MODE EXCITATION IN GYROTRONS WITH CONTROLLABLE GUN PERVEANCE*

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Present-day gyrotrons developed for plasma heating and current drive experiments operate in high-order modes. Therefore, as a rule, in such gyrotrons in the process of voltage rise some higher-frequency parasitic modes are excited prior to the desired mode[1]. This excitation can be avoided when at intermediate voltages the beam current is below the starting value for parasitic modes. As known, in gyrotrons with triode-type electron guns this can be realized by lowering the mod-anode voltage at intermediate cathode voltages because lowering of the mod-anode voltage reduces electron orbital velocities and therefore increases the start current. In gyrotrons with diode-type electron guns, however, such opportunity does not exist. In the present paper, we analyze another opportunity which can be realized in such gyrotrons, viz. lowering the beam current density at intermediate voltages. As a rule, diode-type electron guns used in high-power gyrotrons operate in regimes of temperature limited emission where the beam current becomes close to its nominal value when the cathode voltage is even below the half of its nominal value. Redesigning of such guns in order to lower the emission current density (i.e. to lower the gun perveance) at intermediate voltages may contribute to significant reduction of the beam current in this voltage range. Thus, the excitation of high-frequency parasitic modes at these voltages can be avoided. In the paper we formulate this concept in a quite general way and illustrate it by considering some examples. It is also shown that this method offers some additional advantages for gyrotrons operating in power-modulated regimes which are used for suppression of neoclassical tearing modes in large-scale plasma installations.

1. G. S. Nusinovich, O. V. Sinitsyn, L. Velikovich, M. Yeddulla, T. M. Antonsen, Jr., A. N. Vlasov, S. R. Cauffman, and K. Felch, “Startup scenarios in high-power gyrotrons,” IEEE Trans. Plasma. Sci., vol. 32, pp. 841-852, 2004.

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