Measurement of plasma parameters of a continuous ECR discharge with a high volumetric energy input [[1]](#footnote-1)\*)

DOI: 10.34854/ICPAF.2023.50.2023.1.1.142

1,2Polyakov A.V., 1,2Izotov I.V., 1,2Skalyga V.A., 1,2Vybin S.S., 1,2Kiseleva E.M., 1Bokhanov A.F.

1Federal Research Center Institute of Applied Physics of the Russian Academy of Sciences
 (IAP RAS), Nizhny Novgorod, Russia
2Lobachevsky State University of Nizhny Novgorod, Nizhny Novgorod, Russia

Nowadays, plasma sources of singly and multiply charged ions based on a discharge used in magnetic traps of electromagnetic radiation radiation under the conditions of an electron cyclotron resonance (ECR) day are among the most perspective types of sources, as they are well applicable in both applied and fundamental research.

There are two main types of ECR ion sources: classical and quasi-gasdynamic. In the first one the plasma is confined in the so-called collisionless mode, which can be characterized by the low plasma density, the high average energy of electrons and their long lifetime in the trap. In the second one the are the high plasma density, high collision rate and the short electron lifetime. Therefore there are a high average charge of ions in the beam and a relatively low extracted ion current (about 1 mA) in the classical sources and the high extracted ion current (about 100 mA), but the low to moderate average ion charge in the beam in the quasi-gasdynamic sources.

At the Institute of Applied Physics of the Russian Academy of Sciences, an intense ECR ion source with a gas-dynamic confinement type GISMO (Gasdynamic Ion Source for Multipurpose Operation) operating in a continuous mode was developed. The plasma is created by microwave radiation from a gyrotron at a frequency of 28 GHz with a power of up to 10 kW and is confined in a magnetic field created by permanent magnets. A unique combination of parameters results in a very high volumetric energy input of up to 200 W/cm3.

Gas-dynamic sources have a wide range of applications and are used as: a source of multiply charged ions, an injector of high-intensity light ion beams, a compact neutron generator for boron neutron capture therapy (BNCT), a point source of neutrons for neutron tomography, etc.

In this work, we studied the dependence of plasma parameters in an ECR discharge with powerful plasma heating on the pressure of a neutral gas (hydrogen and helium) and microwave radiation power in a wide range of their values. Knowing these dependencies is useful for tuning the ECR source to the desired mode of operation.

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