3rd International Conference on Theoretical and Experimental Studies in Nuclear Applications and Technology

10-12 May 2017 Çukurova University, Adana, Turkey

Abstract Book

Editors

Eyyüp TEL, Abdullah AYDIN, İsmail Hakkı SARPÜN
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Abdullah AYDIN
İsmail Hakkı SARPÜN

tesnat.org
Dear Colleagues,

Welcome to the 3rd International Conference on Theoretical and Experimental Studies in Nuclear Applications and Technology (TESNAT 2017). This conference is the third step of the TESNAT Conference series. TESNAT 2015 was held in Osmaniye Korkut Ata University, Osmaniye and TESNAT 2016 was held in Mustafa Kemal University, Hatay. The world of nuclear physics is an exciting area in which to work, and we’ll continue to meet and bring inspired people together in conference like this, to ensure TESNAT remains at the cutting edge.

We intend in this conference to discuss and compare all applicable methods as are being applied at present in nuclear physics. The problems faced in these fields at present are focused in the development of new methods and in the improving of existing techniques to achieve an understanding of existing experimental data and in predicting with high reliability new properties and processes. We propose this conference as a mean to bring together all these related communities with the goal of creating an enriching dialog across the disciplines. The conference will give an overview on the theoretical and experimental challenges in nuclear physics and applications.

We’d like to thank each of you for attending our conference and bringing your expertise to our gathering. You are truly our greatest asset today and tomorrow, and we could not accomplish what we do without your support and leadership.

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Middle East Technical University (METU), Turkey
### Scientific Programme

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<td>13:10</td>
<td>MP001 – Koç An application study about maintaining quality in radioisotope calibrators which are used in nuclear medicine centers</td>
<td>LU016 – Nur Solution combustion synthesis, structural and dosimetric characterization of ZnB₂O₃:Eu nanophosphors</td>
<td>MP015 – Portakal Influence of sintering time on the thermoluminescence characteristics of Eu²⁺ doped CaO obtained from sea-urchin skeleton: a preliminary study</td>
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<td>MP020 – Tunçman Genç Investigation of tissue inhomogeneity effect on dose distribution for 3D high dose rate brachytherapy using EBT3 gafchromic film</td>
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<td>MP015 – Demir A dosimetric comparison with 3D conformal and volumetric modulated therapy for endometrial cancer</td>
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<td>LU024 – Tunçel A review of TLD’s zero count based on temperature and radiation history of them</td>
<td>LU011 – Açeş Quality control test of In¹⁷⁷Ir perteknetat marked hydroxyethylene difosphonate (HEDP) radiochemical</td>
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<td>14:50</td>
<td>MP007 – Kovan Radiation doses to pediatric patients originated from adult patients in nuclear medicine waiting room</td>
<td>LU020 – Uzun Numerical analysis of the thermoluminescence glow peak of the Kardak rocks</td>
<td>MP009 – Kovan Quality control test of In¹⁷⁷Ir perteknetat marked hydroxyethylene difosphonate (HEDP) radiochemical</td>
</tr>
<tr>
<td>15:00</td>
<td>MP008 – Kovan Voltage (kV) and current (mA) optimization for gamma ray attenuation correction by computed tomography in SPECT</td>
<td>LU010 – Dönmez Kesen Evaluation of optically stimulated luminescent dosimeters in open field surface dose measurements</td>
<td>MP009 – Kovan Quality control test of In¹⁷⁷Ir perteknetat marked hydroxyethylene difosphonate (HEDP) radiochemical</td>
</tr>
<tr>
<td>15:00</td>
<td>MP010 – Pehlivanlı Comparison of radiotherapy treatment plans in prostate cancer</td>
<td>LU012 – Yüksel Obtaining pure quartz from soil samples and calculation of its kinetic parameters using isothermal decay method</td>
<td>MP017 – Tanyıldızı Radiation absorbed dose calculation of Yttrium-90 microsphere therapy</td>
</tr>
<tr>
<td>15:00</td>
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<td>LU017 – Yazıcı Evaluation of the f(0) functions of TLD-600 and TLD-700 exposed to β⁺Ce neutron + gamma radiations</td>
<td>LU018 – Birlik Synthesis and thermoluminescence properties of Eu doped CaMoO₄</td>
</tr>
</tbody>
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**Wednesday, May 10, 2017**

**Conference Hall**

**HALL 2**

**HALL 3**

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**TESNAT 2017**

**Adana, Turkey**
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<tr>
<th>15.30, 15.45</th>
<th>MP011 – Altıparmak</th>
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<tbody>
<tr>
<td></td>
<td>Investigations of target volume and critical organ doses in stomach cancer with 3D conformal radiotherapy and intensity modulated radiotherapy techniques</td>
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<tr>
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<td>LU014 – Doğan</td>
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<td>Preliminary dose response results of quartzite using thermoluminescence method</td>
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<td>MP016 – Okutan</td>
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<td>The treatment techniques in localized prostate cancer who has a hernia: a case study</td>
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<td>NA011 – Tedjini</td>
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<td></td>
<td>Ab initio study of physical properties of semiconductors radiation detectors</td>
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</tbody>
</table>

**BREAK**

16.00, 16.15
Chair: Prof. Dr. Gülsen ÖNEN GÜT
Chair: Prof. Dr. Ahmet BOZKURT

**IS3 Prof. Dr. Virgilio CORRECHER**

An overview of techniques for the detection of irradiated food

16.15, 16.30 | MP012 – Yazgan |
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<thead>
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<tbody>
<tr>
<td></td>
<td>NA014 – Erkut</td>
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<tr>
<td></td>
<td>Investigation of new-generation digital electronic, NUMEXO2 for gamma ray spectrometer EXOGAM2</td>
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<td>LU005 – Özdemir</td>
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<td></td>
<td>Ll&lt;sup&gt;180&lt;/sup&gt;BiO&lt;sub&gt;2&lt;/sub&gt;Ag,Tb phosphor and its neutron sensitivity for dosimetry applications</td>
</tr>
<tr>
<td></td>
<td>LU001 – Topaksu</td>
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<tr>
<td></td>
<td>Preliminary results on dose response of serpentine mineral from Kuzldağ plateau in Karaisalı, Turkey</td>
</tr>
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16.30, 16.45 | MP013 – Abderrahim |
<table>
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<tr>
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<tbody>
<tr>
<td></td>
<td>Study of the iodine-131 dose variation as a function of the size within ananthropomorphic thyroid phantom</td>
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<tr>
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<td>AP010 – Bozkurt</td>
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<td>Performance of PARIS phoswich: linearity, efficiency, energy resolution and time response</td>
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<td>NA023 – Karahan</td>
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<td></td>
<td>Cyclic voltammetric investigation of high corrosion and heat resistant Ni and Ni-Al alloys for nuclear systems</td>
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<td>LU013 – Yüksek</td>
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<td>Thermoluminescence characteristics of SrAl&lt;sub&gt;2&lt;/sub&gt;O&lt;sub&gt;4&lt;/sub&gt;Dy phosphor prepared by the solution combustion method</td>
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</tbody>
</table>

**BREAK**

17.00, 17.15
Chair: Prof. Dr. Meral ERAL
Chair: Prof. Dr. Sezai YALÇIN

**MP014 – Uğur**

Depth dose calculations

17.15, 17.30 | AP002 – Yıldız |
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<td>Neutron beam production</td>
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<td>NA016 – Karabacak</td>
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<td>Correction of the pulse pile-up reject and the pulse pile-up for gamma ray spectrometry</td>
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<td>LU008 – Altunlu</td>
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<td></td>
<td>Preliminary study of Li&lt;sub&gt;2&lt;/sub&gt;MoO&lt;sub&gt;4&lt;/sub&gt;: Ce,Cu,Na phosphor for OSL dosimetry</td>
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<td>NA022 – Karahan</td>
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<td>Synthesis of Ni-based alloys for nuclear power stations via electrophoretic deposition</td>
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17.30, 17.45 | AP003 – Yıldız |
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<tr>
<td></td>
<td>Output laser parameters at linear accelerators</td>
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<td>NA012 – Taşın</td>
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<td>Measurement of resonance productions at high energies with the Alice detector at the LHC</td>
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<td>LU007 – Gökşan</td>
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<tr>
<td></td>
<td>Investigation of OSL characteristics of Li&lt;sub&gt;2&lt;/sub&gt;MoO&lt;sub&gt;4&lt;/sub&gt;:Pr, K,Cu,Na phosphor</td>
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<tr>
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<td>NA027 – Turhan Irak</td>
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<td>Properties of candidate structural reactor material, BN composites</td>
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17.45, 18.00 | AP006 – Ertürk |
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<tr>
<td></td>
<td>Performance of PARIS cluster: ELBE experiment</td>
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<td>RM021 – Karahan</td>
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<td>Radon measurements of some touristic places in Hatay, Turkey</td>
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<td>NA021 – Unal</td>
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<td></td>
<td>Morphological studies of Ni/β-hBN composite coatings which can be used in nuclear systems</td>
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<td>NA032 – Oral</td>
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<td>Research of adsorption of La(III) ions from aqueous solutions by magnetic nano graphen oxide (MNGO)</td>
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18.00, 18.15 | AP005 – Cufia |
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<td>NA004 – Shpagina</td>
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<td>NA018 – Almahdi</td>
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<td>NA002 – Garayeva</td>
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**Thursday, May 11, 2017**

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<td><strong>09.00</strong></td>
<td><strong>09.15</strong></td>
<td><strong>09.30</strong></td>
</tr>
<tr>
<td>Chair: Prof. Dr. Jameel-Un NABI</td>
<td>Prof. Dr. Mohamed BELGAID</td>
<td>NPO30 – Guven</td>
</tr>
<tr>
<td>Detailed investigation of the tensor force on the evaluation of magicity for the Si isotopes, N=20 and N=28 isotopes with skyrme-hartree-fock-bogoliubov calculations</td>
<td>Calculation of eigenvalues for neutron transport equation with P&lt;sub&gt;3&lt;/sub&gt; and U&lt;sub&gt;3&lt;/sub&gt; approximation using Heneyey-Greenstein phase function in slab geometry</td>
<td>NPO30 – Guven</td>
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<tr>
<td>09.30</td>
<td>09.45</td>
<td>09.50</td>
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<tr>
<td>Chair: Prof. Dr. Akkayun</td>
<td>NPO06 – Akkoryun</td>
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<td>09.50</td>
<td>09.55</td>
<td>09.50</td>
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<tr>
<td>Chair: Prof. Dr. Bahar</td>
<td>NPO17 – Bahar</td>
<td>NPO17 – Bahar</td>
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<td>NPO09 – Mansour</td>
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Adana, Turkey
<table>
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<tr>
<th>Time</th>
<th>Presenters</th>
<th>Title</th>
<th>Authors</th>
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</thead>
<tbody>
<tr>
<td>09:30</td>
<td>NP028 – Quilyev</td>
<td>Investigation of the scissors mode in $^{151}$Dy nucleus</td>
<td>NA020 – Öztok</td>
</tr>
<tr>
<td>10:15</td>
<td>NP027 – Turan</td>
<td>Solution of bohr hamiltonian with nikiforov-uvarov method for X(3) critical point symmetry</td>
<td>NA010 – Visnak</td>
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<tr>
<td>10:45</td>
<td>NA008 – Aydın</td>
<td>Electromagnetic performances of homogenous calorimeters with electron beams</td>
<td>NA005 – Tunçel</td>
</tr>
<tr>
<td>11:30</td>
<td>NA007 – Türeci</td>
<td>The distribution of ionizing radiation in the area surrounding the target mass using OSL</td>
<td>NA001 – Biçer</td>
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<tr>
<td>12:15</td>
<td>NA006 – Aydın</td>
<td>The investigation of electric pygm dipole resonance in $^{174}$Hf</td>
<td>NA002 – Zümrut</td>
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<tr>
<td>13:00</td>
<td>RM007 – Türeci</td>
<td>Half-space albedo problem for linear-quadratic anisotropic scattering according to moments of incoming neutron distribution</td>
<td>RM006 – Gümsüz</td>
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<tr>
<td>13:30</td>
<td>RT002 – Günay</td>
<td>Three-dimensional Monte Carlo Calculation on the nuclear parameters of each isotope in some fluids</td>
<td>RM005 – Kocakoç</td>
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<tr>
<td>14:15</td>
<td>NP036 – Elhatisari</td>
<td>Ab initio nuclear structure and nuclear scattering</td>
<td>NP037 – Çelik</td>
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<tr>
<td>14:45</td>
<td>NP037 – Çelik</td>
<td>A compton suppression system for gamma-ray spectroscopy</td>
<td>NP038 – Çelik</td>
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<tr>
<td>15:30</td>
<td>RT003 – Günay</td>
<td>The effect of collimation on the shape of the compton continuum and backscattering peaks</td>
<td>RT003 – Günay</td>
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<tr>
<td>16:15</td>
<td>RM005 – Bozkurt</td>
<td>Monte Carlo calculation of proton stopping power and ranges in water for therapeutic energies</td>
<td>RM005 – Dicle Erdamar</td>
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Chair: Prof. Dr. Aysel KAYIŞ TOPAKSU  Chair: Dr. Serkan AKSOYUZ

12:00 – 13:00 LUNCH

3rd International Conference on Theoretical and Experimental Studies in Nuclear Applications and Technology

Adana, Turkey
| 15:00 - 15:15 | NP040 – Manisa Nuclear matter symmetry energy: VMC calculations | RT005 – Bardakçılı The investigation of convert $^{238}_{92}$Pu($n$,y)$^{244}_{92}$Pu in a hybrid reactor | NA030 – Yakut Water and paraffin as shielding material | AP004 – Yıldız GeV energy laser vacuum system and components |
| 15:30 - 15:45 | NP046 – Büyükylidiz Bronze and brass alloys as alternative radiation shielding materials | RT007 – Şeker The investigation of radiation damage for certain reactor grade-plutonium fluids in a hybrid reactor | NA021 – Sayın ESR and microbiological analysis of gamma irradiated grape seeds | AP003 – Porsuk RF power supply and RF transmission line at linear accelerators |
| 15:45 - 16:00 | BREAK |

**Friday, May 12, 2017**

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<th>Conference Hall</th>
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<tbody>
<tr>
<td>09:00 - 09:15</td>
<td>E5002 – Biçer A homogeneous comparison of Turkey and BRICS countries in terms of energy efficiency</td>
<td>RM006 – Gören Radioecological assessment of natural radioactivity in soil near a lignite-burning power plant in Turkey</td>
</tr>
<tr>
<td>09:05 - 09:15</td>
<td>ES003 – Biçer An evaluation of shale gas in terms of economics and environmental problems: a discussion paper</td>
<td>RM008 – Altıkgal Analyses of natural radioactivity in Yatağan coal – fired power plant in Turkey</td>
</tr>
<tr>
<td>09:15 - 09:30</td>
<td>ES001 – Kaplan The overview of nuclear energy situation in the world and turkey</td>
<td>RM013 – Yağıc Seasonally measurement of radon activity in Bitlis region</td>
</tr>
<tr>
<td>09:45 - 09:55</td>
<td>NP032 – Özer Solution of bohr hamiltonian with the pseudo harmonic potential using nikiforov-uvavar method for X(3) critical point symmetry</td>
<td>NPO31 – Özer Solution of bohr hamiltonian with the pseudo harmonic potential using nikiforov-uvavar method for Z(5) critical point symmetry</td>
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<tr>
<td>Time</td>
<td>Session</td>
<td>Chair/Presenter</td>
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<tr>
<td>10:30</td>
<td>RM014 – Çakal An application of LSC technique to determine $^{90}$Sr/$^{90}$Y radionuclides in dry tea samples</td>
<td>RM020 – Uğur New applications and developments in the neutron shielding</td>
</tr>
<tr>
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<td>CNP006 – Boydaş Calculation of photo-nuclear cross sections of Ruthenium isotopes</td>
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<td>CNP015 – Büyükömürmen Inelastic scattering of 14.6 MeV neutrons from $^{27}$Al, $^{18}$Sc, $^{56}$Co target nucleus</td>
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<td>10:00</td>
<td>BREAK</td>
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<td>10:15</td>
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<tr>
<td>10:30</td>
<td>I5S Prof. Dr. Jameel-Un NABI</td>
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<tr>
<td>11:00</td>
<td>Gamma heating rates in stellar matter due weak rates on sd-shell nuclei</td>
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<tr>
<td>11:30</td>
<td>NPO09 – Ay Nuclear level densities of $^{14}$Li,$^{18}$Nd isotopes</td>
<td>NRO05 – Kılıç An investigation of the partial and total cross sections of the $^8$(l,n)$^{13}$B reaction at astrophysically relevant energies</td>
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<td>CNP008 – Yeşildağ Effects of level density models on (p,n) reactions in some natural metal targets</td>
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<td>CNP026 – Sarpın Proton emission of B$_2$C composites</td>
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<td>11:00</td>
<td>NPO14 – Aşçı Determination of radiative strength function by using dicebox simulation code</td>
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<td>NRO06 – Kılıç Material dependence of ZH(d,p)3H cross section at the very low energies</td>
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<td>CNP018 – Özdön Production cross–section calculations of medical Pb isotopes</td>
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<td>11:30</td>
<td>NPO11 – Büyükata The calculation of the deformation parameter of $^{155}$Nd target and its effect of this parameter on the cross sections of (y,2n), (n,2n), (p,2n) reactions</td>
<td>NPO60 – Şimşek Yapor Chebyshev polynomials of the first kind for the eigenvalue spectrum and monoezerogetic neutrons in a slab with anisotropic, backward and forward scattering</td>
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<td>CNP039 – Özcan Level density parameter dependence in fission cross sections $^{172}$Tb, $^{178}$U and $^{237}$Np nuclei induced by alphas with the incident energy up to 200 MeV</td>
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<td>CNP013 – Çetin Excitation functions of deuteron induced nuclear reactions on natural cadmium target used for production of $^{109}$In, $^{110}$In, $^{112}$In, $^{114}$In radionuclides</td>
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<tr>
<td>12:00</td>
<td>NPO50 – Özgür The y-ray strength functions of $^{146,148}$Nd isotopes</td>
<td>CNP033 – Yıldız Yorgun $(n,γ)$ reaction cross section calculations of some isotopes used in nuclear applications</td>
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<td>CNP032 – Kartal Cross section calculation of neutron poison isotopes by neutron reaction models</td>
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<td>CNP029 – Poyraz Particle induced nuclear reactions calculations of boron target nuclei</td>
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<td>12:30</td>
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<td>NPO55 – Oztürk Numerical solution for eigenvalues of the transport equation: anisotropic, backward and forward scattering in a slab</td>
<td>NPO58 – Ege Chebyshev polynomials approximation for the eigenvalue spectrum of monoezerogetic neutrons in 1-D geometry</td>
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<td>CNP035 – Korkmaz Investigation of Spherical and Cylindrical Natural Iridium Targets by Photoneutron Reaction</td>
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<td>CNP023 – Şahan Calculations of neutron-induced alpha emission double-differential cross section of fluorine at 14.2 MeV</td>
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<td>CNP014 – Çetin The study of the comparison excitation functions for $(n,x)$, $(d,x)$ and $(γ,x)$ reactions for natural titanium target</td>
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<td>NPO52 – Bülbül Diffusion approximation for the negative scattering parameters of Anl, Gungör phase function using $U_n$ method</td>
<td>CNP036 – Korkmaz Study on excitation functions of neutron-induced reactions of $^{181}$Ta nucleus</td>
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<td>CNP025 – Yıldız Nuclear model calculations of $(n,γ)$ reaction cross sections for some isotopes in heavy concrete</td>
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<td>NRO02 – Belouadah Thermal neutron cross-section measurement for the $^{153}$Sm $(n,γ)$ $^{153}$Sm reaction at 0.0372 eV energy</td>
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<td>14:00</td>
<td>NAO01 – Kavun Determination of dietary habits on teeth by photoactivation analysis in southern turkey</td>
<td>CNP030 – Alkanli Calculation of $(n,a)$ reaction cross sections by using some skyrme force parameters for potassium $(^7K)$ target nuclei</td>
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<td>CNP038 – Yıldız Cross-section values $(a,n)$ reaction for iron group elements some isotopes (Sc to Ni) in the range of 10-20 MeV</td>
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<td>NPO19 – Ünlü Two-neutroino double beta decay rates for some spherical nuclei</td>
<td>CNP015 – Karaoğlan Reaction cross section calculation some alkaline earth elements</td>
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<td>CNP027 – Korkut</td>
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<td>CNP021 – Tel Proton bombarded reactions of calcium target nuclei</td>
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<td>NAO03 – Aygör</td>
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<td>NPO13 – Çopuroğlu</td>
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<td>NPO16 – Somuncu</td>
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<td>NPO12 – Çopuroğlu</td>
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<td>NRO03 – Polonov</td>
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<td>16:00</td>
<td>CNP018 – Ordoğan</td>
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<td>CNP017 – Sarpın</td>
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<td>CNP024 – Sardoğan</td>
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<td>CNP009 – Hussein</td>
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<td>CNP001 – Abdiev</td>
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3rd International Conference on Theoretical and Experimental Studies in Nuclear Applications and Technology

TESNAT 2017

Adana, Turkey
Invited Talks
The practice of radiation protection: Old habits, new trends

BOZKURT A.

Akdeniz University, Faculty of Engineering, Department of Biomedical Engineering, Antalya, Turkiye

Radiation protection is the science of protecting people and the environment from harmful effects of exposure to ionizing radiation. Today, radiation emitting devices and radioactive substances are used extensively for many beneficial purposes ranging from medical to industrial applications. This makes the protection efforts a major and vital part of radiation safety programs that are inherently designed to address the issues specific to both normal operations and extraordinary situations. It also creates the need to reserve more resources for achieving the essential goals of such programs. This study discusses the problems encountered in many fields utilizing various forms of ionizing radiation in the light of the most basic principles and the novel understanding of health physics.
Uses nuclear techniques of radiotracers and INAA of rare earth elements for soil erosion assessment

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1 Nuclear Research Center of Algiers, Alger-Gare, Algiers, Algeria
2 Nuclear Research Center of Draria, Sebela-EI Achour, Algiers, Algeria
3 USTHB, Faculté de Physique, Laboratoire SNIRM, Algiers, Algeria

Soil erosion is a global environmental problem, and anthropogenic fallout radionuclides offer a promising tool for describing and quantifying soil redistribution on decadal time scales. Conventional techniques for measuring erosion rates are time-consuming and need long data records. The $^{137}$Cs technique for investigating rates and patterns of soil erosion has now been successfully applied in a wide range of environment.

Use of Rare Earth Elements (REEs) as tracers for study of the process of erosion of watersheds can reveal quantitatively the relationship between the characteristics of spatial distributions and localization of areas of sedimentation and erosion along the profile watershed. In this work, we give an example of a series of soil samples from an experimental site located in the region many sites in Algeria. The soil collected from the experimental sites were analysed by two complementary methods. The first is to measure the concentration of radioactive $^{137}$Cs in soil samples by gamma spectrometry to locate areas of sediment deposition. The second is to identify and quantify the stable rare earth elements (La, Nd, Eu, Tb, Yb, Hf) in the same soil samples by Instrumental Neutron Activation Analysis (INAA) to study the redistribution of REEs in these areas. The samples were irradiated at the NUR reactor under a neutron flux of $2.10^{13}$ n cm$^{-2}$ s$^{-1}$ for 04 hours and analysed by gamma spectrometry. The determination of the concentrations of REEs, allowed us to identify areas of erosion and accumulation in the studied watersheds.
IS3

An overview of techniques for the detection of irradiated food

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Losses of food at a world scale as a result of infestation, contamination and putrefaction are very high, particularly in developing countries, where those losses are much harder to bear. In such countries, the grain losses during such storage could reach the order of 10\%, the vegetable and fruit affected by contamination and putrefaction could be up to 50\%, and the losses of dried fish as a result of infestation and putrefaction arises about 35\%. Such losses, along with the high percentage of diseases transmitted by food contamination via pathogenic bacteria, have, over the last 20 years, resulted in the development of new technologies for increasing food preservation (cooking, smoking, canning, freezing, chemical preservation and so on), irradiation being the latest method. From a toxicological viewpoint, in 1982 the Commission of Codex Alimentarius, decided that food could be irradiated with a total radiation dose of up to 10 kGy, a decision in agreement with the conclusions of a Joint FAO/IAEA/WHO Expert Committee in Geneva in 1980. As a result of these decisions, it has become necessary to develop new control methods to enable the authorities (i) to identify irradiated food; (ii) to verify correct labeling; (iii) to avoid multiple irradiations; (iv) to test the total absorbed doses and (v) to check the homogeneity in the dose distribution. Such methods should be fast, simple, reproducible, reliable and economic. A great deal of effort has been involved in the investigation of some specific parameters of irradiated food and in the subsequent development of techniques for their identification. Techniques include: chemiluminescence; viscosity measurements; electron spin resonance (ESR); thermoluminescence (TL); impedance measurements; and measuring chemical changes in proteins, DNA, lipids and enzymes. At present the most promising methods appear to be ESR, TL and the analysis of radiolytic products from lipids.
The distribution of ionizing radiation in the area surrounding the target mass using OSL

TANIR A.G.¹, YEDEK H.¹, BOLUKDEMIR M.H.¹, KOC K.²

¹Gazi University, Ankara, Turkey
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The scattered doses received by the area surrounding the target subjected to x-rays were investigated. Two experiments were carried out: 1- Al₂O₃: C was used as dosimeter and the luminescence counts were measured using both the RisØ TL/OSL system and an ion chamber. 2- BeO aliquots were used and the counts were read using the IBEOX/OSL system. According to the results, the doses absorbed by the area surrounding the target are significantly amount.
Gamma heating rates in stellar matter due weak rates on \textit{sd}-shell nuclei

NABI J.-U.

\textit{GIK Institute, Topi-23640, KP, Pakistan}

Gamma ray heating rates due to weak interaction processes on \textit{sd}-shell nuclei in stellar core are calculated using the proton neutron Quasiparticle Random Phase Approximation theory (pn-QRPA). The recent extensive experimental mass compilation of was taken into account. The selected \textit{sd}-shell nuclei are of special interest for the evolution of O-Ne-Mg core in 8-10 solar mass stars due to competitive gamma ray heating rates by URCA processes. The outcome of these competitions is to determine, whether the stars end up as a white dwarf (WD), an electron-capture supernova or Fe core-collapse supernova. The selected \textit{sd}-shell nuclei in this work are 20,23O, 20,23F, 20,23,24Ne, 20,23,24,25Na and 23,24,25Mg. The gamma heating rates are calculated for density range \((10 \leq \rho \text{ (g/cm}^3) \leq 1011)\) and temperature range \((0.01 \times 10^9 \leq T(\text{K}) \leq 30 \times 10^9)\). The pn-QRPA calculated gamma heating rates are orders of magnitude bigger than the shell model rates (except for 25Mg at low densities). At high temperatures, the gamma heating rates are in reasonable agreement.
Monoenergetic fusion-based neutron sources (D-D and D-T) and their applications

BELGAID M.

Houari Boumediene University of Sciences and Technologies, Faculty of Physics, Algiers Algeria

Neutron generators based on the $^2$H(d,n)$^3$He and $^3$H(d,n)$^4$He fusion reactions are the most available mono-energetic neutron sources. Current developments of new neutrons generators make them attractive as effective alternatives to isotopic neutron sources for irradiation purposes.

