EXPERIMENTAL STUDY OF THE DIVERGENCE OF A WEDGE-TYPE ION BEAM

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A first study of the divergence $\alpha$ of an ion beam emitted from a slit (1) disclosed the dominant effect of the meniscus curvature (plasma boundary at the slit) in determining the value of $\alpha$. Later, the contributions of other factors were recognized (2), mainly the lens effect of the electrode slit and the space charge in the interelectrode region. The overall value of $\alpha$ was calculated, taking into account these effects and assuming Pierce-shaped electrodes in all cases (3).

In the present experimental study, the value of $\alpha$ was measured in the MEIRA isotopo separator (4) as a function of electrode distance $d$ for different values of the following parameters: total ion current $i_e$ (10, 14, 20, 30, 45 and 60 mA), ion mass $M$ (helium, neon, argon, xenon), slit width $f$ (1.0, 1.5, 2.0 mm), slit aperture angle ($2^\circ$, $2\times70^\circ$, Pierce-shaped). Since it is practically impossible to use the correct Pierce profile for each parameter combination, most of the measurements were made with a standard $2\times60^\circ$ aperture angle. The results were compared with the calculated values according to the expression of Menat (3) assuming, for simplicity, that all the coefficients in the Menat expression are unity. The agreement, in general, is satisfactory, considering all the approximations adopted and the experimental errors. Abbreviated results for a particular case (neon, $f=1.5$ mm) are shown in Fig. 4. For practical applications, therefore, one may use the simplified relation:

$$\alpha = \alpha_0 + \frac{1}{2} \left(\alpha_0 + \frac{f}{d}\right) + \frac{1}{2} \left(\alpha_0 + \frac{f}{d}\right) \frac{4}{5} \left(\alpha_0 + \frac{f}{d}\right)$$

where the first term $\alpha_0$ is the contribution of the meniscus curvature as defined in Ref. 1, the second term represents the electrode lens effect and the last term, the space-charge effect. The last term is usually small and may be neglected in most cases, considering the approximate quality of the expression.
Beam divergence as a function of electrode distance for various beam currents of a neon beam emitted from a slit 1.5 mm wide with an aperture angle of 2×60°.

- - - calculated; ---+--- experimental

REFERENCES:
2. Chavet, I., Proc. in: Int. Conf. on EMIS and the Techniques of their Applications 1970 Marburg, ed. by H. Wagner and W. Walcher, Physikalisches Institut der Universität Marburg, p. 303

VARIATION OF THE TRANSVERSE PROFILE OF A WEDGE-TYPE ION BEAM UNDER DIFFERENT OPERATIONAL CONDITIONS
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In addition to the main divergence α discussed in the previous report, other interesting features of the profile of an ion beam emitted from a slit are disclosed by the "divergence curve" obtained by scanning the beam in the horizontal direction with a vertical probe. The shape and quality of this divergence curve may be adversely affected by non-essential factors described