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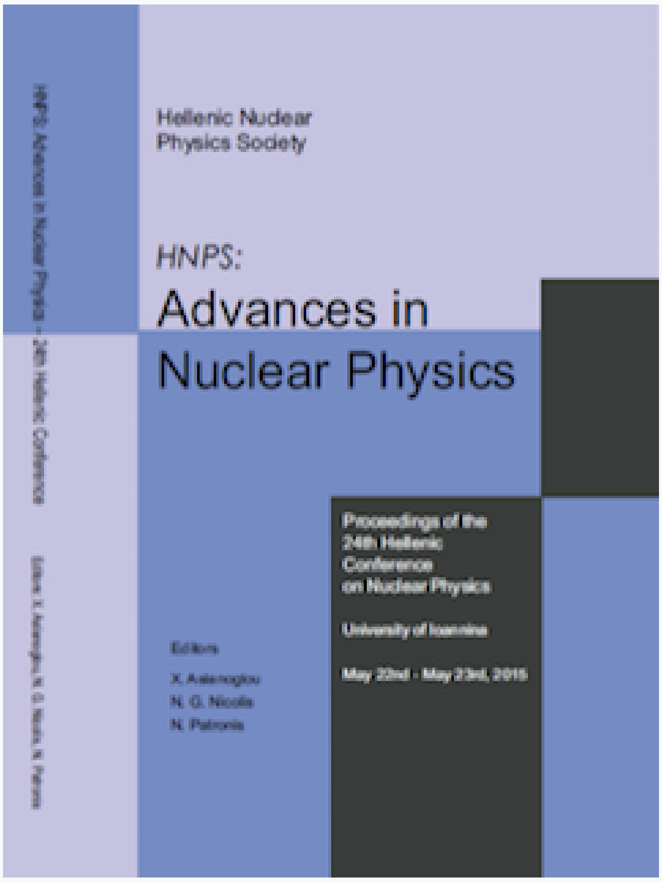

Aggregate abstracts-only section (multiple authors)

Abstracts only no papers submitted

Proceedings of the 24th Syposium of the HNPS

Study of capture reactions in inverse kinematics relevant to nuclear astrophysics*

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The term *p* process refers to the process that describes the formation of the so-called "*p* nuclei", 35 stable, heavier than iron, neutron deficient nuclei. The synthesis of the *p*-nuclei proceed by a sequence of *(γ,p), (γ,n), (γ,α)* and the inverse *(p,γ), (n,γ)* and *(α,γ)* reactions along with *β*+ decay and Electron Capture. There are various nucleosynthetic scenarios describing the production of the *p* nuclei however, in most cases, the theoretical and the observed abundances present significant discrepancies that necessitate the review of not only the astrophysical assumptions involved in the *p*-process modeling but also the reaction rates involved in the reaction network. Due to the huge number of reactions involved in this network *p*-nuclei abundance calculations have to rely on the predictions of the Hauser-Feshbach (HF) theory. It is therefore necessary to check the predictions of HF theory and specifically the reliability of the nuclear parameters entering the HF calculations, i.e., the nucleon-nucleus and the nucleus-nucleus Optical Model Potential (OMP), the Nuclear Level Densities (NLD) and the γ-ray Strength Function (γSF). Under these conditions, systematic cross-section measurements of *p*- and *α*-particle capture reactions at energies between 1 and 3 MeV/u are necessary. To achieve this goal, there exist different approaches, amongst which the *(p,γ)* and *(α,γ)* measurements at sub-Coulomb energies in inverse kinematics using state-of-the art detectors combined with modern recoil-mass separators is very transparent and, from the experimental point of view, a challenging one.

In order to perform cross-section measurements, the knowledge of the efficiency of the setup is essential. This work aims at the determination of the efficiency of the Wien Filter, the velocity filter mounted at the LISE3 setup [1] of the Grand Accélérateur National d'Ions Lourds (GANIL) in Caen, France. To accomplish this we need to measure in inverse kinematics a well-known reaction using the LISE3 setup. The ratio of the cross-section values given in literature for the selected reaction to those that will be obtained using the LISE3 apparatus is equal to the requested efficiency.

