THE BEAM DIAGNOSTIC SYSTEM AT THE RADIATIVE-TECHNOLOGICAL FACILITY WITH LINEAR ELECTRON ACCELERATOR

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The main purpose of the production technology is the receiving the materials (production) with specific properties. The radiative technologies belong to the science intensive ones and allow to realize processes, which depend on the exact numerous parameters and ensure the stable production characteristics. The modern radiation technologies engage thin effects of the substance transformation to the manufacture and allow to create unique production.

During development of new radiation production processes, the exactness of parameters monitoring of the irradiation is the defining moment, and accordingly – the choice of methods and means of measurement of beam characteristics. The comparison of beam (irradiation) parameters with effects of raw material modification observed is the main purpose of the technological researches and development. Therefore, during development of the new radiative-technological complex based on the electron accelerator at the Institute for Nuclear Research, Nat. Ac. Scie. of Ukraine, the particular attention was given just to the diagnostics system engineering of the beam, which is designed for irradiation objects.

The development of the diagnostics methods and technique was performed with regard to the experience of scientific researches at the INR, and also features and design parameters of the beam linear electron accelerator "Electronics U-003" [1]. For convenience of using it was decided to construct this unit as a separate device located just behind the exhaust window of the accelerator in front of the deflection or scanning system. After analysis of different diagnostic methods [2, 3, 4] for development of the unit of beam diagnostics we applied the most simple induction methods and tools, which ensure the necessary exactness of measurements with minimum expenditure for the beam of typical intensities.

The diagnostic unit is constructed with the so-called signal electrodes.

Taking into consideration the real needs of the technological processes of the biomaterials and food products processing, the more sensitive device for the linear accelerator was created on their basis. The device includes the intensity beam sensor, two-coordinate sensor of the beam center position (Fig. 1), and protective electrodes. The increase of the exactness and reduction of the distortions is ensured by using in all measurement contours the differential methods of the information receiving and processing and sensors design features.

The two-level beam monitoring system is foreseen. The first (lower) level is based on the principles of analog information processing, where, except own functions of the information receiving, the independent analog contours of beam stabilization on the target are created. The further signal processing for receiving the summarized information on the irradiation parameters is realized by means of the computer facilities and nuclear electronics engineering.

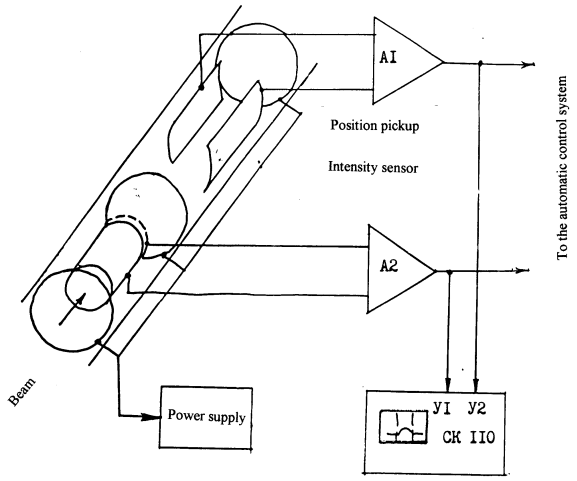

Fig. 1. The structure of the beam diagnostic device

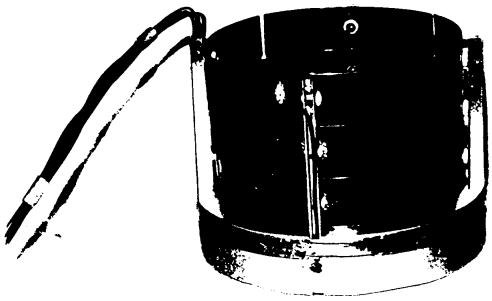

Fig. 2. The sensors' design

The sensors are constructed as one unit, Fig. 2, which works reliably under the average beam current ranging from 1 mkA to 10 ìA. Having the aperture of 100 mm in the diameter the device ensures the sensitivity on the beam center position about 1 mm. During the measurement of the average current value the sensitivity of the device does not concede to that of the typical sensor of the beam linear accelerator "Electronics U-005". It is expected to use in future such type of devices for applied works at other accelerators, with more complicated transportation system (transport channel) of the beam to the target. As a rule, in this case the beam monitoring system in many points of its way

through the ionic optics elements of the transport channel is used. Such systems are expensive and inexpedient for the applied accelerators, because they increase the cost of the facility and the cost price of the radiation technologies. Thereforeit is desirable to draw perfect methods of the information receiving and processing.

