AUTOMATED SETUP FOR STUDYING THE ATOMIC SYSTEMS EXCITATION BY ULTRAMONOENERGETIC ELECTRONS

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The experimental apparatus has been developed for studying the excitation of atoms and molecules from the ground and metastable states by monoenergetic (ΔE=20 meV) electrons with the use of the photon spectroscopy technique. The studies on the selective excitation of the 6^3P_1- levels of the Hg atoms by electrons, produced both by an electron gun and hypocycloidal electron monochromator, were performed.

The experimental apparatus has been developed for studying the excitation of atoms and molecules from the ground and metastable states by monoenergetic ($\Delta E \approx 20$ meV) electrons with the use of the photon spectroscopy technique. The principal units are as follows: a hypocycloidal electron monochromator (HEM) [1], an electron gun for the metastable state population, a collision chamber with a vapour-filled cell or an atomic beam source, a spectral monochromator, a photon detector, the controlled power supplies and detection units, the digital-analog and the analog-digital converters, a PC with the interface board for data input/output, the pulse counters (16 or 32 bit) and a timer (Fig.1).

HEM produces the electron beams with the 20–80 meV energy spread at the 0.5–30 eV energies. The vapour-filled cell is used for the substances with high vapour pressures at relatively low temperatures (Na, K, Rb, Cs, Hg or gases), while the multichannel atomic beam source for those Ba, Zn, Cd, Tl etc.).

The process of measurement is fully automated by means of an IBM PC. The control and measurement algorithms have been developed for studying different processes. The Turbo Pascal V7.0-based program has been developed for measuring, data processing and visualization.

The program allows one to study the current-vs-voltage characteristics of both electron beam sources and the energy dependences of excitation cross sections for the atomic systems within a wide energy range with the 2.5–500 meV step. The precise digital voltmeters, nano- and microampermeters, pulse counters readings are written to the data files. In addition, the data on the experimental conditions (i.e. the electron source electrode potentials, atomic source temperatures, exposure time, etc) are also recorded and can be easily reproduced.

The program graphics allows the experiment to be controlled in the on-line mode with the simultaneous visualization of a number of parameters in different combinations on the display. The computer dialog is performed by means of a main menu with branched submenus. A program can easily be modified and extended can easily be modified and extended depending on the demands that may vary.

The studies on the selective excitation of the $6\ ^3P_1$-levels of the Hg atoms by electrons produced both by an electron gun and HEM have been carried out for the first time.

The emission was detected by the FEU-142 photomultiplier and the "Photon" photomultiplier with the UFS-1 light filter, respectively. The results of the measurements are presented in Figs. 2 and 3.