Among all the beams that can be provided at GANIL, ^{58}Ni at 5 MeV/A was chosen to be the primary beam because of the fact that at this energy ^{58}Ni has been studied for both the *(α,γ)* and *(p,γ)* reactions. In addition, preliminary simulations, performed by means of the *LISE*++ (version 9.9.3) [2] and the *ZGOUBI* (version 5.1.0) [3] codes, indicated that with the use of the LISE3 setup the primary beam will be separated from the produced ^{62}Zn and ^{59}Cu nuclei.

* This work is supported by KRIPIS Grant (MIS 448332)

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The UoA online database for nuclear electromagnetic moments data: Status and perspectives *

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An existing online database of nuclear electromagnetic moments [1], i.e. dipole magnetic and electric quadrupole moments has been recently upgraded and enriched with the most recent experimental data available. The database is now an official part of IAEA's Livechart [2] earning worldwide status.

Old and new features of the database, such as spectroscopic data, experimental values of nuclear electromagnetic moments, bibliographic data and information on experimental techniques will be presented. Additional operational features of the database, as well as future prospects for making the database more accessible and user-friendly will be discussed.

A Prospect to Nuclear Reactor Neutrino Detection via the Coherent Scattering with the Spherical Proportional Counter

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Abstract

Nuclear Power Reactors are the most powerful neutrino sources as they emit large numbers of antineutrinos, at energies up to 10 MeV. The reactor neutrino detection is very important for fundamental physics goals, as well as for applications, among them being the possibility to determine the isotopic composition of the reactor's core. This could lead to application of neutrino spectroscopy for reactor monitoring, either for improving the reliability of operation of power reactors or as a method to accomplish certain safeguard and non-proliferation objectives. We present here the possibilities on detecting neutrinos coming from nuclear reactors with the Spherical Proportional Counter (SPC), by exploiting the coherent neutrino-nucleus elastic scattering. Two big problems are associated with the neutrinos coherent-nucleus scattering: the very low energy of the recoil nucleus and the background signals in the detector.

On the Validation of Charged-Particle Differential Cross-Section Data at Low Energies

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The implementation of all Ion Beam Analysis (IBA) depth profiling techniques critically depends on the accuracy of the available differential cross sections for the reactions involved. Unfortunately, the existing experimentally determined differential cross-section data are in many cases quite scarce and/or discrepant, thus their reliability is highly questionable. On the other hand, the evaluated cross-sections, when available, are the most reliable ones to be used in analytical studies, since they involve a critical assessment of the experimental datasets, followed by a proper tuning of the corresponding nuclear model parameters. However, it is important to point out that most of the evaluated datasets are still not adequately validated. A carefully designed benchmarking experimental procedure (i.e. the validation of differential cross-section data via the acquisition of thick-target spectra followed by their simulation) is thus mandatory. Benchmarking can also provide the necessary feedback for the adjustment of the parameters of the nuclear model used in the evaluation process, and can help in assigning realistic uncertainties to the cross sections. Moreover, in the absence of evaluated cross sections, it can indicate recommended experimental datasets.

Recently, a dedicated effort was made to thoroughly document this procedure [1], followed by a technical meeting organized by IAEA. In the present review an attempt is made to present the recommended steps and to critically assess the problems of the benchmarking process in the following cases: (1) In $^{nat}Si(p,p_0)$, for E_p=1.5-3.5 MeV, where channeling perturbations in crystalline wafers, if not carefully treated, can seriously affect the accuracy of the measurements, while the size of the powder used in pressurized tablets can affect the shape of resonances in the experimental thick-target yield spectra, (2) in $^{19}F(p,p_0)$ and $^{nat}B(p,p_0)$, for E_p=1.5-2.5 MeV, where, for the removal of the important underlying α-particle background, DE/E telescopes have been implemented, and (3) in $^{nat}O(p,p_0)$, for E_p=1.5-4 MeV, where target related effects (e.g. roughness) need to be taken into account.