This presentation gives an overview on the main characteristics and possible applications of neutron generators. The use of Neutron Generators for irradiation of samples for analytical purposes has been intensively explored in the past, consequently the use of these devices for some industrial and research applications and for education purposes are feasible and might be attractive.

The Neutron Generators have been shown to be effective for many applications including homeland security, nuclear medicine, neutron therapy and the on-line analysis of aluminium, coal and cement. Potential applications in land mine detection, cargo screening, archaeology, and isotope production have been proposed. In airports and at border crossing, neutron based non-destructive inspection techniques are deployed to stop the smuggling of drugs, explosive, nuclear materials and other contrabands.

The realization of these different applications with monoenergetic fusion-based neutron sources, are based on the several methods issued from the physical phenomena due to the interaction of neutrons with materials as NAA PGNA, TNA, FNA, PFNA, APFNG, TOF, etc.
The latest news from CERN

ONENGUT G.

Çağ University, Adana, Turkey

After a short presentation of CERN, Large Hadron Collider (LHC), experiments on LHC (ALICE, ATLAS, CMS, LHCb) and other elements of CERN accelerator complex like ISOLDE and nTOF, Turkey-CERN relationship will be summarized and new physics results from the experiments will be given. Plans for the future of CERN (HL-LHC, FCC, CLIC) will also be explained.
Presentations
NP001

Calculation of the scattering probability with LEIS technique

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KHALAL-KOUACHE K.\textsuperscript{1}

\textsuperscript{1} USTHB, Faculté de Physique, Bob-Ezzouar, Algiers, Algeria
\textsuperscript{2} Faculté des Sciences et de la Technologie, Université Yahia Farès de Médéa, Algeria
\textsuperscript{3} Faculté des Sciences, Université de Blida 1, Algeria

Low Energy Ion Scattering (LEIS) is widely used for quantitative composition and structure analysis of solid surfaces. A solid surface is bombarded with ions (He\textsuperscript{+}) at low energy (0.5 to 10 keV). A TOF-LEIS set-up is used to detect the scattered particles in a given direction. The obtained TOF spectra are then converted to energy spectra. These experimental data are very important to study the scattering potential and the energy loss of the projectile in the target.

Different methods can be used to calculate energy spectra (molecular dynamics and Monte Carlo codes). Due to the large calculation times required by these simulations, an alternative was proposed. This model is based on the solution of the Boltzmann equation and is valid for small scattering angles. The binary collision approximation is assumed with a random homogenous distribution of scattering centers. The TFM (Thomas-Fermi-Moliere) potential is used to describe the projectile-target atom interaction.

The probability for a projectile to be scattered at an angle $\alpha$ and in the solid angle $\Delta\Omega$ with a total path length in the solid comprised between $L$ and $L+\Delta L$ is calculated. Energy spectra can be deduced from the calculated scattering probabilities.

In this contribution, results of the scattering of H\textsuperscript{+} and He\textsuperscript{+} ions from solid surfaces (Cu, Au) are presented. The scattering probabilities are calculated especially for low $L$ values (which correspond to higher probabilities). Energy loss of the projectiles in the solid is taken into account. Different values of the incident and the scattering angles are considered. The obtained energy spectra are compared to those calculated with TRIM (TRansport of Ions in Matter) code.
The behavior of the even-even $^{80-88}$Zr nuclei

AYDOGAN M., BOYUKATA M.

Kirikkale University, Faculty of Science and Arts, Department of Physics, Kirikkale, Turkey

In this study, we first investigated the experimental energy levels in the ground-state (g.s.), gamma ($\gamma$) and beta ($\beta$) bands. Then their energy ratios were calculated and compared with the experimental ones of the dynamical symmetries; U(5), SU(3) and O(6). These values change from 2.86 to 2.02 located in between the typical ratios of SU(3) and U(5), also include O(6). In this chain, $^{84}$Zr nucleus shows the phonon multiplets picture occurs as ($0^+_1$); ($2^+_1$); ($4^+_1$, $2^+_2$, $0^+_2$) in the energy level scheme. The ($2^+_2$, $0^+_2$) levels of $^{82}$Zr are not known but the other levels show similar behavior of $^{84}$Zr. The known levels are calculated and unknown ones in g.s., $\gamma$ and $\beta$ bands can be predicted within the interacting boson model-1 (IBM-1). To understand the behavior of the 80-88Zr nuclei, some of the structural properties of these nuclei were calculated and compared with the experimental data.
The structure of the even-even $^{74-86}$Sr isotopes in the A~80 region

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$^1$Kirikkale University, Institute of Science, Department of Physics, Kirikkale, Turkey
$^2$Kirikkale University, Faculty of Science and Arts, Department of Physics, Kirikkale, Turkey

Some nuclear structural properties of $^{74-86}$Sr nuclei were studied within the interacting boson model (IBM) in this work. For the investigation, we first analyzed their experimental energy ratios ($R_{4^+/2^+}$) in the ground-state (g.s.) band and these ratios change in between 2 and 3 moving from U(5) to SU(3) symmetries. Therefore, these isotopes lie along to the spherical to the deformed region. For the calculation process, the Hamiltonian were constructed and the ist parameters were fitted from the experimental data obtained at the National Nuclear Data Center (NNDC). Our main aim is to describe the behavior of these isotopes and so we calculated energy spectra and the electromagnetic transition probabilities within the IBM-1 model. We later compared the energy ratios, calculated IBM-1, with experimental ones and also other calculated properties compared with experimental data. As a result, we see that these isotopes include spherical and deformed nuclei.
Ground-state properties of even-even $^{136-180}$Dy and $^{138-182}$Er nuclei by using RMF model with DEFNE interaction

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$^1$Sinop University, Quantum Systems Modelling Department, Sinop, Turkey

$^2$Sinop University, Nuclear Energy Engineering Department, Sinop, Turkey

$^3$Cumhuriyet University, Physics Department, Sivas, Turkey

Recently, we have proposed a new non-linear interaction parameter set called DEFNE for relativistic mean field (RMF) model. In the present study, we have employed it to carried out various ground-state properties of even-even rare-earth $^{136-180}$Dy and $^{138-182}$Er nuclei within the framework of RMF model. For these nuclei, calculated binding energies, two-neutron separation energies and charge radii in this work are in agreement with available experimental data. In some cases, our results are close to literature values then the those of other non-linear RMF model parameters. Furthermore, calculated quadrupole moment deformation parameters of considered nuclei have been presented.
NP007

Half-space Albedo problem for linear-quadratic anisotropic scattering according to moments of incoming neutron distribution

TURECI R.G.

Kırıkkale University, Kırıkkale Vocational School, Kırıkkale, Turkey

One speed, time independent neutron transport equation for a slab geometry can be solved with the linear-quadratic anisotropic scattering kernel. As an application, the half-space albedo problem can be examined for this scattering. Albedo is the ratio between the net outgoing and the net incoming neutron fluxes. Using the proper neutron distributions albedo can be calculated. In this study the effect of the incoming neutron flux moments has been calculated by using the Modified FN method.
The criticality problem for the triplet anisotropic scattering with modified $F_N$ method

TURECI R.G.

Kirikkale University, Kirikkale Vocational School, Kirikkale, Turkey

One speed, time independent neutron transport equation in slab geometry can be solved with the triplet anisotropic scattering for the criticality problem. Case’s eigenfunctions, normalization relation and the orthogonality relations must be derived for this scattering in order to use the modified $F_N$ method. The value of the critical slab thicknesses is investigated as numerical by using the method. Some selected values, which can be calculated from the criticality equation, can be tabulated.
NP010

The structure of $^{152}$Sm target and the effects of the deformation parameter on cross sections of neutron induced reactions

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²Afyon Kocatepe University, Physics Department, Afyonkarahisar, Turkey

In the presented work, we first investigated the structure of $^{152}$Sm nucleus within the interacting boson model-1 (IBM-1). This nucleus is selected as a target nucleus for the neutron induced reactions, namely, (n,2n), (n,p) and (n,γ) reactions. For the nuclear structural part, the energy levels of the target were calculated and then its geometry was predicted by plotting potential energy N surface as function deformation parameters ($\beta, \gamma$). Later we used the $\beta$ parameter as an input in the TALYS 1.8 code to calculate the cross sections of these neutron induced reactions. Our main purpose is to see the effect of this parameter on these reactions. Therefore, we used different projectiles to study in detail effects of the deformation parameter on reaction types. Moreover, TALYS default deformation parameters were used as an input to calculate the cross sections. Finally, all calculated results were compared with each other and with the experimental data from EXFOR.
The calculation of the deformation parameter of $^{150}$Nd target and its effect of this parameter on the cross sections of ($\gamma$,2n), (n,2n), (p,2n) reactions

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\textsuperscript{1}Kirikkale University, Physics Department, Kirikkale, Turkey
\textsuperscript{2}Afyon Kocatepe University, Physics Department, Afyonkarahisar, Turkey

For the determination of the deformation parameter of the target nucleus ($^{150}$Nd) we first focused on the prediction of its geometric shape. For this process, we used the potential energy surface formalism obtained from the Hamiltonian of the interacting boson model-1 (IBM-1) in the classical limit. After complete the calculation of the deformation parameter, we tested its effects on the reaction cross sections of the $^{150}$Nd(n,2n), $^{150}$Nd(p,2n), and $^{150}$Nd($\gamma$,2n) reactions. To see this effect, the obtained deformation parameter was used in the TALYS 1.8 code to calculate the cross sections on these reactions. We also used the TALYS default deformation parameters for the cross section calculations and compared all results and the experimental data (given in EXFOR). For the detail analyzing of results, the different projectiles were used to study the effects of this parameter on reaction types.
NP014

Determination of radiative strength function by using Dicebox simulation code

ASICI C., ALGIN E.

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Nuclear level densities and radiative strength functions are important for pure and applied nuclear physics. They are key elements for Hauser-Feshbach statistical model calculations. Also, they can be used for testing of nuclear models. Applications include astrophysics, the study of nuclei far from the stability line, and nuclear reactor design.

Radiative strength function characterizes the average electromagnetic properties of excited nuclei. It is closely connected to radiative decay and photo-absorption processes, and directly associated with reduced transition probabilities. Radiative strength function can be determined in a thermal neutron-capture experiment by calculating the intensities of gamma transitions feeding the low lying states using a Monte Carlo code like Dicebox.
We have obtained eigenvalues and eigenfunctions of the collective Bohr Hamiltonian with the inversely quadratic Yukawa potential within the framework of the asymptotic iteration method for γ-unstable case structure. For arbitrary n principal and τ seniority quantum numbers the energy eigenvalues and the normalized eigenfunctions are obtained by using an approximation to the centrifugal term. The normalized eigenfunctions are obtained in terms of hypergeometric functions.
Charge exchange spin-dipol excitations in spherical nuclei ($0^+\leftrightarrow 0^-$ transitions)

SELAM C. 1, CAKMAK S. 2, CAKMAK N. 3, UNLU S. 4

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3Karabük Üniversitesi, Karabük, Turkey
4Mehmet Akif ERSOY Üniversitesi, Burdur, Turkey

In this study, the $K\pi = 0^-$ band of charge-exchange spin-dipole interactions in spherical nuclei was investigated. As the average field potential was taken the spherical Saxon-Woods potential. Residual charge-exchange spin-dipole interaction was taken in separable form and problem was solved by QRPA method. The Log ($\beta$) values of the beta transitions for some spherical nuclei, are calculated and compared with the appropriate experimental values. The contributions from relativistic events in calculations also taken into account. It has been found that the contributions from relativistic events are significant in the first forbidden beta decay.
Two-neutrino double beta decay rates for some spherical nuclei

UNLU S.¹, CAKMAK N.², CAKMAK S.³, SELAM C.⁴

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The present work contains an application of SU(4) symmetry restoration for two neutrino double beta decay process. SU(4) symmetry violations in the mean field level of approximation are restored using Pyatov’s Restoration Method. Then, the nuclear matrix element and half-lives for two-neutrino double beta decay are obtained within the framework of pn-QRPA method. The calculated decay rates are compared with other calculations and available experimental data.
NP020

The study of dipole and spin dipole strength distributions in Sn isotopes

CAKMAK S.\textsuperscript{1}, UNLU S.\textsuperscript{2}, CAKMAK N.\textsuperscript{3}, SELAM C.\textsuperscript{4}

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In the present work, the electric dipole excitations ($\Delta L=1, \Delta S=0$) in various Sn isotopes are investigated within a translational invariant and Galilean invariant method which was previously applied for deformed nuclei. Also, the spin-dipole excitations ($\Delta L=1, \Delta S=1$) are calculated in the framework of (pp+nn) QRPA method. Thus, a theoretical description of spin-dipole excitations is given using charge-conserving QRPA procedure. A comparison of calculated results with available experimental data is presented.
Scattering of $^{17}$F exotic nuclei from $^{58}$Ni target at 58.5 and 170 MeV

KARATEPE S.

Bitlis Eren University, Hizan Vocational School, Bitlis Turkey

In this study, elastic scattering for the system $^{17}$F + $^{58}$Ni at the energies 58.5 MeV and 170 MeV were examined theoretically by using Continuum-Discretized Coupled-Channels (CDCC) Method, Double Folding Model and Optical Model. The results were compared with data in the literature. Total reaction cross sections were determined. The results obtained have been successful in explaining experimental data.
In this study, Gamow's Formula Calculations for 4n+2 series radioisotopes have been investigated. Gamow assumed that the α decay was due to the quantum mechanical tunneling of a charged α particle through the nuclear Coulomb barrier. The up to date experimental systematic of α particles's half life can be found in NUDAT. A good agreement with the experimental data for 4n+2 series radioisotopes.
Nuclear structure of In isotopes in $^{100}$Sn mass region

LAOUET N., BENRACHI F.

LPMS Laboratory, Frères Mentouri University-Constantine, Algeria

The monopole effect resulting from the interaction between the magic core and the valence particles has a particular interest in the study of nuclear structure. To understand the importance of this interaction, we have realized some spectroscopic calculations for odd-odd In isotopes containing one hole and few particles in addition to $^{100}$Sn doubly magic core in their valence spaces. The using interaction is derived from jj45apn one taking into account the monopole interaction in the studied mass region, and using recent single particle and hole energies. The calculations are performed in the framework of the nuclear shell model by means of Oxbash nuclear structure code.
Spectroscopic properties of $^{130}$Sb, $^{132}$Te and $^{134}$I nuclei in $^{100}$Sn and $^{132}$Sn magic cores

BENRACHI F., KHITER M., LAOUET N.

Frères Mentouri Constantine 1 University, Mathematical and Subatomic Physics Laboratory, Algeria

We have performed shell model calculations by means of Oxbash nuclear structure code using recent experimental single particle and single hole energies with valence space models above the $^{100}$Sn and $^{132}$Sn doubly magic cores. The two-body matrix elements (tbme) of CD-Bonn realistic interaction are introduced after have been modified taking into account the three-body forces. We have focused our study on spectroscopic properties evaluation of $^{130}$Sb, $^{132}$Te and $^{134}$I nuclei, in particular their energy spectra, transition probabilities and moments have been determined. The getting results are in reasonable agreement with the experimental data.
NP025

ΔJ=2 first forbidden β-decay transitions in even-even heavy nuclei

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For neutron-rich nuclei, first-forbidden transitions are favored mainly due to the phase-space amplification for these transitions. In this work, we calculate as unique first forbidden (U1F) ΔJ=2 transitions strength in even–even heavy nuclei. The pn-QRPA model was used with a schematic separable interaction to calculate U1F transitions. The logft values and reduced transition probabilities for the $2^- \leftrightarrow 0^+$ transitions were also calculated. We compared our calculations with the previously RPA calculation and experimental results. Our calculations are in better agreement with measured data.
The allowed GT half-lives for $^{117,119,121}$Te isotopes by Pyatov method

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The violated commutation condition between the total shell model Hamiltonian and Gamow-Teller operator has been restored by Pyatov method. An additional effective interaction term $h_0$ coming from this restoration contributes to the total Hamiltonian. The eigenvalues and eigenfunctions of the restored Hamiltonian with the separable residual Gamow-Teller effective interactions in the particle-hole and particle-particle channels have been solved within the framework of pn-QRPA. The Woods–Saxon potential basis has been used in our calculations. The calculated half-lives have been compared with the corresponding experimental data.
Solution of Bohr Hamiltonian with the Kratzer potential using Nikiforov-Uvarov method for X(3) critical point symmetry

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A $\gamma$-rigid solution of the Bohr Hamiltonian is derived for $\gamma=0$ utilizing the Kratzer potential in the $\beta$ variable. This solution is going to be called X(3)-Kratzer. The energy eigenvalues and wave functions are obtained by using an analytic method which has been developed by Nikiforov and Uvarov. B(E2) transition rates are calculated.
Investigation of the scissors mode in $^{161}$Dy nucleus

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The low-lying magnetic dipole ($M_1$) transitions from the ground- to excited-states in heavy deformed odd-mass $^{161}$Dy isotope have been microscopically investigated on the basis of the quasiparticle phonon nuclear model (QPNM). The problem of the spurious state mixing in $M_1$ excitations is overcome by a restoration method allowing a self-consistent determination of the separable effective restoration forces. The calculation predicts $3/2^+$ excitations with summed $M_1$ strength $1.341 \mu_N^2$ and $7/2^+$ excitations with summed $M_1$ strength $1.353 \mu_N^2$ in the interval energy 2-4 MeV. We found a strong fragmentation of the $M_1$ strength in $^{161}$Dy which was in qualitative agreement with the experimental data. The calculated fragmentation of the $M_1$ strength in $^{161}$Dy is much stronger in comparison with that in $^{160}$Dy.
The investigation of electric pygmy dipole resonance in $^{176}$Hf

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The properties of pygmy dipole resonance in $^{176}$Hf isotopes are investigated in the framework of the Quasiparticle Random Phase Approximation (QRPA). Analysis of the numerical calculations indicates that both K=1 and K=0 branches of excitations plays significant role in formation of low energy electric dipole response. It has been shown that the main part of E1 strength, observed below the threshold in this nucleus may be interpreted as main fragments of the PDR.
NP030

Detailed investigation of the tensor force on the evaluation of magicity for the Si isotopes, N=20 and N=28 isotones with Skyrme-Hartree-Fock-Bogoliubov calculations

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In this work, the magicity of the $^{34}$Si and $^{42}$Si nuclei are inspected. For this purpose, effects of tensor force on the ground state properties of the $^{28-48}$Si nuclei are investigated in the framework of spherical Skyrme-Hartree-Fock-Bogoliubov approach and results are calculated using SLy5, SkI3 and SGII Skyrme energy functionals as well as T44 and T66 tensor forces by calculating even-even nuclei. In conclusion, it is examined that $^{34}$Si nucleus shows the double magicity due to the closure of both proton and neutron shells and $^{42}$Si nucleus shows variable neutron shell closure to the Skyrme energy functionals without tensor force. Hence, when the tensor interaction is taken into the account, the magicity of the N=28 vanishes. These results are in good agreement with experimental studies in the literature.

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NP031

Solution of Bohr Hamiltonian with the pseudo harmonic potential using Nikiforov-Uvarov method for Z(5) critical point symmetry

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The Z(5) symmetry was proposed to describe the critical point symmetry for prolate to oblate shape-phase transitions. In the case in which the potential has a minimum around \( \gamma = 30 \). In this study, the \( \beta \) part of Bohr Hamiltonian for \( \gamma \approx 30 \) is solved with pseudo harmonic potential using the Nikiforov-Uvarov method. The obtained energy spectra and the calculated B(E2) transition rates are presented and compared with existing experimental data.
NP032

Solution of Bohr Hamiltonian with the pseudo harmonic potential using Nikiforov-Uvarov method for X(3) critical point symmetry

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A $\gamma$-rigid solution of the Bohr Hamiltonian is derived for $\gamma = 0$ utilizing the Pseudo Harmonic potential in the $\beta$ variable. This solution is going to be called X(3)-PH. The energy eigenvalues and wave functions are obtained by using an analytic method which has been developed by Nikiforov and Uvarov. B(E2) transition rates are calculated.
Inelastic scattering (Coupled Channel Calculations-CC) is very important in nuclear reaction processes, because it also involves the excited states of both projectile and target nuclei. Investigations on the elastic scattering of $^6$He on $^{64}$Zn target nuclei have been presented by some researchers in previous studies. Based on these literature reports, I have seen that there is no study related to inelastic effects on cross-section of $^6$He+$^{64}$Zn until now and this creates the motivation of this work. All calculations have been done with FRESCO-CC. Excitation states and deformation parameters of projectile and target nuclei have been used in the code.
NP035

Microscopic double folding model of $^9\text{Be}^{+209}\text{Bi}$

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The elastic scattering angular distributions of $^9\text{Be}^{+209}\text{Bi}$ reaction have been studied using the microscopic double-folding model within the framework of the optical model at energies near the Coulomb barrier for twelve energy from 37 MeV to 44 MeV. All of the computations have been utilized using FRESCO code. The density distribution of $^{209}\text{Bi}$ nuclei has been taken from Reference Input Parameter Library, but $^9\text{Be}$’s density distribution has been taken as:

$$P_{^9\text{Be}}(r) = (A + BC^2 + r^2) \exp(-C^2r^2) + (D + EF^2r^2) \exp(-F^2r^2)$$
NP036

Ab initio nuclear structure and nuclear scattering

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We perform ab initio nuclear lattice simulations for the calculations of nuclear scattering and nuclear structure using the nuclear forces from chiral effective field theory which is an effective theory of QCD. To study nucleus-nucleus scattering we develop and use the adiabatic projection method. It is a general framework for scattering and reactions on the lattice, which uses a set of initial cluster states and Euclidean time projection to give a systematically improvable description of the low-lying scattering cluster states. We show that using the adiabatic projection method and applying the auxiliary field Monte Carlo makes large scale calculations practical.
A Compton suppression system for gamma-ray spectroscopy

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A Compton suppression system was designed using Monte Carlo simulation technique. A HPGe detector was shielded by an annular and a plug NAI detectors in order to reduce the unwanted background signal that appear in gamma-ray spectroscopy. This system uses multiple detectors operated in anticoincidence mode to remove the scattering interactions that raise the Compton continuum from the spectrum. As a result of the suppression small peaks are allowed to be analyzed which might be deteriorated before the Compton continuum was suppressed. A disadvantage is that some real counts might be lost and hence the detection efficiency might be reduced in a certain extend.
The effect of collimation on the shape of the Compton continuum and backscattering peaks

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The shape of the Compton continuum and backscattering peaks were determined by Monte Carlo simulation for the energy value of 662 keV from $^{137}$Cs radioactive point source. First the source was put in front of the detector window without any collimator (isotropic source), then the collimator was introduced with the diameter values ranging from 2 mm to 20 mm. The effect was shown by overlapping the peaks.
Monte Carlo calculation of proton stopping power and ranges in water for therapeutic energies

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Monte Carlo is a statistical technique for obtaining numerical solutions to physical or mathematical problems that are analytically impractical, if not impossible, to solve. For charged particle transport problems, it presents many advantages over deterministic methods since such problems require a realistic description of the problem geometry, as well as detailed tracking of every source particle. Thus, MC can be considered as a powerful alternative to the well-known Bethe-Bloche equation where an equation with various corrections is used to obtain stopping power and ranges of electrons, positrons, protons, alphas, etc. This study presents how a stochastic method such as MC can be utilized to obtain certain quantities of practical importance related to charged particle transport. Sample simulation geometries were formed for water medium where disk shaped thin detectors were employed to compute average values of absorbed dose and flux at specific distances. For each detector cell, these quantities were utilized to evaluate the values of the range and the stopping power, as well as the shape of Bragg curve, for mono-energetic point source pencil beams of protons. The results were found to be ±2% compared to the data from the NIST compilation. It is safe to conclude that this approach can be extended to determine dosimetric quantities for other media, energies and charged particle types.
Nuclear matter symmetry energy: VMC calculations

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The nuclear matter symmetry energy, which is defined as the difference in energy per nucleon between the pure neutron matter and the symmetric nuclear matter, is an important quantity. The symmetry energy per particle of asymmetric nuclear matter can be expanded about symmetric nuclear matter in Taylor series in terms of the proton fraction $Y_p$:

$$E(\rho, Y) = E_s(\rho)(1 - 2Y)S(\rho)$$

Where $E_s(\rho)$ and $S(\rho)$ are the energy per nucleon of symmetric nuclear matter and the symmetry energy, respectively. In this study, we obtain $E(\rho, Y_p)$ and $E_s(\rho)$ from Variational Monte Carlo (VMC) calculations. Also using the VMC results we obtain the symmetry energy.
Equation of state of neutron-rich matter

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The theories of neutron-rich nuclei, and their collisions require a knowledge of the asymmetric nuclear equation of state (EOS). The investigation of the EOS for neutron-rich matter (NRM) at high densities provides an important source for the studies making theoretical predictions on the properties of neutron stars and heavy-ion collisions. In this study, we obtain the EOS of NRM using a Variational Monte Carlo (VMC) method with the realistic Urbana V\textsubscript{14} two nucleon interaction.
Investigation of properties of neutron matter is important in nuclear physics and astrophysics. The properties of neutron matter are also important for the understanding of neutron star crusts and the exterior of large neutron-rich nuclei. In this study, we investigate the equation of state (EOS) of pure neutron matter (PNM) by using a Variational Monte Carlo (VMC) method.
Investigations of supernovae and properties of neutron matter and neutron stars are among the most interesting topics of nuclear physics and astrophysics. The aim of this study is a new Skyrme parameter set for neutron matter. A Variational Monte Carlo (VMC) method is employed to investigate the Skyrme parametrization of neutron matter. The realistic Urbanav14 nucleon–nucleon interaction potential of Lagaris and Pandharipande was used in the VMC calculations with addition of a phenomenological density-dependent term to simulate many-body interactions.
Predictions of the gamma ray mass absorption coefficients of sodium alginate

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Designing of materials which can be used in the application of radiation protection is a hot topic. Sodium alginate is widely used in textile applications such as warp sizing, dyeing finishing and printing paste. It has unique properties as the paste of reactive dyes. Making of its hybrid structures with metals are possible. In the present study, we have carried out the gamma-ray mass absorption coefficients of sodium alginate by using GEANT4 simulation code. Furthermore, we have considered Sodium alginate + Lead hybrid structure to obtain bigger mass absorption coefficients. In the present study, protective capability of this hybrid structure for gamma rays are discussed in details.
Bronze and brass alloys as alternative radiation shielding materials

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Radiation attenuation parameters such as linear attenuation coefficient (μ), mass attenuation coefficient (μ/ρ), half-value layer (HVL), mean free path (MFP) and effective atomic number (Z_{eff}) and electron density (N_e) of PbCu and WCu bronze and brass alloys have been investigated with respect to photon interactions at different photon energies. For this purpose, all specimens were irradiated using gamma rays emitted from $^{133}$Ba point radioactive source. Attenuated and unattenuated radiation emitted through the targets were detected and attenuation coefficients were determined at $^{133}$Ba energies. Then, MFP, HVL, $Z_{eff}$ and $N_e$ values of these alloys were determined for the mentioned energies. For comparison, theoretical values of alloys were also calculated at the same energies in terms of attenuation of gamma photons. Good agreements in different methods between $Z_{eff}$ for experimental and theoretical values were found for the chosen alloys. Also, these parameters of alloys were calculated continuous energy region, and significant variations were determined as the photon energy changes.
Studies of radiological properties of some shielding materials on charged particle interaction for storage of radioactive wastage

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Effective atomic number (Zeff) and electron density (Neff) of some shielding materials were studied for charged particle interaction. For this aim, the mass stopping powers were calculated for the oxide dispersion strengthened (ODS) steels (12Y1, 12YWT, 1DS, IDK, Eurofer97, MA956, MA957 and PM2000), alloys such as Carbon steel-516 (CS-516), Stainless steel-403 (SS-403), Stainless steel-410 (SS-410), Inconel-600 (IL-600), Stainless steel-316L (SS-316L), Stainless steel-304L (SS-304L), Monel-400 (MN-400), Cupero-nickel (CN) and some bricks in the energy region 10 keV-10 MeV for He ion. Then, effective atomic numbers (Zeff) and electron densities (Neff) of the all materials were calculated in the energy region 10 keV-10 MeV using mass stopping powers from SRIM Monte Carlo software for He ions for the first time. Maximum values of Zeff were observed for 12YWT (28.10) for ODSs, for CN (28.83) for steels and for CK-1 (10.99) for bricks in the continuous kinetic energy region respectively. Also, variation of the effective atomic numbers (Zeff) and electron densities (Neff) with energy were compared with each other and discussed in the continuous energy region in detail.
Since the first description made by Hans Bethe, the nuclear level densities have been very important quantities in experimental nuclear physics. They are used for testing nuclear models, and also are useful ingredients for cross-section calculations, nuclear waste transmutation, and for designing nuclear power plants. The Nuclear Physics Group in University of Oslo has found a genuine way to extract the nuclear level densities and γ-ray strength functions simultaneously from the γ-ray spectra. The nuclear level densities were determined via the Oslo method for $^{144,145}$Nd isotopes below the neutron separation energies by studying $^{144}$Nd(d, d') and $^{144}$Nd(d, p) reactions. The level densities obtained from these reactions will be presented.