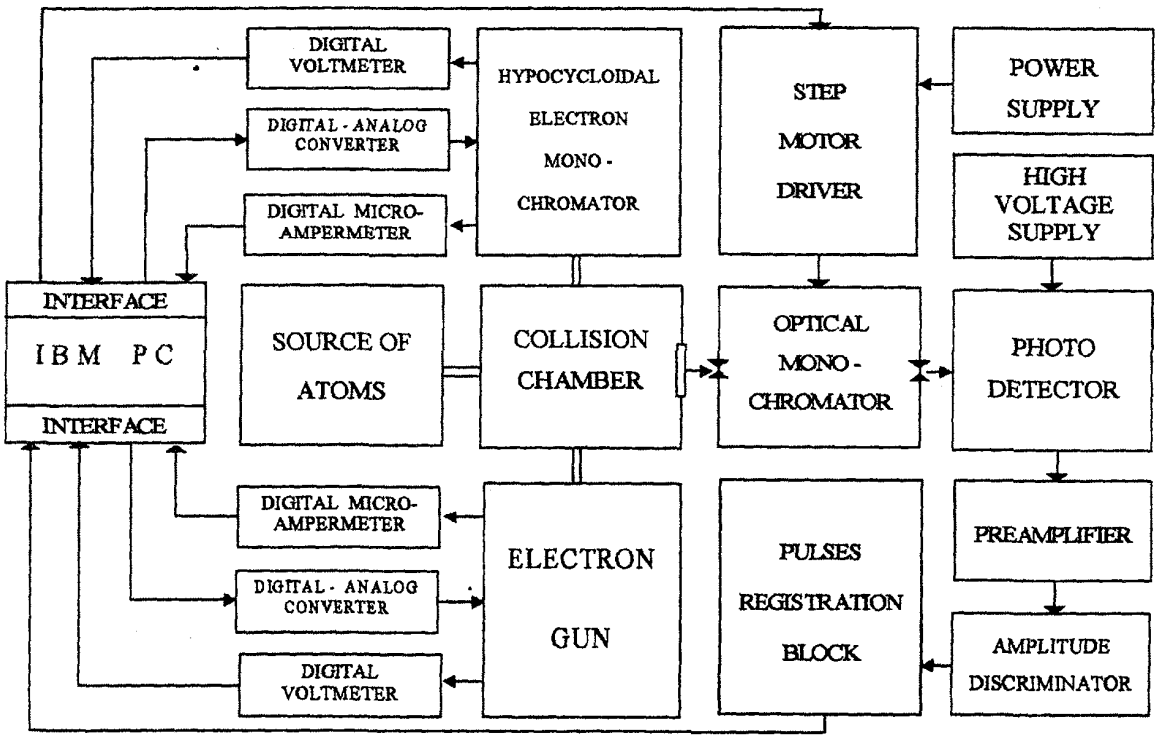

Fig.1 Schematic layout of the experimental apparatus.

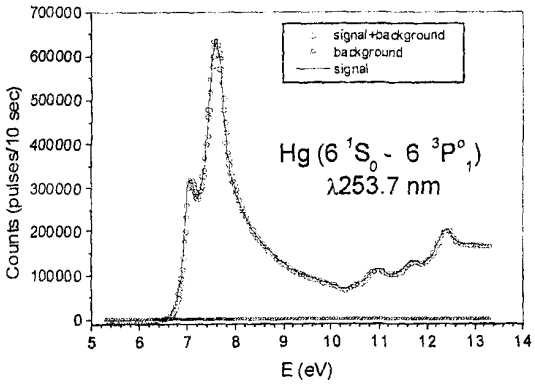

Fig. 2. The excitation function for the resonant 253.7 nm line.

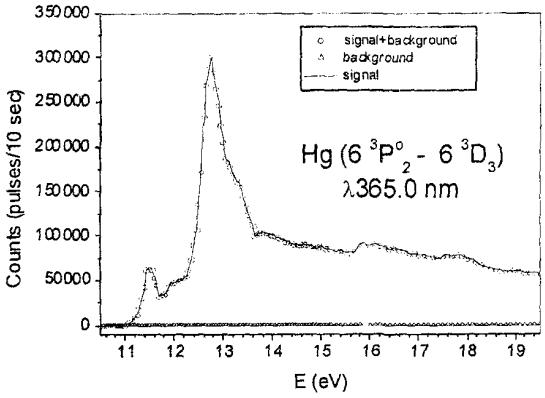

Fig. 3. The excitation function for the 365.0 nm line.

Reference

1. O.B.Shpenik, N.M.Erdevdy, N.I.Romanyuk *et al., Prib. Tekhn. Eksper.* **41**, 66 (1998).

АВТОМАТИЗОВАНА УСТАНОВКА ДЛЯ ВИВЧЕННЯ ЗБУДЖЕННЯ АТОМНИХ СИСТЕМ УЛЬТРАМОНОЕНЕРГЕТИЧНИМИ ЕЛЕКТРОНАМИ

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Створено експериментальну установку для вивчення процесів збудження атомів і молекул в основному та метастабільному станах за допомогою моноенергетичних (ΔE=20 меВ) електронів з використанням фотонної спектроскопії. Отримано попередні результати по вивченню селективного збудження 6^3P_1- рівня атома ртуті за допомогою електронів від електронної гармати та гіпоциклоїдального електронного монохроматора.