PECULIARITIES OF RELATIVISTIC BACKWARD-WAVE OSCILLATORS AND AMPLIFIERS OPERATING NEAR SELF-EXCITATION THRESHOLD

E. B. Abubakirov, A. P. Konyushkov
Institute of Applied Physics, Russian Academy of Sciences, Nizhny Novgorod, Russia

The report contains the analyses of transient processes in relativistic backward-wave oscillator (BWO) and amplifier (BWA) near self-excitation threshold. Relativistic BWO has comparatively short length and respectively high strength of high frequency (HF) electromagnetic field. This results in appearance of special non-linear operation regimes. Particularly, in case of short-length devices hard (or sub-critical) regime of operation becomes apparent [1], which means ability to operate below self-excitation threshold. It was shown that operation of a BWO in hard regime (or close to that) gives possibility to realize short oscillation rise-time and stable efficient operation of the device at small exceeding of the excitation threshold.

At the same time, existence of hard operation regions plays a negative role for BWA. Input electromagnetic signal can a BWA to parasitic self-excitation in hard regime when the operating current is less than the starting one. This leads to strong limitation on gain G, as it is proportional to $G \sim (1 - I/I_{st})^{-1}$, and due to risk of parasitic hard excitation one can not set the operating current I close to the starting value I_{st}.

It was shown that the operation regime depends on peculiarities of electron bunching over the interaction space, and hard excitation is typical for short-length microwave oscillators of Cherenkov type.

1. E. B. Abubakirov, A. P. Konyushkov, A. S. Sergeev, “The hard excitation regime for a relativistic backward-wave oscillator” Radiophysics and Quantum Electronics, vol. 51, no. 8, 2008.