This study is supported by the Scientific and Technological Research Council of Turkey (TUBITAK) under the Project No: 115F196.
The $\gamma$-ray strength functions of $^{144,145}$Nd isotopes

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$\gamma$-ray strength functions are measures of average electromagnetic properities of atomic nuclei and are also releated to the $\gamma$-ray transmission coefficient. They provide important information for understanding the formation of heavy elements. The $\gamma$-ray strength functions have been obtained for $^{144,145}$Nd isotopes by using the Oslo method below the neutron seperation energy. The results are compared with photo-neutron cross section of $^{144,145}$Nd data in a region from neutron threshold up to 14 MeV to verify the validity of the Axel-Brink hypotesis.

This study is supported by the Scientific and Technological Research Council of Turkey (TUBITAK) under the Project No: 115F196.
NP052

Diffusion approximation for the negative scattering parameters of Anli-Güngör phase function using $U_N$ method

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$U_N$ approximation is applied to neutron transport equation in slab geometry and then diffusion lengths are calculated for the negative values of scattering parameters ($t$) using Anli-Güngör phase function. Numerical results obtained from $U_1$ and $P_1$ approximations are compared with each other for different collision parameters and $t$ parameters.
NP053

Calculation of eigenvalues for neutron transport equation with $P_9$ and $U_9$ Approximation using Henyey-Greenstein phase function in slab geometry

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$P_9$ and $U_9$ approximations are applied to neutron transport equation in slab geometry then eigenvalues are obtained using Henyey-Greenstein (HG) phase function. Firstly, HG phase function is inserted into neutron transport equation then eigenvalues are calculated for different values of collision parameters $c$, and negative values of $t$ parameters. All results obtained from these approximations are compared each other and tabulated for the comparison.
NP054

S₄ solution of the transport equation for eigenvalues using Legendre polynomials

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Numerical solution of the transport equation for monoenergetic neutrons scattered isotropically through the medium of a finite homogeneous slab is studied for the determination of the eigenvalues. After obtaining the discrete ordinates form of the transport equation, separated homogeneous and particular solutions are formed and then the eigenvalues are calculated using the Gauss-Legendre quadrature set. Then, the calculated eigenvalues for various values of the cₒ, the mean number of secondary neutrons per collision, are given in the tables.
Numerical solution for eigenvalues of the transport equation: anisotropic, backward and forward scattering in a slab

OZTURK H.

Osmaniye Korkut Ata University, Physics Dept., Osmaniye, Turkey

The numerical solution of the transport equation for monoenergetic neutrons in a finite homogeneous slab is investigated for the eigenvalue spectrum. The forward-backward-anisotropic scattering kernel is used in transport equation and then the discrete ordinates form of the transport equation is solved for the fourth order approximation of the method. The calculated eigenvalues for various values of the anisotropy parameters using the Gauss-Legendre quadrature set are given in the tables.
NP056

S4 solution of the transport equation for eigenvalues: isotropic, backward and forward scattering in a slab

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The transport equation is solved numerically for monoenergetic neutrons in a finite homogeneous slab with backward and forward scattering for the eigenvalue spectrum. The forward-backward-isotropic (FBI) scattering kernel is used in transport equation and then the transport equation is converted into discrete ordinates form to obtain the eigenvalues. Finally, the eigenvalues are calculated for various values of the scattering, backward and forward scattering parameters using the Gauss-Legendre quadrature set and they are given in the tables.
NP057

Calculation of the extrapolation distance for one-speed neutrons in a slab with isotropic scattering using Marshak boundary condition

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The conventional Legendre polynomials approximation ($P_N$ method) of first order is used to calculate the extrapolated end points for one-speed neutrons leaking from a slab with isotropic scattering. The calculated extrapolation distances, obtained by using Marshak type vacuum boundary condition, are given in the table with the exact ones for comparison.
NP058

Chebyshev polynomials approximation for the eigenvalue spectrum of monoenergetic neutrons in 1-D geometry

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The eigenvalue spectrum for monoenergetic neutrons in a slab with isotropic scattering is studied in neutron transport theory. For this purpose, first the neutron angular flux in transport equation is expanded in terms of the Chebyshev polynomials of first kind and then moment equations are obtained. Thereby, the eigenvalues are calculated for various values of the $c$, the mean number of secondary neutrons per collision, and they are given in the table.
NP059

Calculation of eigenvalues of monoenergenic neutrons in a slab with backward and forward scattering using Chebyshev polynomials

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The neutron transport equation for monoenergetic neutrons in a slab with backward and forward scattering is solved for determining the eigenvalue spectrum. First the neutron angular flux is expanded in terms of the Chebyshev polynomials of first kind ($T_N$ method) and then the $T_N$ moments of the the equations are obtained. Finally, the eigenvalues are calculated for various values of the collision, backward and forward scattering parameters and they are given in the table.
NP060

Chebyshev polynomials of the first kind for the eigenvalue spectrum of monoenergetic neutrons in a slab with anisotropic, backward and forward scattering

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The eigenvalue spectrum for monoenergetic neutrons in a slab with anisotropic scattering is studied using the Chebyshev polynomials of first kind in the expansion of the angular flux in transport equation. The backward, forward and linear anisotropic scattering kernel is used as the scattering function. Then, \( T_N \) moments of the the equations are obtained. The calculated eigenvalues for various values of the anisotropy parameters are given in the tables.
Extrapolation distance in one-speed neutron transport equation using low order Legendre polynomials with Mark boundary condition

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In this study, the extrapolated end points for one-speed neutrons in a slab with isotropic scattering are calculated using the conventional Legendre polynomials approximation ($P_N$) method. The extrapolation distances for the neutrons of one-speed leaking from the system are calculated using Mark type vacuum boundary condition and they are given in the table with exact results to query the validity of the method.
CNP001

Calculation of excitation functions of some elements with $(^3\text{He},p)$ reactions

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In this study, the excitation functions of nuclei of $^{64}\text{Zn}$, $^{63}\text{Cu}$, $^{24}\text{Mg}$ and $^{16}\text{O}$ targets bombarded with $^3\text{He}$ particles at specific energy ranges were calculated with TALYS 1.8 nuclear reaction code. Theoretically calculated cross sections were compared with experimental cross sections available in EXFOR library.

According to the obtained results, the theoretical and experimental cross sections of the $(^3\text{He},p)$ reactions are in good agreement.
CNP002

Double differential proton emission cross sections for structural fusion materials $^{28}$Si

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In this study, double differential proton emission cross sections of $^{28}$Si target nuclei have been theoretically calculated by the TALYS 1.8 code at 14 MeV neutron incident energy. Theoretical calculated cross sections were compared with available experimental data in EXFOR library. Furthermore, in theoretical calculations direct, compound and pre-equilibrium reaction contribution have been investigated.

Theoretical and experimental values are in good agreement for all emission angles.
Photoneutron production calculations in some osmium isotopes

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In this study, theoretical evaluation of photoneutron reaction cross sections for some Osmium isotopes (Os-186, Os-188, Os-189, Os-190, Os-192) have been investigated in the different incident photon energy range. TALYS 1.8 was used to calculate the photoneutron cross sections. The results are compared with the experimental results in the literature which is available in the EXFOR nuclear reaction data library. The photoneutron cross section results and the effects of the mass number of target nuclei are discussed.
Photonuclear reaction data are very important for understanding the structure and dynamics of the atomic nucleus. Moreover, many photonuclear reaction data are widely used for variety of applications such as; radiation shielding design, radiation transport analysis, activation analysis, astrophysical nucleosynthesis, safeguards and inspection technologies, human body radiotherapy absorbed dose calculation, etc. Various features of photonuclear reaction are needed however, the most important one is the energy dependence of reaction cross–section (excitation function - probability of interaction of definite energy photons with nucleus). The nuclear reaction models are generally required to get the prediction of the reaction cross–sections, especially if no experimental data are obtained or in cases where it is difficult to carry out the experimental measurements. Photon induced nuclear reaction cross–section evaluation for materials attaches’ special importance to use of reaction systematics. Photoabsorption cross–section is used for characteristic calculations of any photonuclear reaction in the GDR region. In this study, $^{27}\text{Al}(\gamma,\text{abs})$, $^{25}\text{Mg}(\gamma,\text{abs})$, $^{26}\text{Mg}(\gamma,\text{abs})$, $^{58}\text{Ni}(\gamma,\text{abs})$, $^{60}\text{Ni}(\gamma,\text{abs})$ and $^{181}\text{Ta}(\gamma,\text{abs})$ reaction cross–sections have been calculated with TALYS 1.6 nuclear reaction code, and Standart Lorentzian Model. The calculated results have been compared and analyzed with the experimental data taken from EXFOR.
Comparison of the level density models for photo-neutron reactions on tin targets

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In this study, it is aimed to compare the level density models for photo-neutron reactions on tin targets. For this, we have used the level density models such as Constant Temperature + Fermi Gas Model (CTFGM), Back-Shifted Fermi Gas Model (BSFM), Generalized Superfluid Model (GSM), Hartree–Fock–Bogoliubov Microscopic Model (HFBM). The theoretical photo-neutron cross sections for tin targets have been calculated on these level density models by using TALYS 1.8 code for photon energies up to 30 MeV. The obtained results have been compared with each other and experimental data in the EXFOR database.
Calculation of photo-nuclear cross sections of ruthenium isotopes

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We have planned an experiment to determine the energy levels and half-lives of ruthenium isotopes by photo-nuclear reactions. In this experiment, we will use bremsstrahlung photons generated from a clinic linac. The bremsstrahlung photons have an endpoint energy of 18 MeV. In this study, we have investigated different photo-nuclear reaction channels for stable ruthenium isotopes before the experiments. For this, the theoretical photo-nuclear cross sections for ruthenium targets have been calculated by using TALYS 1.8 code for photon energies up to 25 MeV. The obtained results have been compared with TENDL-2015 Nuclear Data Library and EXFOR database. Therefore, it was determined which reaction channels could be realized.

This study was supported by Kirikkale University, Science Research Projects Coordination Unit with the grant number 2017/001.
Neutron emission calculations on $^{56}\text{Fe}$, $^{63}\text{Cu}$, $^{72}\text{Ge}$ and $^{84}\text{Kr}$ target elements

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In this study, we have studied neutron emission reactions induced by protons at energy range up to 60 MeV on $^{56}\text{Fe}$, $^{63}\text{Cu}$, $^{72}\text{Ge}$ and $^{84}\text{Kr}$ target elements. (p,n), (p,2n) and (p,3n) reaction cross sections for each element were drawn in the same graph with comparison of experimental values taken from EXFOR library. Figures show that, our theoretical calculations of TALYS nuclear code is in good agreement with experimental cross sections.
CNP008

Effects of level density models on (p,n) reactions in some natural metal targets

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The total reaction cross sections of some natural metals (natCr, natCu) were calculated using TALYS 1.8 nuclear reaction code for proton induced reactions through the three phenomenological level density models in the energy range from up to 15 MeV. Theoretical calculations have compared with each other and with the available experimental data obtained from EXFOR library.
With the increase of modern daily life's energy needs, the use of nuclear reactors for energy production has been increased, too. The world wide running nuclear reactors for energy production have been using the fission principle, in which the control of neutrons has a very important point for the safety and operation. The control rods are the main units responsible to adjust the rate of the fission reaction and also its continuity. Due to that, they have a significant importance. In this study, the neutron induced elastic scattering reactions' cross-section calculations have been completed for several isotopes of cadmium, which is a well known and commonly used nuclear reactor control rod material. The $^{106}$Cd(n,el)$^{106}$Cd, $^{108}$Cd(n,el)$^{108}$Cd, $^{110}$Cd(n,el)$^{110}$Cd, $^{112}$Cd(n,el)$^{112}$Cd and $^{116}$Cd(n,el)$^{116}$Cd reactions were investigated with TALYS 1.6 code. Several models such as Equilibrium Model, Two Component Extion Model, Constant Temperature Fermi Gas Model, Back Shifted Fermi Gas Model and Generalized Superfluid Model exist in the TALYS 1.6 code have been employed for calculations. All obtained calculation results for given reactions with mentioned models have been compared with the experimental data exist in the literature.
Many radioisotopes are used in the field of medicine for diagnostic applications and treatments. Ytterbium-169 ($^{169}$Yb) is used in the medical field where it has been proposed as an alternative for $^{125}$I and $^{103}$Pd in the treatment of prostate cancer while it is also used for diagnostics in the gastrointestinal tract. Small amounts of $^{169}$Yb is used as a radiation source substitute for portable X-ray machines where electricity is not available. In the present study, we have investigated $^{169}$Yb product cross sections for neutron induced reactions of stable Yb isotopes. For this investigation, the TALYS-1.8 code has been used. Neutron energy range has been considered as 0-50 MeV. $^{169}$Yb cross section rates in the neutron induced reactions of stable Yb isotopes have been discussed and compared with the results of TENDL-2015 data.
Reaction cross section calculation some alkaline earth elements

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Reaction cross section knowledge is crucial to application nuclear physics such as medical imaging, radiation shielding and material evaluations. Nuclear reaction codes can be used if the experimental data are unavailable or are improbably to be produced because of the experimental trouble. In this study, the reaction cross sections of some target alkaline earth elements have been calculated by using pre-equilibrium and equilibrium nuclear reaction models for nucleon induced reactions. While these calculations, the Hybrid Model, the Geometry Dependent Hybrid Model, the Full Exciton Model, the Cascade Exciton Model for pre-equilibrium reactions and the Weisskopf-Ewing Model for equilibrium reactions have been used. The calculated cross sections have been discussed and compared with the experimental data taken from Experimental Nuclear Reaction Data library.
CNP013

Excitation functions of deuteron induced nuclear reactions on natural cadmium target used for production of $^{107}$In, $^{109}$In, $^{111}$In, $^{114}$In radionuclides

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Activation data induced by deuteron on cadmium are of interest in different practical applications. Indium radioisotopes are commonly used in nuclear medicine. Therefore in this study, deuteron induced cross sections of the nat Cd(d,x) reactions were calculated with TALYS 1.6 nuclear reaction simulation code. However, with this reaction was used to investigate the excitation functions for the isotopes of In radionuclides, especially $^{107}$In, $^{109}$In, $^{111}$In and $^{114}$In radionuclides. The obtained theoretical data were compared with the earlier experimental data from EXFOR library.
The study of the comparison excitation functions for (α,x), (d,x) and (γ,x) reactions for natural titanium target nuclei have been calculated by TALYS 1.6 nuclear reaction simulation code. The (α,x), (d,x) and (γ,x) reaction cross sections for titanium have been compared with each other and experimental data from EXFOR library.

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CNP015

Inelastic scattering of 14.6 MeV neutrons from $^{23}$Na, $^{27}$Al, $^{32}$S, $^{54}$Co target nucleus

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In this study, for scattering of neutrons of 14.6 MEV energy from $^{23}$Na, $^{27}$Al, $^{32}$S, $^{54}$Co target nucleus. Differential cross sections are calculated by TALYS 1.8 nuclear reaction code. Calculated cross sections are compared to experimental cross sections which are available in EXFOR Library.

According to results, evaluated and experimental differential cross sections are in a good agreement.
Total cross–section calculations of neutron induced reactions for some control rod materials used in nuclear reactors

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The most preferable usage of the nuclear reactors is about energy production due to the rapid increase of energy requirements of the modern daily life. There exist different types of nuclear reactors which may classified according to their fuel, moderator and coolant type or type of reaction as fission or fusion. Almost all reactors, which are still in use for energy production, are working on fission principle. Among all processes of fission reaction, “neutron control” has a key importance in the reactions continuity which effects the amount of produced energy. Also, the control of neutrons has a vital importance on the reactors safety, reliability and operation. The main aim of this study is to investigate the effects of different energetic induced neutrons on the control rod materials. Due to that, the total reaction cross–section calculations have been completed for different isotopes of boron, dysprosium and europium elements with neutron induced reactions where the used neutrons have been selected in the thermal (0.025 – 1 ev), epithermal (1 eV – 10 keV) and fast (10 keV and more) energy regions. All calculations have been done by using TALYS 1.6 and EMPIRE 3.2 codes, which are the most widely used and verified computation codes. Among many theoretical calculation models exist within these codes, Two Component Exciton model from TALYS 1.6 and Exciton model from EMPIRE 3.2 have been employed during calculations. Obtained results were also compared with the exist experimental data taken from the EXFOR database.
Ionic channels are integral membrane proteins in the cell membrane of nerve, muscle and other tissues. They produce and transduce electrical signals in living cells. Excitation and electrical signalling in nervous system involve the movement of ions through ionic channels such as Na\(^+\), K\(^+\), Ca\(^{2+}\) and Cl\(^-\). Voltage gated sodium channels play an essential role in the initiation and propagation of action potentials in neurons and other electrically excitable cells such as myocytes and endocrine cells. When the cell membrane is depolarized by a few millivolts, sodium channels activate and inactivate within milliseconds. Influx of sodium ions through the integral membrane proteins comprising the channel depolarizes the membrane further and initiates the rising phase of the action potential. Recent studies indicate that high and low frequency electromagnetic radiations have been able to change the kinetics of the potassium and sodium channels in a squid giant axon model. In this study, we aim to investigate early biological effect of radiation on voltage gated sodium channel using GEANT4-DNA package. Obtained results were compared experimental results taken from the literature.
Production cross–section calculations of medical Tb isotopes

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Technical developments in nuclear physics have allowed them to develop in the field of medical imaging. Production of radioisotopes used in medical diagnosis and treatment are mostly based on the nuclear reactions. The probability for a nuclear reaction is expressed in terms of a cross–section. The data of the cross–section is important to understand nuclear reaction models and to improve of radioisotopes and neutron usage that generated by this reaction. Experimental difficulties and lack of data may cause the theoretical calculations came forward in some cases. For these situations, scientists have developed different nuclear reaction codes, such as TALYS, EMPIRE, GEANT, MCNP to compute reaction cross–section, spectrum of out-going particles and dose calculations including many theoretical nuclear models. In this study, it was investigated that the production cross–sections of Tb radioisotopes by using TALYS 1.6 computer code with three different level density models which are Constant Temperature Fermi Gas, Back Shifted Fermi Gas and Generalized Superfluid Models. The obtained results have been discussed and compared with the experimental data taken from the Experimental Nuclear Reaction Data Library, EXFOR.
Investigation of neutron and gamma induced reaction effects on TiO$_2$ and Al$_2$O$_3$ coated nickel used at nuclear reactors

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Material development provided by specific studies for exclusive parts of high technological devices or structural materials of major constructional parts has an undeniable positive effect on technological development and scientific process. With the developed materials usage in the specialized field according to the requirements, the feedbacks and outcomes may become more and more effective, reliable and correct. Also, by using of specially developed materials, it is easier to lower the costs and prevent the goods from damage. To obtain the given results, specially produced materials have been using at nuclear reactors for many years both for scientific studies and energy production. Different parts of nuclear reactors require different materials for protection, sustainability, ease to construct and lower the cost. In this study, the nickel material, which is one of the most commonly used structural material in nuclear reactors due to its high ferrite and resistance to corrosion, coated with TiO$_2$ and Al$_2$O$_3$ has been investigated in terms of neutron and gamma induced particles effects. The study has been completed by using Geant4 simulation code. Geant4 is a free, valid and most commonly used simulation program in a wide range of area ie. high-energy physics, medical physics, space and radiation physics, military applications, material development etc. To see the effects of neutron and gamma induced reactions on TiO$_2$ and Al$_2$O$_3$ coated nickel material, generated neutrons in the energy range of 0-20 MeV, and generated gammas in the energy range of 0-5 MeV have been used within the Geant4 code. Obtained results with respect to the effects of neutrons and gammas such as neutron/gamma damage, neutron/gamma energy decrement percent, neutron/gamma flux etc. have been presented and discussed.
Proton bombarded reactions of calcium target nuclei

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Calcium is an important component for the living and necessary for human life. Free calcium metal is too reactive to occur in nature also it is produced in supernova nucleosynthesis. Calcium has five stable isotopes ($^{40}$Ca, $^{42}$Ca, $^{43}$Ca, $^{44}$Ca and $^{46}$Ca). In stellar studies, one of isotopes $^{41}$Ca is very important attention due to $^{41}$Ca decays to $^{41}$K, a critical indicator of solar-system anomalies. In this study, proton bombarded nuclear reactions calculations of Calcium target nuclei have been investigated in the incident proton energy range of 1–50 MeV. The excitation functions for $^{40}$Ca target nuclei reactions (p,α), (p,n), (p,p) have been calculated via the semi-empirical formula. The obtained results were compared with the experimental data taken from EXFOR library.
CNP023

Calculations of neutron-induced alpha emission double-differential cross section of fluorine at 14.2 MeV

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In this present study, calculations of neutron-induced alpha particle emission double-differential cross section of fluorine (\(^{19}\)F) at 14.2 MeV have been calculated by using ALICE, EMPIRE, and TALYS model programs for six different emission angles ranging from 30º to 150º. Calculated results from the Hybrid Monte Carlo pre-equilibrium emission and the full featured Hauser- Feshbach model have been compared with the experimental (EXFOR). The calculated double-differential cross section results using three codes are in good agreement with experimental data.
Nuclear model calculations of (n,γ) reaction cross sections for some isotopes in heavy concrete

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Shielding system is one of the important component of the nuclear reactors. It includes thermal, biological and electronic shielding. Biological shielding is an important one through these tasks of shielding systems. We emphasize that biological shielding should provide safe environment for both individual and public.

Main goal of the shielding systems is to stop neutron and gamma rays, which has high energy and high penetrating power. For this aim, heavy concrete as a shielding material is used very commonly in nuclear reactors.

In this study for some elements such as $^{26}\text{Mg}$, $^{27}\text{Al}$, $^{28}\text{Si}$, $^{31}\text{P}$ and $^{56}\text{Fe}$ used in concrete, (n,γ) cross section calculations were performed in 2 - 20 MeV energy region. For these calculations PCROSS and Alice/Ash computer programs used. Moreover, we compared our results with experimental and evaluated data obtained from literature.

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Proton emission of B₄C composites

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In the nuclear energy researches, composites with enhanced performance play an important role. In nuclear reactor structural material researches, composites, and in particular ceramic composites are suitable for both fission and fusion reactors as first-wall or blanket material. The structural materials have to endure much higher temperatures (1200°C) and higher neutron doses (tens of displacements per atom, dpa).

In this study, B₄C composites, which have been produced in Eskisehir Osmangazi University, used as target material to obtain proton emission spectra by MCNPX.

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CNP027

Swift heavy ion irradiation of several fusion structural materials by Monte Carlo calculations

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The evidence of the impact of heavy ion irradiation is revealed by several experimental studies. Recent progresses are provided through the use of these results. On the other hand, semi-empirical Monte Carlo calculations have another important role. 5 and 10 MeV energetic swift Au ion irradiation to Chromium, Nickel and Zirconium is simulated by SRIM and GEANT4 Monte Carlo Codes. The results were discussed in the view of particle and ion induced effects.
CNP028

**Systematic studies of CN cross sections with the optical model. Applications to the (n, alpha) excitation function reactions**

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By using the optical model, systematic studies of CN cross sections were carried out and analytical expressions have been deduced for calculating the neutron, proton and alpha reaction cross sections. The new empirical formulae obtained, allow a faster calculation of reaction cross sections in an energy range from threshold to 20 MeV and for target nuclei of mass number $50 \leq A \leq 100$. The choice of optical model parameters is based on the reproduction of experimental differential cross section data of the elastic scattering at angles $0^\circ \leq \theta \leq 180^\circ$. The systematic behavior of the optical model results was studied before choosing the pertinent dependence on the energy and the mass number, and setting up the reaction cross sections formulae.

The analytical expressions, of the reaction cross sections for neutrons and alpha, were used within the evaporation statistical model to calculate the excitation functions of (n, a) reactions in the same energy range as reaction cross sections. The description of the (n, a) cross sections by these systematic studies has been compared to experimental data available in the nuclear data library EXFOR. The results of the (n, a) excitation function shows a good agreement with recent experimental data.
Boron is usable many areas such as health, industry and energy. Especially, Boron neutron capture therapy (BNCT) is one of the medical applications. This method is known as radiotherapy based on the nuclear capture and fission reactions. Boron target is irradiated with low energy thermal neutrons and at the end of reactions alpha particles occur. After this process recoiling lithium-7 nuclei is composed. Therefore, BNCT enables the application of a high dose of particle radiation selectively to tumor cells in which boron-10 compound has been accumulated.

In this study, charge particle induced nuclear reactions calculations of Boron target nuclei have been investigated in the incident proton and alpha energy range of 5–50 MeV. The excitation functions for $^{10}$B target nuclei reactions have been calculated by using PCROSS Programming code. The semi-empirical calculations for $(p,\alpha)$ reactions have been done by using cross section formula with new coefficient obtained by Tel et al. The calculated results were compared with the experimental data from the literature.
Calculation of \((n,\alpha)\) reaction cross-sections by using some skyrme force parameters for potassium \((^{41}\text{K})\) target nuclei

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In this study, the \((n,\alpha)\) nuclear reaction cross-sections were calculated for \(^{41}\text{K}\) target nuclei for neutron and proton density parameters using SKa, SKb, SLy5, and SLy6 Skyrme force for 1.8 fm radius. We obtained theoretical cross-sections for the \((n,\alpha)\) nuclear reaction using a formula developed by Tel et al. Results were compared with experimental data from EXFOR. The results calculated from this formula is seen in a close agreement with experimental result for 1.8 fm radius.
Excitation functions of neutron poison elements evaluated using pre-equilibrium and equilibrium models

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Neutron emitted after fission reactions are so important for sustaining reaction. For this reason, the number of neutrons must be regulated at a certain level. One of the factors that negatively affects the value of the neutron multiplication coefficient is the absorption of emitted neutrons by the atoms.

