MODELING THERMAL BEAM EFFECTS IN COUPLED CAVITY TWTs*

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Successful design and optimization of coupled cavity TWTs (CC-TWTs) operating in the mm and sub-mm wavelength range requires adequate simulation tools capable of including many details of the beam-wave interaction for realistic beams. In particular, the designs of CC-TWTs require taking into account effects of the finite emittance of the electron beam used in the device. The 2.5D large-signal code TESLA-CC [1] is capable of accurate modeling of CC-TWTs with different beam injection models, including beams imported from the collector/gun design code MICHELLE [2]. The typical number of particles included in the electron gun simulations by MICHELLE can be a few thousands for a cold beam; taking into account "thermal" beam effects will require increasing this number even more to allow proper statistics. Although the direct use of such a large number of particles by TESLA-CC is possible, it is desirable to de-populate the given set of particles without loosing valuable information about the beam particles' distribution. A new de-population algorithm has been introduced in TESLA-CC to create a beam distribution using a reasonable number of particles that accurately represent the "thermal" beam distribution prepared by MICHELLE. The algorithm is based on correlation analysis of MICHELLE data and generation of a two-dimensional distribution function, taking into account an arbitrary level of correlation between components of the electrons' transverse velocities. Results of this algorithm are used to perform detailed simulations to find impact of the "thermal" effects on a predicted performance of coupled cavity TWTs.

1. A.N. Vlasov, et al., "Modeling of Coupled Cavity TWT with TESLA", 10th International Conference on Vacuum Electronics, April 25-30, 2009, Rome, pp.155-156.
2. J.J. Petillo, et al., "Recent Developments in the MICHELLE 2D/3D Electron Gun and Collector Modeling Code", *IEEE Trans. Electron Devices*, vol. 52, no. 5, May 2005, pp.742-748.

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