [1] is a major European project to develop, build and operate a world-leading precision gamma-ray detection instrument for in-beam studies of nuclei. AGATA uses a technique known as gamma-ray tracking, which relies on determining every gamma-ray interaction point in a germanium detector and neighbouring germanium detectors so that the whole path of a gamma-ray can be tracked and used to measure not just the energy, but also the angle at which the original gamma-ray was emitted. The AGATA spectrometer is a state-of-the-art instrument that moves between laboratories to take full advantage of the different beams and facilities available, and hence to maximise the breath of science that is addressed. The AGATA demonstrator is presently being commissioned at the Legnaro National Laboratory (LNL) in Italy. This presentation will give an overview of the status of the AGATA spectrometer, an insight into some of the research and development taking place within aspects of the project and how the technology used may develop in the coming years.

Keywords: AGATA**,** Gamma-ray spectroscopy, Gamma-ray tracking, HPGe detectors

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Islands of Shape Coexistence

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Abstract:

Shape coexistence in even-even nuclei [1] is observed when the ground state band of a nucleus is accompanied by another K=0 band at similar energy but with radically different structures. We attempt to predict regions of shape coexistence throughout the nuclear chart using the parameter-free proxy-SU(3) symmetry [2] and standard covariant density functional theory [3]. The role played by particle-hole excitations [1] across magic numbers as well as the collapse of magic numbers [4] as deformation sets in is clarified.

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Heavy-Ion Induced Direct Reactions in view of the NUMEN Project: A Multi-Channel Approach [$]

Francesco Cappuzzello[1,2,*] for the NUMEN collaboration [$]

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Abstract:
To get quantitative information on the neutrino absolute mass scale from the possible measurement of the 0νββ decay half-lives, the Nuclear Matrix Elements (NME) involved in such transitions are required. Recently the use of heavy-ion induced double charge exchange (DCE) reactions towards the NME has been proposed in Italy [1-2] and Japan [3]. The basic point is that there are important similarities between the two processes, mainly that the initial and final states are the same and the transition operators are similar, including in both cases a superposition of Fermi, Gamow-Teller and rank-two tensor components [4]. The NUMEN project at the INFN-LNS laboratory in Italy proposes to explore the whole network of nuclear reactions connecting the initial and final nuclear states of the ββ-decay. This includes DCE, Single Charge Exchange (SCE), multinucleon transfer reactions, and elastic and inelastic scattering, to fully characterise the properties of the nuclear wave functions entering the 0νββ decay NMEs.
A key aspect is the consistent investigation of all the above reaction channels. This multi-channel approach demands that: i) the cross-sections for all the relevant reaction channels are measured under the same experimental conditions; ii) the theoretical analysis is performed in a coupled-channel approach within a large model space which includes all the reaction channels adopting nuclear structure inputs taken from the same structure model. Experimental campaigns have been performed at INFN-LNS to explore medium-heavy ion induced reactions on the target of interest for 0νββ decay. These studies are complemented by strong activity on the theoretical side, specially tailored to give a detailed description of the challenging DCE reaction mechanisms [5]. An overview of recent activities performed in Catania in this field will be presented at the Conference.

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The Concept of Effective Charge and Electronic Energy Loss Calculations for Intermediate Energy Electrons and Positrons

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Abstract:

Analytical expressions are given for the effective charge and effective average excitation ionization energies by using different shielding functions in the electronic energy loss calculations of electrons and positrons. The calculation method is based on the utilization of the modified Bethee Bloch stopping power expression and an analytical expression for effective atomic electron number and effective mean excitation energies of target atoms, and for the effective charge of incoming electrons, and positrons. An analytical expression for the practical energy loss calculations using Bethe approximation and Thomas Fermi model of the atom is taken from a previous study and the calculated results of the energy loss from this formula for electrons and positrons in some elemental solids are calculated and rigorously compared with experimental data.The results are found to be in good agreement for some targets but some limited agreement for some energies and targets is also observed.

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Beam Dynamic Studies at SRF Accelerator System for Free-Electron Laser and ATLAS Experiment ADCoS Duties at CERN

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Abstract:

One of the important factors in high radiation generation facilities is the production of a high-quality electron beam. For this, it must be determined to meet the requirements of an optional electron source, (current, radiation emission, etc.). For this purpose, cavity beam dynamics simulation studies of 1.4, 1.5, 1.6 and 1.8-cell SRF gun systems were performed. Utilizing Astra and CST programs, we have performed beam dynamic simulations, and compared all half-cell SRF cavities from many aspects and especially to emittance and beam energy. In the framework of these studies, the 1.6-cell cavity is preferred for the main linac studies. The simulation results of the two programs agree with each other. The special and distinctively designed solenoid is also included in the simulations by utilizing CST and Superfish/Poisson Codes. The effects of the solenoid on the beam dynamics have been monitored and detailed. The behaviour of the electron beams in the accelerator components in the injector path has been examined to obtain an optimized beam and the beam dynamic parameters have been compared with each other to decide the best choices for the meets of the gun system. As a result of our studies, > 3 MeV electron beam energy with ≤ 2 π $mm\ mrad$ were achieved from the 1.6-cell SRF gun cavity with the solenoid in the injector. On the other hand, the ATLAS (A Toroidal LHC ApparatuS) detector at CERN will be explained briefly in addition to Class2 –ADCoS (***ATLAS*** Distributed Computing Operations Shifts) duties that can be handled online.

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Updated Status of Key Nuclei for Presupernova Evolution

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Abstract:
An ensemble consisting of 728 nuclei, in the mass range of A=1–100, under stellar conditions was considered in this study. The mass fractions of these nuclei were computed using Saha's equation for predetermined values of T (core temperature), ρ (stellar density), and Y_e (lepton to baryon fraction) and assuming nuclear statistical equilibrium. The nuclear partition functions were obtained using a newly introduced recipe where excited states, up to 10 MeV, were treated as discrete. The weak interaction rates (electron capture (ec) and β-decay (bd)) of all 728 nuclei were calculated in a microscopic fashion using the proton-neutron quasiparticle random phase approximation model and without assuming the Brink–Axel hypothesis. The calculated rates were coupled with the computed mass fractions to investigate the time rate of change of Y_e of the stellar matter. Noticeable differences up to orders of magnitude were reported with previous calculations. A new list of the top 50 ec and bd nuclei, which have the largest effect on Y_e for conditions after silicon core burning was published.
American Astronomical Society (AAS) Journals Senior Lead Editor, Prof. Frank Timmes interviewed the leading author for his AAS Journal Author Series on 19th May 2021 on account of this publication (YouTube link: https://youtu.be/xH8MouvsFG8)

Quantum Simulation of the Agassi Model in Trapped Ions [$]

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Abstract:

A quantum simulation of the Agassi model from nuclear physics is proposed to be implemented within a trapped-ion quantum platform. Numerical simulations and analytical estimations for a small system illustrate the feasibility of this proposal with current technology. In addition, the approach presented is fully scalable to a larger number of sites (larger systems). The use of a quantum correlation function is studied as a signature of the quantum phase transition by quantum simulating the time dynamics, with no need of computing the ground state.

$ Work done in collaboration with Álvaro Saiz, Pedro Pérez-Fernández, José-Enrique García-Ramos, and Lucas Lamata.

Nuclear Compression Modes from Stable to Exotic Nuclei

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Abstract:

The study of isoscalar giant resonances and, in particular, the Isoscalar Giant Monopole (ISGMR) and Dipole (ISGDR) Resonances, has been pursued for several decades at many facilities worldwide. Since the discovery of the ISGMR in 1977 [1], many experiments were performed with inelastic scattering of isoscalar probes making use of magnetic spectrometers to measure at very forward angles where angular distributions of different multipolarities are quite distinct. Much has been learned from these experiments about the properties of the giant resonances, their microscopic structure as well as the incompressibility term of the Equation of State (EoS) of nuclear matter. With the advent of radioactive ion-beam facilities, prospects for giant resonance studies in exotic nuclei become rich and promising.

Recently, the isoscalar giant resonances were studied in inelastic scattering off deuterium and helium targets in inverse-kinematics using two techniques: the active-target method [2-4] and the storage-ring method [5]. This included investigation of the isoscalar giant quadrupole resonance (ISGQR) as well as the ISGMR and ISGDR, the so-called compression modes important for determining the key parameters of EOS of nuclear matter. The most recent results for the few cases studied will be presented and the advantages and disadvantages of both methods will be discussed.

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Challenges in the Study of Double-Beta Decay

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Abstract:

Double beta decay (DBD) is the nuclear process with the longest lifetime measured until now, whose study is of great interest. Indeed, it provides a good test of the nuclear structure models and, particularly, the search for its neutrinoless double beta ($0\nu\beta\beta$) decay mode offers a wide range of investigations beyond the Standard Model (BSM) processes.

In my talk, I make first a short review of the current challenges faced by the DBD study. Then, I particularly refer to the investigations of the Lorentz invariance violation (LIV) that can affect the electron spectra and their angular correlations in two-neutrino double beta ($2\nu\beta\beta$) decay. After showing the challenges in the computation of DBD space phase factors, I provide reliable predictions of the electron spectra and angular correlations along with their LIV deviations. An alternative, new method, of constraining the LIV counter-shaded coefficient is proposed, as well. The results presented represent useful theoretical support for the LIV searches which are ongoing in several DBD experiments.

Recent Developments in SPECT and PET Medical Imaging Systems

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Abstract:
Positron emission tomography (PET) and Single-photon emission tomography (SPECT) are used mainly for diagnostic purposes in medicine. This study will review recent challenges both in PET and SPECT medical imaging systems. There have been improvements in scintillators and photon transducers and other materials used in medical imaging systems. In addition to these improvements, there are also new methods to obtain a better medical image using new image processing techniques. This presentation will cover improvements in both materials and techniques in medical imaging systems. Performance from recent studies will be presented.

We acknowledge TUBITAK (121F264 project number) for their support.

Allowed and Forbidden Contributions to Two-Neutrino Double Beta Decay Process

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Abstract:
The nuclear matrix element for two-neutrino double beta decay is obtained by including the contributions coming from the allowed and first-forbidden excitations in intermediate nuclei within the framework of proton-neutron quasi-particle random phase approximation. The suitable effective interaction potentials for different excitations are defined within Pyatov's restoration method [1]. The calculated results are compared with other calculations and the corresponding experimental data.

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Solving Puzzles of Light Hypernuclei by Using Heavy-Ion Beams, Nuclear Emulsions and Machine Learning

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Abstract:

Light hypernuclei, especially with A=3, had a large interest experimentally and theoretically in the last decade. Hypertriton, the known lightest hypernucleus, has been investigated by experiments employing energetic heavy-ion beams, and they have revealed different quantities of its lifetime and binding energy from the formerly known values (see the summary in Ref. [1]). Furthermore, the existence of an unprecedented bound state of A=3 with two neutrons and a Lambda hyperon (nnΛ state) [2] has also recently been discussed in the field of few-body physics, and several experiments have been planned/performed to confirm whether or not the nnΛ state can exist. These problems must be solved/clarified urgently since the property of the hypertriton and the existence of the nnΛ state are the base for hypernuclear physics.

We are studying these A=3 light hypernuclei precisely. The WASA-FRS experiment will be performed in February-March in 2022 to measure the lifetime of hypertriton precisely [1,3] and to study the existence of the nnΛ bound state [1]. We are also analyzing the existing J-PARC E07 nuclear emulsion data by developing particular machine learning models for determining the binding energy of the hypertriton at the world's best accuracy [1,4]. We will discuss the current status of these projects and their perspectives.

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Low-energy M1 States in Deformed Nuclei: Spin Scissors or Spin-flip?

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Abstract:

A low-energy magnetic dipole ($M1$) spin-scissors resonance (SSR) located just below the orbital scissors resonance (OSR) was recently predicted in deformed nuclei within Wigner Function Moments (WFM) approach, see e.g. [1-3]. We analyze this prediction for ^{160,162,164}Dy and ^{232}Th using the fully self-consistent Skyrme quasiparticle random phase approximation (QRPA) method [4]. The accuracy of our calculations is confirmed by a good description of $M1$ spin-flip giant resonance. It is shown that Dy isotopes indeed have 1.5–2.4 MeV 1^+ states with a large $M1$ spin strength. In contrast to WFM, these states are not collective but dominated by a few 2qp low-orbital (l=2, 3) spin-flip configurations. Besides, in contrast to the spin-scissors picture, we show that deformation is not a primary origin of the low-energy spin $M1$ states but only a factor affecting their features. The calculated low-energy spin and orbital M1 strengths are mixed and exhibit a significant interference. In ^{232}Th, the low-energy $M1$ spin strength is negligible. The calculated nuclear currents confirm the orbital-scissors flow but not the spin-scissors one. A general critical analysis of low-energy spin and orbital M1 excitations in deformed nuclei is done.

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Effects of Single-Particle on Shape Phase Transitions in odd-even Systems

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Abstract:
The effects of an odd particle on shape phase transitions (SPTs) in odd-A nuclei will be discussed in the framework of the interacting boson-fermion model in both the classical and quantum ways. It is shown that the spherical to prolate (U(5)-SU(3)) SPT and spherical to gamma-soft (U(5)-O(6)) SPT may occur in the odd-even system with the SPT signatures being strengthened in the former but weakening in the latter. In addition, the possibility of phase coexistences in odd-even nuclei is also mentioned.

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ABSTRACTS OF ORAL PRESENTATIONS

Calculation of Secondary Neutron Spectrum and Additive Dose in a Water Phantom of 135 MeV/u Carbon Ion Beam by Monte Carlo Method

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Abstract:
Since the cancer treatment with carbon ions is more advantageous than the treatment with photons, the interest in treatment with carbon ions is increasing. Due to the long-range of neutrons, which are secondary particles formed as a result of the interaction of carbon ions with patient tissues, it may cause an additive dose in healthy tissues far away from the target volume. Since this situation poses a danger to the future health of cancer patients, it is important to determine the secondary neutrons that occur in carbon ion radiotherapy and to calculate their contribution to the treatment dose. In this study, a carbon beam with 135 MeV/u energy was sent to a 40 cm^3 water phantom in the form of a pencil beam, and the secondary neutron spectrum formed as a result of nuclear interactions was calculated with the PHITS MC code. The results were confirmed by comparing with the data obtained in the literature previously. Secondary neutron number and lateral dose distribution in the total volume were obtained in the selected geometry. The number of neutrons produced for 135 MeV/u carbon in the water phantom is 1.08 per nucleon. The deposited dose by neutrons along the beam axis is maximum. The neutron dose decreases with distance from the beam axis.

Keywords: Carbon ion, Water phantom, Monte Carlo, PHITS, Secondary neutron

The Criticality Problem for the Pure Quadratic Anisotropic Scattering with the F_N Method

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Abstract:

A critical slab thickness for a one-speed linear transport equation with pure quadratic anisotropic scattering is studied. The critical thickness is calculated by the F_N method. To apply the F_N method, the Case's eigenfunctions and the orthogonality relations are derived analytically for this anisotropic scattering. Then numerical results are tabulated.

Keywords: Criticality problem, F_N method, quadratic anisotropic scattering, transport equation.

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Study of Resonant Reactions at Nur-Sultan DC-60 Cyclotron

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Abstract:

Resonant reactions are a well-known source of the information on nuclear structure. This information is also in high demand by nuclear astrophysics for the understanding of the chemical evolution of the universe. We are studying resonant reactions in inverse kinematics by the Thick Target Inverse Kinematics (TTIK) method using beams of the DC-60 cyclotron in Nur Sultan (Kazakhstan). The DC-60 provides heavy ions from Li to Xe with an energy of 0.3-2.0 MeV/nucleon. The TTIK method provides for continuity in energy excitation functions at different angles including 180 degrees in c.m. frame in a single run [1]. These data must be free from target admixtures in experiments with rare isotopes.

In this talk, we'll present details of our application of the TTIK method in a combination with the time of flight measurements. We'll review the spectroscopic results of the studies of the ^{13}C, ^{15}N, ^{16}O, ^{17}O and ^{18}O interaction with helium and hydrogen [2-7] and the nuclear structure of the populated states, important for astrophysics and for understanding exotic nuclear structure. Figure 1 presents the R-matrix fit of the first data on the excitation function for the ^{17}O(α, α) ^{17}O elastic scattering. The obtained spectroscopic information shows that large resonance cross-sections are strong evidence for a developed alpha cluster structure in odd-even nucleus ^{21}Ne.

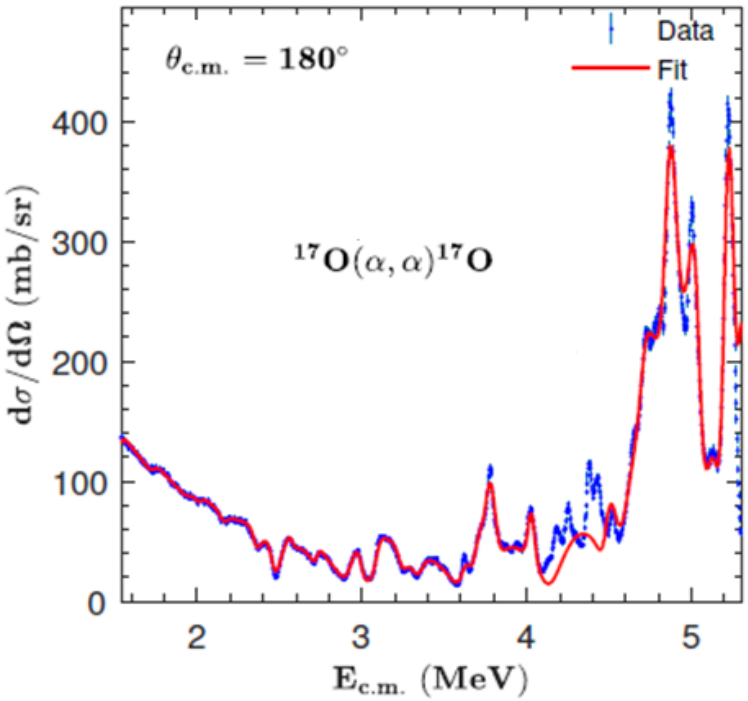

Figure 1: The excitation function for the ^{17}O(α,α) ^{17}O elastic scattering at 180° c.m

Keywords: Accelerators, Astrophysics, Inverse Kinematics, Nuclear Physics, Resonance Reactions

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Quantum Phase Transition and Band Mixing in Odd Mass Nuclei

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Abstract:
Quantum phase transition (QPT) associated with a shape change occurs in dynamical systems such as nuclei. Dynamic symmetries have been used extensively in nuclei since the 1970s when the Interacting Boson Model was introduced [1]. We will consider the signature of QPT in the framework of the Interaction Boson Fermion Model [2-7]. This work aims to investigate further the nature of the interplay between these modalities within the framework of an even–even boson core described by an Interacting Boson Model Hamiltonian coupled to a single fermion as a function of the strength of the coupling constant that links the boson and fermion pictures. Moreover, we have applied a simple two-state mixing model [8] to matrix elements for some specific transitions to figure out the collective states in odd mass nuclei.

Keywords: Quantum phase transition, Interacting Boson Model, Interaction Boson Fermion Model and band mixing.

