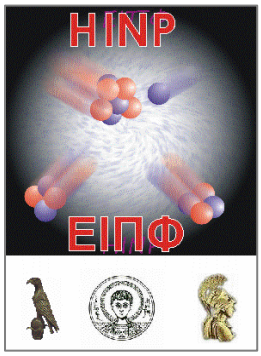

1st one day Workshop

on

New Aspects and Perspectives

in Nuclear Physics

Abstracts

8th of September, 2012

Ioannina, Greece

Department of Physics
University of Ioannina

Organizing committee

A. Pakou
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Proton–neutron interactions in heavy nuclei

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Abstract

δV_{pn} is a particular double difference of nuclear binding energies serving as a filter isolating the valence proton–neutron interaction. δV_{pn} is known to exhibit spikes in light nuclei at $N = Z$, explained by the SU(4) Wigner supermultiplet. Recently, it has been found [1] that δV_{pn} values in the rare earth region show similar peaks, occurring at $N_{val} \sim Z_{val}$. These peaks, evident for both even and odd Z values, are interpreted in terms of large spatial overlaps of respective proton and neutron wave functions whose Nilsson quantum numbers are related by $\Delta K[\Delta N, \Delta n_z, \delta\Lambda] = 0[110]$, i.e., the wave functions differ only by a single oscillator quantum in the z-direction. The implications of this for the development of collectivity and deformation in heavy nuclei, and the locus of this development, are dicussed [2].

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Nuclear equation of state effects on the r-mode instability of neutron stars

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Abstract

We study the effect of nuclear equation of state on the r-mode instability of a rotating neutron star. We consider the case where the crust of the neutron star is perfectly rigid and we employ the related theory introduced by Lindblom *et al.* [1]. The gravitational and the viscous time scales, the critical angular velocity and the critical temperature are evaluated by employing a phenomenological nuclear model for the neutron star matter. The predicted equations of state for the β-stable nuclear matter are parameterized by varying the slope L of the symmetry energy at saturation density on the interval 50 MeV $\leq L \leq$ 110 MeV. The effects of the density dependence of the nuclear symmetry energy on r-mode instability properties are presented and analyzed. A comparison of theoretical predictions with observed neutron stars in low-mass x-ray binaries is also performed and analyzed.

Keywords: Neutron stars; Nuclear equation of state; Nuclear symmetry energy; r-mode instability; Gravitational waves.

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Semi-leptonic weak interaction processes in nuclei and their role to Astrophysics

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Abstract

Conventional and exotic semi-leptonic weak interaction proccesses in nuclei (neutral- and charged current–neutrino-nucleus reactions, lepton capture by nuclei, -decay modes, etc.) are studied by using a general description for the corresponding nuclear transition matrix elements [1, 2, 3]. The method is based on the multipole decomposition of the hadronic current density operators entering the relevant interaction hamiltonians [4, 5]. This decomposition leads to the basic tensor multipole operators [3] the matrix elements of which are computed through realistic nuclear structure calculations (quasi-particle random phase approximation) [1]. Then, the data of known probes measuring nuclear transition densities are used as analyzers in studying the nature of the weak interactions [6, 7] while, simultaneously, reliable predictions for as-yet-unmeasured weak nuclear processes (like the muon-to-electron conversion, flavour changing neutrino-nucleus scattering, etc.) are obtained [1, 2]. Finally, we focus on the role which play these processes in the evolution of massive stars, the supernova physics and the detection of astrophysical neutrinos in terrestrial experiments.

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Spectra and B(E2)s in atomic nuclei with deformation dependent mass, solved by SUSYQM

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Abstract

In [1] a new form of the Bohr Hamiltonian is proposed, by letting the mass to depend on the deformation, which is equivalent to a conformal transformation of the Bohr's phase space. Through SUperSYmmetric Quantum Mechanics (SUSYQM), exact solutions are obtained using the Davidson potential for spectra and intraband and interband B(E2) transition rates. The increase of the moments of inertia with deformation is moderated, in agreement with experimental data.

