Ion beam extraction systems study at GISMO facility [[1]](#footnote-1)\*)

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Nowadays, the problem of intense light ion beams formation with high quality is important. In general, these beams are used to be injected into accelerators. The latest achievements in the development of intense light ion beam injectors are the following. The source for the FRANZ project [1] forms a proton beam at 100 mA current, 95 keV energy and 0.25 π mm mrad normalized rms emittance. The another example is the beam of deuterium ions at 140 mA current, 100 keV energy and 0.2 π mm mrad normalized rms emittance which was obtained at the IFMIF facility [2]. The average plasma flux density in the extraction region did not exceed 200 mA/cm2 in these cases. The plasma source in both cases is an ECR discharge with microwave heating at frequency of 2.45 GHz and input power of several kW. Sources of this type are reliable and characterized by stable and long-term operation. The main limitation of these ion injectors is the moderate plasma flux density which leads to the use of plasma electrodes with a large aperture (diameter is about 1 cm) to obtain a high current beam. Improving the characteristics of ion injectors is possible by increasing the plasma flux density. It is preferable to maintain the frequency of the heating radiation at the same level. Accordingly, plasma heating is studied in regimes where its density exceeds the critical value for a given microwave frequency [3].

Another method of the plasma density increase is to use microwave radiation with higher frequency and power to heat the plasma. The gasdynamic ion source GISMO (Gasdynamic Ion Source for Multipurpose Operation) was developed in accordance to this paradigm. Microwave radiation from gyrotron [4] at 28 GHz frequency and up to 10 kW power is used to heat the plasma. A high volumetric energy input (at the level of 250 W/cm3) is achieved because of the relatively small plasma volume compared to the 2.45 GHz ECR ion sources. Therefore, it is possible to extract ion beams with an initial current density of more than 1 A/cm2 [5].

This work is devoted to the development of systems which are capable to extract the beams with current density about 1 A/cm2 as well as to the study of their operating modes under various external conditions (the gas pressure, the microwave radiation power, the extractor geometry). The ion beam was extracted from the plasma using a two-electrode extraction system, and its current was measured using a Faraday cup.

References

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