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Evaluation the Knowledge and Radiation Protection of radiation workers of Ibensina Hospital

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Abstract

Each day people are affecting by Ionizing radiations. The ionizing radiation is produced several types of hazards. Thus, technicians are working at hospitals should be have good knowledge about radiation protection, to evaluate the knowledge and awareness of radiation worker's towards radiation protection. The questionnaire based cross-sectional study was performed at Ibensina hospitals-Sirte city, Libya between July and August on 30 out of 38 radiation workers. Data was collected from some questionnaire and was analyzed by microsoft Excel softwere.The results show that the average age of the radiation workers are between 31 – 40 years bachelor holders 23 (76.7%), 6 male and 15 female. All radiation workers (100%) did primary examination before starting to work. However, they did not periodical examination before starting to (100%). It is important for technicians during work to wear personal film badges as mentioned in international commission of radiation protection. However, all radiation workers arenot supplied with personal film badges and most of technicians are working each week between 39 and 42 hours. Colibration X -rays machine and Radiation survey have not been done. Most of the radiation workers have poor knowledge about radiation protection. Healthy program for radiation technicians is important. Thus, personal film badges and training radiation protection courses should be provided to radiation workers.

Keywords: Radiation Protection, Radiation Workers, Ionizing Radiation and Film Badges.

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Radiogenic Heat Generation Analysis of Fly Ashes Collected From Turkish Coal-Burning Thermal Power Plants

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Abstract:
Fly ash (FA) is the major industrial residue (waste or by-products) formed during the burning of pulverized coal (lignite, hard and imported coal) in thermal power plants (TTPs) installed to generate electricity. The coal-burning TPPs in Türkiye produce a total of over 15 Mt of FA annually. The largest fraction of FAs is collected and usually stored in piles, or dumped or deposited on the lands in the vicinity of the TPPs. FAs contain an enhanced concentration of the natural radionuclides in the radioactive series of ^{238}U, ^{232}Th, and ^{40}K. In this study, the radiogenic heat generation (RHG) caused by the emitted ionizing radiation from these natural radionuclides in 297 FA samples collected from FA piles of the 15 coal-burning TPPs in operation was estimated. The values of the estimated RHD varied from 0.6 to 53.1 μW/m^3 with an average value of 8.2 μW/m^3. The results revealed that radionuclides in the ^{238}U series were predominant in generating radiogenic heat.

Keywords: Fly ash, radiogenic heat generation, ^{238}U, ^{232}Th, ^{40}K

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Nucleonic Odd-Even Effects for (n,2n) Reaction Cross Sections at 14-15 MeV

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Abstract:

The (n,2n) cross-sections data are very important in nuclear reactor applications for neutron multiplier calculations and researching reactor neutronic. And also, these data are required for researching neutron dosimeter. In the literature, the empirical and semi-empirical (n,2n) reaction cross sections have been investigated by many authors, but theoretical calculations have not been adequate because the character of the nuclear structure is exactly unknown. In this study, odd-odd, odd-even,even-odd and even-even nucleon numbers effects for target nuclei (*n,2n*) cross-sections have been investigated at 14-15 MeV. The (n,2n) experimental cross sections data have been taken from EXFOR nuclear library. Depending on the mass number-A, asymmetry parameter for target nuclei have been studied and determined four different parameters groups by the classification of nuclei into even-even, even-odd, odd-even and odd-odd for (*n,2n*) reactions at 14-15 MeV. The empirical formulas for the evaluation of the (*n,2n)* reactions cross-sections and obtained results were discussed.

Keywords: Asymmetry parameter, Cross-section, Empirical formula, (n, 2n) reaction, Odd-Even

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Lightest Pseudo-Mirror Nuclei in the Nuclear Chart

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Abstract:
Many-body nuclear models are essential to studying the properties of the nucleus. In this context, the nuclear shell model plays a vital role [1]. There are other models in the nuclear market as well, such as the interacting boson model [2], and the quasi-particle random phase approximation model [3]. The objective to construct these convoluted-math-involving models is to scan most of the parts of the nuclear chart with all possible aspects. However, a large group of nuclei can be qualitatively studied in a simple fashion offered by valence correlation schemes. A valence correlation scheme is an approach that attempts to give a unified description of nuclear observables. One such valence correlation scheme is the particle-hole scheme that gives crucial information about the development of quadrupole collectivity in the medium and the heavy mass nuclei. There is another advantage of this simple scheme - it allows us to extend the perspective of the nearly identical energy spectra from the mirror nuclei to a new kind of nuclei referred to as pseudo-mirror nuclei. These nuclei are described by N_pN_n values where N_pN_n is the product of the particle and holes numbers of protons and neutrons counted from the nearest closed shells. According to N_pN_n scheme, if two nuclei have the same particle-hole product, they can have similar energy spectra [4, 5]. Pseudo-mirror nuclei were presented by Moscrop et. al, [6] for the first time in 1988. Recently, Sayğı [7,8] has reported new pseudo-mirror nuclei covering the mass regions from A~100 to A~200. A year ago, we have reported eight pseudo-mirror nuclei in the A~80 mass region [9]. In the present work, we discuss our very recent finding in which ^{64}Fe–^{70}Zn and ^{60}Cr– ^{74}Ge are identified as the lightest pseudo-mirror nuclei in the nuclear chart. The energy spectra in the pair have eye-catching symmetry. Furthermore, the kinematic moment of inertia in the pair has good similarity. Details of this work can be found in [10].

Keywords: N_pN_n scheme, Pseudo-mirror nuclei.

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Investigation of Stopping Power and Range Values as a TLD Parameter

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Abstract:
Radiation dose is the energy deposited to the material by incident ionizing radiation. It's also called the absorbed dose. Determination of absorbed dose is an important subject in the field of radiation protection. For this purpose, personal and environmental doses are monitored by using especially Optically and Thermally Stimulated Luminescence materials. The dosimeters made with such materials have been called OSL and TLD. These dosimeters are characterized by their effective atomic numbers, sensitivity, reusability, dose-response linearity etc. Since the absorbed dose is proportional to the stopping power, in this work stopping power of several dosimeter materials for beta radiation is calculated and compared with each other. Besides, stopping power, range and depth dose curves were also compared. In this way, it's aimed to find another parameter for the determination of dosimeter material's effectiveness. Effective charge method and Continuous Slowing Down Approximation (CSDA) have been used for the calculation of stopping powers of targets and calculation of the range of beta radiation, respectively. In this work, well-known TLD dosimeters TLD-100, TLD-600, TLD-700, $Li_2B_4O_7$ and MgB_4O_7 have been investigated.

Keywords: TLD, dosimetry, stopping power, CSDA range, electron, positron

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First Forbidden Transitions by a Self-Consistent Model in Odd Mass Nuclei

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Abstract:

The first forbidden beta transitions were investigated for the spherical odd mass nuclei by a self-consistent model. The pn-QRPA model was used without a schematic separable interaction to calculate the first forbidden transitions by considering the Woods–Saxon potential basis in the Chepurnov parameterization. This new model was implemented by us for the first time. The beta transition probabilities in this model were calculated within the ξ-approximation. The related nuclei were considered in spherical form for all simulations. To test the new model, we calculated log(ft) values and the beta strength distributions for some nuclei. The obtained results were found to be in better agreement with the measured data.

Keywords: First Forbidden transitions, pn-QRPA, Woods-Saxon potential, Self-Consistent Model

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Comparing the Shielding Features of Graphene with Impregnated Activated Carbon for Gamma-Rays

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Abstract:
Since the structures of graphene- or carbon-based materials are the most important ones of daily life from day to day, they are very attractive for researchers. The richness of various optical and electronic behaviours has made them one of the rapidly rising materials on the horizon of material science and condensed matter physics. Having the sheets of atoms that are stacked in a disorganized manner makes activated carbon different from other forms of carbon –graphite- structures [1]. Research on the shielding properties of graphene [2] and activated carbon atoms [3] for gamma-rays is very rare and required to be improved. Since the use of radioactive sources in different fields (nuclear industry, shielding material, radiation biophysics and space research application, etc.) has been increasing expeditiously, the photon interactions with the matter have gained more importance in the world of material science technology. In this work, we reviewed the basics of the impregnated activated carbons (AC1 and AC2) and graphene, as well as the link between the structural behaviours and the gamma shielding properties in terms of both quality and efficiency. Both XCom software and EGSnrc simulation code were used to obtain the theoretical calculations that are significantly important to be able to understand the shielding properties of impregnated activated carbons (AC1 and AC2) and graphene for gamma-rays. In the end, the mass attenuation coefficients (μ_m), the half-value layer (HVL), the tenth-value layer (TVL), and the mean free path (MFP) values of such materials were calculated and then compared with those of some other known shielding materials like lead, borosilicate, concrete, and vermiculite. The calculated data showed that impregnated activated carbons (AC1 and AC2) are very appropriate and consistent to be one of the candidates for shielding materials of gamma-rays even though the graphene is seen as inconsistent for such purpose.

Keywords: Activated carbon, Graphene, Absorption, Shielding material, Gamma-rays

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Investigation of the Effect of the Patient Cover Materials on Surface and Build-Up Region Doses

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Abstract:

It has been shown by the studies that additional materials such as fixation tools or bolus used in high-energy photon beams cause changes in the surface dose. However, the change in the surface dose of the cover materials that can be used in the clinic for different reasons during the treatment has not been examined. The purpose of this study was to measure the surface and build-up region doses of different cover materials in the RapidArc linear accelerator (Varian, PALO ALTO, Calif.,) for different field sizes using a parallel plate ion chamber. Dose measurement was made by using different cover materials that could be used on the patient, such as a paper towel, a disposable patient apron, a sheet, and a blanket. Surface and maximum dose region measurements were made for 5x5, 10x10, 20x20, and 30x30 cm^2 field sizes with different cover materials and compared with the open field at SSD 100 cm (Figure 1). The phantom surface was assumed to be the surface depth. The maximum dose region was also measured at five different depths of 2, 4, 8, 12, and 16 mm for a 6 MV photon beam.

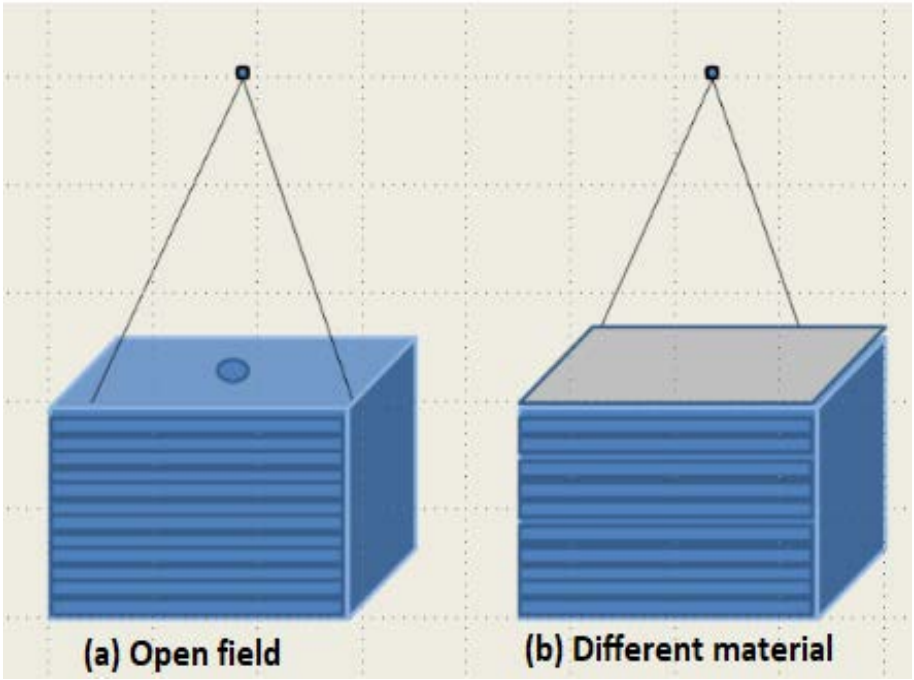
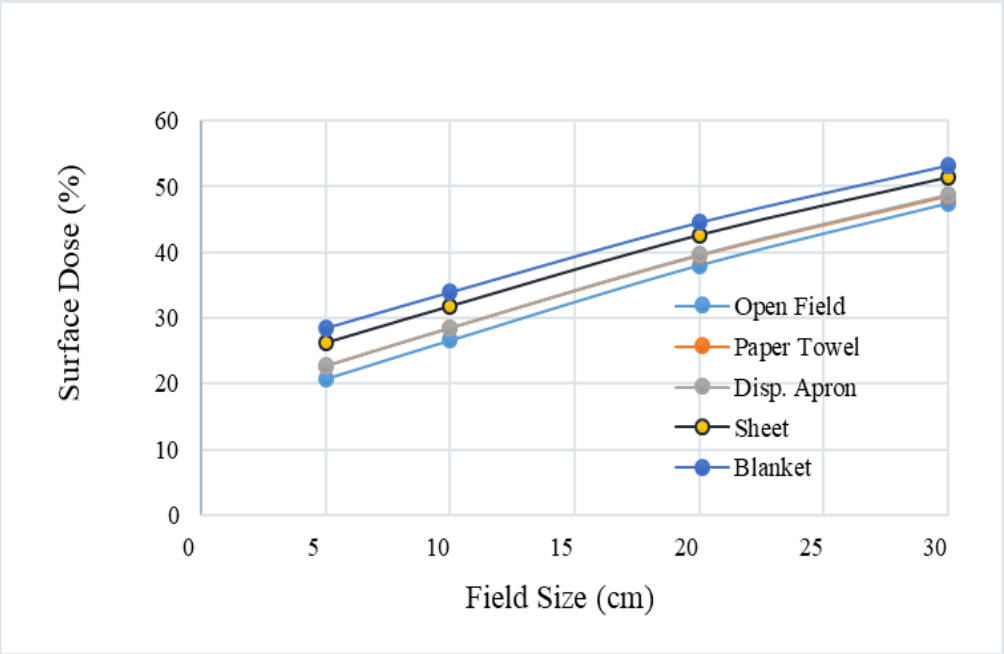


Figure 1. A schematic drawing of geometry for the measurement. (a) open field (b) different cover material

Measurements were made using Markus parallel plate ion chamber (PTW Freiburg, Freiburg), and RW3 solid water phantom (SP34, PTW, Freiburg, Germany). The polarity effect of the dosimeter was corrected to acquire accurate ionization readings. Fixed separation parallel plate ion chambers require over response corrections because the ion chamber has a plate separation of 2 mm. The overdoses in the buildup region were corrected for the Markus chamber according to Gerbi and Khan's correction method. The measurements were repeated 3 times for an average value with and



without the covers. The measured dose values were normalized to the maximum depth dose. The increase in surface dose is directly proportional to the field sizes and cover thickness (Figure 2).

Figure 2: Surface doses for different cover materials

The highest variation of cover materials on the surface dose was measured in the 3.1 mm thick blanket, and as the field size increased, the surface dose increased due to the increase in scattering. The differences between the open and the disposable apron material were found to be 3.4%, 0.7%, 0.4% 0.2%, 0.3% and 0.0% for 0, 2, 4, 8, 12, and 16 mm, respectively in the buildup region. Thus, it has been observed that materials such as covers or clothes that may remain in the treatment area for different reasons cause a change in the surface dose.

Keywords: Dosimetry, Surface dose, Build up Region

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Hounsfield Unit (HU) Comparison of Different Materials Produced by Plastic Injection Molding Method with Commercial Bolus

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Abstract:
In radiation therapy, a bolus is a kind of tissue-equivalent material used to deliver an adequate radiation dose to the level of the skin and improve dose homogeneity in superficial tumours. With the development of technology, bolus material is produced with a 3 Dimension (3D) printer in radiotherapy. Polylactic Acid (PLA) and Acrylonitrile Butadiene Styrene (ABS) are generally used as bolus material produced in a 3D printer. In addition to 3D printers, one of the cheapest and the most common methods used to produce plastic parts is plastic injection moulding. In a radiotherapy treatment planning system (TPS), essential input is the data from computed tomography (CT) simulator scan, which takes into account the effect of inhomogeneities in dose calculations. Since HU values affect dose distribution in treatment planning, the values in TPS and CT should be compatible with each other. In this study, we performed an HU comparison of different materials (ABS, PLA) produced by the plastic injection molding method with commercial bolus material routinely used in radiotherapy. ABS, used in natural color and the granule form, was obtained from the company Sabic under the trade name cycolac resin. PLA, the alternative second material used in this study, was obtained from the company Ingeo in the granular form under the trade name Biopolymer 3052D. The test specimens were produced by direct injection molding in an ISO D2 type mold made of S235JR steel (material number 1.0038) according to ISO 294-3. Both of the materials are 10x10x1 cm^3 (L x W x H) dimension. Their densities are 1.040, 1.240, and 2.56 g/cm^3 for ABS, PLA, and bolus, respectively. ABS, PLA, and commercial bolus materials were placed on RW-3 solid water phantom and scanned by General Electric (GE) Discovery RT CT simulator (Figure 1).

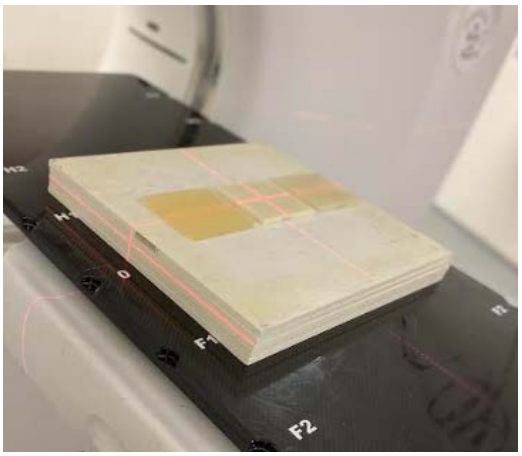

Figure 1. CT scanning setup with RW-3 solid water phantom and different materials.

CT images were obtained with 120 kV and 300 mA scanning parameters. HU values were determined from the center, left and right edges for all three materials with circular regions of interest (ROIs) in GE CT software programme. In the same way, the HU values were also obtained from Varian Eclipse Treatment Planning System (TPS) for each material. The reported HU variations may be explained due to using different density materials. In literature for various CT scanners, the difference between the measured HU numbers and nominal HU number values has been reported especially for different materials. Maximum HU number difference was observed within the range of 1-19 HU for bolus, ABS, and PLA when the measured values were compared with nominal values quoted in the manual CT simulator and TPS systems. HU values in materials with different densities are given in Table 1.

Table 1. HU values of different materials

Material	**HU (-4 cm)**		**HU (center)**		**HU (+ 4cm)**		**Density**
	CT	**TPS**	**CT**	**TPS**	**CT**	**TPS**	**(g/cm^3)**
ABS	-78.02	-80	-77.92	-80	-94.65	-90	1.04
PLA	101.45	90	108.49	90	136.00	131	1.24
Bolus	52.26	60	27.40	25	42.51	49	2.56

In terms of HU values, ABS material was found to be compatible with polystyrene, and PLA was found to be compatible with acrylic material. Although it has been found that the materials do not have significantly different HU values than the bolus, detailed dosimetric studies on these materials are going to be studied.

Keywords*:* Plastic Injection Molding, Hounsfield Unit, Bolus.

