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Motivation of Concepts for the Negative Ion Extraction from a Single Element of the Matrix Source

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The 2D model of a single element of the matrix source [1] presented in the study is in the trends of recent experiments [2] on the negative ion extraction from the source. The matrix source of volume-produced negative ions, studied regarding fusion applications, is with the design of a matrix of small radius discharges, with planar coil inductive driving and single aperture extraction from each discharge. The efficiency of the source is based on strong accumulation of negative ions in the discharge region with high dc potential, due to the flux of the ions in the dc electric field in the discharge when the discharge radius is small. Since the spatial distribution of the negative ions obeys that of the dc potential in the discharge, the two concepts studied for the ion extraction involve control on its behaviour in the vicinity of the first electrode of the extraction device. The first concept is for extraction of ions non-locally accumulated in the discharge region with high dc potential. Since in the planar coil inductive discharges the maximum of the dc potential is close to the coil, the concept is for ion extraction from a short length discharge, with a high bias applied to the first electrode of the extraction device. The latter ensures straightening in the axial profile of the dc potential needed for avoiding the capture of the ions inside the discharge. The second concept – ion extraction from a long length discharge with and without a magnetic filter – is for extraction of ions locally produced close to the extraction device. The high potential applied to the first electrode of the extraction device is needed for formation of a deep potential well in front of it and, respectively, of a strong electric field for the ion acceleration towards the electrode. The results for the spatial distribution of the plasma parameters in the discharge obtained from the presented 2D model and the outlined conclusions appear as a motivation of these two concepts.

References

1. St. Lishev, Ts. Paunska, A. Shivarova, and Kh. Tarnev, *Rev. Sci. Instrum.* **83**, 02A702 (2012).
2. St. Lishev, D. Yordanov, and A. Shivarova, *AIP Conf. Proc.* **1655**, 040013 (2015).