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Neutron spectrum determination of a sub-critical nuclear reactor by multi-disc neutron activation technique

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The neutron spectrum of the sub-critical nuclear reactor of Aristotle University of Thessaloniki was measured in three radial distances from the reactor core. The multi-disc neutron activation technique was applied. Fifteen elements have been irradiated and 40 reactions in total (n,γ), (n,p) and (n,α), were determined in each position. Due to the relevant low neutron flux, discs instead of foils were used, so the gamma self-absorption factors had to be calculated for the gammas lines used to determine the induced activity of the discs. The specific activities calculated for all the isotopes were the input to the SANDII code, which is provided by NEA Data Bank and it was built specifically for the neutron spectrum de-convolution when neutron activation technique is used. For the optimization of the results a technique was used to minimize the influence the initial spectrum shape which SANDII uses.

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Theoretical investigation of the ^{19}F(p,p_0) differential cross section up to E_p=2.3 MeV

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Elastic Backscattering Spectroscopy (EBS) is one of the most suitable IBA techniques for light element detection and depth profiling. The implementation of the technique depends mainly on the availability and accuracy of the existing corresponding differential cross-section data. A compilation of all the available experimental cross-section values is found in IBANDL, along with evaluated data provided by SigmaCalc.

Concerning fluorine analytical studies, the corresponding experimental data are quite inadequate and discrepant, proving the significance of the evaluated values, which provide the most reliable data being produced by the incorporation of the available experimental cross sections within a unified theoretical approach. The present work contributes in this field by reproducing and extending the corresponding evaluation for ^{19}F(p,p_0), which ranges up to 1730 keV, to proton energies at 2250 keV, using the AZURE code. The performed R-matrix calculations involved the simultaneous analysis of several input datasets, as well as spectroscopic information concerning the formed compound nucleus ^{20}Ne, while valuable feedback information was provided by proton benchmarking spectra on ZnF_2 taken at E_p=1730 and 2250 keV for the fine tuning of the parameters used. The problem of the ^{19}F(p,p′) and ^{19}F(p,α_x) contributions in the obtained thick target yield spectra is also discussed.

Radon migration in soil and its relation to terrestrial gamma radiation

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Radon concentration as function of the soil depth (0- 2.6 m) was measured during the years (2002-2003), (2003-2004), (2010-2011), (2011-2012) and (2014-2015) in a location of the Aristotle University campus. Radium distribution in soil was found constant. On the contrary, as expected, radon concentration increases with soil depth. However, radon concentration does not follow the well known monotonous increase, which levels off to a saturation value. Radon concentration increases up to a soil depth of about 80 cm, seems to remain constant at depths of 80-130 cm and then increases again. The experimental distribution was reproduced by solving the general transport equation (diffusion and advection). The main finding of the numerical investigation is that the aforementioned, experimentally observed, profile of radon concentration can be explained theoretically by the existence of two soil layers with different diffusion-advection characteristics. Soil sample analysis verified the existence of two different soil layers. The equivalent diffusion coefficient could be uncovered from the experimental profile, which can then be used to estimate the radon current on the surface of the soil (radon exhalation).

The radon exhalation was directly measured during the years 2010-2011 , 2011-2012 and 2014-2015. About 100 measurements were performed .The direct measurement of mean radon exhalation is in reasonable agreement with the (mean) one deduced indirectly from the experimental profile. The radon concentration at the soil surface is an important parameter . It may influence the gamma dose rate measurements performed 1 meter above soil by the gamma radiation early warning devices. Two different boundary conditions of the radon concentration at the soil surface were used for the solution of the diffusion-advection equation . It was found that the calculated radon concentration in the soil, away from the soil surface, is the same for the two boundary conditions used . However, the usually used boundary condition of zero radon concentration at the soil surface $I(0) = 0$, cannot deduce from the experimental profile the radon concentration at the soil surface. On the contrary, with the use of a more appropriate boundary condition , the radon concentration at the soil surface could be deduced from the experimental profile.

A previously reported (Szegvary et al ,Atmos. Environ. 43,1536,(2007)) radon flux map of Europe used terrestrial gamma radiation extracted from automation monitoring networks. In the present study we investigated the correlation between gamma radiation 1 meter above soil due to soil radon progeny and radon exhalation in 4 locations of the Greek early warning system network.