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Parafermionic behaviour in Bose–Einstein Condensates

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Abstract

The aim of this project is to explain the transition from the bosonic to the fermionic behaviour of the Bose–Einstein Condensates that were created in an experiment at Rice University. A Bose–Einstein Condensate (BEC) consists of a number of atoms which are trapped in a small space area and cooled down to almost zero Kelvin temperature. These individual atoms exhibit a bosonic behavior. The paradox is that the BEC, although it is a collection of bosonic particles, exhibits a fermionic behaviour. This "paradox" has been explained by the theory of the Generalised Parafermionic Oscillators. The theory introduces a quantity called the "order of the parafermion", which measures the divergence from the bosonic behaviour. It is proved that the nonlineality of the BEC's energy E(N), where N is the number of atoms, signifies the divergence from the bosonic behaviour.

Anisotropic oscillators with Rosochatius interactions

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Abstract

In this paper we studied the anisotropic oscillator with Rosochatius interaction terms as a superintegrable system. We found the eigenvalues of the energy of the system and a representation using the deformed oscillator algebra approach and we connected our results with previous papers. Moving forward we connected our results with the studies of parafermionic systems. In this direction we found a way to contract "generalized" angular momentum components for this system.

Flavour Changing Neutral-Current Processes in Nuclei

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Abstract

The flavour changing neutral current (FCNC) reactions taking place in the presence of nuclei are investigated. Specifically, in the present work we focus on the ν-nucleus FCNC reactions of the form ${}_{A}N_{Z}\left(\nu_{\alpha},\nu_{\beta}\right){}_{A}N_{Z}^{*}$ and ${}_{A}N_{Z}\left(\tilde{\nu}_{\alpha},\tilde{\nu}_{\beta}\right){}_{A}N_{Z}^{*}$, with $\alpha\neq\beta$. We adopt the Seesaw mechanism, which extends the Standard Model by adding a heavy right-handed neutrino singlet (N_R) per neutrino generation and predicts such exotic processes. In this description we have been inspired by the successful application of this model in other lepton flavour violating (LFV) processes, studied in detail previously, like the $\mu^{-}\rightarrow e^{-}$ conversion in nuclei, [1,2].
FCNC ν-nucleus reactions have a great impact in Astrophysics and hence a comprehensive study of such processes is of significant importance. From a nuclear theory point of view, the projection method of Donnelly-Walecka is employed for ν-nucleus cross sections calculations, [3]. The single-particle transition matrix elements are evaluated with the use of an in house Mathematica code constructed for this purpose using the compact formalism of Ref. [4]. Results for differential cross sections [5] on some concrete nuclear systems are expected to be obtained soon.

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Realistic nuclear structure calculations for orbital e-capture by nuclei

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Abstract

The orbital electron capture process on nuclei is revisited. We focus on e-capture on "iron group peaked isotopes" that are important for searching the explosive nucleosynthesis [1,2]. Towards this purpose, we improved our method: 1) In the level where use of compact analytical expressions for the required reduced matrix elements of all basic multipole operators (isospin representation) is made. 2) By employing the Bonn C-D potential (instead of the Bonn C used up to now) for realistic two-body nuclear forces [3,4].
We have constructed the ground state of the nuclear isotopes chosen by solving iteratively the BCS equations. Also we have calculated their excitation spectrum by solving the QRPA equations [3,4]. Results for the relevant cross sections are expected to be obtained soon.

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1 Acknowledgments

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Model Independent Analysis of the γ*p →Δ Transition with Polarized Electron Scattering Data

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Abstract

A novel method for extracting physical parameters from experimental and simulation data is presented. The method is based on statistical concepts and it relies on Monte Carlo simulation techniques. It identifies and determines with maximal precision parameters that are sensitive to the data. The method has been extensively studied and it is shown to produce unbiased results. It is applicable to a wide range of scientific and engineering problems. It has been successfully applied in the analysis of experimental data in hadronic physics and of lattice QCD correlators. In the current project, this method is being applied to recently obtained data in pion electroproduction. Response functions extracted from angular distributions of differential cross sections for polarised electron scattering at Q^2=0.127 $(GeV/c)^2$ (Bates Data), Q^2=0.060, 0.200 $(GeV/c)^2$ (Mainz Data) and Q^2=1.000 $(GeV/c)^2$ (JLab Data) at W values across the Δ Resonance are extensively analyzed in the framework of this model.

