

## INJECTOR OF MULTIPLY CHARGED IONS FOR ACCELERATORS AND IMPLANTERS

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An injector of separated ions based on the use of the PIG ion source is developed of the Institute of Nuclear Research (Kiev). The efficiency of the beam transport is increased by the radial focusing of the beam in the field of the source magnet and axial focusing at the output boundary formed by a magnetic screen.

The project of an external separated-ion injector was developed in connection with the creation of an axial injection system for the U-240 cyclotron. This injection system is to provide the cyclotron with an ion beam produced by an external source. The injector consists of an arc source multiple-charged ions, of the source magnet, a magnetic shield and a magnetic analyzer (Fig. 1).

To increase the efficiency of extracting ions from the external arc source, and thereby to increase the beam intensity at the output of the injector, the beam extracted from the source is focused radially in the field of the source magnet and focused axially while crossing the exit boundary of the fringing field at the angle  $\epsilon$ .

The fringing field is formed with the help of the magnetic shield. The ion source emittance and the magnetic analyzer acceptance are matched by forming the exit effective boundary of the magnetic field of the ion source in such a way as for the tangents to the trajectories of the ions that have reached the effective boundary to intersect the main trajectory of the magnetic analyzer over a length equal to the entrance arm  $l_1$  of the magnetic analyzer. The angle of rotation of ions in the source magnetic field  $\Phi$  and the tilt of the effective boundary  $\epsilon$ , which determines the focusing and matching of the beam in the vertical plane, are calculated from the formulae of work [1].

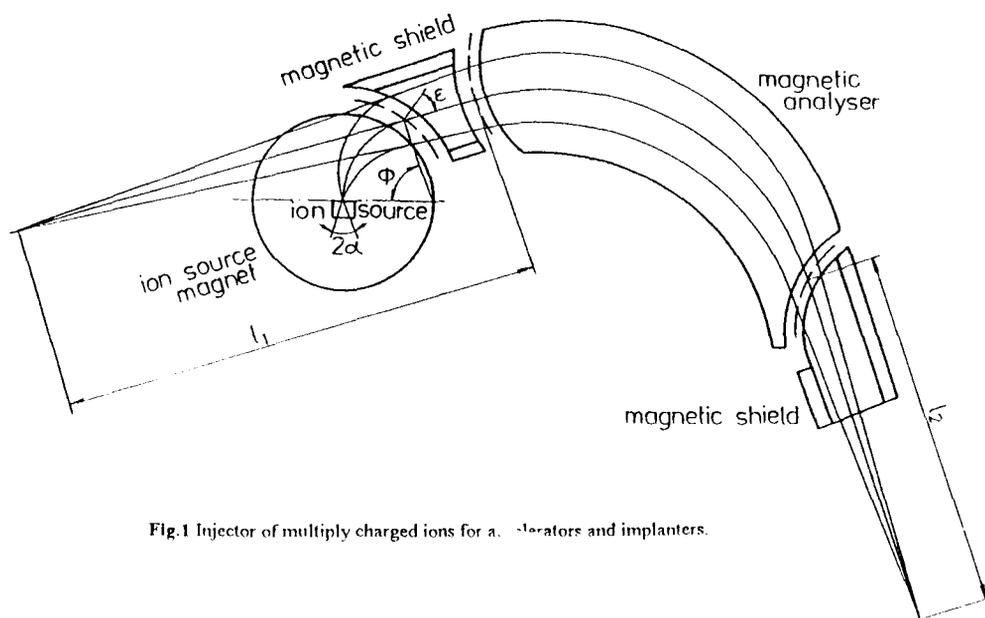


Fig.1 Injector of multiply charged ions for accelerators and implanters.

The arc source installed at the U-240 isochronous cyclotron is 162 mm in height and ~50 mm in diameter. Therefore the electromagnet required must have a pole piece of diameter >300 mm and a gap of ~180 mm.

The proposed injector has an increased angle of capturing ions ( $15^\circ$  instead of the ordinary  $6^\circ$ ), which is achieved by placing the exit slit of the source closer to the entrance of the magnetic analyzer and by using the

uniform magnetic field of the source to focus the divergent beam.

Use is made of the magnetic analyzer previously developed by us for a mass-separator but made on the scale 1:2 [1]. Thus, by focusing the ions extracted from the arc source, within a wider capture angle and using a magnetic analyzer, a beam of ions separated by charge (mass) can be produced whose intensity is several times higher than that of an unfocused beam.

### Reference

1. N.I. Tarantin, A.V. Demyanov, A.P. Kobachenko, Nucl. Instr. Methods, 38, 103, 1965.