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Preliminary analysis of in-situ radioactivity measurements in the south Caspian Sea

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Caspian Sea is the largest closed marine compartment on Earth, with a surface area of around 380,000 km^2 and a volume of about 78000 km^3. The formation of Caspian Sea is possibly due to the Tethys Ocean that was made landlocked 5.5 million years ago from the plate tectonics and their movement. This Sea is sourrounded by five countries (Russia, Azerbaijan, Iran, Turkmenistan and Kazakhstan) and it is devided in three compartmets: North, Middle and Sourth Caspian Seas. In this work the KATERINA [1] system was used for studying the current status of the radioactivity levels in the seawater and in the seabed in the compartment of the South Caspian Sea. The system was calibrated before the deployment according to methodologies for in-situ quantitative measurements [2, 3]. In order to analyse the convoluted peaks of natural radioactivity (e.g 609 and 583 keV), the acquired spectra are analysed using deconvolutions algorithms which are incorporated in the SPECTRW software [4]. The preliminary analysis exhibits enhanced levels in seawater and in sediment due to Uranium (radium / radon) and Thorium progenies as well as due ^{40}K, originating from the Natural Occuring Radionuclides Materials (NORM). The data are interpreted taking into account gas hydrates phenomena as well as the oceanographic regime of the south Caspian Sea.

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Integrating the radiological impact assessment in all life organization levels by an innovative tool based on nuclear applications and cytogenetic observations

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The environmental quality assessment is a complicated issue usually faced by different viewpoints depending on the pollutants and focused on anthropocentric approach. Besides, the synergism of the several environmental stressors can be not reliably estimated, as the apportionment of each pollutant is approximated at the monitoring level (the dose rates are also based on the pollutant levels of the environmental components either abiotic and organisms), whereas the eco-centric approach, posed combatively by ecologists, are neglected, because of the excessive cost. Therefore, a comprehensive but harmonized tool for the evaluation of the good environmental status, either for humans' and non-humans' welfare is an urgent need under the nowadays challenges of environmentalists, as the lack of the appropriate information usually results to overestimation of the technological risk assessment. This tool must be flexible, sensitive with its science-supported mechanism good enough popularized.

The concept of this scientific challenge is based on the development of a new methodology of combined research disciplines to a harmonized tool for the radiological quality assessment and evaluation of the consequent risk by use of real time radioactivity measurements and biological cytogenetic observations in the various levels of life organization. Several disciplines supporting the innovation in radiation protection, such as laboratory experiments, modelling, statistics etc are also applied for the integration of the tool. Besides, the comparative risk of radioactive and conventional pollutants can be also discriminated and apportioned respectively, whereas the synergism of the various pollutants can be taken into account.

In the present study the proposed innovation is exposed step by step and justified by case studies in areas of elevated artificial and enhanced natural radioactivity levels.

Keywords: Nuclear applications, Radioactivity measurements, Cytogenetic observations, Radiological impact assessment, Innovation in radiation protection

SPECT, a novel cardiac single-photon emission computed tomography system*

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Single-photon emission computed tomography (SPECT) is the leading imaging method of myocardial perfusion, important for the diagnosis and treatment of coronary artery disease. C-SPECT is a proposed novel cardiac SPECT system designed to achieve at least double the geometric efficiency compared to general-purpose dual-head gamma cameras. This improvement can be used to reduce patient dose or achieve fast or dynamic imaging. The system consists of stationary detector modules of pixelated NaI(Tl), a slit-slat collimator with interchangeable slits, and an integrated CT for attenuation correction. The design provides a minification of 1/2 for a maximal number of non-overlapping projections, given the spatial resolution of the pixelated detector. We will present the design principles and preliminary imaging performance using data from Monte-Carlo simulations and iterative image reconstruction with resolution recovery.