When reactor start to produce power, fission products start to build up not only fuel elements, but also reactor wessel. Neutron multiplication coefficient and reactor activities get a bad influence by accumulation of fission products called neutron poison. Among the neutron poisons, Xe and Sm are the most important fission products because of their high neutron absorption cross section. However, even though the cross-sections of the other fission products have lower cross sections than above two, the accumulation of the fission products in the reactor over a long operational period has significant affects to the reactor.

In this study, we calculated cross sections of (n,p) and (n,a) reaction of ⁹⁵Mo, ⁹⁹Tc, ¹⁴⁷Sm, ¹⁴⁹Sm be counted as a neutron poison. Neutron incident energy has been taken between 2-20 MeV. Weisskopf-Ewing and Full Exciton Models in PCROSS program, Equilibrium, Hybrid and Geometry Dependent Hybrid Models in ALICE/ASH program have been utilized. The calculated results have been compared with experimental and theroretical cross-section data which are obtained from libraries of EXFOR and JANIS.
Cross section calculation of neutron poison isotopes by nuclear reaction models

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Neutron emitted after fission reaction may whether interact with reactor structure material or escape from core without any interactions or absorbed by nuclei not used as a fuel. This situation causes a bad influence to neutron economy. Some elements absorb neutrons, causing the reactor to run inefficiently. They are called neutron poison due to loss of neutrons.

Neutron poison can be either natural elements or yield of fission. Radioactive yield nucleus resulted of fission reactions have whether short lifetime or long lifetime. There is possibility that radioactive yield nucleus having long lifetime may pile up inside the reactor. Considering the effect of poisons such as Xe and Sm in short time, researches calculate multiplication coefficient. However, it is a difficult task to calculate neutron loss because other fission yields reaching an equilibrium state in the long term. It is so important for design of fuel to predict neutron absorption cross section of fission yield nucleus build up core.

In this study, we calculated cross sections of (n,p) and (n,α) reaction of $^{103}$Rh, $^{133}$Cs, $^{143}$Nd be counted as a neutron poison. Taking incident gamma energy values between 2 to 20 MeV, Full Exciton, Hybrid and Geometry Dependent Hybrid Models were used for pre-equilibrium calculations and Weisskopf-Ewing (Equilibrium) Model was used for equilibrium model calculations. Calculation results were compared with experimental and theoretical data. While experimental results were obtained from EXFOR, JANIS data base were used to get theoretical results.
The ability to achieve the desired results in all applications of nuclear technology depends on the choice of structural materials. In the material selection, the maintenance, reliability, replaceability and recycling properties of each material should be considered within the framework of the engineering approach that includes physical and mechanical properties. In addition, the building materials should have the high radiation resistance, the low activation against the dense neutron flow and the low neutron absorber properties.

The nuclear cross section calculations are an indispensable component for fusion and fission reactor applications, radiation damage, medical physics, radionuclide production, dosimetry and other fields. One of the primary tasks of nuclear applications is to provide personnel and environmental safety. For this purpose, the prediction of (n,γ) reaction cross sections by the theoretical calculations is very important. Many nuclear reaction models are proposed for the theoretical calculations, especially for the difficulties encountered with experimental data.

In this study, the theoretical (n,γ) reaction section calculations of the structural materials such as $^{51}$V, $^{55}$Mn, $^{59}$Co, $^{63}$Cu, $^{65}$Cu and $^{181}$Ta, were calculated by equilibrium and pre-equilibrium models. The calculations performed by taking incident neutron energy between 2 to 20 MeV with using Weisskopf Ewing Model for equilibrium calculations, Full Exciton, Hybrid and Geometry Dependent Hybrid Models for pre-equilibrium calculations. The obtained results are compared with experimental data taken from EXFOR and evaluated data taken from JANIS.
The (n,γ) cross section calculations at 2-20 MeV energy range of some structural materials used in nuclear reactors

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Nuclear energy is a very important energy source because of its potential. The structural materials used in both fission and fusion reactors take place at all stages from the generation of energy to the transfer of it to the external systems. The choice of suitable materials is vital for nuclear reactors, as the physical and chemical conditions to which structural materials will be exposed at these stages will vary depending on the type of environment to be used.

Neutrons and gamma rays emitting from the reactor core have a high energy and penetrating power, posing a serious threat to the safety of personnel and electronic equipment. For this reason, it is very important to calculate the neutron and gamma cross sections especially for the structural materials used in the shielding systems.

In this study, the (n,γ) cross section calculations of 32S, 40Ca, 41K, 45Sc ve 89Y isotopes used as the structural materials for the fission reactors were calculated by equilibrium and pre-equilibrium models. PCROSS and ALICE/ASH computer programs were used in the calculations made on 2-20 MeV energy range and the results obtained were compared with the experimental and evaluated data in the literature.
CNP035

Investigation of spherical and cylindrical natural iridium targets by photonuclear reaction

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In this study, natural iridium consisting of Ir-191 and Ir-193 isotopes was irradiated with 21 MeV photons. The distribution of photons, neutrons, electrons and proton fluxes in the spherical and cylindrical natural iridium target was calculated using MCNPX 2.7.0 Monte Carlo code. The intensity of the photon fluxes on both targets was compared to the $10^6$ particle story by showing them as mesh and optimizing the two targets.
CNP036

Study on excitation functions of neutron-induced reactions of $^{181}$Ta nucleus

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Tantalum is a desirable material in the production of super alloys for nuclear reactors. In this paper, the excitation functions of neutron-induced reactions of $^{181}$Ta target nucleus were investigated. The calculations of $^{181}$Ta(n,p)$^{181}$Hf, $^{181}$Ta(n,2n)$^{180}$Ta, $^{181}$Ta(n,3n)$^{179}$Ta, $^{181}$Ta(n,$\alpha$)$^{178}$Lu nuclear reactions were performed by using Weisskopf-Ewing model, two component exciton model and Hauser-Feshbach model. Cross section results were compared to existing experimental values. Finally, the obtained cross sections are in good agreement with the experimental data.
Calculation of cross sections $^7$Li and $^9$Be target nuclei used in building materials of hybrid reactors

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$^7$Li and $^9$Be target nuclei have been used for reflector, coolant and neutron source in building materials of hybrid reactors technology. In this study, $^7$Li and $^9$Be target nuclei used in fusion-fission reactor were selected and investigated (n,p) reactions cross section at 14-15 MeV energy. The nuclear reaction cross-sections were calculated by neutrons for the selected $^7$Li and $^9$Be target nuclei that depending on density are calculated by using the SKM* parameters. The obtained results were compared with experimental data and theoretical calculations in the literature.
Cross-section values (α,n) reaction for iron group elements some isotopes (Sc to Ni) in the range of 10-20 MeV

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Iron group elements Sc to Ni (Sc, Ti, V, Mn, Fe, Co, Ni) especially very important because structural material selection in design of fusion–fission reactors is very crucial. Obtained results from the nuclear reactions using structural materials can be used developing for these structural materials some isotopes. For this reason, in this study cross sections of the $^{45}$Sc(α,n)$^{48}$V, $^{46}$Ti(α,n)$^{49}$Cr, $^{51}$V(α,n)$^{55}$V, $^{55}$Mn(α,n)$^{58}$Co, $^{54}$Fe(α,n)$^{57}$Ni, $^{59}$Co(α,n)$^{62}$Cu, $^{62}$Ni(α,n)$^{65}$Zn reactions have been calculated at 10-20 MeV energy ranges. We worked on theoretical calculations, the TALYS 1.6 and NON-SMOKER codes were used. After checked to the experimental data obtained from EXFOR database.
CNP039

Level density parameter dependence in fission cross sections $^{232}$Th, $^{238}$U and $^{237}$Np nuclei induced by alphas with the incident energy up to 200 MeV

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This study aims to show the dependence on the choice of the ratio of the level density parameters $a_f$ and $a_n$ corresponding to the saddle-point of fission and equilibrium deformation of nucleus, respectively, on the alpha induced fission cross sections of $^{232}$Th, $^{238}$U and $^{237}$Np subactinide targets. The method was employed using different level density parameter ratios for each fission cross-section calculation in ALICE/ASH computer code. The ALICE/ASH code calculations were compared with the available experimental data. It is found that the fission cross sections depend heavily on the choice of level density parameter ratio in the fission and neutron emission channels, $a_f/a_n$, for some subactinide nuclei. To get a good description of the measured fission cross sections for subactinide nuclei, we used a ratio of the level density parameters in the fission and neutron emission channels, $a_f/a_n$, depending both on the target-nucleus and on the energy of the projectile, in agreement with results published in literature.
Dispersion nuclear fuels are being developed as fuels for research reactors, which are consists of U–Mo particles dispersed in an Al matrix. The product of the reaction UAlx system has become the subject of numerous studies since the middle of last century owning to its outstanding role in nuclear fuel development. Therefore, in order to fully exploit the product material, it is imperative to obtain a good understanding of the physical properties of the UAlx system, and in particular, their structures and dynamic properties. A detailed theoretical study of structural, electronic, and elastic properties of cubic UAlx (x=1,2,3) have been presented employing the pseudopotential plane-wave method based on density-functional theory. The structural, elastic, electronic and bonding nature and vibrational properties of UAl in B2 structure under zero pressure have been investigated by performing first principles calculations using density functional theory. The exchange-correlation potentials were treated within the generalized gradient approximation (GGA). The calculated quantities are agreed well with the available results. The electronic properties such as band structure and density of states reveal that UAl is metallic in nature with large overlap at Fermi level. The single-crystal elastic stiffness constants of UAl are investigated using stress-strain method. Present results for elastic constants show that this compound is mechanically metastable which is agreement with previous study. The chemical bonding is interpreted by calculating the density of states and electron density distribution analysis. UAl has metallic bonding characteristic. The presented phonon dispersion curves and one-phonon DOS are also confirmed that this compound is dynamically unstable.
Nitrogen forms a large part of the air. It is found in the structure of living organisms. It is also an important component of foods, fertilizers and explosives. The nitrogen cycle in the world is very important especially for living life. In this study, (n,p) nuclear reactions calculations of $^{15}$N target nuclei have been investigated in the incident neutron energy range of 14–15 MeV. The reaction cross section $^{15}$N(n,p) reactions have been calculated via the Tel et al. semi-empirical formula and using SKa Skyrme Potantial parameter. The obtained results were compared with the experimental data taken from EXFOR library.
Thermal neutron cross-section measurement for the $^{152}\text{Sm}(n,\gamma)^{153}\text{Sm}$ reaction at 0.0372 eV energy

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The neutron capture cross section for the $^{152}\text{Sm}(n,\gamma)^{153}\text{Sm}$ reaction at 0.0372 eV energy was measured by using the activation technique (NAA). The gold foils were used as neutron flux monitor via the $^{197}\text{Au}(n,\gamma)^{198}\text{Au}$ reference reaction. The irradiations were performed at horizontal channel of the ESSALAM nuclear research reactor. The $\gamma$–ray spectra from the irradiated samples were collected with a calibrated n-type high purity Germanium (HPGe) detector. The cross sections at this neutron energy are measured for the first time and the results show a good agreement compared with those evaluated in the ENDF/B-VII.1 and JENDL-4.0 databases. The experimental results were corrected for thermal neutron self-shielding effects and gamma attenuation.
NR005

An investigation of the partial and total cross sections of the $^8\text{Li}(a,n)^{11}\text{B}$ reaction at astrophysically relevant energies.

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The investigation of cross sections for the $^8\text{Li}(a,n)^{11}\text{B}$ reaction has important impact for both primordial nucleosynthesis in the inhomogeneous models as well as constraining the physical conditions characterizing the r-process. However, there are large discrepancies existing between inclusive and exclusive measurements of the $^8\text{Li}(a,n)^{11}\text{B}$ reaction cross section below 3 MeV. As a proposed experimental set up, TRIUMF-ISAC-I is an excellent facility to investigate this low energy nuclear astrophysical reaction. The TIGRESS array of HPGe detectors and the Bambino charged particle detector are well suited for detecting gamma-rays emitted from excited states of the $^{11}\text{B}$ recoil. Coupling the newly developed DESCANT neutron detectors to TIGRESS will allow us to uniquely identify the reaction channel of interest. The theoretical nuclear reaction rates and cross section calculation using DWBA, WKB and Monte Carlo methods of this reactions will be presented, together with the status of our experimental plans.
Material dependence of $^2$H(d,p)$^3$H cross section at the very low energies

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Calculations of the material dependence of $^2$H(d,p)$^3$H cross section and neutron-to-proton branching ratio of d+d reactions have been performed including a concept of the 0\textsuperscript{+} threshold single particle resonance. The resonance has been assumed to explain the enhanced electron screening effect observed in the d+d reaction for different metallic targets. Here, we have included interference effects between the flat and resonance part of the cross section, which allowed us to enlighten observed suppression of the neutron channel in some metals such as Sr and Li. Since the position of the resonance depends on the screening energy that strongly depends on the local electron density. The resonance width, observed for the d+d reactions in the very hygroscopic metals (Sr and Li) and therefore probably contaminated by oxides, should be much larger than for other metals. Thus, the interference term of the cross section depending on the total resonance width provides the necessary material dependence.
RT001

Monitoring Akkuyu nuclear reactor using antineutrino flux measurement

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I present a simulation-based study for monitoring Akkuyu Nuclear Power Plant’s activity using antineutrino flux originating from the reactor core. A water Cherenkov detector has been designed and optimization studies have been performed using Geant4 simulation toolkit. It was found that 1 ton of water Cherenkov detector with 0.3%-0.5% amount of gadolinium should be used for monitoring a nuclear reactor.
Three-dimensional Monte Carlo calculation on the nuclear parameters of each isotope in some fluids

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In the present investigation, a fusion–fission hybrid reactor system was designed by using 9Cr2WVTa ferritic steel structural material and 99–95% Li20Sn80 + 1-5% RG-Pu, 99–95% Li20Sn80 + 1-5% RG-PuF4, and 99–95% Li20Sn80 + 1-5% RG-PuO2 the molten salt-heavy metal mixtures, as fluids. The fluids were used in the liquid first wall, blanket and shield zones of a fusion–fission hybrid reactor system. Beryllium (Be) zone with the width of 3 cm was used for the neutron multiplicity between liquid first wall and blanket.

The contributions of each isotope in fluids on the nuclear parameters of a fusion–fission hybrid reactor such as tritium breeding ratio (TBR), energy multiplication factor (M), heat deposition rate was computed in liquid first wall, blanket and shield zones. Three-dimensional analyses were performed by using Monte Carlo code MCNPX-2.7.0 and nuclear data library ENDF/B-VII.0.
RT003

The effects on radiation damage of each isotope in structural material for a hybrid reactor

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In this study, the fluids were used in the liquid first-wall, blanket and shield zones of the designed hybrid reactor system. In this study, salt-heavy metal mixtures consisting of 99–95% Li$_{20}$Sn$_{80}$ + 1-5% RG-Pu, 99–95% Li$_{20}$Sn$_{80}$ + 1-5% RG-PuF$_4$, and 99–95% Li$_{20}$Sn$_{80}$ + 1-5% RG-PuO$_2$ were used as fluids. In this study, the effect on the radiation damage of reactor-grade (RG)-Pu, PuF$_4$, PuO$_2$ contents was investigated in the structural material of a designed fusion--fission hybrid reactor system. In the designed hybrid reactor system were investigated the effect on the radiation damage of the selected fluid according to each isotopes of structural material in the structural material for 30 full power years (FPYs). Three-dimensional analyses were performed using the most recent MCNPX-2.7.0 Monte Carlo radiation transport code and the ENDF/B-VII.0 nuclear data library.
The calculation of neutron flux using monte carlo method

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In this study, a hybrid reactor system was designed by using 99–95% Li$_20$Sn$_{80}$ + 1-5% RG-Pu, 99–95% Li$_20$Sn$_{80}$ + 1-5% RG-PuF$_4$, and 99–95% Li$_20$Sn$_{80}$ + 1-5% RG-PuO$_2$ fluids, ENDF/B-VII.0 evaluated nuclear data library and 9Cr$_2$WVTa structural material. The fluids were used in the liquid first wall, liquid second wall (blanket) and shield zones of a fusion–fission hybrid reactor system.

The neutron flux was calculated according to the mixture components, radial, energy spectrum in the designed hybrid reactor system for the selected fluids, libraries and structural materials. Three-dimensional nucleonic calculations were performed using the most recent version MCNPX-2.7.0 the Monte Carlo code.
The investigation of convert $^{238-242}\text{Pu}(n,\gamma)^{239-243}\text{Pu}$ in a hybrid reactor

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In this study, the fluids were composed with increased mole fractions of mixture the molten salt-the heavy metals $^{99-95}\% \text{Li}_{20}\text{Sn}_{80} + 1-5\% \text{RG-Pu}$, $^{99-95}\% \text{Li}_{20}\text{Sn}_{80} + 1-5\% \text{RG-PuF}_4$, and $^{99-95}\% \text{Li}_{20}\text{Sn}_{80} + 1-5\% \text{RG-PuO}_2$. In this study, the effect of each isotope ($^{238-242}\text{Pu}$) in reactor grade plutonium content on convert $^{238-242}\text{Pu}(n,\gamma)^{239-243}\text{Pu}$ was investigated in designed the hybrid reactor system. Beryllium (Be) is neutron multiplicity by (n,2n) reactions. Thence, Be zone in thick 3 cm was used in order to contribute on $^{239-243}\text{Pu}$ between liquid first wall and blanket. $9\text{Cr}_2\text{WVTa}$ ferritic steel is used as a structural material.

The convert to $^{238-242}\text{Pu}(n,\gamma)^{239-243}\text{Pu}$ was calculated in liquid first wall, blanket and shield zones, which reactor grade plutonium content. Three-dimensional nucleonic calculations were performed by using the most recent version MCNPX-2.7.0 Monte Carlo code and nuclear data library ENDF/B-VII.0.
Three-dimensional Monte Carlo calculation of some nuclear parameters

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In this study, a fusion–fission hybrid reactor system was designed by using $\text{9Cr}_2\text{WVTa}$ Ferritic steel structural material and the molten salt-heavy metal mixtures $99–95\%\text{Li}_{20}\text{Sn}_{80} + 1-5\%\text{RG-Pu}$, $99–95\%\text{Li}_{20}\text{Sn}_{80} + 1-5\%\text{RG-PuF}_4$, and $99–95\%\text{Li}_{20}\text{Sn}_{80} + 1-5\%\text{RG-PuO}_2$, as fluids. The fluids were used in the liquid first wall, blanket and shield zones of a fusion–fission hybrid reactor system. Beryllium (Be) zone with the width of 3 cm was used for the neutron multiplication between the liquid first wall and blanket.

This study analyzes the nuclear parameters such as tritium breeding ratio ($TBR$), energy multiplication factor ($M$), heat deposition rate, fission reaction rate in liquid first wall, blanket and shield zones and investigates effects of reactor grade Pu content in the designed system on these nuclear parameters. Three-dimensional analyses were performed by using the Monte Carlo code MCNPX-2.7.0 and nuclear data library ENDF/B-VII.0.
The investigation of radiation damage for certain reactor grade-plutonium fluids in a hybrid reactor

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In this study, salt-heavy metal mixtures consisting of 99–95% Li$_{20}$Sn$_{80}$ + 1-5% RG-Pu, 99–95% Li$_{20}$Sn$_{80}$ + 1-5% RG-PuF$_4$, and 99–95% Li$_{20}$Sn$_{80}$ + 1-5% RG-PuO$_2$ were used as fluids. The fluids were used in the liquid first-wall, blanket and shield zones of the designed hybrid reactor system. A beryllium (Be) zone with a width of 3 cm was used for neutron multiplicity between the liquid first wall and the blanket. 9Cr$_2$WVTa ferritic steel with the width of 4 cm was used as the structural material.

Proton, deuterium, tritium, He-3 and He-4 gas production rates are the parameters of radiation damage. In this study, the effect on the radiation damage of the selected fluid according to heavy metal content were investigated for 30 full power years (FPYs) in the structural material. Three-dimensional analyses were performed using the most recent MCNPX-2.7.0 Monte Carlo radiation transport code and the ENDF/B-VII.0 nuclear data library.
The Inertial Electrostatic Confinement (IEC) fusion reactor is among the small fusion devices. In this study, the cross section of the DD fusion reactions performed in SNRTC-IEC, the first IEC reactor in Turkey and situated at TAEK, was calculated. Because the IEC reactor operates at low pressure, fusion reactions are generally assumed to occur in the cathode zone. The fusion rate expression depending on the geometric structure of the IEC reactor and the reaction parameters that Piefer et al. has been used in the cross section calculation. The value of the cross section for neutrons is calculated to be approximately 3 mb.
One up to three ion sources operation on SNRTC-IEC

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In this study, it is investigated effect of ion source number on neutron production at SNRTC-IEC (Sarayköy Nuclear Research and Training Center-Inertial Electrostatic Confinement) device. Three ICP (Inductive Coupled Plasma) ion sources are added to SNRTC-IEC device is studied at low pressure (1–10 × 10⁻⁴ mbar) at 85kV cathode voltage. Results shows that total neutron production rate increases approximately linearly by number of ion sources. The neutron production rates were calculated as 2.27x10⁴ n/s, 4.6x10⁴ n/s and 3.6x10⁵ n/s at the system added one ion source, two ion sources and three ion sources, respectively.
Monte Carlo simulations on the performance and radioactive waste production levels of the advanced (Th, Pu) O$_2$ fuel system

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Recently there are many more investigations on the Thorium based nuclear reactor core designs together with Uranium and Plutonium. Turkey has 11% of the World’s total Thorium Reserves. So, thorium should be used in the nuclear energy systems as a fuel element. In this study, an advanced (Th, Pu) O$_2$ mixed oxide fuel was used to design a 17x17 PWR lattice. Effect of thorium usage in the fuel and atomic densities of radioactive wastes were estimated using by SERPENT Monte Carlo code system developed by VTT Laboratory in Finland. Results of this study has important data to use thorium in the nuclear energy industry.
Output self amplified spontaneous emission laser parameters at the exit of the undulator system are studied. Optimised laser parameters are mainly depends on the undulator length, undulator type, undulator wavelength, and gap of the undulator parts. Gain length, saturation length and power, pierce parameter, small signal gain, laser power, pondoramative phase, growth rate of radiation, current profile, photon beam size, and transverse sigma are obtained by utilizing Genesis Code. Analytical calculation of laser wavelength has been done for various beam energies and pierce parameters. Utilizing Genesis 1.3 and Interactive Data Language (IDL) Code, one can obtain laser power at the order of GW versus longitudinal beamline. From this longitudinal beamline, undulator length can be determined. Optimized laser with GW power and nanometric wavelength are obtained and will be presented in this study.
Electron beam is generally produced through either thermionic emission or photoemission for the linear and circular accelerators. An ordinary laser can be used by utilizing beam splitter to obtain a quarter wavelength ordinary laser in order to extract electrons from the Cs₂Te photocathode. After photocathode superconducting gun - cavity cells, superconducting solenoid, bunch compressors, quadrupoles, dipoles, main accelerator cells, position and current diagnostic system instruments such as beam position monitors (BPM), optical transition radiation (OTR) screen, wire scanner, Faraday Cup, Fast and DC current transformers, ... are used throughout the beamline. They are located at some certain locations. Electron beam energy can be obtained above the 3.4 GeV beam energy after main accelerator system. Beam dynamics are also studied and included in the presentations.
RF power provides RF frequency for accelerating resonance waveguide and in this study, design of RF power system is determined throughout the beamline at linear accelerator systems. RF power is obtained from RF power source that is named klystron, transmission line distributions to waveguides are searched and determined the appropriate components of the RF systems in this work. In the determining process, klystron types that are used as RF power source and RF power transfer line are accomplished for gun and main accelerator systems throughout the beamline. In this study, high peak power RF systems are used in order to have 1.3 GHz operating frequency in the linear accelerator system. Determining RF power source systems with working under ultra high vacuum, narrow bandwidth, high gain, and approximately 10 Hz repetition rate at 5 MV high peak power are considered for gun waveguide that form first accelerating waveguide. Ultimately 10 MeV electron beam energy at the end of the gun system with approximately 46-50 MV/m maximum field gradient inside the gun waveguide are obtained. Besides, a 10 MW power source between 12 crymodule at main accelerators are considered. Also, with total 12 high-efficiency beam amplifiers klystrons that we considered in the main accelerator waveguides average maximum 30- 32 MV/m peak values for whole accelerator system in our studies. At the end of the main linear accelerator system, we have reached approximately 3.5 GeV electron beam energy.
3.5 GeV energy laser system is simulated along the beamline including whole diagnostic system equipments and required accelerating and focusing parts. In the simulation, vacuum system instruments are placed on the longitudinal beamline for mentioned laser system. Whole system need to be kept ultra high vacuum (UHV) level, that’s why in order to obtain UHV level, turbomolecular pump, ion pump rotary pumps, are used in the beamline in such a way that to obtain $< 10^{-9}$ Torr vacuum conditions throughout the beamline. Pumps, Valves, Vacuum Chamber Parts, Leak Detection, Flange, Cleaning, Baking, Venting, Titanium supplimation pump and Gauges are used and explained detailly for the vacuum system along the beamline.
The main of this study is to measure the performance of PARIS Cluster using the ELBE facility at HZDR, Dresden, Germany. During this experiment, we aimed to determine performance of each individual PARIS phoswich separately and determined the performance of whole PARIS Cluster. In order to perform this study at ELBE facility, a 16 MeV electron beam was converted into Bremsstrahlung photons which subsequently impinged $^{11}$B target. This allowed us study of 15.1 MeV excited states of $^{12}$C and 2.125, 4.445, 5.020, 7.285 ve 8.920 MeV excited states of $^{11}$B. Performance of both LaBr$_3$(ce) and NaI(Tl) detectors, PARIS phoswich and PARIS cluster will be presented.
Electron beam processing for industrial and medical applications

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In recent years, electron beam processing has been widely used for medical and industrial applications. Electron beam accelerators are reliable and durable equipment that can produce ionizing radiation when it is needed for a particular commercial use. The industrial usage of electron beam processing started in the late 1950s, by the cross linking of polyethylene wire insulation. At the present time, the number of electron accelerators in use for various radiation processing applications exceeds more than thousand. On the industrial scale, accelerators are used to generate electrons in between 0.1-100 MeV energy range. These accelerators are used mainly in plastics, automotive, wire and electric cables, semiconductors, health care, aerospace and environmental industries, as well as numerous research and development facilities around the world.

This study presents the current applications of electron beam processing in the industrial and medical sense.
Electron accelerators have been used in a variety of applications for scientific research, medicine and industrial radiation processing. In recent times, the fastest growing sectors for industrial accelerators have been in low-energy regime (100-300 keV). Though the low energy electrons do not penetrate deep into the material's surface the application of such beams can be effective enough in some technological processes, i.e. for processing the materials surface or for realizing processes in gases.

In the low-energy range, the majority of industrial installations rely on linear cathode concept to distribute the electrons over a wide web of material that is moving through the beam. The production and acceleration of electrons are done inside a long-evacuated vacuum tube. The electrons emitted from the thermionic cathode are accelerated over a single stage to pass through the anode (a thin metallic window) producing a continuous stream of electrons to irradiate materials or products in atmospheric conditions.

