

**EDUCATIONAL, RESEARCH AND IMPLEMENTATION ACTIVITIES  
IN THE DEPARTMENT OF ATOMIC PHYSICS AT PLOVDIV UNIVERSITY**

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1. The Department of Atomic Physics at Plovdiv University has 40 year long experience in educating students in Atomic and Subatomic Physics. Besides the core disciplines in these majors, the department conducts courses and seminars in:

- Experimental methods in Nuclear Physics;
- Neutron and reactor physics, nuclear energy;
- Radiation physics and technology;
- Dosimetry and radiation protection;
- Nuclear electronics;
- Nuclear chemistry and radiochemistry;
- Radiobiology and radioecology etc.

We aim at making the knowledge gained in nuclear physics part of the culture of our students. The Department has published all the necessary course books and instruction manuals for the course of study (fig. 1), [1-5].



Fig.1: Course books and instruction manuals published by the Department of Atomic Physics.

The Laboratory Practicum employs all the newly developed equipment and methodology by the Department. The laboratory tasks for experimental testing of Compton theory and the study of the characteristic x-ray and Moseley's Law apply computerized multi-channel spectrometers [6], in the experimental scheme for the study of Rutherford's alpha-particle scattering of various nuclei we use surface-barrier semiconductor detector [4], for the purposes of neutron activation analysis and gamma-spectrometry with high resolution we apply computerized multi-channel spectrometer with semi-conductor detector of HP-Ge (fig.2), [7].

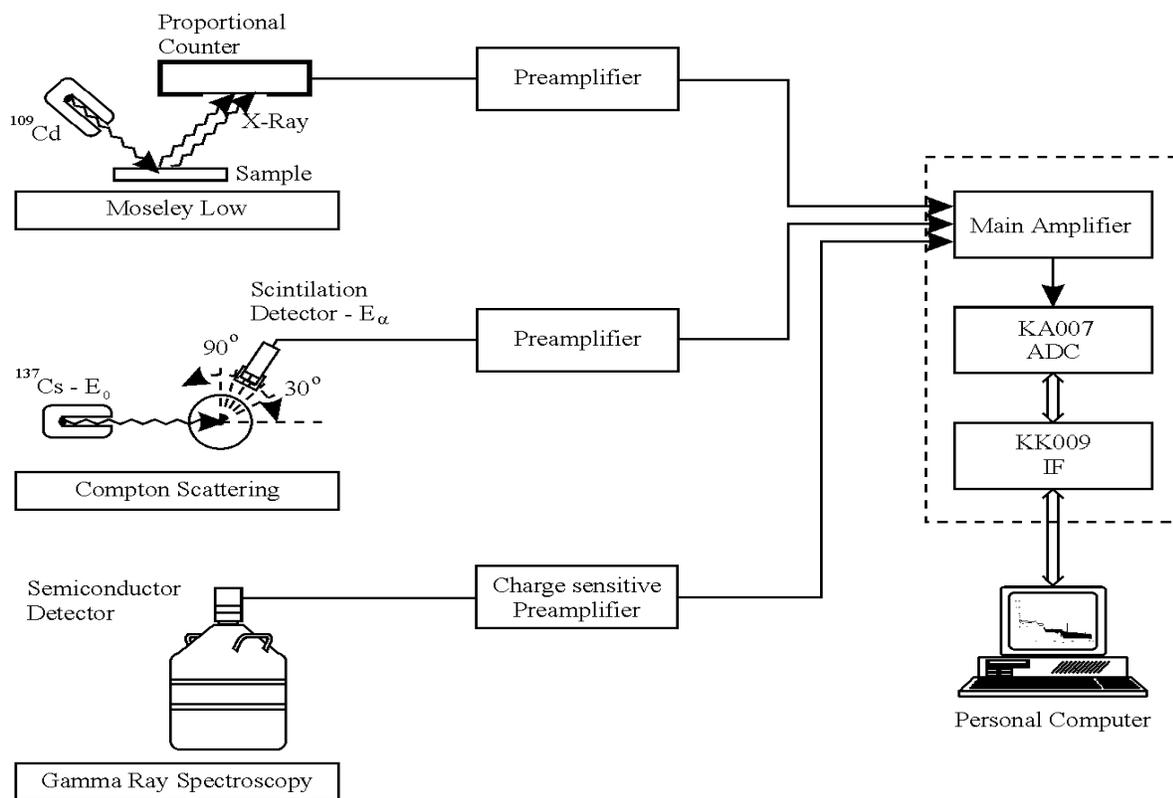


Fig.2: General scheme for the "on-line" PC laboratory practice

Parallel to the educational activities within the University, the Department conducts educational activities for the wider community, especially among high school pupils. The team organizes and runs educational and professional development seminars and courses and uses the media in discussing relevant to nuclear energy and its application issues.

2. At the core of our educational activities lies our long-term cooperation with JINR-Dubna in the study of atomic nuclei. By means of  $(n,\alpha)$ ,  $(\gamma,\alpha)$ ,  $(n,p)$ ,  $(\gamma,n)$ ,  $(\gamma,\gamma^1)$  etc. reactions we have studied the characteristics of a number of nuclei in the wide range of  $Z$  and  $A$ , [8-10]. Figure 3 illustrates the achievements of the department in nuclear physics and shows in the research of which nuclei we have taken part.



