

**Experiment Title:**  
PIXE analytical technique applied  
on environmental samples (drinking and surface water)

**Experiment Responsible:**  
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## 1. Introduction

Particle Induced X-ray Emission (PIXE) analytical technique at the Van de Graff Tandem accelerator of DFN in IFIN-HH will be used to determine minor and trace elements in environmental samples (drinking and surface water), with the scope of anthropogenic pollution control, in the frame of two on-going PNII and JINR Joint Projects:

- "High Precision Analytical Techniques applied in the environment pollution biomonitoring in Romania", Project PNCDI II, No. 72-172/2008 (TIPSARMER) - Partner P2.
- "Nuclear and related analytical techniques applied in environmental studies", Joint Research Project IFIN-HH-JINR Dubna, Protocol No. 3871-4-08/10.

Analytical sensitivities in PIXE are situated in the range of  $\text{mg}\cdot\text{kg}^{-1}$ .

High precision and sensibility techniques (AAS, INAA and PIXE) are proposed to be applied in the frame of PNCDI II TIPSARMER project with the scope of investigation the environmental pollution due to anthropogenic activities from the South, South-East and Central development regions of Romania.

## 2. Materials and Method

The environmental samples to be investigated consist in drinking and surface water collected from areas of interest in the projects.

Thin targets ( $< 1 \text{ mg}\cdot\text{cm}^{-2}$ ) are prepared by adding to the investigated samples (decanted water) of yttrium as internal standard (from Y solution), for a quantitative determination of elemental concentrations. Volumes of 150-200  $\mu\text{L}$  are pipetted on Mylar foil (2.5  $\mu$  thickness) and dried under electric bulb (around 40 °C).

Reference materials (RM) of similar matrix with the investigated samples will be used for quantitative analysis in PIXE (Y internal standard being considered a beam flux monitor): e.g. chemically digested IAEA-393 (algae), IAEA-140 (*Fucus* brown seaweed), NBS1575 (Pine needles). In addition, standards prepared from chemical compounds are used to assess experimental  $K_{\alpha}/K_{\beta}$  ratios for different elements present in the samples.

### *Experimental set-up*

A 3 MeV collimated proton beam ( $\sim 3 \text{ mm}$  diameter) is used. The target is placed at an angle of  $45^{\circ}$  with respect to the incident beam. The proton beam current on the target is about 0.5 nA. The transport tubes and the target chamber are maintained at a high vacuum ( $10^{-6}$  torr).

The X-ray spectra measurements are performed using an electronic spectrometric chain with Si(Li) detector and Canberra 100 MCA acquisition system based on PC.

Appropriate absorbers follow to be used to reduce the high Ca X-rays peaks in the water spectra, with the scope of improving the analytical sensitivity for higher Z elements (e.g. V, Cr, Fe, Ni and Cu).

### **3. Results**

The following elements are expected to be determined by PIXE in the water samples: Al, Si, P, S, Cl, K, Ca, Ti, V, Cr, Mn, Fe, Ni, Cu, Zn, Sr and Pb.

The concentration results obtained in this beam will be presented in the Project Reports, having the dead-line November-December, 2010.

#### *Future applications of the results*

The analytical results will be published in scientific journals and conference proceedings.