In this study, design and simulation of a low energy electron curtain accelerator is introduced. Several physical and mechanical design of this facility is discussed in detail thoroughly, in conjunction with SIMION 3D electron trajectory simulation software. And some efforts to modulate cathode structure have been done to optimize the electron beam uniformity effectively.
In order to determine the performance of PARIS phoswich detector a proton capture reaction $^{11}\text{B}(p,\gamma)$ and different radioactive sources were used. During this experiment to determine the performance of PARIS phoswich in term of its linearity, efficiency, energy resolution and time response CAEN digitisers V1720 and V1751 were used, both data, using radioactive source and nuclear reaction examined for low and high energy gamma-rays respectively. Both analog and digital electronic CAEN digitiser were also compared during this experiment. Comparison of both electronics and determined results of PARIS phoswich detector in terms of its linearity, efficiency, energy resolution and time response will be presented.
Preliminary study on natural radionuclide concentrations in some soil samples

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The purpose of this work is to conduct a preliminary study about determination of natural radionuclides concentration in some villages of Tarsus. In order to obtain basis data of the content of radionuclides, firstly, the soil samples were collected from Alibeyli, Kurbanlı, Kurtçukuru, Sanlica and Yanıkkışla villages. The soil samples were screened and dried at 110°C for 24 hours and then they were packaged using plastic sample containers. After the sample containers were waited three weeks in laboratory to provide a permanent balance between $^{226}$Ra and $^{222}$Rn, they were counted using a gamma spectrometer by HPGe detector. The mean activity concentrations of $^{226}$Ra, $^{232}$Th, and $^{40}$K were determined as 36.86±1.54, 23.02±2.38 and 287.5±6.96 Bq/kg, respectively.
Calculations of natural radioactivity levels in soil samples from Çukurova University campus, Turkey

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Natural radioactivity measurement, radiation monitoring of the region, dose assessment and interpretation of radiological related parameters are important with regard to the public consciousness and environmental safety. In this study, we investigated 10 soil samples collected from soil regions of nearest to Çukurova University campus measured through HPGe gamma ray spectrometry. The average values of $^{226}\text{Ra}$, $^{232}\text{Th}$, $^{40}\text{K}$ activity concentration that soil samples contain were found to be $21.57\pm1.47$ Bq/kg, $30.55\pm3.09$ Bq/kg and $274.18\pm8.08$ Bq/kg, respectively. When the investigated concentration of radionuclides in the soil samples of University of Çukurova, we found that these values are nominal and do not produce any harmful health effects to the general public.
RM003

Measurements of radioactivity levels in soil samples from southeastern Anatolia region, Turkey

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In local, regional and global context, it is necessary to study the environmental radioactivity. Natural radioactivity (²³⁸U, ²³²Th, ⁴⁰K), originates from radioactive elements in the earth crust and from extraterrestrial sources, and artificial radioactivity (¹³⁷Cs), the result of man-made actions, are the main objects of this study. The activity concentrations in 18 soil samples collected from Southeastern Anatolia (Adıyaman, Gaziantep, Şanlıurfa cities and their surrounded districts) measured through HPGe gamma ray spectrometry at Çukurova University, Physics Department. The average values of ²³⁸U, ²³²Th, ⁴⁰K, ¹³⁷Cs activity concentration that soil samples contain were found to be 14.48 Bq/kg, 19.15 Bq/kg, 288.92 Bq/kg, 5.16 Bq/kg, respectively. The results obtained in this study were compared with the international average values reported by UNSCEAR, 2000.

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Detection of gamma irradiated medicinal herbs with EPR method

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In the present work, the results of EPR studies on medicinal herbs before and after gamma radiation were investigated. Before irradiation all samples display singlet EPR spectra. After irradiation gamma-induced cellulose free radicals detected in medicinal herbs. Fading study of the radiation-induced cellulose free radicals and heat sensitivity of the central EPR lines in irradiated and non-irradiated samples was detected as an evidence for pre-radiation process. In the light of the findings on all EPR experimental data, we suggest that extending the period for identification of radiation treatment of all medicinal herbs in solid dry state could be technically feasible.
Radieological assessment of natural radioactivity in soil near a lignite-burning power plant in Turkey

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Natural radionuclides are released into the environment together with fly ash from the coal-burning power plant and cause an increase in the natural radioactivity in environmental samples. The study concerns to the evaluation the influence of Kangal lignite-burning power plant (LBPP) with a power of 457 MWe, which has been in operation since 1989, on natural radionuclide a concentration in surface soil samples around it. Activity concentrations of natural radionuclides (\(^{226}\)Ra, \(^{232}\)Th, \(^{40}\)K and \(^{222}\)Rn) in the soil samples were determined by using a gamma-ray spectrometer with an HPGe detector. The average values of \(^{226}\)Ra, \(^{232}\)Th and \(^{40}\)K were found as 37±5, 17±3 and 222±30 Bq/kg, respectively. Absorbed gamma dose rate in outdoor air and the corresponding effective dose rate from external exposure and excess lifetime cancer risk were estimated to evaluate radiological hazards for human population.
RM007

Natural radioelement concentrations in the soil of the Mila region of Algeria

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The radioactivity levels and the gamma absorbed dose rates were determined in two fertilizers and in fertilized and unfertilized soil samples collected at various depths from Algerian agricultural region El-Athmania Mila, using high resolution gamma ray spectrometry. The activity concentrations of $^{226}$Ra, $^{232}$Th and $^{40}$K were found unchanged with the depths and ranged from $23.72 \pm 2.37$ to $65.47 \pm 5.06$ Bq/kg for $^{226}$Ra, from $26.45 \pm 0.78$ to $28.7 \pm 0.9$ Bq/kg for $^{232}$Th and from $220.8 \pm 10.01$ to $290.1 \pm 10.5$ Bq/kg for $^{40}$K respectively. The presence of $^{37}$Cs is found in all measured samples and its average activity was $3.12 \pm 0.26$ Bq/kg. To assess the radiation hazard, the radiation equivalent activity (Ra$_{eq}$), the representative level index, I$_r$, the external hazard (H$_{ex}$), the internal hazard (H$_{in}$) and absorbed dose rate due to three primordial radionuclides for all samples were calculated. The measured values were compared with the published data in different countries and were found to be safe for public and environment.
Analyses of natural radioactivity in Yatağan coal – fired power plant in Turkey

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Use of the coal in order to generate electricity increases the exposure of people to radiation. In this study, the activity concentrations of nuclides $^{226}$Ra, $^{232}$Th and $^{40}$K in samples of coal and bottom ash from the Yatagan Coal – Fired thermal power plant in the Western Anatolia were measured using gamma ray spectrometer with a NaI(Tl) scintillation detector. The mean activity concentrations of $^{226}$Ra, $^{232}$Th, and $^{40}$K in the coal samples were found to be 37 Bq/kg, 51 Bq/kg and 166 Bq/kg, respectively. Whereas in the bottom ashes, the concentrations of the corresponding radionuclides were found to be 62 Bq/kg, 87 Bq/kg, and 221 Bq/kg, respectively. The findings show that the activity concentrations in bottom ash were higher than the relevant activity concentrations in the coal samples. The absorbed gamma dose rate in outdoor air DROUT and annual effective dose rate (AED) from coal were calculated to assess radiological risk. The mean values of DROUT and AED were found to be 56 nGy/h and 68 µSv/y, respectively.
Natural gross radioactivity in waters in Erzin, Turkey

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In this study, Gross-alpha and gross-beta and tritium and radon activities of 10 taps and wells, a lake and 10 hot spring and 5 sea and 15 drinking water supplies in Erzin (Turkey) will be determined. Additionally, yearly radiation doses from these sources taken by the people who living in Erzin will be calculated.

Until now, it has performed location determination and sample collection phase.
RM010

Natural radioactivity investigation in Dam sediments of northeast Algeria

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Current research paper intends to estimate the natural radioactivity levels in the Dam sediments using high resolution HPGe detector. The mean activity concentrations values obtained for the $^{232}$Th, $^{226}$Ra and $^{40}$K radionuclides are 18.5 ± 0.1, 19.1± 1.1 and 148.9± 3.8 Bq/kg, respectively. These results are lower than the worldwide average values. The $^{137}$Cs anthropogenic radionuclide have been observed with maximum activity concentration value of 2.1 ± 0.4 Bq/kg, which is considered an insignificant amount. In order to assess the radiological threat of gamma radiations emitted by these radionuclides on the health of the population, radiation hazard parameters have been calculated such as absorbed dose rate and the annual effective dose equivalent. The obtained values are compared with the worldwide average ones.
Radioactivity investigation of Samples of Ünye Hill Yunus Emre

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In this study, the level of radioactivity concentrations was determined from the naturally occurring radionuclides $^{226}$Ra, $^{232}$Th and $^{40}$K in 6 soil samples collected from Ünye Hill Yunus Emre (Ordu, Turkey) using $\gamma$-ray spectrometry. Samples of soil were collected in their natural form and they were dried at 105°C for two hours and then were counted any chemical pre-treatment. The mean activity concentrations of $^{226}$Ra, $^{232}$Th, and $^{40}$K is 20.8±0.7, 29.61±2.08 and 360.78±5.2 Bq/kg respectively are derived from all the soil samples studied.
Radioecological analysis of Unye Curi beach and Gölevi neighbourhood

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In this study, the level of radioactivity concentrations was determined from the naturally occurring radionuclides $^{226}$Ra, $^{232}$Th and $^{40}$K in 4 soil samples collected from Ünye Cudi Beach and Gölevi Neighbourhood (Ordu, Turkey) using γ-ray spectrometry. Samples of soil were collected in their natural form and they were dried at 105°C for two hours and then were counted any chemical pre-treatment. The mean activity concentrations of $^{226}$Ra, $^{232}$Th, and $^{40}$K is $13.83±0.5$, $20.93±1.43$ and $272.75±3.88$ Bq/kg respectively are derived from all the soil samples studied.
Seasonally measurement of radon activity in Bitlis region

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Bitlis Eren Üniversitesi

Radon (Rn-222) radioactivity was determined in selected 11 tap waters, 13 spring waters, 1 well water, 1 lake water samples collected during spring, summer, autumn and winter seasons in 2014-2015 in region of Bitlis, Turkey. Radon measurements were performed by an AlphaGUARD radon gas analyzer. The measured radon radioactivities for tap waters ranged from 1.04±0.25 to 15.38±0.60 Bq/L for spring season, from 1.05±0.06 to 15.89±0.68 Bq/L for summer season, from 1.02±0.13 to 15.77±1.06 Bq/L for autumn season, from 0.84±0.06 to 14.03±0.35 Bq/L for winter season. The measured radon radioactivities for spring waters ranged from 0.45±0.11 to 65.05±2.47 Bq/L for spring season, from 0.55±0.04 to 62.39±0.57 Bq/L for summer season, from 0.78±0.08 to 80.48±6.10 Bq/L for autumn season, from 0.24±0.06 to 74.95±19.74 Bq/L for winter season. The measured radon radioactivities for spring waters ranged from 0.45±0.11 to 65.05±2.47 Bq/L for spring season, from 0.55±0.04 to 62.39±0.57 Bq/L for summer season, from 0.78±0.08 to 80.48±6.10 Bq/L for autumn season, from 0.24±0.06 to 74.95±19.74 Bq/L for winter season. The measured radon radioactivities for well water was found to be 48.21±1.31 Bq/L for spring season, 28.02±2.60 Bq/L for summer season, 18.55±0.80 Bq/L for autumn season, 45.54±0.50 Bq/L for winter season. The measured radon radioactivities for lake water (Van lake) was found to be 7.75±0.11 Bq/L for spring season, 7.93±0.59 Bq/L for summer season, 6.62±0.24 Bq/L for autumn season, 3.14±1.05 Bq/L for winter season.
An application of LSC technique to determine $^{90}$Sr/$^{90}$Y radionuclides in dry tea samples

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$^{90}$Sr radionuclide, one of the radioisotopes of strontium, is the most relevant radionuclide coming from the nuclear fallout, nuclear facilities or accidents such as Chernobyl and Fukushima. $^{90}$Sr being one of the most hazardous radionuclides, due to its long physical (28.80 years) and biological half-life, can be detected in the environmental samples such as vegetables, soil and water. When the contaminated food is ingested by humans, it accumulates in bone tissue and causes damage to bone marrow due to $^{90}$Y, the high energy beta particles of its daughter nuclide. Tea plant, having large leaves and root system absorb the nutrients together with the fallout isotopes from the soil matrix. The radioactivity of the tea samples can be taken as an indicator of fallout rate and uptake from the soil. The aim of this study is to develop a radiochemical separation procedure for $^{90}$Sr/$^{90}$Y from the plant samples and then to apply this procedure to dry black tea samples originating from different countries by using low level LSC technique using Quantulus 1220 device (Perkin Elmer). In the radiochemical separation procedure, the tea samples are first ashed at elevated temperature up to 400°C and then cold leached using HNO$_3$ and H$_2$O$_2$. The leachate is passed from the Dowex cation exchange resin and after evaporated to dryness, it is dissolved in HNO$_3$ and passed from crown ether based Sr resin. Strontium is stripped from the Sr column into the tarred glass scintillation vial. After evaporated to dryness, the precipitate is dissolve in distilled water and mixed with Optiphase Hi safe3 scintillation cocktail. The vial is counted for 400 min in the liquid scintillation counting system after $^{90}$Sr/$^{90}$Y equilibrium (nearly 20 days) is achieved and $^{90}$Sr activity concentration is determined. The chemical yield is determined gravimetically. As a result, $^{90}$Sr activity concentrations of the dry black tea samples are found to be in the range of 3-20 Bq/kg. In the presentation, the employed methods and the results will be discussed in detail.
Radon concentrations in well waters on Akşehir fault zone and the relationships with seismic activity

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The changes of radon concentration in well water gas can be used for the earthquake prediction. The strain changes occurring within the earth's surface during an earthquake is expected to enhance the radon concentration in well water. In the case of an earthquake, the radon emanation changes due to the creation of new fractures and fissures associated with the earthquake process.

All regions in Afyonkarahisar Province located in central western Anatolia are within the 1st and 2nd degree seismic zones. The most important active fault in this region is called as “Akşehir fault zone” which lies along Sultandağı and Çay towns of Afyonkarahisar. This region was an active earthquake area in historical and instrumental eras and the earthquakes occurred in this region had created surface fractions. Radon concentrations were investigated along Akşehir fault in Afyonkarahisar by taking samples from 9 different well waters during 24 months (January 2014–December 2015). Measurements were conducted by Genitron AlphaGUARD PQ2000 PRO Radon Monitoring System.
ESR investigation of gamma irradiated coffee beans

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Turkish coffee is an Intangible Cultural Heritage of Turkey confirmed by UNESCO. It is consumed primarily in Anatolia, South-Eastern Europe, the Middle East, the Caucasus and around the Black Sea, all being regions influenced by Ottoman cuisine.

In this study, gamma irradiated Turkish coffee beans were investigated using ESR spectroscopy. ESR is a powerful technique applicable to systems in a paramagnetic state which have net electron angular momentum due to unpaired electrons. Spectroscopic splitting value, g, is sensitive to the chemical environment of the paramagnetic center and it can be used for the identification of the radical structure. Also, there are additional features such as temperature behavior, line width and microwave power dependence of the signals that are used to characterize the investigated radical.

The powdered coffee beans between the 125-250 µm grain sizes were irradiated between 0.5-11 kGy at room temperature using the ⁶⁰Co irradiation facilities of the Turkish Atomic Energy Authority. The absorbed doses were. ESR spectra of samples were recorded at several spectrometer conditions with JEOL JesFa-300 X-band ESR spectrometer located in Selcuk University Advanced Technology Research and Application Center ESR Laboratory. Microwave, radiation and temperature dependency of the signals were investigated for both natural and irradiated samples. The isothermal and isochronal kinetic behavior of central line with the g value 2.004 were analyzed to determine the irradiation effect. It was shown that kinetic measurements can be used for the ESR food irradiation detection in the absence of satellite lines.
The initiation of the Malatya-Ovacık fault zone: Evidence from apatite fission track thermochronology

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The Southeast Anatolian Orogenic belt experienced continent-continent collision between Anatolian (Eurasia) and Arabian platforms during Oligo-Miocene period. The North Anatolian Fault Zone (NAFZ) and the East Anatolian Fault Zone define the northern and eastern boundaries of the Anatolian Plate and accommodate the main deformation of the westward extrusion of the Anatolia, as a result of the ongoing collision. The Malatya-Ovacık Fault (MOF), splaying from NAFZ near Erzincan, is a left lateral strike-slip fault system cutting the Anatolian plate. The age of the fault is estimated to ~3 to ~5 my by the active tectonics studies.

Apatite Fission Track (AFT) thermochronology is widely used to determine paleoclimatology, uplift rate, denudation rate, upper crust tectonics and the upper crust and mantle interaction. The AFT data from the magmatic intrusion near Doğanşehir (Malatya) area, where MOF cuts the west-northwest part of the intrusion, yield 30 to 12 my ages. These age data combined with track lengths shows that the intrusion uplifted/cooled first in early Oligocene (~30 My) then in Miocene. The age-elevation diagrams shows no age-altitude relation. This result indicates a tectonic effect on the AFT ages rather than a erosion or exhumation. The MOF cuts the W-NW part of the intrusion into 2-4 slices, where we collected the samples. Each slice uplifted individually during the collision. The cooling profiles obtained from the age and the track length data indicate a steady state cooling after the crystallization and went under an accelerated cooling regime at ~7-8 Ma and cooled under 60°C at ~2-3 Ma.

Our data suggest that the development of MOF, which is active since Pliocene, may initiated during early Oligocene period. As a result, the uplifting of the region since Miocene led to the development of the EAFZ and related structures and the exhumation of the Doğanşehir granitoid under fault control.

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RM016

From source to sink in SE Anatolia: The detrital zircon U-Pb chronology of the Malatya basin

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The Southeast Anatolian Orogenic belt was formed as result of the convergence between between Anatolian (Eurasia) and Arabian platforms during Late Cretaceous to Miocene period. In this study, detrital samples from the Oligo-Miocene Malatya Basin are subjected to zircon U-Pb analyses to date the magmatic events in the source area and to reconstruct the paleogeography of the region. The basement rocks from Paleozoic to Eocene is outcropped in the region. The magmatic rocks, formed at various episodes in various tectonic settings such as Arabia-Nubia shield, Bitlis-Pütürge massifs, Malatya-Keban massifs, metamorphic, ophiolites, arc magmatics, and collisional to post-collisional volcanism. The age span vary between pre-Cambrian and Quaternary.

The Malatya Basin was formed in an intermontain setting during Oligo-Miocene period. The basin consist of marine and terrestrial sedimentary and carbonate rocks with volcanic interbeds at the upper parts.

The zircon U-Pb geochronology is used to detremine the source distrubution and source change in time. Any change in the source area can be expressed as erosion, tectonic denudation and/or a new component in the source area. The zircon U-Pb ages indicate at least 10 different magmatic events in the source area.

The oldest magmatic event occured during ~3000 Ma, whereas the youngest one occured during 2-4 Ma. The age of tuff interbedded with the sandstones of the Boyaca fm limit the formation age of this unit to ~18 Ma.

The similar U-Pb ages with the deposition ages of the Malatya Basin indicate a fault controlled sedimentation during basin evolution.

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The influence of ionizing radiation on antipsychotic drug olanzapine: an EPR study

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The antipsychotic Olanzapine in powder in powder form was exposed to a range of doses of $^{60}$Co gamma radiation to investigate the effects of ionizing radiation on the basis of Electron Paramagnetic Resonance (EPR) technique.

Dose-response curves have been evaluated for determining gamma-irradiation effects of Olanzapine. Numerical simulations have been carried out for various possible models and it has been shown that for Olanzapine, exponential function gives the best fit to the experimental curves. Decay of gamma radiation induced paramagnetic species was obtained using a biexponential model. According to the results of all EPR experimental data, we suggest that the radiosterilization of Olanzapine drug samples in the solid dry state could be technically feasible.
New applications and developments in the neutron shielding

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Shielding neutrons involve three steps, that are slowing neutrons, absorption of neutrons, impregnation of gamma rays. Neutrons slow down with thermal energy by hydrogen, water, paraffin, plastic. Hydrogenated materials are also very effective for the absorption of neutrons. Gamma rays are produced by neutron (radiation) retention on the neutron shield, inelastic scattering, and degradation of activation products. If a source emits gamma rays at various energies, high-energy gamma rays sometimes specify shielding requirements. Multipurpose Materials for Neutron Shields; Concrete, especially with barium mixed in, can slow and absorb the neutrons, and shield the gamma rays. Plastic with boron is also a good multipurpose shielding material. In this study; New applications and developments in the area of neutron shielding will be discussed in terms of different materials.
Radon measurements of some touristic places in Hatay, Turkey

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$^{222}$Rn is a colorless, odorless, tasteless, radioactive gas that occurs naturally in soil, rocks, underground water, and air. It is produced by the natural breakdown of $^{226}$Ra in soil and rocks. In outdoor air, radon is usually presents at such low levels that there is very little risk. However, when radon enters a building, it and its decay products can accumulate to high concentrations. Radon, itself, naturally breaks down and forms radioactive decay products. As one breathes, the radon decay products can become trapped in lungs. As these decay products break down further, they release small bursts of energy which can damage lung tissue and lead to lung cancer. In this study, the indoor radon concentrations of some historical and touristic places at Hatay (Turkey) were determined. Nuclear track detectors (CR-39) were used for the measurements of $^{222}$Rn levels in the touristic buildings. The annual effective dose equivalent from $^{222}$Rn was calculated in these buildings.
Preliminary study on natural radionuclide concentrations in some soil samples

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The purpose of this work is to conduct a preliminary study about determination of natural radionuclides concentration in some villages of Tarsus. In order to obtain basis data of the content of radionuclides, firstly, the soil samples were collected from Alibeyli, Kurbanlı, Kurtçukuru, Sanlıca and Yanıkkışla villages. The soil samples were screened and dried at 110°C for 24 hours and then they were packaged using plastic sample containers. After the sample containers were waited three weeks in laboratory to provide a permanent balance between $^{226}$Ra and $^{222}$Rn, they were counted using a gamma spectrometer by HPGe detector. The mean activity concentrations of $^{226}$Ra, $^{232}$Th, and $^{40}$K were determined as 36.86±1.54, 23.02±2.38 and 287.5±6.96 Bq/kg, respectively.
OSL kinetic using AOSL approximation

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OSL technique is based on measuring the luminescence intensity from a sample that has been exposed to ionizing radiation. It is obviously that humans can be also exposed to ionizing radiation both of internal or external. The determination of ionizing radiation dose in human blood has been previously performed by us. In this study, the detrapping constants for human blood samples were investigated using Curve-Fitting, Active OSL-Approximation and Linear Modulation techniques. The Active OSL-Approximation was based on the radioactive decay law of successive disintegration. It allows obtaining the peak forms of luminescence signal. It has been seen that the decay rates for blood sample exposed to different radiation doses were changed with dose. AOSL-Approximation is appropriate to deconvolution the peaks that correspond to decay rates.
LU003

Determination of potential use of Li$_2$B$_4$O$_7$: Ag,Tb for dosimetry purposes using OSL technique

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In this study, Optical Stimulate Luminescence (OSL) characteristics of Ag and Tb doped lithium tetraborate (Li$_2$B$_4$O$_7$) (LTB) have been reported. LTB: Ag, Tb powder phosphor was synthesized using solution combustion method. The structural investigation of undoped and doped Li$_2$B$_4$O$_7$ were performed by X-ray diffraction (XRD), Fourier transform infrared (FT-IR) analyses, scanning electron microscopy (SEM) and Thermal Gravimetric Analysis (TGA) methods. OSL properties such as decay curve analysis, dose response and energy response of the phosphor were investigated. No significant variation of OSL responses for 10 repeated measurements were observed. 1 month dark storage showed < 10 % fading. LTB: Ag, Tb phosphors show that good OSL dosimetric properties under beta irradiation.

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LU004

OSL study of LiB$_3$O$_5$: Nd, K, Cu, Na samples synthesized by Solid State Method

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Lithium triborate, (LiB$_3$O$_5$), is a well-known lithium borate compound and a technologically important material for diverse applications, such as nonlinear optical materials, surface acoustic wave devices and dosimetry applications. The aim of this study is to investigate the dosimetric properties of Nd, K, Cu, Na doped lithium triborate powder phosphors (LiB$_3$O$_5$: Nd, K, Cu, Na) prepared by Solid State Synthesis method using the Optically Stimulated Luminescence (OSL) technique. Dosimetric characteristics of the phosphor were investigated by performing basic dosimetric experiments such as determination of OSL decay curve, beta dose response, reusability and short fading after 1 Gy beta dose exposure. The OSL decay curve and TL glow curve of the phosphor irradiated with 1 Gy beta dose were recorded. The main TL peak appeared at 200°C at a heating rate of 5°C/s. The OSL decay signal was fitted to a curve which is the resultant of the three different components. The lifetimes of these components are 1.30 s, 0.44 s and 19.48 s, respectively. The time integrated OSL intensity is found to be lineer in the range from 0.1 to 10 Gy. Fading of the OSL signal was found to be around 28% at the end of 24 hours. The result indicated that LiB$_3$O$_5$: Nd, K, Cu, Na phosphor can be studied on and developed for the purpose of its usage for dosimetric purposes in the personal and medical dosimetry applications.
LU005

Li$_2^{10}$B$_4$O$_7$:Ag,Tb phosphor and its neutron sensitivity for dosimetry applications

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In this study, Li$_2$B$_4$O$_7$: Ag, Tb and Li$_2^{10}$B$_4$O$_7$: Ag, Tb phosphor were synthesized using Solution Combustion Synthesis (SCS) method. The Optical Stimulated Luminescence (OSL) characteristics of Li$_2$B$_4$O$_7$: Ag, Tb phosphor were investigated through analysis of OSL decay curves, reusability, dark fading, effect of annealing, dose response/ energy response, and different heating rates measurements using $^{90}$Sr/$^{90}$Y beta irradiation. No significant variation of OSL responses for 10 repeated measurements was observed. The beta dose response of the phosphor was found to be linear as the exposure varies from 0.1 to 20 Gy. In order to increase the sensitivity of this material to neutrons, the preliminary work was carried out by using the same method to produce material using isotopically enriched boric acid (H$_3^{10}$BO$_3$). The synthesized phosphor was irradiated to $^{252}$Cf neutron source for 2 Gy dose and OSL glow curve was recorded. Li$_2^{10}$B$_4$O$_7$: Ag, Tb phosphor showed a high OSL sensitivity under $^{252}$Cf neutron irradiation. It was determined that this material shows high sensitivity to beta, gamma and neutron dose and it can be examined for the possibility of developing a new material for OSL neutron dosimetry.

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Preparation of CaSO$_4$:Eu with neutron converter $6\text{Li}_2\text{CO}_3$ to develop a new OSL material with high sensitivity to neutron irradiation

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This study was carried out in order to investigate the usability of CaSO$_4$:Eu as an OSL dosimeter in neutron dosimetry applications. It presented the effect of neutron converter on OSL characteristics of CaSO$_4$:Eu. In the synthesis of this new material, lithium carbonate 95% enriched with $6\text{Li}$ ($6\text{Li}_2\text{CO}_3$) was used as a neutron converter and mixed with CaSO$_4$:Eu powder. The OSL signals of various samples after neutron irradiation were determined for this mixture using a $^{252}\text{Cf}$ source and normalized to OSL signals after gamma irradiation. The results showed there exists the possibility of developing an OSL dosimeter made of CaSO$_4$:Eu and a neutron converter ($6\text{Li}_2\text{CO}_3$) which is sensitive to neutrons and be used as a neutron dosimeter.

