Contribution ID: **25**

Type: **Poster**

P02 - Ion optics of probe forming systems on the base of magnetic quadrupole lenses with conical aperture

Friday, 11 July 2014 13:00 (1 hour)

One crucial factor in the nuclear microprobe resolution improvements is the beam optical performance of the focusing system with an acceptable ratio between demagnification and aberration. One of the way resolution improvement may be using magnetic quadrupole lenses (MQL) with a conical aperture. The optics of such lenses is described in the paper [1]. The main difference of MQL with a conical aperture from conventional quadrupole lenses consists in that, the poles are not parallel to the lens axis and positioned at a certain angle. The conical angle influences on the longitudinal distribution of the field gradient, which leads to a changing of the optics of such type quadrupole lens. In MQL with a conical aperture the longitudinal field distribution profile is not symmetric relative to the geometric center of the lens. The focal plane of such lens can be shifted by means of the variable conical angle. Due to this fact the lens aberrations value can be changed by the conical angle.
Investigations of the ion-optical properties of probe-form systems (PFS) on the base of doublet and triplet of MQL with a conical aperture are presented in this work. The dependence of PFS optics from the conical angles and geometric parameters of the system was determined. There is a possibility to increase the acceptance of PFS to use MQL with a conical aperture for a doublet in one and a half times, and for triplets - more than double as opposed to conventional systems. This result confirms a more favorable ratio between demagnification and aberration for analyzed PFS.
Those magnetic quadrupole lenses with a conical aperture are expected to be useful for the focusing system, and there is an opportunity to design quadrupole lenses with a permanent magnet poles. The conical angle variation leads to a change of the focal power lens and allows adjustment of the system.

[1] A.G. Ponomarev, D.V. Magilin, V.I. Miroshnichenko et al. Applied physics 3 (2011) 117.

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Session Classification: Poster Session with Cheese and Wine