Production of neutron-rich nuclei towards the r-process path in peripheral heavy-ion collisions at low energies

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Neutron-rich nuclides have traditionally been produced in spallation reactions, fission and “cold" projectile fragmentation. Apart from these main production approaches, the search for new synthetic routes is currently of importance to nuclear studies towards the neutron-drip line. Towards this goal, we have undertaken a systematic study of the production cross sections of neutron-rich rare isotopes from binary collisions of neutron-rich beams on heavy neutron-rich targets at energies below the Fermi energy (see recent works, e.g., [1-3]).

Recently, the reactions of 15 MeV/nucleon ^{86}Kr beam on ^{64}Ni, ^{58}Ni and ^{124}Sn, ^{112}Sn targets have been studied in detail using the MARS recoil separator at the Cyclotron Institute of Texas A&M University [4]. We are currently employing two model approaches to describe the data : a deep-inelastic transfer (DIT) code and the microscopic CoMD (Constrained Molecular Dynamics Model). From a practical viewpoint, we indicate that such reactions offer an attractive approach with high-intensity stable beams, as well as, in two-stage production schemes (namely, by using a neutron-rich radioactive beam on a neutron-rich target). Possibilities of nuclear structure and reaction studies that may be offered by re-accelerated radioactive beams at present and future radioactive beam facilities will be outlined.

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Transfer reactions at REX-ISOLDE: The ^{66}Ni(d,p)^{67}Ni experiment

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Theoretical studies indicate that the size of shell gaps can alter when changing the N/Z ratio leading to changes in magic numbers when going away from the line of stability. One of the most interesting regions of the chart of nuclides is around ^{68}Ni. The observation of the high excitation energy of the first 2^+ state of this nucleus, in combination with the minimum in the systematics of B(E2;$2^+ \rightarrow 0^+$), has led to interpretations in terms of a harmonic oscillator subshell closure. On the other hand, the two-neutron separation energies in the N=40 region do not present any irregularity - characteristic of a shell closure. In view of this controversial experimental evidence, the single particle character of the ^{67}Ni has been decided to be investigated.

In the last four decades the one-nucleon transfer reactions have been proved to be the workhorse for the deduction of spectroscopic information for nuclei at or near the valley of stability. Nowadays, the development of radioactive ion beams allows access to nuclei that were previously unapproachable. Accordingly, the excitation spectrum of ^{67}Ni was studied by performing the ^{66}Ni(d,p)^{67}Ni reaction study in inverse kinematics with an energy of 3 MeV/u. The experiment was realized at the REX-ISOLDE radioactive ion beam facility in CERN. The MINIBALL setup was used in combination with the newly built T-REX particle detection array. In this experiment, levels with excitation energy up to 6 MeV have been populated and extensive new spectroscopic information was deduced. The first results of the analysis will be presented with emphasis to the abilities of the T-REX particle detection array. Future plans, as well as current work on the transfer reactions at REX-ISOLDE will be also discussed.

Large Volume Spherical Proportional Counter: Development and Applications

Ilias Savvidis

Abstract: A large volume ($1m^3$) spherical proportional counter has been developed. The high voltage is applied to a small sphere 15mm in diameter, located in the center of the counter and the wall of the counter is grounded. The resolution of the detector has been measured using ^{222}Rn gas, in order to have the response of the total active volume of the detector. The 3 alpha peaks from ^{222}Rn decay and ^{222}Rn daughters decay have been measured with FWHM less then 2%. The energy threshold has been pushed down to about 25 eV and single electrons are clearly collected and detected. To reach such performance low energy calibration systems have been successfully developed: A pulsed UV lamp extracting photoelectrons from the inner surface of the detector and various radioactive sources allowing low energy peaks through fluorescence processes. The very low noise, the limited wall effect, the good resolution and the high sensitivity are some of the advantages of the detector. The above characteristics give the possibility for several applications of the spherical proportional counter:
a) double beta decay experiment
b) Ultra low energy and single electron detection
c) Uranium, plutonium detection
d) Reactor neutrino and supernova neutrino detection
e) Relativistic atmospheric neutron detection
f) Low flux neutron detection.