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Theoretical Study of the Giant Dipole Resonance in the ^{233}Th Nucleus

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Abstract:
In this paper, we have investigated the giant dipole resonance (GDR) in the ^{233}Th nucleus. The theoretical basis of electric dipole (E1) excitations is the microscopic Translational Galilean Invariant Quasiparticle Phonon Nuclear Model (TGI-QPNM). The model reproduces experimental data well in both rare earth and actinide regions. When the results obtained in this study for ^{233}Th are compared with the photo-absorption cross-sections measured for ^{232}Th in the 7-19 MeV energy range by Gurevich et al. In 1976 [1], it is seen that the two spectra overlap quite well. Also, the approximation allows testing the energy-weighted sum rules for E1 transitions.

This work has been supported by the Scientific and Technological Research Council of Türkiye (TUBITAK) (Project no. 118F094) and the Research Fund of the Sakarya University (Project No. 2020-7-25-55). In addition, the two authors (E. Kemah, MSc., and G. Hoşgör, MSc.) have been supported by the Council of Higher Education (CoHE) 100/2000 through PhD Scholarships and the Scientific and Technological Research Council of Türkiye (TUBITAK) 2211-A PhD Scholarship Program.

Keywords: GDR, TGI-QPNM, ^{233}Th

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An Overview of a New Neutron Scattering Function in a Nuclear Reactor

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Abstract:
In the theoretical study, one of the basic equations used to calculate the basic nuclear parameters is the transport equation. This equation contains a scattering function. For this, some scattering function is proposed. A new scattering function is proposed for nuclear reactor problems. This scattering function is compared with the Henyey-Greenstein scattering function. And the conditions that this scattering function must obey are tested. Different systems can be analyzed by using the newly proposed scattering function instead of scattering functions in computer program codes.

Keywords: Control of nuclear reactor, Neutron scattering, Transport equation

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Nucleon Densities of Samarium Isotopes Calculated by Skyrme and Gogny Models

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Abstract:
The ground-state properties of the nuclei are generally calculated using two different methods, namely Skyrme and Gogny force methods. Nucleon densities of Samarium isotopes are calculated by using Hartree-Fock-Skyrme (using Woods-Saxon Potential) (SHF-WS), Hartree-Fock-Skyrme (using Harmonic Oscillator Potential) (SHF-HO), Hartree-Fock-Bogolyubov-Skyrme (HFB-S) and the Hartree-Fock-Bogolyubov-Gogny (HFB-G) interactions. In the first two methods, the densities and rms radii for both proton and neutron of Samarium isotopes were calculated by different Skyrme parameters set. Theoretical calculated charge density was compared with experimental data of Angeli and Marinova (2013) to determine the best parameter set for each Samarium isotope. Then, all nucleon densities were compared to each other. All methods gave similar results for all Samarium isotopes.

Keywords: Hartree-Fock, Skyrme, Gogny, Nucleon Density

Calculation of Electric Dipole ($E1$) Resonance in ^{167}Er from threshold to 22MeV

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Abstract:

The electric dipole photonuclear cross-section in odd-neutron ^{167}Er has been investigated from threshold to 22 MeV within the Translational and Galilean Quasiparticle-Phonon Nuclear Model (TGI-QPNM). The theoretical results have been compared with the available experimental data. The double-peaked structure of the experimental photon-absorption cross-section has been well reproduced in theory. The obtained width and centroid energies of the GDR peaks also well agree with the experimental data.

This work was supported by the Scientific and Technological Research Council of Türkiye (TUBITAK) (Project no. 118F094) and the Research Fund of the Sakarya University (Project No. 020-7-25-56). E. Kemah, MSc. and G. Hoşgör, MSc. are supported by the Council of Higher Education (CoHE) with 100/2000 Ph.D. Scholarship and Scientific and Technological Research Council of Türkiye (TUBITAK) 2211-A Ph.D. Scholarship Program.

Keywords: ^{167}Er, GDR, TGI-QPNM.

Isotopic Distributions in Relativistic Heavy-Ion Collisions

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Abstract:

Production cross-sections of the projectile like residues produced in the reaction system ^{124}Xe+Pb at 1GeV/nucleon projectile energy were measured with the high-resolution magnetic spectrometer, the Fragment Separator (FRS) of GSI [1]. We have theoretically analyzed isotopic distributions of projectile like residues in the same reaction based on the ensemble approach within the statistical multifragmentation model. Comparing the predicted results of the reaction with the experimental data, it is seen that a reduced symmetry energy parameter at low densities is required to reproduce the experimental data. This is in agreement with the results in the literature and our previous findings [2-5].

Keywords: Isotopic distribution, multifragmentation, symmetry energy**.**

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Design and Initial Results of the Experiment for Proton Cross-Section Measurement with Stacked-Foil Technique

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Abstract:
A new gamma-spectroscopy laboratory featuring 2 Clover HPGe, and 2 single crystal HPGe with their BGOs is taking shape at the Turkish Accelerator and Radiation Laboratory (TARLA). At the same time, TARLA has a close connection to the 30 MeV and 1.2 mA proton cyclotron owned and operated by Türkiye Enerji, Nükleer ve Maden Araştırma Kurumu (TENMAK) where proton induced reactions can be performed. By combining the capacity of these two laboratories, measurements of proton cross-section can be performed. While at a later stage online measurements are planned, as a first step offline experiments using the stacked-foil technique to measure the proton cross-section has been envisioned. The cross-section and associated quantities induced on Tantalum and Praseodymium isotopes for proton energies from 10 MeV to 30 MeV are planned to be done. Stacked-foil technique relies on using several foils of the sample together with a degrader to measure several different energies at the same time. In addition, the method requires the creation of a radioactive nucleus with a sufficiently long half-life to be measurable offline with a gamma-ray detector. The decay of the nucleus created will provide information on the amount of material activated. This together with data from monitors on proton flux and energy will give the desired value of the cross-section. However, the exact thickens of both the target foils, monitor foils and degrader foils, length of activation, as well as several other experiment parameters, need to be optimized. This optimization can be best performed with a combination of the Monte-Carlo simulations and a simplified experimental setup. We aim to present the outcome of the design process as well as the results of initial measurements.

Keywords: Gamma-ray spectroscopy, HPGe detectors, proton accelerator, proton cross-section

Seyler-Blanchard Effective Interaction Calculations for Nuclear Matter

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Abstract:
The Seyler-Blanchard effective interaction consists of an attractive Yukawa function multiplied by a quadratic momentum-dependent term [1,2]

$$v(r,p) = -328.61\frac{e^{r/a}}{r/a}\left(1-\frac{p^2}{b^2}\right), \qquad (1)$$

with a=0.62567 and b=392.48 MeV/c. This interaction leads to the EOS

$$\frac{E}{A}(\rho) = \alpha\left(\frac{\rho}{\rho_0}\right)^{2/3} - \beta\left(\frac{\rho}{\rho_0}\right) + \gamma\left(\frac{\rho}{\rho_0}\right)^{5/3}. \qquad (2)$$

The first term proportional to $\rho^{2/3}$ represents the kinetic energy of noninteracting nucleons, the second term $\sim \rho$ represents the binding energy of the attractive Yukawa function, and the third term $\sim \rho^{5/3}$ represents the repulsion at short distances arising from the momentum dependence, which is responsible for saturation. In this study, the nuclear matter Equation of State (EOS) was obtained by using the Seyler Blanchard (SB) model. A Variational Monte Carlo (VMC) method is employed to determine the new parameter set, which are alfa, beta and gamma, for the SB model. Also, the incompressibility and pressure of nuclear matter were obtained with new SB parameters.

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Investigation of Low-Lying Dipole Excitations in Doubly Even $^{124-130}$Xe Isotopes

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Abstract:
In this manuscript, we have systematically investigated the magnetic and electric dipole responses of the spectroscopic energy region via Quasiparticle Random-Phase Approximation (QRPA) for even-even $^{124-130}$Xe γ-soft deformed nuclei. Because of the γ-soft nuclei have less-deformed, we made a comparison between the γ-soft and well-deformed nuclei in the scissors mode region. Using the analytically derived expressions, ω excitation energies, B (π1) dipole transitions, Γ (π1) radiation widths and ωi centroid energies have been calculated for 1^+ and 1^- states. The low-lying dipole strength in double even γ-soft $^{124-130}$Xe nuclei are highly fragmented. The obtained results are in agreement with the available experimental data. Since the experiment could not determine the parity of dipole states, the claim that all dipole states are of magnetic character have been answered by theoretical calculation of E1 excitations.

Keywords: Magnetic and electric dipole, parity, scissors mode, QRPA, 124-134Xe, γ-soft nuclei.

Investigation of Empirical Systematics for (p, α) Cross-Sections at 17.9 MeV

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Abstract:
Empirical systematics are widely used at present for cross-section calculations. Especially, the systematics play an important role in determining the cross-sections at incident energies of which there are no experimental values or scattered about. There are many empirical systematics in predicting the cross-sections of neutron-induced reactions but there are very few for proton-induced reactions in literature. Data on the excitation function of proton-induced reactions are needed to understand the nature of nuclear interaction and nuclear structure. So, obtaining the cross-section systematics on proton-induced reactions is very important. The systematics in literature was mostly obtained by modifying the original Levkovskii' s formula. In this study, we proposed a new empirical systematic for (p, α) reaction cross sections at 17.9 MeV. The present empirical systematic with two parameters is based on the statistical theory. In addition, the statistical dependence (R^2) of (p, α) cross-sections is examined in the mass range 46≤A≤197. It is seen that the new empirical formula gives good fits with the (p, α) experimental cross-section data in the literature.

Keywords: statistical theory, cross-section, empirical systematic, (p, α) reaction.

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Calculations of (n,p) Reaction Cross Sections for ^{182,183,184,186}W Isotopes

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Abstract:
The energy generation from nuclear fusion is a potential alternative source to provide renewable and sustainable electricity. The fusion devices need structural fusion materials, which can mitigate the radiation damage. Thus, the development of appropriate structural materials for fusion reactors is one of the most important goals of nuclear technology. Tungsten, also known as wolfram, is one of the desirable materials in the production of super alloys for nuclear fusion technology. In this letter, the cross-sections of (n,p) reactions on ^{182,183,184,186}W isotopes were calculated using TALYS-1.95, CEM03.01 and ALICE/ASH codes. It is known that the level density is a crucial input parameter in predicting the cross-sections for a given nuclear reaction. Here, the effects on cross-section calculations of level density models were also investigated. In addition, we carried out the cross section calculations using the different equilibrium and pre-equilibrium models such as Weisskopf-Ewing model, Hauser-Feshbach model, hybrid model, geometry dependent hybrid (GDH) model, cascade exciton model, exciton model and two component exciton model. The new results are compared with the experimental data and the evaluated libraries JEFF-3.3 and TENDL-2019.

Keywords: ALICE code, cross-section, (n,p) reactions, TALYS code, Tungsten.

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Neutron Flux Characterization of a 2 Ci Am-Be Neutron Source Irradiation Cell

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Abstract:
In this study, the thermal and epithermal neutron flux characteristics of the irradiation channels located in different geometric positions of the Howitzer vessel, which hosts a 2 Ci Am-Be isotropic neutron source, were determined. In (Indium) the current monitor technique was used to determine the neutron flux change. For this purpose, the gamma rays emitted as a result of the $^{115}In(n,\gamma)^{116m1}In$ reaction were counted in the Hp-Ge gamma spectrometer. To distinguish between thermal and epithermal neutrons, the In monitor was irradiated in two series, inside a cadmium sheath and without cadmium. As a result of irradiations and counts, the places where the thermal and epithermal flux are maximum and their changes according to the distance from the source were found. In the neutron flux determination process, the standard foil technique was used. Pure gold was chosen as the standard foil material, and calculations were made for the single-energy (E_γ=411.80 keV) gamma-ray peak released as a result of the $^{197}Au(n,\gamma)^{198}Au$ reaction, and the thermal and epithermal neutron flux at different points from the neutron source location of the 2Ci Am-Be Howitzer cup has been appointed.

Keywords: Am-Be Neutron source, Epithermal neutron, Foil technique, Thermal neutron flux

Investigation of Alpha Optical Model Potential Effects on ^{165}Ho(a,xn) Reaction Cross Section

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Abstract:
The investigation of the reaction mechanisms of nuclei requires reaction cross sections, including fission and fusion cross sections at 1-200 MeV energy range, which are measure or theoretically calculate via many experimental techniques and theoretical models. In this study, the cross-sections of the ^{165}Ho(a,xn) reaction were calculated with alpha optical model potentials implemented in TALYS 1.95 code to determine the effects of these model with induced alpha energies more than 10 MeV. These theoretically calculated reaction cross sections compared with experimental data, available in EXFOR library. Machine learning technique also applied these models to investigate semi-empirical equation.

Keywords: Nuclear reaction, Talys, Optic potential model

Radon Concentration and Its Indices in Bulak Cave Safranbolu Town/Türkiye

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Abstract:

The Bulak Cave is near the village of Bulak in Safranbolu city. It's one of the longest caves in Türkiye, which goes 6 kilometres from the inside, but only 500 meters are accessible to visitors. For travelling further into the cave where there are lakes, a waterfall, and rivers, you need a professional guide and special equipment. These places are essential for cavers, tourists, and researchers, where enjoy. However, there are possible severe health problems for cave visitors. Monitoring the cave environment is essential, especially radon concentrations, which is the goal of this study. Twenty-two detectors were distributed inside the tourists' part and six detectors in deeper of the cave. The exposure time was one month on 24 September 2020, in addition to two soil samples collected from the cave used for medical purposes. These detectors are collected after 30 days and then etched with a chemical solution. By using an optical microscope, the track density in detectors was calculated then radon concentrations, which are ranged between 16.437 and 48.652 (Bq/m^3), AED, LCR, PAEC, D_{soft}, D_{lung} and H_{eff} have minimum values 0.415, 1.22E-08, 0.002, 0.082, 0.657, 2.959 and maximum values 1.227, 3.61E-08, 0.006, 0.243, 1.946, 8.757 respectively. Radon concentrations for two soil samples were 26.956 and 59.172 (Bq/m^3), and all the results were within the acceptable limits recommended by ICRP and UNSCEAR. The analysis XRD for the soil sample indicated the presence of clay and non-clay minerals, Feldspar, Quartz, Gypsum, Calcite, Palygorskite, Kaolinite, and Montmorillonite. In addition, an XRF examination was performed, which indicated the presence of Fe, Cu, Zn, As, and Mn minerals with high concentrations of 1012601, 552, 1337, 237, and 1601ppm, respectively, which they are all more than the world permissible limits.

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Analysis of Midrapidity Transverse Momentum Distributions of Identified Charged Particles in Pb+Pb Collisions at $(S_{nn})^{1/2}$=5.02 TeV Using Non-Extensive Tsallis Statistics with Transverse Flow

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Abstract:

The midrapidity transverse momentum distributions of the charged pions and kaons, protons and antiprotons, measured by ALICE Collaboration at ten centrality groups of Pb+Pb collisions at $(s_{nn})^{1/2}$=5.02 TeV [1], have been analyzed using simultaneous (combined) minimum χ^2 fits with the thermodynamically non-consistent as well as thermodynamically consistent Tsallis function with the embedded transverse flow. The p_t intervals, used for combined minimum χ^2 fits with the model functions, have been as follows: [0.5-5.0] GeV/c for π^++π^-, [0.2-5.0] GeV/c for K^++K^-, and [0.3-5.0] GeV/c for p+$\bar{p}$. The corresponding results of combined minimum χ^2 fits using thermodynamically consistent Tsallis function with an embedded transverse flow are presented in Table 1.

Table 1 Parameters obtained from combined minimum $\boldsymbol{\chi^2}$ fits of p_t distributions of identified charged particles using thermodynamically consistent Tsallis function with the embedded transverse flow at different centralities of Pb+Pb collisions at $(s_{nn})^{1/2}$=5.02 TeV

Centrality	q (π^++π^-)	q (K^++K^-)	q (p+$\bar{p}$)	T_0 (MeV)	$\langle\beta_t\rangle$	$\boldsymbol{\chi^2}$/*n.d.f.*
0-5%	1.088±0.002	1.086±0.002	1.088±0.002	80±3	0.60±0.01	296/98
5-10%	1.093±0.002	1.088± 0.002	1.090±0.002	79±3	0.59±0.01	301/98
10-20%	1.096±0.002	1.093±0.002	1.092±0.002	79±3	0.58±0.01	270/98
20-30%	1.102±0.002	1.098±0.002	1.095±0.002	77±2	0.57±0.01	216/98
30-40%	1.108±0.002	1.106±0.002	1.098±0.002	77±2	0.53±0.01	167/98
40-50%	1.117±0.002	1.114±0.002	1.100±0.001	76±2	0.49±0.01	116/98
50-60%	1.124±0.001	1.121±0.001	1.107±0.001	78±2	0.43±0.01	72/98
60-70%	1.131±0.001	1.131±0.001	1.112±0.001	82±2	0.33±0.01	31/98
70-80%	1.136±0.001	1.139±0.001	1.116±0.001	87±2	0.22±0.01	20/98
80-90%	1.142±0.001	1.146±0.001	1.118±0.001	86±3	0.14±0.02	21/98

The parameters T_0 (kinetic freeze-out temperature), $\langle\beta_t\rangle$ (average transverse flow velocity), and q (non-extensivity parameter) extracted in Pb+Pb collisions at $(s_{nn})^{1/2}$=5.02 TeV using both consistent and non-consistent Tsallis function with the embedded transverse flow have shown the similar dependencies on collision centrality ($\langle N_{part}\rangle$ - the average number of participant nucleons). The obtained non-extensivity parameter q values have decreased systematically for all studied particle species with increasing Pb+Pb collision centrality, implying an increase in the degree of system thermalization with increasing centrality of heavy-ion collisions. The gap between the parameter q

values for mesons and baryons has decreased with increasing centrality of Pb+Pb collisions, and the q values for mesons and baryons have coincided within uncertainties in region $\langle N_{\text{part}}\rangle$>160, implying the production of highly thermalized QGP (Quark-gluon plasma) in central Pb+Pb collisions. The extracted average transverse flow velocity, $\langle\beta_t\rangle$, has shown significantly different growth rates in regions $\langle N_{\text{part}}\rangle$<71±7 and $\langle N_{\text{part}}\rangle$>71±7, and parameter T_0 has been constant within uncertainties in region $\langle N_{\text{part}}\rangle$>71±7 in Pb+Pb collisions at $(s_{\text{nn}})^{1/2}$=5.02 TeV. The T_0 versus $\langle\beta_{\text{t}}\rangle$ dependencies have proved to be significantly different in regions $\langle\beta_{\text{t}}\rangle$<0.46 and $\langle\beta_{\text{t}}\rangle$>0.46. The linear correlation between the parameters T_0 and $\langle\beta_{\text{t}}\rangle$ has been strongly negative (r_{xy}=−0.9335) in region $\langle\beta_{\text{t}}\rangle$<0.46, and strongly positive (r_{xy}=0.8924) in region $\langle\beta_{\text{t}}\rangle$>0.46. We have estimated that $\langle N_{\text{part}}\rangle \approx 71\pm7$ ($\langle dN_{ch}/d\eta\rangle \approx 251\pm20$) could be a threshold border value for a crossover transition from a dense hadronic state to the QGP phase (or mixed phase of QGP and hadrons) in Pb+Pb collisions at $(s_{\text{nn}})^{1/2}$=5.02 TeV.

Keywords: Collision System Thermalization; Collective Transverse Flow; Deconfinement Phase Transition; LHC; QGP; Transverse Momentum Distribution.

Reference: [1] ALICE Collaboration, S. Acharya *et al*., Phys. Rev. C **101**, 044907 (2020).