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Simulation of neutrino emission in hadronic microquasar jets

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One of the most interesting γ-ray and neutrino sources in the Galaxy is the microquasar jet [1,2]. Microquasars (MQ) are X-ray binary systems comprising hadronic jets which play crucial role in the creation of high-energy neutrinos and gamma rays in the GeV up to few TeV region [2,3]. Our purpose in this work, is to simulate neutrino emission produced in hadronic microquasar jets (like e.g. SS433, Cyg X-1 etc.) as a result of collisions between non-thermal protons with thermal ones [4,5]. We derive appropriate code (using Mathematica) in order to evaluate the neutrino emission by solving numerically the corresponding transport equation.

In the interior of the MQ jet, secondary particles (such as $\pi^{\pm}$, $K^{\pm}$, $\mu^{\pm}$, etc.) are created by p-p interactions of non-thermal protons with local matter (thermal protons) and radiation. Subsequently, pions decay to muons and neutrinos while muons may also decay giving neutrinos, γ-rays and electrons. Before decaying, the muons and pions interact weakly or electromagnetically. On the other hand, fast protons lose energy through synchrotron radiation, inverse Compton scattering, adiabatic processes and p-γ interactions [2]. Emitted neutrinos present a characteristic spectral distribution (one of the main ingredients of this work), which may be observed via space and earth telescopes. In order to simulate neutrino emission, we start with modeling the cascade process using appropriate numerical techniques (numerical solution of the transport equation using appropriate Mathematica code) and obtain the neutrino emissivity Q_ν as a function of the initial proton energy E_p [4]. The latter emissivity results from an adopted pion-energy distribution N_π. Finally, the obtained Q_ν function is compared with that obtained by using semi-analytical approaches [2].

In conclusion, we find that the aforementioned methods agree very well in the proton- energy region of 5 GeV < E_p < 3.2 TeV. Below this region the two methods somewhat disagree while above this region, as expected, the semi-analytical solution is more accurate. These differences may be due to the fact that the transport equation most probable presents some irregularities which do not appear when one is treating them numerically.

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Development of numerical tools for phenomenological description of neutrino emission from microquasars

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Microquasars (MQs) are X-ray binary stars with twin collimated relativistic jets [1] that feature many similarities with active galactic nuclei (AGN). Thus, the study of MQs offers useful insights for a deep understanding of AGN. In the present work we considered MQ jets of hadronic origin for which, a tiny portion of the jet protons (bulk flow protons), are accelerated (via first order Fermi acceleration) at shock fronts within the jet, and in turn collide with bulk jet flow (cold) protons. In general, accelerated particles in the jet can gain energies up to 10^7 GeV. In such MQ jets, the main contribution to the neutrino emission comes from the proton-proton interactions taking place in relativistic jets [2, 4]. Proton-proton interactions produce pions which may decay to muons and neutrinos (prompt neutrinos). Furthermore, muons may decay to electrons and neutrinos (delayed neutrinos). Neutral pions and mesons decay quickly producing high energy γ–rays.

In this work, we developed a code (using the C programming language) to calculate the neutrino emission from a model jet simulated with the PLUTO hydro-code [6] and the necessary physical quantities [5], i.e. the p-p collision cross section, the pion injection function, the pion energy distribution and the optical depth for neutrinos at an elementary unit volume (grid) of PLUTO. Towards this purpose, we utilized the semi-analytical expressions of Ref. [4] adopted also for MQ simulations in Ref. [2]. The numerical integration code (based on the extended Simpson algorithm) converges well at a relatively short number of integration steps and is more efficient than the corresponding Mathematica code of Ref. [4].

From the comparison of our results with those obtained previously [3, 4], we conclude that the derived algorithm is able to reliably reproduce the aforementioned physical quantities with quite good accuracy. Moreover, by combining our code with the PLUTO hydro-code and the radiative transfer code of Ref. [8], one may simulate non-thermal emissions from MQ jets by consuming less time than when using the code of Ref. [3]. This offers the possibility to increase the number of grid cells. In the near future, we aim to improve the advantages of this code in such a way that more neutrino producing reactions and cooling (non-thermal proton deceleration, [2]) mechanisms in MQs to be considered for obtaining even more realistic results.

