Magnetic trap and ion beam extraction system development for proton injector for DARIA project [[1]](#footnote-1)\*)

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Decrease of available neutron sources (caused by nuclear research reactors decommissioning) leads to reduction of studies and makes them more expensive. On the other hand, compact and relatively cheap neutron sources are needed for research, development, education and training. Therefore, a compact neutron source project DARIA (Dedicated to Academic Research and Industrial Application) [1] was developed. Neutron source is based on a linear accelerator.

A proton injector for DARIA is considered in this work. Proton beam injector GISMO (Gasdynamic Ion Source for Multipurpose Operation) was successfully tested before [2]. Intensive ion beam flow (with density up to 1.5 A/cm2) can be formed due to high-power (up to 10 kW in continuous-wave mode and up to 200 W/cm3 input power density) and high-frequency (28 GHz) microwave heating. An optimization of the existing proton injector is described in this work.

The magnetic trap change is made to soften the requirements for the ion beam formation system. The magnetic system consists of permanent magnets NdFeB(N48) with radial and axial magnetization direction. It can be fully described using geometrical parameters of its parts.

An extraction system optimization aims to reduce the beam losses in the extractor and improve the beam quality. A three-electrode system (with an additional shielding electrode) was used to form a proton beam. Magnetic lens was used to make a low-divergent beam. The beam space charge compensation at the level of 90% was taken into account. A 40 keV proton beam formation with total current more than 100 mA and normalized emittance less than 1 π mm mrad (for 95% beam fraction) was calculated. The initial ion beam current density reached several hundreds of mA/cm2. Simulations were made using a computational package IBSimu [3].

References

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1. \*) [abstracts of this report in Russian](http://www.fpl.gpi.ru/Zvenigorod/XLIX/Lt/ru/ET-Vybin.docx) [↑](#footnote-ref-1)