Study of Midrapidity Transverse Momentum Spectra of The Charged Pions and Kaons, (Anti-) Protons in Xe+Xe Collisions at $(S_{nn})^{1/2}$=5.44 TeV Using Tsallis Distribution with Embedded Transverse Flow

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Abstract:

The midrapidity transverse momentum distributions of the charged pions and kaons, protons and antiprotons, measured recently by ALICE Collaboration at nine centrality groups of Xe+Xe collisions at $(s_{nn})^{1/2}$=5.44 TeV [1], have been described well using simultaneous (combined) minimum χ^2 fits with the simple thermodynamically non-consistent as well as thermodynamically consistent Tsallis function with the embedded transverse flow. The parameters T_0 (kinetic freeze-out temperature), $\langle\beta_t\rangle$ (average transverse flow velocity), and q (non-extensivity parameter) extracted in Xe+Xe collisions at $(s_{nn})^{1/2}$=5.44 TeV using both consistent and non-consistent Tsallis function with the embedded transverse flow have shown the similar dependencies on collision centrality ($\langle N_{part}\rangle$ - the average number of participant nucleons). The obtained non-extensivity parameter q values have decreased systematically for all studied particle species with increasing Xe+Xe collision centrality, implying an increase in the degree of system thermalization with increasing centrality of heavy-ion collisions.

The gap between the parameter q values for mesons and baryons has decreased with increasing centrality of Xe+Xe collisions, and the q values for mesons and baryons have coincided within uncertainties in region $\langle N_{part}\rangle$>225. This could indicate that the highly thermalized QGP (Quark-gluon plasma) is produced in central Xe+Xe collisions with $\langle N_{part}\rangle$>225. The obtained average transverse flow velocity, $\langle\beta_t\rangle$, has demonstrated significantly different growth rates in regions $\langle N_{part}\rangle$<44±5 and $\langle N_{part}\rangle$>44±5, and the parameter T_0 has stayed constant within uncertainties in region $\langle N_{part}\rangle$>44±5 in Xe+Xe collisions at $(s_{nn})^{1/2}$=5.44 TeV. The negative linear correlation between the parameters T_0 and $\langle\beta_t\rangle$ has been weak (r_{xy}=−0.1415) in region $\langle\beta_t\rangle$>0.44, and quite strong (r_{xy}=−0.8956) in region $\langle\beta_t\rangle$<0.44 (see Figure 1).

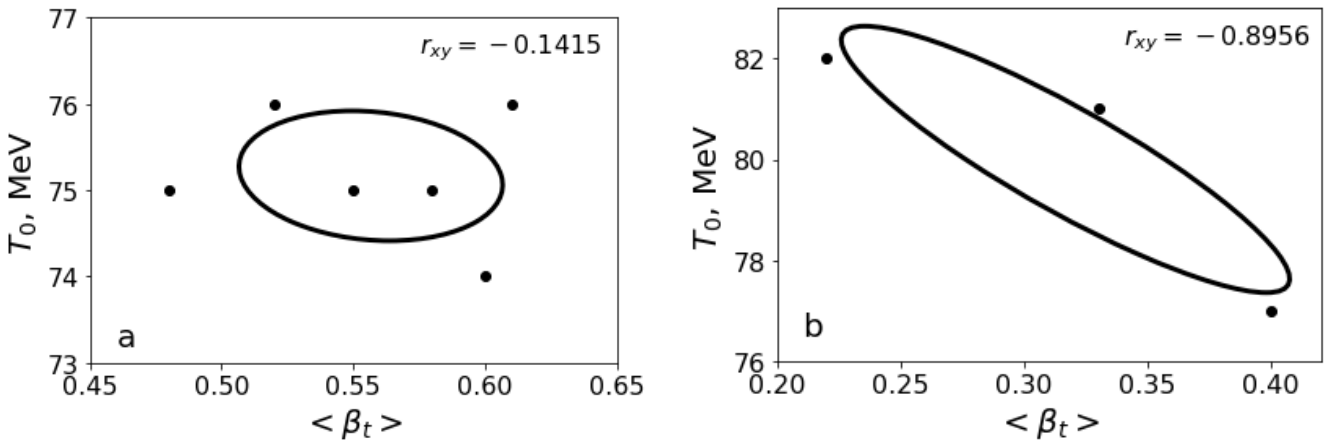

Figure 1. (*a*) Dependence of T_0 versus $\langle\beta_t\rangle$ parameters (●) in region $\langle\beta_t\rangle$>0.44, obtained from fits with thermodynamically consistent Tsallis function with the transverse flow. (***b***) Dependence of T_0 versus $\langle\beta_t\rangle$ parameters (●) in region $\langle\beta_t\rangle$<0.44, obtained from fits with thermodynamically consistent Tsallis function with the transverse flow. The 1-sigma confidence ellipse (corresponding to 68% confidence interval) of the covariance of the parameters T_0 and $\langle\beta_t\rangle$ and the calculated Pearson correlation coefficient, r_{xy}, between T_0 and $\langle\beta_t\rangle$ are also shown in the figures.

It is argued that $\langle N_{\text{part}}\rangle \approx 44\pm5$ ($\langle dN_{ch}/d\eta\rangle \approx 158\pm20$) could be a threshold border value for a crossover transition from a dense hadronic state to the QGP phase (or mixed phase of QGP and hadrons) in Xe+Xe collisions at $(s_{\text{nn}})^{1/2}$=5.44 TeV. Analyzing the extracted $\langle\beta_t\rangle$ versus $\langle N_{\text{part}}\rangle$ and $(p+\bar{p})/(\pi^+ + \pi^-)$ yield ratio versus $\langle dN_{ch}/d\eta\rangle$ dependencies, we have verified that the depletion (enhancement) of baryon-to-meson ratio at low p_{t} (intermediate p_{t}) values with increasing $\langle dN_{ch}/d\eta\rangle$, observed in high-energy heavy-ion collisions at the LHC, is due to radial flow effects.

Keywords: Collision System Thermalization; Collective Transverse Flow; Deconfinement Phase Transition; LHC; QGP; Transverse Momentum Distribution.

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Observation of $pp\pi^+$ Resonance State in $^{12}C^{12}C$ Collisions at 3.37 *A* GeV

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Abstract:
Recent experimental results [1] on the search and investigation of the possible $pp\pi$ resonance states in inelastic $^{12}C^{12}C$ collisions at 3.37 *A* GeV ($(s_{nn})^{1/2}$=3.14 GeV) are presented. The statistically significant peak structure with mass $M(pp\pi^+)$=2117.8 ± 1.2 MeV and Breit-Wigner width Γ=4.1 ± 1.1 MeV is observed for the first time in the spectrum of invariant masses of the $pp\pi^+$ system. The experimental excess of the number of events due to the observed structure proved to be 122±20, with an excess of events at a mass of approximately 2118 MeV with a statistical significance of 4.5 standard deviations (4.5 sigma) above background expectations at the peak. The inclusive cross-section of formation of this possible eight quark $pp\pi^+$ resonance state is estimated to be σ_{incl}= 4.93 ± 0.86 mb. The significant maximum (peak) structure with the centre estimated at $M(pp)\approx$1930±5 MeV, and having a narrow width (<10 MeV), is observed in the spectrum of the invariant masses of two protons in $^{12}C^{12}C$ collisions at 3.37 *A* GeV for the case when the value of the invariant mass $M(pp\pi^+)$ of the $pp\pi^+$ system falls inside the region of the observed $pp\pi^+$ resonance structure: 2110 $\leq M(pp\pi^+) \leq$ 2126 MeV. The analyzed experimental material consisting of 20527 $^{12}C^{12}C$ inelastic collision events is a unique one, being an isoscalar and symmetric system of colliding nuclei with practically all charged products of reaction detected and measured at 4π solid angle. Therefore, the multiplicities of π^+ and π^- mesons as well as their average kinematical characteristics in symmetric minimum bias $^{12}C^{12}C$ collisions at 3.37 *A* GeV proved to agree with uncertainties in the experiment as well as model calculations in earlier works. Naturally, the question arises then why is the $pp\pi^+$ resonance structure observed in the experiment, but not the $pp\pi^-$ one? Further detailed research using high statistics experiments is required to verify the findings of the present analysis.

Keywords: Relativistic nucleus-nucleus collisions; Invariant mass distributions; Production of multiquark resonance states.

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Upgrade of the MAGNEX Magnetic Spectrometer toward the High-Intensity Beams at INFN-LNS

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Abstract:

The presentation aims at describing an updated overview of the Research & Development activities related to the NUMEN and NURE projects at INFN – LNS (Catania, Italy). The physics case deals with an innovative technique to access the nuclear matrix elements entering the expression of the lifetime of the double beta decay by cross-section measurements of heavy-ion induced Double Charge Exchange (DCE) reactions. The main experimental tools for this research program are the K800 Superconducting Cyclotron and MAGNEX large acceptance magnetic spectrometer. First experimental results have given an encouraging indication of the capability of the proposed technique to access relevant quantitative information. However, the tiny values of the measured cross-sections and the resolution requirements demand beam intensities much larger than those manageable with the present facility. This physics case has given the scientific motivation for an upgrade of the cyclotron accelerator and of the MAGNEX spectrometer to work with high-intensity heavy-ion beams (up to 10^{13} pps at the target). The ongoing upgrade of the INFN-LNS facilities in this perspective will be discussed at the Conference.

Developing a Novel Dosimeter System Used in Radiotherapy

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Abstract:
Nowadays, using novel radiotherapy treatment techniques such as IMRT, radiosurgery, brachytherapy, IORT, and MRI-linac cause difficulties in measuring the dose accumulated in the patient during treatment. Therefore, it would need to develop new dosimetry systems that are accurate, easy to use, compact, and capable of real-time in vivo monitoring. Scintillation materials are one of the best alternatives to real-time dosimetry systems, which are more sensitive and provide better spatial resolution than the ion chamber. Since organic plastic scintillators are water and tissue-equivalent and can be produced in small sizes, they are widely used in radiotherapy. Non-water-equivalent inorganic scintillators have promise in RT due to high light output, measuring dose even at lower energy radiation, and overwhelming signal intensity compared with the Cherenkov Effect. In this study, the dosimeter system using new generation inorganic scintillation materials was modeled in Geant4 simulation. The dose values were obtained by sending the photon energy distribution of Varian brand linac in the range of 6-25 MV to the water phantom. The results for various inorganic scintillators were compared with the water to find out the correction factor.

Detailed Study of Radioactive Decay Properties of Nobelium Isotopes With α, β, γ-Spectroscopy Method

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Abstract:
At FLNR JINR, experiments are aimed to investigate the radioactive decay properties (α, β, γ spectroscopy) and the cross-sections measurements of transfermium elements, synthesized in complete fusion reaction of the accelerated heavy-ion beam with target nuclei, with subsequent evaporation of several light particles at the kinematic separator SHELS [1,2]. Many experiments were devoted to the study of the radioactive decay properties of Nobelium isotopes produced as an evaporation result of two or three neutrons by a compound nucleus in the reaction of ^{48}Ca beam with ^{204,206,208}Pb targets and the asymmetric reaction of ^{22}Ne with ^{238}U. These Nobelium isotopes have sufficiently high production cross-sections, which allow us to collect good statistics for studying decay properties by methods of alpha, beta, and gamma spectroscopy. Nobelium isotopes are interesting due to the possibility to study changes in radioactive decay properties around the neutron subshell N=152, thereby could be obtained data necessary to understand how the properties of heavy element isotopes behave in the region of neutron subshell N=162

Keywords: alpha decay, beta decay, fusion-evaporation reactions, heavy-ion nuclear reactions, lifetimes, nuclear energy levels, nuclear properties, X-rays.

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Relativistic Three-Body Bound States in Momentum Space[+]

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Abstract:

In this talk, we review the relativistic Faddeev integral equations for three-body bound states in momentum space. We show how the boosted fully off-shell two-body t-matrices, the inputs for the relativistic Faddeev integral equations can be obtained by two different approaches: i.) solving the relativistic Lippmann-Schwinger integral equation with boosted potentials; ii.) solving the first resolvent integral equation with nonrelativistic Right-Half-Shell t-matrices, with no need to calculate the relativistic potentials. In both approaches, we present the numerical results for the relativistic three-body binding energies obtained from Malfliet-Tjon potentials. In addition, the contribution of different relativistic corrections and the numerical tests for the accuracy of the solution of the Schrödinger equation will be discussed in detail.

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Study of the Effects of Nuclear Level Density Parameters on the Cross-Sections for Elements with Z≥90

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Abstract:
Nuclear reactions induced by photons are of prime importance role in different aspects of basic research and applications in physics such as activation analyses, preparation of medical isotopes and characterization and transmutation of nuclear wastes, and have been widespread since the 1940s. The characteristics of the giant dipole resonance for the actinide nuclei and the deformation parameters of these nuclei are of particular interest. For such high-Z, high-Coulomb-barrier nuclei, the total photonuclear cross-section is equal to the sum of the photoneutron and photofission cross-sections. To study the effects of nuclear level density parameters on the cross-sections for the actinide nuclei, the energy region for incident photon energy has been selected near the giant dipole resonance peak energy. The result of the analysis obtained by using different level density models in TALYS nuclear modular codes was compared with available data in the experimental data library EXFOR.

Keywords: Nuclear reactions, level, density, TALYS

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Theoretical Study of the Competition of Quasi-Fission and Fusion-Fission Processes in the Reactions Leading to the Formation of New Superheavy Nuclei in the Framework of the Dynamical Model

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Abstract:
The synthesis of neutron-enriched isotopes, thereby advancing to the center of the "island of stability", and the production of superheavy elements with Z=119, 120 are the key trends in superheavy elements physics. The reactions of ^{48}Ca beam with actinide target nuclei have been discussed in the framework of a multidimensional dynamical model of nucleus-nucleus collisions, based on the Langevin equations [1,2]. The cross-sections of capture and fusion and the cross-sections of evaporation residues for two combinations of colliding nuclei ^{48}Ca+^{244}Pu and ^{48}Ca+^{248}Cm have been studied. The possibilities of obtaining new neutron-enriched isotopes of nihonium and moscovium in complete fusion reactions followed by evaporation of a proton and one or two neutrons have been analyzed.
The competition of quasi-fission and fusion-fission processes in the reactions leading to the formation of 119 and 120 elements has been studied. Uncertainties in the calculation by different theoretical models of the fission barriers determining the survival probability of the compound nucleus have been investigated.

Keywords: fusion-fission, nuclear reactions, quasi-fission, superheavy elements.

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Rank 1 First Forbidden Transition in Hg-194 Isotope

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Abstract:
The rank1 first forbidden (FF) transition was investigated by using Schematic Model (SM) for the neutron-rich isotope of Hg-194. We solved by considering only the particle-hole channel the eigenvalues and eigenfunctions of the rank1 transition Hamiltonian within the framework of proton-neutron Quasi Random Phase Approximation (pn-QRPA). The Woods-Saxon (WS) potential basis was used in our calculations. The relativistic beta moment matrix element of the rank1 transition was calculated directly without any assumption. The Hg-194 isotope was considered in a spherical shape in the simulation. The calculated log(ft) value and the rank 1 beta strength distribution of the Hg-194 isotope were compared with the experimental studies. The obtained results were found to be closer to these values.

Keywords: Rank1 transition, pn-QRPA, Schematic Model, Woods-Saxon potential.

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A pioneer approach for nuclei formation in relativistic ion collisions

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Abstract:
During the last decade, many experimental groups at different laboratories and countries, e.g., FOPI, MAMI, HypHI and FAIR in Germany, STAR, ALICE in the USA, NICA in Russia, and RIKEN in Japan, have focused on investigations of nuclei and hypernuclei formation. In the experiments of these facilities, exotic nuclei and hypernuclei can be formed in the peripheral or in the central nucleus-nucleus collisions. For this reason, the new model for statistical disintegration of excited systems formed in heavy-ion collisions [1] is further developed [2]. Comparisons with experimental data from Ni+Ni and Au+Au at Eb/A=150 and 250 MeV and , respectively, Eb/A=90, 120, 150 and 250 MeV are done. Based on these findings, we foresee that our new theoretical approach can be a pioneer to analyse hypernuclei which can be obtained in future experiments.

Keywords: Central nucleus-nucleus collisions, coalescence, nuclei formation.

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Finding Gamma Shielding Properties of Li2B4O7 (Lithium Borate) Based Glasses in GA TE simulation

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Abstract:

Ionizing radiation is found at nuclear power plants, nuclear waste sites, hospitals and nuclear physics laboratories. The radiation shielding is of great importance for the safety of people working with radiation and the biological environment. Shielding properties of the Li2B4O7 (lithium Borate), CaMg(CO3) and Nd2O3 doped lithium borate glasses were investigated by NaI(Tl) scintillation detector system in Monte Carlo simulation. In this study, mass attenuation coefficients (μm), mean free path (MFP) and half value layer (HVL) of the glasses based on lithium borate were calculated at the gamma ray photon energies range in 80-2000 keV . XCOM software was also employed for theoretical calculation of the glasses' radiation shielding parameters for 1 keVto 10^5 MeVenergy region.

Keywords: Half value layer, Lithium Borate, Mass attenuation coefficients, Mean free path.

Determination of Photon Radiation Shielding Properties of Some Boron Doped Glass Materials Using MCNP6 and Calculation of Removal Cross-Section Values

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Abstract:

In today's world, the place that radiation has in our lives in energy, health and industrial areas is increasing day by day. While making use of radiation so much, the harm it may cause should not be ignored. For this reason, shielding is the most basic protective measure in every area where radiation is used. Considering the world reserves, Türkiye is a boron-rich country. In this sense, while developing radiation shielding materials, boron-doped materials have been prioritized in the recent past [1]. In this study, the mass attenuation coefficients (MAC), which form the basis of photon radiation shielding, for 40-60% B_2O_3 doped glass samples produced by Liu et al. in 2022 [2] were calculated using the Monte Carlo Method based MCNP 6.2 program. The obtained results were compared with the XCOM database and their suitability was investigated. At the same time, neutron removal cross-section calculations of the relevant glass materials were performed.

Keywords: Boron, Mass Attenuation, MCNP 6.2, Radiation Shielding, Removal Cross Section.

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The Investigation of Electromagnetic Transition Properties of even-even $^{108-114}$Cd Isotopes by the Framework of IBM

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Abstract:
Searching the answers to questions concerning deformation for the region between the nuclear magic numbers Z=50 and Z=82 has been raised recently. As it is known very well that the nuclei around the middle part of the N=50−82 major neutron shell are strongly collective which extends to nuclei at or near the Z=50 closed proton shell. The structure of electromagnetic transition properties and energy levels of even-even Cd isotopes have long been cited as one of the prime examples of vibrational behavior and were identified as shape coexistence besides underlying vibrational nature remained perfect [1-9]. The Cd isotopes have also been pointed out by both Bohr-Mottleson [10] and Arima-Iachello [11,12], as some of the best examples of nuclei showing vibrational behaviors in nuclear structure. However, some experimental data and calculations have reflected a new modified picture of such nuclei, particularly emphasizing them to be soft about the γ deformation with an almost maximum effectivity trivially of γ=30 [13]. In this study, the ground state, quasi beta and quasi gamma-band energies of ^{108,110,112,114}Cd isotopes have been investigated by using both (IBM-1 and IBM-2) versions of the interacting boson model (IBM). In calculations, the theoretical energy levels have been obtained by using PHINT and NP-BOS codes. The presented results are compared with the experimental data in respective tables and figures. In the end, it was seen that the obtained theoretical results are in good agreement with the experimental data.

