DEVELOPMENT IN RUSSIA OF MEGAWATT POWER GYROTROTS FOR MAGNETIC FUSION INSTALLATIONS

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Gyrotrons are the most powerful sources of millimeter wavelength radiation. They are widely used in electro-cyclotron-wave systems of nuclear fusion setups.
In Russia gyrotrons are developed in cooperation of three institutions: Institute of Applied Physics, Russian Academy of Sciences, Nizhny Novgorod, Industrial company GYCOM Ltd, Nizhny Novgorod, and Kurchatov Institute, Moscow.

GYCOM Ltd exports gyrotrons and transmission line components since 1992. More than 50% of plasma installations over the world use Russian gyrotrons. During last year several new gyrotrons were designed and tested by Russian gyrotron team. Main efforts were spent for elaboration of 170GHz/1MW/50%/CW gyrotron for ITER project and multi-frequency gyrotrons.

The industrial prototype of the ITER gyrotron was tested at power 1.02 MW in 200 second pulses, 0.65 MW in 800 second pulses. The test stand is equipped with an evacuated transmission line and load. The pulse energies were limited by overheating of the collector insulator. The modifications have been made in the collector insulator cooling system and they will allow gyrotron to run at ITER nominal parameters. The last gyrotron version operates in LHe-free magnet. Simultaneously a short pulse gyrotron mock-up with an increased size cavity was tested at power 1.5-2 MW aiming development of ITER gyrotron with the enhanced power.

The main problems in development of multi-frequency gyrotrons are to provide: efficient gyrotron operation at different modes, efficient conversion of different modes into a Gaussian beam, reliable operation of broadband or tuneable window. Considering this three key problems one can say that first two of them are solved. Efficient gyrotron operation at several frequencies was demonstrated in many experiments. New synthesis methods allow the design of efficient mode converters for multi-frequency gyrotrons. However realization of a CVD diamond window for a megawatt power level multi-frequency gyrotron met some real difficulties. Now three window concepts are under consideration: Brewster-angle window, window with matched surfaces and double-disc resonant window.