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Model exercise of radionuclides' deposition on Gulf Thermaikos and its catchment

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Radioactive fallout contamination exercises have been performed based on the hypothesis of a single and instantaneous deposition of a given amount of ^{90}Sr and ^{137}Cs on a vast geographical area including Gulf Thermaikos and its catchment. The radiological model of Thermaikos Gulf ecosystem has been already designed and tested for its accuracy [1, 2], based on the MOIRA-PLUS decision support system [3]. Aim of the present model exercise is to evaluate the impact of an accident at regional scale including both the marine and the fresh water ecosystems. The analysis includes the radiological impact and the dose rate to biota from the marine pathway (fish and mussels ingestion, external irradiation from the sea) and the whole set of possible terrestrial pathways (for instance the consumption by man of crops and animal products contaminated by radionuclide directly deposited onto ground rather than by the sole irrigation with polluted water). The exercise clearly showed that the doses associated with the fresh water pathways in the sea catchment are significantly higher than those from the marine pathways, varying from 1 to 4 orders of magnitude for ^{137}Cs and ^{90}Sr respectively.

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Determination of the effective solid angle of the 1s2s2p ^{4}p metastable Auger decay in fast ion-atom collisions using simion 8.1 in a monte-carlo type simulation

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The research initiative APAPES [1] has established a dedicated beam line for research on atomic collisions which is located at the 5 MV TANDEM accelerator of the National Research Center "Demokritos" in Athens. The set up consists of a hemispherical deflector analyzer (HDA) with a 2-dimensional position sensitive detector (PSD) combined with a doubly-differentially pumped gas target. The basic aim of this initiative is the investigation of the decay of the 1s2s2p ^{4}P metastable states formed in energetic He-like-ion-atom collisions by single electron capture. These states have long lifetimes (10^{-6}-10^{-9} s) and thus the projectile ions can Auger decay well after their excitation in the target area making the determination of the effective detection solid angle, which is necessary for the calculation of the absolute cross section, non-trivial.

Here, we present Monte-Carlo type simulations, using the SIMION 8.1 package [2]. Random electron distributions in energy and emission angles were used to simulate the metastable Auger decay along the projectile ion trajectory, while the number of electrons detected at the PSD was recorded. Also included in these simulations for the first time are kinematic effects particular to Auger emission from fast moving projectile ions such as line broedening and solid angle limitations allowing for a more accurate and realistic line shape modeling. Comparison with previously published data concerning metastable ^{4}P and prompt Auger projectile states formed by electron capture in collisions of 25.3 MeV F^{7+} with H_2 and 12.0 MeV C^{4+} with Ne [3] were found to be in excelent agreement [4]. These results are of importance for the accurate evaluation of the 1s2s2p ^{4}P/^{2}P ratio of K-Auger cross sections whose observed non-statistical production by electron capture into He-like ions, recently a field of interesting interpretations [5], awaits further resolution.

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Quantification of 3D SPECT stress / rest volume differences in Myocardium Perfusion Imaging

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Cardiac stress test is a nuclear medicine test, used in cardiology to measure the ability of heart, responding to external stress in a controlled clinical environment. Stress response is usually induced in clinical routine by exercise or drug stimulation [1]. Left ventricle contractile abnormalities constitute an important indication of coronary artery disease (CAD). The present work consists of modelling the heart left ventricle at stress and rest situation and focuses on the possibility of quantification of the differences, obtained by 3D stress/rest images.

Fifteen cardiac patients completed stress and rest tests by intravenous injection of 20 mCi (740MBq) Tc-99m tetrofosmin in one-day protocol by a GE-Starcam-4000 gamma-camera; 3D myocardium images were reconstructed by GE Volumetrix software in the GE Xeleris processing system, by FBP reconstruction method and transferred in a Dicom format, by advanced algorithms which integrate 3D visualization [2].

Tomographic image reconstruction in a SPECT (Single Photon Emission Computed Tomography) camera produced a series of parallel transverse (or transaxial) images, perpendicular to the long axis of the patient. The myocardial perfusion was estimated by comparing SPECT slices and the suspicion of an ischemia was indicated [1]. The Dicom file, for each patient and each phase was imported to MATLAB (R2011b) [2]. A series of isocontour surfaces were studied. The appropriate threshold value, which isolates myocardium surface from the rest image area was identified. Based on this, the myocardium volume was evaluated and reconstructed in a 3D image. The possible difference between rest and stress 3D data, in voxels, was calculated, using image processing analysis.