Keywords: Energy Level, Electromagnetic Transition, Multipole Mixing Ratio, Cd isotope, IBM.

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Designing a Particle Accelerator for the Future: FCC-e+e-Injector Complex Design

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Abstract

The FCC-e+e- is a design project of a circular collider of around 100 km circumference with a center of mass energies of the collider ring varying between 91.2 and 365 GeV. The current injector complex design of the FCC-e+e- project consists of e+/e− linacs, which accelerate the beams up to 6 GeV, a damping ring at 1.54 GeV, a pre-booster ring, accelerating the beam up to 16 GeV and a booster synchrotron ring integrated in the collider tunnel accelerating the beams up to the collision energies. In this study, the damping ring and pre-booster ring design is reviewed including some various considerations as different options.

Keywords: Damping ring, future circular collider, injector complex, lepton ring design, pre-booster ring.

A Proposal for Kırıkkale-2053 Vision: Hadron Therapy Center

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Abstract:
Particle accelerators have many applications as well as their success in fundamental research throughout history with very large machines to understand what the universeis made of and how it works. One of the most successful accelerators has been used inmedicine to treat cancer with relatively smaller machines. In addition to radiotherapy based on linear electron accelerators, hadron therapy centres have been taking an important role for the benefit of humanity for decades. Hadron therapy uses fast hadronsfor cancer treatment as providing better dose deposition and sparing healthy tissues compared to conventional radiotherapy. Although the number of hadron therapy centres has been increasing around the world, there is no centre established in Türkiye so far.In this study, the Kirikkale-2053 vision will be introduced, the applications of accelerators will be reviewed with a focus on hadron therapy and a hadron therapy centre proposal will be drafted to be established in Kırıkkale, Türkiye.

Keywords: Linac, synchrotron, gantry, conventional therapy, hadron therapy.

Analysis of D-T Nuclear Fuel Depletion in Advanced Fussion Reactor of Approximate Method

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Abstract:
In this study, the netronic data and results obtained by fusing D-T (Deuterium-Tritium) isotopes of the fuel required for the advanced fusion reactor at very high temperatures in plasma environments, according to the output power and geometrical condition of the reactor in suitable environments, were calculated. In fusion reactors, high energy is obtained and other reactions, D-D or D-T fusion fuels, are used as fuel. In the hybrid reactor, the energy obtained with D-D fuel is less than that of D-T fuel. Therefore, D-T fusion fuel is preferred as fuel. High-temperature D-T nuclei that come together for the reaction. Plasma desired to be formed by fusion is obtained. Different isotopes of light elements can be paired to achieve fusion; (DT) reaction has been described as the most efficient for advanced fusion reactors. In the future, fusion reactors will use the hydrogen isotopes deuterium and tritium to fuel the fusion reaction. In the deuterium-tritium (DT) fusion reaction, high-energy neutrons are released along with helium atoms. These electrically neutral particles escape the magnetic fields confining the plasma and are engulfed by the blanket covering the surrounding walls. About 80% of the energy released as a result of the D-T fusion reaction14.04 MeV of the incoming energy belongs to very high energy fusion neutrons. In fusion and hybrid reactors, it is necessary to provide the TBR terms to maintain the continuity of the operation of the reactors. In the situation when there are no additions made to the blanket, the values TBR< 1.25for Flibe are observed. In this study, both simulation program MCNP/5X and theoretical studies were used for neutronic analysis.

Keywords: D-T fuel, Apex Hybrit Reactor, TBR, Energy Multiplication

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Evaluation of the Wobbling Motion in Even-Even Nuclei within a Simple Rotor Model

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Abstract:
A unique fingerprint of triaxiality in nuclei, i.e., wobbling motion, is studied for several even-even isotopes within the A~130 mass region. The used formalism is based on a simple rigid rotator, which achieves triaxiality due to the asymmetry of the three moments of inertia corresponding to the rotational ellipsoid. From the initial rotor Hamiltonian, a set of equations for each wobbling band will emerge. The equations describe a rotational (collective) motion of the nucleus around the axis with the largest moment of inertia, combined with an oscillatory-like perturbation of phonon character around the other two axes. With the obtained analytical results, the wobbling spectrum for ^{130}Ba, ^{134}Ce, and ^{136}Nd isotopes is studied, performing calculations of quantities such as excitation energies, quadrupole moments, deformation parameters, transition probabilities and so on. This straightforward approach provides a good quantitative analysis of the wobbling motion in even-even nuclides.

Keywords: Wobbling motion, particle rotor model, rotation, collective motion, triaxiality, signature, parity.

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The Study of Multiplicity Distributions for Prompt Neutrons Emitted in Spontaneous Fission of Transfermium Isotopes

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Abstract:

The experiments on the study of the spontaneous fission properties of transfermium isotopes using the SHELS (Separator for Heavy Element Spectroscopy) and the SFiNx (Spontaneous Fission, Neutrons and X-rays) detectors setup [1] were carried out at the Flerov Laboratory of Nuclear Reactions (JINR, Dubna, Russia). The Tikhonov statistical regularization method [2] is used for the analysis of the yield of fission neutrons. As a result, many distributions of multiplicity for the emission probability of spontaneous fission prompt neutrons were obtained for neutron-deficient isotopes (^{252}No, ^{254}No, ^{254}Rf, ^{256}Rf, ^{244}Fm, ^{246}Fm, ^{248}Cm, ^{244}Cm). Special interest is the high negative distribution asymmetry for ^{256}Rf and ^{246}Fm: it might suggest the exotic fission modes. The theoretical calculations of neutron multiplicity distributions were carried out with the improved scission point [3,4] and GEF models [5]. Both models work well for isotopes of Cm and Cf. There are no good agreements with experimental results for heavier isotopes (especially for isotopes placed on the 152 neutrons shell).

In this report, the technique to restore multiplicity distribution is discussed. Also, exotic modes of spontaneous fission search results are shown in comparison with the theoretical calculation.

Keywords: Exotic nodes**,** prompt neutrons, spontaneous fission, statistical regularization.

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Collective Motion in γ-Unstable Nuclei within Energy-Dependent Davidson Potential and Deformation Dependent Mass Formalisms

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Abstract:
In this work, we propose an exactly solvable model which is constructed by considering energy-dependent Davidson potential in the β part of the generalized version of the collective quadrupole Bohr Hamiltonian (BH) within deformation-dependent mass (DDM) formalism. Analytical expression of the energy spectra and corresponding wave functions are derived by means of the asymptotic iteration method. The combined effect of DDM and the energy dependence of the potential coupling constant is duly investigated. Also, the numerical calculations of the electric quadrupole transition ratios and energy spectrum of several nuclei undergoing a γ-unstable shape phase transition are performed and compared with experimental data as well as with other theoretical models. Besides, we investigate the correlation between both formalisms: energy-dependent potential and DDM, through solutions of BH for transition nuclei in the limit E(5) with Davidson potential.

Keywords: Bohr Hamiltonian, collective motion, deformation dependent mass, energy-dependent Davidson potential.

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Mass and Decay Constants of Radially Excited Heavy Mesons in QCD Sum Rule

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Abstract:

QCD sum rule (QCDSR) proposed by Shifman, Vainstein, Zakharov in 1977 [1] is a successful theory to determine the hadronic properties like mass, decay constants, and form factors, and coupling constant. Perturbative solutions can be obtained in the deep inelastic regime of hadrons since the QCD coupling constant is small in this region. However, as the interaction range increases, the coupling constant increases, and non-perturbative contributions are needed to determine the hadronic properties. These parameters can be determined in a low energy regime via the QCD sum rule in terms of the quark masses, strong coupling constants, and non-perturbative quark and gluon condensates. To determine the mass and decay constant of mesons under consideration in the QCDSR method, a two-point correlation function is considered

$$\Pi(q^2) = i \int d^4x \, e^{iqx} < 0|T(J(x)\, J(0)|0 > .$$

The local current J(x) carries the same quantum numbers as the meson under consideration. The correlation function in the QCDSR method is calculated in two different kinematic regions, namely, in terms of hadrons and terms of quarks and gluon degrees of freedom in the deep Euclidean region. Then, two representations of the correlation functions are matched by using the quark-hadron duality ansatz. To enhance the ground state contributions as well as to suppress higher state contributions, Borel transformation is carried out as the last step. After these operations, the relevant sum rules are derived for obtaining the required hadronic properties. Many excited states of mesons and baryons have been experimentally discovered. For instance, the radially excited mesons, $\eta_c(2S)$, $\Psi(2S)$, $\eta_b(2S)$ $\Upsilon(2S)$, $B_c(2S)$, $B_c^*(2S)$ have already been observed. Among them, B_c mesons were harder to detect due to the small cross-sections, and this observation was achieved in 2019 by CMS and LHCb collaboration [2,3] . Predicting these radially excited states' mass and decay constants is crucial for testing the theoretical models and can shed light on further experimental studies. Hence, a systematic theoretical analysis will be a good way to test the predictions of the model. In a previous study, we investigated the $B_c(2S)$ $B_c^*(2S)$ mesons in QCD sum rules [4] and in this work, we extend our analysis to investigate the properties of radially excited pseudoscalar $\eta_c(2S)$, and $\eta_b(2S)$ vector $\Psi(2S)$, and $\Upsilon(2S)$ mesons. We constructed the relevant QCD sum rules for these mesons and applying two different numerical methods, the mass and decay constants of these mesons are determined. Our findings are also compared with the findings of the experiments as well as other theoretical approaches.

Keywords: Pseudoscalar mesons, QCD sum rule, Radial excitation

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Determination of the Shell Model Single-Particle Energies by Using Machine Learning Method

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Abstract:
One of the common methods used to investigate the nuclear structures of atomic nuclei is the nuclear shell model which is like the atomic shell model of the electrons that protons and neutrons are thought to occupy the orbits within the nucleus following the Pauli Exclusion Principle. Atomic nuclei with closed shells are very stable and in the nuclear shell model calculations, valence nucleons that are more than these nuclei are included in the calculations. For the solution of the Hamiltonian of the nuclear system, the information about single-particle energy and two-body interaction between valance nucleons is needed. In this study, we have used machine learning method in order to obtain neutron single-particle energies by using existing experimental values in the literature. After, we have performed nuclear shell model calculations by using obtained single-particle energies. According to the results, the nuclear spectrum is closer to the experimental spectrum than the results of the calculations by the existing literature single-particle energy values.

Keywords: Nuclear shell model, single-particle energy, machine learning.

Gamow-Teller Transitions for even-even Nuclei of Zn Isotopes by Using pn-QRPA

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Abstract:

The most important weak interaction phenomenon is the nuclear beta (β) decay process, which is typically calculated taking into account that the allowed GT transitions play a crucial role in the classification of astrodynamic events [1]. In this work, we calculate Gamow–Teller (GT) transitions for even-even nuclei of Zinc isotopes, using QRPA methods. Three different QRPA models (single quasi-particle (sqp), Pyatov Method (PM)[2] and the Schematic Model (SM)) are used for the GT strength distributions, including the schematic residual spin isospin interaction between nucleons in the particle-hole and particle-particle channels. Particle-hole and particle-particle interaction parameters are calculated respectively with $\chi^{GT}{}_{ph}$ =5.2/$A^{0.7}$ MeV and $\chi^{GT}{}_{pp}$=0.58/$A^{0.7}$ MeV.. Using these models, Gamow-Teller distribution, sum GT strengths along electron capture direction (Σ $B(GT)_{+}$) and Ikeda sum rule (ISR) are calculated. Our results are also compared with previous theoretical calculations and measured strength distributions wherever available. It is hoped that current research on GT properties will be useful and may lead to a better understanding of the pre-supernova evolution of massive stars.

Keywords: Gamow Teller Distribution, Zinc Isotope, Sum B(GT), β-decay and Electron Capture.

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CDCC Calculation of Elastic Scattering of ^{8}Li on Different Targets

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Abstract:
In this study, angular distributions for ^{8}Li elastically scattered from different targets were investigated and reanalyzed using the continuum-discretized coupled channels (CDCC) method. It tested the accuracy and reliability of the CDCC model for ^{8}Li projectile and studied the contribution of channels to the elastic scattering cross-sections. For the CDCC calculations, the ^{8}Li projectile was described as ^{7}Li + n. The nucleon-target potential was used as the phenomenological optical potential. Single-channel and multi-channel CDCC calculations were performed to determine the effect of exciting channels. The calculation was compared with the literature and found to be in good agreement with experimental data.

Keywords: Elastic scattering, CDCC, ^{8}Li.

Determination of Gamma Radiation Shielding Properties of Metal Boride Coated Aisi 304l Stainless Steel

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Abstract:
In this study, AISI 304L austenitic stainless steel was coated with a metal boride layer by a solid boriding method, which is a thermo-chemical heat treatment. The coating process was carried out at 950 ^{o}C for 2, 4, 6 and 8 hours. Mass absorption coefficients (μ/ρ) and half-value layer (HVL) against gamma sources at Eu-152 and Co-60 energies were determined with boronizing and untreated samples 121.8, 244.7, 344.3, 778.9, 964.1, 1085.9, 1173.2, 1332.5, 1408 keV. Obtained experimental results were compared with WinXCOM theoretical values. Interaction parameters for the selected samples have been computed and provided in the extended energy range of 10^{-3}–10^{4} MeV. The coating-matrix interface exhibited a flat, smooth and thin structure of morphology. Coating thicknesses were determined in the range of approximately 20-50.1μm by Scanning Electron Microscopy (SEM). The mass attenuation coefficients were increased with the increasing boronizing time. It was determined that the HVL values of boronizing samples were lower than the non-boronized material. Thus, we can say that boron coated materials are more suitable for gamma radiation shielding and improve the radiation protection properties of boronized AISI 304L austenitic stainless steel.

Keywords: AISI 304L, Boronizing, Gamma-ray, Radiation shielding

Characterization of Different Reactor Parameters of TRIGA Mark II, PWR and VVER under Various Conditions

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Abstract:

In this study, different reactors parameters were analyzed with experimental and simulation calculations. Burnup values [1,2] were obtained for a specific fuel element using experimental non-destructive gamma spectroscopy for the TRIGA Mark II research reactor. In addition, burnup calculation and gamma spectroscopy for a fuel element have been obtained using the MCNP simulation program for TRIGA Mark II reactor. On the other hand, infinite multiplication factor were determined with different burnable absorbers and weight percentages at different temperatures for Triga Mark II, PWR, and VVER reactor fuel assemblies. The results were compared with base fuel which does not contain burnable absorber at different temperatures. According to the results, reactivity was decreased with increased temperature for different absorbers [3].

Keywords: Burnup calculation, burnable absorber, reactor parameters, infinite multiplication factor

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Decay Modes and Half-life of Some Ds Isotopes

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Abstract:
The decay modes and half-lives of superheavy (SHN) $^{265-282}$Ds isotopes are investigated using Relativistic Mean Field (RMF) model with density-dependent point-coupling and density-dependent meson-exchange interaction. The potential energy surfaces (PESs) as a function of β-γ deformation parameters for Ds nuclei have been obtained by using a triaxially symmetric RMF model calculation for the investigation of their ground-state shapes and binding energies. The calculated ground-state binding energy values of Ds isotopes have been used for calculations of Q values of the alpha α, β^+/EC, β^- and spontaneous fission (SF) decay modes. The dominant decay modes and half-lives of the considered Ds isotopes have been predicted using the computed Q-values and some empirical formulas. The results of the present study show that the Ds isotopes are well deformed, with prolate configuration in their ground-states. Our estimations for decay modes and half-lives are consistent with available experimental data.

Keywords: Decay modes, Ds isotopes, Half-life, Relativistic mean-field theory, Superheavy nucle.

Effects of Level Density Models on ^{165}Ho(a,xn) Reaction Cross Section

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Abstract:
Reaction cross-section, measured or evaluated theoretically, studies are required for the investigation of reaction mechanisms as well as the structure of nuclei. In the many all-in-one nuclear reaction codes, some theoretical models are implemented inside the code and calculations are realized via these models at 1-200 MeV energy range, including fission and fusion cross-sections. In this study, the cross-sections of the ^{165}Ho(a,xn) reaction were calculated with level density models implemented in TALYS 1.95 nuclear reaction code to determine the effects of these models with induced alpha energies of more than 10 MeV. The theoretically calculated reaction cross sections compared with experimental data, available in EXFOR, the experimental nuclear reaction library of IAEA.

Energy Loss and Depth Dose Calculations in Gonad Tissues for Electron Radiation

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Abstract:

In the radiation interaction with matter, it is known that stopping power and absorbed dose of the target are closely related to each other. This relationship has been observed in our previous work on several biological compounds. In this study, this relationship has been also investigated for electrons incident on ovary and testis at the energy from 1-20 MeV. The stopping power is calculated by taking into account the velocity-dependent effective charge and effective mean excitation energies of the target material. Target electronic charge densities have been determined with the Hartree-Fock-Roothaan (HFR) atomic wave function. Depth dose values have been also determined by EGS code. Stopping power, depth dose values and CSDA ranges were compared, and a linear relationship between stopping power and dose values have been observed. In this study, it is also revealed the difference between gonadal and other soft tissues by means of their response to radiation.

Keywords: Absorbed dose, CSDA Range, EGSnrc, Electron, Stopping Power

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ABSTRACTS OF POSTER PRESENTATIONS

Effects of Deuteron and Alpha Optical Model Potentials on the Production Cross-Section Calculations of Some Radiobromine Isotopes

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Abstract:

The extensive use of radioisotopes in diverse fields, particularly in medical studies for diagnosis and treatment, is one of the outcomes of evolving technology and improved scientific research. Among the various radioisotopes used for medical purposes, an example that can be highlighted considering their properties and utilization possibilities is radiobromine isotopes. As the use of radioisotopes expands, experimental and theoretical investigations regarding various radioisotopes have become more frequent in the literature. In this regard, it is apparent that studies undertaken not just experimentally but also theoretically provide undeniable contributions to the literature. Besides, theoretical studies might offer information to researchers in circumstances when experimental studies cannot be carried out for a variety of reasons. One of the metrics that might give information to the researchers is the cross-section, which is data associated with the occurrence of a reaction. The framework of this study was constructed by taking into account the importance of radiobromine isotopes in medical applications as well as the effects of some parameters that might have an impact on their production cross-section calculations. In this context, the impact of five deuterons and eight alpha optical model potentials, which are available in the 1.95 version of the TALYS code, on the production cross-section calculations of $^{75\text{-}77}$Br radioisotopes through some (d,x) and (α,x) reactions have been studied. The results of the calculations of each investigated reaction were compared visually and numerically with the experimental data available in the literature for each reaction, and the outputs were interpreted.

Keywords: Alpha optical model potential, cross-section, deuteron optical model potential, radiobromine, TALYS.

Production of Vector Leptoquarks at FCC Based γp Collider

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Abstract:
In this study, we analyze the production of vector leptoquarks at FCC-based γp Collider in a model-independent framework. The production cross-section for the vector leptoquark production in FCC-γp collider is calculated for the case of finite anomalous gauge boson couplings $\kappa_{\gamma,Z}$ and $\lambda_{\gamma,Z}$. The discovery limits for the masses of vector leptoquarks have been analyzed in both cases.

