The Applied Research Program of the High Flux Neutron Generator at the National Nuclear Center, Havana.

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ABSTRACT: The Havana High Flux Neutron Generator facility is an intense neutron source based on a 20 mA duoplasmatron ion source and a 250 kV high voltage power supply. It has been installed in the Neutron Generator Laboratory at the Center of Applied Technologies and Nuclear Research in 1997. This paper deal outlined the future applied program to be carried out in this facility in the next years. The Applied Research Program consists on install two nuclear analytic techniques: the PELAN tecnhique which uses the neutron generator in the pulse mode and the Low Energy PIXE technique which uses the same facility as a low energy proton accelerator for PIXE analysis.

The Neutron Generator Laboratory at the CEADEN has a future applied research program to be carried out in the next years on the base of a high flux neutron generator. The Applied Research Program consists on installing two nuclear analytic techniques: the PELAN (Pulsed Elemental Analysis with Neutrons) tecnhique, which uses the neutron generator in a pulse mode and the Low Energy PIXE technique, which uses the same facility as a low energy proton accelerator for PIXE analysis.

The High Flux Neutron Generator facility is an intense neutron source based on a 20 mA duoplasmatron ion source and 250 kV high voltage power supply. Under this parameters D^+ions produced are extracted and accelerated up to 250 KeV by the static linear accelerator. A rotation TiT target with 300Ci activity is considered and through deuterium-tritium (d-T) reaction produces fast neutrons with an energy range of 14 MeV and a maximum flux – $1x10^{12}$n.seg $^{-1}$.

Originally, the Neutron Generator works in continuos mode. In order produce ion pulses (protons and deuteron), recently there was develop a system wich allows the functioning of the generator in the pulse mode by modifying the ion extracting potential. At present the system is being characterized. Up to now the frecuency can be regulated between 0 and 100 Hz, and pulses rise time 5 μseg wide.

The introduction of a neutron pulsed system will allow the increasing first of all, the analytic capabilities of our laboratory and besides introduces the possibility of carring out new basic research programs. In particular the developed system will be utilized to introduce the PELAN technique which uses fast neutron activation in order to detect the presence of H,C,N,O and some other elements inside of drugs and hidden explosive materials. This technique utilizes both the fast neutrons to identificate such elements as C and O, by measuring the characteristic gamma radiation from neutron inelastic scaterring and the thermal neutrons for the measurement of elements such as N and H through the characteristic γ-rays from the capture reaction.

The transportation of illicit drugs has shown an increasing trend during the last decade and the development of fast, non-destructive interrogation methods are required for the inspection of cargo containers, trucks and airline baggages. Taking this account into, the PELAN technique is one of several neutron- based techniques that are now under study with the purpose of being used for non-intrusive detection of hidden contraband materials such as illicit druggs and explosive.

To develop an experimental base for the PIXE analysis with proton beams of low energy is another main purpose in the applied research program of the Neutron Generator Laboratory.

For us is well known that with slight modifications , lower voltage accelerators routinely used as neutron generators can be made to produce low energy protons in the range of 100 KeV. These protons have very small penetration depth in matter and can therefore be used mainly in surface studies and analysis of light matrices through the PIXE method.

Particle Induced X-ray Emission (PIXE) is a powerful analytical technique. It can be characterized as a qualitative, accurate and highly sensitive method for multi-elemental analysis of materials in general and in particular is considered the preferred method for trace element detection in biological tisuue.

Typically, the PIXE analysis based on an ion beam with energies between 1.5-3 MeV, provids detection limits as low as 1 ppm or even better, depending on the sample type and its preparation.

The possible advantages of using particle induced X-ray emission (PIXE) with proton beams energies below 1 MeV are, the low background radiation, good sensitivity for light elements, and lower secondary excitation in thick targets.

There is a number of laboratories in the world based on accelerators providing proton beam energies below 1 MeV. Some of them have developed different applications of low energy PIXE while some others have dedicated some efforts to the such basic researches related to PIXE in this energy range.

In such fields like material sciences, enviroment and archaelogy several authors have focused a number of applications such as light element detection, thin film measurement and the possibilities of depth profiling. These applications have shown the convenience of using low energy PIXE considering its capability of solving particular problems what justifies the attention raised now a today to the low energy PIXE.