An Introduction to selected Applied Nuclear Physics activities at Ioannina

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http://omega.physics.uoi.gr

Environmental Radioactivity

- 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.

Recent activities/Results

Work on countermeasures was epitomized in these two publications

1) Compendium of Countermeasures for the management of food production systems

Food and Agriculture Restoration. Management Involving Networked Groups. (FARMING)

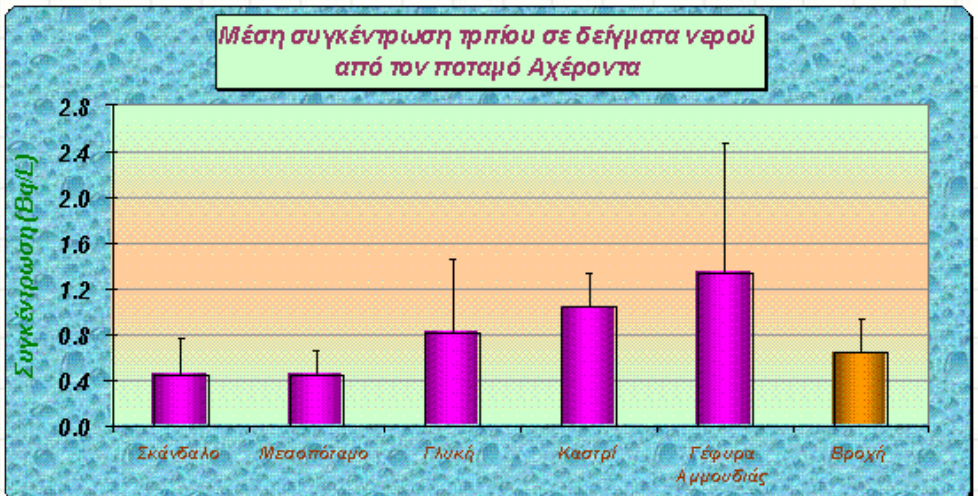
2) Generic handbook for assisting in the management of contaminated food production systems in Europe following a radiological emergency

EURANOS: European approach to nuclear and radiological emergency management and rehabilitation strategies

http://www.euranos.fzk.de/index.php?action=euranos&title=products

Radioactivity measurements in water bodies in Epirus

http://www.ecodonet.gr/



Facilities/Measurements: Alpha activity

Water (Radium)-> adsorption to MnO2+> alpha spectroscopy with silicon surface barrier detectors

Total alpha activity: Measured by proportional gas counter

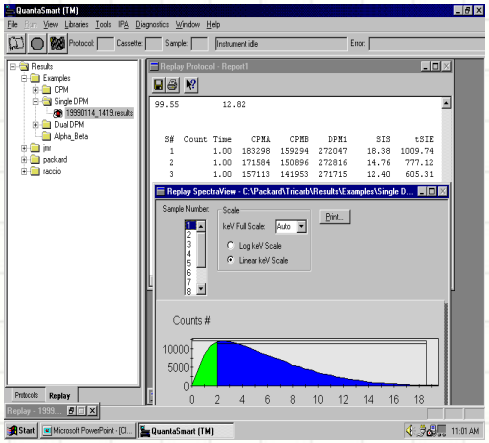
Total alpha/radium/radon: Measured by Liquid Scintillation Counting

Uranium/Thorium: Anodic stripping voltammetry

Facilities/Measurements: Beta activity

Total beta activity: Measured by proportional gas counter

Total beta/ Tritium/ Carbon-14: Measured by Liquid Scintillation Counting



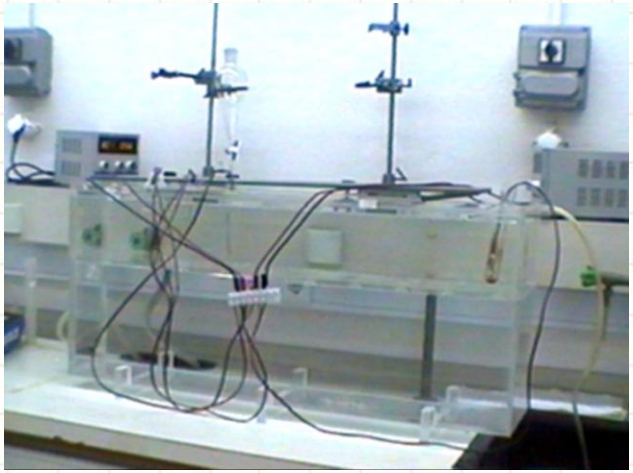
Rapid screening of ^{90}Sr activity in water and milk samples using Cherenkov radiation

Also applications to Hydrology/ Meteorology/ Correlation with solar activity

Facilities/Measurements: Tritium

The measurement of tritium concentration in rainwater is of importance because it can be used for hydrology investigations such as the recharge mode or the vulnerability of aquifers