Keywords: anomalous gauge boson couplings, FCC, Leptoquarks, γp colliders.

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Simulating the Effect of Activity and Volume of Radioisotopes on a Gamma Camera's Performance

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Abstract:
Generally, the methods that are utilized in the enhancement of gamma camera's performance and renovation are hardware (as modifications in crystals and /or collimators characteristics) and software (as tomographic image reconstruction algorithms)**.** The importance of using simulation platforms for the development and renovation of gamma cameras resides in providing both methods that are utilized in the development of these cameras. In addition, the simulation provides accurate results without the need for direct, costly and time-consuming experimentations. The effect of radioisotopes activity and volume on image quality was investigated in this work, by using one of the Monte-Carlo simulation platforms (Gate) in nuclear medicine imaging. Acquisitions of both constant and variable-dimensional cylindrical ^{99m}Tc sources placed in a cubic-phantom of air and a cubic-phantom of water with a dimension of 20*20*20 cm were made for this purpose, depending on the activity used. The simulation model included Gate modeling of the low energy all-purpose camera collimator (hole length 20 mm and diameter 1.6 mm) and a back-compartment accounting for photomultiplier tubes and associated electronics. The results obtained from the simulation were in agreement with the direct experimental results.

Keywords: Simulation, Monte-Carlo, Phantom, Gamma camera.

Production of Vector Leptoquarks at FCC Based μp Collider

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Abstract:
Leptoquarks (LQs) are hypothetical bosons, each coupling to a lepton and a quark of a given generation. In this study, we investigate the production of vector leptoquarks at the Future Circular Collider (FCC) based muon-proton (μp) colliders, in a model-independent framework. We calculate the signal and corresponding background cross-sections and analyze the kinematical distributions to obtain suitable cuts for the discovery. Also, we determine the leptoquark mass limits at the FCC-based μp collider taking into account the criteria Statistical significance(SS), SS $\geq$ 2, SS $\geq$ 3 and SS$\geq$ 5 which denote the 2σ (exclusion), 3σ (observation)and 5σ (discovery) limits, respectively.

Keywords: FCC, Leptoquarks, muon-proton colliders.

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Investigation of Centering Problem in the Cadmium Zinc Telluride (CZT) Cardiac Camera

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Abstract:

CZT Cardiac Cameras; are special SPECT cameras with solid-state cadmium zinc telluride detectors. Unlike standard [NaI(Tl)] crystal gamma cameras, the CZT detector is a semiconductor that converts gamma photon energy directly into an electrical signal. The diagnostic method applied in the evaluation of coronary artery disease; is well designed for myocardial perfusion scintigraphy. The device has a C-shaped gantry with a fixed geometry detector. It has 19 fixed detectors arranged in 3 rows, oriented perpendicular to the long axis of the patient, each equipped with pinhole collimators with an aperture diameter of 5.1 mm. All detectors face the same center of rotation where the heart should be positioned and heart focused collimation is being done.

In patients who are obese, morbidly obese or not in the normal location of the heart in the body (middle heart); due to body thickness or the position of the heart, the center of the heart and the isocenter of the device do not coincide. A phantom study was conducted to see how this affects the imaging performance of the CZT cardiac camera. A homogeneous and spherical ball with a diameter of 4 cm was used for the research. To be able to measure away from the center a wooden phantom with 8 cavities and a total length of 32 cm was designed. For the first imaging, the spherical ball was placed in the first recess of the phantom. By matching the center of the device with the center of the sphere; the center, which is our reference point, has been determined. For the next image, the image was taken by placing the spherical ball in the other cavities, respectively, without changing the center. In the imaging; for the X-axis, a total of 8 images were taken by moving the spherical ball 4 cm from the center along the axis; for the Z-axis, a total of 5 images were taken by moving the spherical ball 4 cm from the center along the axis. For the diagonal axis, a total of 5 images were taken by moving the spherical ball 4 cm away from the center along both the X and Z axis.

In the phantom study; in patients whose heart center does not coincide with the isocenter, the image quality and dose distribution were investigated. According to the results obtained, apart from centering, deviations from sphericity and differences in dose distribution were observed. Count values were obtained at the center; for the X-axis, it decreased by 15.7% at the 3rd imaging (8 cm from the center), and for the Z-axis it decreased by 11.9% at the 3rd imaging (8 cm from the center) and 21.7% at the 3rd imaging 11,3 cm from the center) on the diagonal axis. For each axis, from the 4th imaging, a disaster area has been formed and the image area has been exited. It is very important to center the patient as much as possible, otherwise, the doctor will misdiagnose.

Keywords: Cardiac Imaging, (CZT) SPECT, Nuclear Medicine

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Fermi Transition Logft Values for V-46 and Cr-46 isotopes

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Abstract:
Superallowed beta decays are defined to be beta transitions taking place between component states of an isospin multiplet between isobar analogue states. The transition occurs between $J^{\pi}=0^{+}\rightarrow 0^{+}$. Since the superallowed beta decays depend uniquely on the vector part of the weak interaction, the Fermi matrix element M_V is quite important for these decays. In this study, allowed Fermi (F) transition was simulated using Pyatov Method (PM) for V-46 and Cr-46 isotopes. The Fermi beta (β) decay calculations were obtained by the pure Pyatov Method without introducing effective values of coupling constants using the proton-neutron quasi-particle random phase approximation (pn-QRPA). The pn-QRPA was utilized in the PM's particle-hole (ph) and particle-particle (pp) channels. The Woods–Saxon (WS) potential basis was used in our calculations. We solved the secular equations of Fermi transitions for eigenvalues and eigenfunctions of corresponding Hamiltonians. A spherical shape was assigned for these nuclei throughout all simulations. The calculated log*ft* values of the allowed Fermi transitions of PM simulations were found to be closer to the experimental values.

Keywords: Fermi decay, pn-QRPA, Pyatov method, Woods-Saxon potential

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The Discussions on the Atomic Structures of Two Newly-Synthesized Boron Compounds; Stated as the new Radiation Shielding Materials

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Abstract:
Boron compounds have recently been observed as shielding materials for applications of new technologies in the industrial and medical areas [1]. There has recently been a wide interest in investigations on matter-photon interactions especially in the fields like radiation biophysics, protective materials, nuclear industry and space exploration applications, etc [2-4]. In this study, the conclusions about the atomic structure of two newly synthesized boron compounds (LaB_6 and CeB_6) were curiously discussed because they were theoretically stated as good radiation shielding materials [5] by using the Monte Carlo method. The expressions of the analyzed results of such compounds are based on the X-ray diffraction (XRD) patterns and Scanning Electron Microscope (SEM) images. It was concluded that the produced compounds of hexaborides have interesting structural features as the challenging materials for gamma radiation shielding.

Keywords: Atomic structure, Hexaboride, Monte Carlo, Radiation Shielding

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Investigation of Production Reactions Cross Sections of ^{64}Cu Radionuclide Using in Nuclear Medicine

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Abstract:
Nuclear medicine and nuclear medical imaging methods are very effective methods for diagnosis and treatment of many diseases. In the nuclear medical imaging method are used radiopharmaceuticals or radiotracers to examine the physiology and metabolism of the body. One of the imaging modalities in nuclear medicine studies is positron emission tomography (PET) and the other imaging method is single-photon emission computed tomography (SPECT). ^{64}Cu radionuclide is used in PET and SPECT. In the present study, producting reaction cross sections of ^{64}Cu radionuclide have been calculated. The different producting method of ^{64}Cu radionuclide, using cyclotron or neutron generotor, has been compared and discussed. The producting reaction cross sections of ^{64}Cu radionuclide were predicted by using the Tel et al formulas and available other on literature formulas. The calculated cross-section values from the formulas were compared with the each other and with the available experimental data from EXFOR.

Keywords: Cross Section, Nuclear Medicine, ^{64}Cu, PET, SPECT, Tel et al. formula.

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Neutron Emission Cross-Section Calculations of Production of ^{44}Sc, ^{62}Cu, ^{72}As, ^{89}Zr, ^{117}Te, ^{119}Te and ^{124}I Medical Radioisotopes with Alpha Beams

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Abstract:
The production routes of medical radioisotopes have been mostly carried out using low-energy accelerators with proton and deuteron beams. These production routes require highly enriched target materials. To avoid the use of highly enriched targets and the recovery problems new production methods have been investigated. In the present study, neutron emission cross-sections for ^{44}Sc, ^{62}Cu, ^{72}As, ^{89}Zr, ^{117}Te, ^{119}Te, and ^{124}I medical radioisotopes irradiated with alpha have been calculated up to 50 MeV using ALICE/ASH nuclear reaction model code. The hybrid model and geometry dependent hybrid (GDH) model for pre-equilibrium reaction and Weisskopf-Ewing (WE) model for equilibrium reaction have been performed. The results of the theoretical and available experimental calculations have shown that the alpha incident energy in the range of 15-21 MeV may be sufficient to produce these medical radioisotopes by (α,n) reactions.

Keywords: ALICE/ASH, Cross-section, Hybrid Model, GDH, Medical radioisotopes.

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Double beta decay calculations of ^{46}Ca nucleus

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Abstract:
The study of double-beta decay 2νββ has been widely used in nuclear physics to probe nuclear structure theories. ^{46}Ca is one of the lightest double beta decay candidates on which this work focuses. We have evaluated some nuclear spectroscopic properties and 2νββ nuclear matrix elements (NME) of Gamow-Teller transitions in A=46 isobars. We have performed nuclear shell model calculations by means of NuShellX@MSU structure code. The full fp-shell valence space is used with various effective Hamiltonians valuable in this mass region. The obtained results are then discussed and compared with the available experimental data. Statistical analysis is investigated to achieve any correlation between 2νββ NME and some calculated observables.

Keywords: Double beta decay, 2νββ matrix elements, fp space model, GT strength distributions, the nuclear structure of ^{46}Ca, ^{46}Sc and ^{46}Ti nuclei, NuShellX&MSU code.

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Dosimetric Study of Heterogeneity in Lung Cancer with RX Radiotherapy Treatment

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Abstract:
Cancer is a major public health problem. Treatments can be systemic or locoregional. In the latter case, the treatment technique plays an important role in making it possible to specify the tumour location. The radiotherapy goal is to deliver a curative radiation dose to the target volume while sparing nearby organs at risk (OAR). Determining the precise location of this target volume as well as the OARs makes it possible to define the position and power of the irradiation beams to be used.

In this work, we used the clinical challenges of 12 lung cancer cases. The results of the various treatments were evaluated using a dosimetric study. According to the therapeutic regimen recommended by the Oncological Radiotherapy French Society (SFRO), the total 60 Gy dose assigned to these lung cancer patients was divided into 30 fractions. Several interesting results can be noted in our study. The dose constraints, concerning the target volume and the organs at risk, were respected. However, qualitative and quantitative analyzes of the results show optimal target volume coverage only in the 6 cases.

Keywords: Lung, treatment cancer, radiotherapy, RX.

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Determination of Front and Lateral Dead Layer Thickness of a p-type HPGe Detector by Monte Carlo Method

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Abstract:
To accurately evaluate the activity of natural and artificial radioactive nuclei in biological, geological, and environmental materials, precise characterisation of HPGe detectors with high energy resolution is necessary. In the characterization with the Monte Carlo method, it is expected that the experimental and the calculated efficiency will agree within acceptable limits. One of the most important parameters of the characterization is the thickness of the dead layer, a parameter that has a significant impact on efficiency and that the manufacturer does not provide with full precision and that thickens over time. In a previous study, the outer dead layer thickness of a p-type HPGe detector was found to be 1.29 mm. Many studies suggest that the thickness of the dead layer may vary at the front and lateral surface of the crystal. For this reason, for each of the front dead layer thickness varying between 1.2-1.5 mm in 0.1 mm steps, the lateral dead layer thickness varying in the range of 1.2-1.5 mm at 0.1mm intervals was scanned with the MC method and the compatibility of the obtained efficiencies with the experimental efficiency was examined. This study was carried out with point sources for 17 photon energies varying in the range of 59-1408 keV. It has been observed that the simulation efficiencies for each energy are in good agreement with the experimental efficiency when the front dead layer thickness is 1.42 mm and the lateral-dead layer thickness is 1.2 mm. While the biggest difference with the experimental efficiency in the outer dead layer thickness was 16.0 %, it was 3.4 % when it was separated as front and lateral dead layers.

General Calibration Procedures for the NaI(Tl) Detector and their Application to Natural Radioactivity Measurements

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Abstract:

NaI (Tl) detector systems with high detection efficiency operating at room temperature are widely used today to measure the activities of low-level radioactive sources. In this study, we first aim to present the calibration of the NaI (Tl) 3″×3″ scintillation detector (Ortec&Ametek inc.) for different reference sources (such as IAEA references, Moss-Soil reference, Eckert & Ziegler Analytics standard source and point sources emitting gamma-rays in the 59.5–2614 keV range). Then, the window-based procedures used to determine the stripping rates (α, β, γ, a, b, g) and calibration factors (K_T, K_U, K_K) to be used in the determination of natural radioactivity in soil samples were compared. The conventional window-based procedures used to determine K, U, and Th concentrations are performed by summing the counts in the windows around the energy channel of the most prominent photopics of the radio elements or associated decay series. Such data processing includes, for example, correction of dead time, reduction of background radiation, and stripping of K, U, and Th contributions to the three windows ("unmixing")[1]. We performed simulation measurements to determine standard spectra and stripping rates. The obtained stripping ratio and sensitivity factor results are in reasonable agreement with literature data and published IAEA values [1-3]. In addition, using these values, the natural radioactivity levels of the soil samples collected from the Keleş district of Bursa were determined.

Keywords: NaI (Tl), Natural radioactivity, Sensitivity factors, Stripping ratios

Acknowledgements: This work was supported by the Sakarya University Research Funds (SAU BAP), Project No: 2020-7-25-55

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Photonuclear Reaction Cross-Section Calculations of Sn Isotopes

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Abstract:
Although the atomic nucleus has a history of more than a century, the interactions of the nucleons that make up the nucleus are not yet fully understood. It is possible to better understand the interactions in the nuclear structure by removing nucleons from the nucleus by using photons as projectile particles. The interaction of the atomic nucleus with the photon is energy-dependent due to the wavelength change of the incident photon. Depending on the incident photon's energy, different resonance states may occur in the nucleus. A photon with energy below 30 MeV follows the giant dipole resonance (GDR) mechanism. In this process, the photon energy is transferred to the nucleus by the oscillating electric field of the photon, which causes oscillations between the nucleons inside the nucleus. The reaction cross-section-energy curves of the giant dipole resonance mechanism exhibit the Lorentzian function. The reaction cross-section in the GDR region is calculated by using the Lorentzian function, where resonance cross-section, full width half maximum, resonance energy, and incident photon energy are used. Resonance cross-section, full width half maximum, and resonance energy are called GDR parameters. In this study, photo-nuclear reaction cross-sections of various Sn isotopes have been calculated by using TALYS 1.96 code. GDR parameters, which we found using artificial neural networks in our previous studies, were used in the calculations. Computation results have been compared with the experimental data in the literature.

Keywords: Photo-nuclear reaction, cross-section Giant dipole resonance parameters, TALYS 1.96.

The electric dipole response of even-even ^{160,162}Dy isotope

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Abstract:
The excitation of pygmy and giant dipole resonance (PDR) in even-even ^{160,162}Dy nuclei are examined through quasiparticle random-phase approximation (QRPA) with the effective interactions that restores the broken translational and Galilean invariances. Where, the transition cross sections and probabilities, photon strength functions, transition strengths, isospin character, and collectivity of the predicted E1 responses were studied.

Keywords: GDR, PDR; QRPA; ^{160,162}Dy.

Comparison of PTV and Critical Organ Doses of AAA, AXB and MC Algorithms Used in Lung Stereotactic Body Radiotherapy

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Abstract:
The main purpose of radiotherapy is to give the maximum dose to the determined tumour volume while giving the minimum dose to the critical organs around the tumour. With the developing technology, progress has been shown in the irradiation techniques of tumours formed in small volumes [1]. Chief among these is stereotactic body radiotherapy (SBRT). The main principle of SBRT is based on the delivery of high doses to the targeted volume in a single or several fractions [2]. In this study, it is aimed to compare the differences in lung SBRT treatment plans obtained with different algorithms for 10 cases on critical organs and target volume. In the study, images were obtained from patients by performing free-breathing, static and 4DCT (Four-Dimensional Computed Tomography) scanning. All these images were transferred to the Eclipse and Monaca treatment planning systems (TPS). A total of 30 plans were created in the Anisotropic Analytical Algorithm (AAA), Acuros XB (AXB) and Monte Carlo (MC) treatment algorithms. Two half-arc Volumetric Modulated Arc Treatment (VMAT) technique, consisting of the same angles, was used in all plans. The plans created were compared with each other. As a result of these comparisons, the differences between the treatment plans obtained from 3 different algorithms were investigated. No statistical difference was found in the experimental results.

Keywords: Lung, SBRT, Anisotropic Analytical Algorithm (AAA), Acuros XB (AXB), Monte Carlo (MC)

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Characteristics of Secondary Particles Associated with the Leading Protons in N^{12}c and P^{12}c Collisions at 3.37 GeV incident Energy

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Abstract:
In this work, we have presented the experimental data on the dependencies of the average multiplicities of the charged pions and accompanying protons on the longitudinal and transverse momenta of leading protons in inelastic minimum-bias n^{12}C and p^{12}C collisions at 4.2 GeV/c (corresponds to incident kinetic energy 3.37 GeV). The longitudinal and transverse momentum distributions of the leading protons for both collision types have been also presented and discussed. The experimental results on the associative multiplicities of charged pions and accompanying protons have been compared systematically with the predictions of the modified FRITIOF model. As expected from the energy-momentum conservation, the average multiplicities of charged pions and accompanying protons decrease with increasing longitudinal momentum P_{Lmax} of the leading protons. However, the average multiplicities of the negative pions in n^{12}C collisions are higher than those in p^{12}C collisions at all P_{Lmax} values, which is related to additional production of π^- mesons in neutron-carbon interactions due to the inelastic charge exchange ($np \rightarrow pn$ and $n \rightarrow p+\pi^-$) or $n \rightarrow \Delta^0 \rightarrow p+\pi^-$ reactions.
The average multiplicities of positive pions and accompanying protons both in the experiment and modified FRITIOF model increase with increasing P_{tmax}. It can be explained that the increase in the number of rescatterings of the leading protons on the nucleons of the carbon nucleus leads to the increase of both the transverse momentum of leading protons and the average number of accompanying protons knocked out by them. The modified FRITIOF model describes quantitatively within the uncertainties the dependence of the average multiplicity of accompanying protons on the transverse momentum of the leading proton in n^{12}C collisions. Regarding p^{12}C collisions, the model describes the data qualitatively and model calculations overestimate the experimental values, on average, by a factor of ≈1.2 in almost all ranges of P_{tmax}.
The average multiplicities of negative pions in n^{12}C collisions initially decrease with P_{tmax} up to $P_{\mathrm{tmax}} \approx 0.5$ GeV/c, then they increase with P_{tmax} up to the maximum value of P_{tmax}. In p^{12}C interactions, the average multiplicities of negative pions first increase with P_{tmax} up to $P_{\mathrm{tmax}} \approx 0.5$ GeV/c, then they slowly decrease with P_{tmax} up to the maximum P_{tmax} values. We also note that for all P_{tmax} values, the average multiplicities of negative pions in n^{12}C collisions turn out to be larger than those in p^{12}C collisions. The average multiplicity of the negative pions in the modified FRITIOF model is greater than that in the experiment at all values of P_{tmax} for both n^{12}C and p^{12}C collisions at 4.2 GeV/c.
From the systematic comparison of the experimental data with the model calculations (especially from the comparison of the dependencies of the average multiplicities of charged pions on P_{tmax} of

the leading protons), we could conclude that for a realistic description of the studied experimental dependencies, it is probably necessary to take into account the interaction of strings for the case when fragmentation of strings occurs not outside of the nucleus (as it is assumed in the model [4-8], but inside and, possibly, on the boundary of the nucleus in the modified FRITIOF model.
The spectra of longitudinal momentum of the leading protons in n^{12}C and p^{12}C collisions turned out to be almost identical in shape and have coinciding average values. The fact that the probability (coefficient) of inelastic nucleon charge exchange is independent of the incident momentum has been also confirmed. The transverse momentum spectra of the leading protons in n^{12}C and p^{12}C collisions differ slightly in shape, but their average values coincide with each other. Hence, we can conclude that, on the whole, the kinematical characteristics of the leading protons in n^{12}C and p^{12}C collisions are approximately the same, although they are formed as a result of different processes.

