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Thesis Title	A computational study of space-charge effect on the design of electrostatic lenses			
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Abstract

Synopsis

The importance of electrostatic lenses lies in the focusing of accelerated ion beams and the construction of electron guns and ion sources. With the aid of a personal computer and using the numerical analysis method the present computational investigation has been mainly concerned with the effect of space charge on the design and aberration of various types of electrostatic lenses operated under preassigned magnification conditions. The space charge is highly dependent on the value of electron beam current and it has been found to be an important parameter affecting the geometry of electrostatic lenses required for a specific preassigned beam trajectory with the lowest possible aberration coefficients.

For the various operational modes such as the zero, infinite and finite magnification conditions a trajectory equation has been put forward for each mode. It was used for determining the electrostatic potential and field distributions by solving the paraxial ray equation. The electrode shape which would produce the computed potential was obtained by solving Poisson´s equation. The choice of the trajectory equation

	depends on achieving the lowest possible values of the aberration coefficients which were computed from the knowledge of the potential distribution and its first and second derivatives. The effect of the imaging beam cross-sectional area on the aberration coefficients has also been investigated for each operational mode which showed that it is a significant factor. **The present work introduced new and simple designs of two and three-electrode electrostatic lenses suitable for preassigned magnification conditions in the presence of space charge. The three-dimensional diagrams of the electrodes have shown that these electrodes are practically possible to manufacture and assemble. The results have indicated that the electrodes geometrical shape can be greatly simplified and at the same time the aberration coefficients can be substantially reduced even in the presence of space-charge effect. Thus the inverse problem optimization method makes it now possible to predict the geometry and the optical performance of a complete electrostatic lens.**