This project has been supported by Cukurova University Rectorate, Scientific Research Projects Unit under the project number FBA-2016-6000.
Investigation of OSL characteristics of LiB$_3$O$_5$:Pr, K, Cu, Na phosphor

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Lithium triborate (LiB$_3$O$_5$) is a promising material for medical and radiotherapy applications due to its non-toxic and tissue equivalent properties. In this study, the dosimetric properties of Pr, K, Cu, Na doped lithium triborate powder phosphors (LiB$_3$O$_5$:Pr, K, Cu, Na) prepared by Solid State Synthesis method were examined using the Optically Stimulated Luminescence (OSL) technique. Dosimetric characteristics of the phosphor were investigated by performing basic dosimetric experiments such as obtaining its OSL decay curve, beta dose response, reusability and short fading. The phosphor has linear dose response between 0.1-10 Gy. The OSL decay curve after 1 Gy dose exposure was recorded and the OSL signal has been determined as being the resultant of the three components. The decay lifetimes of these three components were determined as 0.49 s, 1.50 s and 17.63 s, respectively. 7 repeated readout cycles led to variations in OSL sensitivity as high as 7%. The resultant data shows that LiB$_3$O$_5$:Pr, K, Cu, Na phosphor can be studied for the purpose of its development for its utility in medical applications.

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The purpose of this study is to investigate the dosimetric properties of Ce, K, Cu, Na doped lithium triborate powder phosphors (LiB3O5:Ce, K, Cu, Na) prepared by Solid State Synthesis method using the Optically Stimulated Luminescence (OSL) technique. The OSL characteristics of the phosphor were carried out through the analysis of OSL decay curve. The main TL peak was determined as appearing at 215°C at a heating rate of 5°C/s. We determined dose response after 90Sr/90Y beta irradiation, reusability and dark fading characteristics of the samples. LiB3O5:Ce, K, Cu, Na has linear dose response between 0.1-10 Gy. 7 repeated readout cycles led to variations in OSL sensitivity as high as 5%. Fading of the phosphor was found to be 19% in the first hour, probably due to the shallow traps; followed by subsequent fading of 25% over the next 7 days. The results indicated that LiB3O5:Ce, K, Cu, Na phosphor can be studied on and developed for the purpose of dose determination in medical applications. Routine radioactivity surveys, low level LSC technique can be considered to be a more reliable method due to its relatively easy sample preparation and high scintillation efficiency of PMTs, thus resulting in high sensitivity. With use of LSC method, reproducible, more accurate and precise results can be obtained as a result of high count statistics acquired in a short time.
LU009

Studying $^6\text{Li}_2\text{CO}_3$ as a neutron converter for investigation of the neutron responses from synthesized BeO pellets using OSL

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This paper presents the basic characterization analysis and OSL characteristics of synthesized BeO nanophosphors. The material structure of BeO was studied using DSC/TGA, XRD, SEM and FTIR analysis. Due to the results of characterization analysis, BeO nanophosphors were determined as successfully synthesized and the regularly shaped particles and their narrow size distribution (20-85 nm) was observed. The OSL decay curve and dose response of BeO (synthesized without using any converter) were determined using $^{90}\text{Sr}/^{90}\text{Y}$ beta source. In this work, Lithium Carbonate ($6\text{Li}_2\text{CO}_3$) was chosen as a neutron converter and BeO was synthesized with enriched $^6\text{Li}$. The neutron and gamma sensitivity of samples, in the form of pellets were determined using a calibrated $^{252}\text{Cf}$ source and a gamma source, respectively. It was determined that more detailed neutron exposure studies are necessary for increasing the understanding of the properties and the nature of the OSL signals from BeO-$6\text{Li}_2\text{CO}_3$ pellets. The preliminary experiments related to the dosimetric properties of the signal have given the hope for using the material for neutron dose assessment in the future.

This research is sponsored by Cukurova University Rectorate through the Project FYL-2015-3944 and FBA-2016-6000. We gratefully acknowledge Cukurova University for financial support.
Evaluation of OSL dosimeters in open field surface dose measurements

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Even though it is extremely difficult to accurately measure dose on the phantom surface and in the build-up area, it is very crucial that the treatment is applied to the patients correctly. High sensitivity extrapolation ion chambers are always preferred for surface dose measurements. However, nowadays, these ion chambers, which are found in very few clinics, are frequently replaced by parallel plan ion chambers. For this reason, measurements taken with the Markus parallel plan ion chamber in our clinic are considered as references to other dosimetry systems. In this study, it was aimed that to determine the behavior of the optically stimulated luminescence (OSL) system for surface dose measurement with comparing by markus parallel plane ion chamber. It is also researched whether OSLs can be used for in vivo dosimetry confidently and easily or not.

All measurements were taken on a Varian Trilogy LINAC with 6 MV at SSD=100 cm. Since the measurements to be taken included problematic dose regions, solid water phantom was added on the plate to be taken at different depths, and the SSD value was not changed to provide the necessary sensitivity for the distance. Measurements were taken for 5 x 5 cm², 10 x 10 cm², 20 x 20 cm² open fields and 0° beam angle, at surface, 1, 2, 5, 10 and 15 mm physical depths with OSL and parallel plane ion chamber. Ion chamber and OSLs were placed in their own special RW3 phantom; to balance the back scatter, enough RW3 phantom were put under it. Measurements were also repeated at the surface and in the buildup region of the 6 MV for 10⁰ x 10⁰ cm² field size and 30⁰, 60⁰ and 80⁰ gantry angles to investigate angular dependence of OSLs. 100 MUs were given for each measurement and measurements were repeated for three times by OSLs and ion chamber to determine the rate of the deflection. The average readings were calculated. Inverse square correction was applied to the measurement data. The distance-corrected measured values were normalized to the maximum dose depth of 6 cm photon energy at 1.5 cm for each field size. The OSLs are illuminated in closed configurations during measurements. In this configuration, the effective measurement distance of the nanodots is 0.85 mm.

The surface doses (at 0.07 mm) using 6 MV photon beams for 5 x 5 cm², 10 x 10 cm², 20 x 20 cm² field sizes were found to be 14.00 %, 19.69 % and 30.87 %; 13.17 %, 21.63 % and 28.71 % for Markus chamber and OSL, respectively. Surface dose at 0 mm obtained by extrapolation for markus chamber and OSL were different because of the variation of their effective measurement depths. But the surface dose increased with field size for each dosimeter.
Oblique rays are known to cause an increase in surface dose. Also in this study, the surface dose increased as the angle of the incident radiation beam became more oblique. As at the 0° gantry angle, OSL measurements were also found much more than ion chamber at different gantry angles.

OSL is over-responding to surface dose with respect to the parallel plate ion chamber for all gantry angles. But at 0.07 mm which was accepted as surface dose depth, measurements obtained by two different dosimeters, are compatible with all field sizes. Due to the easy use of OSL, considering its behaviors in surface dose measurements, it can be used safely in in-vivo dosimetry.
The effect of Eu dopant amount on the characteristics of thermoluminescence of Eu$^{3+}$ doped CaO obtained from sea urchin skeleton

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Sea Urchin Skeleton is an important source, abundantly contains calcium carbonate (CaCO$_3$), to produce CaO. The CaO production is accomplished by heating the sea urchin skeleton to high temperatures with release of CO$_2$ molecule. The Sea Urchin which was used in present study was collected from Foça in İzmir and by using solid state method Eu$^{3+}$ doped CaO obtained from sea urchin skeleton was prepared to determine the effect of Eu dopant amount on the Characteristics of TL. At the preparation process of the sample, the CaO sample was doped with Eu$^{3+}$ within the form of oxide in proportion as 1 g CaO and 0.05 g, 0.10 g, 0.20 g Eu$_2$O$_3$ (0.5, 1, 2 pct wt).

The aim of the present study is to investigate the effects of different dopant amounts of 0.5%, 1% and 2% on the TL response of Eu$^{3+}$ doped CaO obtained from Sea Urchin Skeleton. The data of TL glow curve were recorded in the dose range of 0.1–240 Gy for all doping concentrations and also to determine the linearity of the dose response, the peak area versus the dose was plotted. All TL measurements were performed using an automated Lexsyg Smart TL/OSL reader equipped with an internal $^{90}$Sr/$^{90}$Y source with a dose rate of 0.115 Gy/sec. The TL measurements were carried out from room temperature to 450 °C with a constant heating rate of 2 °C/s. In the light of the measurement results, it is seen that the dosimetric peak of Eu$^{3+}$ doped CaO is a well-defined and centered at around 149 °C for all Eu$^{3+}$ concentration. There is no significant shift in maximum peak temperature ($T_m$) with beta dose variations in the range of 0.1-240 Gy at TL glow curves of CaO doped with various Eu$^{3+}$ concentration. While increases in the beta dose lead to an increase of TL intensity, the highest TL intensity is observed at 1% Eu$^{3+}$ doped CaO. It can be deduced from the measurements that 1% Eu$^{3+}$ doped CaO obtained from Sea Urchin Skeleton is more suitable dosimetric material compared to 0.5% and 2% Eu$^{3+}$ doped CaOs.
Acknowledgement: All authors are grateful to Research Fund of the Cukurova University for its financial support under the Project Number: FAY-2015-4735 to purchase lexsysg smart TL/OSL reader.
Obtaining pure quartz from soil samples and calculation of its kinetic parameters using isothermal decay method

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The second most abundant mineral is quartz after feldspars and approximately 12% of the mass of the Earth’s crust is made of quartz. From this reason, it is possible to obtain quartz from soil samples. Quartz samples are used in many studies such as luminescence dating, retrospective dosimetry applications and etc. In this study, soil samples were collected from Seyhan Dam Lake terraces near Çukurova University Campus and then the quartz grains were obtained from soil samples using some separation methods. Whether the obtained samples were quartz or not were tested by OSL measurements. The coarse grain quartz (90-140 µm) samples were used TL measurements in order to determine luminescent-kinetic parameters by isothermal decay method (IDM) and minimum detectable dose (MDD) of quartz samples.
Thermoluminescence characteristics of SrAl$_2$O$_4$:Dy phosphor prepared by the solution combustion method

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In this preliminary study, SrAl$_2$O$_4$:Dy phosphor was synthesized by solution combustion synthesis (SCS) method using SrCO$_3$, Al(NO$_3$)$_3$·9H$_2$O, Dy$_2$O$_3$, H$_3$BO$_3$, urea and HNO$_3$ starting materials. In order to characterize the prepared material, XRD and SEM techniques were used. TL glow curves were recorded from room temperature to 400°C at a constant heating rate of 1°C/s after preheat process at 130°C for 10 second using lexsyg smart TL/OSL reader. It was observed that the samples have a high temperature peak at about 160°C. Dose responses of Dy-doped SrAl$_2$O$_4$ phosphors were investigated after the beta irradiation in the dose ranges from 0.5 Gy to 100 Gy and it was determined the SrAl$_2$O$_4$:Dy phosphors show a linear dose response in these dose ranges. In addition to these studies, the activation energy and frequency factor of SrAl$_2$O$_4$:Dy phosphor were also calculated by peak shape method.

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Preliminary dose response results of quartzite using thermoluminescence method

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Natural minerals as dosimetric materials have been investigated with thermoluminescence procedure. In this study, TL dose response results of natural quartzite were determined after β-irradiation (\(^{90}\)Sr/\(^{90}\)Y) at room temperature. All TL measurements were carried out on three aliquots of 20±0.1 mg samples by using Lexsyg Smart TL/OSL reader. The incandescent background was subtracted from the TL data. The relationship between dose and the TL response of the quartzite sample was studied over the dose range of 1 Gy – 600 Gy of beta irradiation. The results show that the response of this sample appears to be linear 1-600 Gy.

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Influence of sintering time on the thermoluminescence characteristics of Eu$^{3+}$ doped CaO obtained from sea-urchin skeleton: a preliminary study

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The skeletons of sea urchins are porous, single crystal Magnesium-rich calcite [(Mg, Ca)(CO$_3$)] with a three dimensional meshwork architecture. When heated, CaCO$_3$ decomposes to CaO and CO$_2$. TL properties of doped and undoped CaO have been extensively studied in the literature. However, the TL properties of 0.5% Eu$^{3+}$ doped CaO obtained from sea-urchin skeleton were investigated using different sintering time for the first time. The sea urchins were collected from Foca in Izmir, Turkey and then after drying process, the skeleton was ground using planetary ball mill. To determine the calcination temperature, the powder samples were subjected by differential thermal analysis (DTA). Based on the DTA result, the powder form of the sea urchin skeleton was calcined at 1050°C for 2 hours to obtain CaO. The CaO sample was then doped with Eu-rare earth element in the form of oxide. 1 g CaO and 0.05 g Eu$_2$O$_3$ (0.5 pct wt) were mixed in an agate mortar, then the mixture was put into porcelain crucible and heated at 1050°C for different duration of heating (2-4-6-24 hours, respectively). After sintering process, all samples were cooled in a desiccator and then reground. In this study, the preliminary results on the TL response of all sintered 0.5% Eu$^{3+}$ doped samples have been studied in detail. The TL glow curves were recorded over the dose range of 0.1 – 240 Gy of beta irradiation which is a linear dose range for 0.5% Eu$^{3+}$ doped samples determined from the peak area versus the dose graphs. All measurements were carried out with a Lexsyg smart TL/OSL reader which has a $^{90}$Sr/$^{90}$Y source with 1.95 GBq emitting beta particles with a maximum energy of 2.2 MeV. TL measurements were performed from room temperature (RT) up to 450°C with a heating rate of 2°C/s. It was observed that the shape of TL glow curves of five apparent TL peaks changed by the sintering time over the dose while the temperatures of the peaks stayed constant. The highest TL intensity was achieved in 4 h sintered Eu$^{3+}$ samples which is of great importance to choose the most convenient sintering time. It can be stated that the preliminary results show that 4 h sintered 0.5% Eu$^{3+}$ doped CaO obtained from sea-urchin skeleton is a promising dosimetric material, so it is worth to carry out continuous and systematic investigations to improve its quality adequate for dosimetry applications.
Solution combustion synthesis, structural and dosimetric characterization of ZnB$_2$O$_4$:Eu nanophosphors

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In this study, undoped zinc borate samples were synthesized by Solution Combustion Synthesis method which is one of the adopted technique to obtain nanomaterials. Synthesized zinc borate samples were doped with Eu by using different amounts (0.1, 0.5, 1 and 2.5 %) and the best TL intensity obtained from 0.1% Eu doped ZnB$_2$O$_4$ (ZBS) nanophosphors. According to this result, detailed dosimetric studies were achieved for 0.1% Eu doped ZBS samples; CGCD analyzing of TL curves, obtaining kinetic parameters, dose response, reusability and fading characteristics of the samples were carried out. Obtained results indicated that 0.1% Eu doped ZBS samples consist of two well separated peaks occurred at around 90 °C and 150 °C. The reusability of the samples was checked and only 1% reduction observed after 10 repeated reading-irradiating recycles. Dose response measurements showed that there is good linearity (superlinearity index g(D) calculated as 1.046) between 0.1 Gy and 100 Gy of beta dose. The trap parameters of 0.1% Eu doped ZBS samples were examined with three different methods namely various heating rate (VHR), whole TL glow curve method (WGH) and computerized curve de-convolution analysis (CCDA) methods. The examined activation energy (E) were in agreement (0.98, 1.04 and 1.08 eV respectively) indicated the good correlation between these methods. Fading study of the samples showed that 43% reduction in TL intensity after 4 weeks were occurred.

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LU017

**Evaluation of the \( f(D) \) functions of TLD-600 and TLD-700 exposed to \( ^{252} \text{Cf} \) neutron+gamma radiation**

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In the application of TL, one usually hopes that, at least in certain dose ranges, the measured effect would be proportional to the applied dose. In many other materials or dose ranges, however, different degrees of nonlinearities of different sorts are observed. Nonlinearites often occurs in the dose dependence of TL. These include sublinearity, usually when there is an approach to saturation in the dose dependence, as well as supralinearity, also termed superlinearity in the literature. The term supralinearity has presented by many authors as response per unit of dose, normalized to a dose in the initial linear range. In this study, the dimensionless function termed supralinearity index or dose response function \( f(D) \) has been evaluated for TLD-600 and TLD-700. After annealing, the samples were irradiated by \( ^{252} \text{Cf} \) neutron+gamma radiations and the readings were done at a linear heating rate of 1oC/s. The results have shown that the peaks show the main properties of the \( f(D) \) function. That is, an initial linear range is followed by a nonlinear (i.e. superlinear) region before saturation effects set in.
LU018

Synthesis and thermoluminescence properties of Eu doped CaMoO$_4$

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Thermoluminescent materials are used as passive dosimeters in a wide range of radiological applications. Rare-earth ion doped calcium molybdate (CaMoO$_4$) has attracted much interest due to its wide luminescence applications. These include optical filters, solid state lasers, LED, scintillators, microwave dielectrics, cryogenic detectors and fluorescent lamps. Moreover, some of its attractive features include a high melting point (1445–1480°C), refractive index (1.98), effective average decay time (14 µs), photo electron yield (9%) and it is also chemically resistant and non-hygrosopic. CaMoO$_4$ shows a broad blue and/or green luminescence emission peak in the range 350–650 nm with a peak maximum around 500 nm. In the given study, Eu doped Calcium Molybdate phosphors have been synthesized using the sol-gel method and the thermoluminescence properties were investigated in detail. The additive dose (AD), variable heating rate (VHR), peak shape (PS), and computerized glow deconvolution (CGCD) methods were used to determine the kinetic parameters namely the order of kinetics (b), activation energy (Ea) and the frequency factor (s) associated with the dosimetric TL glow peaks of CaMoO$_4$: Eu after different dose levels with β irradiation.
LU019

Numerical solutions of the thermoluminescence equations by using mathematica

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Some models have been proposed so far to explain thermoluminescence emission and it should be emphasized that each model has its own equations set. The equations are not linear and thus analytical solutions are not possible. From this point on, numerical solutions of the TL equations by using Mathematica have been effectively used in TL studies. In this paper, some of the TL models were solved, numerically by using Mathematica and some interesting results were also discussed.

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LU020

Numerical analysis of the thermoluminescence glow peak of the karadağ rocks

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Karadağ mountain is situated in Karaman where located in the south of the Central Anatolia Region between 37.11 north latitudes and 33.15 east longitudes. Karadağ is a volcanic mountain.

In this paper rock samples were collected from different locations in Karadağ and thermoluminescence glow curves were measured. After then, numerical models were proposed for the experimental glow curves and numerical solutions of the models were also performed by using Mathematica. Numerical results were compared with experiments.

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LU021

The investigation of thermoluminescence properties of feldspathic ceramic used in dental processes

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In retrospective dosimetry applications, evaluation of the absorbed dose during nuclear accidents or radiological terrorist events is necessary for the estimation of health effects following such an exposure. In such cases specimens of the materials taken from directly human body are readily available for quick and reliable dose estimations. The thermoluminescence properties of feldspathic ceramic used in dental prostheses was examined. Feldspathic dental ceramic which are investigated of luminescence properties was obtained from Vivadent Ivoclar, Turkey. The feldspathic dental ceramics were irradiated with $^{90}$Sr-$^{90}$Y β-source from 12 Gy to 6.9 kGy and had linear dose responses for the absorbed doses ranging from 12 Gy to 288 kGy. According to the reproducibility properties of the feldspathic dental ceramic, the area under the glow curve increased about 30 percent after seven cycles. The feldspathic dental ceramics undergo about 45 percent faded at the end of 6 weeks waiting and after 1 week waiting the peak located at 180°C completely faded.
Calcite (CaCO$_3$ crystal of trigonal symmetry) is a natural mineral easily available in large quantities and found in many geological formations. Its thermoluminescence properties has been studied for some time mainly due to its role in geological and fossil dating.

All irradiations will be performed at room temperature with beta rays from a $^{90}$Sr-$^{90}$Y source. The irradiation equipment is an additional part of the 9010 Optical Dating System which is also available in physics department. The glow curves will be obtained by QS 3500 manual type TL reader interfaced to a PC where the TL signals are analyzed. The additive dose (AD), variable heating rate (VHR), initial rise (IR), computer glow curves deconvolution (CGCD) and peak shape (PS) methods have been used for the evolution of TL glow peaks. These methods were used to determine the number of peaks and kinetic parameters.
LU023

Investigation of thermoluminescence properties unique Rosso Levanto marble

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The marble removed from Elazığ resembles red meat in appearance and is only found in Elazığ, Turkey. This kind of marble has been widely used in most famous building such as the white house and the Kaaba. In this study, TL properties of a unique marble originated from Turkey, named as Rosso Levanto were investigated. Two distinct TL peaks are observed at 160 °C and around 400°C. Dose response, heating rate, cycle of measurement and fading experiments were carried out for the samples whose particle size are 200µm. The results reveal that good linearity is observed up to 0.6 kGy. While reproducibility is almost good, the peak intensity decreases 40% in first six hours storage in dark room.
A review of TLD's zero-count based on temperature and radiation history of them

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In order to review the background value of a group of TLD-100, the count values was collected from the first reading and after seven years after using them in experimental irradiations. Based on group average and standard deviation of reading counts, the zero-counts for this two condones was calculated and the dependence of temperature and radiation history of this group was evaluated.

A hundred TLD100 type was selected. Lithium fluoride doped with magnesium and titanium (LiF:Mg,Ti) is manufactured in the form of solid pellets of 4.5 mm diameter, 0.9 mm thickness under the code name MTS (MTS-N Poland) was annealed in a heat- time programmed oven. The TLDs were annealed at 400°C for 1h and 100°C for 1h using a PTW high temperature oven (PTW Freiburg GmbH) for initial temperature treatment. And before reading TLDs the pre-read heating processed was performed (100°C for 1h). The luminescent signals for zero-counts were counted by an automated TLD reader RADOS RE-2000RT (RadRro Int. GmbH Germany). After seven years irradiation experiments the amount of TLDs was 80 so the collection of zero-count values was done for these remnant. This process was repeated three times for obtaining consistency of zero-count values.

This study recommended that after frequently irradiation of TLDs the rearrangement for obtaining zero-count value must be performed before using TLDs in a new irradiation examinations. Regarding on memory of radiation and thermal history, the sensitivity can change after receiving a large dose of radiation and undergoing readout. Additional annealing would be necessary to restore the original sensitivity.
An application study about maintaining quality in radioisotope calibrators which are used in nuclear medicine centers

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Radioisotope calibrators are used to measure the amount of radioactive substance to be given to patients in Nuclear Medicine Centers. Achieving the desired results in the analyses to be made depends on measuring the amount of radioactive substance to be given to patients with the least possible error. The radiation, which is intentionally given to patients, must be measured well. This can be possible with the condition that radioisotope calibrators that enable measuring the radioactive substance must have proper performances. This is only possible with a set of quality control works which should be made in routine periods. In this study, measurements for maintaining quality control such as accuracy and sensitivity analysis, and linearity control were conducted for the same type three different radioisotope calibrators in a Nuclear Medicine Center and the calibrator with the highest performance was determined by discussing the results.
Dosimetric comparison of stereotactic body radiotherapy and three-dimensional brachytherapy in patients with locally advanced cervical cancer

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Intracavitary brachytherapy (BT) used in combination with external beam radiation therapy (EBRT) is the accepted treatment method for locally advanced cervical cancer. The main advantage of BT is, while the high doses occurs in the target, the rapid fall-off of dose at edge of the target will be ensured maximum protection to critical organs. Unsuitable medical or anatomic conditions and invasive procedure of BT make necessary to find an alternative treatment modality to BT. The purpose of this study is to investigate that whether stereotactic body radiation therapy (SBRT) would be an alternative treatment modality to brachytherapy (BT).

In this study; computed tomography images of fifteen patients were obtained by using both with applicator and without applicator. BT and SBRT plans were created by using both images. High risk clinical target volume (HR-CTV) and critical organs were delineated according to GEC-ESTRO recommendations on Oncentra treatment planning system (TPS) for BT plans. Gross target volume (GTV) and same critical organs were also delineated on Multiplan TPS for SBRT plans. The doses, which delivered to volumes of 0.1cc, 1cc, 2cc for rectum, bladder and sigmoid, measured in both SBRT and BT plans and compared as statistical. HR-CTV D100 was compared to GTV D100 and HR-CTV D90 was compared to GTV D98.

There are no significant differences among target, rectum, bladder, and sigmoid volumes delineated on both Oncentra and Multiplan TPS separately. GTV D100, compared with HR-CTV 100, was found significantly to be greater. GTV D98, compared HR-CTV D90, was found significantly to be greater. There is no significant difference between sigmoid doses (for volume of 0.1cc, 1cc, 2cc). The bladder and rectum doses (0.1cc, 1cc, 2cc) were found significantly to be lower with BT.

In conclusion, SBRT could be considered an alternative treatment modality to BT for cervical cancer, if BT could not be applied in some situations.
MP003

Critical organ dose comparison of multichannel cylinder applicator and central cylinder applicator in high dose rate brachytherapy

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Brachytherapy is an adjunctive therapy which is generally applied after the external radiotherapy. It is used to increase the local control by increasing the dose received by the tumor in endometrial cancer patients. In our clinic, according to the type of the tumor, High Dose Rate (HDR) brachytherapy is applied with 3-dimensional brachytherapy treatment device by using various applicators. In this study, multichannel cylinder applicator used in treatment of endometrial cancer patients was compared to central channel cylinder applicator for critical organ doses such as rectum, bladder and sigmoid.

In this study, 10 endometrial cancer patients’ brachytherapy plans which were previously performed with multichannel cylinder applicator were used. These plans were recalculated by de-activating the lateral channels while leaving the central channel activated as if it is a central channel cylinder plan. For each plan, the dose was adjusted as 90 % of the target volume should be irradiated by 5 Gy. Rectum, bladder and sigmoid doses were investigated and compared for the plans.

In treatment plans which were prepared by using multichannel cylinder applicator, average doses of 2cc volume of rectum, bladder, and sigmoid were found 10%, 12% and 38% lower than doses calculated in treatment plan with central canal cylinder, respectively.

It was seen that the brachytherapy plans prepared by using multichannel cylinder applicator provides a greater flexibility in dose control and a reduction in critical organ doses, as compared to the plans with central channel cylinder applicator. Thus, use of multichannel cylinder applicator is suggested instead of central channel cylinder applicator for clinics in endometrial carcinoma patients.
Measurement of neutron contamination from 18-MV medical linac

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Linear accelerators are increasingly used in the medical field. However, the unwanted photo-neutrons production can be contributed to the dose delivered to the patients during treatments. Neutron contamination contributes to the risk of secondary malignancies in patients. So, it is important to determine neutron dose during radiotherapy treatment. In this study, it is aimed to investigate the effect of field size, distance from axis and depth on the amount of in-field and out-field neutron contamination using ElektaVmat accelerator with 18 MV energy. The neutron spectra at the distance of 75, 150, 225, 300 cm from target and on the isocenter of beam were scored for 5x5, 10x10, 20x20, 30x30 and 40x40 cm² fields. Results demonstrated that the neutron spectra and dose are dependent on field size and distances. Beyond 225 cm of isocenter, the dependence of the neutron dose on field size is minimal. It is concluded that as the open field increases, the neutron dose decreases. It is important to remember that when treating with high energy photons, the dose from neutrons must be considered.
MP005

Surface dose measurement with gafchromic EBT3 film for intensity modulated radiotherapy technique

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Accurate dose measurement in the build-up region is extremely difficult. A lot of factors including treatment technique, beam angle, beam energy, bolus materials and source to skin distance (SSD) effect the dose excessively in such shallow depths. The aim of the study was to compare the film measurements and TPS calculations for surface dose in head and neck cancer treatment using intensity modulated radiation therapy (IMRT).