Optical Potential and Relevant Reaction Mechanisms at near barrier energies with nucleus-nucleus collisions

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A survey will be given for the research performed by our group the last ten years, related with the optical potential and the reaction mechanisms at near barrier energies with weakly bound projectiles. Previous and present results on elastic scattering and fusion will be discussed.

Fusion Cross Sections of $^{8}B+^{28}Si$ at near barrier energies

A.Pakou[1], E. Stiliaris[2], D. Pierroutsakou[3], M. Mazzocco[4], N. Alamanos[5], A. Boiano[3], C. Boiano[6], D. Filipescu[7], T. Glodariu[7], J. Grebosz[8], A. Guglielmetti[9], M. La Commara[10], C. Parascandolo[11], C. Signorini[4], R. Silvestri[10], O. Sgouros[1], F. Soramel[4], E. Strano[4], L. Stroe[7], D. Toressi[4], K. Zerva[1]

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Fusion cross sections were measured for $^{8}B + ^{28}Si$ at near barrier energies by detecting the alpha particles produced in the evaporation process. Preliminary results and comparisons with cross sections obtained by other weakly bound projectiles on various targets will be presented.

Elastic backscattering measurements and optical potential analysis for the systems ^{6,7}Li + ^{58}Ni, ^{116,120}Sn, ^{208}Pb at sub- and near-barrier energies

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It is well known that barrier distributions from elastic backscattering can probe surface properties of the potential as well as the reaction mechanisms at near and sub-barrier energies[1,2]. Additionally it was shown in recent publications[3,4] that by forming barrier distributions for the system ^{6,7}Li+^{28}Si the energy dependence of the potential can be probed to very low sub-barrier energies with good accuracy. Under these motivations we have performed elastic backscattering measurements for the weakly bound nuclei ^{6,7}Li on medium and heavy mass targets ^{58}Ni, ^{116,120}Sn and ^{208}Pb for $E_{c.m.}/V_{bar.}$ = 0.6 to 1.3. We will present our results and discuss the backscattering method of barrier distributions as a valuable tool for probing the potential and the reaction mechanisms at near and sub- barrier energies.

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This research has been co-financed by the European Union (European Social Fund – ESF) and Greek national funds through the Operational Program "Education and Lifelong Learning" of the National Strategic Reference Framework (NSRF) - Research Funding Program: Heracleitus II. Investing in knowledge society through the European Social Fund.

Study of the reaction $^{20}Ne+^{28}Si$: Elastic scattering at near barrier energies

V. Soukeras[1], O. Sgouros[1], A. Pakou[1], I. Strojek[2], A. Trzcinska[2], N. Alamanos[3], N.Keeley[4], M. Mazzocco[5], N. Patronis[1], E. Piasecki[2], K. Rusek[2,4], E. Stiliaris[6], K.Zerva[1].

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Elastic scattering angular distributions has been measured for the reaction $^{20}Ne+^{28}Si$ at near barrier energies of 43, 53, 71MeV. The results were analyzed in optical model framework by using the codes FRESCO and ECIS. The basic conclusion was the existence of an anomalous increase of cross section at backward angles. The analysis of probing the potential is in progress.

Study of the system $^{20}Ne+^{28}Si$: Transfer reactions at near barrier energies

O. Sgouros[1], V. Soukeras[1], A.Pakou[1], I.Strojek[2], A.Trzcinska[2], N. Alamanos[3], N. Keeley[4], M. Mazzocco[5], N. Patronis[1], E. Piasecki[2], K. Rusek[2,4], E. Stiliaris[6], K. Zerva[1].

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Angular distribution measurements of one-alpha and two-alpha transfer reactions for the system $^{20}Ne+^{28}Si$ at two near barrier energies, at 53 and 71 MeV, were performed at the HIL laboratory of the University of Warsaw. The results were analyzed in a simple DWBA framework with the code FRESCO, by using as entrance potential the empirical one, suggested from a parallel analysis of the elastic scattering results. The agreement with the data is good for both energies, indicating the validity of the proposed potential.

Έρευνα στα χρόνια της οικονομικής κρίσης: Μιά σύντομη παρουσίαση της πρόσφατης ερευνητικής δραστηριότητας του Ραδιοχημικού Εργαστηρίου του Α.Π.Θ.

