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2P16 - Simulations of a W-Band Circular TWT

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We are exploring the amplification of W-band electromagnetic radiation using a dielectric-loaded traveling wave tube (TWT) by employing several particle–in–cell (PIC) codes. We are seeking to replicate recent results obtained by a Naval Research Laboratory's (NRL's) dielectric–loaded TWT design [1] consisting of a solid circular electron beam (26 kV, 100 mA and 0.185 mm beam radius) surrounded with dielectric material, εr=13.5, and coupled to a TM01 electromagnetic wave at a frequency of 94 GHz. NRL used a finite-difference-time-domain (FDTD) formulation in a 2–D cylindrical coordinate system to perform the dielectric–loaded TWT simulations. In our case, we have opted for PIC simulations comparing three different software tools–a 3–D Cartesian coordinate system 'FDTD–PIC method–based MAGIC', 'CST Electromagnetic and Multiphysics Simulation Studio Suite', and 'Improved Concurrent Electromagnetic Particle–In–Cell (ICEPIC)'. An earlier structure similar to that published by NRL, but at K-band and using a sheet beam and planar dielectric material, has been studied and confirmed by Los Alamos National Laboratory (LANL). We are seeking to confirm the results obtained by LANL at K-band using PIC simulations in a 3-D Cartesian system. Results from MAGIC and CST simulation will be presented.

1. J. P. Calame and A. M. Cook, "Design and large-signal modeling of W-band dielectric TWT,"IEEE Trans. Plasma Sci., vol. 45, 2820–2834 (2017).

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