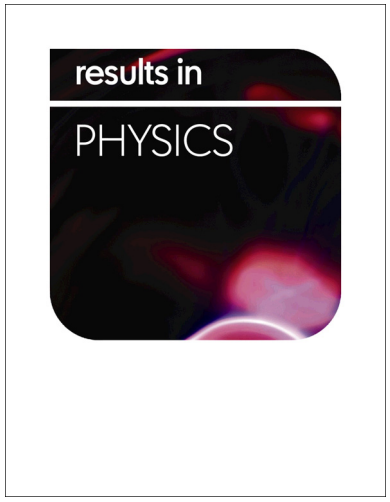

The project of W-band gyrotron at third cyclotron harmonic with an annular diaphragm

A.S. Sedov, A.S. Zuev, E.S. Semenov, A.A. Bogdashov, A.P. Fokin

PII: S2211-3797(18)30954-9
DOI: https://doi.org/10.1016/j.rinp.2018.07.040
Reference: RINP 1587

To appear in: *Results in Physics*

Received Date: 19 April 2018
Revised Date: 28 July 2018
Accepted Date: 31 July 2018

Please cite this article as: Sedov, A.S., Zuev, A.S., Semenov, E.S., Bogdashov, A.A., Fokin, A.P., The project of W-band gyrotron at third cyclotron harmonic with an annular diaphragm, *Results in Physics* (2018), doi: https://doi.org/10.1016/j.rinp.2018.07.040

The project of W-band gyrotron at third cyclotron harmonic with an annular diaphragm

Sedov A.S.[1], Zuev A.S. [1], Semenov E.S.[1], Bogdashov A.A[1]., Fokin A.P. [1]

[1]Federal Research Center Institute of Applied Physics of the Russian Academy of Sciences (IAP RAS), 46 Ul'yanov Street, 603950, Nizhny Novgorod, Russia

The article presents the modeling results of the waveguide with round diaphragm for mode selection in gyrotrons operating at high harmonics of gyrofrequency. Excitation of the third harmonic in a W-band gyrotron was considered. The use of a diaphragm in this setup allowed to increase the output power in conditions of mode competition.

Keywords: gyrotron, W-band, mode selection

One of the most popular microwave frequency bands now is the W-band [1,2]. It is attractive by the atmospheric transparency window, which makes it promising for a number of scientific and technical applications including radiolocation, communication, detection of hidden objects and the creation of medical devices [3-6]. The output power level in both continuous and pulsed regimes for the aforementioned applications should be in the order of several kilowatts and above. This makes the gyrotron one of the most high-potential sources of electromagnetic radiation in this range [7].

One of the main subsystems of the gyrotron setup is a magnet that creates the necessary level of the guiding and cavity magnetic field in a given volume. Cryomagnets operating with low-temperature fluids are expensive and require special operating conditions. However, now there are cheaper projects of "warm" (with water or oil cooling) magnets with a bore hole diameter sufficient for a gyrotron and a field level of more than 1 T [8-9]. The simplest estimates show that for the creation of a low-cost W-band gyrotron setup with a warm magnet it is required to operate at the third harmonic of the cyclotron frequency [10-11].

In this case, the acutest problem is the selection of the working mode type since the increase of cyclotron harmonic number leads to the decrease in the electron beam and wave coupling factor as well as the increase of the operating current and the length of the cylindrical part of the cavity. This also leads to the fact that a mode at a lower cyclotron harmonic will be excited with a higher probability [12]. Currently, there are many different methods to ensure the correct selection of the operating mode [13]. They can be divided into two types: electrodynamic and electronic. The significant drawback of both types of selection is the considerable complication of the gyrotron design and increasing number of requirements for the accuracy of gyrotron elements manufacturing. In this paper, we propose a method of electrodynamic selection based on the use of a diaphragm in the output waveguide of a gyrotron. This method seems to have a high potential because this design does not contain small-scale elements and is easy for manufacturing.