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Αυτή η σύντομη παρουσίαση πρόκειται να συνοψίσει την πρόσφατη ερευνητική δραστηριότητα του Ραδιοχημικού Εργαστηρίου του Τμήματος Χημείας του Α.Π.Θ., που επικεντρώνεται στην

1. ***Μελέτη πυρηνικών αντιδράσεων αναλυτικού ενδιαφέροντος.***
2. ***Εφαρμογές πυρηνικών αναλυτικών τεχνικών στο χαρακτηρισμό και μελέτη επιφανειακών στρωμάτων υλικών.***
3. ***Μελέτη της αλληλεπίδρασης ραδιονουκλιδίων και βαρέων μετάλλων με φυσικά και συνθετικά προσροφητικά υλικά.***
4. ***Μετρησεις φυσικής ραδιενέργειας.***

Η παρουσίαση περιλαμβάνει παραδείγματα και αναφορά στις προσφατες δημοσιεύσεις του Εργαστηρίου.

Research in the years of the economic crisis: A short review of the recent research activity of the Radiochemical Laboratory of the Aristotle University of Thessaloniki.

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Department of Chemistry, Aristotle University, 54124 Thessaloniki, Greece

This short lecture is going to present the current research activities of the Radiochemical Laboratory of the Department of Chemistry A.U.Th., which can be summarized as:

1. **Study of low-energy nuclear reactions of analytical interest.**
2. **Application of ion beam analysis techniques to the characterization and study of thin near-surface layers of materials.**
3. **Investigation of the interactions of radionuclides and heavy metals with natural and synthetic sorbents.**
4. **Measurements of natural radioactivity.**

The presentation will include examples and references to recent publications of the Laboratory.

RADIONUCLIDES IN THE ENVIRONMENT AND THEIR APPLICATIONS
Radiation Physics Group

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The main research activities of Radiation Physics Group of the Nuclear Physics Laboratory, Physics Department, Aristotle University of Thessaloniki (AUTH) are:
Environmental radioactivity - radioecology. Natural and man-made radionuclides in the environment. Environmental radioactivity from Chernobyl and Fukushima accident. Escaping Radioactivity from Coal Power Plants. Radioactivity of building materials. Radon exposure in dwellings and caves. Radon soil gas variations due to seismic activity. Uranium in groundwater. Radioactive aerosols. In the present work main emphasis will be given in the radioactive aerosol activity.

The group has more than 30 years of experience in environmental radiation studies, more than 120 publications in scientific journals and more than 500 references and has an experience in participating in more than 20 Research Programs. All group members have active collaborations with Universities and Institutes from Greece and abroad.

There is a full infrastructure for environmental radioactivity studies, with four Ge detectors, one alpha system, a complete radon system for measurements in soil, water, air and a number of air samplers and aerosol impactors as well as a full access in a sub-critical reactor with 10^5 n cm^{-2} s^{-1}, which belongs to the Nuclear Physics Laboratory and it is used for educational and research activities.

Information of the above research activities are given in www.physics.auth.gr site of the Physics Department of Faculty of Science, AUTH, Greece, and with more details at http://users.auth.gr/~metaxia/RadiationPhysics/default.html.

APPLICATION OF ION BEAM AND RADIOCHEMICAL TECHNIQUES IN MATERIALS SCIENCE AND ENVIRONMENT

Fotini NOLI

Radiochemical laboratory, Department of Chemistry, Aristotle University of Thessaloniki

The research activities of the radiochemical laboratory (Department of ChemistryAUTH) involve the use of nuclear and radiochemical techniques. Techniques based on nuclear interactions, as nuclear reaction analysis-NRA and Rutherford backscattering spectroscopy-RBS, applied for the characterization of near surface layers of materials for industrial applications and investigation of their resistance to oxidation and corrosion whereas the corrosion resistance and the biocompatibility of biomaterials is also studied.

Examples of the measurement of natural radioactivity and determination of radionuclides in environmental samples using γ- and α- ray spectroscopy as well as neutron activation analysis will be also presented.