An Index of Quantification (IQ) was determined to define the global quantitative defect size as a fraction of the myocardial volume area, based on the Volume of Interest (VOI) at rest and stress, considering that it is an indicative diagnostic factor, increasing the reliability of myocardium perfusion diagnosis. It is expected that further significant improvement in image quality will be attained, increasing the confidence of image interpretation. This method decreases the effects of operator variability and increases the reliability of diagnoses of organ irregularities.

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Calibration of Radiation Monitors

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Spacecraft are exposed to several distinct radiation sources over their lifetime. The European Space Agency (ESA) systematically measures geo-space particle radiation with a number of radiation monitors on-board ESA missions. These measurements are valuable for the characterization of the particle radiation levels in the geo-space environment, resulting from solar eruptive events, radiation belt particles and galactic cosmic rays. In order to evaluate the measurements and derive reliable proton and electron fluxes, the determination of reliable response functions through experimental and numerical calibrations is needed.

In this work, we present recent efforts for the determination of the response functions of the Radiation Environment Monitor (REM) on-board the STRV1c spacecraft, and the Radiation Monitor on-board the X-ray Multi Mirror (XMM) mission. Moreover, preliminary work on the Environmental Monitor Unit (EMU) unit is also performed. The numerical calibrations are based on detailed Monte Carlo simulations by means of the GRAS/Geant4 [1] software package.

Our results are compared to available experimental data and previous simulations with a view to using the product, a set of high-quality radiation data sets spanning a long time period, to develop new and updated models of the space radiation environment.

This work is performed in the framework of the Hellenic Evolution of Radiation data processing and Modeling of the Environment in Space (HERMES) project, which is implemented by the Institute of Accelerating Systems and Applications (IASA) under ESA contract no. 4000112863/14/NL/HB.

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Volume Quantification of ^{123}I-DaTSCAN Imaging for the Differentiation and Grading of Essential Tremor and Parkinsonism

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^{123}I-DaTSCAN is a cocaine analogue that binds to presynaptic dopamine. 123I-DaTSCAN imaging studies have shown the ability to detect loss of striatal dopamine transporters [1]. The present work evaluates whether mathematical approach of striatum imaging data by Matlab program processing could differentiate between parkinsonian syndromes, of various stages, and essential tremor (ET), and thus increase diagnostic accuracy [2], [3].

For this reason, DaTscan imaging was completed in 2 groups of patients. Group 1 was consisted of 14 patients, with a diagnosis of Parkinsonism in various stages and group 2, included 8 patients with a diagnosis of ET. The study subjects received 400 mg of potassium perchlorate 1 hour before injection of tracer and 200 mg 12 and 24 hours after injection in order to reduce ^{123}I uptake in their thyroid gland. 148 MBq DaTscan were injected intravenously. The radioligand for striatal dopamine transporter imaging were supplied by GE Healthcare. Then, SPECT acquisition studies were performed.

Imaging of thet patients was completed by GE Starcam 4000. Brain neurotransmission SPECT imaging with 123I was performed with low energy high resolution (LEHR) parallel collimator. Total radiation exposure –effective dose- to the study subjects was 9–12 mSv. The subjects were scanned 4 hours post injection (at peak time of the specific activity of 123I-DaTSCAN). Unprocessed projection data were reviewed in cinematic display, prior to reconstruction, to assess the presence and degree of motion and other potential artefacts, in order to exclude (remove) angular projection data in a possible patient motion.

The GE Xeleris-2 image processing system was used to reconstruct angular projections data. Transaxial, sagittal and coronal slices were reconstructed using the filtered back-projection (FBP) technique. Chang’s attenuation correction was applied (uniform attenuation coefficient of 0.12 cm−1).

The extraction of parameters by digitized processing of 123I-DaTSCAN (123I-ioflupane) images to differentiate between parkinsonism and essential tremor and evaluation of SPECT imaging of the dopamine transporters (DAT) in vivo, will produce a display of pattern recognition. Eccentricity, major & minor axis length, orientation, area, equivalent diameter and integral intensity of both left & right ganglia were determined. A specific ratio of both ganglia parameters gives a classification indication and contributes in diagnosis decision.