Keywords: Relativistic nucleus-nucleus collisions; invariant mass distributions; Production of multiquark resonance states.

Gamow-Teller Beta Decay Logft Value for P-32 Isotope

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Abstract:
Gamow–Teller (GT) transition is one of the allowed transitions in β-decay. This transition includes the spin-isospin (στ) operators and the angular momentum transfer ΔL equals zero. The τ operator can convert a neutron (ν) to a proton (π) and vice versa. Therefore, its contribution to β decay as well as in charge-exchange reactions is important. Changes in the spin structures are allowed in GT transitions caused by the στ operator [1]. In this study, Gamow-Teller transition properties of P-32 nuclei are studied within the formalism of proton-neutron Quasiparticle Random Phase Approximation (pn-QRPA) both the Pyatov method and Schematic model. The Woods-Saxon potential is used in our calculations. Radioactive nuclei can be produced by reactions $^{32}S(n,p)^{32}P$ and $^{31}P(n,\gamma)^{32}P$ in P-32 nuclear reactors. The most important medical applications of this isotope can be listed as the use of polycythemia vera in primary medicine, leukaemia, and different skin use in elderly patients [2]. The obtained logft value is discussed by comparing it with the theoretical and experimental data in the literature.

Keywords: Gamow-Teller transition, pn-QRPA, Pyatov Method, Woods-Saxon potential

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Resonance Production of Scalar Leptoquarks at FCC Based ep Collider

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Abstract:
In this study, we analyze the prospects of observing scalar leptoquarks at the upcoming Future Circular Collider in hadron-electron mode (FCC-ep), in a model-independent framework. Scalar leptoquarks can be resonantly produced through s- and t-channel signal processes at ep colliders. We calculate the signal and corresponding background cross-sections and analyze the kinematical distributions to obtain suitable cuts for the discovery. Also, we estimated exclusion, observation and discovery limits for the scalar leptoquarks at the FCC – ep collider.

Keywords: FCC, Leptoquarks, electron-proton colliders.

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Assessment of the Radiation Protection Performance of some Boron-Doped Component with SRIM and Monte Carlo Simulations Code

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Abstract:
In this study, the radiation protection properties of boron-doped glass components were investigated for the 0.1-10 MeV energy region using the SRIM code. Considering the increase in the promising radiation applications of boron-doped glasses, the number of studies in this field is needed to increase day by day [1,2]. The effect of glass compounds with Boron additives and Er- Dy content on gamma radiation shielding was investigated. Furthermore, MSP and PR values were also calculated for proton (H^{1}) and alpha (He^{+2}) particles. Neutron macroscopic cross-sections (ΣR) of the glasses were computed. It can be recommended that the effect of glass compounds with B_2O_3 and SiO_2 additives and Er- Dy content may be preferred shield materials in the sense of gamma, alpha, and proton.

Keywords: Radiation protection, MCNP, MSP, PR.

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Comparison of Full and Half VMAT Treatment Plans for 6 MV Photon Beams in Lung SBRT

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Abstract:
For early-stage non-small cell lung cancer (NSCLC), surgery is often the primary treatment option. However, stereotactic body radiation therapy (SBRT) is an alternative treatment for patients who may not be suitable candidates for surgery. SBRT has proven to be an effective technique for treating NSCLC patients by locally delivering a high radiation dose to the tumour with an acceptable risk of toxicity to surrounding healthy tissues. This dosimetric study aims to compare the dosimetric parameters between full and half arc SBRT treatment plans in volumetric modulated arc therapy (VMAT) technique in lung cancer radiotherapy. The SBRT treatment plans of 10 lung cancer patients treated at 60Gy in 3 fractions (60 Gy) were analyzed and compared retrospectively. For this analysis; the planned target volume (PTV) was intended to cover 95% of the isodose volume. Treatment plans for all patients were made using Eclipse treatment planning computer in a TrueBeam medical linear accelerator with 6 MV photon beams, full arc and half arc. In both treatment techniques, the dose criteria for PTV were kept the same, and the doses received by the Critical Organs (OAR; lung, heart, esophagus and medulla spinalis) were evaluated.
When the PTV was evaluated for the two techniques, the Conformity index (CI) value did not change (0.97±0.12), while the Heterogeneity index (HI) value was lower in the full arc plane (0.091±0.15) than in the half arc (0.103±0.10). Lung-PTV V20Gy (%) value is lower in the full arc (3.97±0.05), while it is higher (4.21±0.02) in half arc, Lung-PTV V5Gy (%) value in half arc plan lower (17.41±0.1) and higher (23.15±0.2) in the full arc plane. Heart Dmean(cGy) dose (361.6±24.15) and Heart V5Gy(cc) dose (157.92±34.5), Spinal Cord Dmax(cGy) dose (1487.3±102.6) and Spinal Cord D0.1cc(cGy) dose (1386.6±145.2) and Esophagus Dmean(cGy) dose (352.7±24.2) were found to be lower in the half arc plane. When the plans made are evaluated; It was determined that the PTV received the planned radiation dose in both full and half arc plans. However, we can say that the half-arc treatment plans to be made on the lung where the PTV is located, especially according to the location of the tumour, reduces the dose of critical organs.

Keywords: Full and half VMAT, Lung Ca, SBRT

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Energy Modulated Treatment Plan Optimization for Lung SBRT

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Abstract:
Stereotactic body radiation therapy (SBRT) is a Radiotherapy treatment in which high doses of radiation are given per fraction and completed in a few fractions. SBRT treatments can be applied to tumours with a tumour diameter of less than 5 cm. This dosimetric study aims to compare the dosimetric parameters between the two energies in the dual photon energy medical linear accelerator device and the lung SBRT treatment plans made with the energy modulation created by using these two energies together on the same plan. Lung SBRT treatment plans of 10 patients who were scheduled for SBRT treatment with a radiation dose of 20 Gy per fraction and 60 Gy in 3 fractions for peripherally located tumours with a tumour diameter of less than 5 cm were analyzed and compared. For this analysis; The planning target volume (PTV) was intended to cover 95% of the isodose volume. Treatment plans for all patients were made using the Eclipse treatment planning computer on a TrueBeam medical linear accelerator using the half arc technique with photon beams created with a combination of 6 MV, 15 MV and 6-15 MV. In both treatment techniques, the dose criteria for PTV were kept the same, and the doses received by the Critical Organs (OAR; lung, heart, esophagus and medulla spinalis) were evaluated.
When the PTV was evaluated in three different treatment plans, the Conformity index (CI) value did not change (0.97±0.1), while the Heterogeneity index (HI) value was found to be better than the others (0.103±0.01) in the half-arc plan made with 6 MV. Lung-PTV $V_{20Gy\,(\%)}$ value (4.21±0.02), Lung-PTV $V_{5Gy\,(\%)}$ (17.41±0.1) and Lung-PTV D_{mean}(Gy) (383.8±34.3) values were found to be lower by half arc made with 6 MV. Heart D_{mean}(cGy) dose (345.7±17.5) and Heart V_{5Gy}(cc) dose (146.0±24.2), Spinal Cord D_{max}(cGy) dose (926.0±27.4) and Spinal Cord $D_{0.1cc}$(cGy) dose (843.17±32.6), Esophagus D_{mean}(cGy) dose (296.6±16.4) and Esophagus D_{max}(cGy) doses (1357.7±102.4) It has been determined that it is lower in half arc plans created with 6 MV and 15 MV energy modulation. When the plans made are evaluated; It was determined that PTV received the planned radiation dose in all three plans. For critical organs, we can say that the doses of critical organs have decreased in lung SBRT treatment plans made with 6-15 MV energy modulation.

Keywords: Energy Modulated, Lung Ca, SBRT

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Spectroscopic Properties of A=96 Proton Rich Systems

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Abstract:
To emphasize the importance of nuclear systems near the proton drip line in developing our understanding of nuclear force properties, proton-rich nuclei laying close to the astrophysical *rp*-process path were the subject of major experimental and theoretical studies. Indeed, these systems allow examining the efficiency of the existing theoretical models in extreme conditions. In this context, we carry out some spectroscopic calculations in the framework of the nuclear shell model. These calculations aim to investigate Gamow-Teller decay properties of A=96 isobars using NuShellX@MSU nuclear structure code. The used effective interaction is founded on the *mkh* original one, considering the similarity between ^{132}Sn and ^{78}Ni neighbouring nuclei. The obtained results have been compared to the available experimental data.

Keywords: A=96 isobars, Beta-decay properties, *mkh* effective interaction, NuShellX@MSU code, Proton rich nuclei, *rp*-process path.

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U1F Transition Logft Value for I-124 Isotope by pn-QRPA

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Abstract:

The shape function of a first-forbidden unique $\beta^{\pm}$ transition contains the tensor-axial nuclear matrix element [1]. In this study, the unique first forbidden (U1F, $\Delta J=2$) transition for the I-124 isotope was studied by Schematic Model (SM) within the formalism of proton-neutron Quasiparticle Random Phase Approximation (pn-QRPA). The pn-QRPA is adopted to construct the excited states of the odd-odd nuclei. The firstly in the pn-QRPA formalism is to solve the BSC equation. We start the construction of the nuclear states by forming all two-quasiparticle states with good angular momentum J_{ω} and parity π_{ω} as the second step. The beta decay of the 2^- ground state of I-124 is dominated by the beta decay to the 0^+ ground state of Te-124. We solved the secular equations of the U1F transition for eigenvalues and eigenfunctions of corresponding Hamiltonians in the Woods–Saxon (WS) potential basis [2]. The calculated logft value in the SM is compared to the other QRPA results in the literature and is found to be in better agreement with the experimental data.

Keywords: pn-QRPA, Schematic Model, U1F transition, Woods-Saxon potential

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Research of Optically Induced Luminescence (OSL) Properties of Thin Film PVP / Boron Compounds

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Abstract:
In recent years, regarding the study of different properties of boron compounds, there are researches on development in many areas of technology. The element boron which is in the form of a compound in nature contains boron oxide in its structure in varying proportions. Tincal (borax), Colemanite and Ulexite boron compounds which are widely used in Türkiye have a very important commercial importance for our country. In addition, boron compounds have an extremely important place in reactor technologies (reactor control rods, neutron absorbers, etc.) in nuclear power plants, neutron detection in nuclear waste storage, nuclear safety/security areas and industrial applications.
In this study; Borax Pentahydrate ($Na_2B_40_7.5H_2O$), Borax Decahydrate ($Na_2B_4O_7.10H_2O$), Anhydrous Borax ($Na_2B_4O_7$), Boric Acid (H_3BO_3) ve Sodium Pentaborate ($NaB_5O_8.5H_2O$) were used. The dosimetric properties of thin-film PVP/boron compounds were investigated using the OSL method. In the literature, although different applications have been made with boron compounds which are the subject of the study, no study has been found on this subject as a thin film. Polyvinyl pyrrolidone (PVP) is obtained by radical polymerization of the monomer N-vinyl pyrrolidone. It is a synthetic polymer also called povidone.PVP is soluble in water or different polar solvents, a physiologically compatible and odorless polymer.
In the first stage of the study; an aqueous solution of PVP and boron-based compounds of 30% and 40% were formed on glass substrates as thin-film samples using the Spin Coating method. In the second stage of the study; the luminescence signals of these thin-film samples against doses ranging from 0-100Gy, dose-response behavior, linearity index, and the effect of thin-film samples of different thicknesses on OSL signals were reviewed using $^{90}Sr/^{90}Y$ beta source. In this context, according to the results obtained from the measurements; Anhydrous Borax and Borax Pentahydrate to the highest linear dose-response in the dose ranges were studied; Boric Acid was observed to have the lowest. As a result of the measurements; It has been investigated that the produced boron thin-film materials can be used as a luminescence dosimeter in the literature. Results show that the studied materials are pioneering due to their thin-film dimensions and on this subject aimed to contribute to the literature.

Keywords: Beta radiation, Borax Decahydrate, Borax Pentahydrate, Boric Acid, OSL, Sodium Pentahydrate, Anhydrous Borax.

Production Cross-Section and Reaction Yield of ^{76}Br For ^{Nat}Se(P,Xn)^{76}Br Reaction Channels

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Abstract:

There are many radioisotopes used for diagnostic and therapeutic purposes in nuclear medicine. One of these radioisotopes used as be positron emitter in positron emission tomography (PET) is ^{76}Br. It is a radioisotope used in the imaging of body tumours and the examination of some brain functions. In this study, we have investigated some possible proton-induced production mechanisms of ^{76}Br. ^{nat}Se(p,xn)^{76}Br reaction channels have been investigated using the CTFGM, BSFGM, and GSM models within the framework of the TALYS nuclear reaction code. It has been seen that the production cross-section, reaction yields and total activation values calculated up to 60 MeV beam energy value are in agreement with the available data in the literature.

Keywords: Proton induced reactions, Production cross-section, Reaction yield, Bromine-76.

Continuous Spectrum of Protons and Alphas from Reaction initiated by Protons of 22 MeV on ^{59}Co Nucleus

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Abstract:

Verification of nuclear models, increasing their predictive power, is an urgent applied task in the design of perspective nuclear facilities, in particular, ADS electro-nuclear facilities for the transmutation of long-lived radioactive waste from the nuclear industry and energy production. At present, many computer codes based on various models have been developed, which makes it possible to calculate all possible channels of nuclear reactions in the energy range from 1 keV to 200 MeV and associated observables. To optimize the parameters of the model, it is important to obtain new experimental data on the cross-sections of nuclear reactions. The inclusive cross-section measurements of the reactions (p,xp) and (p,xα), originated by protons with E=22 MeV, on nucleus ^{59}Co have been carried out on the cyclotron U-150M of the institute of Nuclear Physics of the Republic of Kazakhstan, within the range of 30-135^0, with a step of 15^0. The registration and identification of reaction products were carried out by the system of multi-programming analysis based on ΔE-E - method.

The analysis of the experimental data was performed in the Griffin exciton model [1] of the pre-equilibrium decay of nuclei by the program PRECO-2006 [2]. The normalization factor was taken equal to 15 MeV. In the parameterization of the square of the matrix elements, the values of normalization constants were: $K_{\pi\pi}$: $K\pi\nu$: $K_{\nu\nu}$=2200:900:900 MeV^2. A satisfactory agreement between theoretical and experimental cross sections has been achieved. The contribution of the different mechanisms in the formation of inclusive spectra of protons has been established.

This research was funded by the Ministry of Energy of the Republic of Kazakhstan (BR09158499).

Keywords: Accelerator driven system, Double-differential cross-section, Exciton model, Nuclear reaction.

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Cross-Section Calculations of Medical Radioisotope ^{64}Cu for (p,x), (n,x) and (d,x) Reactions

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Abstract:

Today, the research and cost-effective production of medical radioisotopes are important in terms of easy access and development of treatments. In this study, the ^{64}Cu radioisotope, whose academic research continues on diagnostic and therapeutic use, was examined. ^{64}Cu radioisotope is unique among other Cu isotopes for medical use due to its low positron energy, 650 keV endpoint, appropriate half-life and short penetration into tissues. Thanks to these features, as well as the absence of significant additional gamma decay, it allows image acquisition from modern PET scanners with an accuracy of a few millimetres. In cases where experimental data are missing, cross-section calculations can be used and the existence of the cross-section data may provide various advantages in terms of the management of time, cost and efficiency.

In this context, detailed cross-section calculations of the ^{64}Cu isotope were investigated. To this end, cross-sections obtained from different calculation programs were compared with the literature data on the reactions and alternative production routes were investigated. Production cross-sections of the ^{64}Cu isotope were investigated from the ^{64}Ni(p,n)^{64}Cu, ^{65}Cu(p,n+p)^{64}Cu, ^{68}Zn(p,n+α)^{64}Cu, ^{65}Cu(n,2n)^{64}Cu, ^{64}Ni(d,2n)^{64}Cu, and ^{63}Cu(d,p)^{64}Cu reactions by utilizing equilibrium and pre-equilibrium models of nuclear reaction codes TALYS 1.95 and EMPIRE 3.2. Obtained results were compared with the available experimental data are taken from the Experimental Nuclear Reaction Data (EXFOR) data library.

Keywords: Copper-64, Cross-Section, EMPIRE 3.2, Medical Radioisotope, Nuclear Reaction, Radioisotope, TALYS 1.95

Radiation Measurements with Ring Dosimeters

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Abstract:

To protect against radiation, personal dosimeters have been developed. In the study, a ring dosimeter (ISO Rad Phantom) and a RADKOR ext dose OSL dosimeter reader system with 5 different ISO 4037 standards were used. The parameter to be measured is the skin dose (Hp(0.07)) and the test standard is ISO IEC 62387. Different dose rates and different delivery conditions of Cs-137 and X-ray (N-40, N-60, N-80, N-100, N-120 and N-150) rays were determined. In summary, five different rings of doses irradiated from six different sources were measured with a dosimeter and read by a dosimeter reader system. The Decisiveness, reliability and deviation ratios of ring dosimeters between irradiated and read were determined.

Keywords: Radiation, Ring dosimeter, Rad Fantom, OSL.

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Investigation of even-even Ti and Fe isotopes within IBM-1

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Abstract:

In this study, some nuclear structural properties of the even-even isotopes of Ti and Fe nuclei in the A~50 mass region were investigated within the interacting boson model-1 (IBM-1) [1]. This investigation includes the calculations of energy levels, B(E2) values of given isotopes and also analysis of ratios of energy levels and B(E2) values to understand their behavior along to isotopic chains. First, the experimental energy ratios ($R_{4/2}$) were analyzed by comparing the typical values of U(5), SU(3), O(6) dynamical symmetries and E(5), X(5) critical point symmetries. Later model Hamiltonian was constructed according to the behavior of given isotopes. The low lying energy levels of each isotopes were calculated by using the fitted parameters in the model Hamiltonian and their B(E2) values were calculated by using the corresponding electromagnetic transition operator in the IBM-1. The calculated energy levels and B(E2) values are compared with recent experimental data [2] and they show good agreement. Finally, $R_{4/2} = E(4_1^+)/E(2_1^+)$, $R_{0/2} = E(0_2^+)/E(2_1^+)$, $B(E2: 4_1^+ \rightarrow 2_1^+)/B(E2: 2_1^+ \rightarrow 0_1^+)$, and $B(E2: 0_2^+ \rightarrow 2_1^+)/B(E2: 2_1^+ \rightarrow 0_1^+)$ ratios were analyzed along isotopic chain to see the behavior of given isotopes [3,4].

