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	Radiochemistry	Part 1 : Spectrophotometric Determination of Uranium with 4-(2-Pyridylazo) resorcinol A simple method for selective spectrophotometric determination of uranium(VI) with 4-(2-pyridylazo)resorcinol (PAR) over pH 7.0–9.0 will be used. The molar absorptivity of the complex is in the range of 38700 mol−1·cm−1 at the absorption maximum. Part 2: Extraction of uranium from acidic solutions by monoamide Liquid-liquid extraction of U(VI) from nitric acid medium will be carried out using a class of CHON based molecular extractants namely monoamide. The extraction behavior of uranium(VI) will be discuss as a function of various parameters, such as the duration, aqueous phase concentrations of feed acid, extractant, etc… Liquid scintillation will be used to measure the coefficient distribution of uranium.	Dr. Ali Ouadi ali.ouadi@iphc.cnrs.fr
2	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 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).	*Dr. GALINDO Catherine* *catherine.galindo@iphc.cnrs.fr* *Dr. COURSON Olivier* *Olivier.courson@iphc.cnrs.fr*

3	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 does 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 this two kinds of detectors and compare them.	Pr. GALL Benoit Benoit.gall@iphc.cnrs.fr Pr. DORVAUX Oliver Olivier dorvaux@iphc.cnrs.fr
4	Study of a low-background gamma spectrometry system	This experimental project addresses the photon detection and activity estimation through the study of the performance of a low-background gamma spectrometry system. This system is composed of an HPGe detector and an anti-Compton system. The project will start by the connection and the adjustment of the electronic acquisition chain (amplifier, analogue-to-digital converter, coincidence module, delay). Then a complete calibration of the detector (energy calibration, detection efficiency) will lead to the activity estimation of specific radionuclides. Finally the contribution of the anti-Compton system will be studied. This project is aimed at those interested in the detection of ionizing radiation particularly with gamma spectrometry.	Dr. WILHELM Emilien emilien.wilhelm@iphc.cnrs.fr
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. RAFFY Quentin quentin.raffy@iphc.cnrs.fr

6	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. This code will then be used to optimize the detection system by studying the relationship between the radiation-matter interaction processes, the simulation parameters and the measurement performance. This project is particularly aimed at those interested in the detection of ionizing radiation and the Monte Carlo simulation of radiation-matter interactions. Basic computer skills (Linux, C ++) will be useful but not essential to this project.	Dr. ARBOR Nicolas nicolas.arbor@iphc.cnrs.fr