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Production of He-like ionic beams in both pure ground ($1s^2$) and mixed state ($1s^2$, 1s2s) with the use of Gas and Foil post-strippers for zero-degree Auger Projectile Electron Spectroscopy *

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The research initiative APAPES has established a new experimental station at the 5MV TANDEM of the NCSR "Demokritos" with a new beam line dedicated exclusively to atomic collisions physics research [1]. The experimental setup, developed for zero-degree Auger projectile spectroscopy, will perform high resolution studies of electrons emitted in ion-atom collisions at 0° with respect to the ionic beam direction. The apparatus consists of a hemispherical deflector analyzer, equipped with a 4-element zoom lens at its entry and a 2-dimensional position sensitive detector, together with a doubly-differentially pumped gas target. It is currently fully operational and used in performing systematic isoelectronic investigations of K-Auger spectra emitted from collisions of He-like ions with gas targets. Our goal is to provide a better understanding of the cascade feeding of the 1s2s2p ^4P metastable states produced in collisions of He-like and H-like ions with gas targets [2].

Our experimental measurements so far have been limited to electron capture to a mixed state ($1s^2$, 1s2s ^3S) 12 MeV C^{4+} ion beam generated at the terminal foil stripper. In order to perform measurements with both pure ground state as well as mixed state beams, it is necessary to incorporate: i) A terminal *gas* stripper [3], ii) A stripping point along the beam line after acceleration hosting both foil and gas (post) strippers. This also allows us to vary the fraction of metastable 1s2s ^3S component. The intensities of the expected beam charge states after stripping are calculated from a charge state analysis code using mainly the semi-empirical formulas of Nikolaev and Dmitriev [4] and Sayer [5] along with the beam energy, its characteristics (Z, atomic mass) and the incoming charge state.

A description of the characteristics and the operation principles of both gas and foil post- and terminal- strippers will be presented.

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Natural Radioactivity in Marine Sediment Cores from the Shallow-sea Hydrothermal System off Milos Island, Greece

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Abstract

Milos Island is part of the Hellenic Volcanic Arc and hosts a unique shallow-sea hydrothermal system, which covers almost 35 km^2 of seafloor, down to (at least) 300 m water depth, with maximum temperatures reaching 150°C [1]. The most intense submarine venting occurs in Palaeochori Bay, where hydrothermal fluids and CO_2-rich gasses discharge through the sediments and produce hydrothermal precipitates of various colors.

This study aims to investigate the levels of natural radioactivity (^{238}U, ^{232}Th decay series and ^{40}K) in marine sediment cores sampled from the hydrothermal system off Palaeochori Bay by SCUBA diving. The research focused on: a) the white-colored hydrothermal precipitates, collected in slices of 2 cm down to 22 cm depth, b) the seagrass area, where sampling reached the depth of 12 cm and c) the brown-grey area that is considered the background sediment, down to 20 cm depth.

The samples have been analyzed with the UoA GEROS γ-ray spectrometry station (a 23% HPGe detector with appropriate Pb shielding and special holders to accommodate samples of different geometries). Collected spectra were analyzed with the SpectrW software suite [2] and the results will be presented in depth profiles. The mean measured values of the ^{238}U-series radioisotopes were: ^{226}Ra: 603 ± 4 Bq/kg, ^{214}Pb: 18.3 ± 0.2 Bq/kg, ^{214}Bi: 24.9 ± 0.3 Bq/kg, while ^{228}Ac: 18.6 ± 0.4 Bq/kg and ^{208}Tl: 55.4 ± 1.8 Bq/kg were obtained for the ^{232}Th-series. ^{40}K was measured at: 530 ± 6 Bq/kg. The artificial radionuclide, ^{137}Cs, was not observed in significant amounts above the background. A correlation to the hydrothermal sediments geochemical characteristics will be discussed in prospect of the awaited results from additional spectroscopic techniques that are currently under detailed analysis.

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