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Inclusion of Circuit Loss in an Exact Treatment of a Helix Traveling Wave Tube

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A recent treatment of a thin tape helix traveling wave tube (TWT) yielded an exact hot tube dispersion relation [1]. This work modified Pierce's classical theory by introducing a new parameter, "q", which accounts for space charge effects on the phase velocity of the circuit mode. This is analogous to the familiar Pierce space charge parameter, Q, which accounts for the space charge effect on the beam mode. However, the crucial assumption in [1] is that there is no cold tube loss, i.e., the Pierce's loss parameter d = 0. Here we propose a method of including the effects of this loss by introducing an imaginary component of permittivity to the dielectric support structure [1]. The effect of local resistive sever is also studied. We thank D. Chernin and P. Wong for many useful discussions.

[1] P. Wong, D. Chernin, and Y. Y. Lau, IEEE Electron Device Lett. 39, 1238 (2018).

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