IMRT plans were generated for 5 head and neck cancer patients by using Varian Eclipse TPS. Quality assurance (QA) plans of these IMRT plans were created on random phantoms for surface dose measurements. EBT3 films were cut in size of 2.5 x 2.5 cm² and placed on the left side, right side and the center of larynx. The films were irradiated with 6 MV photon beams. The exposed films were scanned after 24 hours from irradiation and then the calibration curve of the film batch which was created before irradiation was used to obtain the absolute doses. The measured doses were compared with TPS. In this study, the comparison of film measurements and TPS calculations were also performed in 10 x 10 cm² open field using RW3 water equivalent slab phantoms for 6 MV photon beams to evaluate surface and buildup region doses in different setup conditions.

The surface dose difference between TPS calculation and EBT3 measurement is greater in IMRT because of the using oblique fields. The lack of surface dose calculation in TPS should be considered while evaluating the radiotherapy plans.
MPO06

Alternative radiotherapy planning for head and neck cancer treatment

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Types of radiotherapy techniques such as intensity modulated radiation therapy (IMRT) and volumetric modulated arc therapy (VMAT) have been developed for homogenous dose delivery for years. In some cases, neither IMRT nor VMAT can give the satisfactory dose distribution. In this study, an alternative plan technique named Hybrid was investigated.

An advanced stage head and neck cancer patient underwent computed tomography (CT) scanning with 3 mm slice thickness; head and neck were immobilized with a thermoplastic mask. The gross tumor volume (GTV) was defined as all gross disease in the planning CT and then planning target volumes (PTVs) were delineated by radiation oncologist. Also, the organs at risk (OARs) were contoured. Both IMRT and VMAT plans were created by using Eclipse 8.9.17 (Varian, Palo Alto, CA) TPS on Varian Trilogy LINAC endowed with a 120 leaf MLC, using 6 MV photon beams. Hybrid plan was a combination of 7 field IMRT and triple arc VMAT plans. In this study, total number of fractions was divided as IMRT and VMAT to generate the Hybrid plan. The original 7 field IMRT and triple arc VMAT plans were not changed. The dose distribution and the conformity of the Hybrid plan were evaluated in plan sum. Conformity index (CI) and homogeneity index (HI) were calculated for each technique to compare the plan qualities.

The 95% of PTVs were received 100% of the prescribed doses. The maximum dose of brain stem was found to be 51.50 Gy, 52.46 Gy and 50.97 Gy for IMRT, VMAT and Hybrid plan, respectively. Spinal cord was received 40.41 Gy, 44.49 GY and 39.85 GY in IMRT, VMAT and Hybrid plan, respectively. Also, optic nerves and chiasm doses were found to be lower in Hybrid technique compare to IMRT. Hybrid plan had greater serial organ sparing compared to IMRT and VMAT.

Hybrid technique is a combination of IMRT and VMAT. In advanced stage head and neck cancer, radiotherapy planning becomes a challenging issue due to big target volumes and anatomic location of the tumor. When IMRT and VMAT techniques are not sufficient for providing homogenous dose distribution, the Hybrid technique can be used by benefiting advantages of both IMRT and VMAT techniques. Also, the Hybrid technique can be developed by using new technologies and different applications.
Radiation doses to pediatric patients originated from adult patients in nuclear medicine waiting room

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Radiation protection is one of the most problematic issues in the nuclear medicine department. In perhaps the most neglected issue is the pediatric patients who wait in nuclear medicine department. In present study, we measured the radiation doses to pediatric patients originated from adult patients in nuclear medicine waiting room. The situations for pediatric patients at adult waiting room and at pediatric waiting room were separately investigated during 5-days period. In adult waiting room, average daily number of adult patient injected $^{99m}$Tc was 16.4 and average administered $^{99m}$Tc activity per an adult patient is 630 MBq. Average waiting time for adult patients is 2.6 hours. In pediatric waiting room, average daily pediatric patient’s number is 4.4 and the average administrated $^{99m}$Tc activity per pediatric patients is 147 MBq. Average waiting time for pediatric patients is 2.2 hours. According to our measurements, while a pediatric patient waiting in adult room has up to 184.6 µSv dose originated from adult patients injected $^{99m}$Tc, a pediatric patient waiting in separate pediatric waiting room has only 18 µSv dose from other pediatric patients. The received radiation doses by pediatric patients originated from other patients at nuclear medicine waiting patient room are completely unnecessary and it can be largely avoided. Our recommendation is that pediatric patients should be waited in a separate waiting room apart from adult patients.
Voltage (kV) and current (mAs) optimization for gamma ray attenuation correction by computed tomography in SPECT

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After SPECT-CT had been discovered, their usage in nuclear medicine increased rapidly. SPECT-CT device which is a hybrid imaging system enables anatomical correlation with CT fusion images. Attenuation correction values for gamma rays are calculated by using the Hounsfield Unit (HU) values obtained from CT scan and it is added to count statistic. In the image quality and anatomic correlation procedure, the most important problem is given radiation dose to patient because of CT scan. Especially in radionuclide treatment, patient is scanned by using SPECT-CT device at 4-5 times after each treatment. Thus, CT radiation doses given to patient are very important and kilo-volt (kV) and milli-ampere seconds (mAs) values should be minimum. In the present study, we aim to investigate the suitable kilo-volt (kV) and milli-ampere seconds (mAs) values for the correct attenuation correction procedure in SPECT-C the use of low kV and mAs values versus high kV and mAs values in SPECT-CT imaging for attenuation correction does not cause data loss. The use of low kV and mAs values is important in terms of the reducing the patient dose.T.
Quality control test of $^{99}$MTC perteknetat marked hydroxyethylene diphosphonate (HDP) radiopharmaceutical

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Nuclear medicine is the diagnosis and treatment of diseases. The radionuclides are combined with organ specific pharmaceuticals to form the radiopharmaceutical form. Acceptable radiochemical purity rate for HDP should be $\geq 95\%$. In this study, quality control tests of $^{99m}$Tc-HDP radiopharmaceutical for bone scintigraphy were performed and the results were evaluated. A distance of 1 cm from one end of Whatman Paper was marked as origin. 1-2 µCi was dropped on the paper using a radiopharmaceutical fine needle and injector as an original point. Watman paper was soaked to a serum bottle containing solvent. The radiopharmaceutical was spread out on Whatman Paper with the help of solvent. After Whatman paper was waiting 4 minutes in the bottle, it was cut from the middle. The part where the origin was located was numbered 1 and the upper part was numbered 2. Both parts were counted in the dose calibrator. The same procedure was repeated with saline. The HDP purity ratios of the 30 different day's quality control tests were found as average % 98.6. The result of one of the tests was 94.6%. Since this test result purity rate was below 95%, the radiopharmaceutical was prepared again. HDP quality control test should be performed routinely in clinical applicati
MP010

Comparison of radiotherapy treatment plans in prostate cancer

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In this study, tomography images taken pre-treatment of 10 patients with prostate cancer diagnosis were used. Treatment plans were made in the planning systems of three-dimensional conformal radiotherapy and tomotherapy linear accelerators devices. Doses taken by target and critical organs were considered through dose volume histograms obtained. Minimum, maximum and 95\% dose values absorbed by target were compared. The maximum, minimum and volumetric dose differences between the two treatment planning systems were calculated. In conclusion, according to three-dimensional conformal radiotherapy treatment plans, in tomotherapy treatment plans it can be concluded that it is possible to give more homogeneous dose to target and that the critical organs were better preserved.
Investigations of target volume and critical organ doses in stomach cancer with 3D conformal radiotherapy and intensity modulated radiotherapy techniques

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A Comparison of three-dimensional conformal radiotherapy (3D-CRT) planning and intensity modulated radiotherapy (IMRT) planning in stomach cancer were performed. The doses of critical organs and target volumes were compared. A Varian model accelerator and Eclipse V13.0 treatment planning system (TPS) at Gaziosmanpasa University Radiation Oncology Department is used. 3D-CRT and IMRT plans made at TPS retrospectively, for 20 selected stomach cancer patients. Achieved data is presented and discussed.
Study of the iodine-131 dose variation as a function of the size within an anthropomorphic thyroid phantom

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In order to study the internal gamma dose in the thyroid gland we followed the same way of our previous work by making this time a comparative study between fifteen geometric shapes. The most suitable geometric shape simulating the thyroid gland has been determined by taken results of MIRD 15 as criteria to validate the model. Therefore, we determined the variation of the absorbed gamma dose as a function of the size of thyroid gland. Both gamma and beta dose distribution of iodine-131 in the thyroid gland are determined and discussed.
In this study, calorimetric method is used to derive the depth doses calculation. In the experiment At the KeV level, an Ir-192 source with three different gamma energies was used. The source activity is approximately 9.15 curie. The Ir-192 radioactive source is mainly used for industrial purposes. This study has been made to determine organ dose values in any industrial accident. The data are calculated as surface dose and depth dose. Values for different time intervals have been measured. Time and depth parameters for measurements and calculations were obtained for 30 different values. The results of the experiment and the calculations have been compared. As a result, the more the depth of the phantom was the less the dose values obtained. It is observed that the dependence was changed exponential.
A dosimetric comparison with 3-dimensional conformal and volumetric modulated arc therapy for endometrial cancer

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The aim of present study is to compare the differences of the dosimetric parameters between 3-dimensional conformal and volumetric modulated arc therapy in endometrial cancer.

Ten endometrial cancer patients who treated with volumetric modulated arc therapy radiotherapy after hysterectomy at the Istanbul University Oncology Institute were randomly selected for this study. Computed tomography (CT) images of patients were acquired with 3 mm slice thickness using Phillips Brilliance Big Bore 4D CT (Philips Electronics N.V.) in the supine position. The planning target volume (PTV), rectum, bladder, bowel and bilateral femurs were delineated on the CT data. The treatment plan of each patient was generated with using coplanar full arcs. 3-dimensional conformal therapy plan of each patient were created with a four-field box technique using 15-MV photon beams.

Doses to critical organs were found to be lower in volumetric modulated arc therapy compared with 3-dimensional conformal therapy. CI closer to 1 means better dose conformity. HI should be 0 for better dose homogeneity in PTV.

The volumetric modulated arc therapy enables improved in dose homogeneity in the PTV with reduction in the doses to OAR for postoperative endometrial cancer patients.
The treatment techniques in localized prostate cancer who has a hernia: A case study

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A patient who has a hernia close to prostate tumor has been received radiotherapy in our clinic. Like the other critical organs, sparing the hernia is aimed while generated the treatment plan. The purpose of the present study is to investigate which treatment technique is better in localized prostate cancer patient who has a hernia.

Computed tomography (CT) images of the patient were obtained with 3 mm slice thickness using Phillips Brilliance Big Bore 4D CT (Philips Electronics N.V.) in the supine position and transferred to Varian Eclipse Version 8.9.17 treatment planning system (TPS) for both contouring and planning. The planning target volume (PTV), rectum, bladder, hernia and bilateral femurs were contoured on the CT images. Two coplanar full arcs (counter-clockwise from 179.9⁰ to 180.1⁰, collimator angle 330⁰ and clockwise from 180.1⁰ to 179.9⁰, collimator angle 30⁰) were used on the ARC plan. Avoidance sector (0 MU) from 300⁰ to 70⁰ was used to sparing the hernia. For this study, seven-field IMRT (gantry angles-70⁰, 100⁰, 120⁰, 140⁰, 220⁰, 245⁰, 275⁰ 300⁰ and collimator angle 0⁰) was created by using same optimization criteria used in the arc plan. 15-MV photon beams from Varian Trilogy LINAC (Varian Medical System, Palo Alto, CA) were used for the ARC and IMRT plans. Doses in the critical organs are shown in Table 1. IMRT provides the better sparing critical organs except femurs. MU values are 537 and 732 for ARC and IMRT, respectively.

When beam is avoided the hernia in the beam’s eye view on IMRT plan, the hernia sparing is achieved. IMRT could be chosen for special cases as it is in this study.
MP017

Radiation absorbed dose calculation of yttrium-90 microsphere therapy

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In this study, it was aimed to make calculations for determine optimal amount of administered activity in inoperable liver metastasis and hepatocellular carcinoma patients treated Y-90 microspheres and to evaluate radiation absorbed doses with patient specific dosimetry to compare according to liver toxicity level.

A total number of 31 patients (11 female and 20 male) were included in this study. The mean age of the patients was 47 ± 0.2, the height was 1.6±0.04 m, the weight was 73.6±0.2 kg. To make the patient specific dosimetry, liver volume, tumor volume, shunt ratio with ⁹⁹mTc-MAA, tumor/liver ratio (TLR) were determined by computerized tomography. Instead of traditional internal dosimetry models (Empiric Model, BSA (Body Surface Area) Model) MIRD (Medical Internal Radiation Dosimetry) model was used.

According to datas, the mean liver volume was 1942.28±1.4 cm³, the average tumor volume was 355.24±0.6 cm³, the mean TKO was 6.24±0.08 and the average percentage of the intestinal tract was 7±1, giving an average of 1649.60±1.3 MBq activity. The average normal liver dose was calculated as 29.63±0.17 Gy, the mean tumor dose was calculated as 125.62±0.36 Gy and the mean lung dose was calculated as 5.67±0.07 Gy respectively, when an average of 1649.60±1.31 MBq activity was given. As a result of the dosimetry, it is seen that the normal liver doses for each patient do not exceed the maximum accepted 30-35 Gy liver dose. There is no radiation dose value exceeding lung dose which is a maximum of 12 Gy. Based on the mean normal liver and lung dose values, the amount of activity planned to be given according to the MIRD model has produced radiation doses that can be tolerated in critical organs. The MIRD model offers patient-specific dosimetry and is useful for routine Y-90 microsphere dosimetry calculations.

Basically MIRD formalism and Partition model derived from MIRD are based on more scientific bases than previous models. They determine the optimal amount of activity that should be given by calculating parameters such as tumor mass, liver mass, lung mass, SF, TKO, Uptake liver, Uptake tumour.
The dose calculations in air using different gamma energy

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Gamma rays cause damage at a cellular level and are penetrating, causing diffuse damage throughout the body. However, they are less ionizing than alpha or beta particles, which are less penetrating. Low levels of gamma rays cause a stochastic health risk, which for radiation dose assessment is defined as the probability of cancer induction and genetic damage. High doses produce deterministic effects, which is the severity of acute tissue damage that is certain to happen. The different gamma energy dose calculations are very important medical applications, both staff and patient. In this reason; the dose calculations in air have been obtained by using different gamma energy.
Brachytherapy is an important treatment technique in cancer therapy. Nowadays, high dose rate (HDR) brachytherapy is applied by using 3D image dataset of patients. The treatment is delivered with a HDR radioactive source which stops at various dwell positions for various dwell times. Many treatment planning systems (TPS) are available for create 3D brachytherapy treatment plans. Dose calculation algorithms of TPS are based on the AAPM TG-43. The dose calculation formula which derived from TG-43 assumed all tissues of patients are a homogeneous water equivalent medium. However, human body is not homogenous due to different tissues like air cavities, lung etc. The purpose of this study is to investigate of differences between doses planned by TPS and measured by EBT3 gafchromic film in inhomogeneous medium.

Measurements were carried out on a phantom which consists of different tissues, i.e. bone, air cavity and lung tissues. Computed tomography images of the phantom were acquired and transferred to TPS. A treatment plan was created by using these images. A calibration curve was also created for gafchromic film by exposing with doses ranging from 1 to 20 Gy. Then, a film was cut and put into the phantom. This phantom is irradiated with $^{192}$Ir source from microselection high dose rate (HDR) brachytherapy unit (Nucletron International, The Netherlands) which is installed in Istanbul Medicine Faculty, Oncology Institute. The measured doses were compared with TPS calculated doses.

Point dose difference below the bone tissue and air tissue were found to be 17% and 29% respectively. TPS overestimates the doses on inhomogeneous medium.

TPS which based on the AAPM TG-43 formalism of dose calculation does not take into account the density differences in the tissues. The dose calculation formalism which included heterogeneity correction must be used in clinical application.
The examination of the MDA change and the time until the excretion of the Tc-99m radionuclide found in radiopharmaceutical used in nephro-urological nuclear medicine methods of 0-15 years children

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Nephro-urological diseases are very common diseases in childhood including kidney urinary tract, bladder and urinary tract. Diagnosis is made by nuclear medicine imaging methods.

Tc-99m is used as a radio isotope in nuclear medicine imaging methods, with 140 keV photon energy and 6.0057 hours’ half-life. Tc-99m is given to the body, then 88% of the 140 keV gamma configuration makes the appearance of images. However, ionized radiation emitted by Tc-99m causes free oxygen radicals in the body and these free oxygen radicals cause tissue damage.

In our study, the amount of malondialdehyde (MDA) caused by damage to the cell membrane of free oxygen radicals caused by ionizing radiation released by Tc-99m will be measured over time and the relationship between Tc-99m application time and tissue damage will be revealed. This study aimed to require the use of a radioisotope material with lower energy and shorter half-life in children's radiopharmaceuticals.
MP022

Investigation of the effect of patient respiratory motion on the dose distribution in breast cancer radiotherapy

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External RT is one of treatment modality of breast cancer. However especially in patients with left-sided breast cancer, to prevent possible cardiovascular morbidity risk due to the RT, reduction of irradiated heart of dose-volume quantities is crucial. Organ movements controlled breath-hold RT technique (BHRT) is one of the methods to reduce the dose to the heart. We evaluated the effect of the BHRT on critical organ doses compared to normal free breathing (FB).

10 breast cancer patients underwent CT-simulation scans in free breathing (FB) and BH. Conventional tangential treatment planning was performed on the FB and BH scans. Volumes of the ipsilateral lungs were controlled and compared both for FB and BH ct images. Doses to the heart, left anterior descending (LAD) artery, and ipsilateral lung were assessed. Plans were compared and BH plans demonstrated significantly reduction in risky organs.

The ipsilateral lung volume receiving 5, 20 and 30 Gy was reduced by BHRT more than FBRT significantly. By using DIBH, the average mean heart dose was reduced from 433 cGy to 131.97 (p=0.005).

The use of BH during RT of the left-sided breast considerably reduces the doses delivered to the lung, heart and LAD artery significantly.
Comparison of 3DCRT, VMAT and IMRT techniques in metastatic vertebra radiotherapy: A phantom study

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Vertebra metastases can be seen during the prognosis of cancer patients. Treatment ways of the metastasis are radiotherapy, chemotherapy and surgery. Three-dimensional conformal therapy (3D-CRT) is widely used in the treatment of vertebra metastases. Also, Intensity Modulated Radiotherapy (IMRT) and Volumetric Arc Therapy (VMAT) are used too.

The aim of this study is to examine the advantages and disadvantages of the different radiotherapy techniques. In the aspect of this goal, it is studied with a random phantom in Uludag University Medicine Faculty, Radiation Oncology Department. By using a computerized tomography image of the phantom, one 3DCRT plan, two VMAT and three IMRT plans for cervical vertebra; three different 3DCRT plans, two VMAT and two IMRT plan for lumbar vertebra are calculated. To calculate 3DCRT plans, CMS XiO Treatment System is used and to calculate VMAT and IMRT plans Monaco Treatment Planning System is used in the department.

The study concludes with the dosimetric comparison of the treatment plans in the spect of critical organ doses, homogeneity and conformity index. Especially thyroid doses and kidney doses are important for this work.

As a result of this study, all critical organ doses are suitable for QUANTEC Dose Limit Report and critical organ doses depend on the techniques which used in radiotherapy. According to homogeneity and conformity indices, VMAT and IMRT plans are better than one in 3DCRT plans in cervical vertebra radiotherapy plans. According to the results of lumbar vertebra radiotherapy plans, homogeneity index is better in VMAT and IMRT plans. Also for lumbar vertebra treatment plans, IMRT technique is better than other techniques by conformity index.
Dosimetry comparison between VMAT and RC3D techniques: prostate as case of treatment

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Considered as the second men cancer in Algeria, prostate cancer is treated in 70% by radiation. That’s why radiation therapy is therapeutic weapon for prostate cancer. Conformational Radiotherapy in 3D (RC3D) is the most common technique but Volumetric Modulated Arc Therapy (VMAT) technique is more beneficial in term of gain in dose.

The use of conventionally optimized treatment plans (RC3D) is compared at case scenario at optimized treatment plans (VMAT) for prostate cancer. The evaluation of the two optimizations strategies focused on the resulting plans ability to retain dose objectives under the influence of patient set up. Dose Volume Histogram (DVH) in the planning target volume (PTV) and dose in the organs at risks (OAR) are used to calculate the conformation index, main tool of comparison.

The situation was analyzed systematically. The 14% dose increase in the target leads to a decrease in the dose in adjacent organs with 39% in the bladder. Therefore, the criterions for better efficacy and less toxicity reveal that (VMAT) is the best choice.
NA001

**Determination of dietary habits on teeth by photoactivation analysis in southern Turkey**

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In this study, the effect of dietary differences on the teeth elements were investigated and especially the effect of meat consumption was investigated. We expect to provide an insight on health issues like eating habits by photoactivation analysis, a non-destructive method, will be used for the first time associated with medical sciences in our country. The collected teeth samples from Akdeniz University Faculty of Dentistry and prepared standards (SrO and CaO) irradiated by using a clinical linear accelerator (cLINAC) of 18 MeV bremsstrahlung energy to achieve photo activation. Afterwards, irradiated teeth samples and standards were analyzed with gamma spectroscopic analysis method using an HPGe detector system. This will also set an example for future studies.
Infectious diseases are an important global problem in public health and causing mortality and morbidity due to their microbial resistant mechanisms. As known new antimicrobial compounds which will be effective on these resistance mechanisms, have been still synthesized. In this study, ITFSI [bis(trifluoromethanesulfonyl) imide] compound was labeled with $^{131}$I via iodogen method and quality control studies was determined with TLRC (Thin Layer Radio Chromatography). When TLRC results are evaluated ITFSI compound was labeled with $^{131}$I with high efficiency (95.5 ± 2.3%).

In vitro uptake results show that maximum uptake of $^{131}$I-ITFSI was 92.3±7.7% at 1 hour for Staphylococcus aureus (S. aureus) and 80.1±1.5% at 2 hours for Escherichia coli (E. coli). Therefore, the uptake of $^{131}$I-ITFSI was observed high uptake efficacy in both bacterial strains and the uptake decreased in both bacterial strains with time. In the biodistribution study, $^{131}$I-ITFSI was assessed for discrimination between sterile inflammation which was formed with sterile turpentine oil and bacterial infection to being created with S. aureus on rats. The results display that $^{131}$I-ITFSI are promising to be a nuclear imaging agent to detection of bacterial infection.
NA006

Transport of Lanthanum (III) through supported liquid membranes using CMPO carrier and ionic liquid diluter

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Turkey has a large thorium reserve includes substantial amount of rare earth elements (REEs) such as lanthanum, cerium and neodymium. REEs have been used in numerous fields (mobile phones, televisions, notebooks, automotive etc.) hence it is significant to recovery them. However, lanthanides have very similar properties thus to separate them from each other becomes difficult. Until now, there have been used many separation methods like; solvent extraction, adsorption etc. Supported liquid membrane (SLM) is an alternative method that has technological advantages like using small quantities of organic phase and carrier, having one-step mass transfer and possibility of reaching high separation factor and concentrating components during separation.

In this study, to prepare SLM firstly, octylphenyl-N, N-diobutylcarbamoylmethylphosphine oxide (CMPO) is solved in 1-Butyl-3-methylimidazolium bis(trifluoromethylsulfonyl)imide. Afterwards this mixture is immobilized into porous membrane filter. CMPO is used as carrier, [C4mim] [Tf2N] as diluter and EDTA as stripping phase. In the membrane system to optimize the factors of lanthanum transport two factor full factorial design is used. The experiments were carried out with nine points contains the control run. Feed phase concentration, CMPO concentration and pH are investigated factors. The statistical design and data analysis were carried out by Design Expert Software. Relationship between variables and response are expressed by modified model.

Optimum factors of lanthanum transport are; 59.95 ppm initial La(III) feed phase concentration, 11.92 mM CMPO concentration and pH 2.99. Theoretically, approximately 32% transport is achieved in these conditions. pH is found the most effective factor on transport of La(III) in this study. Membrane characterization is carried out by means of Environmental Scanning Electron Microscopy. After immobilization, it has seen the pores are filled up. The Model F-value of 16.73 implies that the model is statistically significant. The "Pred R-Squared" of 0.9010 is in reasonable agreement with the "Adj R-Squared" of 0.9077.
Comparison of BIRADS 4th edition and BIRADS 5th edition density scale for healthy breast images for estimation of mean glandular dose

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In this study, the variability in inter-rater reliability between assessments of mammographic density were investigated using the 4th and 5th edition of the BIRADS density classification scales, acronym: BIRADS 4th edition and BIRADS 5th edition.

BIRADS is the one of the method for reporting the mammography imaging systems. It is used for many parameters such as classification of breast density, identification of lesions etc. This study is only dealt with the classification of the breast density in healthy women. Breast density refers to the amount of fibroglandular tissue relative to adipose tissue (fat) in the breast. It is generally accepted that breast density assessment has in recent times been an important component of screening mammography reports and conveys information to referring clinicians about mammographic sensitivity and the relative risk for breast cancer. Because the amount of glandular tissue is linked to breast cancer risk. Therefore, an objective quantitative analysis of glandular tissue can aid in risk estimation.

In this study, 100 healthy female mammograms were evaluated with BIRADS 5th edition and BIRADS-4th edition, respectively. Firstly, the images are assessed on the basis of BIRADS 5th edition by a medical doctor as radiologist view. Then those images were classified on the basis of BIRADS 4th edition to estimate glandular tissue. To achieve this, an algorithm was developed in the MATLAB program in which an interface serves to estimate glandular and fat ratios of the breast. In this quantitative assessment, this MATLAB interface module gives results for the determination of the breast density. In this presentation, a comparison between the results classified as BIRADS 4th edition and those obtained from BIRADS 5th edition will be discussed in more detail.

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NA008

Electromagnetic performances of homogenous calorimeters with electron beams

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CHG3 is a scintillating fluoride glass with high density and it could be used as an active material of calorimeters in high energy physics experiments. This material has excellent optical clarity and relatively high refractive index. In this study, electromagnetic performance of such calorimeter made only with the scintillating material mentioned above is presented. Calculations were performed Geant4 simulation program. Incident electron beams with different energies were used to obtain linearity and resolution of such homogenous calorimeters.
NA009

Multilinear analysis of time-resolved laser-induced spectra of U(VI) containing natural water samples

VIŠŇÁK J. 1,2,3

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Natural waters uranium level monitoring is of great importance for health and environtmental protection. One of possible detection method is the Time-Resolved Laser-Induced Fluorescence Spectroscopy (TRLFS), which offers possibility to distinguish different uranium species (that is important since they have different sorption properties, mobility and requires different protection measures). Samples originate from Saxony, Germany and have been provided by Wismut GmbH company. They have been characterized by total elemental concentrations and TRLFS spectra. Uranium in the samples is supposed to be in form of uranyl(VI) complexes mostly with carbonate (CO$_3^{2-}$ and bicarbonate HCO$_3^{-}$) and to lesser extend with sulphate (SO$_4^{2-}$), arsenate (AsO$_4^{3-}$), hydroxo (OH$^-$), nitrate (NO$_3^{-}$) and other ligands. Presence of alkaline earth metal dications (M = Ca$^{2+}$, Mg$^{2+}$, Sr$^{2+}$) will cause most of uranyl to prefer ternary complex species, e.g. M$_n$(UO$_2^{2+}$)(CO$_3^{3-}$)$_3^{2n-4}$ ($n \in \{1;2\}$). From species quenching the luminescence, Cl$^-$ and Fe$^{3+}$ should be mentioned. Measurement has been done under cryogenic conditions to increase luminescence signal. Preliminary experimental study on cryogenic freezing influence on sample speciation is presented for a well-defined UO$_2^{2+}$ -SO$_4^{2-}$ system (room temp. TRLFS vs. cryo TRLFS).

