Program European Summer School
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Radiation Measurements and Radiochemistry in Environment and Decommissioning

Experimental work

Institut Pluridisciplinaire Hubert Curien – Strasbourg

Practical work	Title	Description	Supervisor (s)
1	Characteristics comparison of different photon detectors	To fully investigate the structure of a nucleus, spectroscopic studies require a high precision energy and timing measurements with the highest possible detection efficiency. Unfortunately, the « ideal » photon detectors do not exist. Either semiconductor detectors will give an excellent energy resolution but with a rather poor detection efficiency and timing measurement. Either fast scintillators will give a high detection efficiency and a good timing measurement but with a rather poor energy resolution. We then propose in this project to compare and to characterize the performances of a Highly Pure Germanium Detector (HPGe) with a rather new type of scintillators, the Lanthanum Bromide detector. After a short introduction to the detection principles, the students will have to perform an energy resolution measurement with these two kinds of detectors and compare them.	Pr. Olivier DORVAUX olivier.dorvaux@iphc.cnrs.fr
2	Calibration of a Photomultiplier response	Photomultipliers are important devices in nuclear instrumentation. They are used to convert light into electrical signal. This practical work proposes to become familiar with a procedure used to calibrate one photomultiplier. A dedicated experimental setup has been elaborated with a light injector system able to perform this absolute	Dr. Eric BAUSSAN eric.baussan@iphc.cnrs.fr

		calibration. In the first part of the work, the students will use an oscilloscope to read and understand the signal coming from light impulsion. All data will be treated using dedicated routine in ROOT environment using statistical models to extract the calibration parameters.	
3	Geant4/GATE Monte Carlo Simulation for Gamma Spectrometry	This project presents the Monte Carlo (MC) simulation tools Geant4/GATE through a gamma spectrometry application. After a short course on the basic principles of the MC simulation with Geant4/GATE (geometry, particle source and physical processes), participants will develop their own code (based on an existing example) to model a typical system of gamma spectrometry and some radioactive sources. The simulation will then be used to compute radiation protection quantities. This project is particularly aimed at those interested in the detection of ionizing radiation, the Monte Carlo simulation of radiation-matter interactions and the dosimetry. Basic computer skills (Linux, C ++) will be useful but not essential to this project.	Dr. Nicolas ARBOR nicolas.arbor@iphc.cnrs.fr
4	A rapid Sr-90 determination in milk samples	Milk and dairy products are the principal source of calcium in human diet. As strontium and calcium present similarities in their chemical and biochemical behaviour, milk is the major way of Sr-90 (released upon nuclear accident or as nuclear weapon use) incorporation in the human organism. As a beta emitter Sr-90 is mainly determined by liquid scintillation counting (LSC). However, this technique requests a single radioisotope solution, especially without milk major components and other beta emitters (K-40 and Y-90). To cope Sr-90 dosage with a	*Dr. Olivier COURSON* *Olivier.courson@iphc.cnrs.fr* *Dr. Sylvia GEORG* *sylvia.georg@iphc.cnrs.fr*

		detection limit less than 0.1 $Bq.kg^{-1}$ within 2 days, a rapid and efficient sample pre-treatment is required to concentrate and isolate Sr. We proposed to experiment a purification method, based on calcination, precipitation and extraction chromatography, using LSC and ICP-MS measurements (determination of the separation yield).	
5	Physicochemical measurement of the dose deposited by accelerated ions	In the framework of its research interests in the field of accelerated ion-matter interactions, in a context of cancer radiotherapy by ions, or hadrontherapy, the Radiochemistry group has developed an original platform allowing irradiation of liquid aqueous solutions with low-energy ions produced by a particle accelerator (protons and alpha particles of 1 to 3 MeV). In such experiments, the precise measurement of the deposited dose is essential. The practical work we propose consists of performing these dose measurements by a physicochemical method, the Fricke dosimeter. After an introduction to the notions of linear energy transfer (LET), water radiolysis and the principle of the Fricke dosimeter, you will prepare the solutions, and realize some radiolysis experiments on the accelerator. These will allow determination of the dose deposited in real time under irradiation, by absorption spectroscopy.	Dr. Quentin RAFFY quentin.raffy@iphc.cnrs.fr
6	Alpha-decay spectroscopy	Charged-particle spectroscopy is a well-established technique to probe the nuclear structure. Unlike non-charged radiation (e.g. photons and neutrons), charged particles are very reliable "messengers" since they easily interact with matter, hence their total energy can easily be absorbed with close-to-100% efficiency. In particular alpha particles emitted in alpha-decay processes can be used to probe the nuclear structure of the daughter nucleus.	Dr. Mohamad MOUKADDAM mohamad.moukaddam@iphc.cnrs.fr

		After an introduction to a considerably simple experimental setup and decay conservation laws, we propose to study the nuclear structure of ^{208}Tl and compare with the literature followed by an interpretation of the intensities within the theory of alpha-decay.	
7	Radiological impact of nuclear power plant decommissioning through the lens of Life cycle assessment	In this this practical work, a short brief will help participants to familiarize themselves with the theory and recent open-source software developments of life cycle assessment. We will then delve a bit deeper on the radiological impact assessment frameworks available, in order to understand the notion of characterization factors at midpoint and endpoint levels. Expected radionuclides' effluents data for 2 nuclear power plant decommissionings will be used to compute expected radiological impact. Analysis of the results and comparison with what can be obtained with the classical Risk Assessment framework will help to understand the respective relevance of these approaches.	Dr. Paul ROBINEAU paul.robineau@iphc.cnrs.fr