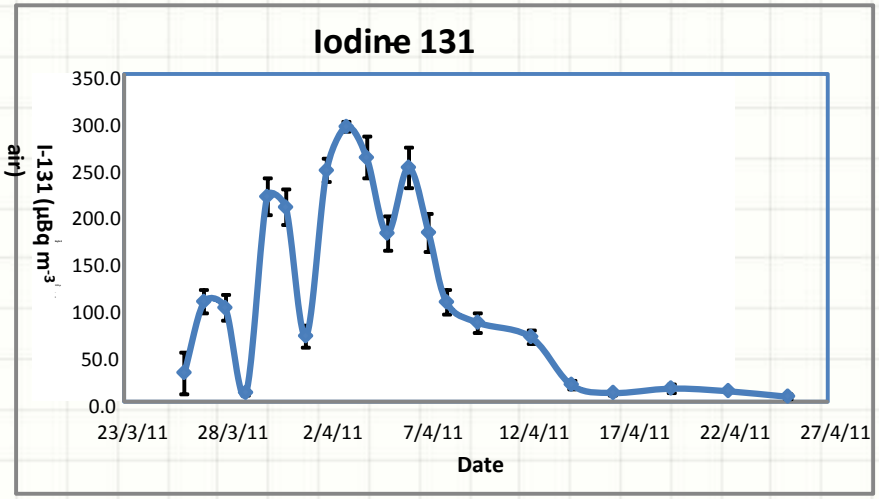
Our samples may be enriched . Enrichment is accomplished by electrolysis and lowers the MDL.



Facilities/Measurements: Gamma activity

Activity in air-> High Volume air pumps-> gamma spectroscopy

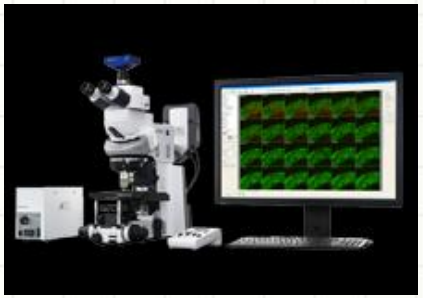
Three gamma spectroscopy systems in operation



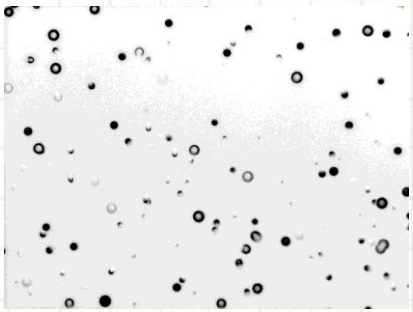
Iodine 131 in air measured in Ioannina, month following Fukushima

Radon applications

Our Radon Group has been engaged in radon research in various fields, including:



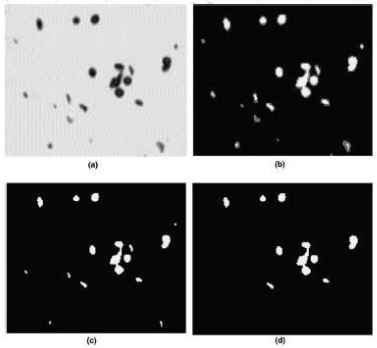
- Indoor and Outdoor Radon Surveys
- Radon Studies in the Laboratory
- Radon and Earthquake Prediction
- Radon and Geological Applications



- Radon measurements are performed using both passive and continuous monitoring techniques, such as:
- Solid State Nuclear Track Detectors
- Electret Detectors
- Semiconductor Detectors

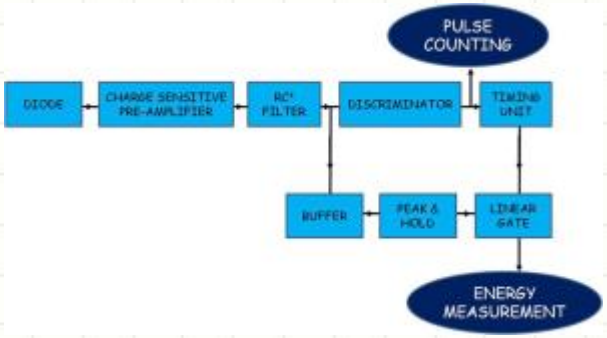
Radon: Recent work

Our recent work includes the development of computer codes to automatically measure the alpha track surface density in exposed CR39 detectors