Data analysis has been based on Singular Value Decomposition and monoexponential fit of corresponding loadings (for separate TRLFS spectra) and Parallel Factor Analysis (PARAFAC, all data analysed simultaneously). From individual component spectra, excitation energies $T_{00}$, uranyl symmetric mode vibrational frequencies $\omega_{gs}$ and excitation driven U-O$_{yl}$ bond elongation $\Delta R$ have been determined and compared with quasirelativistic (TD)DFT/B3LYP theoretical predictions to cross-check experimental data interpretation.
Quantum algorithms for computational nuclear physics revisited, particular case of second quantized formulation

VIŠŇÁK J. 1,2,3, VESELÝ P. 4 VEIS L. 2

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No core Full Configurational Interaction (NCFCI) calculations of Nuclear Bonding energy are resource demanding, in particular, computational time scales exponentially with the nucleon number A.

In contrast to that, usage of quantum computers would allow an efficient (in polynomial time) NCFCI calculation and speed-up for other beyond-Mean-Field (correlation energy including) methods.

To initiate feasibility studies of given quantum algorithms, we present a preliminary classical-computer simulation for the case of spherical nuclei (and 4He in particular) within NCFCI with realistic chiral NNLO_opt potential.
Ab initio study of physical properties of semiconductors radiation detectors

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II-VI semiconductor compounds are available fabrication of compound semiconductor radiation detectors of X-ray and Y-ray and optical applications. Our study, it is about Ab initio calculation of physical proprieties of materials from group II-VI compounds for found a relation between ab initio study and detection proprieties. We report ab-initio calculations of the structural, electronic, optical, elastic and dynamic properties of CdX and ZnX (X=S, Se, Te) and CdMnTe, CdZnTe alloys as a material using in radiation detector. Ab-initio calculations are based on the density functional theory (DFT) with in the generalized gradient approximation (GGA) and Local density approximation (LDA) implemented in the Abinit package. The obtained results of lattice parameters, bulk modulus, Band structure, linear optical functions, elastic constant and dielectric constant showed reasonable agreement with the previous results of other calculations and experimental measurements.

This research is an overview of different results of physical properties of some suitable materials which help researchers to realize good detectors, optical devices and solar cells, and in other hand to find new semiconductors materials in it.
Measurement of resonance productions at high energies with the ALICE detector at the LHC

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Resonances are extremely short lived particles (τ ~ 10^{-23} s) which makes them to be a significant probe to understand the evolution of the medium created in high energy nuclear reactions. Different than other particles the medium modifies their properties such as mass, width and yield. Studying such resonance properties provide information about the medium effect on resonance production mechanism. In addition, measurement of resonances in different high energy reactions allows understanding possible system size dependency of their production. For this purpose, resonance productions in different high energy collisions are studied with the ALICE detector at the LHC. In this talk, the recent ALICE resonance results in pp, p-Pb and Pb-Pb collisions at LHC energies will be presented.
The HVL value measurements of the cone beam CT (CBCT) kV beam using ionization chamber, diode and gafchromic XR-QA2 film

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The aim of this study was to establish the HVL measurements data acquired from the x-ray Volumetric Imager (XVI Elekta Synergy Systems) and On Board Imager (OBI Varian Medical Systems) Cone Beam Computed Tomography systems using ionization chamber (IC), semiconductor diode (SD) and GafChromic XRQA2 film and to compare measurements provided by IC and SD instruments and XRQA2 films for assessing agreement between the methods.

We also investigated the influence of the collimator diameters on the measurements. We applied two methods of HVL measurement in 120kVp x-ray beam from an Elekta Synergy linac: the ion chamber tip was oriented horizontally and than vertically to the radiation beam to determine the consistency between the two sets of data.

The measured HVLs for all investigated beams are in good agreement within the statistical and experimental uncertainties. HVLs measured using ionization chamber and different collimator sizes varied up to 1.2 %. However, the variation was up to 5.8% when chamber tip and chamber horizontal methods were used. The percentage difference of the HVL values measured using the diode and ionization chamber ranged between 5.8% - 10.8% compared with 6.6% - 10.1% when HVLs measured using Gafchomic film and ionization chamber.

Ionization chambers, semiconductor diodes and Gafchomic films can be used to measure HVLs of photon beams with variations in HVL values of up to 10%. The effect of using different detectors on the measured HVLs seems to be stronger than the effect of collimator sizes and the chamber orientation with respect to the beam.
Investigation of new-generation digital electronic, NUMEXO2 for gamma ray spectrometer EXOGAM2

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In this study, we will present the current status of newly developed digital electronic namely NUMEXO2 for gamma-ray spectrometer EXOGAM2. The design and results of the FADC mezzanine for the EXOGAM2 (EXOtic GAMma array spectrometer) which is going be used for high efficiency gamma-spectrometer for exotic nuclei spectroscopy using exotic radioactive beams at GANIL (Grand Accélérateur National d’Ions Lourds, Caen, France). We will present the results from a test experiment performed at GANIL using NUMEXO2 with EXOGAM2 detectors in order to determine the dependency of energy resolution regarding the K-parameters of NUMEXO2.
Performance of PARIS phoswich: linearity, efficiency, energy resolution and time response

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In order to determine the performance of PARIS phoswich detector a proton capture reaction $^{11}\text{B}(p,\gamma)$ and different radioactive sources were used. During this experiment to determine the performance of PARIS phoswich in term of its linearity, efficiency, energy resolution and time response CAEN digitisers V1720 and V1751 were used, both data, using radioactive source and nuclear reaction examined for low and high energy gamma-rays respectively. Both analog and digital electronic CAEN digitiser were also compared during this experiment. Comparison of both electronics and determined results of PARIS phoswich detector in terms of its linearity, efficiency, energy resolution and time response will be presented.
Correction of the pulse pile-up reject and the pulse pile-up for gamma ray spectrometry

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Three corrections are important in measurements from gamma ray detectors: Dead time correction, pile-up pulses correction and rejected pile-up pulses correction. Correcting the dead time from these corrections is well known and frequently performed. However, corrections to the pile-up pulses that significantly affect the spectrometric analysis accuracy and the pulses rejected by the pile-up rejection circuit used to prevent these pulses are not known. There are only a few studies available in the literature on the pulse pile-up correction. However, it is annoying and time consuming to implement these correction methods. That is, there is no practical correction method in the literature. In addition, there is no method for correcting the pulses rejected by the reject circuits. Recently, studies on these last two corrections have been made. In this study, a practical pile-up and rejected pulse correction methods are proposed. These proposed methods have been experimentally tested on a marble sample. Experimental studies were carried out on the determination of the mass reduction coefficient of a marble sample using $^{60}$Co and $^{137}$Cs radioactive sources.
Standard source preparation from cellulose matrix for the detection efficiency measurement used for the analysis of environmental samples

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In recent years, the samples having low-level activity are measured preferably in the close-counting geometry in HPGe gamma-ray detectors to obtain more accurate results in a reasonably short measurement period because this close counting geometries provide high detection efficiency. This needs to determine precise efficiency calibration for different counting geometries. To achieve this, the reliable way is to employ the calibrated standard sources.

In this study, in-house gamma-ray calibration sources were prepared with use of cellulose matrix with low density. A cylindrical geometry(80-120 ml) and Marinelli beakers (500 ml) filled with cellulose matrix mixed with OKA-2 powder containing decay products of $^{232}$Th, which are suitable for detector calibration in a wide energy range from 120 keV to 2614.5 keV. As powder form, $\text{K}_2\text{CO}_3$ for $^{40}\text{K}$ (1460.8 keV) was also mixed homogenously with cellulose matrix by using a suitable laboratory mixing apparatus.

The homogeneity of the produced in-house gamma-ray sources was tested in a 5ml glass ampoule and 6ml vials in the well of a p-type HPGe detector with a 44.8% relative efficient. The homogeneity is found to be better than 98.5%. The characterization of a relatively larger in-house sources filled in a cylinder and Marinelli-type (re-entrant) beakers were performed by using an n-type 78.5% relative efficient coaxial HPGe detector.

For the efficiency calibration curves, experimental data obtained the certified multinuclide source were checked by using efficiency transfer functions. As a result of the work, the chosen matrix of cellulose due to their low atomic number, low densities and other physical properties such as better homogeneity and stability are suitable for representing the environmental samples.

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Ever increasing collision energies in current and future colliders demand for radiation hard calorimeters. Calorimeters based on secondary electron emission process from dynode metals was proposed in 1990s as radiation hard alternative to overcome this difficulty. Since the discovery of secondary emission of electrons from metal surfaces, there has been many approaches to quantify this process by using semi-empirical models, including Monte Carlo studies. These Monte Carlo studies, however, usually do not include secondary emission process as a part of physics, governing the shower development and the probabilistic nature of the emission process. In this study, we present a Geant4 calorimeter simulation based on a newly developed physics class, which was derived from a probabilistic approach found in the literature. By developing this Physics class inside Geant4 we were able to determine the yield and energy spectrum of secondary emission electrons from metal surfaces. We were also able to determine the calorimeter response to energetic particles by using the showers they create inside the calorimeter layers consisting of dynode structures. We first provide a comparison between data and simulation of a thin foil for the yield and secondary electron energy spectrum. We then give response, linearity, and resolution for a generic sampling calorimeter based on a secondary emission electron process together with results from a scintillating sampling calorimeter for comparison.
Simulation results for novel gamma probe based on silicon photomultipliers

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Radionuclides, when used hand-held probes, play a very important role to diagnose and localize sentinel lymph nodes and tumors. Information from a hand-held probe system to differentiate benign and malignant lesions is shown to improve the success of resection of affected nodes. Today, there are numerous gamma-probes in the market, which differ from each other based on detector and collimation types, and performance parameters (e.g. spatial and angular resolution, sensitivity).

Sensor unit used in gamma probe contains a gamma sensitive material (either a scintillation crystal or semiconductor ionization detector), photo-detector (if scintillation detector is used), amplifier, and associated electronics. The control unit provides visual and audible information for the counts, as well as the status and type of the probes used.

In this study, a complete Geant4 and SPICE electronics simulation and development and of a new gamma-sensitive probe with silicon photo-multipliers based on electronic collimation will be presented. The general of the simulation is to develop and test a new gamma-sensitive probe with electronic collimation capable to detect 511 keV and 140.5 keV gammas from PET radiotracers and metastable nuclear isomers, to be used in radio-guided surgeries.
SiPM readout tests for decay spectroscopy detectors

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This study includes performance tests of the SiPMs used in decay spectroscopy detectors. Bismuth Germanate (BGO) inorganic crystal with an edge length of 4.6 cm with a 5 cm thickness and uniform hexagonal geometry was used as an active material. The surface of this crystal is covered with varying number of SiPMs having 6 x 6 mm² active sensitive area. From this detector, analysis of γ spectrum were performed for ²²Na radioactive source. It was found that, the energy resolution of detector corresponds to less than 30% for 1 MeV per crystal by using only five SiPMs. In addition, the detector efficiency and background signal threshold studies were performed.
ESR and microbiological analysis of gamma irradiated grape seeds

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Food frequently undergo a microbiological contamination resulting in the increased content of various microorganisms and their spores. To eliminate serious health risks, as well as to prolong the shelf-life of these products, the $\gamma$-irradiation treatment is accepted as a standard and safe sterilization procedure. Electron Spin Resonance (ESR) spectroscopy is a significant and unique technique that can analyze paramagnetic centers directly in irradiated food samples.

In this study gamma irradiation effect on grape seeds were investigated by ESR spectroscopy. The powdered samples were irradiated by $^{60}$Co gamma rays between the 3 kGy-12 kGy radiation doses. ESR spectra were recorded using JEOL JesFa-300 X-band ESR spectrometer located in Selcuk University Advanced Technology Research and Application Center ESR Laboratory. ESR parameters of $\cdot CH_2$ radical, used as a marker for detection of irradiated cellulosic plant products, have been calculated. Dose dependency and stability of the satellite peaks related with $\cdot CH_2$ radical and central peak related with semiquinone radical were both investigated by dose response and kinetic measurements. Furthermore, microbiological analysis was performed to determine the effect of radiation on bacteria inactivation.
Synthesis of Ni-based alloys for nuclear power stations via electrophoretic deposition

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Nickel-containing heat and corrosion resisting alloys play an important part in ensuring the integrity, durability and long-term performance of nuclear power stations. They are used in the heat transfer and cooling systems as well as in the reactor vessel internals. They are incorporated in new designs as well as being retrofitted during refurbishment.

In this study, Nickel-Boron-Hexagonal Boron Nitride (Ni-B-hBN) plating was successfully deposited on st-37 low carbon steel applying current of 50 mA/cm² in Watt’s type solution. The synthesis processes of Ni-B films were carried out under chronopotentiometric condition from different hBN concentration (1, 2, 3, 4, 5 g/l) containing 45 g/l NiSO₄ solution. Cyclic Voltammetrical (CV) study was realized for the control and examine the deposition conditions. CV graphs clearly show that Ni-B-hBN plated steel electrode was strongly adherent homogeneous characteristic.
NA023

Cyclic voltammetric investigation of high corrosion and heat resistant Ni And Ni-B alloys for nuclear systems

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Nickel is an element that can be alloyed with a variety of elements such as: iron, chromium and cobalt having a high solubility. Ni-based alloys are used in several industrial applications gas turbine parts, medical applications and nuclear systems, which mainly solve wear resistance, corrosion and thermal fatigue problems. These features lead the development of new Ni-based alloys with mechanical properties that prolong the lifespan.

In this study, pure Nickel and Nickel-Boron- plating was successfully deposited on st-37 low carbon steel applying current of 50 mA/cm² in Watt’s type solution. The deposition processes of Ni and Ni-B films were carried out under chronopotentiometric condition from 240 g/l NiSO₄.6H₂O, 45 g/l NiCl₂. 6H₂O, 30 g/l H₃BO₃, 3 g/l TMAB containing electrolyte. Cyclic Voltammetrical (CV) study was realized for the control and examine the deposition conditions.
Nickel-based alloys are widely used in the energy industry. Nickel-based alloys and composites, especially those containing boron and its compounds, are highly suitable materials for nuclear power plants. Ni-B alloys are a material with remarkable properties such as high hardness, high abrasion resistance and good anti-corrosion. hBN is a very useful material in terms of engineering applications due to its superior tribological, inertness and high temperature properties.

In this study, Ni-B alloy and Ni-B/hBN composite coatings were produced by electro-deposition technique on st-37 steel substrate. Coatings were obtained at constant current density of 50 mA/cm² and time was limited for 60 minutes. The temperature is set at 43±1°C. A traditional Watts type nickel bath was used and trimethylamine boron (TMAB) was used as the boron source. The potential change (chronopotentiometer) graphs obtained during the production of the films were examined. As a result of the studies, the coatings that have high adhesion, compact and smooth properties were obtained. It has been observed that when the concentration of hBN in the bath increased, the potential value that necessary for deposition increased.
Morphological studies of Ni-B/hBN composite coatings which can be used in nuclear systems

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Ni-B alloys are used in many industrial areas such as automotive, nuclear and petrochemical due to its high hardness, abrasion resistance and corrosion resistance, Hexagonal boron nitride (hBN) is a ceramic material with properties such as high thermal conductivity, high electrical resistance, high temperature resistance, chemically inertiess, superior tribological and anti corrosion.

In this study, Ni-B/hBN composite coatings have been produced using electrodeposition technique by reinforcing Ni-B matrix with hBN particles on st-37 low carbon steel substrate. The Watts type nickel bath consist of 240 g/l NiSO₄.6H₂O, 45 g/l NiCl₂.6H₂O, 30 g/l H₃BO₃, 3 g/l trimethylamine borane (TMAB), 0.5 g/l sodium dodecyl sulfate (SDS), 2 g/l saccharin components. hBN particles were added to the bath at different concentrations and their morphological characteristics were examined by scanning electron microscopy (SEM). Also, electroplating baths were mixed with ultrasonic waves for 30 min before deposition. According to the obtained results, the surface of composite coatings is very smooth and compact. And it was observed that the coatings adhered strongly to the substrate.
Properties of candidate structural reactor material, BN composites

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In the nuclear energy research, materials with enhanced performance play a central role. While nuclear reactors have been in operation for several decades, the structural materials need to endure much higher temperatures, higher neutron doses, and extremely corrosive environments, which are beyond the experience on materials accumulated to-date. Based on material development advances, composites, and in particular ceramic composites, seem to inherently possess properties suitable for key functions within the operating envelope of reactors.

In this study, BN, is one of the candidate composites, have been produced in Eskisehir Osmangazi University. Some of the properties of BN composites have been researched.
Some electrical parameters of the Sn/p-Si diode under $\gamma$-irradiation

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The radiation response of metal-semiconductor (MS) contacts has been found to alter significantly when the structures are exposed to pre-irradiation processes at determined doses. Radiation doses greater than a kilogray exposure may cause strong changes on the electrical characteristics of MS structures. It has been also shown that the particle or gamma irradiations induce defects in the band gap which affects the free carrier concentration and leads to an increase and decrease of barrier height in p-type and n-type semiconductors, respectively. The knowledge of the influence of radiation damage on the Schottky barrier diodes (SBDs) performance is a fundamental field of research, having technological relevance for many applications in the semiconductor electronic devices. Hence, it is very much essential to evaluate the effect of irradiation and identify the degradation mechanism to understand the failure mechanisms.

In this work, we have investigated the electrical parameters of the Sn/p-Si Schottky barrier diodes by using I-V and C-V characteristics under $\gamma$-irradiation at room temperature. The basic diode parameters such as ideality factor, barrier height, series resistance and reverse saturation current were extracted from electrical measurements as a function of the irradiation dose. The results indicated that $\gamma$-irradiation induced an increase in the effective Schottky barrier height extracted from both I-V and C-V measurements. Also, it was seen that ideality factor increased with the increasing $\gamma$-irradiation doses. We have also observed that the reverse bias current of the Sn/Si contact exceedingly decreased with increasing irradiation dose with low energy (60 keV). The basic results as related to the gamma irradiation have been indicated that this device may have applications as radiation sensors in order to detect the low energy gamma radiation.
High-energy radiation penetrates the metal-semiconductor (MS) interface and causes damage deep below the interface. Low-energy radiation causes severe lattice damage in the form of vacancies, interstitials and defect complexes at the near interface of the device. The one kind of the radiation is electron beam which is accelerated. Mills was the first to recognize that electrons with energy of 1 MeV would possess enough energy to displace an atom from its lattice position. This observation has led to the increased use of electron accelerators in radiation damage studies. This use has been motivated by two important facts. First, electron bombardment experiments permit the determination of the energy required to remove an atom from its initial position. This is done by increasing the energy of the electrons until an observable change in a radiation-sensitive property is seen. The second important basis for the use electrons lie in the fact that as long as the energy of the electrons is close to the displacement threshold, it is presumed, that only single Frenkel pairs are formed. Thus, many radiation-induced phenomena can be analyzed in terms of a single vacancy and/or interstitial atom, and one avoids the complication attendant upon the generation of complex damage regions presumed to occur in heavy-charged particle irradiation.

In the present paper, a lead/rhodamine-101(Rh101)/p-Si metal/organic interlayer/ semi-conductor diode was fabricated and the effect of 6 MeV-electron irradiation on the electrical characteristics of the diode structure was investigated. It was seen that after electron irradiation the barrier height values, the series resistance values and ideality factors increased. Furthermore, it was seen that the capacitance values increased after electron irradiation. This was attributed to the change in dielectric constant at the interface and/or to decrease in the net ionized dopant concentration and the interface states. The degradation of the diode properties may be due to the introduction of electron irradiation-induced interfacial defects via displacement damage.
Water and paraffin as shielding material

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In this study, mass absorption coefficients were obtained by using water and paraffin as shielding material for the gamma rays in different energies. The obtained experimental and theoretical results are interpreted with graphics. The result is that water and paraffin are good shielding materials.
NA031

Measurement of shielding effectiveness of autoclaved aerated concrete for its use in diagnostic x-ray facilities and industrial facilities

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In this study, radiation shielding effectiveness of AAC as building material were determined using a standard gamma-source, namely ISO s-Cs (0.662 MeV) and diagnostic x-ray beams with max. of 80kVp and 100 kVp. In the latter, the inherent filtration of the used x-ray tube was adjusted to simulate the diagnostic x-rays. Two different irradiation setups (8.58 Ci ¹³⁷Cs source, Hopwell Design Inc. USA and max.150 kVp X-ray tube, GE medical systems) and the calibrated measurement device such as ion chambers (PTW Freiburg GmbH, 28 cm³) and electrometers (UNIDOS) were used in shielding measurements for this purpose. Under identical beam conditions, the transmission values were determined from air kerma values with increasing thicknesses of AAC blocks interposed between the source and the detector. The shielding effectiveness was estimated to be as half value layers (HVL) of 345.6mmAAC equal to 6.86mmPb in thickness of the material. This HVL value is found to be 38.5mmAAC(=0.13mmPb) for 80kVp and 46.21mmAAC(=0.16mmPb) for 100kVp x-rays. This result is very interesting for AAC because it contains high amount of air and has cellular structure. To understand the reason for this property of the AAC we have made an elemental analysis by using SEM-EDX, according to the analysis result AAC contains 48.25% O, 28.4% Ca, 17.3% Si, 1.5% Al and 1.4% Fe in weight. The present study suggests that autoclaved aerated concrete can safely be used alone for indoor walls of diagnostics x-ray facilities when their Pb equivalent values are compared to that of NCRP 147 Report for their use in medical facilities.
Lantanide group elements are very important role for industry such as phosphorescent materials, catalyst, iron and steel industry. Therefore, it is important that lanthanum or other lantanide elements adsorption and desorption processes. Bastnasite and monazite mines contain rare earth elements (REEs) such as lanthanum and cerium besides thorium element and these mines constitute the majority of the REE source in the world. Especially bastnasite is found in abundance all over the world and it is very important from economical point of view that it can be processed. Lanthanum toxicity is still low, but continuous accumulation into the environment may cause health-related problems. In addition, the recovery of lanthanum is still largely unexplored. It is, therefore, crucial to find relatively cheap technologies for its removal and recovery.

A number of technologies have been used for separation and pre-concentration of REEs, such as co-precipitation, ion exchange, and solvent extraction. However, most of them have the disadvantages such as secondary pollution, inefficiency, and high operational cost. Therefore, adsorption has been considered as one of the best methods due to its non-toxicity, reusability, ease of operation, and the abundance of adsorbents in nature. The effluent of Lanthanum-containing wastewater discharged from industrial factories will contaminate the environment and bring danger to human health. Therefore, the recovery and separation of lanthanum become extremely important with the development of industries.

In this study, the effects of initial solution concentration, pH, temperature, adsorbent dosage and contact time on adsorption of La (III) ions on magnetic nano graphene oxide have been investigated in detail. It was shown that the maximum equilibrium uptake capacity of La (III) on MNGO was 42.5 mg/g (0.31 mmol/g). Thermodynamic parameters were calculated and evaluated. This study provided a rapid route to pre-concentrate or separate La (III) in separation processes.
The dependence on the energy and its use has increased in every country due to the increasing population and advanced technology. As a result of it, the reserves of fossil fuel have decreased, several energy crises have occurred from time to time and the alternative energy sources have been on the focus. One of these alternative energy sources is nuclear energy. The nuclear power plants, which were built in order to get nuclear energy, have attracted the attention thanks to some disadvantages such as its high cost and emission of radiation while they do not radiate harmful gases towards environment. The nuclear power plants that have already been and are planned to be constructed by a number of countries have become problematic because of the power plant accidents. On one hand, some countries have abandoned the nuclear power plants owing to the accidents mentioned above, on the other hand some other countries have continued to operate the nuclear power plants by claiming the necessity to meet the increasing demand on energy. It is seen that conflicts and problems experienced in the geography in which Turkey is located impacts the energy security of Turkey and it is understood that this situation may have a negative influence on national security of Turkey. Because of all these reasons, actualizing nuclear energy projects are important for Turkey which is dependent in respect of energy.
The energy supply security, caused by the energy dependence of the countries in the process of economic growth, the increase in production costs and the environmental problems related to greenhouse gas emissions led to the energy efficiency becoming important. In particular, the increasing share of energy consumption of BRICS (Brazil, Russia, India, China, South Africa) countries, which characterize the group of countries that are in the fastest growing and emerging economies and the fact that nearly 35% of the world's energy consumption belongs to these countries bring about the debate in question how efficiently these countries use energy. Considering that Turkey is also rapidly growing and emerging economy and 72% externally dependent on energy input, its place among BRICS countries in terms of energy efficiency gains importance. Examining the studies to measure energy efficiency, it is seen that the share of energy consumption in national income is considered as energy efficiency indicator. However, this is not homogeneous indicator for countries with different economic size, geographical location and population structure. For this reason, with the Logarithmic Mean Divisia Index method, considering the differences in national income and industrial structure among the countries, it is aimed to obtain intensity effect which makes it possible to compare the countries homogeneously by decomposing the production and structural effects from the changes in energy consumption. With this method, it is aimed to compare the real energy efficiency in the industrial sector of Turkey in the period of 1990-2014 with BRICS countries in a homogeneous manner and to make policy proposals for increasing energy efficiency.
ES003

An evolution of shale gas in terms of economics and environmental problems: A discussion paper

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Along with the oil crisis that took place in the 1970s, energy-dependent countries have begun to focus on energy supply security and have diversified their energy supply sources. In this period, serious increases in the energy prices and fact that exporting countries go to retrenchment in the energy supply made the importing countries in a difficult situation. As the world's largest producer and importer of energy, the United States has begun to focus on shale gas, an unconventional source of energy, and especially since the beginning of the 2000's, it has reached considerable quantities in the production of natural gas derived from shale gas. With this development, natural gas prices in the United States have become respectively three and five times cheaper compared to EU and Japan, and greenhouse gas emissions have fallen to the level of the early 1990s. This situation brought about the debate in question that shale gas which was shown among alternative energy source could be a solution to economic problems caused by increase in the naturel gas prices and to environmental problems caused by greenhouse gas emissions. The report, published by the US Department of Energy Information Office in 2013, shows that shale gas reserves were found in 41 countries, including Turkey. In this relevant report, it is stated that Turkey, which is dependent on foreign gas by 98%, has 4.6 trillion cubic-meters reserves of shale gas, of which about 650 billion cubic-meters are at a producible level. In recent studies on increasing energy efficiency, it is asserted that starting to assess shale gas reserves which was given in the report will be a solution to the environmental problems arising from the consumption of primary energy resources and to the increases in natural gas prices which reduce international competitiveness, particularly effecting energy dependence countries. In this context, this study aims to investigate the possible effects of starting the production of shale gas reserves in the World and Turkey on resolving of rising energy prices and environmental problems and to evaluate their impact on the economy of countries.
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