ΕΦΑΡΜΟΓΕΣ ΠΥΡΗΝΙΚΩΝ ΚΑΙ ΡΑΔΙΟΧΗΜΙΚΩΝ ΤΕΧΝΙΚΩΝ ΣΤΗΝ ΤΕΧΝΟΛΟΓΙΑ ΥΛΙΚΩΝ ΚΑΙ ΠΕΡΙΒΑΛΛΟΝΤΟΣ

Φωτεινή Νόλη

Ραδιοχημικό Εργαστήριο, Τμήμα Χημείας, Αριστοτέλειο Πανεπιστήμιο Θεσσαλονίκης

Θα γίνει παρουσίαση των ερευνητικών δραστηριοτήτων του ραδιοχημικού εργαστηρίου που αφορούν στη χρησιμοποίηση πυρηνικών και ραδιοχημικών τεχνικών. Τεχνικές που βασίζονται σε πυρηνικές αλληλεπιδράσεις, όπως ανάλυση με πυρηνικές αντιδράσεις (nuclear reaction analysis-NRA,), φασματοσκοπία οπισθοσκεδασμού κατά Rutherford (Rutherford backscattering spectroscopy-RBS) χρησιμοποιούνται για το χαρακτηρισμό και τη μελέτη της επιφάνειας υλικών για βιομηχανικές εφαρμογές με σκοπό τη διερεύνηση της αντοχής τους στην οξείδωση και τη διάβρωση και βιουλικών για μελέτη της βιοσυμβατότητάς τους.

Επίσης πραγματοποιείται μελέτη της φυσικής ραδιενέργειας και προσδιορισμός ραδιονουκλιδίων σε περιβαλλοντικά δείγματα με τη βοήθεια φασματοσκοπίας ακτίνων-γ και –α και ανάλυση με νετρονική ενεργοποίηση.

An Introduction to selected Applied Nuclear Physics activities at Ioannina

by

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Historically, Applied Nuclear Physics at Ioannina started right after the Chernobyl accident in 1986 in the field of Environmental Radioactivity measurements. Soon, this field was broadened by the addition of research in countermeasures following a nuclear accident and the modeling of radionuclides transfer to environmental components and Man. Today our laboratory facilities complemented by a radiochemistry laboratory allow us to perform most of environmental radioactivity analyses, including alpha radiation measurements (silicon detectors), beta measurements (gas proportional counters, liquid scintillation for tritium and carbon- 14) and gamma radiation measurements (NaI and HPGe systems).

A branch of our environmental radioactivity studies is research on radon and its applications. Our measurements capabilities include CR39 detectors, electrets and active detector systems. Our recent work includes the development of computer codes to automatically measure the alpha track surface density in exposed CR39 detectors and cheap monitoring systems based on PIN diodes. These were tested in a multitude of applications, including the monitoring of radon in the indoors environment, the exploration of geological faults and the study of earthquake precursor phenomena.

Another activity of our group is Energy Dispersive X Ray Fluorescence measurements with applications in research in the study of heavy metals in the environment and the characterization of archeological findings (sherds) through measurements of elemental compositions and subsequent statistical analysis (Principle Component Analysis).

As our group recently has acquired the Riso TL/OSL reader, a new HPGe system and an accompanying sample pretreatment radiochemical laboratory, we have entered the field of Radiochronology, through Thermoluminescence (TL) and Optically Stimulated Luminescence (OSL) measurements for Archeology and Geology, in cooperation with various groups in Greece and abroad.

Finally, we are using the TL/ OSL facilities for Dosimetry research, including the testing of new materials and retrospective dosimetry.

Dating with TL-OSL for Geology and Archaeology

by

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The Archaeometry Center belongs to the Horizontal Labs and Units Network of the University of Ioannina. It was established in 2002 and facilities of the Center are located at the Physics Department of the University of Ioannina.

One of its activities is in the field of Radiochronology, through Thermoluminescence (TL) and Optically Stimulated Luminescence (OSL) measurements for Archeology and Geology, in cooperation with various groups in Greece and abroad. A recently acquired Riso TL/OSL reader (2008), a new HPGe system (2010) and an accompanying sample pretreatment radiochemical laboratory are used to provide dating of a variety of samples (pottery fragments, soil, sediments etc).