For the beam diagnostics systems in the complicated transport channels the special software with utilization of beam behavior modelling principles during the passing of the magnetic optics elements of the channel has been created. The main information for such system are the beam data at the input, and also in a monitoring point of the transport channel. This information is received by 2-3 of the indicated devices. Further, taking into consideration the elements of ionic optics modes, by the mathematical information processing, the beam envelopes on the whole way of its passing are calculated and reflected. The operator gets this information on the screen as the combined vertical and horizontal envelopes (Fig. 3) such, as if measurements are carried out in many points of the transport channel. It allows one to simplify the structure of system and reduce the volume of measurement tools.

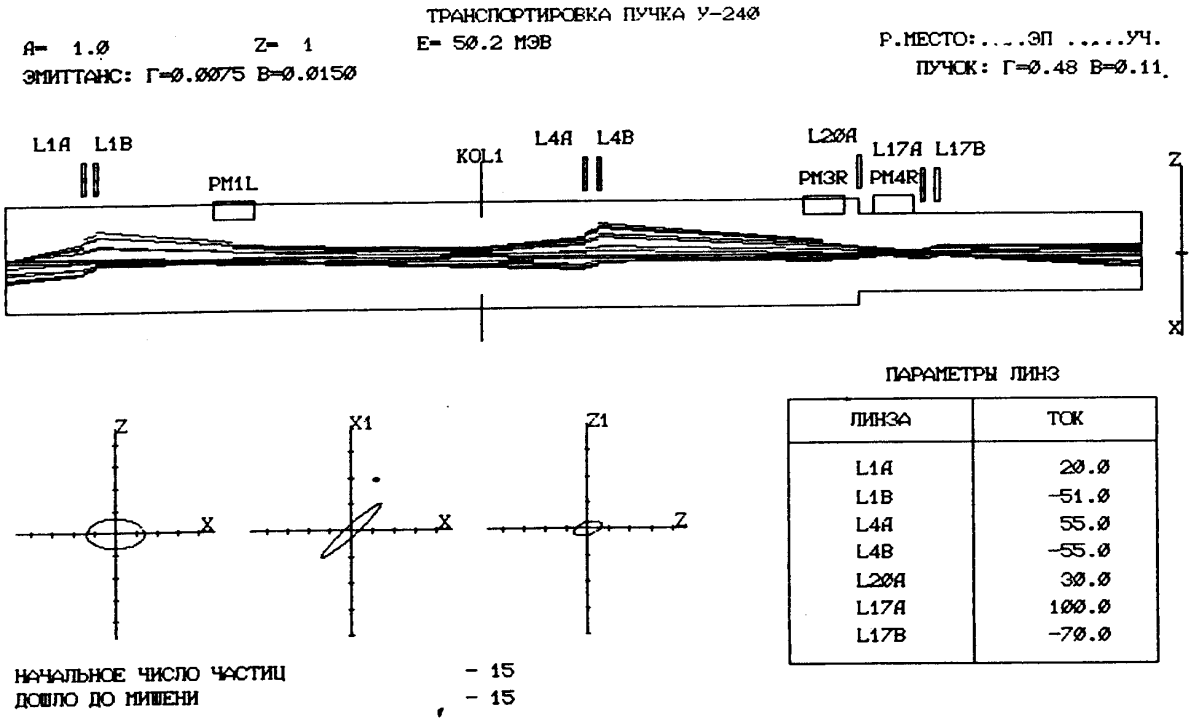

Fig. 3.

REFERENCES

1. V.N. Shubin. Yu.I.Sharanin, S.A.Brusentseva et.al. –Moscow, “Energoatomizdat” Pablition, 1985.
2. A.L.Savchenko, V,I,Sakhno, S.P.Tomchai\\ Proc. of International Simposium on marine-enture, Moscov, VNIRO Publition, 1995, p.94.