TRIAC II code available from CPC library

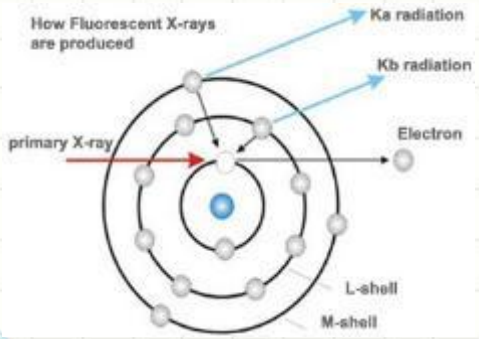
Development of cheap monitoring systems based on PIN diodes



Energy Dispersive X Ray Fluorescence

In the XRF technique, the analyzed sample is irradiated with primary X-rays and subsequently emits fluorescent X-rays, which are characteristic of the atoms present in the sample and are used for the elemental analysis. Thus, any XRF spectroscopy equipment typically consists of an X-ray source for sample excitation and a detection system for detecting the secondary fluorescent X-rays.

Our Unit maintains two home-built ED-XRF spectroscopy arrangements .



1) Si(Li) semiconductor (CANBERRA, SL80175): 5-mm-thick crystal, 80 mm2 active surface, 25-µm-thick Be window, 171 eV resolution at 5.9 keV, LN2 cooling.

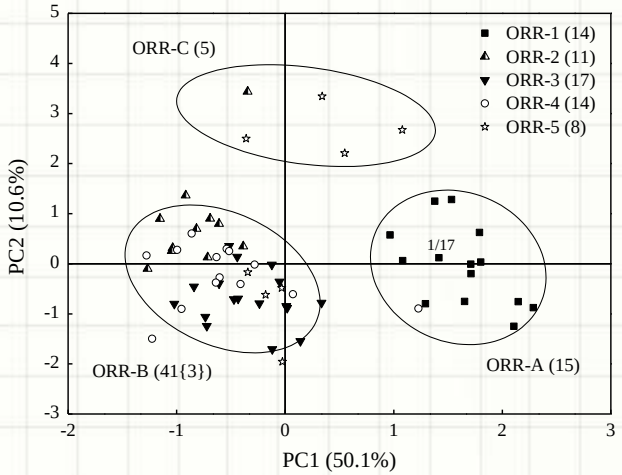
2) Si-PIN diode (Amptek X-123 complete X-ray spectrometer): 300-µm-thick, 6 mm2 area, 12.5-µm-thick Be window, 145 eV resolution at 5.9 keV, thermoelectric cooling

Annular radioisotopic sources: ^{109}Cd ($T_{1/2}$~463 d) and ^{241}Am ($T_{1/2}$~432 y)

EDXRF applications

Amongst other things, X-ray fluorescence spectroscopy is applied here for the compositional characterization of ancient pottery, in studies of provenance and manufacture technology and also in environmental studies, involving heavy metals

Characterization of archeological findings (sherds) through measurements of elemental compositions and subsequent statistical analysis (Principle Component Analysis).



Radiochronology

Our group relatively recently has acquired the Riso TL/OSL reader, a new HPGe system and an accompanying sample pretreatment radiochemical laboratory

Thus , we have completed 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.

UPDATING OF RADIATION DOSE-RATE CONVERSION FACTORS:
A CRITICAL RE-EVALUATION

"In Press"!

Liritzis I , Stamoulis K , Papachristodoulou Ch , and Ioannides, KG
Presented at

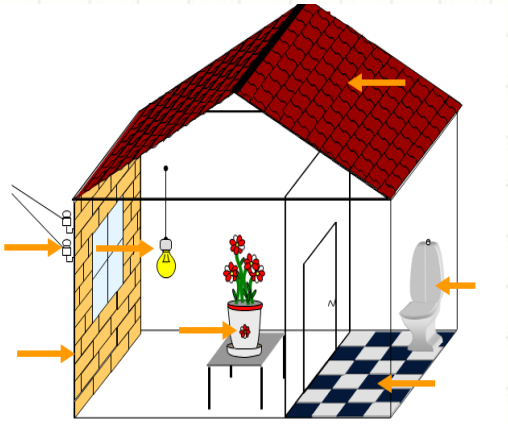
2nd Luminescence in Archaeology International Symposium will be held in Lisbon, Portugal, from the 5th to the 7th of September, 2012.

The issue: Isotopic Concentration of U-238, Th-232, K-40, Rb-87 (in ppm, %) to mGy/yr.

The goal: Dose Rates Evaluation in TL/OSL/ ESR Dating
(Age = ED/Dose-Rate)

The means: Calculations using nuclear data extracted from the ENSDF database (May 2012

Retrospective Dosimetry



Retrospective dosimetry is a new forensic analytical method

Household materials for retrospective dosimetry: Tiles, bricks, common salt porcelain, roof tiles, cell phones, etc.

Optical fiber as dosimeters

Thank you!