Dating of samples is based in the Riso TL/OSL DA-15C/D reader. The single-aliquot regenerative-dose (SAR) protocol is usually followed for the equivalent dose (De) determination. The OSL natural signal is obtained by stimulating the samples with blue LEDs. Also each sample is repeatedly irradiated for various periods of time with a $^{90}Sr/^{90}Y$ source, with a calibrated dose rate of 0.0982 ± 0.0002 Gy/s. To determine the dose rates, the natural radioactivity of sediments from the surroundings of the original sample location, due to potassium 40 (^{40}K) and the uranium (U) and thorium (Th) series radioisotopes is assessed, using gamma spectrometry with a counting system based on a HPGe detector

Since 2008, our Center is in collaboration with Archaeological groups from the University of Ioannina and from the Institute of Archaeology in Tirana, Albania. Samples from Tell el-Kefrein near the Dead Sea, in Jordan were dated as well as samples from two sites in North-East Albania at the Albanian-Greek borders, collected by an international collaboration. There is also an ongoing collaboration with archaeological groups of the University of Ioannina and samples from Ithaca, Astypalaia and Amorgos are dated.

Radiochronological measurements are also performed in geological samples. During an extensive collaboration with a team from the Aristotle's University of Thessaloniki in cooperation with a Turkish team from Canakkale Onsekiz Mart University, samples from various places of Troy and the neighboring area were dated for sedimentation rates of the Skamadros and Simois rivers. Also samples from an archaeological site at Doxipara in the Evros area were processed for dating and for possible paleoseismological evidence. Finally, there is an ongoing collaboration aiming at the chronology of past earthquake events in various sites in Greece.

The Compton Camera in the γ-Ray Imaging

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Abstract

Based on the physical laws governing the scattering processes in the energy domain of the most commonly used radiopharmaceuticals, the Compton Effect can be utilized to detect and reconstruct gamma-ray distributions by replacing the mechanical collimation used by the typical Anger Cameras. The design and construction of a small Compton Camera prototype is investigated in this project. The system is consisted of a Double Sided Silicon Detector (DSSD), acting as scatterer, and a cylindrical, homogeneous scintillation crystal read out by a Position Sensitive PhotoMultiplier Tube (PSPMT). The sensitivity and resolution performance of the system is currently studied with GEANT4/GATE simulations by mainly varying the basic geometrical characteristics of the scatterer and the absorber.

Optical and Infrared Tomography in Medical Physics

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Abstract

In order to gain the necessary anatomical information of an area under examination while applying Single Photon Emission Computed Tomography (SPECT) technique, the aid of other modalities based on Optical and Infrared (IR) Tomography are imperative. The main advantage over other modalities lies on their non-ionizing nature and therefore, the absence of extra dosing loads. Our SPECT-Lab is currently developing a mobile, small-field γ-Camera system based on a Position Sensitive PhotoMultiplier Tube (PSPMT) which is equipped with those IR and Optical-CT modalities. The Optical CT technique is realized with infrared pulses of light, emitted by an ultra-fast LASER and a Streak Camera, acting as a fast light detector system with an extra high time resolution. The present work focuses on the experimental study using appropriately constructed ^{99}Tc, thermal and optical emission phantoms, 3D-reconstructed with various iterative algorithms.

Construction of a High-Resolution Mobile γ-Camera System for Mammography Study

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Abstract

A small field, high resolution γ-Camera system based on a Position Sensitive Photomultiplier Tube (PSPMT) has been recently developed in our Laboratory. This prototype is to be engaged to clinical applications for planar imaging of ^{99}Tc-radiotracers during breast cancer operations. Among the basic requirements during data-taking operation is the absence of any distorting motion, which can drastically affect the image quality. In the present work, all necessary transformations to a clinical prototype are described. This includes the operation of the γ-Camera system with low voltages by utilizing a proper DC-to-DC converter in order to provide proper high voltage to the isolated head system. Camera orientation is critical during operations, thus a 3D-accelerometer will be encased in the head probe providing the necessary information for an automatic alignment of the projected image. The γ-Camera will be connected via a USB portal to a computer with a DAQ system, operating in a fast digitization mode.