Keywords: Energy levels, B(E2) values, Interacting Boson Model, Fe and Ti isotopes.

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Description of $2^{+}_{3,4}$ Intruder States in ^{130}Xe Nucleus by Mixing of Transitional Hamiltonian and O(6) Casimir Operator

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Abstract:

In this paper, we tried to describe the $2^{+}_{3,4}$ intruder stats in the ^{130}Xe nucleus in a configuration mixing framework. To this aim, we have used a transitional Hamiltonian based on the affine SU(1,1) lie algebra in the framework of the interacting boson model. Also, we perturbed this Hamiltonian in version 2 by adding a new term, the O(6) Casimir operator, due to the nature of these intruder states. The results confirm the accuracy of this mixing configuration in the description of all considered energy levels and especially, the intruder states. Also, these results suggest the same approach with adding other Casimir operators of different symmetry chains to extend the ability of this transitional Hamiltonian.

Keywords: Affine algebra; Casimir operator; intruder state; transitional Hamiltonian**.**

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Extension of 2p-2h Excitation Together Transitional Hamiltonian in Description of Intruder Levels of ^{118}Cd

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Abstract:

In this paper, a configuration mixing of a 2p-2h excitation together a transitional Hamiltonian in the framework of interacting boson model is developed. To consider the advantages of this formalism, we examined the ability to reproduce energy spectra of 118Cd nucleus which contains both normal and intruder states. The quantum numbers of both U(5) and O(6) dynamical limits are used to label different levels and also to evaluate eigenvalues of SU(1,1) based transitional Hamiltonian. This Hamiltonian is perturbed with adding the Casimir operator of O(6) limit to increase the efficiency of theoretical predictions for all of considered levels and especially for intruder ones. An improvement is obvious by using this mixed formalism and there are some suggestions for other excited levels.

Keywords: Configuration mixing; dynamical limits; intruder state; transitional Hamiltonian**.**

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SCIENTIFIC PROGRAMME

28 June 2022 Tuesday

Registration 09:00 – 17:25 (During day)

Morning Section-I 10:00 – 11:00 (Hall-1: Yahya KEMAL Hall)

Chair: Mahmut BÖYÜKATA (Kırıkkale University, Türkiye)

10:00-11:00 Opening Ceremony

11:00-11:30 Conference Photo + Coffee Break

Morning Section-II 11:30 – 12:50 (Hall-1: Yahya KEMAL Hall)

Chair: Neçla CAKMAK (Karabük University, Türkiye)

11:30-11:55 **Sefa ERTURK** (Niğde Ömer Halisdemir University, Türkiye)
Recent developments in SPECT and PET medical imaging systems

11:55-12:20 **Hatice DURAN YILDIZ** (Institute of Technology Accelerator, Ankara Univ., Türkiye)
Beam dynamic studies at SRF accelerator system for free electron laser and ATLAS experiment ADCoS duties at CERN

12:20-12:35 **Haris DAPO** (Turkish Accelerator and Radiation Laboratory, Ankara University, Türkiye)
Design and initial results of the experiment for proton cross-section measurement with stacked-foil technique

12:35-12:50 **Özgür ETİŞKEN** (Kırıkkale University, Türkiye)
Designing a particle accelerator for the future: FCC-e+e-injector complex design

12:50-14:15 LUNCH

Afternoon Section-I 14:15 – 15:30 (Hall-1: Yahya KEMAL Hall)

Chair: İsmail BOZTOSUN (NUKEN-TENMAK, Ankara & Akdeniz University, Antalya, Türkiye)

14:15-14:40 **José M. ARIAS** (Sevilla University, Sevilla, Spain)
Quantum simulation of the Agassi model in trapped ions

14:40-15:05 **Sabin STOICA** (International Centre for Advanced Training and Research in Physics (CIFRA), Romania)
Challenges in the study of double-beta decay

15:05-15:30 **Jameel-Un NABI [ON-LINE]** (Wah University, Punjab, Pakistan)
Updated status of key nuclei for presupernova evolution

15:30-15:55 Coffee Break + (Opening Ceremony of Prof. Dr. İhsan ULUER Hall)

Afternoon Section-II 15:55–17:10

	Hall-1: Yahya KEMAL Hall **Chair: Kaan MANISA** (Kütahya Dumlupınar Un., Türkiye)	**Hall-2: İhsan ULUER Hall** **Chair: Bayram DEMİR** (İstanbul Univ., Türkiye)
15:55-16:10	**Samira BAID** (Cadi Ayyad Un., Marrakech, Morocco) **Collective motion in γ-unstable nuclei within energy-dependent Davidson potential and deformation dependent mass formalisms**	**Duygu TUNÇMAN** (Istanbul Univ.-Cerrahpaşa, Türkiye) **Hounsfield unit (HU) comparison of different materials produced by plastic injection molding method with commercial bolus**
16:10-16:25	**Robert POENARU** (Horia Hulubei Nat. Ins., IFIN-HH, Romania) **Evaluation of the wobbling motion in even-even nuclei within a Simple Rotor Model**	**Duygu TUNÇMAN** (Istanbul Univ.-Cerrahpaşa, Türkiye) **Investigation of the effect of the patient cover materials on surface and build-up region doses**
16:25-16:40	**Hasan BİRCAN** (Kütahya Dumlupınar Univ., Türkiye) **Seyler-blanchard effective interaction calculations for nuclear matter**	**Menekşe ŞENYİĞİT** (Ankara Univ., Türkiye) **Developing a novel dosimeter system used in radiotherapy**
16:40-16:55	**Aysel ÖZFİDAN** (Tarsus Univ., Türkiye) **Lightest pseudo-mirror nuclei in the nuclear chart**	**Özgür ETİŞKEN** (Kırıkkale Univ., Türkiye) **A Proposal for Kırıkkale-2053 Vision: Hadron Therapy Center**
16:55-17:10	**Serkan AKKOYUN** (Sivas Cumhuriyet Univ., Türkiye) **Determination of the shell model single particle energies by using machine learning methods**	**Adem PEHLİVANLI** (Kırıkkale Univ., Türkiye) **Calculation of secondary neutron spectrum and additive dose in a water phantom of 135 MeV/u carbon ion beam by Monte Carlo method**

17:10-17:25 Break

SCIENTIFIC PROGRAMME

Afternoon Section-III 17:25–18:25

	Hall-1: Yahya KEMAL Hall **Chair: Tuncay BAYRAM** (Karadeniz Tech. Un., Türkiye)	**Hall-2: İhsan ULUER Hall** **Chair: A. Güneş TANIR** (Gazi Univ., Ankara, Türkiye)
17:25-17:40	**Khusniddin OLIMOV** (Physical-Technical Ins. of Uzbekistan) **Analysis of midrapidity transverse momentum distributions of identified charged particles in Pb+Pb collisions at $(S_{nn})^{1/2}$=5.02 TeV using non-extensive Tsallis**	**İsmail Hakkı SARPÜN** (Akdeniz Univ., Antalya, Türkiye) **Investigation of alpha optical model potential effects on ^{165}Ho(a,xn) reaction cross section**
17:40-17:55	**Khusniddin OLIMOV** (Physical-Technical Ins. of Uzbekistan) **Study of midrapidity transverse momentum spectra of the charged pions and kaons, (anti-)protons in Xe+Xe collisions at $(S_{nn})^{1/2}$=5.44 TeV using Tsallis distribution with embedded transverse flow**	**Ünal YILDIRIR** (Akdeniz Univ., Antalya, Türkiye) **Effects of level density models on ^{165}Ho(a,xn) reaction cross section**
17:55-18:10	**Kosim OLIMOV** (Physical-Technical Ins. of Uzbekistan) **Observation of ppπ$^+$ resonance state in ^{12}C+^{12}C collisions at 3.37 A GeV**	**Aydoğan DOĞAN** (Osmaniye Korkut Ata Univ., Türkiye) **Nucleonic odd-even effects for (n,2n) reaction cross sections at 14-15 MeV**
18:10-18:25	**Hamide AVCI** (Selçuk Univ., Konya, Türkiye) **Isotopic distributions in relativistic heavy-ion collisions**	**Ferhan AKDENİZ** (Akdeniz Univ., Antalya, Türkiye) **Nucleon densities of samarium isotopes calculated by Skyrme and Gogny models**

SECOND DAY'S PROGRAMME

29 June 2022 Wednesday

Morning Section-I 09:30 – 10:45 (Hall-1: Yahya KEMAL Hall)

Chair: Sefa ERTURK (Niğde Ömer Halisdemir University, Türkiye)

09:30-09:50 **Serdar ÜNLÜ** (Burdur Mehmet Akif Ersoy University, Türkiye)
Allowed and forbidden contributions to two-neutrino double beta decay process

09:50-10:15 **Dennis BONATSOS [ON-LINE]** (Institute of Nuclear and Particle Physics, NCSR, Greece)
Islands of shape coexistence

10:15-10:30 **Nihal BÜYÜKÇİZMECİ** (Selçuk Uni., Konya, Türkiye & Ins. Theo. Phys., J.W. Goethe Uni., Frankfurt, Germany)
A pioneer approach for nuclei formation in relativistic ion collisions

10:30-10:45 **Mohammadreza HADIZADEH** (Central State University, Wilberforce, Ohio, USA)
Relativistic three-body bound states in momentum space+

10:45-11:30 Coffee Break + POSTER Section

Morning Section-II 11:30 – 12:50 (Hall-1: Yahya KEMAL Hall)

Chair: José M. ARIAS (Sevilla University, Sevilla, Spain)

11:30-11:55 **Andrew BOSTON [ON-LINE]** (Liverpool University, Liverpool, England)
The AGATA Spectrometer

11:55-12:20 **Francesco CAPPUZZELLO** (Catania University, Italy)
Heavy-ion induced direct reactions in view of the NUMEN project: a multi-channel approach

12:20-12:35 **Manuela CAVALLARO** (INFN - LNS, Laboratori Nazionali del Sud, Catania, Italy)
Upgrade of the MAGNEX magnetic spectrometer toward the high-intensity beams at INFN-LNS

12:35-12:50 **Aliya NURMUKHANBETOVA** (Energetic Cosmos Lab., Nazarbayev University, Kazakhstan)
Study of resonant reactions at Nur-Sultan DC-60 cyclotron

12:50-14:15 LUNCH

Afternoon Section-I 14:15 – 15:20 (Hall-1: Yahya KEMAL Hall)

Chair: Hatice DURAN YILDIZ (Institute of Technology Accelerator, Ankara Univ., Türkiye)

14:15-14:35 **Hasan GÜMÜŞ** (Ondokuz Mayıs University, Samsun, Türkiye)
The concept of effective charge and electronic energy loss calculations for intermediate energy electrons and positrons

14:35-14:50 **Tuncay BAYRAM** (Karadeniz Techninal University, Türkiye)
Decay modes and half-life of some Ds isotopes

14:50-15:05 **Tayfun AKYÜREK** (Marmara University, İstanbul, Türkiye)
Characterization of different reactor parameters of TRIGA Mark II, PWR and VVER under various conditions

15:05-15:20 **Selçuk BİLMİŞ** (Middle East Technical University, Ankara, Türkiye)
Mass and decay constants of radially excited heavy mesons in QCD sum rule

15:20-15:55 Coffee Break + POSTER Section

Afternoon Section-II 15:55–17:10

	Hall-1: Yahya KEMAL Hall **Chair: Serkan AKKOYUN** (Sivas Cumhuriyet U., Türkiye)	**Hall-2: İhsan ULUER Hall** **Chair: M. Nureddin TÜRKAN** (İstanbul Med. U., Türkiye)
15:55-16:10	**Faruk YAŞA** (Kahramanmaraş Sütçüimam Univ., Türkiye) **An overview of a new neutron scattering function in a nuclear reactor**	**Huseynqulu QULIYEV** (Nat. Aviation Acad. of Azerbaijan) **Investigation of low-lying dipole excitations in doubly even $^{124-130}$Xe isotopes**
16:10-16:25	**Rezvan REZAEIZADEH** (Guilan University, Iran) **Analysis of D-T nuclear fuel depletion in advanced fussion reactor of approximate method**	**Gamze HOŞGÖR** (Sakarya University, Türkiye) **Calculation of the electric dipole (E1) resonance in ^{167}Er from threshold to 22 MeV**
16:25-16:40	**Aybaba HANÇERLİOĞULLARI** (Kastamonu Un., Türkiye) **Evaluation the knowledge and radiation protection of radiation workers of Ibensina hospital**	**Elif KEMAH** (Sakarya University, Türkiye) **Theoretical study of the Giant dipole resonance in the ^{233}Th nucleus**
16:40-16:55	**Aybaba HANÇERLİOĞULLARI** (Kastamonu Un., Türkiye) **Radiogenic heat generation analysis of fly ashes collected from Turkish coal-burning thermal power plants**	**Olcay GÜRBÜZ** (Gazi Univ., Ankara, Türkiye) **The investigation of electromagnetic transition properties of even-even $^{108-114}$Cd isotopes by the framework of IBM**
16:55-17:10	**İpek BALNAN** (Yıldız Tech. Un., İstanbul, Türkiye) **Neutron flux characterization of a 2 Ci Am-Be neutron source irradiation cell**	**Dilara İÇKECAN** (Marmara Univ., İstanbul Türkiye) **Comparing the shielding features of graphene with impregnated activated carbon for gamma-rays**

17:10-17:25 Break

Afternoon Section-III 17:25–18:25

	Hall-1: Yahya KEMAL Hall **Chair: Serdar ÜNLÜ** (Burdur Mehmet Akif Ersoy U., Türkiye)	**Hall-2: İhsan ULUER Hall** **Chair: Aynur ÖZCAN** (Gazi Univ., Ankara, Türkiye)
17:25-17:40	**Khalid Hadi Mahdi Aaal-SHABEEB** (Baghdat Univ., Iraq) **Radon concentration and its indices in Bulak cave Safranbolu town/Türkiye**	**Şule KARATEPE ÇELİK** (Bitlis Eren Univ., Türkiye) **CDCC calculation of elastic scattering of ^{8}Li on different targets**
17:40-17:55	**Cevad SELAM** (Muş Alparslan Univ., Türkiye) **First forbidden transitions by a self-consistent model in odd mass nuclei**	**Şadiye ÇAKMAK** (Osmangazi Univ., Eskisehir, Türkiye) **Gamow-Teller transitions for even-even nuclei of zinc isotopes by using pn-QRPA**
17:55-18:10	**Neçla CAKMAK** (Karabük Univ., Türkiye) **Rank 1 first forbidden transition in Hg-194 isotope**	**Nuray YAVUZKANAT** (Bitlis Eren University, Türkiye) **Finding gamma shielding properties of Li2Br4O7 (Lithium Borate) based glasses in GATE simulation**
18:10-18:25	**Ali Zafer BOZKIR** (Kırıkkale Univ., Türkiye) **The criticality problem for the pure quadratic anisotropic scattering with the FN method**	**Nuri YORULMAZ** (Harran Univ., Urfa, Türkiye) **Determination of photon radiation shielding properties of some boron doped glass materials using MCNP6 and calculation of removal cross section values**

SCIENTIFIC PROGRAMME

THIRD DAY'S PROGRAMME

30 June 2022 Thursday

Morning Section-I **09:30 – 11:05 (Hall-1: Yahya KEMAL Hall)**

Chair: Aybaba HANÇERLİOĞULLARI (Kastamonu Univ., Türkiye)

09:30-09:55 **Takehiko R. SAITO [ON-LINE]** (High Energy Nuclear Physics Laboratory, RIKEN Japan)
Solving puzzles of light hypernuclei by using heavy ion beams, nuclear emulsions and machine learning

09:55-10:20 **Muhsin N. HARAKEH [ON-LINE]** (Groningen University, Groningen, Netherlands)
Nuclear compression modes from stable to exotic nuclei

10:20-10:35 **Murat DAĞ** (Kırşehir Ahi Evran University, Türkiye)
Study of the effects of nuclear level density parameters on the cross sections for elements with Z≥90

10:35-10:50 **Hüseyin DÖNMEZ** (Aksaray University, Türkiye)
Calculations of (n,p) reaction cross sections for ^{180,182,183,184,186}W isotopes

10:50-11:05 **Hüseyin DÖNMEZ** (Aksaray University, Türkiye)
Investigation of empirical systematics for cross sections at 17.9 MeV

11:05-11:30 Coffee Break

Morning Section-II **11:30 – 13:05 (Hall-1: Yahya KEMAL Hall)**

Chair: Mohammadreza HADIZADEH (Cent. State U., Ohio, USA)

11:30-11:55 **Yu ZHANG [ON-LINE]** (Liaoning Normal University, China)
Effects of single particle on shape phase transitions in odd-even systems

11:55-12:20 **Valentin Olegovich NESTERENKO [ON-LINE]** (Joint Institute for Nuclear Research, Dubna, Russia)
Low-energy M1 states in deformed nuclei: spin scissors or spin-flip?

12:20-12:35 **Mereigul TEZEKBAYEVA** (Joint Institute for Nuclear Research, Dubna, Russia)
Detailed study of radioactive decay properties of nobelium isotopes with α, β, γ-spectroscopy method

12:35-12:50 **Nataliia KURKOVA** (Joint Institute for Nuclear Research, Dubna, Russia)
Theoretical study of the competition of quasi-fission and fusion-fission processes in the reactions leading to formation of new superheavy nuclei in the framework of the dynamical model

12:50-13:05 **Roman MUKHIN** (Joint Institute for Nuclear Research, Dubna, Russia)
The study of multiplicity distributions for prompt neutrons emitted in spontaneous fission of transfermium isotopes

13:05-14:15 LUNCH

Afternoon Section-I **14:15 – 15:00 (Hall-1: Yahya KEMAL Hall)**

Chair: Hasan GÜMÜŞ (Ondokuz Mayıs U., Samsun, Türkiye)

14:15-14:30 **Zeynep YÜKSEL** (Ondokuz Mayıs Un., Samsun, Türkiye)
Energy loss and depth dose calculations in gonad tissues for electron radiation

14:30-14:45 **Bayram BİLMEZ** (Ondokuz Mayıs Un., Samsun, Türkiye)
Investigation of stopping power and range values as a TLD parameter

14:45-15:00 **Şule OCAK ARAZ** (Kırıkkale Univ., Türkiye)
Determination of γ-radiation shielding properties of metal boride coated AISI 304L stainless steel

15:00-15:15 Coffee Break

Afternoon Section-II **15:15–16:30 (Hall-1: Yahya KEMAL Hall)**

Chair: Abdullah AYDIN (Kırıkkale University, Türkiye)

15:15-16:15 **PANEL: Mustafa BÖYÜKATA** (Yozgat Bozok University, Türkiye)
Project Design Techniques for TUBITAK Programs

16:15-16:30 **Closing Ceremony:**
Award Ceremony for Graduates with Honors (In Faculty)

16:30-16:35 Break

Afternoon Section-III **16:35–16:50 (Hall-1: Yahya KEMAL Hall)**

16:35-16:50 **NSP2022 Closing Remarks & NSP2023 Decision on next year**