Fig.3: Nuclei researched at the Department of Atomic Physics

3. The department has a diverse set of implementation activities. We dedicate a great deal of attention to the application of nuclear physics methods in a wide range of technical fields – electronics (beta-ray backscatter method), glass industry, metallurgy, biotechnology (gamma-indicator method for furnace and bioreactor investigation) etc., [11,12].

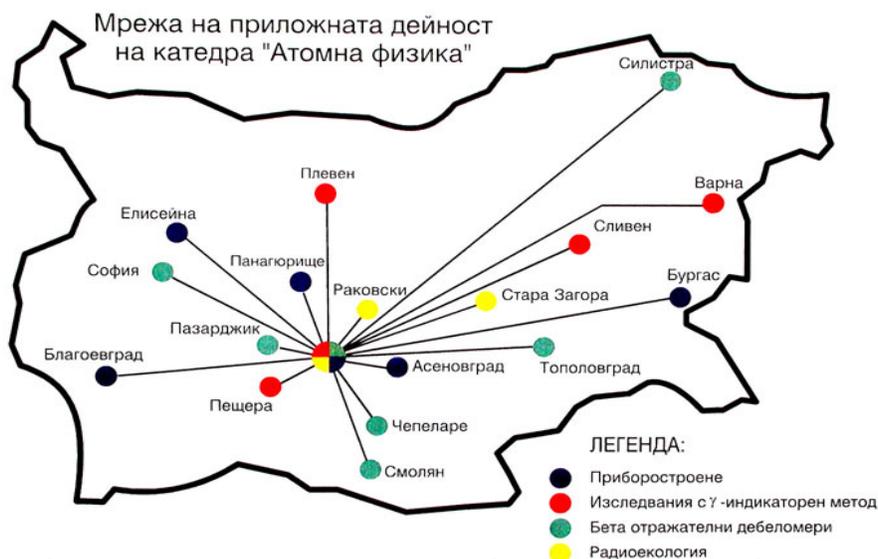


Fig.4: Network of the implementation activities of the Department of Atomic Physics

Figure 4, which shows our implementation network, illustrates the geographical spread of this aspect of our work.

The department has initiated and conducted a number of symposia for the industrial application of nuclear-physics methods (fig. 5). Professionals from all departments applying nuclear methods in the country have taken part in them alongside with colleagues from abroad.



Fig.5: Conference and academic publications

4. In recent years we have focused considerably on radio-ecological research. This strand of our activities enjoys the valuable support of the Nuclear Regulatory Agency. We have conducted research in:

- the radiation status of areas influenced by the uranium mine industry in Plovdiv and Smolyan regions;

- the radiation background along the banks of the upstream Arda;
- the radio-ecological status of some natural reserve areas in the region of Smolyan, including Large Smolyan Lake etc.

## **CONCLUSION**

The Department of Atomic Physics at the Paisii Hilendarski University of Plovdiv has considerable achievements in educational, research and implementation activities and has the potential to develop further these strands. A central problem, impeding the process of development, in recent years is the insufficient funding.

In this respect a definitely positive, possibly even key role, can be played by NPP Kozlodui, since it is essential to its management to ensure that Bulgaria has good specialists in the field of nuclear physics and nuclear energy.

## **REFERENCES**

- [1]. N. Balabanov, M. Mitrikov, Atomic Physics, Kliment Ohridski University Press, Sofia, 1991. [in Bulgarian]
- [2]. N. Balabanov, Nuclear Physics, Plovdiv University Press, Plovdiv, 1998. [in Bulgarian]
- [3]. A. Antonov, N. Balabanov, S. Marinova, Tasks in Atomic and Nuclear Physics, Plovdiv, 1992. [in Bulgarian]
- [4]. A. Antonov et al., Atomic Physics Practicum, Plovdiv University Press, 2002. [in Bulgarian]
- [5]. A. Antonov et al., Nuclear Physics Practicum, PUP, 2003. [in Bulgarian]
- [6]. A. Antonov, M. Mitrikov, B. Toskov, H. Hristov, Experimental Tasks from the Laboratory Practice in Atomic and Nuclear Physics, BPU-5, 5-th General Conference of the Balkan Physical Union, Aug.25-29, 2003, Vranjacka Banja, Serbia and Montenegro.
- [7]. A. Antonov et al., Semi-conductor gamma-spectrometer of the nuclear-physics laboratory Microtron at Plovdiv University, XVII International Symposium in Nuclear Electronics, 15-21 Sept. 1997, Varna, Д13-98-66, Dubna, 1998. [in Russian]

- [8]. N.P.Balabanov et al., Nucl.Phys. A261, 35, 1976.
- [9]. A. Antonov et al., Nuclear Physics, 27, 18, 1978; 39, 794, 1984; 41, 837, 1985; 51, 305, 1990; 53, 14, 1991. [in Russian]
- [10]. N. Balabanov et al., ЭЧАЯ, 21, в.2, 1990; 27, №2, 1996. [in Russian]
- [11]. A.Srents, Research and Application of Back Scattering of Beta-Particles, Dissertation, 1990. [in Bulgarian]
- [12]. N. Kapitanova, Application of Radioactive Indicator Method for Studying the Convective Flow of Glass, Dissertation, 1986. [in Bulgarian]